



# Enabling Green Power – Driving decarbonization

Power Roadshow  
London, 22 – 23 November 2022



# Agenda and speakers

## Agenda

01

Overview & power strategy

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02

Division IPC (incl. SiC)

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03

Division PSS (incl. GaN)

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04

Q&A

## Speakers



**Dr. Peter Wawer**  
Division President IPC



**Adam White**  
Division President PSS

# Upgraded Target Operating Model: committing to more ambitious financial goals and being the sustainability leader



## Target Operating Model through cycle



Revenue growth

**>10%**

Previously

9%+



Segment Result Margin

**25%**

19%



Adj. Free Cash Flow  
Margin<sup>1</sup>

**10-15%**

Invest-to-sales

13%



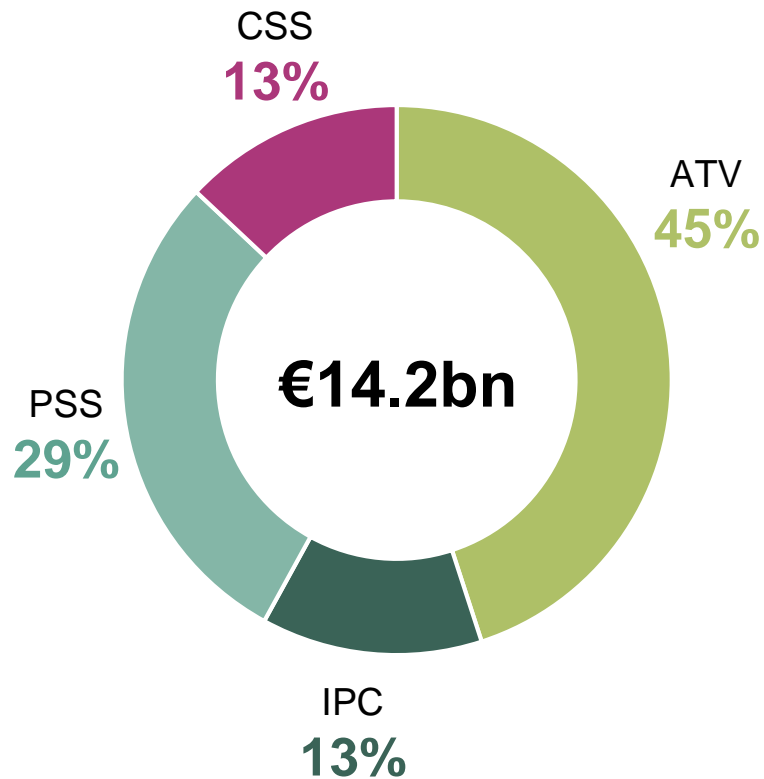
**Sustainability leader – CO<sub>2</sub> neutrality 2030**



<sup>1</sup> Excluding major frontend buildings

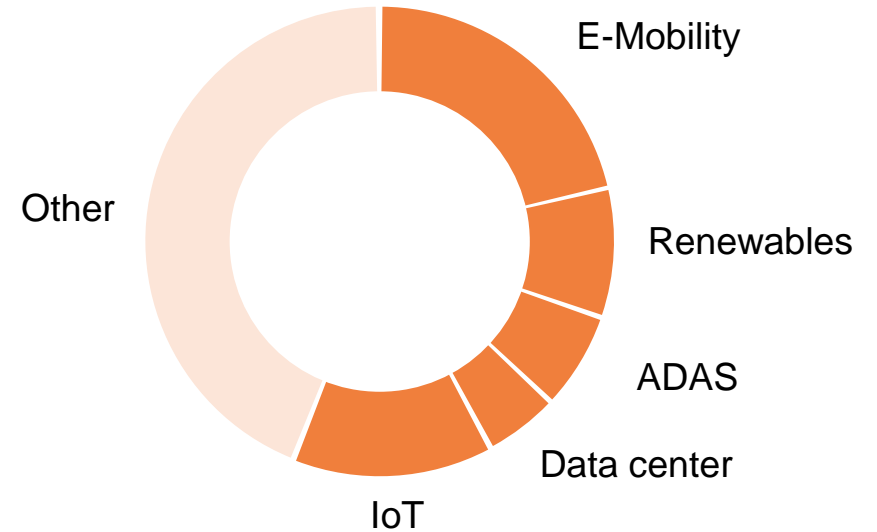
# Double-digit growth ahead – five key applications account for ~60% of growth; well-diversified divisional split

FY22  
Revenue by division



**>10%**  
 CAGR

FY22-27e  
Revenue growth contribution by driver



Through-cycle growth rates by division

ATV	IPC	PSS	CSS
>10%	>10%	~10%	~10%

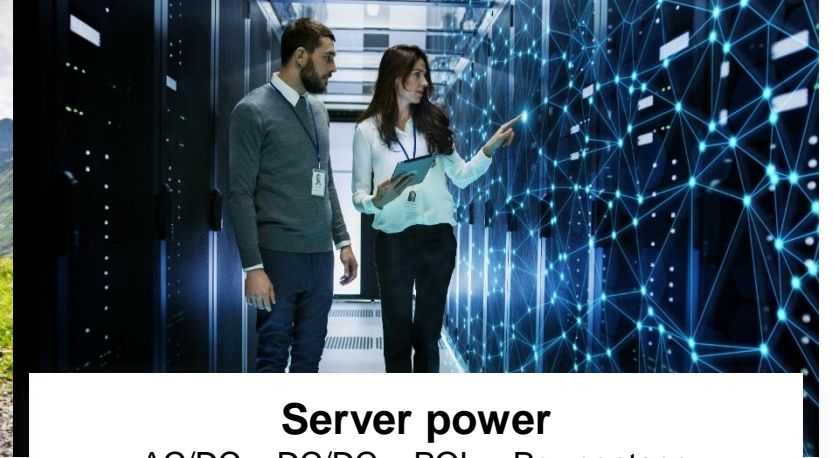
# Leader in Power Systems: Infineon enabling decarbonization by delivering maximum value to customers with holistic system approach



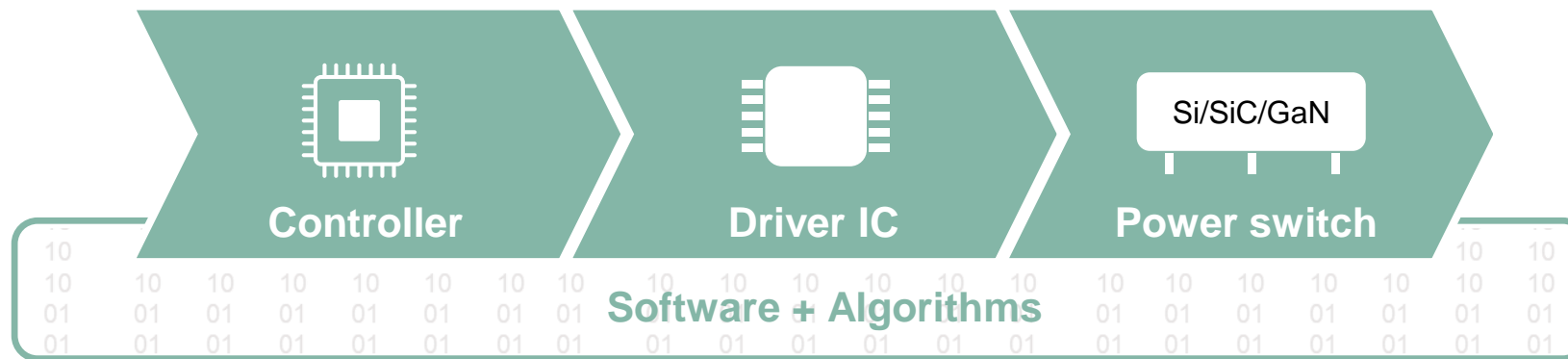
**Solar inverter**  
DC/DC – DC/AC



**Battery-powered applications**  
AC/DC – DC/DC



**Server power**  
AC/DC – DC/DC – POL – Power stage



PoL (point of load): PMIC + Driver IC + MOSFETs | Power stage: Driver IC + MOSFETs

# Infineon is the key enabler for Power Systems that are needed at every step of the entire power transformation chain



## Renewable energy generation

### #1 semi enabler

powering ~50% of currently installed wind/solar capacity

## Energy infrastructure

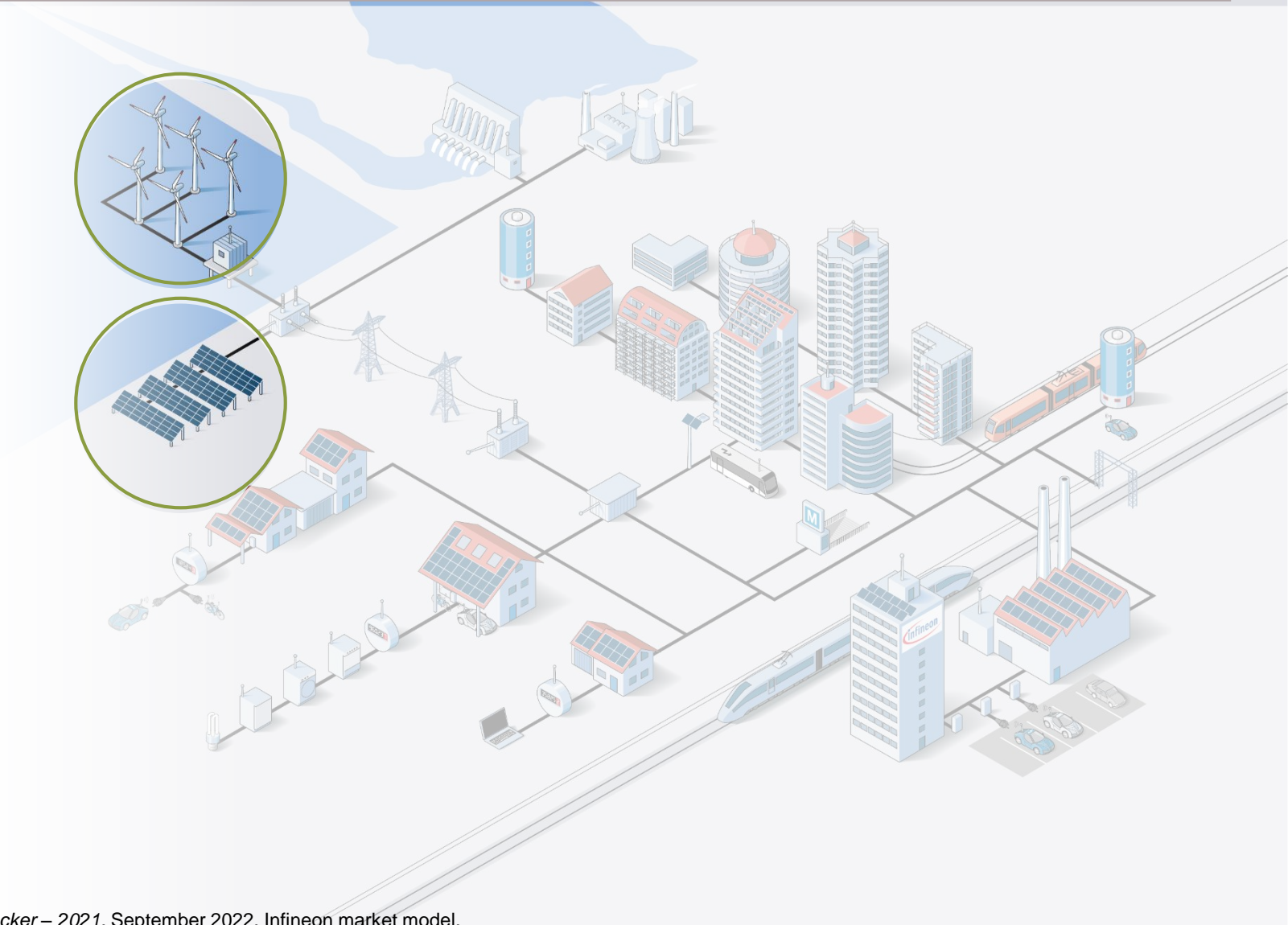
### #1 semi enabler

for ~2/3 of grid infrastructure incl. EV charging

## Energy conversion and usage

### #1 semi enabler

broadest portfolio covering all verticals  
leader in power density and efficiency  
**#1 in vehicle electrification**



Based on or includes research from Omdia: *Power Discrete and Module Market Tracker – 2021*. September 2022. Infineon market model.

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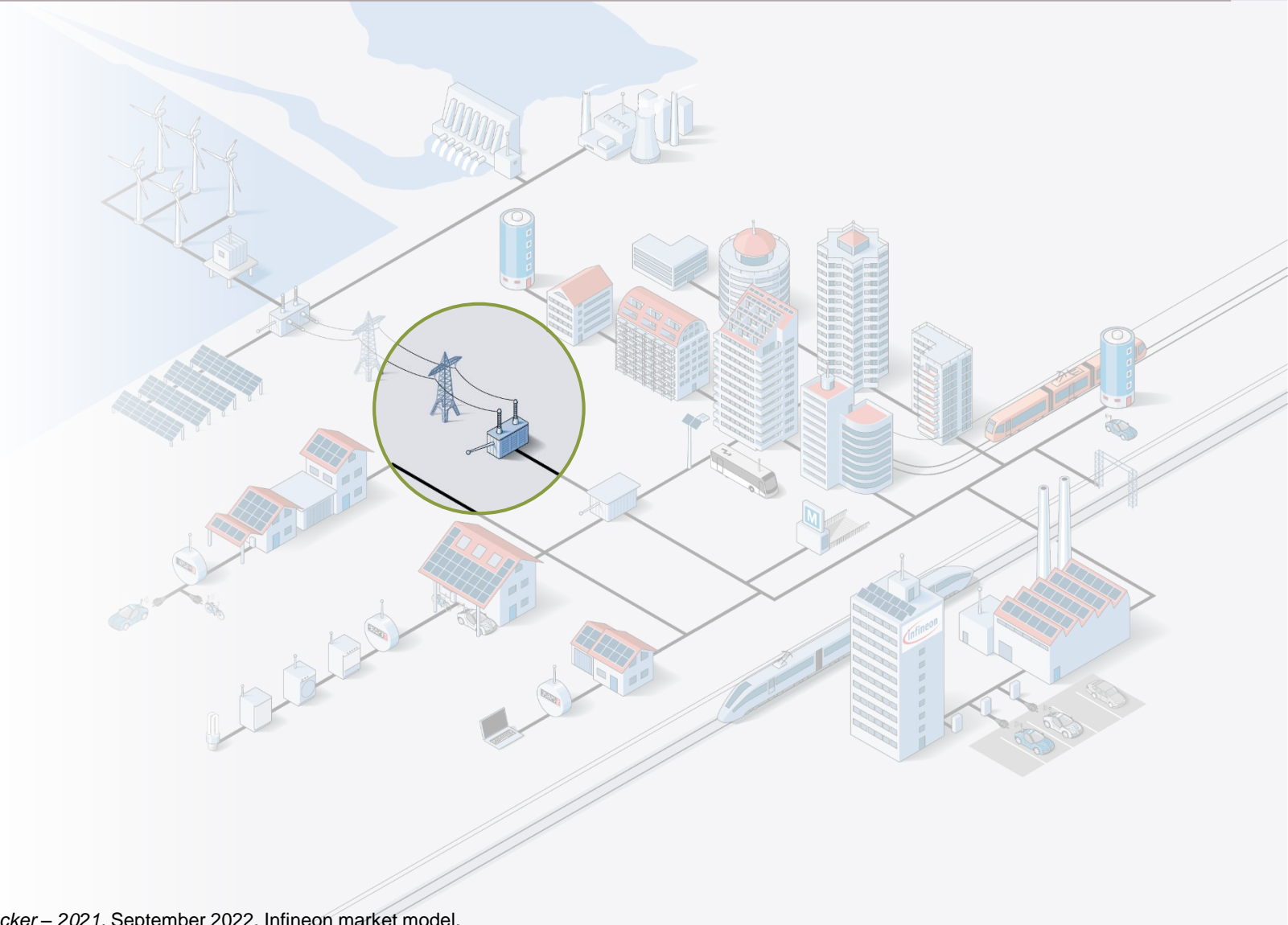
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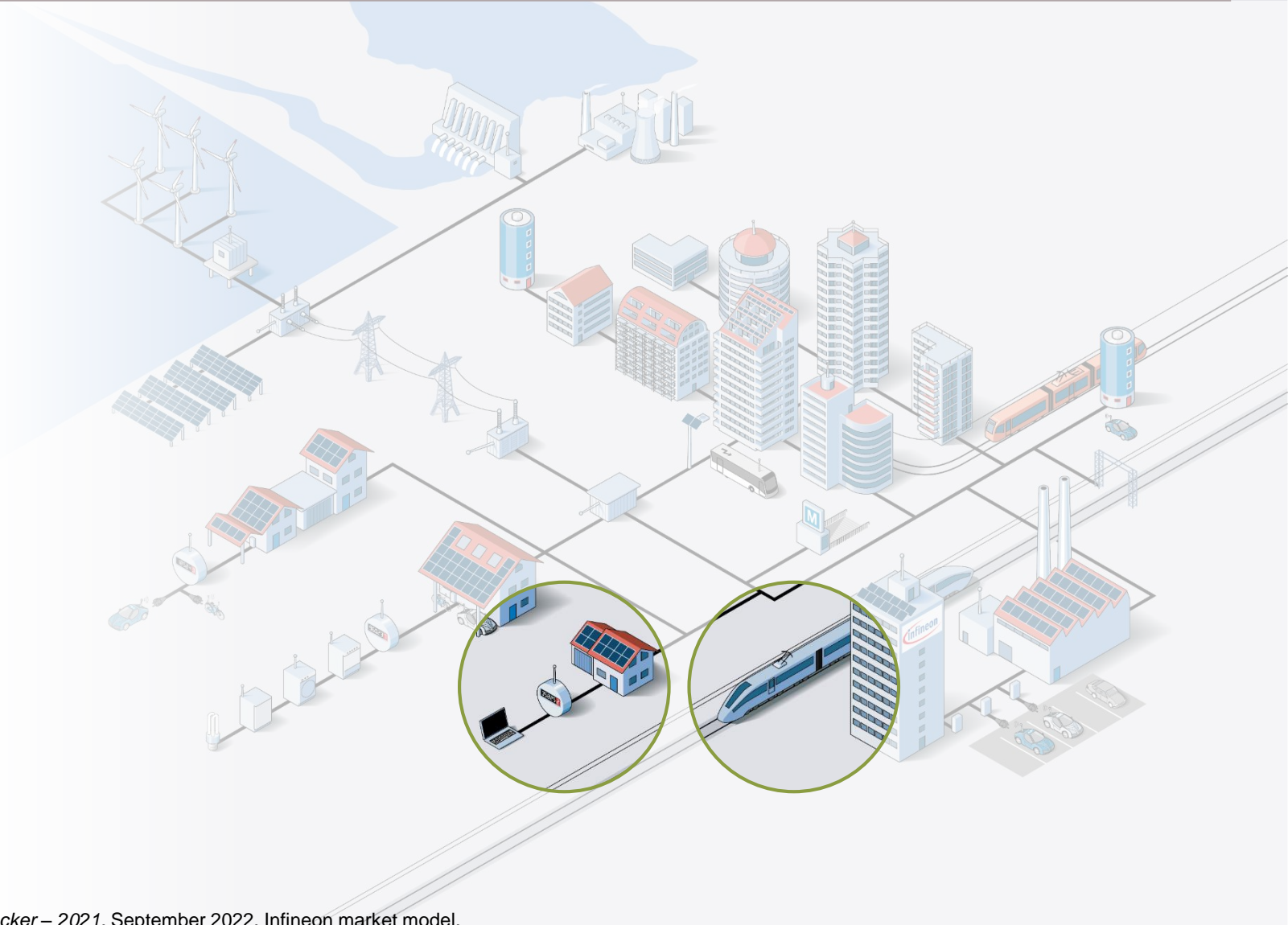
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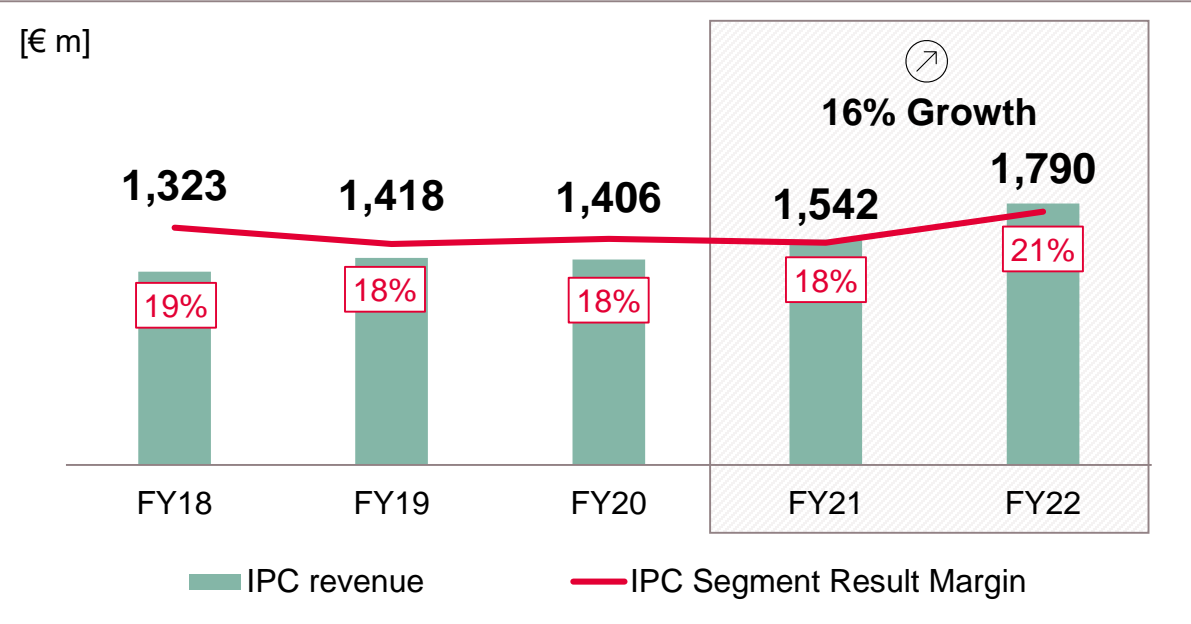


# Industrial Power Control

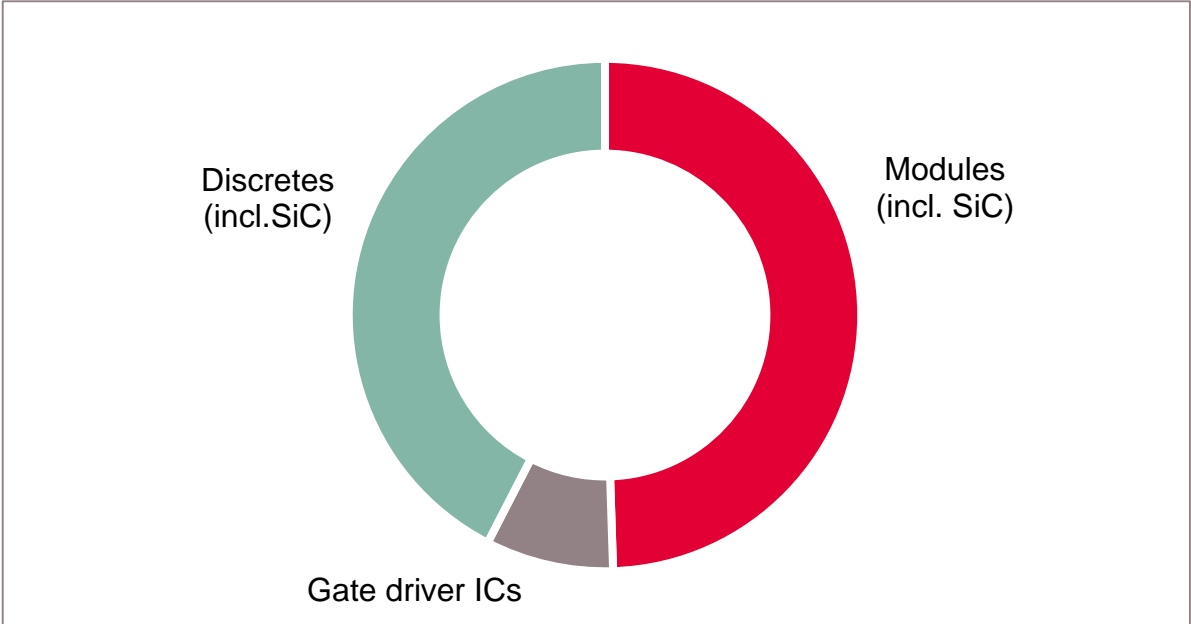


# IPC at a glance

## IPC revenue and Segment Result Margin



## FY22 revenue split by product group

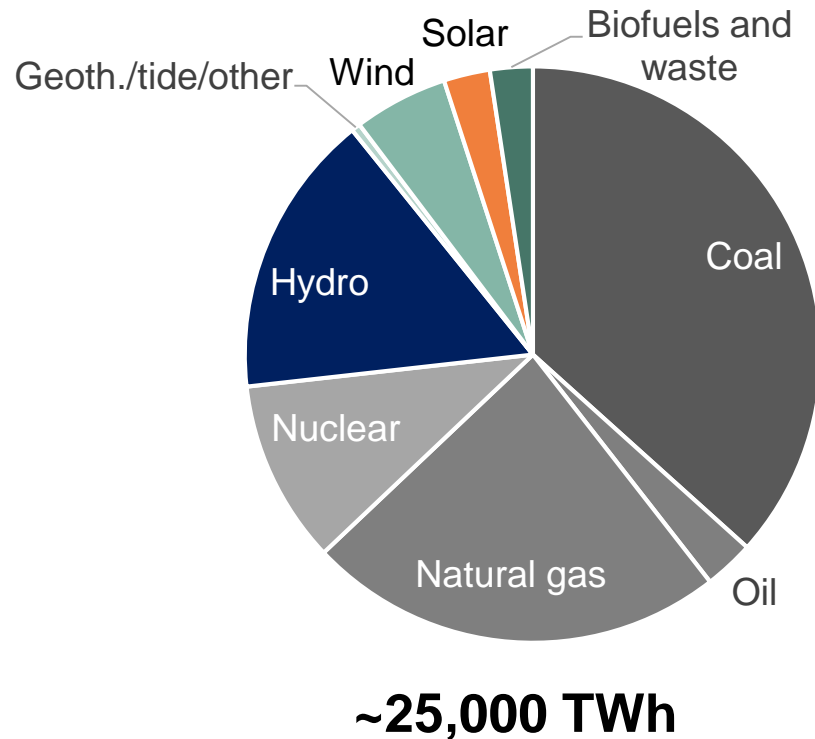


## Key customers



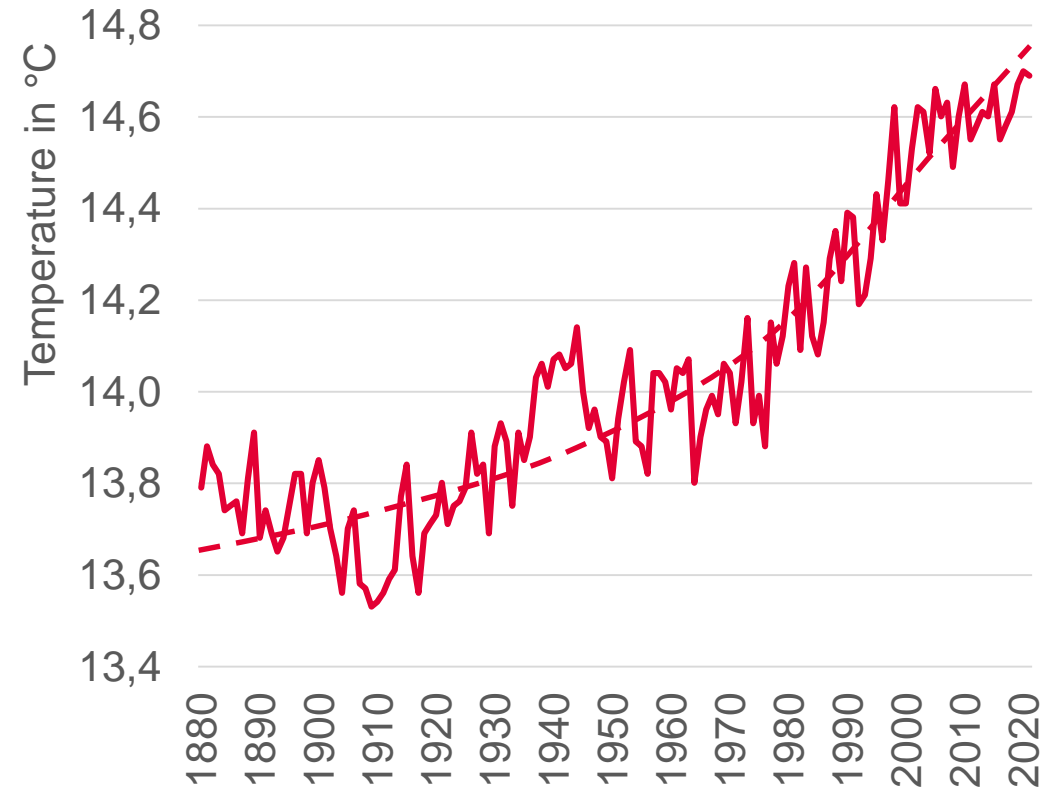
Worldwide energy demand is HUGE and provides almost unlimited growth opportunities for renewables & infrastructure to address the CO<sub>2</sub> issue

### World gross electricity production



iea.org, World gross electricity production by source, 2019







### Earth temperature development



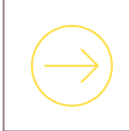





Source: earthpolicy.org

# Renewable energy generation, infrastructure & EV charging continue to see very strong growth momentum

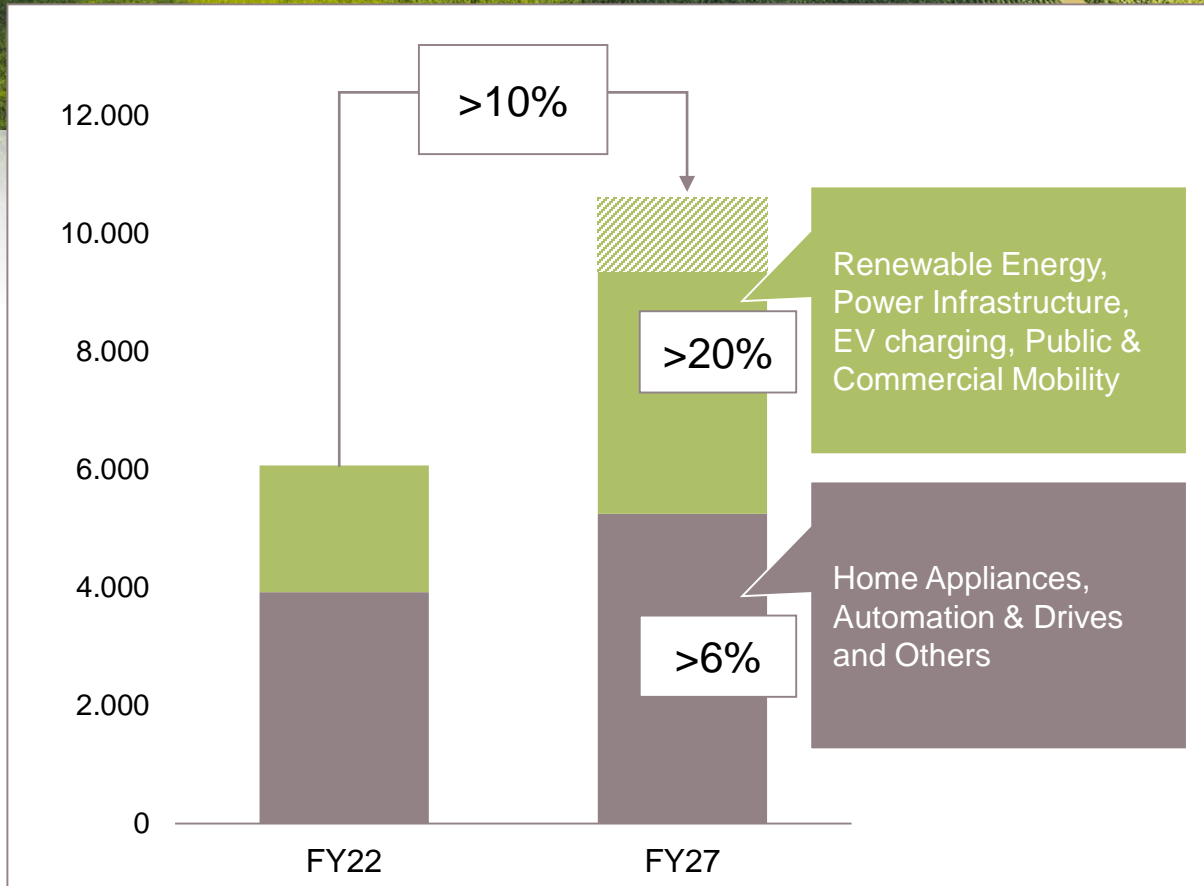
## Applications (% of FY22 segment revenue)

	<b>Automation and Drives</b>	<b>~35%</b>
	<b>Renewable Energy Generation</b>	<b>~26%</b>
	<b>Power Infrastructure</b>	<b>~10%</b>
	<b>Home Appliance</b>	<b>~17%</b>
	<b>Transportation</b>	<b>~5%</b>
	<b>Others</b>	<b>~7%</b>

## Market Outlook for CY23

	<ul style="list-style-type: none"> <li>› Analysts have reduced unit growth while still forecasting market growth rates above long-term average</li> <li>› Customer market expectations remain optimistic for 2023</li> </ul>
	<ul style="list-style-type: none"> <li>› Growth rates remain strong for PV installations (24% YoY)</li> <li>› Wind growth rates will be weaker compared to PV, but project delays from 2022 are expected to be recovered during 2023 (18% YoY)</li> </ul>
	<ul style="list-style-type: none"> <li>› Growth in EV charging infrastructure is expected to remain strong (~50% YoY), supported by enhanced government programs</li> <li>› Further growth of ESS (34% YoY) and T&amp;D due to energy infrastructure needs</li> </ul>
	<ul style="list-style-type: none"> <li>› Strong demand for heat pumps and further potential for inverterization act as growth drivers</li> <li>› We do not expect overall MHA demand recovery (e.g., global RAC output: -2%YoY)</li> </ul>
	<ul style="list-style-type: none"> <li>› Strong growth opportunities for CAV electrification and OBC expected</li> <li>› Traction market to stabilize, increased demand growth expected beyond CY23</li> </ul>
	<ul style="list-style-type: none"> <li>› Long-term positive outlook driven by general trend of electrification in emerging applications (e.g., eAviation, eMarine)</li> </ul>

# IPC markets accelerate growth – Enabling green energy and driving decarbonization



Source: Infineon analysis +x.x% CAGR FY22–27e

## Key facts

**MORE**  
Growth

**MORE**  
SiC

**MORE**  
Profitability

- › The **acceleration of the energy transition** drives IPC markets
- › **SiC penetration accelerates**
- › **SiC** is a key point of **differentiation** and drives IPC **profitability**

# Decarbonization requires to address CO<sub>2</sub> emissions in all sectors – From transportation to buildings and industry



**United States**

CARBON NET ZERO  
2050



**China**

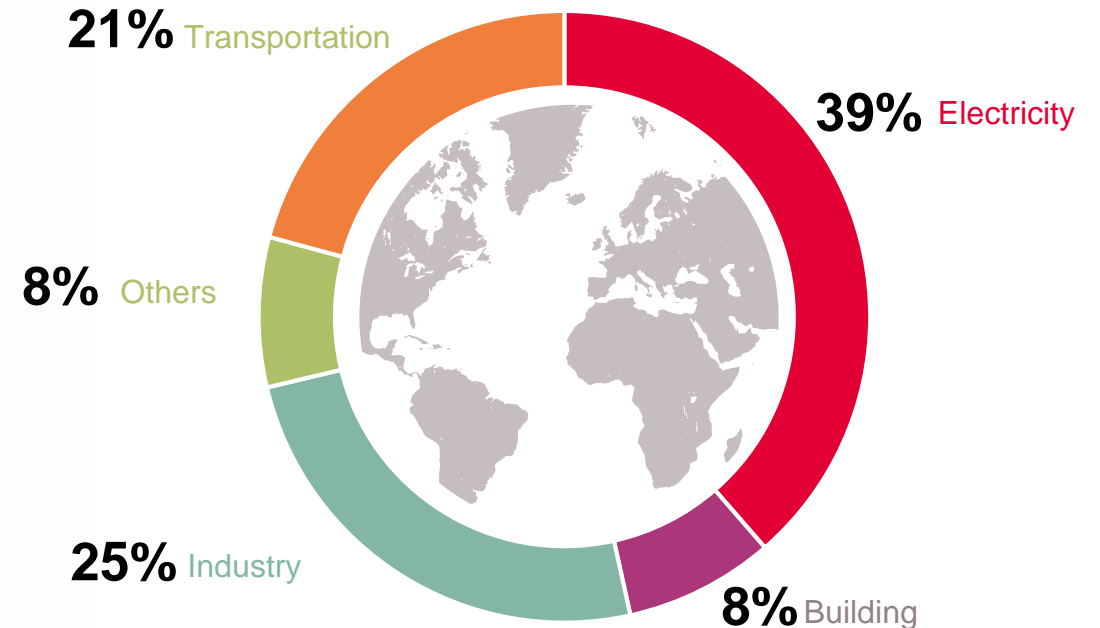
CARBON NET ZERO  
2060  
Peak emissions 2030



**Europe**

CARBON NET ZERO  
2050






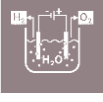



## Energy-related CO<sub>2</sub> emissions by sector 2020 37 Gt



Source: World Energy Outlook 2022, IEA Nov 2022

# Huge potential

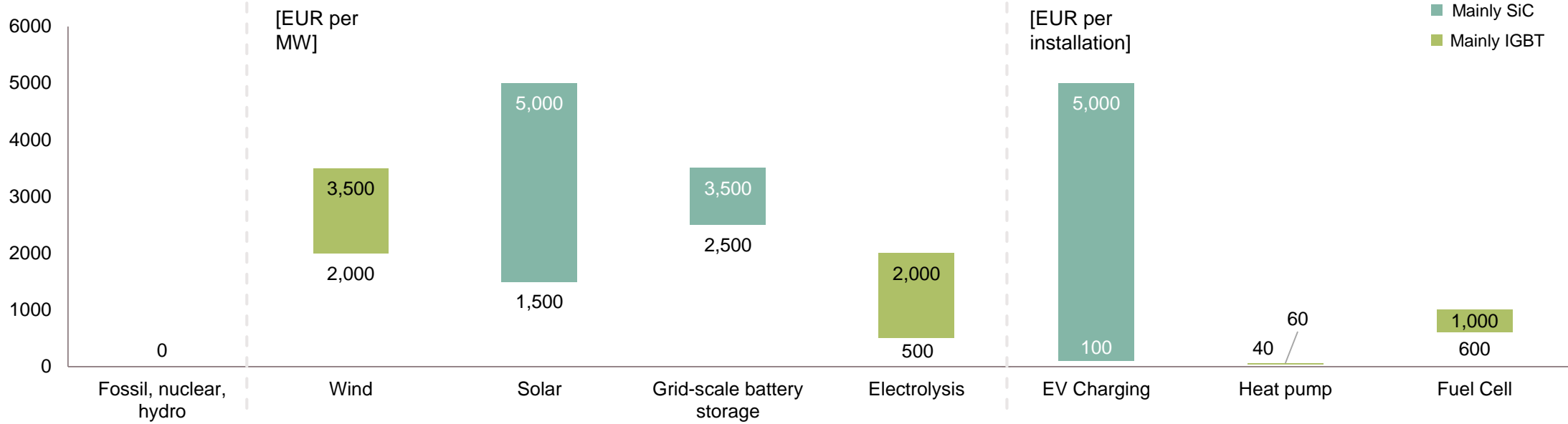
along entire green energy chain until 2030 according to **IEA Net Zero scenario**

Generation		Infrastructure		Consumption		
	Photovoltaic	<b>+4,200 GW</b>		Grid network	<b>600bn annual investments</b>	
	Wind power	<b>+2,400 GW</b>		Grid storage	<b>+660 GW</b>	
				EV Charging	<b>+32m chargers</b>	
				Electrolysis	<b>+720 GW (pipeline: 240 GW)</b>	
					Heat pump	<b>+420m units</b>
					H <sub>2</sub> Fuel Cell*	<b>+200k FC EV +200k FC Trucks</b>
					eAviation   eMarine ?	

**Note:** Based on Net Zero Scenario (IEA)  
**Source:** IEA, \*Internal Analysis

# Green energy generation provides large business opportunities

## Power semiconductor content by application



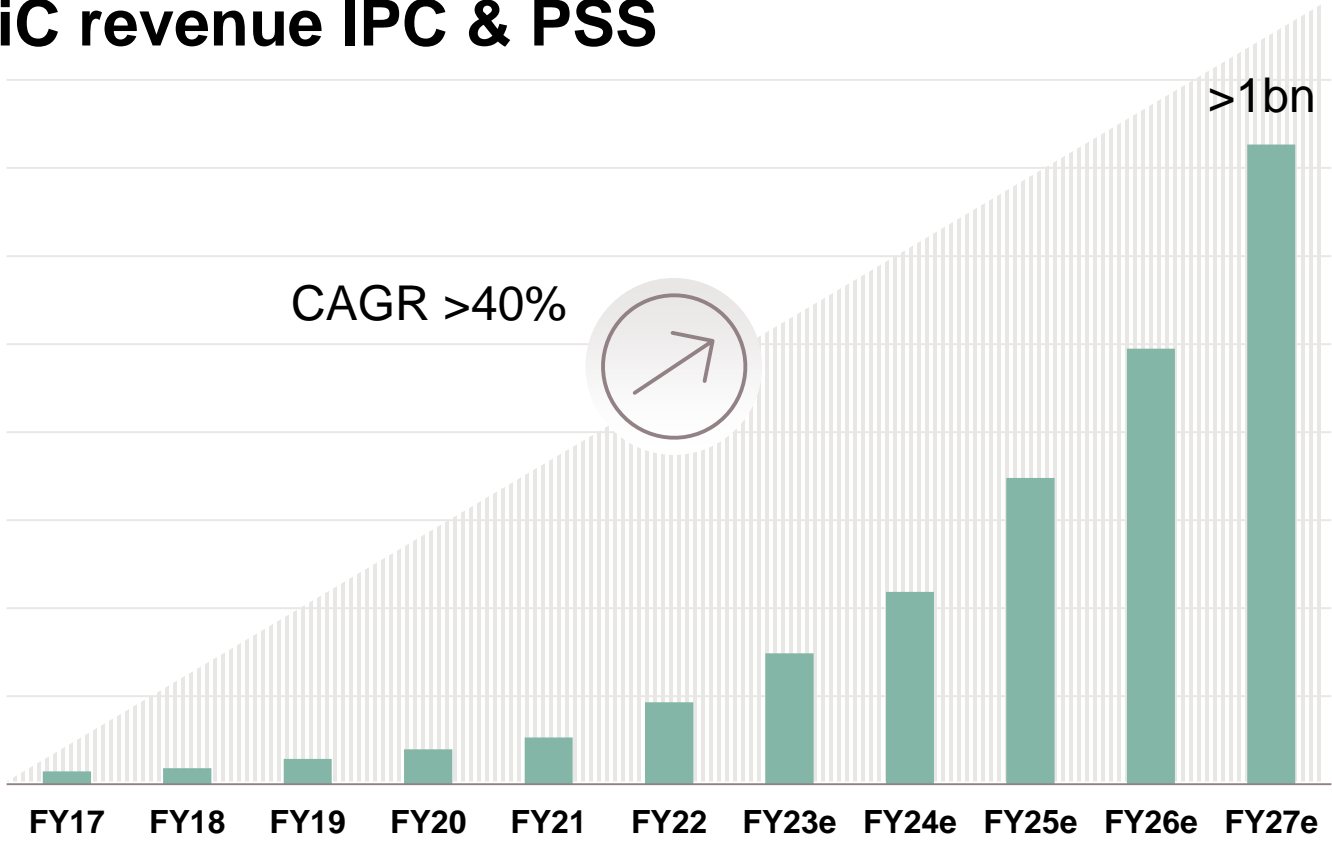
Additions in 2021 <sup>1</sup>	94 [GW]	150 [GW]	6 [GW]	<1 [GW]	<1m [inst.]	20m [inst.]	5k [inst.]
CAGR 2022 – 30	19%	22%	50%	77% <sup>2</sup>	33%	16%	42%

<sup>1</sup> IEA: Net Zero by 2050 – A Roadmap for the Global Energy Sector. May 2021; Sector Tracking reports September 2022; internal Analysis | <sup>2</sup> Based on 240 GW pipeline, >100% based on NZE requirements

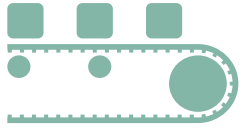


# Strong growth and strong outlook for SiC in industrial applications

## SiC revenue IPC & PSS



# With its comprehensive SiC strategy Infineon is mastering all key success factors



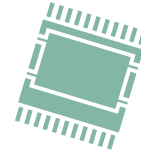
## SiC raw material supply

- > 4 qualified SiC wafer and boule suppliers – more to come
- > Cold Split technology increases productivity, especially in 8 inch



## Superior trench technology

- > 1 – 2 generations ahead of competition
- > More chips per wafer than planar



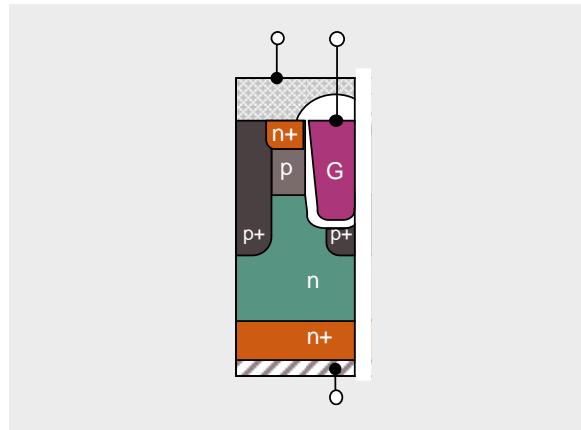
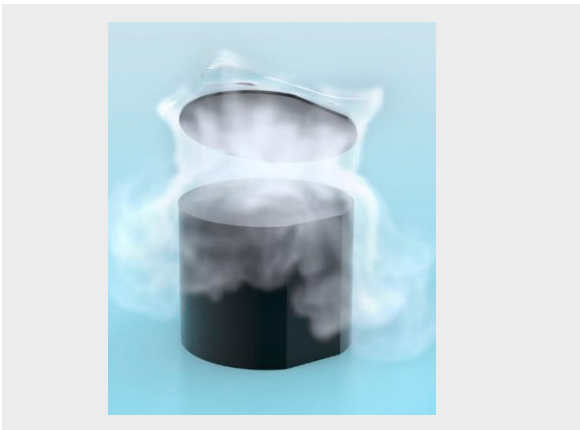
## Packaging portfolio

- > Best-in-class in-house packaging solutions
- > New .XT technology for highest power density



## Deep system understanding

- > Decades of experience in automotive and industrial power
- > Broadest portfolio: Off-the-shelf plus customized solutions



# Infineon is manifesting its leading position in the industrial SiC market with above market 5y CAGR and strong outlook



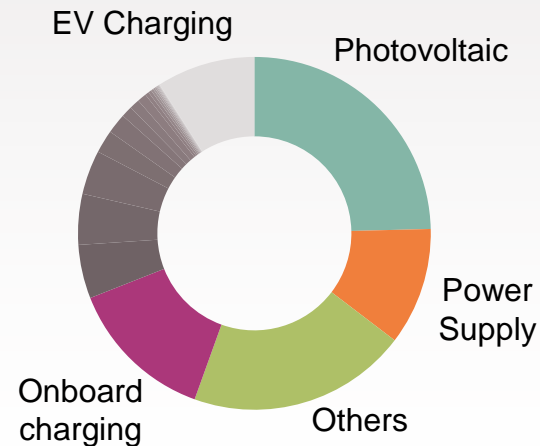
**>300**  
Industrial SiC  
products available



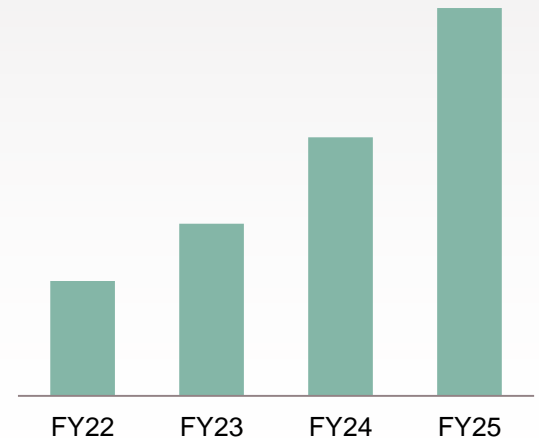
More than  
**3,600 active customers**  
being served



Design opportunity  
pipeline of  
**~€5bn<sup>1</sup>**



Industrial revenue  
**CAGR >40%** –  
cum. Design-Wins  
**almost €2bn**  
on track for revenue of  
**>€500m in 2025**



<sup>1</sup> Excluding Auto Drivetrain

# 30% market share target in SiC by end of decade underpinned by significant capacity expansion



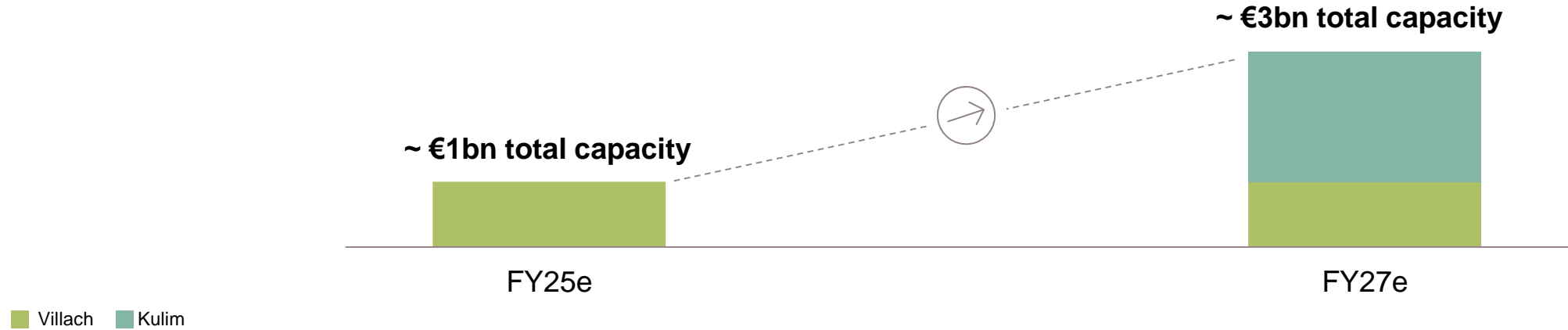
**10x**  
Increase by  
2027 vs.  
today

**Villach**

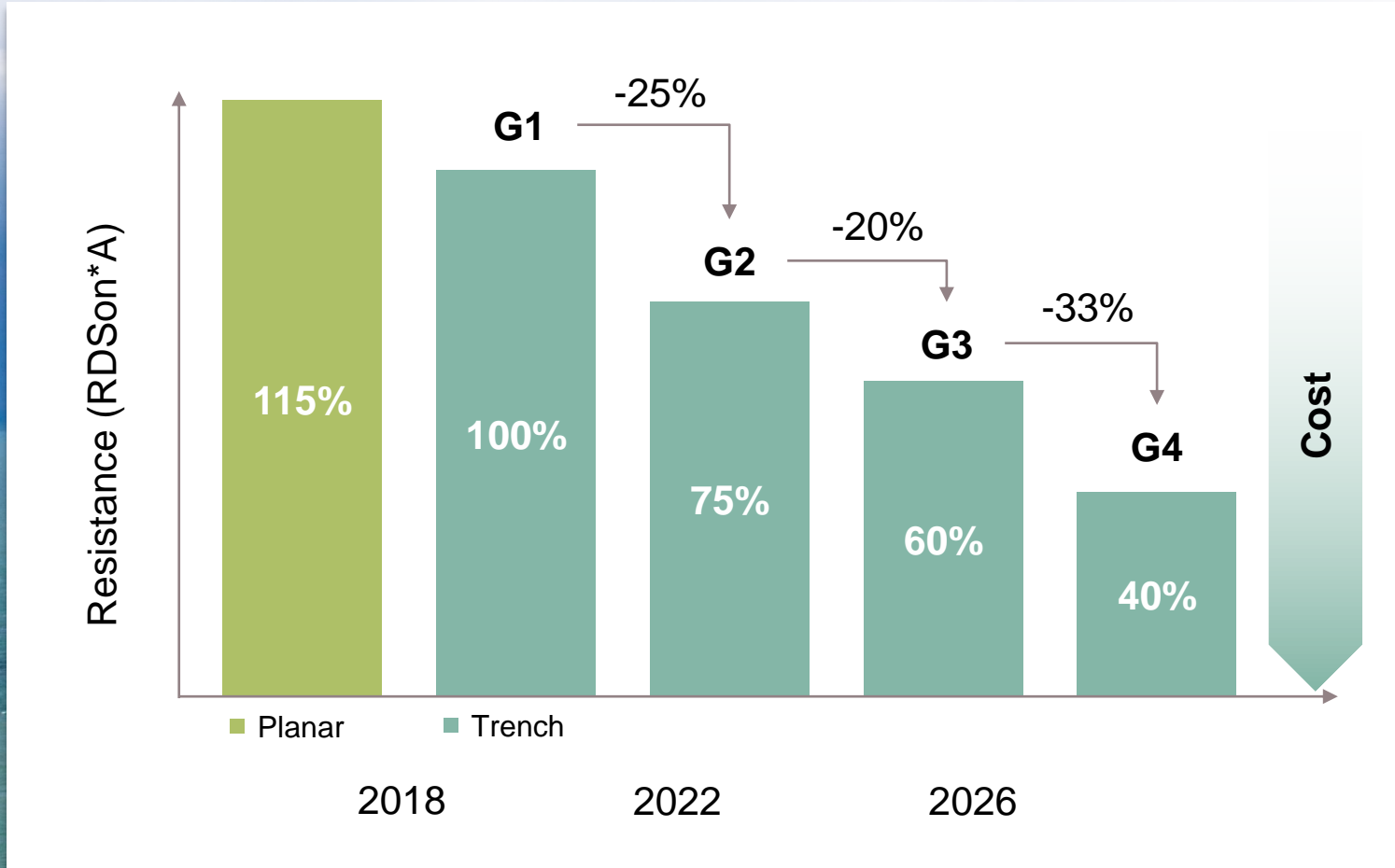
**Kulim**

## Infineon is well positioned for strong SiC market growth

Steep ramp enables market share gains

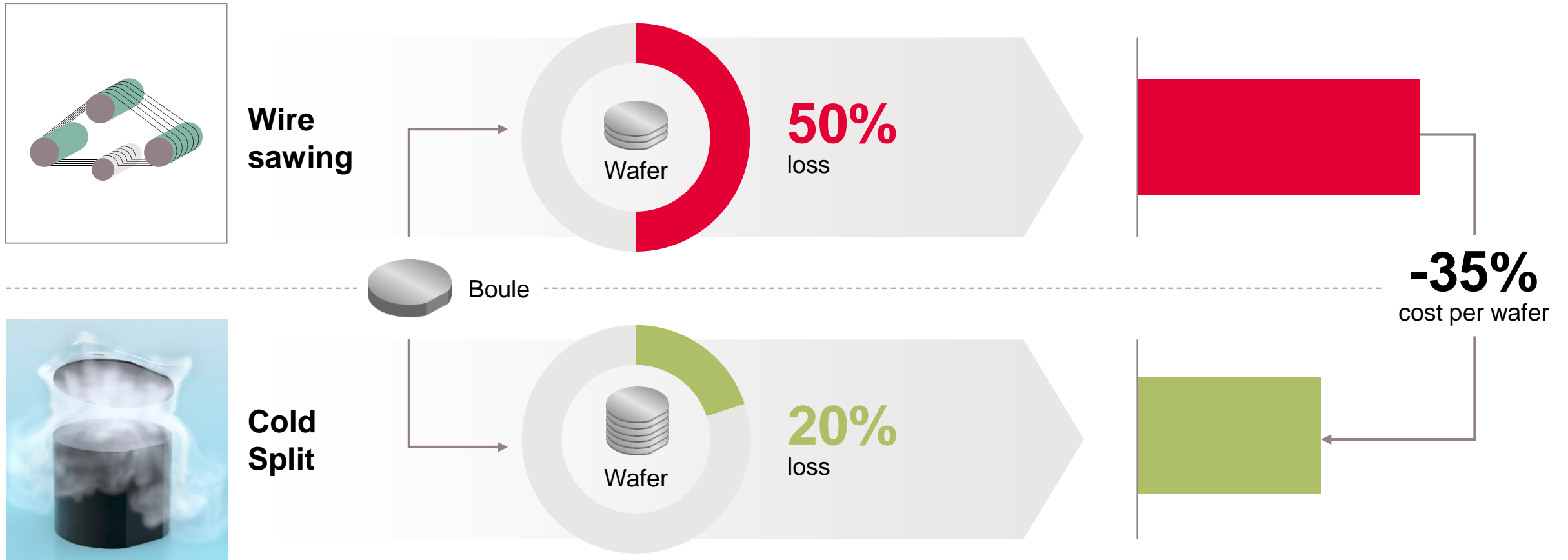


# Superior trench technology drives sustainable competitiveness in cost and performance



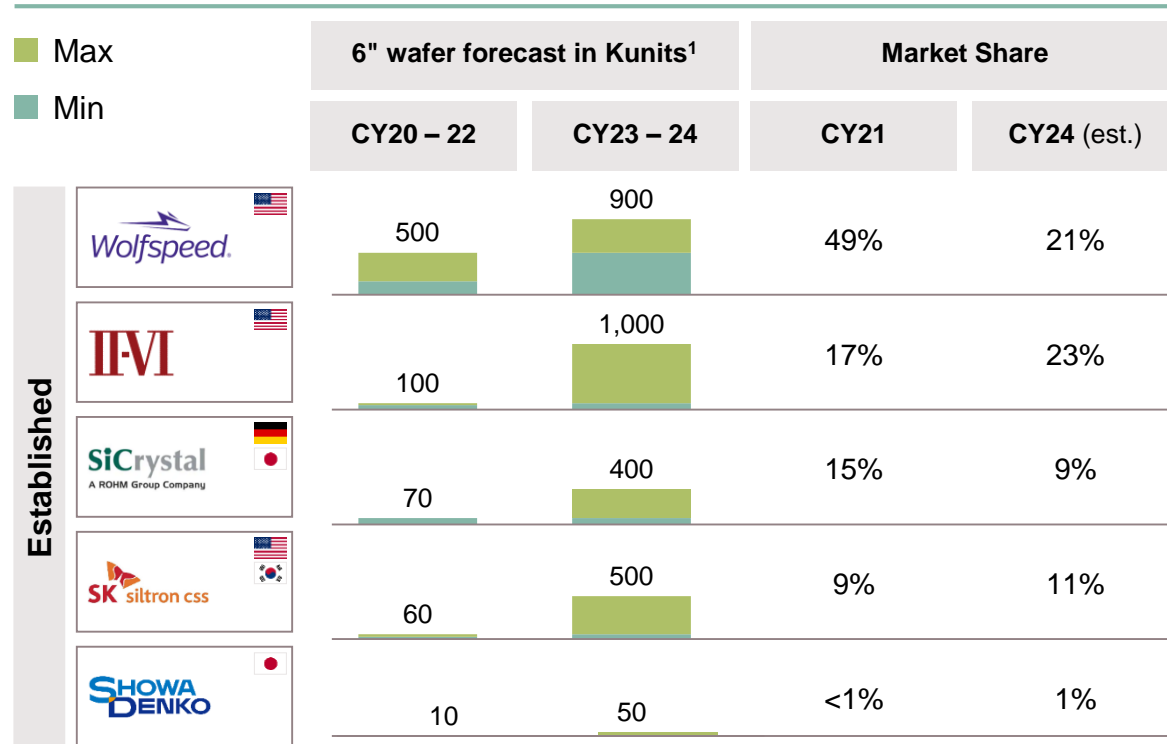
# Cold Split technology by Siltecta – Efficient material utilization and long-term cost down enabler

## Laser based SiC splitting as important productivity lever

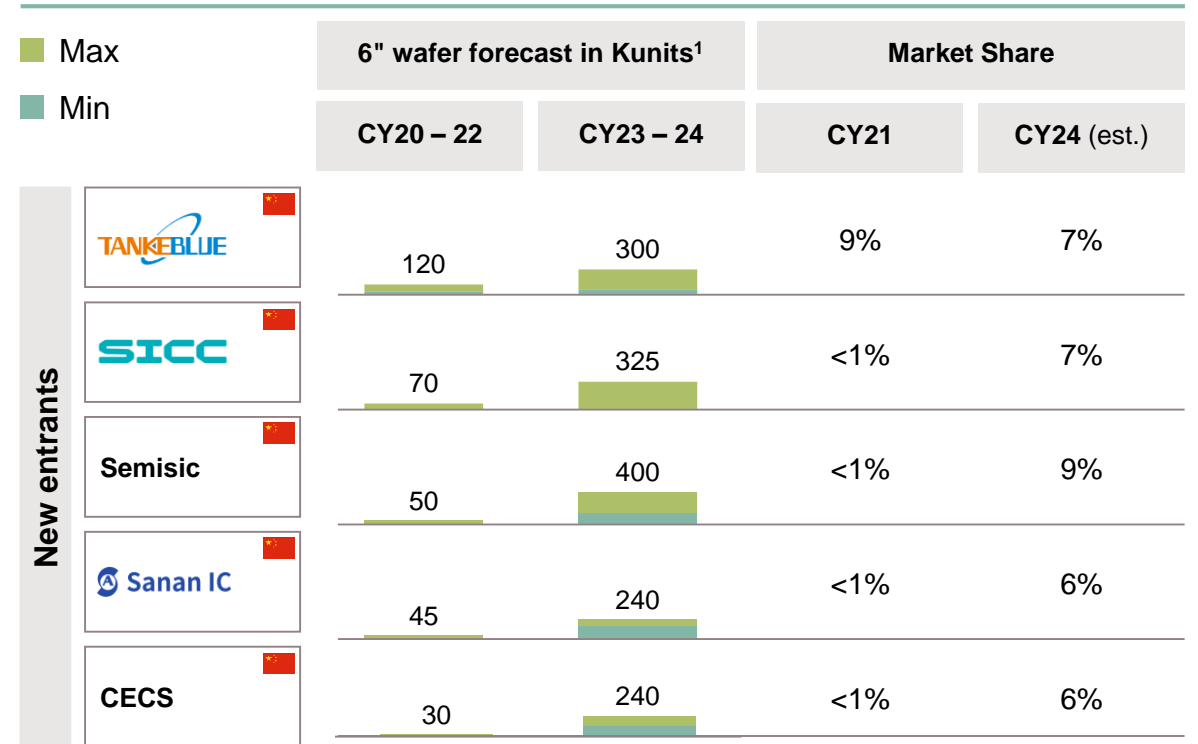


# New entrants will gain major share of the raw-wafer market within the next few years, driving commoditization

## Leading players in boule & wafer processing market



## Emerging players growing fast



**Today:** Established raw-wafer suppliers with ~90% market share

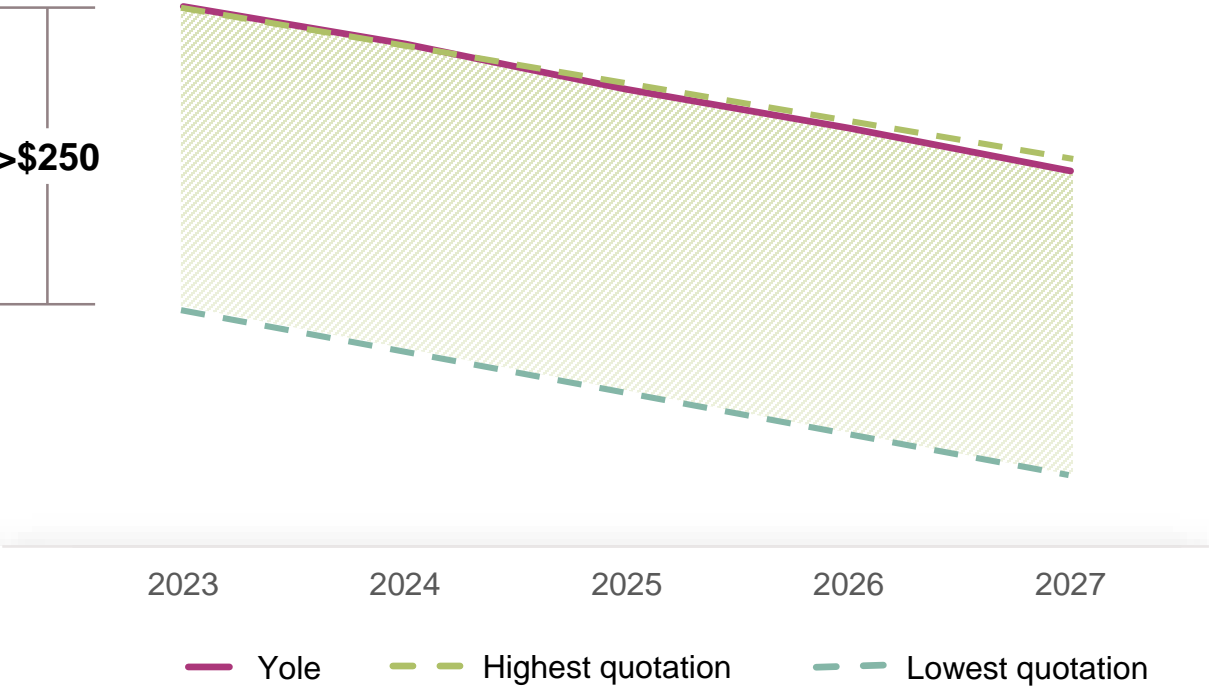
**Tomorrow:** New entrants will triple their market share to >30% in next few years according to public announcements

<sup>1</sup> 6"-equivalent per year. Minimum and maximum values show range of the expected capacity ramp-ups in timeframe

Sources: Yole Intelligence, Power SiC 2022, IFX China Procurement | IDM: Integrated Device Manufacturer

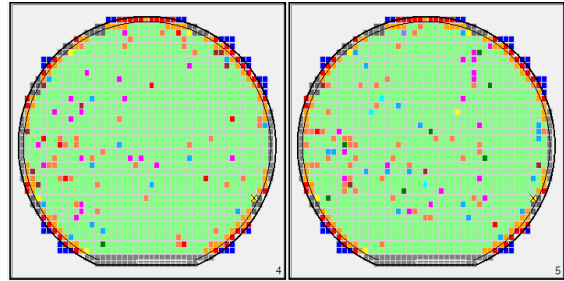
# Variety in supplier substrate pricing: Big price-gap between highest and lowest quotation for 150mm SiC raw wafers

## Price quotation per SiC bare wafer (150 mm)



Our raw-wafer price quotations are significantly below the latest Yole price roadmap

Significant delta between high- and low-price suppliers, low-price suppliers with excellent performance



All suppliers work on 200mm, first samples available at Infineon

Yole Intelligence: Compound Semiconductor Market Monitor Q3 2022



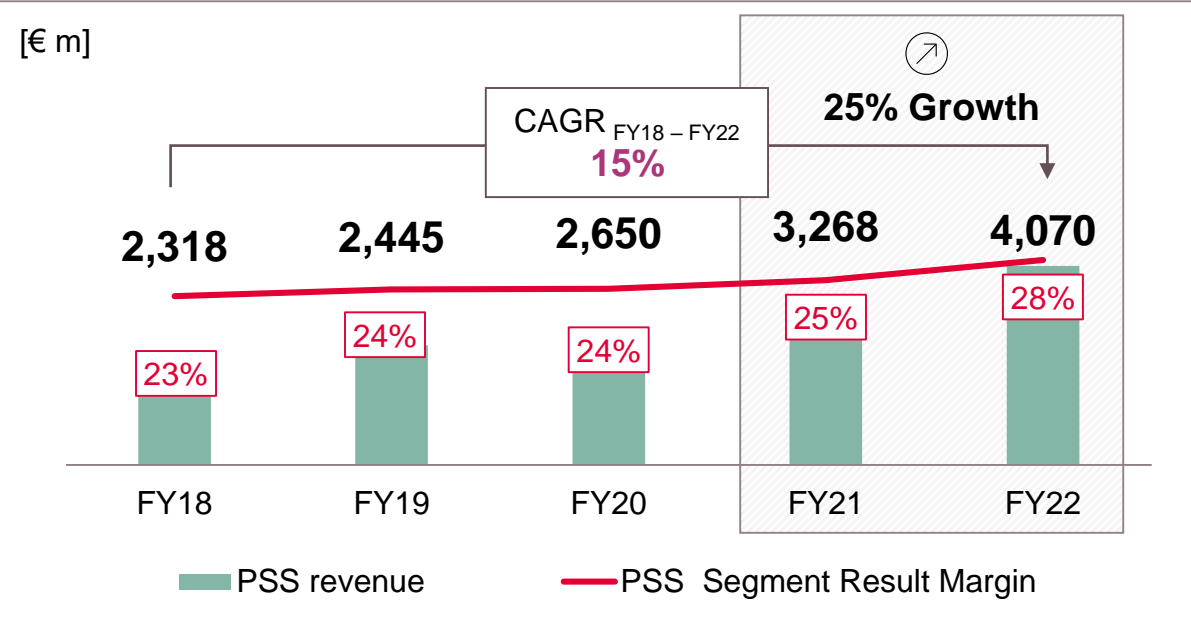


# Power & Sensor Systems

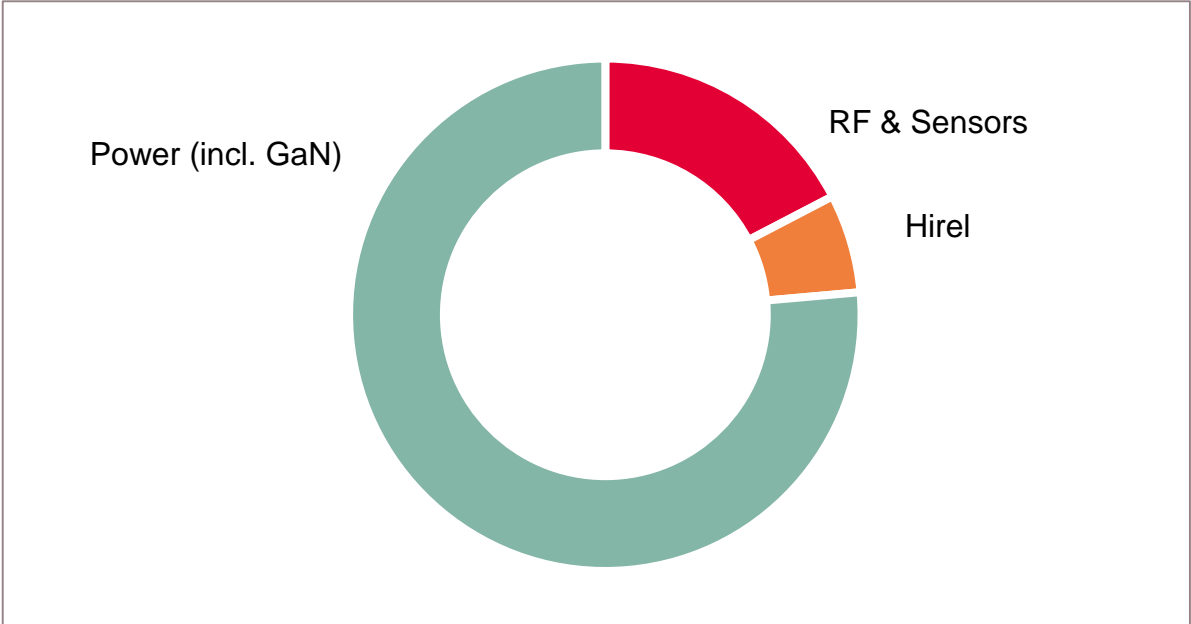


# PSS at a glance

## PSS revenue and Segment Result Margin



## FY22 revenue split by product group

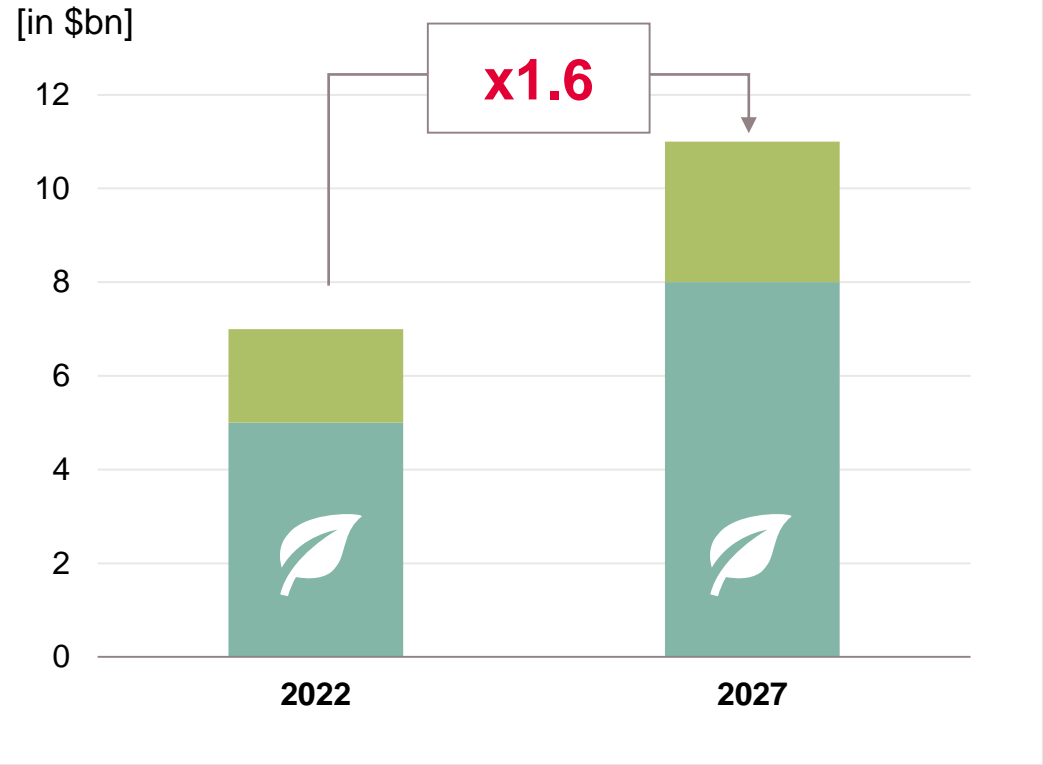


## Key customers


## Distribution partners

# PSS Power-related growth is strongly driven by decarbonization

## Approximately 70% of PSS TAM are power-related



■ Power ■ Non-Power

PSS Estimates

## Why does decarbonization drive our Power business?






- › Electrification/corded to cordless (battery-powered)
- › Acceleration in renewables and EVs
- › Increasing need for energy efficiency in all applications

## The need for smaller, lighter and more flexible designs, thus more power in smaller form factors drives the adoption of GaN, powered by Infineon

- › Operating at highest switching frequencies
- › High efficiency and highest power density
- › Optional integration on chip level enables system integration

# Long-term drivers are still valid, but impact of current macro environment leads to persist in 2023

## Applications (% of FY22 segment revenue)<sup>1</sup>

	<b>Computing</b>	<b>~18%</b>
	<b>Communication</b>	<b>~9%</b>
	<b>Smartphone</b>	<b>~12%</b>
	<b>Consumer</b>	<b>~25%</b>
	<b>Industrial</b>	<b>~32%</b>

## Market Outlook for CY23



- › Enterprise server in slowdown, while hyperscaler still healthy, reduction in hyperscaler Capex may follow
- › PC market expected to further slow down



- › While slowing down in China, other geographies like North America, EU and India to continue 5G roll-out
- › MNO capex may be negatively impacted by macro



Risk of continued weak smartphone market remains on the back of deteriorating macro environment with limited signs of recovery



Global decline in consumer confidence continues to create headwinds for consumer spending

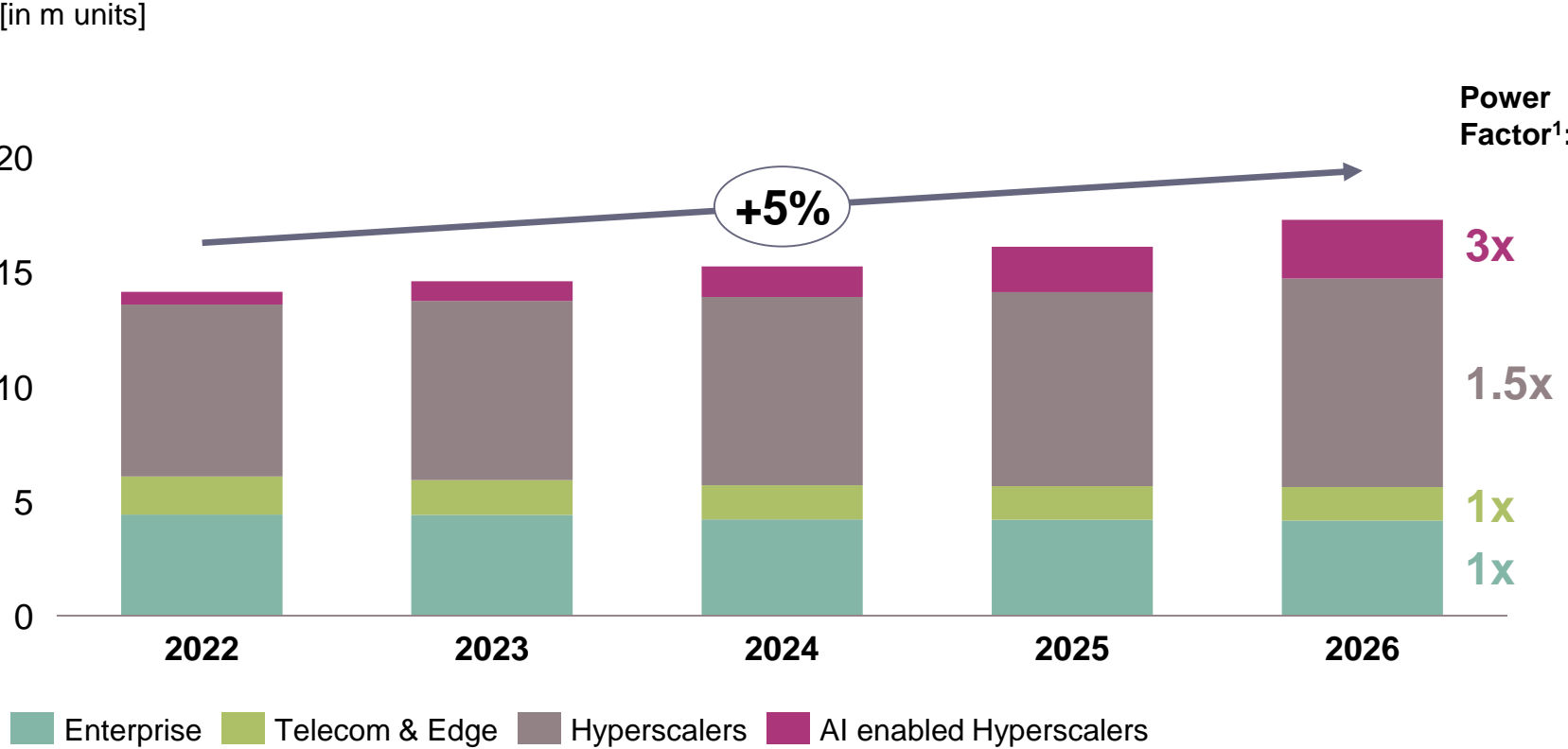


- › Demand in renewable energy, EVs and EV charging expected to further accelerate
- › Stimuli packages for renewables and respective infrastructure to support growth in CY23

<sup>1</sup> Does not sum up to 100% due to other applications not shown here

# Server market offers attractive growth potential

## Server market units as well as BoM expected to grow



Exponential increase in **AI Training & Networking** power level requires cutting-edge innovation in Device & Packaging technologies to solve power efficiency and density challenges

**→ The bill of material is outpacing unit growth by a factor of ~1.3x**

<sup>1</sup> Normalized overall power requirement per server board for x-comparison  
 Based on or includes research from Omdia: *Data Center Server Tracker – 3Q22 Database*. September 2022  
 Results are not an endorsement of Infineon Technologies AG. Any reliance on these results is at the third party's own risk.

# Infineon components enable best power usage effectiveness for data centers



## Supermicro collaborates with Infineon on green computing

### Supermicro MicroBlade servers contain ...

**28** digital multi-phase controllers

**112** power stages

**28** point-of-load controllers

- › Infineon's power stages provide the best power efficiency in the industry
- › Infineon's power IC's high temperature tolerance and excellent reliability enables operations at high ambient temperature → less energy-intensive external cooling needed

### Example

In one use case<sup>1</sup>, the end customer of Supermicro's MicroBlade server saved **56% in data center space utilization, 45% in CAPEX and \$13m/year in electricity**. This led to customer's **data center power usage effectiveness (PUE) of 1,061**

An ideal PUE value is 1.0, which means that all the power required for a data center is **in the actual computing devices**, not in overhead costs such as cooling or power conversion. According to recent research<sup>2</sup>, **IT and data center managers** reported an **average annual PUE ratio of 1.57** at their largest data centers.



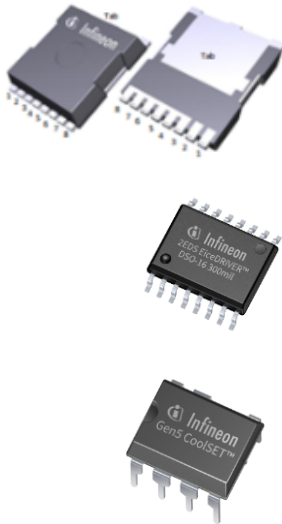
<sup>1</sup> Source: [https://www.supermicro.com/CaseStudies/CaseStudy\\_Fortune100.pdf](https://www.supermicro.com/CaseStudies/CaseStudy_Fortune100.pdf)

<sup>2</sup> Statista Research Department: *Data center average annual power usage effectiveness (PUE) worldwide 2007-2021*. July 21, 2022.

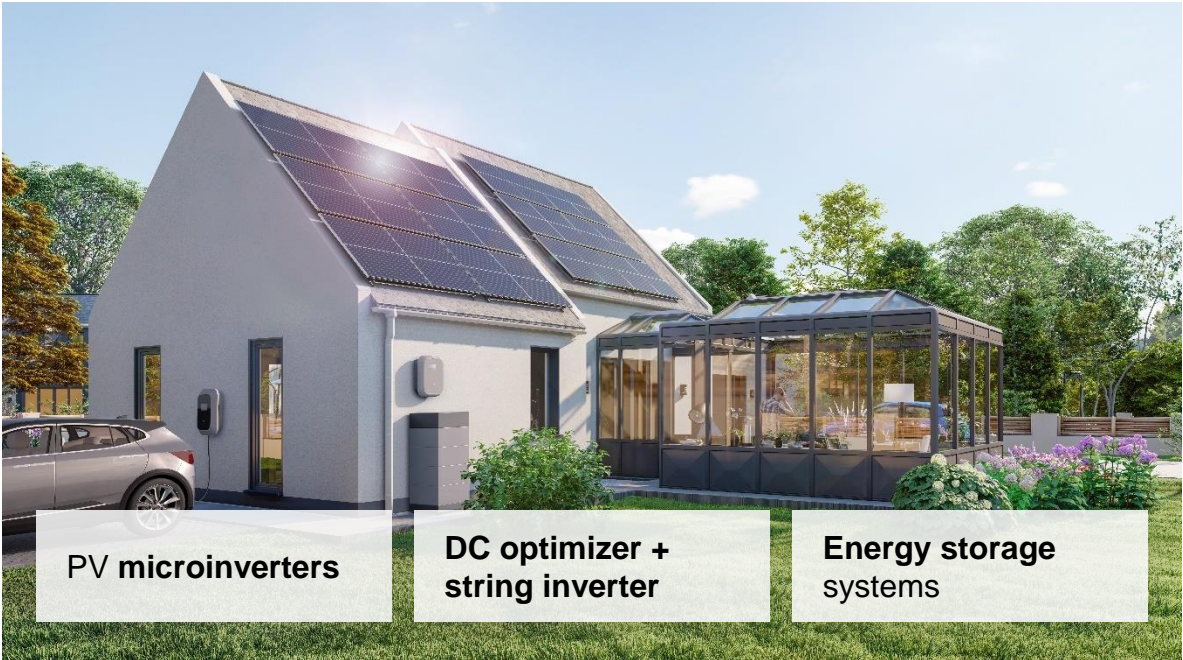
# PSS is a key enabler for residential solar systems

## Full portfolio breadth for solar

- > **Innovative MOSFET transistors**  
for MV & HV applications in all technologies:  
OptiMOS™, CoolMOS™, CoolSiC™, CoolGaN™
- > **Isolated gate driver and GaN driver ICs**  
for high system level efficiencies, excellent power density and consistent system robustness
- > **Coolset integrated power stages**  
for auxilliary power supply
- > **Digital isolaters** enables safe signal transfer



## Enabling residential solar energy systems

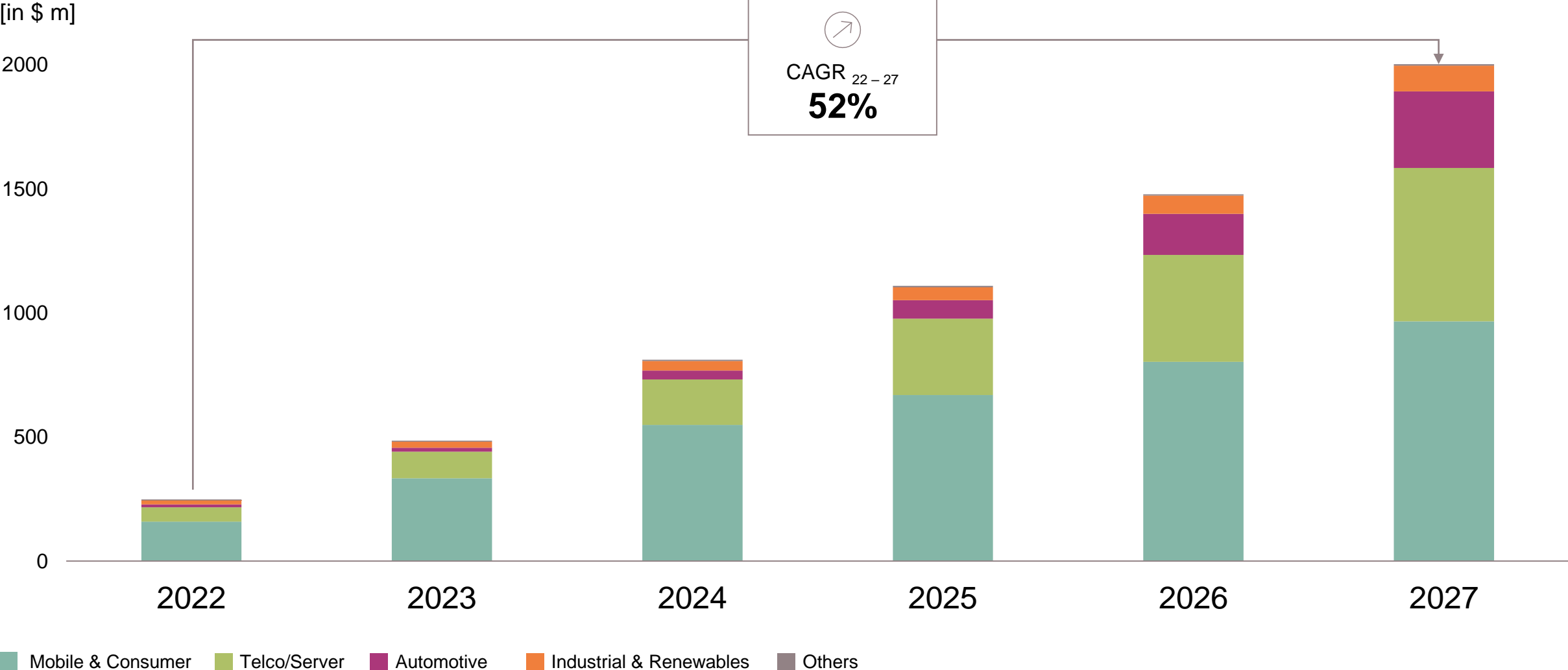


## Partnering with leading customers of the industry

Securing customer and market growth by entering into long-term strategic agreements

Growing above industry CAGR with the leading customers of the industry

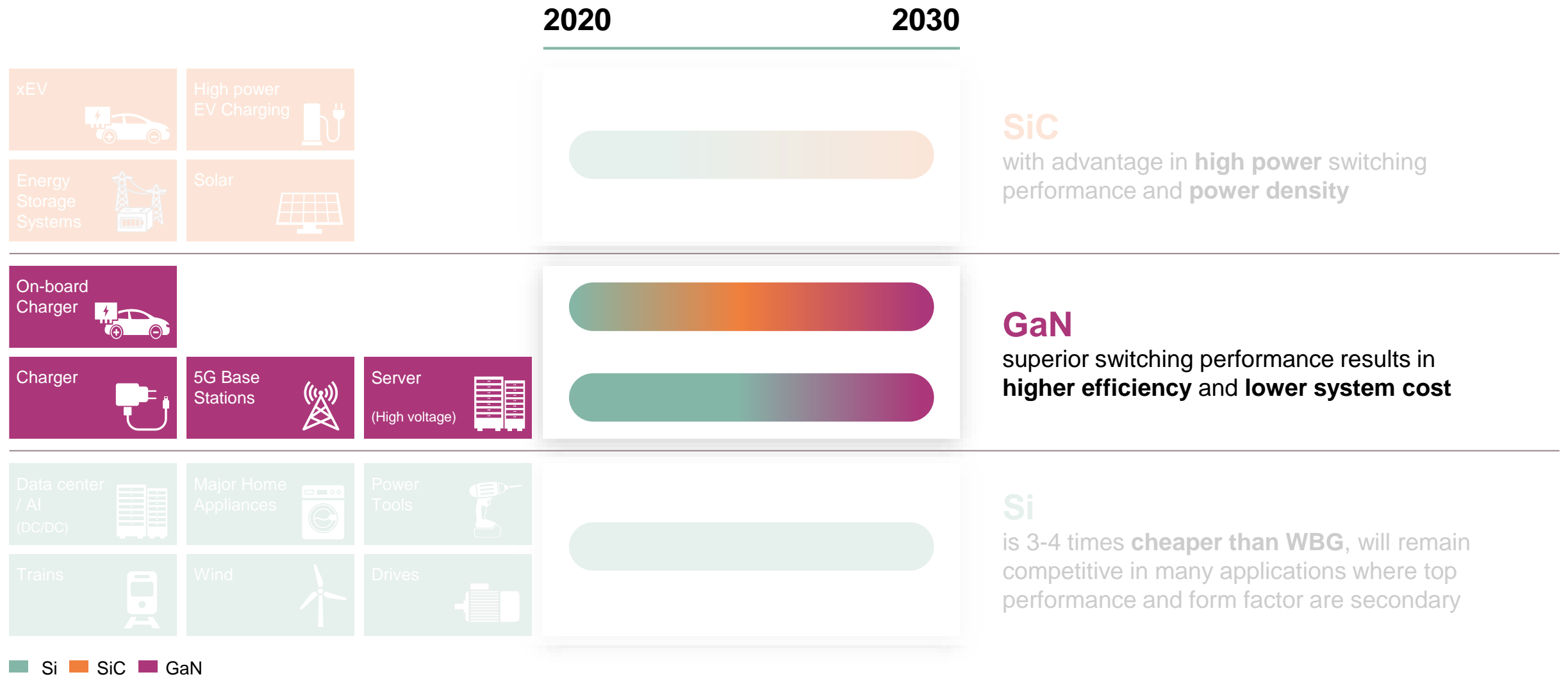
# GaN: immense market opportunity covering key power applications



GaN for power market: Source: Yole Intelligence *Compound Semiconductor Quarterly Market Monitor-Module I* Q3 2022 Database. October 2022



# GaN expected to be the preferred technology in the PSS core portfolio until 2030, silicon still important in cost-intensive applications



Infineon is positioned to be  
**the leading GaN player**

Infineon is an  
**Integrated Device Manufacturer**



**IP**



**We own**  
key IP and all  
Frontend  
process steps

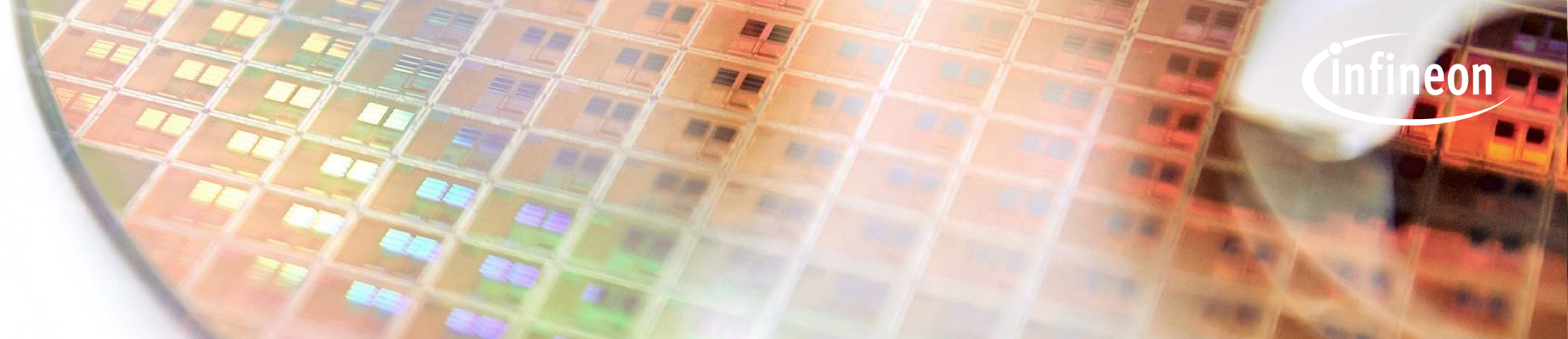
**We move**  
to 8 inch  
(Big potential to  
bring down  
costs)

**We enable**  
dual source  
in-house  
production

**We are the**  
**#1 in power**  
with years  
of innovation  
in GaN

**#1 patent**  
**portfolio**  
for GaN –  
around 300  
patents families

**Innovation is**  
**part of our**  
**DNA**



# GaN has reached an inflection point

Strong revenue growth in FY22 and FY23  
GaN design-wins of around **€1.5bn**

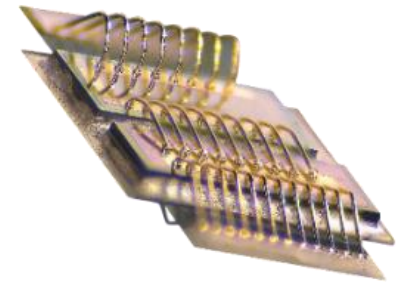
## GaN for power applications

Increasing revenue and design-wins, e.g., in charger and adapter, servers for data center, edge computing and telecom, notebook as well as handhelds.



## GaN for RF applications

GaN power amplifiers are already shipped to a leading global infrastructure provider of power antennas for 5G basebands.





## Adam White

was born in the United Kingdom in 1974.

He holds a Diploma in Engineering, Electronic and Electrical Engineering with Industrial, BEng (Hons) DIS from University of Loughborough, United Kingdom.

### 1996 – 2010

Various R&D, Operations, Marketing, Sales and Management positions, International Rectifier

### 2010 – 2015

Executive Officer & SVP Worldwide Sales<sup>1</sup>, International Rectifier

### 2015 – 2022

Chief Marketing Officer<sup>1</sup> of Power & Sensor Systems Division, Infineon

(Adam White became a part of Infineon 2015 in light of the acquisition of International Rectifier)

### Since 2022

Division President Power & Sensor Systems, Infineon

<sup>1</sup> Last position



## Dr. Peter Wawer

was born in Berlin, Germany, in 1967.

He holds a Diploma in Electrical Engineering from the Technical University in Berlin where he also received his PhD.

He joined Infineon (Siemens AG until 1999) in 1997.

### 1997 – 2008

Various positions  
at Infineon

### 2008 – 2011

Senior VP Technology  
at Q-Cells SE

### 2011

Senior VP Technology  
and Production at Q-  
Cells SE in Bitterfeld,  
Germany

### 2012

Member of the  
Management Board  
of the Power  
& Sensor Division  
(Power Management  
& Multimarket Division  
at that time)

### Since 2016

Division President  
Industrial Power  
Control



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# Disclaimer

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## Disclaimer

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