



Power Semiconductor Roadshow hosted by UBS

virtual, 30 November – 1 December 2020

Dr. Peter Wawer, Division President Industrial Power Control
Andreas Urschitz, Division President Power & Sensor Systems



Agenda and speakers

Agenda

1. Overview & power strategy
2. Division IPC (incl. SiC)
3. Division PSS (incl. GaN)
4. Q&A

Speakers



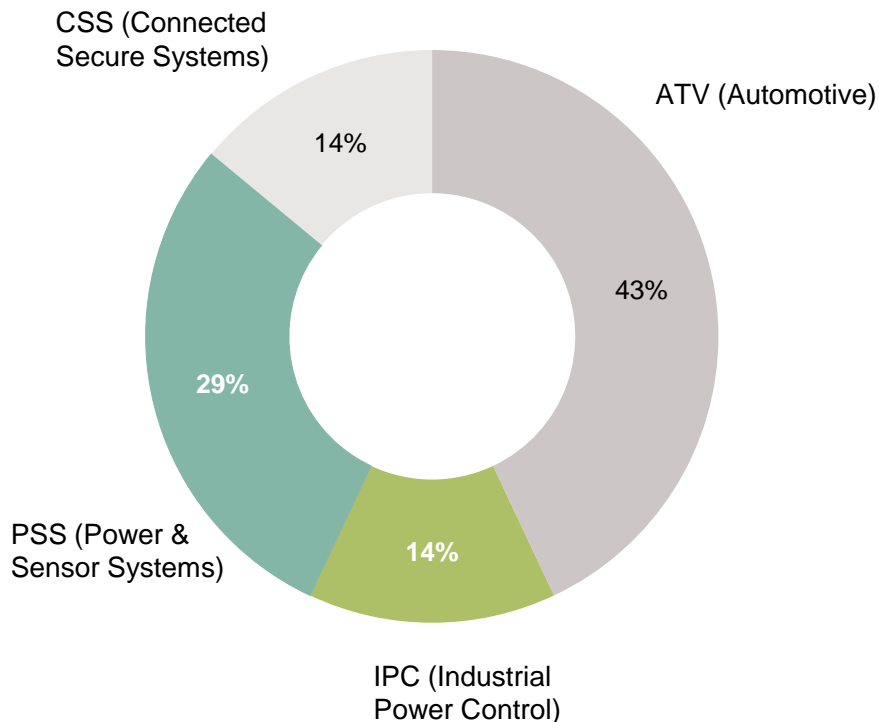
- › Dr. Peter Wawer
- › Division President IPC



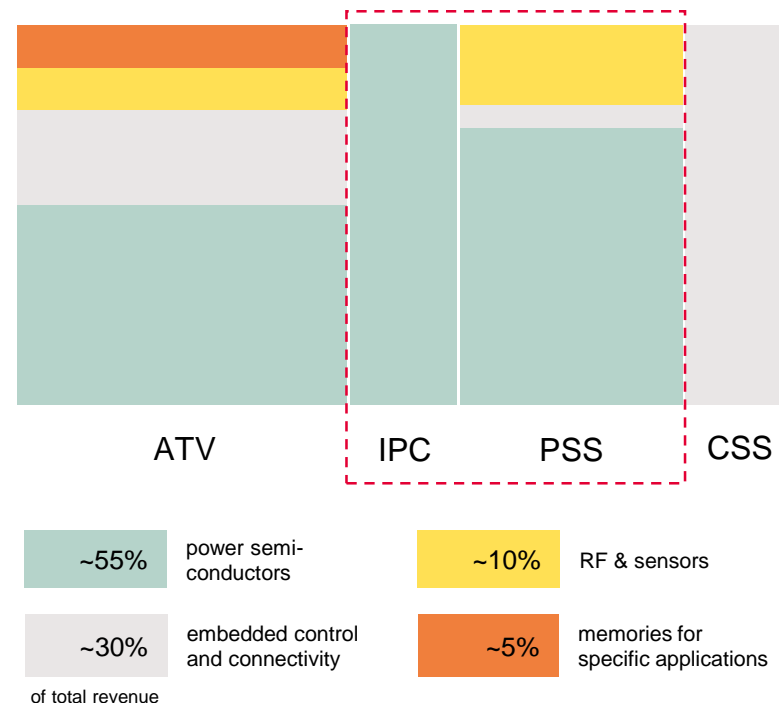
- › Andreas Urschitz
- › Division President PSS

Focus of presentation will be IPC and PSS – non-automotive power

Illustrative aggregated FY20 revenue by segment



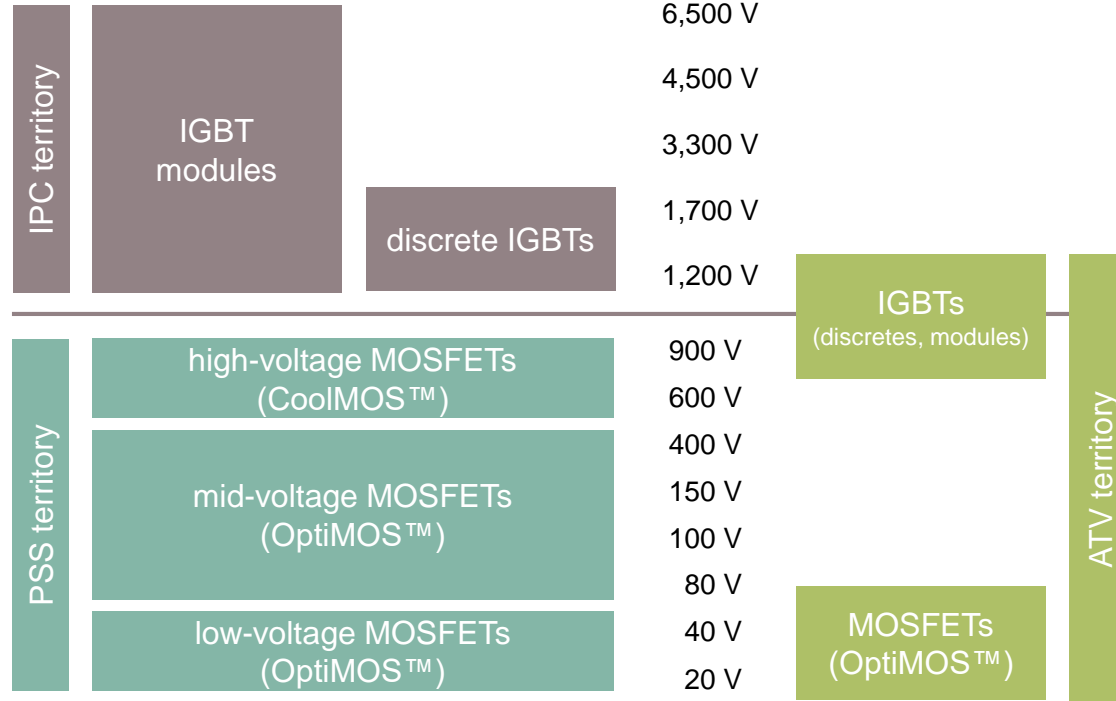
Illustrative aggregated FY20 revenue by product category



Infiniteon's discrete power portfolio* is basically separated by voltage classes

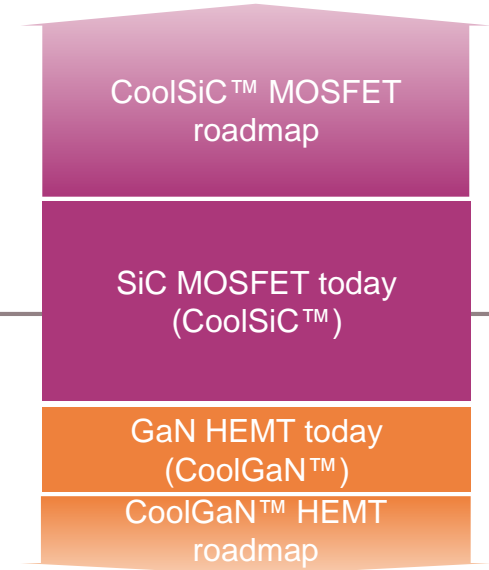


Silicon-based power switches



* excluding drivers and control ICs

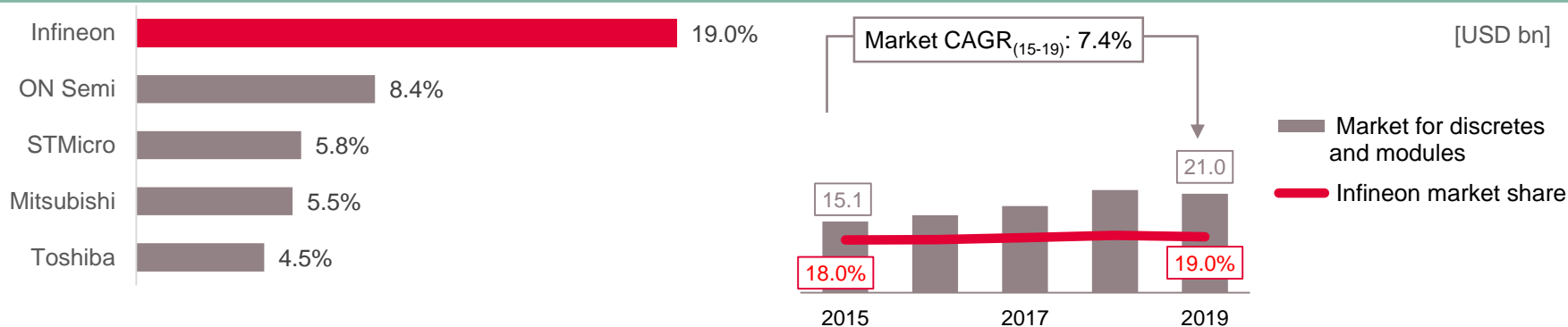
Compound semiconductors



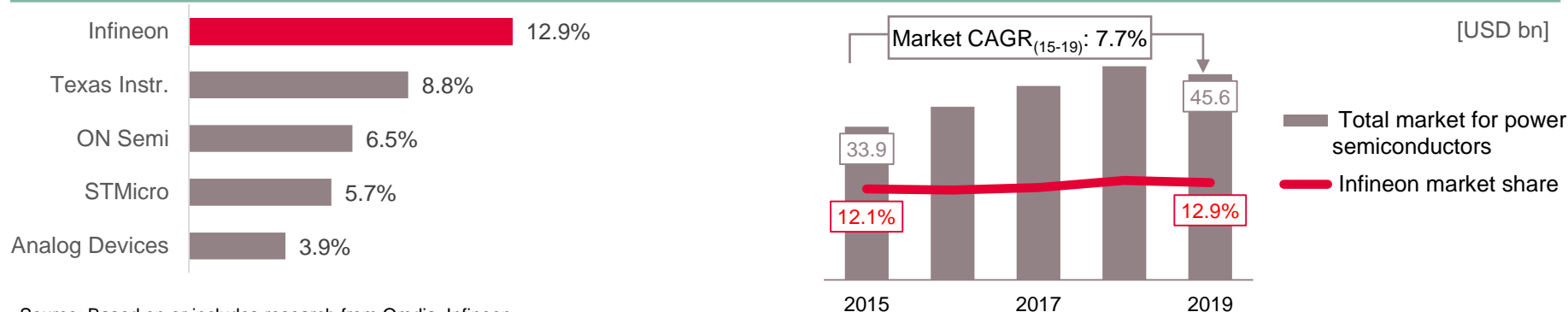
Infineon holds #1 position in power semi market, based on strength in discretes and modules; power ICs provide growth potential



Power discretes and modules: \$21.0bn in 2019



Total market for power semiconductors: \$45.6bn in 2019



Source: Based on or includes research from Omdia, Infineon

Power market leadership based on key success factors



Innovation

- Long history: from IGBTs to super-junction MOSFET
- First SiC diode and GaN HEMT
- Market leading scale enables large R&D roadmap



Customer embeddedness

- P2S: system understanding and solution expertise
- Customization capabilities



Field-proven quality

- Diligent development process and strict quality control
- Track record: decades of supply reliability



Breadth and depth of portfolio

- Power: bare dies, discretes, modules, driver and control ICs
- Beyond: holistic offering with sensors, MCUs, connectivity, security



Differentiated manufacturing at high scale

- Process technology is key for power semiconductors
- Global 300-millimeter thin-wafer pioneer and leader



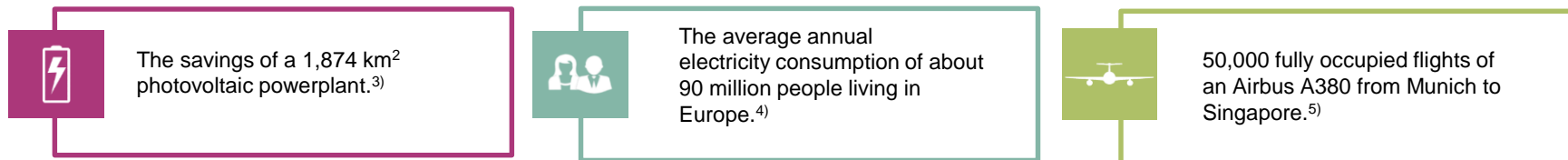
Our products and innovations together with an efficient production are key elements to deal with climate change

We contribute a CO₂ reduction of more than 54 million tons



*The increase in the burden of CO₂ equivalents can be mainly explained by including manufacturing service providers for the first time into the calculation

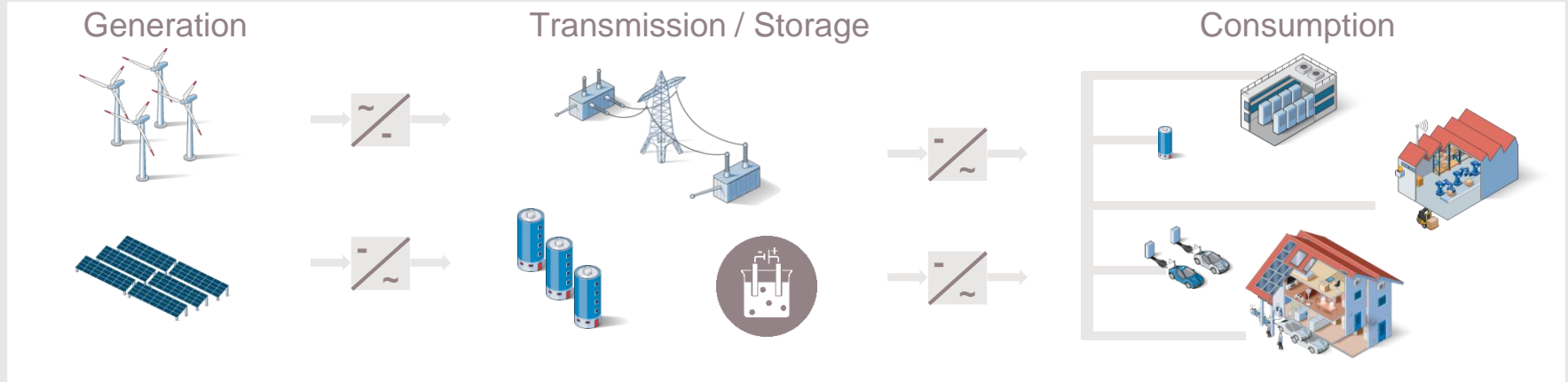
Our net ecologic CO₂ benefit is equal to...



For explanatory notes see page "ESG footnotes" in the appendix.

Electricity will become the most important energy carrier of the 21st century

Shaping the electrical energy chain



Clean energy

- › Wind energy
- › Photovoltaic energy

Stable and efficient supply

- › HVDC (high-voltage direct current)
- › Smart grid
- › Battery storage
- › Hydrogen energy storage

Efficient use – Making more out of less

- › Data center
- › Industrial applications
- › Electro-mobility
- › Smart home

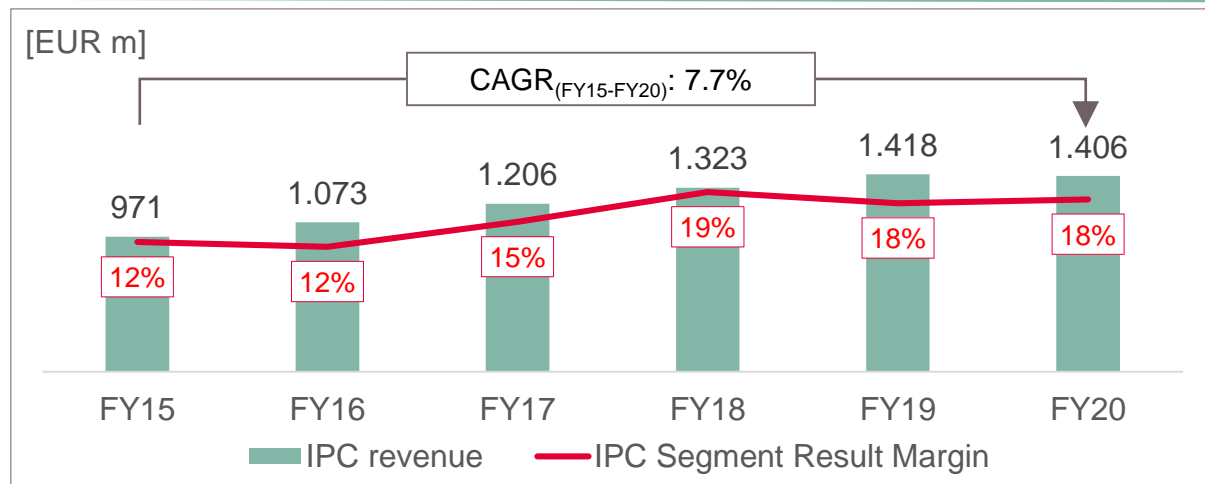


Industrial Power Control

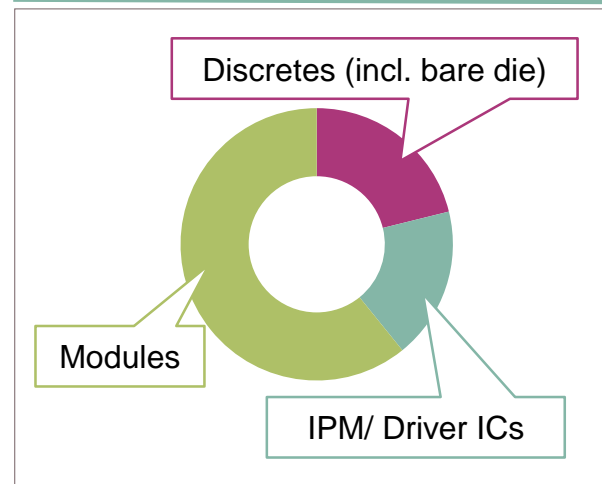


IPC at a glance: market leader in discrete IGBTs, IGBT modules and Driver ICs

IPC revenue and Segment Result Margin



Revenue split by category in FY20















Key customers



Distribution and EMS partners

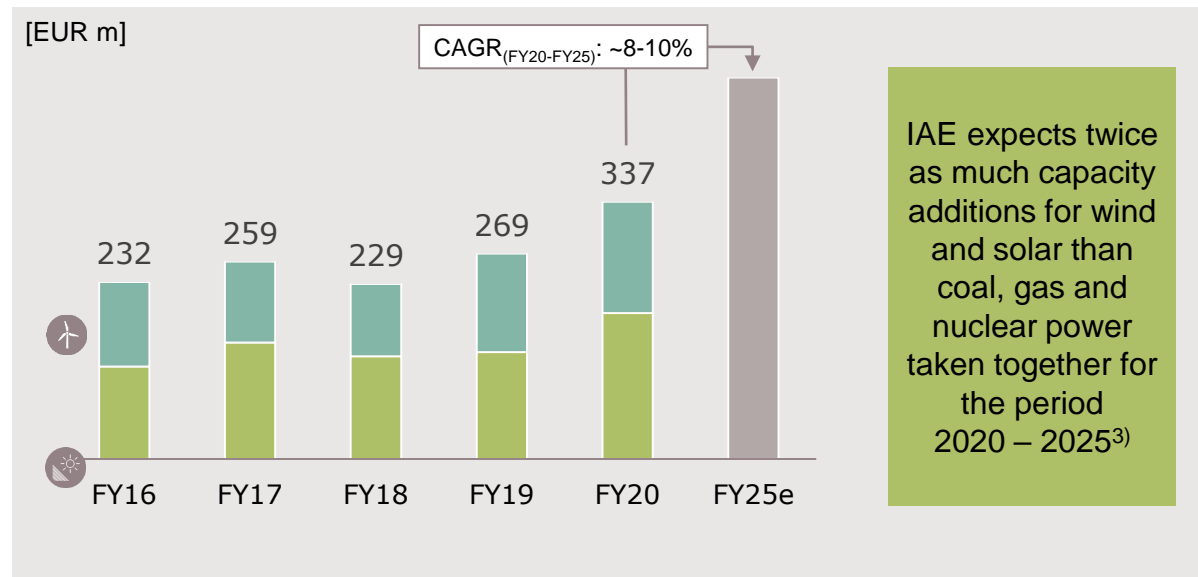


Market outlook for IPC division's target applications

Application (% of FY20 segment rev)	Market Outlook for CY21	
<div data-bbox="226 277 334 390">  <p>Drives</p> </div> <div data-bbox="355 325 421 347">~30%</div>		› Industrial drives expected to recover in low single digits
<div data-bbox="226 397 334 511">  <p>Solar</p> </div> <div data-bbox="355 445 421 467">~14%</div>		› Total installations forecasted close to pre-COVID levels with upside potential in China and Europe
<div data-bbox="226 517 334 631">  <p>Wind</p> </div> <div data-bbox="355 565 421 587">~10%</div>		› Self-sustainable growth due to long-term drivers and increasing competitiveness
<div data-bbox="226 637 334 751">  <p>Home appliance</p> </div> <div data-bbox="355 685 421 707">~16%</div>		› Catch-up of delayed purchases and energy efficiency incentive programs will drive growth
<div data-bbox="226 757 334 871">  <p>Traction</p> </div> <div data-bbox="355 805 421 827">~9%</div>		› Long-term drivers ensure stability, although growth depends on stimuli programs in China and Europe
<div data-bbox="226 877 334 991">  <p>Others</p> </div> <div data-bbox="355 926 421 947">~21%</div>		› Long-term positive outlook driven by infrastructure for further electrification and decarbonization

Infineon serves all major players for PV inverters and wind turbines

IPC revenue in renewables



Infineon is powering all leading renewable energy players*

PV inverter ¹⁾		Wind ²⁾	
1 Huawei	✓	1 Vestas	✓
2 Sungrow	✓	2 SGRE	✓
3 SMA	✓	3 GE	✓
4 Power Electr.	✓	4 Goldwind	✓
5 Solar Edge	✓	5 Enercon	✓
6 ABB	✓	6 Nordex Group	✓
7 TMEIC	✓	7 Envision	✓
8 Sineng Electric	✓	8 Mingyang	✓
9 Growatt	✓	9 United Power	✓
10 Ginlong	✓	10 Suzlon	✓

* Infineon is serving the top-10 of each category but not necessarily as a sole supplier.

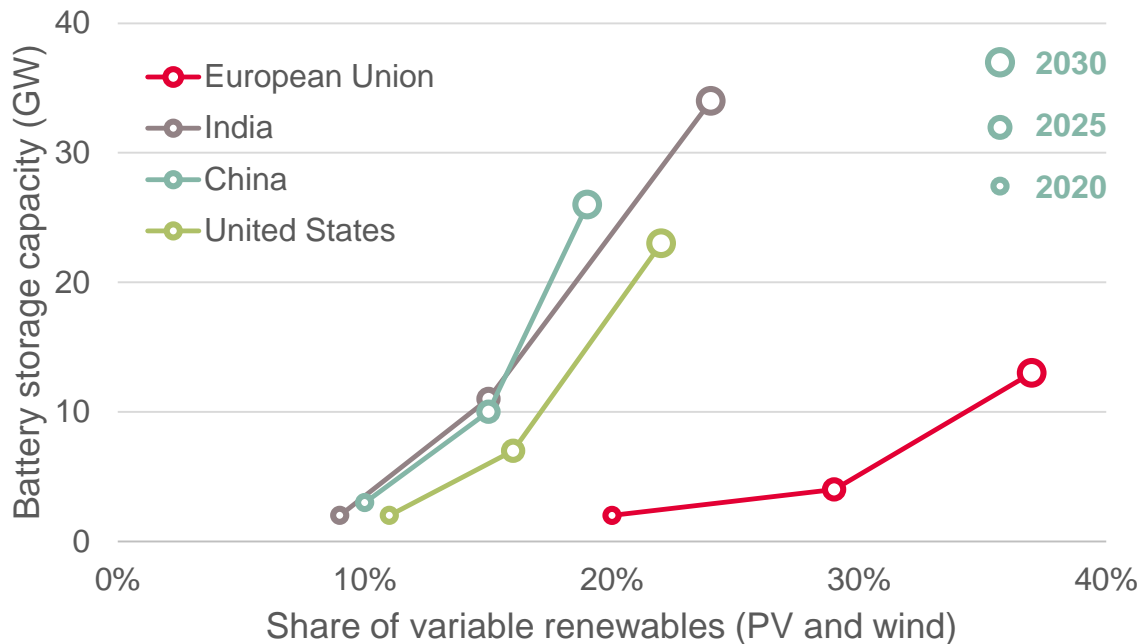
Source: 1) by shipped capacity in MW: based on or includes content supplied by IHS Markit, Technology Group: *PV Inverter Market Tracker* – Q3 2020. October 2020.

2) WoodmacKenzie: *Wind Turbine OEM Market Share*. November 2020.

3) World Energy Outlook 2020, p. 224.

Energy storage is essential to further deploy decentral and renewable energy generation

Battery storage capacity and share of variable renewables¹⁾



Source: 1) World Energy Outlook 2020, p. 248; variable renewables consist of solar and wind energy.
2) Infineon estimate

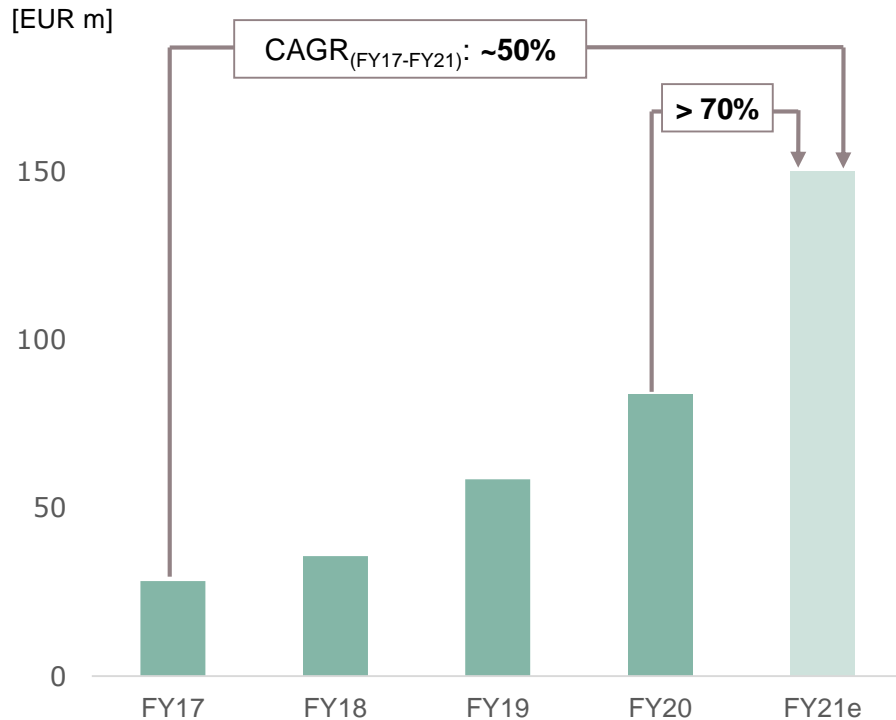
Key drivers

- › **Decentralization** of power generation
- › **Peak shaving** of energy generation and energy consumption
- › **Limited capacity** and flexibility of today's grids
- › **Reduction of standby cost** of fossil power plants

~€3,200 of power semiconductor content per MW of installed energy storage capacity²⁾

SiC is switching gears: industrial still holds the biggest share, but about half of the incremental revenue contributed by automotive

Industrial and automotive applications driving the growth



~150 different CoolSiC™ products as of today

~60 different customers with more than €10k revenue as of today

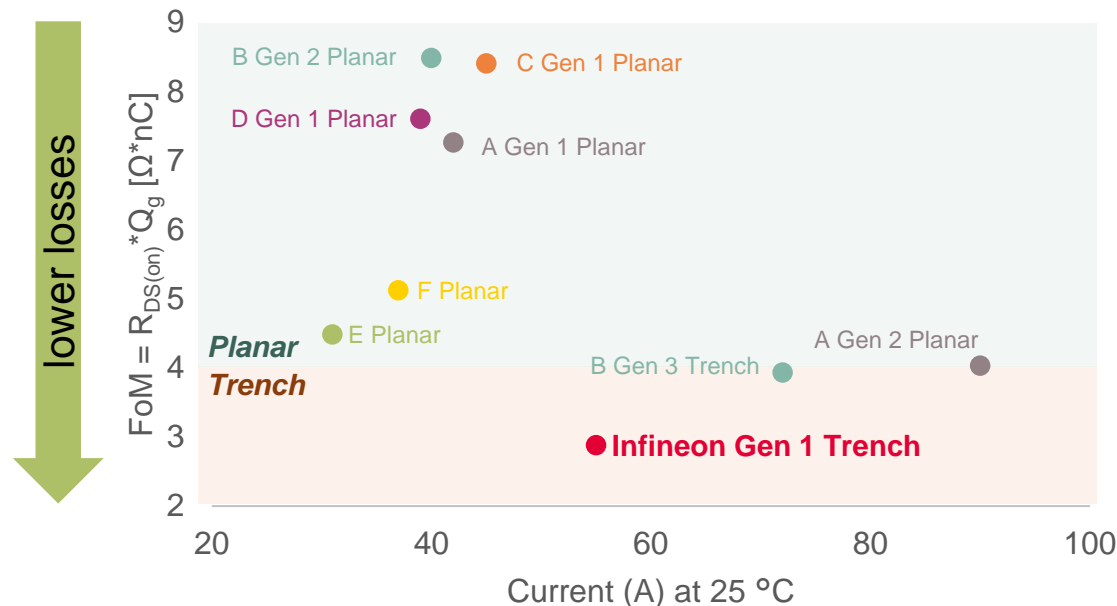
>2,500 total active customers including distribution



Second generation (2nd Gen.) CoolSiC™ Trench MOSFET will increase the addressable market



1st Gen. with lowest losses is the leading technology today



Source: SystemPlus Consulting: SiC Transistor Comparison 2020. November 2020

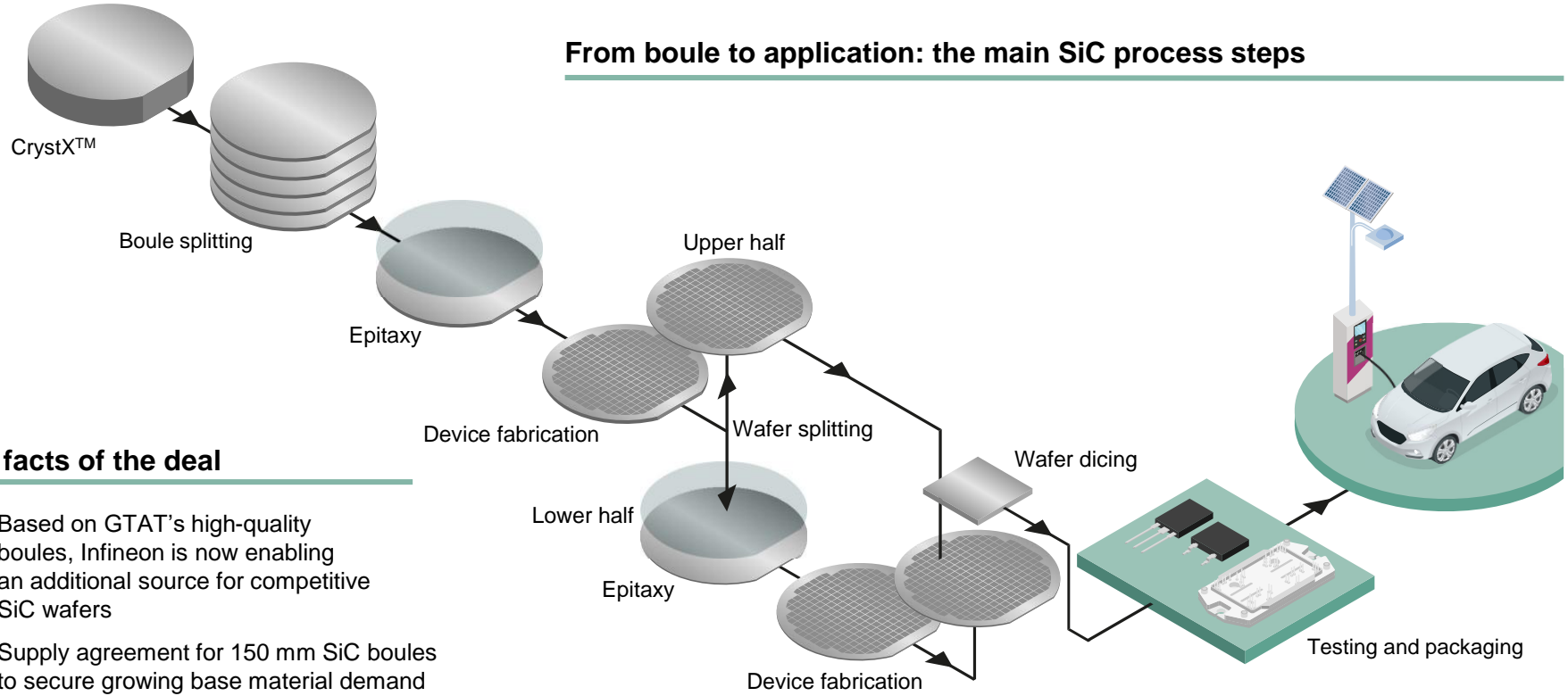
2nd Gen. will expand the lead

- › 2nd Gen. CoolSiC™ Trench MOSFET is in advanced development phase
- › Enhanced power handling capability by 25% – 30%
- › Enhanced safe operating area without compromising quality
- › Enabling SiC in further high volume applications

2nd Gen. CoolSiC™ Trench MOSFET will significantly enlarge the market size for SiC MOSFETs

Infinion expands supply base for SiC boules with GT Advanced Technologies

From boule to application: the main SiC process steps



Key facts of the deal

- › Based on GTAT's high-quality boules, Infineon is now enabling an additional source for competitive SiC wafers
- › Supply agreement for 150 mm SiC boules to secure growing base material demand
- › Contract has an initial term of five years

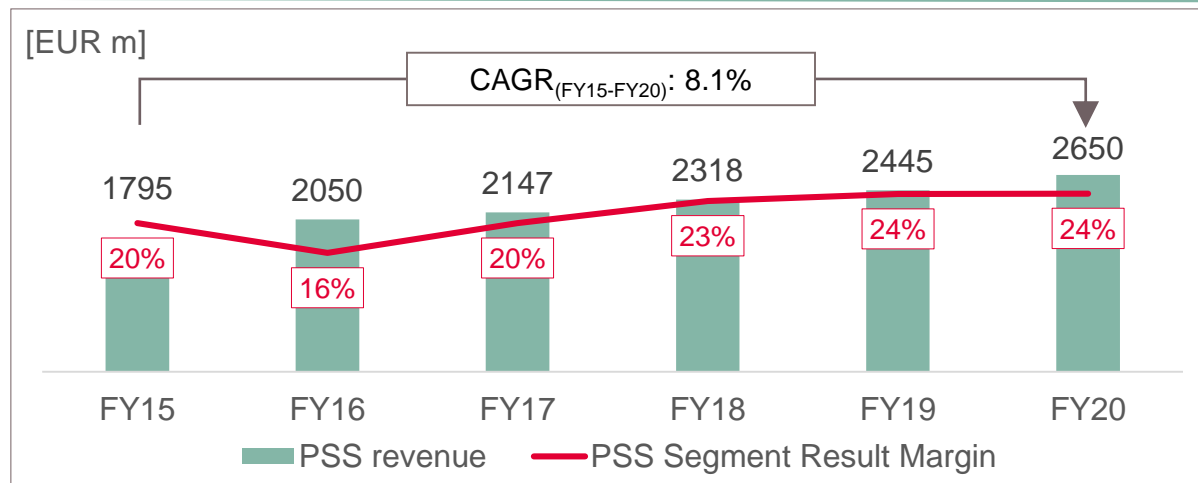


Power & Sensor Systems

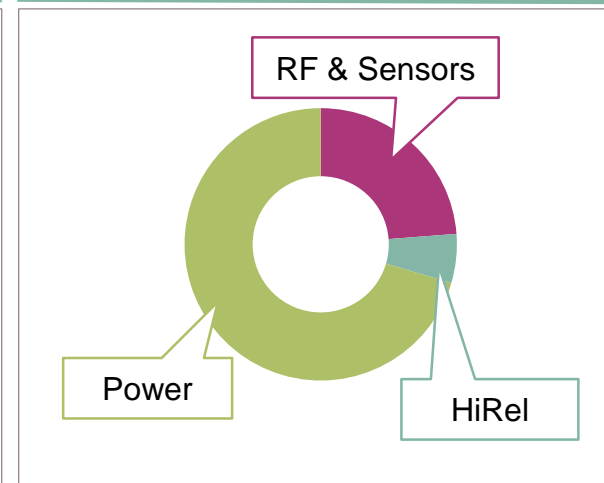


PSS at a glance

PSS revenue and Segment Result Margin



Revenue split by category in FY20













Key customers



Distribution and EMS partners



Market outlook for PSS division's target applications

Application (% of FY20 segment rev*)	Market Outlook for CY21	
<div><div>Computing</div><div></div></div> <div>~20%</div>	<div></div> <div>> Acceleration towards cloud computing to continue</div>	
<div><div>Communication</div><div></div></div> <div>~9%</div>	<div></div> <div>> In general, long-term drivers due to 5G still intact. However, trade tensions generate some uncertainty around speed of roll-out in China</div>	
<div><div>Smartphones</div><div></div></div> <div>~19%</div>	<div></div> <div>> Strong rebound expected driven mainly by economic recovery and migration towards 5G phones</div>	
<div><div>Consumer</div><div></div></div> <div>~20%</div>	<div></div> <div>> Catch-up of delayed purchases leading to market pick-up expected but depends on consumer confidence improving in the light of (potential) new lock-downs; gaming consoles clear beneficiaries from stay-at-home</div>	
<div><div>Industrial</div><div></div></div> <div>~23%</div>	<div></div> <div>> Automotive and other industrial segments show signs of recovery; battery-powered tools continue to show strong momentum</div>	

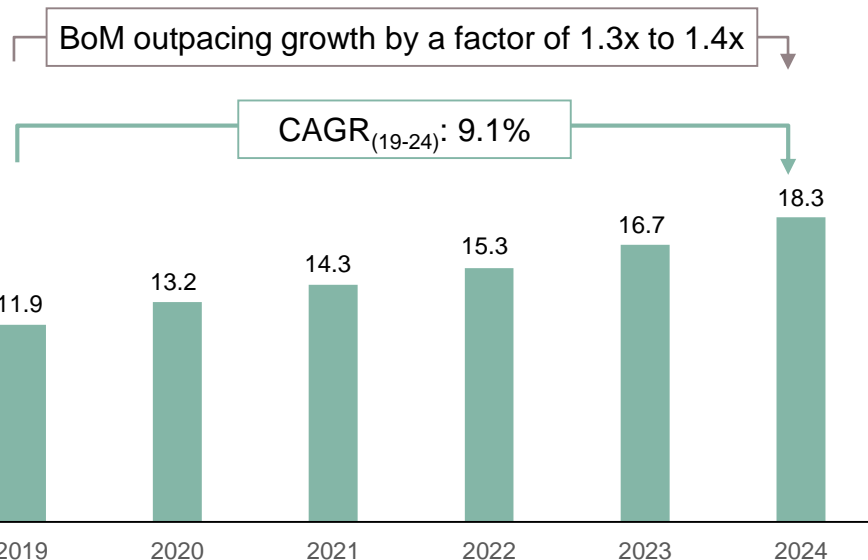
* does not sum up to 100% due to other applications not shown here

Server market offers attractive growth potential

- Next-generation CPUs are more power hungry, driving increased power conversion content (~15% to 25% increased DC-DC power semiconductor content for each new CPU generation)
- AI accelerator attach rate in servers drives incremental content. By CY26, up to ~22% of servers are expected to be AI enabled
- Network switch SoC are approaching 1000+ A, leading to significant increase in the amount of power stages
- AC-DC SMPS solutions for servers are also trending towards higher power (up to 3 kW) and need to meet higher level of efficiency classes (Titanium)

Server market units as well as BoM expected to grow

[in million units]



Based on or includes research from Omdia: *Application Market Forecast Tool Q3 2020. Worldwide Semiconductor Shipment with Regional Splits Pivot*. September 2020

Demand driven by several trends in data server

Four market trends mainly leading to higher semi demand

Increasing power for next-generation CPUs, ASICs and SoCs drive system power levels higher and force new optimized power flow architectures from AC-DC to processor core voltages

AI accelerator modules, used mainly in hyperscale servers, are driving the need for best-in-class high-density power solutions

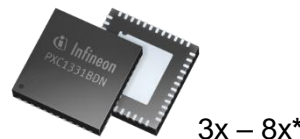
Increasing chip vendor landscape from CPU only (Intel) to GPU/ASIC/SoC vendors (Arm, Nvidia, Xilinx, AMD, etc.) as well as in-house developments by hyperscalers (Google, AWS, etc.) and many more AI chip start-ups

Enterprise server shipments surpassed by hyperscale servers and further driven by work-from-home trend

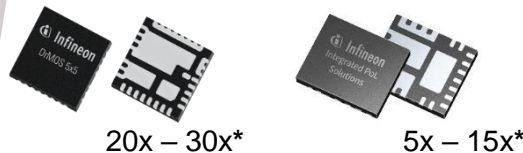
High-density, high-efficiency solutions are critical to support rapidly increasing system level power requirements



Digital controllers
with flexible communications interface



Integrated power stages and iPoL
for high power density



AC-DC SMPS solutions
Full suite of solutions to meet price/performance requirements

- HV-LV-ULV Si / SiC / GaN switches

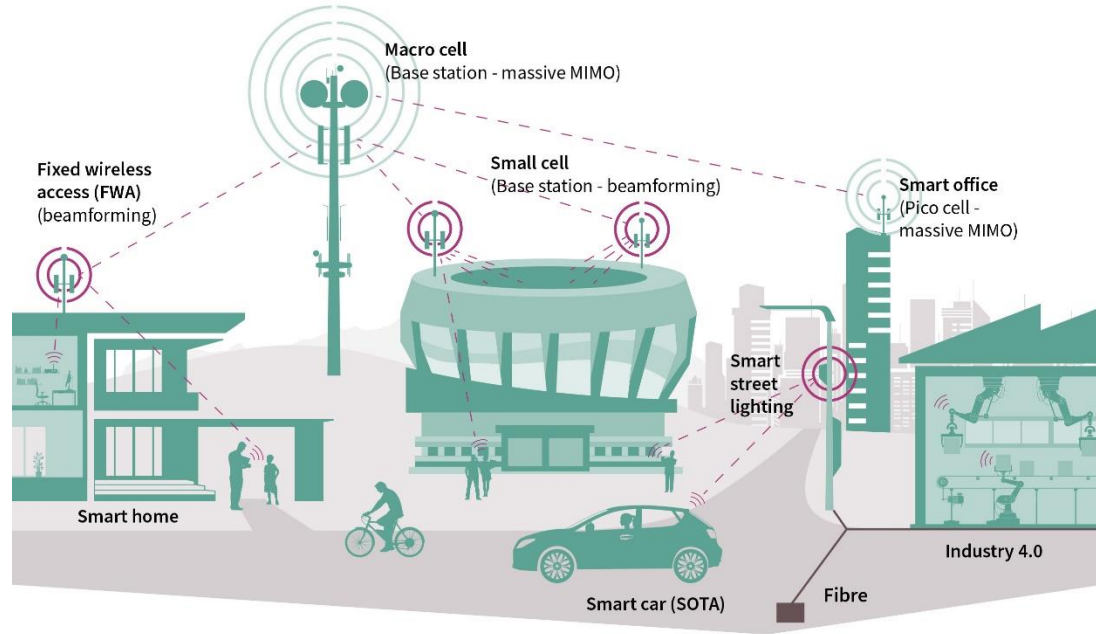


- Controllers, drivers

* devices per server

Transition from 3G/4G to 5G drives demand in power semis for antennas and power supplies

Smart and connected - the communication of tomorrow with 5G



Base station (Macro cell, massive MIMO) < 6GHz



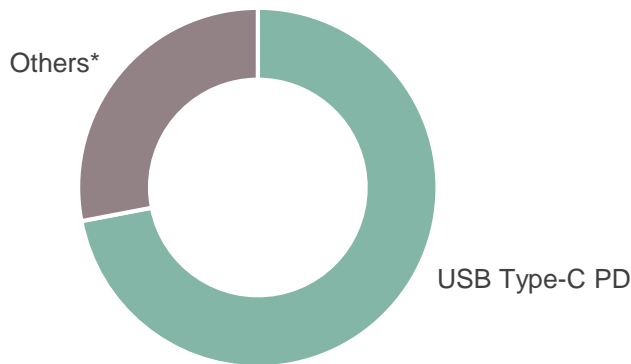
Small Cell (Beamforming) > 6 GHz

SOTA (Software over the air)

- **driver #1:** massive growth of data and computing power
- **driver #2:** higher number of base stations due to dense network
- **driver #3:** ~4x higher power semi content per radio board: from ~\$25 for MIMO antenna to ~\$100 for massive MIMO antenna array
- **driver #4:** fog computing data center as a completely new market

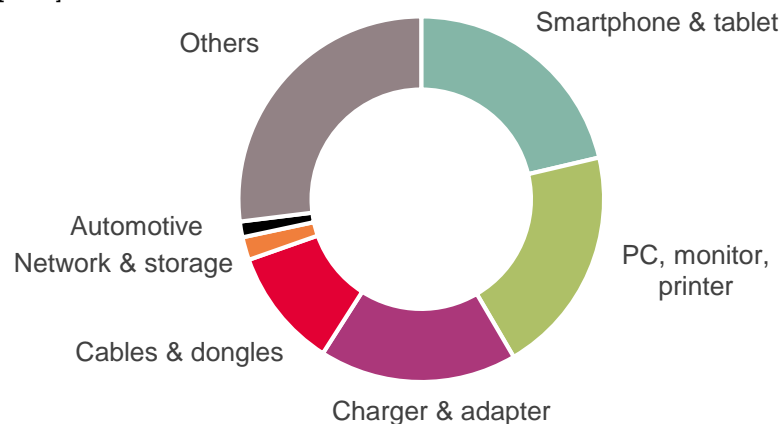
USB is complementing the PSS power business

Infineon USB business dominated by Type-C PD



Infineon USB business split by application

[FY20]

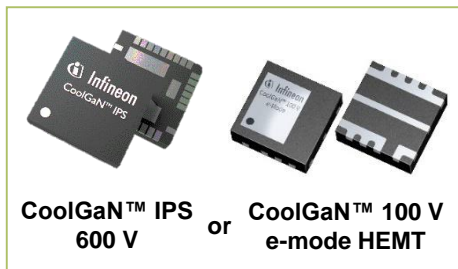


- › Over 10bn USB ports deployed in the market, all will transition to USB Type-C.
- › Current product portfolio comprise more than 30 products thereof more than 10 USB Type-C products.
- › USB Type-C with power delivery in automotive is a nascent segment with good growth opportunities.

* Others is including High-Speed USB, Low-Speed USB, Super-Speed USB, and Communications USB.

Combining CoolGaN™ with digital power and USB chip EZ-PD™ to reshape power densities

Leading-edge system solutions based on Infineon's comprehensive technology portfolio



- > CoolGaN™ integrated power stage (IPS) technology with digital control and USB chip EZ-PD™ power delivery creates system solution for highest power density chargers

- > Addresses next level design and form factor requirements for consumer electronics

State-of-the-art 65 W silicon charger



Power density: 25 W per inch³

25% size reduction

Higher frequency switching
→ less capacitors, smaller transformers
→ **higher power density**

Next level 65 W charger enabled by CoolGaN™

Fits into less than a highlighter
BoM ~\$3 – \$4



Power density: 32 W per inch³



Part of your life. Part of tomorrow.

Dr. Peter Wawer

Division President Industrial Power Control



- › since 2016: Division President Industrial Power Control
- › 2012: Member of the Management Board of the Power & Sensor Division (Power Management & Multimarket Division at that time)
- › 2011: Senior VP Technology and Production at Q-Cells SE in Bitterfeld, Germany
- › 2008 – 2011: Senior VP Technology at Q-Cells SE
- › 1997 – 2008: various position at Infineon

- › 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.



- › since 2012: Division President Power & Sensor Systems
- › 2011: Head of Distribution of the Power & Sensor Systems Division (Power Management & Multimarket (PMM) Division at that time)
- › 2001 – 2011: several management positions within the Power & Sensor Systems Division (PMM at that time)
- › Andreas Urschitz was born in Klagenfurt, Austria, in 1972. He holds a master's degree in Commercial Science from the Vienna University of Economics and Business.
- › He joined Infineon (Siemens AG until 1999) in 1995.

Glossary (1 of 2)

AC	alternating current
AC-DC	alternating current - direct current
AI	artificial intelligence
AR	augmented reality
BEV	battery electric vehicle
BGA	ball grid array
BLE	Bluetooth Low Energy
BoM	bill of material
BT	Bluetooth
CPU	central processing unit
DC	direct current
DC-DC	direct current - direct current
DIY	do it yourself
DPM	digital power management
EV	electric vehicle
FHEV	full hybrid electric vehicle
FoM	figure of merit
FPGA	field programmable gate array
GaN	gallium nitride
GPU	graphics processing unit
HEV	mild and full hybrid electric vehicle
HMI	human machine interaction

HST	high-speed train
HVAC	heating, ventilation, air conditioning
HW	hardware
IC	integrated circuit
IGBT	insulated gate bipolar transistor
IoT	Internet of Things
IPM	intelligent power module
iPol	image processing line
IRF	International Rectifier
LDO	low dropout voltage regulator
LED	light-emitting diode
LSEV	low-speed electric vehicle
LSPS	LS Power Semitech Co. Ltd.
μC	microcontroller
Mb	megabit
MCU	microcontroller unit
MEMS	micro electro-mechanical systems
MHA	major home appliances
MHEV	mild hybrid electric vehicle
MIMO	multiple input, multiple output
micro-hybrid	vehicles using start-stop systems and limited recuperation

Glossary (2 of 2)

mild-hybrid	vehicles using start-stop systems, recuperation, DC-DC conversion, e-motor
MOSFET	metal-oxide silicon field-effect transistor
MPU	microprocessor unit
OBC	on-board charger
OEM	original equipment manufacturer
P2S	Infineon's strategic product-to-system approach
PAS	photoacoustic spectroscopy
PFC	power factor correction
PHEV	plug-in hybrid electric vehicle
PMIC	power management IC
Pol	point-of-load
PSoC	programmable system-on-chip
PV	photovoltaic
RF	radio frequency
rhs	right-hand scale
Si	silicon
SiC	silicon carbide

SiGe	silicon germanium
SMPS	switch-mode power supply
SNR	signal-to-noise ratio
SoC	system-on-chip
SPI	serial peripheral interface
SRAM	static random access memory
SW	software
TAM	total addressable memory
TCO	total cost of ownership
ToF	time-of-flight
UPS	uninterruptible power supply
USB	universal serial bus
VR	virtual reality
VSD	variable speed drive
Wi-Fi	wireless fidelity
xEV	all degrees of vehicle electrification (EV, HEV, PHEV)

Disclaimer

Disclaimer

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ESG footnotes

- 1) This figure considers manufacturing, transportation, function cars, flights, materials, chemicals, water/waste water, direct emissions, energy consumption, waste, etc. and is based on internally collected data and externally available conversion factors. All data relate to the 2020 fiscal year. Manufacturing service providers are not included.
- 2) This figure is based on internally established criteria, which are explained in the explanatory notes. The figure relates to the calendar year 2019 and considers the following fields of application: automotive, LED, induction cookers, server, renewable energy (wind, photovoltaic), mobile phone chargers as well as drives. CO₂ savings are calculated on the basis of potential savings of technologies in which semiconductors are used. The CO₂ savings are allocated on the basis of Infineon market share, semiconductor content and lifetime of the technologies concerned, based on internal and external experts' estimations.
- 3) Calculation based on average polycrystalline photovoltaic cells and the average yearly solar radiation of central Germany.
- 4) Based on the average electricity consumption of private households in Germany and official energy conversion factors.
- 5) Calculation based on average passenger capacity and direct flight route using externally available data and conversion factors.