

Automotive Division Call

hosted by Jefferies

Peter Schiefer, Division President Automotive (ATV)

4 October 2022



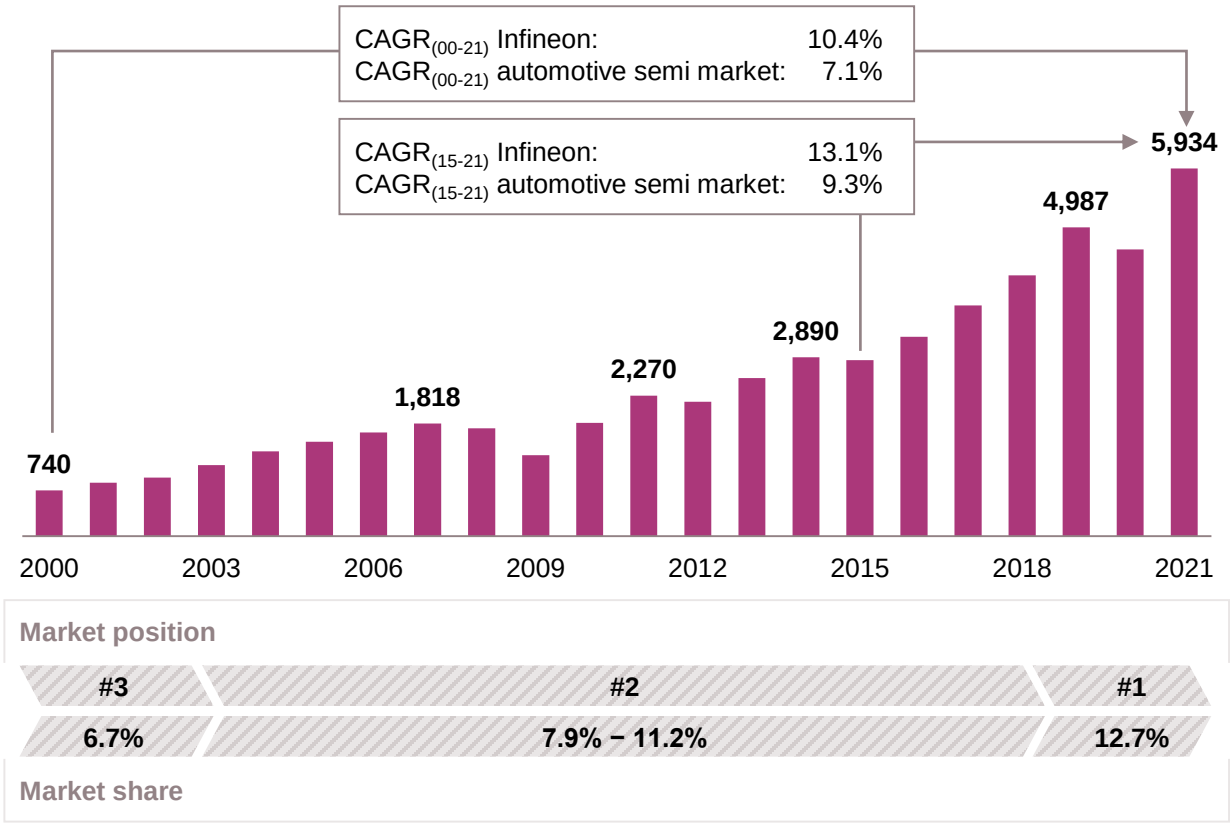
The automotive market and Infineon’s market position

Infineon demonstrates a strong track record in outgrowing the auto semiconductor market with a top-3 position in key product segments

Infineon consistently outperformed the market since 2000

fueled by **Decarbonization** & **Digitalization**

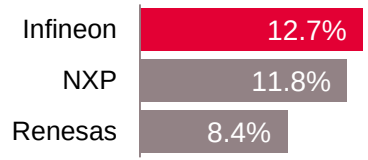
[$m]



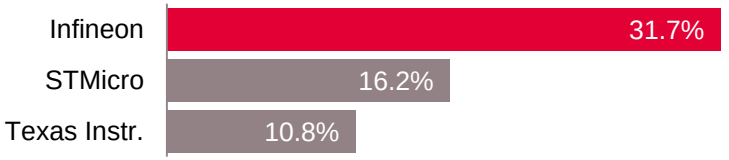
Strategy Analytics: Automotive Semiconductor Vendor Market Shares. 2001 through 2022; Infineon

Infineon is the world's no. 1 automotive semi player

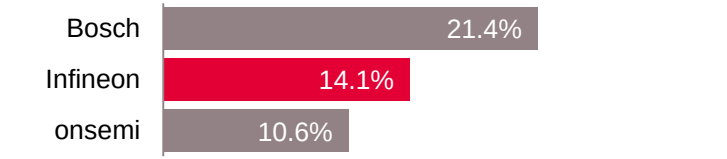
#1
in 2021 total automotive semiconductor market



#1
automotive power semis



#2
automotive sensors



#3
automotive MCUs
(and improving)



and #1
automotive NOR Flash

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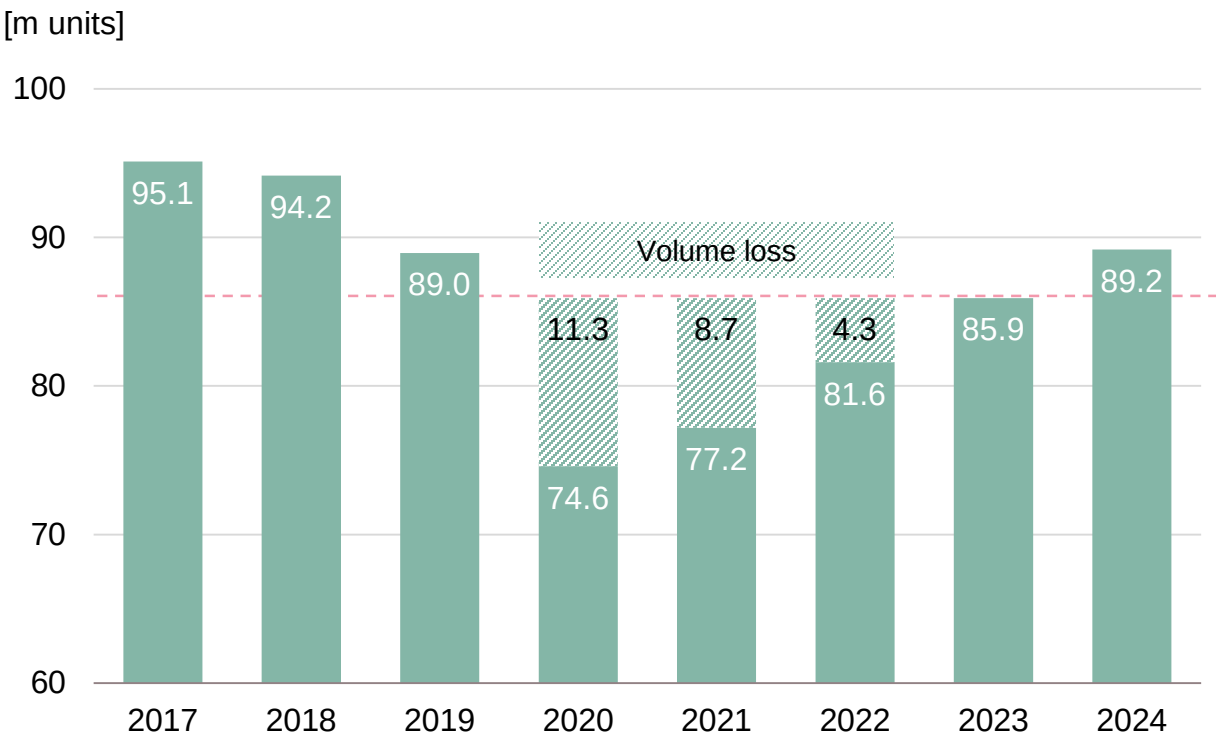
Light vehicle production growth expected in 2023; yet highest contribution of auto semis growth coming from ever increasing content

Total light vehicle production



+

- Pent-up demand from volume loss of up to 20 – 25m vehicles
- Low dealer inventory and reduced OEM rebates
- Depleted used car market
- High OEM order backlog and long delivery lead time
- More feature-rich cars
- More stable Tier 1s' ordering behavior

–

- Weaker macroeconomic conditions
- Geopolitical and COVID-19-related risks
- At Tier 1s, inventory build up for certain semiconductor categories and year-end inventory clean ups

Key growth driver for Infineon: further increase of content per car

S&P Global (former IHS Markit Automotive): *Light vehicle production forecast.* September 2022; Infineon

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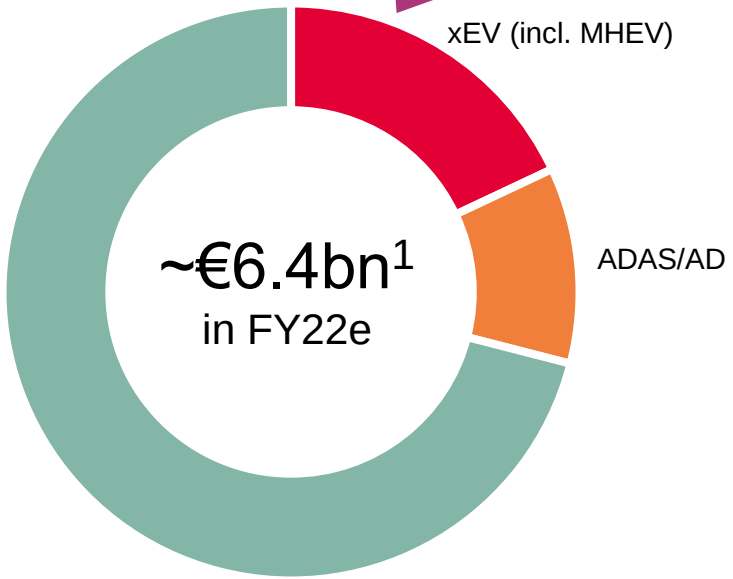
As key enabler of the future car, Infineon's automotive division will outperform the strongly growing automotive semiconductor market

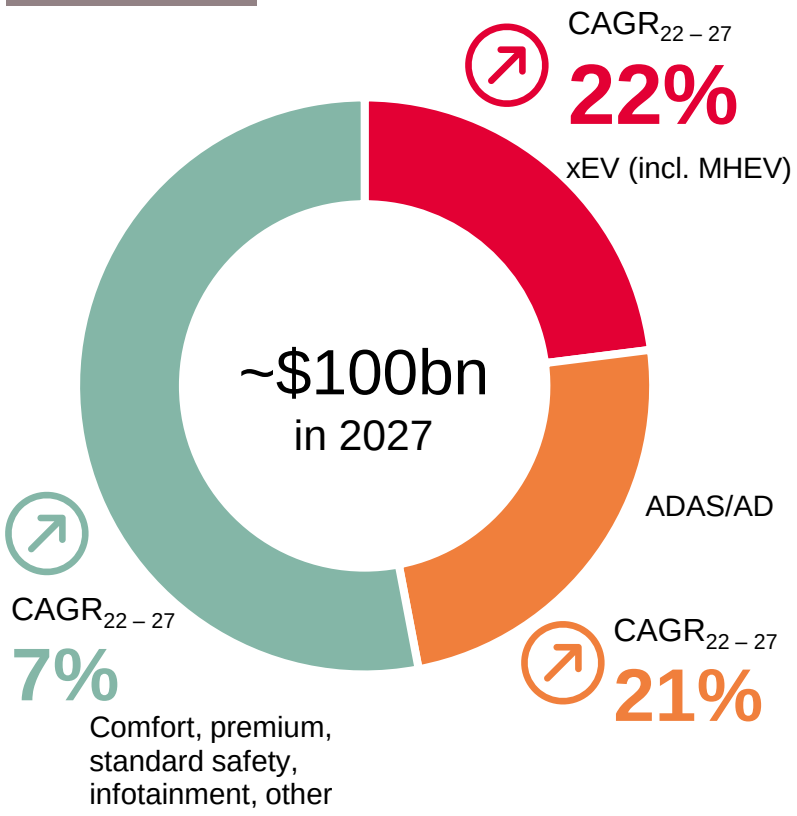
ATV revenue split in FY22e

Infineon's xEV business crossed the €1bn mark in FY22 for the first time ever!



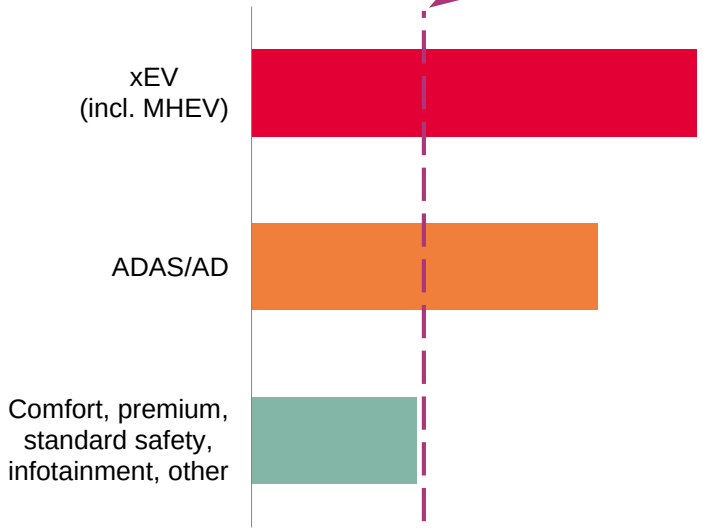
Automotive semiconductor market in 2027[2]

Market view



ATV growth in FY22e – FY27e

ATV mid-term growth rate per CMD 2021: >10%



Infineon continues to outgrow the market in each category

1 Vara consensus as of 22 August 2022
2 Strategy Analytics: Automotive Semiconductor Vendor Market Shares. March 2022; Infineon

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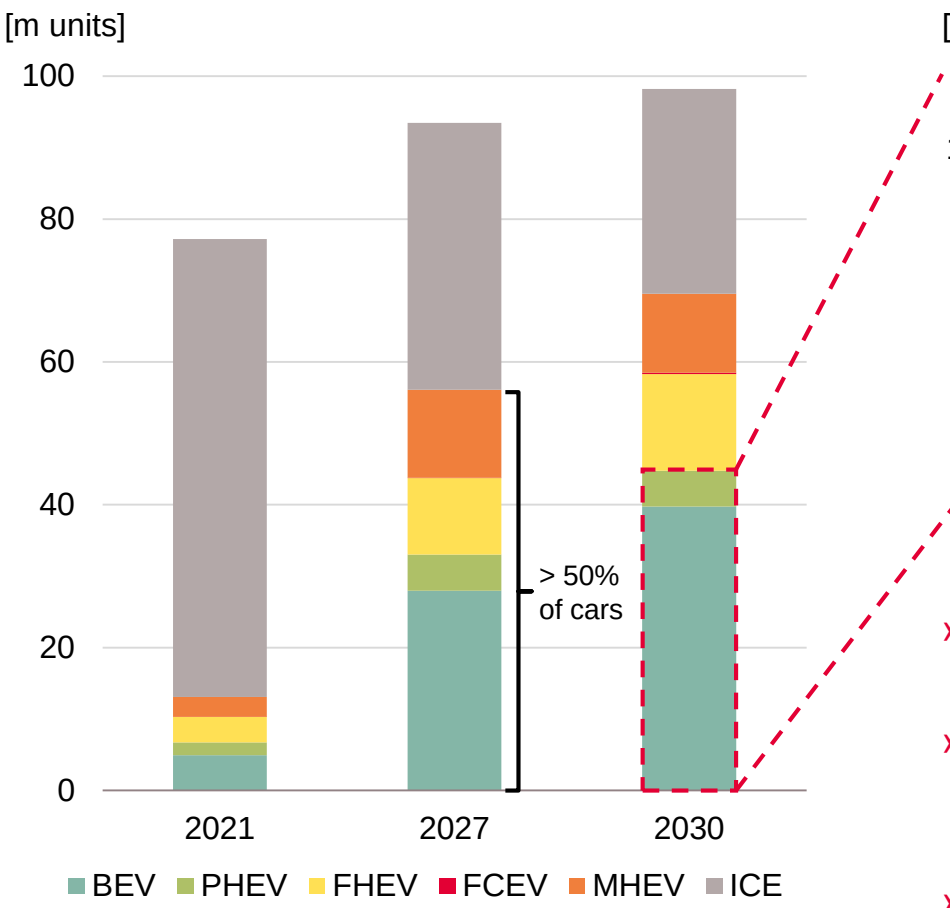
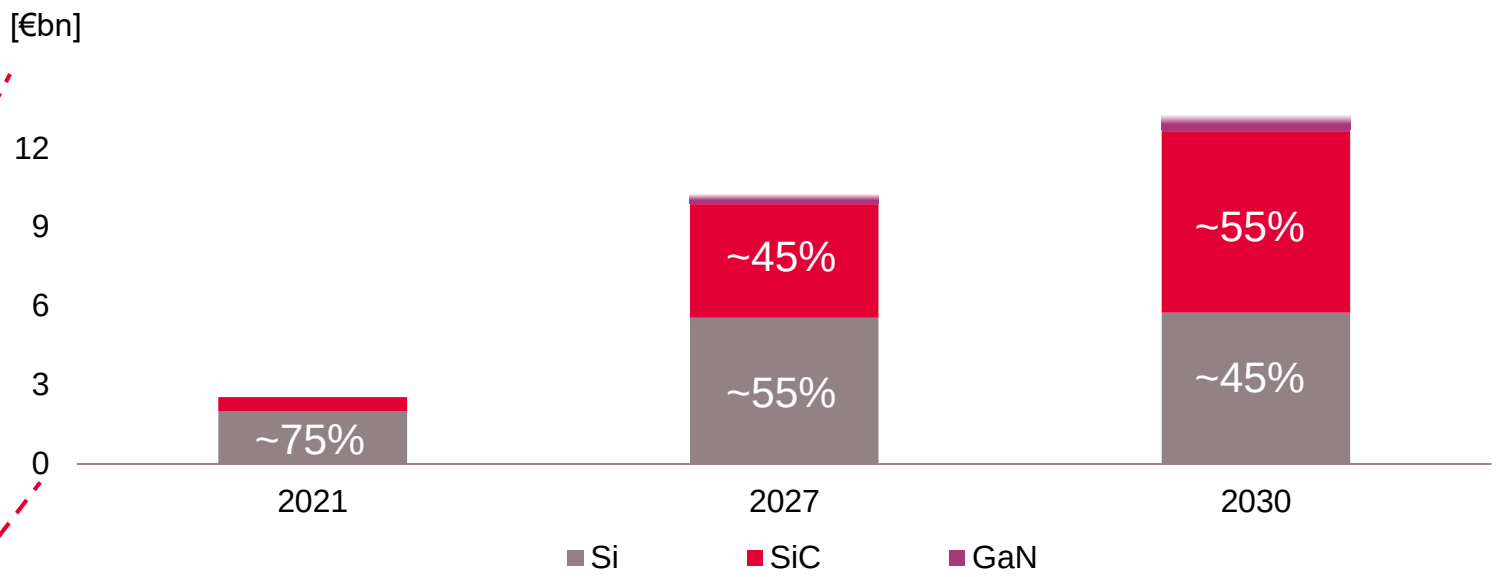
Electromobility

In 5 years, every second car will be fully or partially electrified; SiC to take lead over silicon in the 2027 – 2030 period

Car production by fuel type



xEV drivetrain power semiconductor TAM by technology



- By mid-2022, global BEV + PHEV penetration reached 12.4%, led by China (26.5%) and followed by Europe (15.8%) and the US (6.8%)
- Inverter, OBC, and DC-DC are the three main power semiconductor applications in drivetrains for BEVs and PHEVs;
  48 V MOSFETs and DC-DC are the key applications in MHEVs
- By 2030, SiC will own the lion share; GaN to gain traction in OBC/DC-DC

Based on or includes content supplied by S&P Global (former IHS Markit Automotive). September 2022; Infineon

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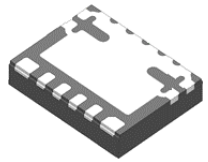
Infineon offers the most comprehensive system solutions addressing all xEV segments: pure EV and all types of hybrids

Infineon offers a full portfolio for the control loop of an electric car



Rotor position sensor



Current sensors, magnetic sensors



AURIX™



High-voltage gate driver



Driver ICs

SiC and IGBT

for high-voltage battery in FHEV, PHEV, BEV



Bare die



Discretes



Modules

MOSFETs

for 48 V MHEV



Bare die



Discretes



Chip embedding

Sensors | MCUs | Drivers | Power semiconductors

Power supply and communication



Power supply IC



Board network transceivers

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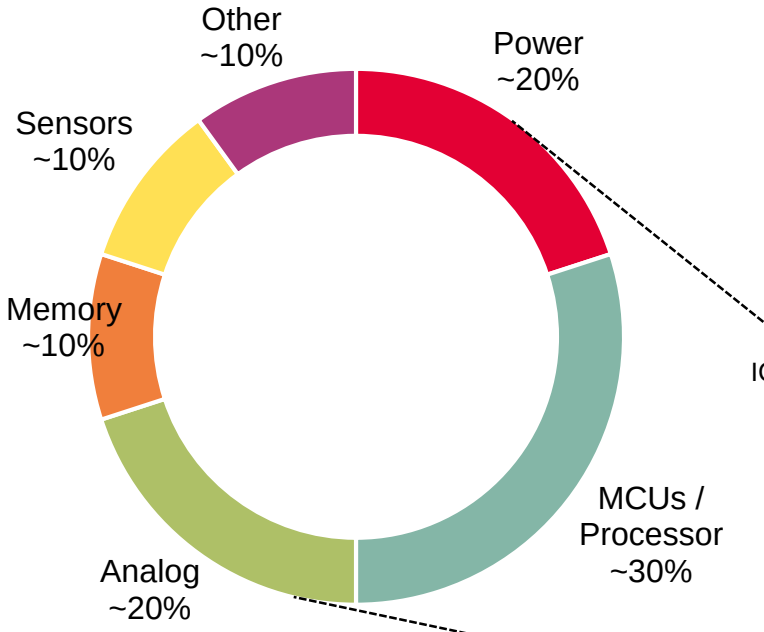
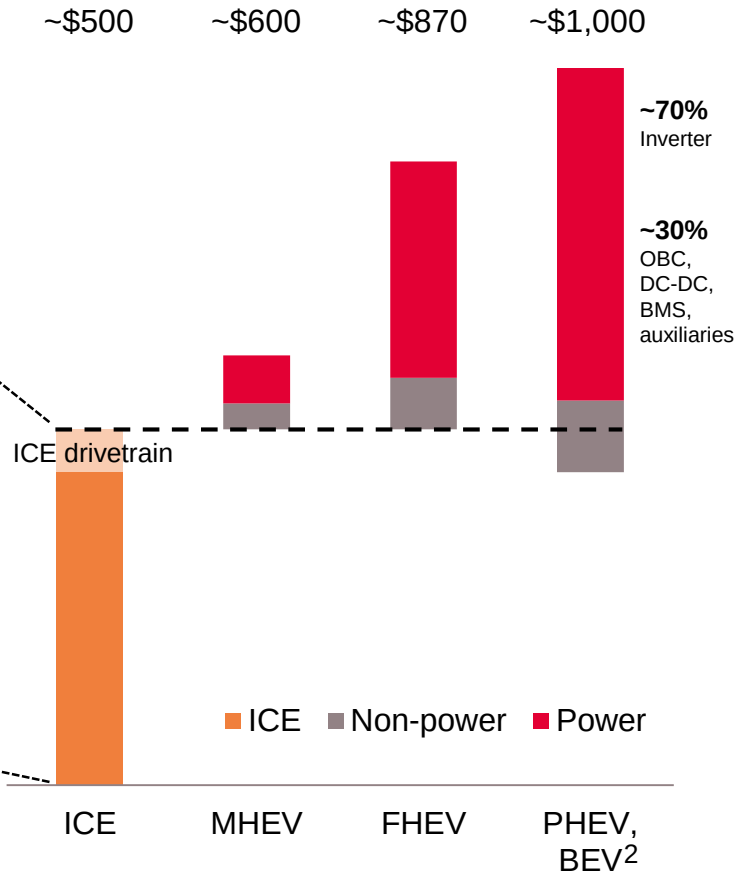
Infineon addresses 100% of power semiconductors for all drivetrains; BEV semi content expected to grow from ~$1,000 to ~$1,500 by 2027

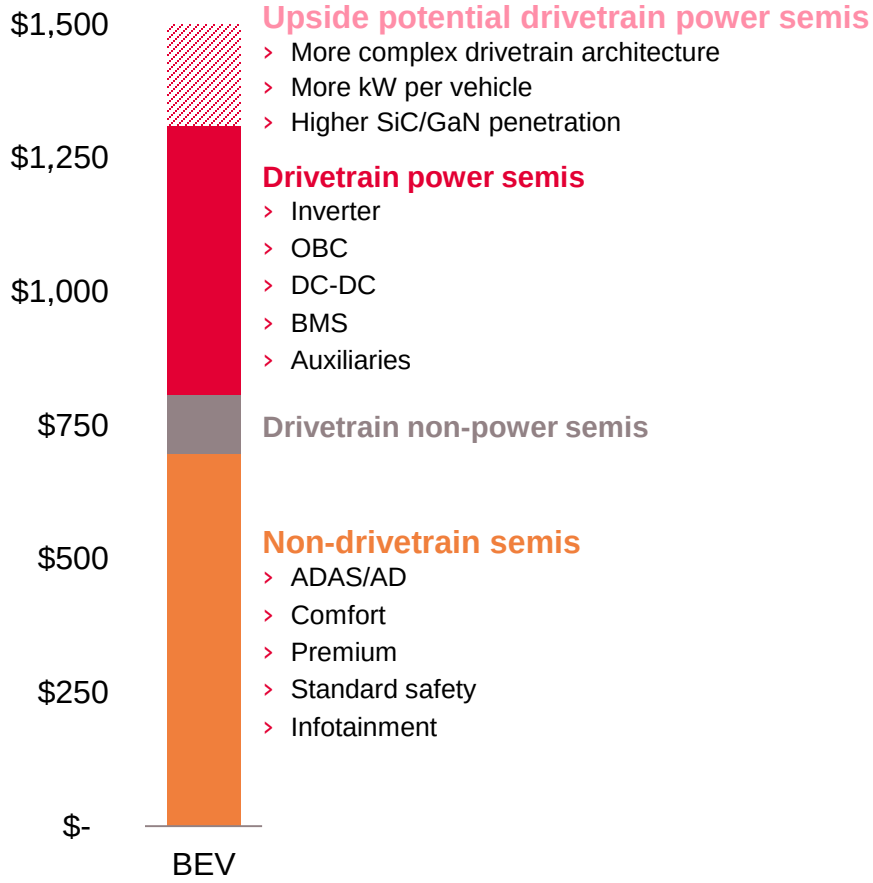
2021 ICE semi content by product[1]



2021 average vehicle semi content[1]



2027 BEV semi content scenario



1 Based on Strategy Analytics: *Automotive Semiconductor Demand Forecast 2019 - 2028*. July 2022; Infineon. "power" includes voltage regulators, ADCs and ASICs.
2 Due to missing ICE engine in BEV the weighted incremental semiconductor content for PHEV and BEV starts below the "~$500" line.

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We accelerate the broad presence of Infineon power semiconductors in automotive applications for IGBT and SiC

World's leading IGBT supplier



















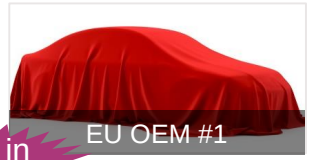

new in FY22





Latest CoolSiC™ design wins including inverter, OBC, DC-DC



















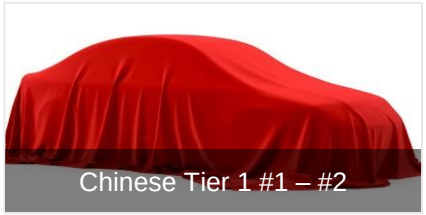



new in Q4 FY22



new in Q4 FY22

- Continuous leadership presence in IGBT with volumes well covering second half of decade
- SiC phase 1: selective focus on most innovative and value-defining applications
- SiC phase 2: massive boost from Kulim expansion, focus on broad presence and scale
- Strong SiC design-win momentum across all regions

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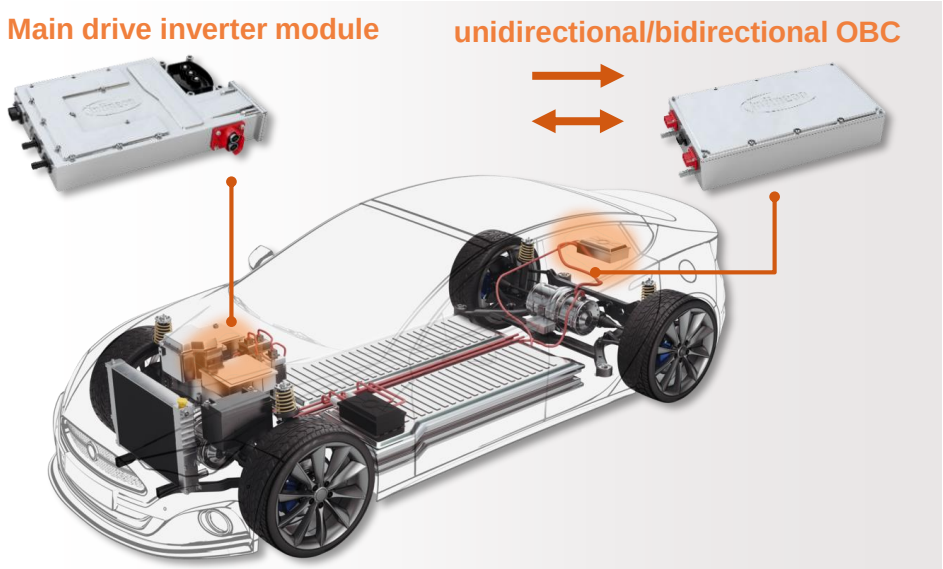
Infineon leads the way to SiC-based inverters and OBC; bidirectional charging increases content and enables xEV for mobile energy storage

Infineon serves the key SiC applications



Bidirectional charging

- provides backup energy for grid stability (V2G) and power to buildings (V2B)
- higher semiconductor content per OBC

Decarbonization: V2G and V2B can complement distributed energy resources (e.g. PV systems)

Infineon is well positioned for strong SiC market growth

- Infineon massively expands WBG supply by introducing further capacities with Kulim and in Villach; SiC capacity to increase 10x by 2027 at 150 mm
- 200 mm in pilot phase – to be rolled out both in Villach and Kulim
  → further volume increase potential by a factor of 1.8x
- Infineon offers broadest portfolio of modules and supports its customers with extensive system competence
- Seamless transition from IGBT to SiC; world's largest IGBT manufacturing capacity offers fallback solution for our customers





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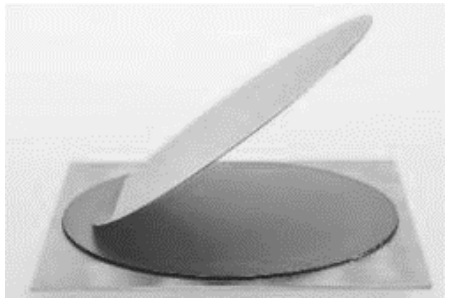
Infineon’s SiC strategy is backed by a strong supply chain, increased productivity and the leading technological position

SiC raw material supply

- In line with our Si strategy, Infineon qualifies several SiC wafer suppliers with long-term contracts
- Multiple qualified SiC wafer and boule suppliers already in place – each with a clear path to 200 mm
- Further announcement to increase flexibility (both for wafer and boule) to follow



SILTECTRA
Cold Split technology

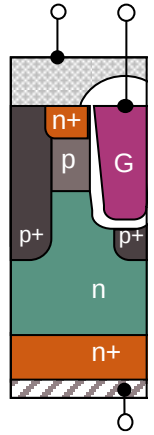


Increased productivity

- Efficient use of material: increase productivity with boule splitting and wafer twinning

Superior trench technology

- Leading position in trench technology
- 1 - 2 generations ahead of competition



- ✓ Low channel resistance
- ✓ Shrink potential higher than in planar technology
- ✓ Oxide corners shielded by folded double trench

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Infineon’s proven track record for Si and SiC continues to attract new and existing customers – we deliver on our promises!

Delivery of promised quantity and quality

Technological superiority of trench design; further improvement with Gen. 2 trench technology

Leverage of Infineon’s comprehensive system understanding (P2S) and module competence



Several OEMs

Customers returning after initially having chosen a different SiC supplier

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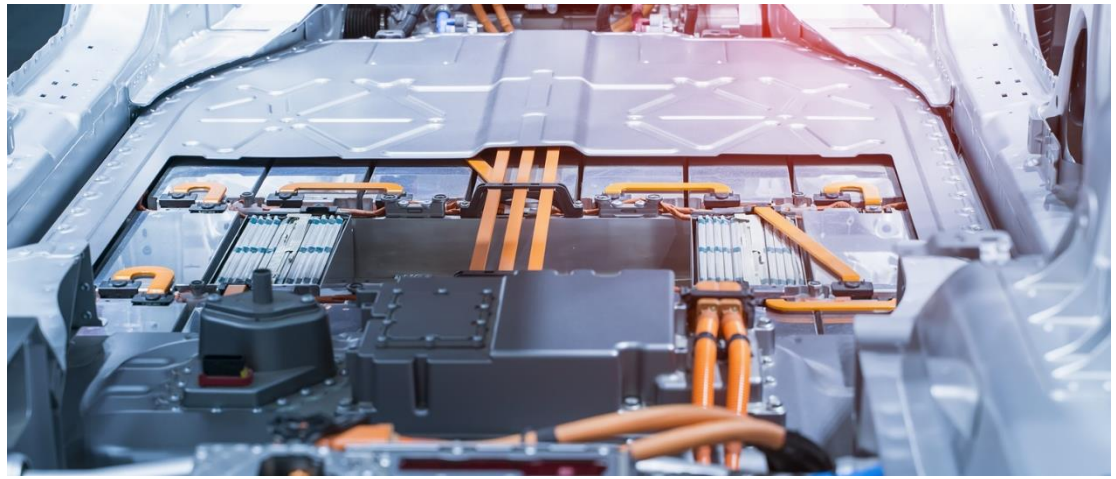
Rapid execution of our BMS strategy showing great success

Infineon's comprehensive BMS portfolio

- PMIC
- Transceiver
- MCU
- F-RAM
- Power switch
- Pressure sensor
- Gas sensor
- Current sensor
- Wireless communications ICs
- Battery monitoring ICs



Auxiliaries for thermal management (e.g., fan, pump etc.)

- MOSFET
- Motor control IC
- Security IC

Selected balancing IC customers



High-volume OEM



Premium car OEM



Chinese bus OEM

TOYOTA

BMS BoM of ~€100 per vehicle

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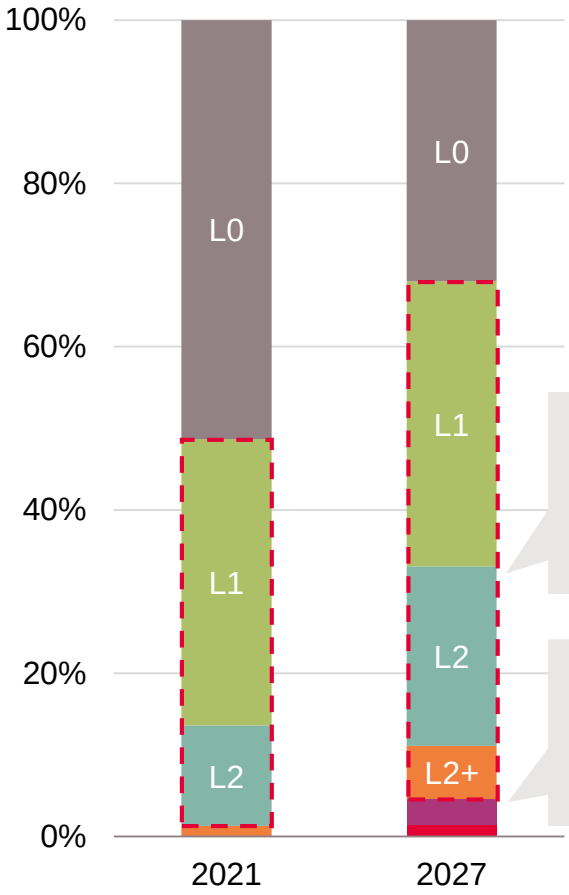
Automated Driving

Growth of L1/L2/L2+ is the main driver of ADAS semiconductor content until 2027

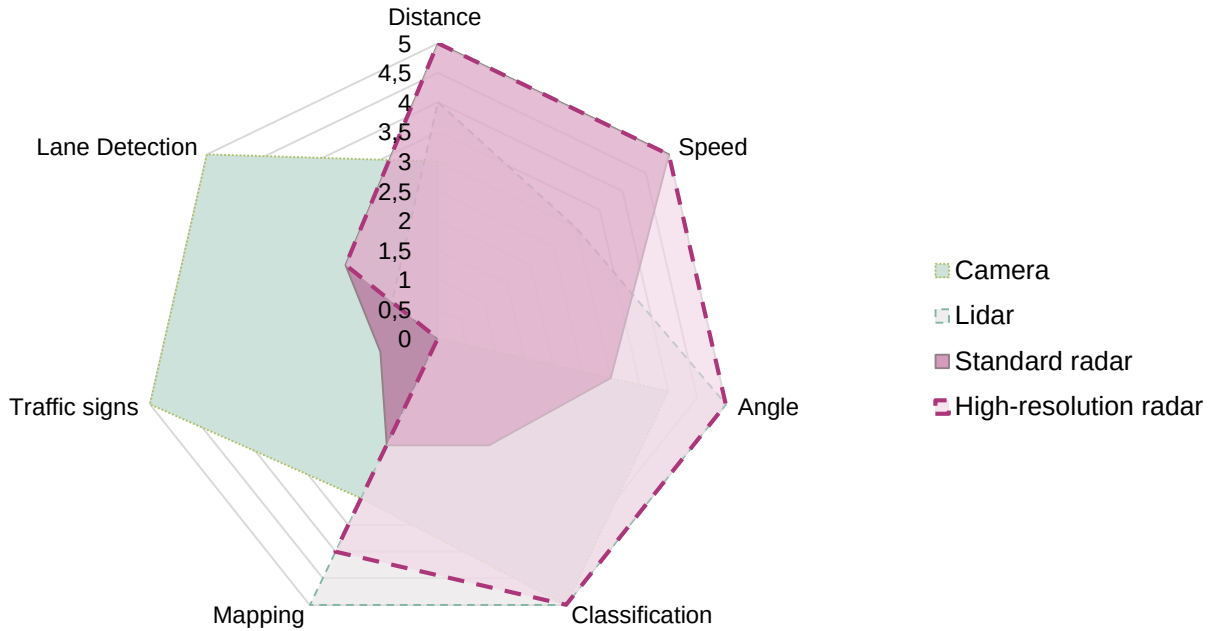
Car production by degree of automation (SAE level)



L1/L2/L2+
to reach ~65% in 2027,
up from ~50% in 2021

L3/L4/L5
to reach ~5% in 2027,
up from ~0% in 2021

Radar is essential to meet decisive requirements of ADAS/AD



- Standard radar is **the** technology to detect distance and speed
- High-resolution radar significantly improves angle and classification

Market research companies; Infineon

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The number of radar systems is expected to grow by 24% annually, driven by new applications and increasing penetration

Today

Total: 55m systems

- AEB
- 3m systems

- AEB
- Low-speed ACC
- Blind spot detection
- 21m systems

- AEB
- High-speed ACC
- Blind spot detection
- 26m systems

Penetration of radar systems per SAE level



Market research companies; Infineon

Future

Total: 200m systems; CAGR$_{(21-27)}$ = 24%

- AEB
- 8m systems; CAGR$_{(21-27)}$ = 18%

- AEB
- ACC
- Blind spot detection
- 70m systems; CAGR$_{(21-27)}$ = 22%

- AEB
- High-speed ACC
- Vulnerable road users detection
- 70m systems; CAGR$_{(21-27)}$ = 18%

- In addition to L2: lane change assist
- 30m systems; CAGR$_{(21-27)}$ = 38%

- 24m systems; CAGR$_{(21-27)}$ = 133%

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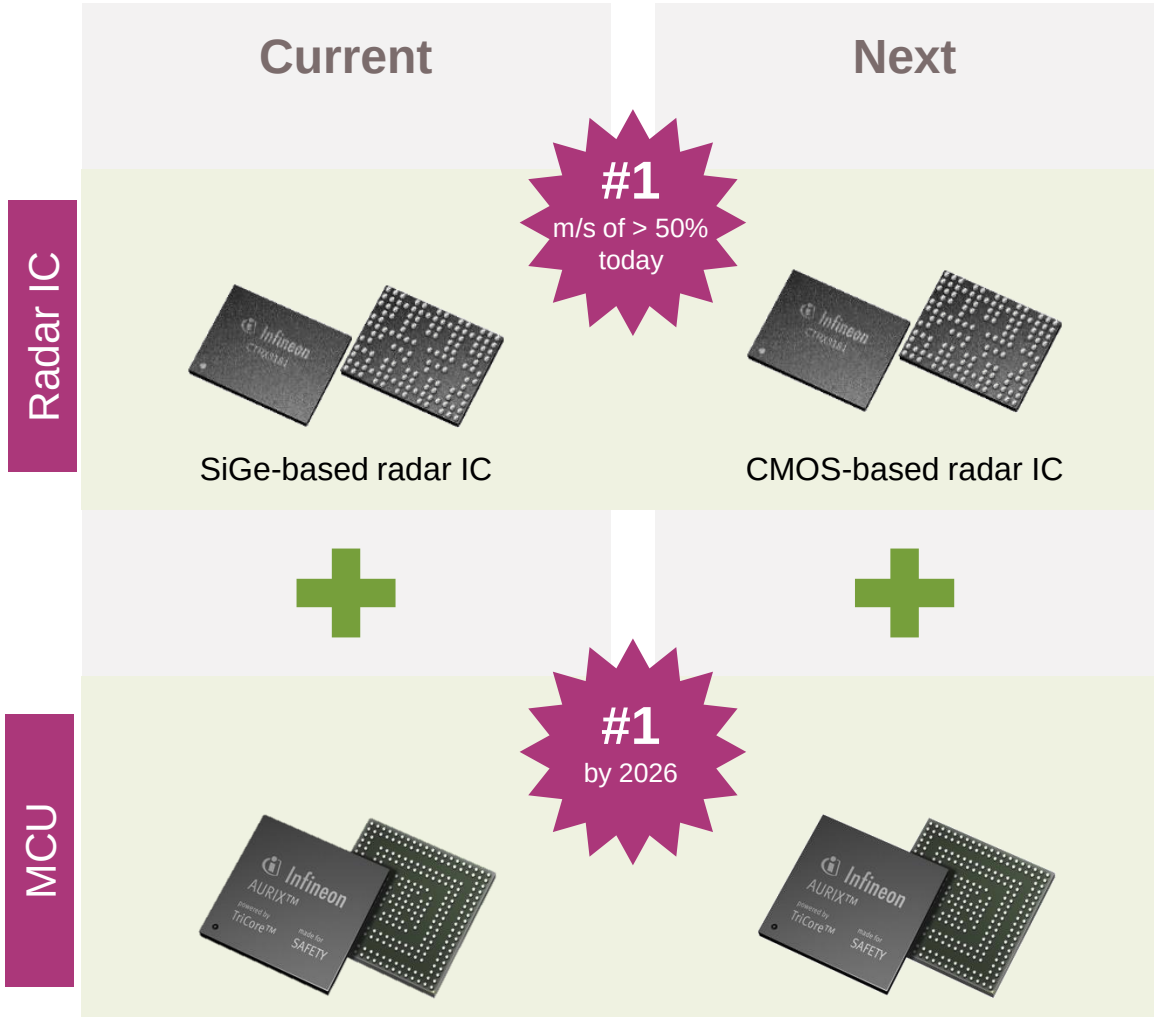
We are shaping the transition to CMOS-based radar solutions; leader in radar ICs today and in MCUs by 2026



Growth of Infineon's CMOS-based radar ICs

- Infineon's 28 nm CMOS radar IC is currently sampling
- Overwhelming customer feedback regarding key performance indicators, especially signal-to-noise ratio and linearity which improves the operating range and object separability
- CMOS radar IC market will take off by mid of the decade
- Different partitioning options allow for tailor-made solutions

All major OEMs decided for Infineon radar solutions

Yole: *Radar for Automotive Database 2022*. May 2022; Infineon

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User experience meets new E/E architecture

User experience meets electrical/electronic (E/E) architecture

Software-defined car
E/E architecture | MCUs | sensors | actuators



Digital cockpit
MEMS sensor technology | MEMS microphones





Premium
Matrix light



Comfort
Motor control ICs | MOSFETs



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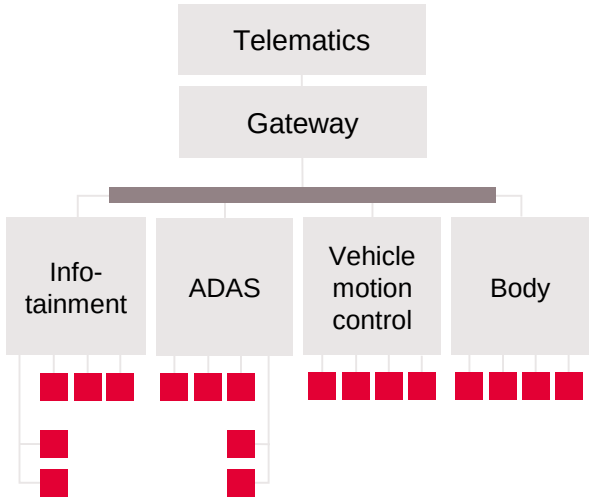
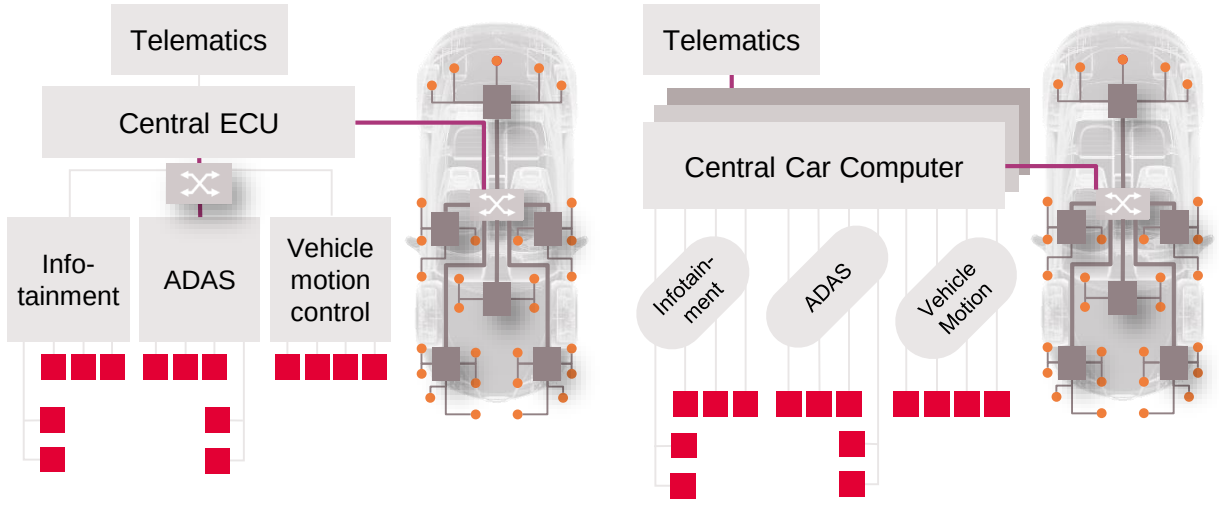
Software-defined cars will become a reality through architectural transformation; Infineon's MCUs to win big here

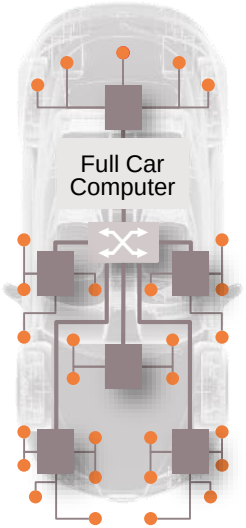
Domain architecture



Mixed domain/zone architecture



Full car computer



ECU incl. Infineon MCU

smart sensor / smart actuator incl. Infineon MCU

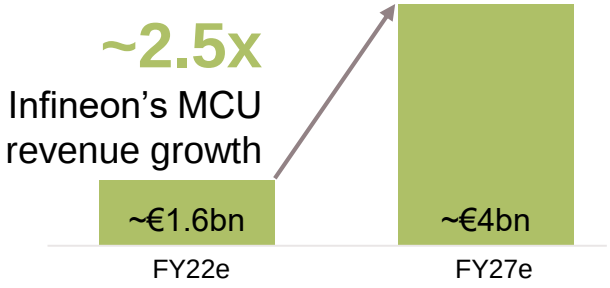
New E/E architectures offer benefits of

- Hierarchical software
- Fail-operational power distribution
- Optimized power management
- Reduced wiring harnesses

... leading to

- More smart actuators
- More smart sensors
- Higher redundancy
- Dependable electronics

... further fueling Infineon's MCU growth



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Game changing innovations from Infineon are defining the digital cockpit of tomorrow

Augmented head-up display based on MEMS mirrors



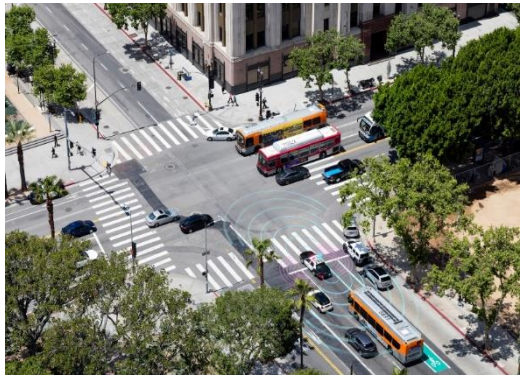


Internal and external MEMS microphones





Example #1
Active noise cancellation



Example #2
Emergency vehicle detection

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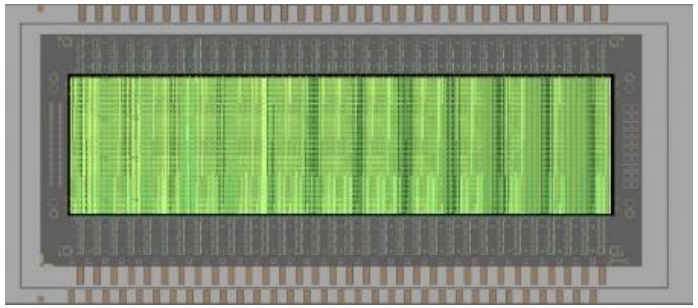
Industry-leading, premium lighting technology offers enhanced user experience on the road

Key facts

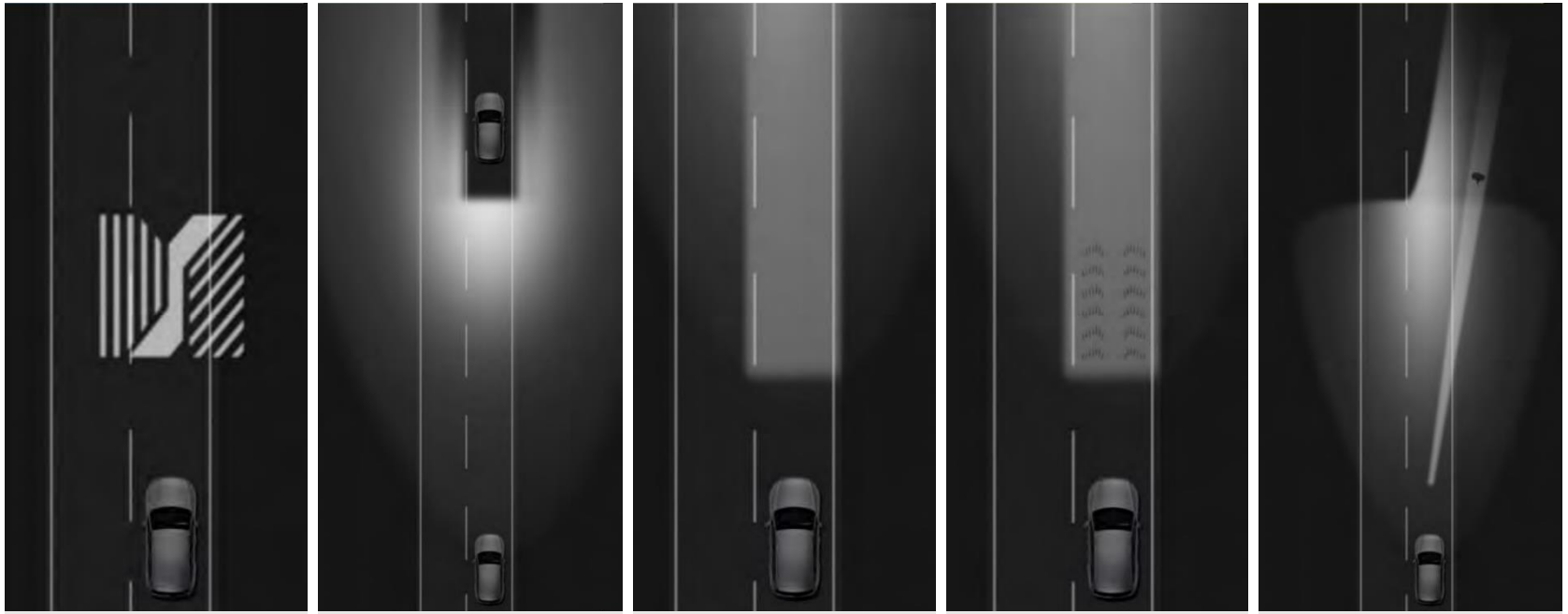
- Infineon driver IC controls each of the 16K µLEDs individually with outstanding luminous intensity
- Lead customer: EU premium OEM (“Best light ever!”)
- Start of production: early 2023

Nichia high-definition micro-pixel light source (HD µPLS)



Courtesy: Nichia

Advantages: Enhanced driving experience, higher safety, more energy efficient



Advanced coming/ leaving home | Glarefree high beam | Lane light | Orientation light | Marking light

Courtesy: Audi AG

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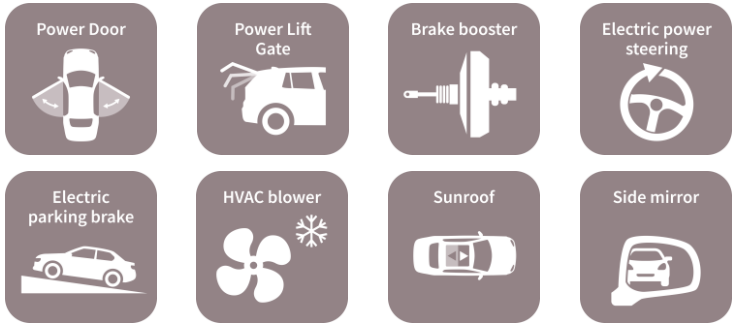
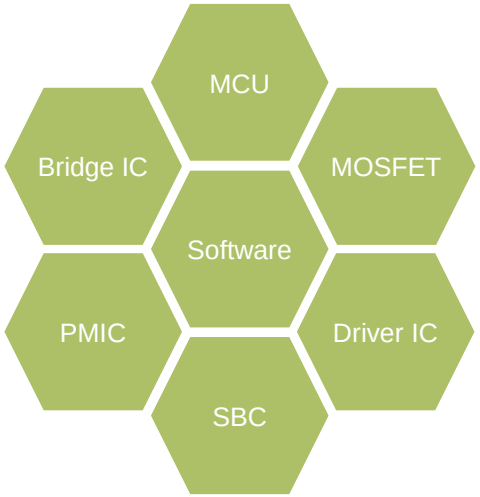
Infineon's suite of motor control ICs lead the way to address fast-growing comfort features

- Comfort features making further inroads into cars; e.g., seats in a mid-range car feature about seven motors today
- Up to ~€80 semiconductor BoM per vehicle for comfort features
- Infineon's leading suite of motor control ICs fits ideally for all comfort applications

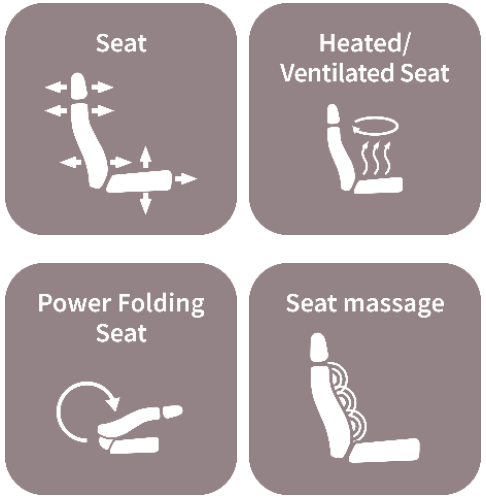
Application examples



Infineon's suite of motor control ICs



On average ~7 motors per seat







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Take aways



- We are the world leader in automotive semiconductors; with our secular growth trends Decarbonization and Digitalization we address all aspects that define the future car – we accelerate our profitable growth journey

- With our comprehensive portfolio and system solutions we see further potential to increase our semi content in BEVs from ~$1,000 to $1,500

- We are rapidly increasing our SiC capacities to match a record level of design wins and strongly accelerating customer interest
- We are proven leaders in SiC technology and system competence

- Our leading position in radar solutions is a key enabler for all levels of autonomous driving
- Strong setup of MCUs with significant growth ahead for virtually all applications, incl. software-defined vehicles and E/E architecture

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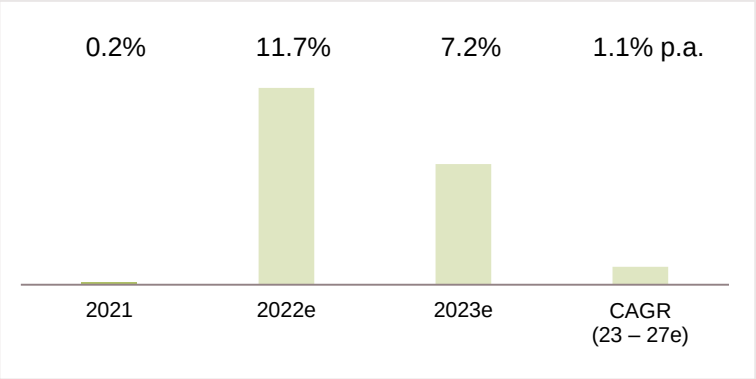
Part of your life. Part of tomorrow.

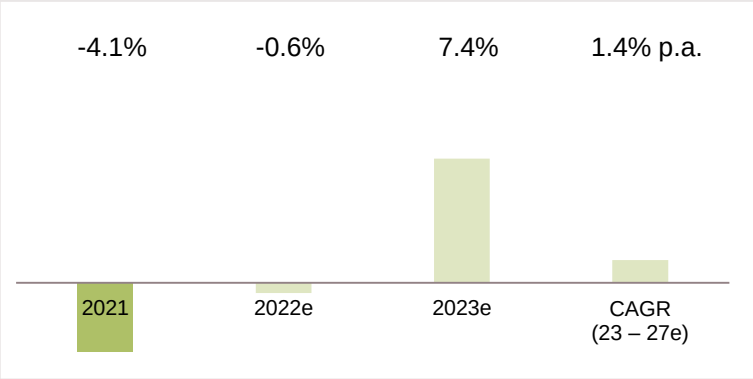
Forecasted growth of light vehicle units positive despite continued supply shortages and macroeconomic concerns

Light vehicle production year-over-year growth

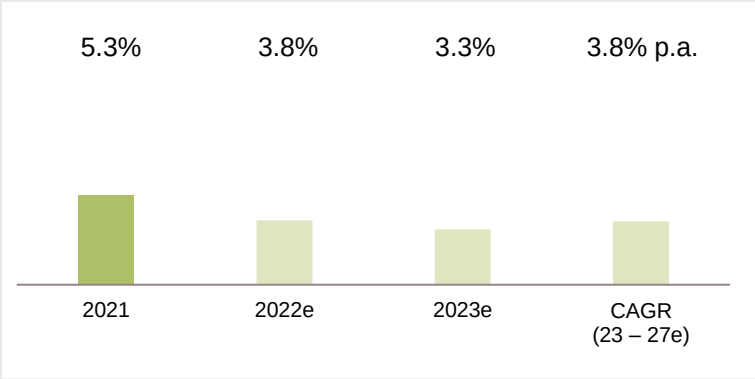
North America (13.0m units in 2021)



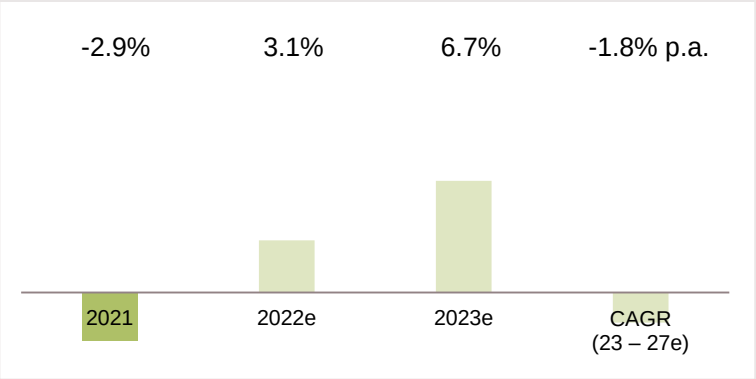
Europe (15.9m units in 2021)



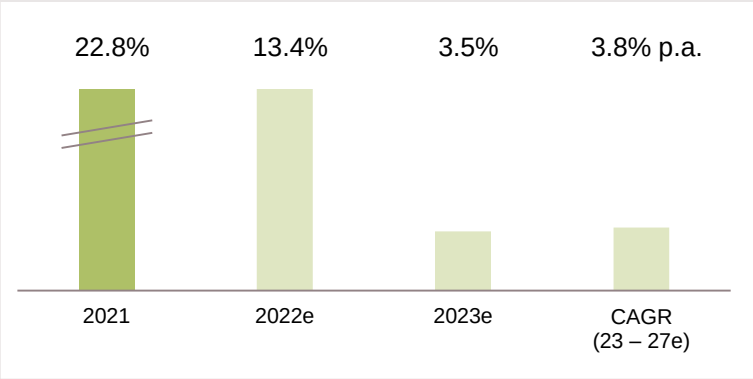
Greater China (24.8m units in 2021)



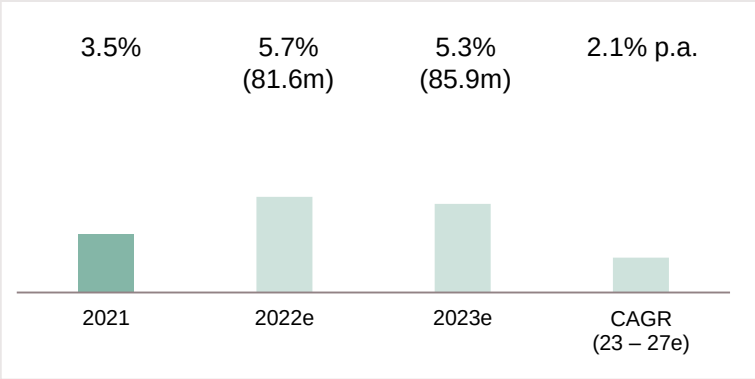
Japan/Korea (10.9m units in 2021)



RoW (12.5m units in 2021)



World (77.2m units in 2021)



Source: Based on or includes content supplied by S&P Global (former IHS Markit), Automotive Group: Light Vehicle Production Forecast. September 2022.

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Glossary

AC-DC	alternating current - direct current
AD	automated driving
ADAS	advanced driver assistance system
AEB	automated emergency braking
BEV	battery electric vehicle
BMS	battery management system
BoM	bill of material
CAN	controller area network
CMOS	complementary metal-oxid semiconductor
CPU	central processing unit
DC-DC	direct current - direct current
ECU	electronic control unit
EPS	electric power steering
EV	electric vehicle
FCEV	fuel cell electric vehicle
FHEV	full-hybrid electric vehicle
GaN	gallium nitride
GPU	graphics processing unit
HV	high-voltage
HW	hardware
IC	integrated circuit
ICE	internal combustion engine
IGBT	insulated gate bipolar transistor
IVN	in-vehicle networking
MCU	microcontroller unit
MEMS	micro electro-mechanical system
MMIC	monolithic microwave integrated circuit
µC	microcontroller
micro-hybrid	vehicles using start-stop systems and limited recuperation
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
PCB	printed circuit board
PHEV	plug-in hybrid electric vehicle
PMIC	power management IC
PT	powertrain
RF	radio frequency
RoW	rest of world
SAE	Society of Automotive Engineers
SBC	system basis chip
Si	silicon
SiC	silicon carbide
SiGe	silicon germanium
SoC	system-on-chip
SOTA	software over-the-air
SW	software
TAM	total addressable market
ToF	time-of-flight
V2B	vehicle-to-building
V2G	vehicle-to-grid
V2X	vehicle-to-everything communication
xEV	all degrees of vehicle electrification (EV, FHEV, HEV, PHEV)

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