

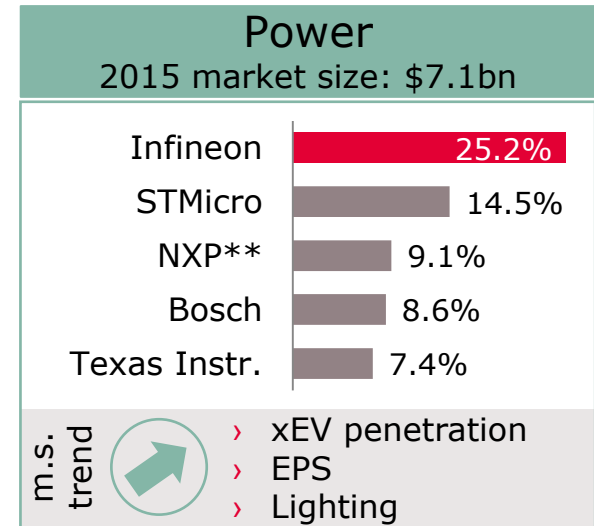
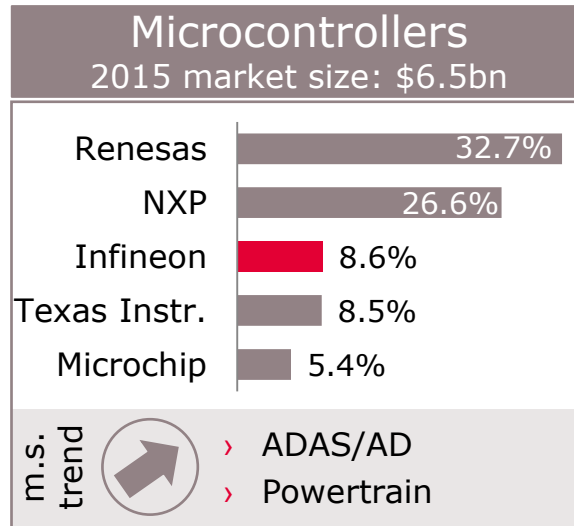
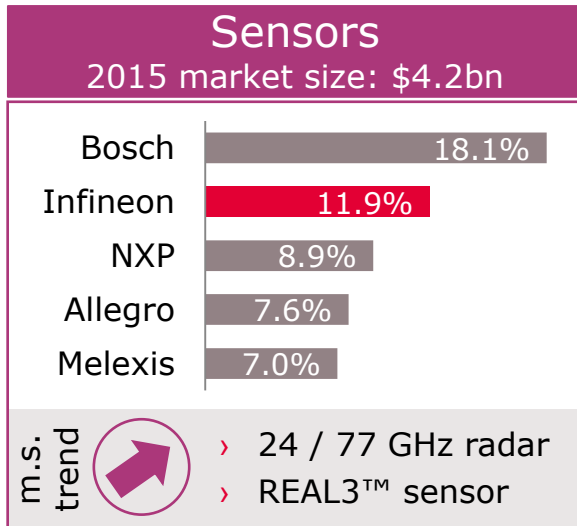
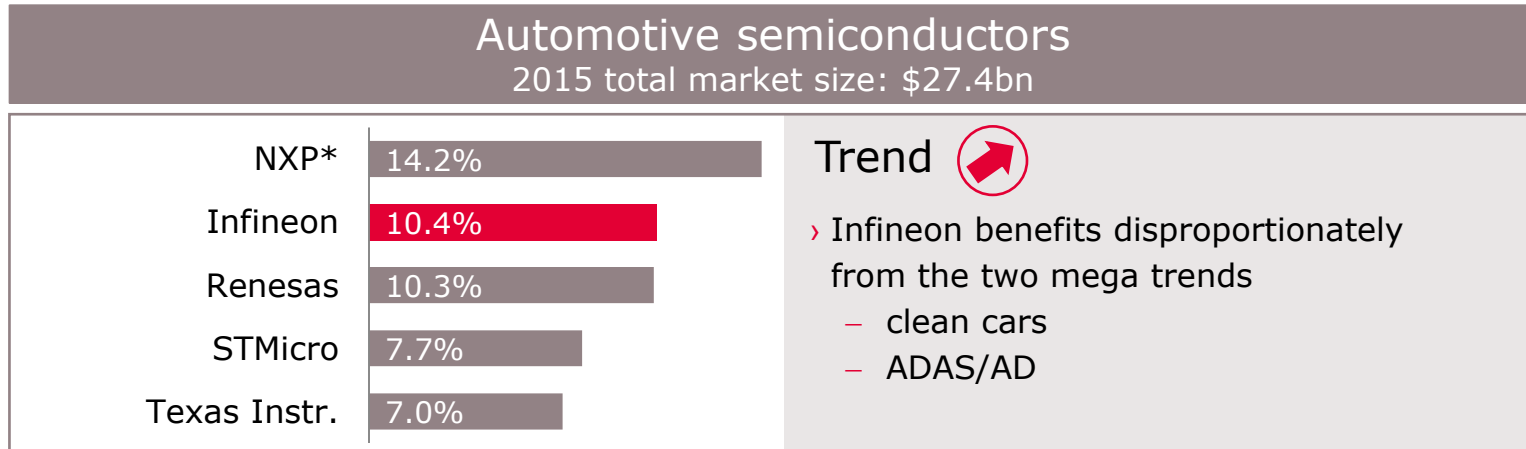
Bernstein Conference on EVs and Energy Storage

London, 16 March 2017



Hans Adlkofer
Vice President
Automotive System Group

Infineon's position in the automotive semiconductor universe



* Divestment of Standard Products business announced

Source: Strategy Analytics, "Automotive Semiconductor Vendor Market Shares", April 2016

Key market trends significantly drive increasing semiconductor content per car

ADAS/AD

- › ADAS and AD (automated driving) are critical enablers to reduce the number of fatalities and serious injuries (“Vision Zero”)



Clean cars

- › To reach CO₂ emission goals, the automotive industry has to focus on
 - a higher efficiency of the classic ICE, and
 - the electrification of the drivetrain (xEV)



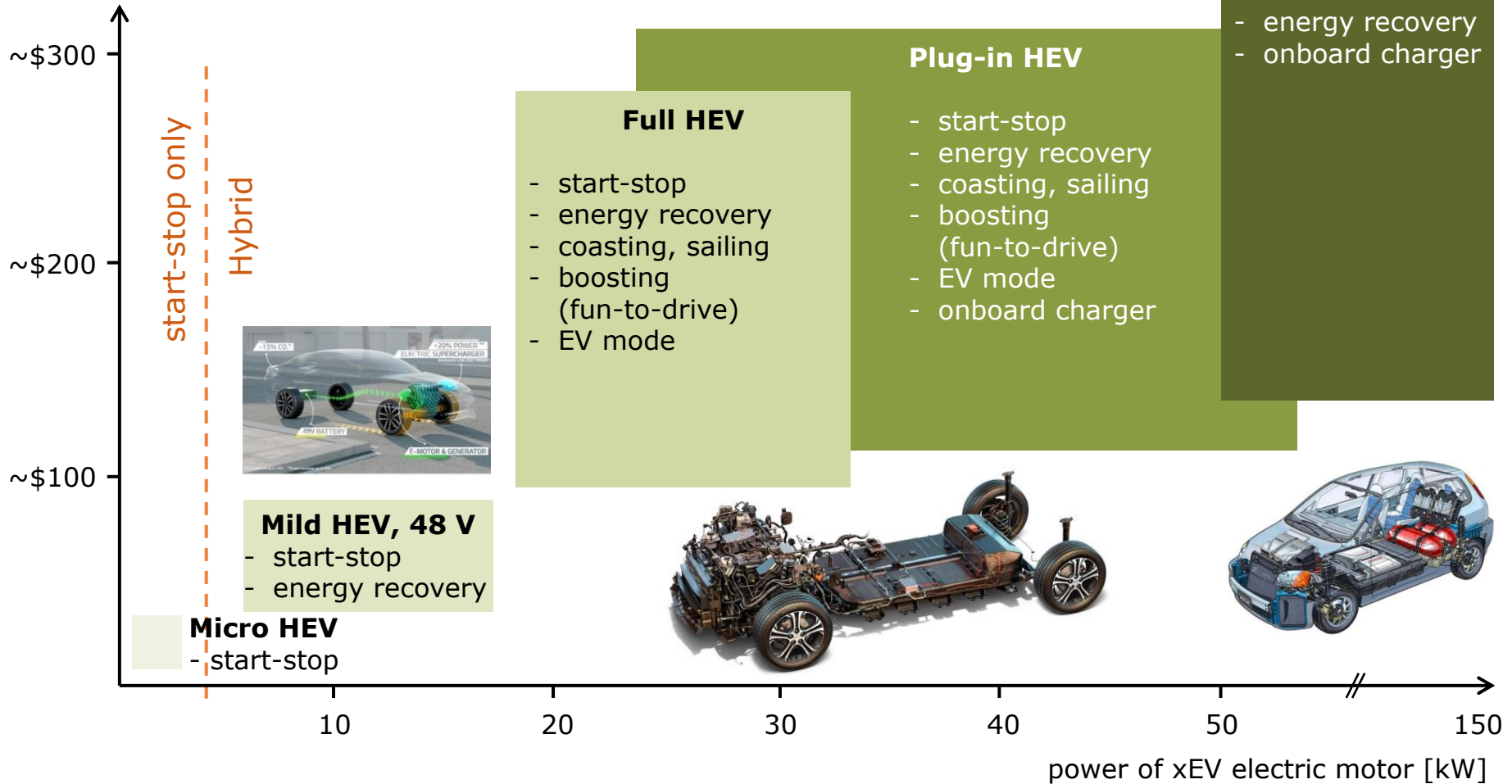
Connectivity/security

- › Advanced connectivity is driven by making the car part of the internet
- › Connectivity must be secure

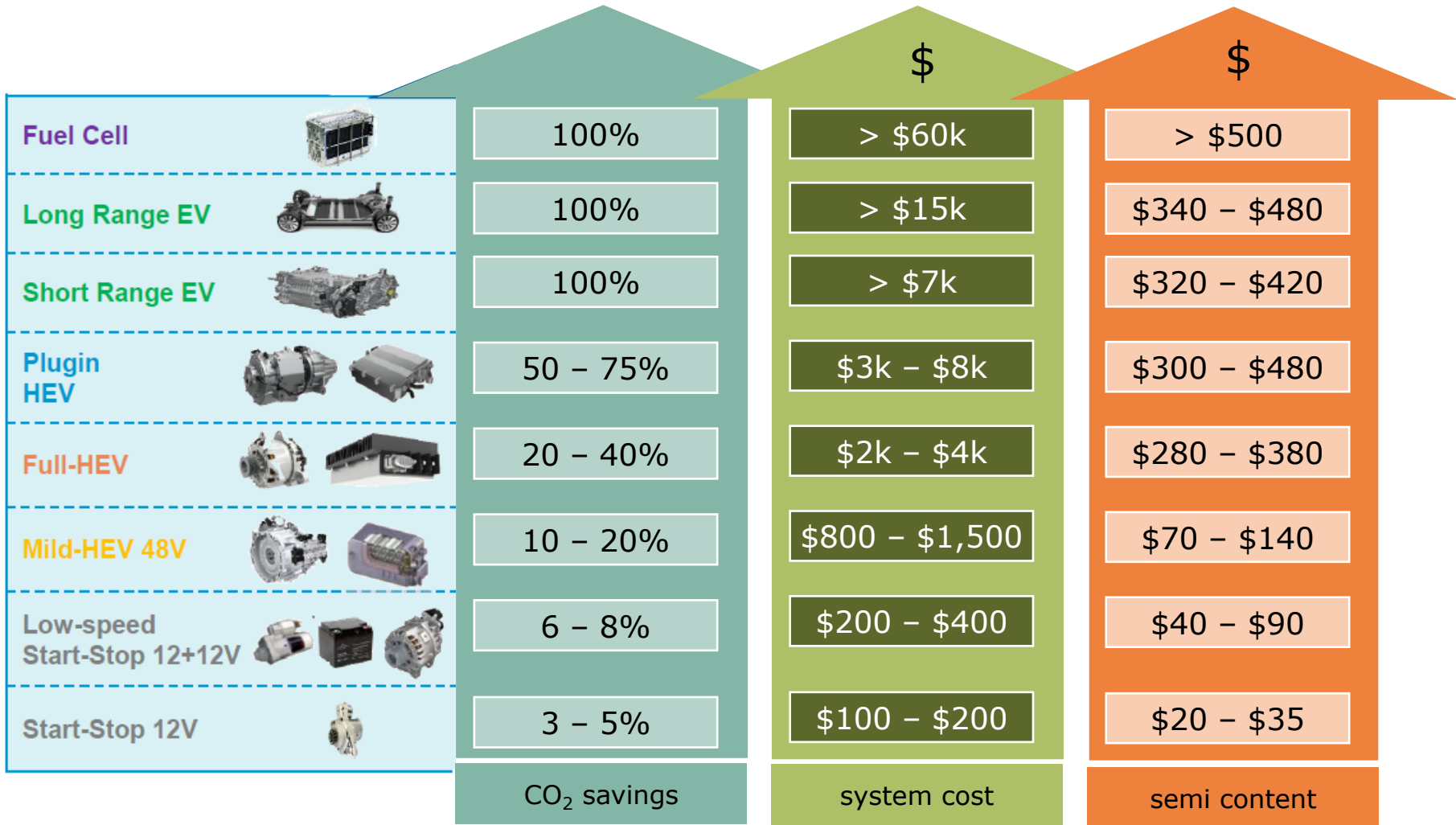


Power semiconductor demand for different levels of electrification

incremental power semi content for drive train



System cost and CO₂ savings of alternative powertrain systems



Source: IHS Markit, January 2016

How to lift the full potential of SiC?

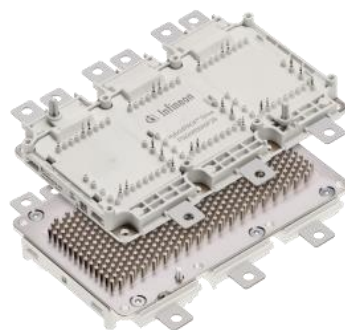
Phase 1 (2017 – 2019):
trial stage



+5%

- › Discrete packages allow for ~5% efficiency increase vs discrete IGBTs

Phase 2 (2019 – 2025):
early market penetration



+10% vs Si

- › Optimized SiC modules allow for ~10% efficiency increase vs IGBT modules

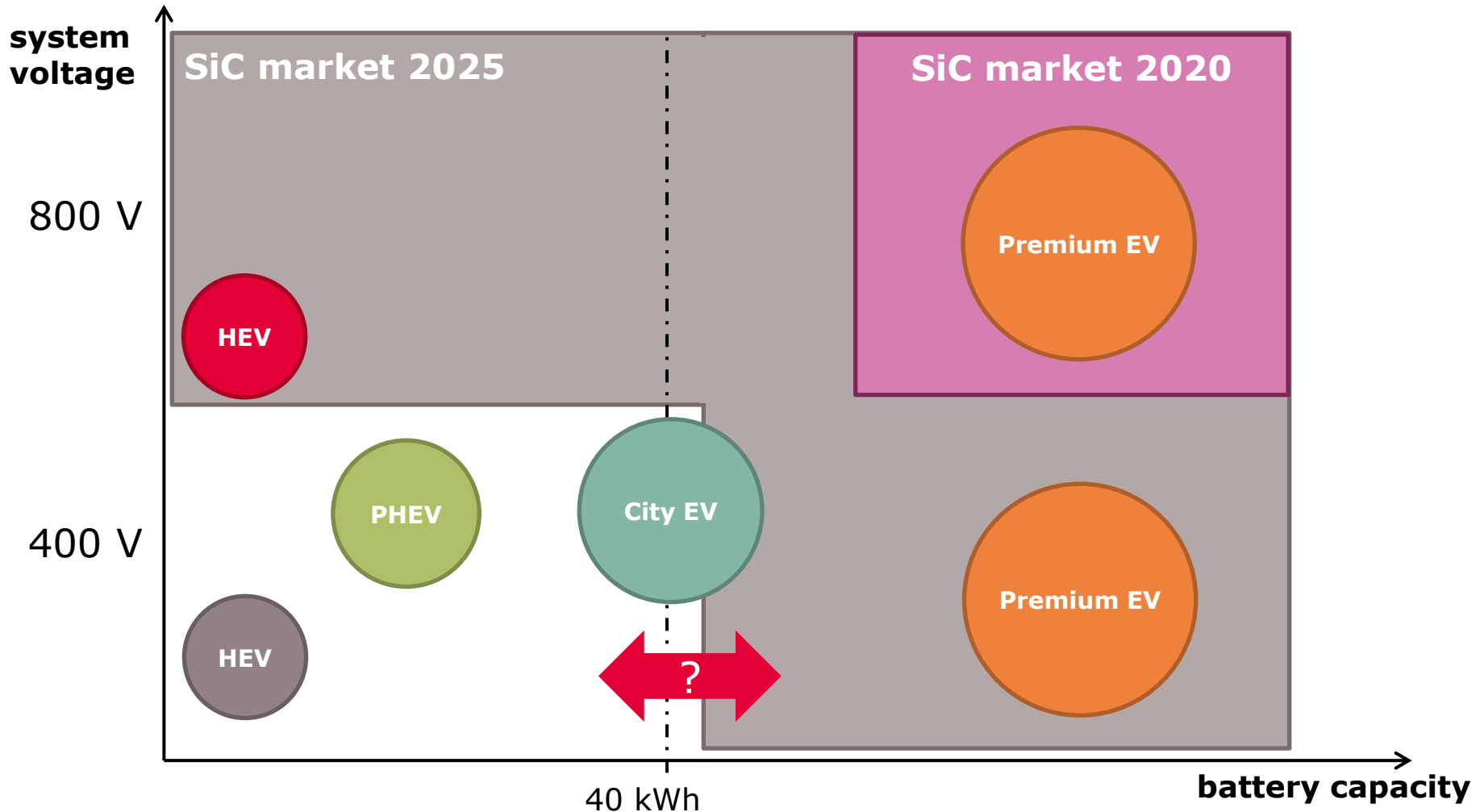
Phase 3 (2025+):
mass production



+20% vs Si

- › SiC components are embedded into electric motor to lift full potential of ~20%

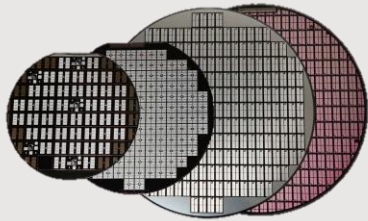
Penetration rate of SiC will be determined by cost/performance ratio at system level



Infineon has unparalleled package expertise for all xEV applications



Bare die



Si bare dies



SiC bare dies

Discretes



Si IGBT

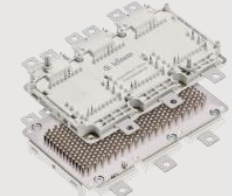
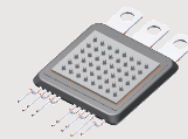
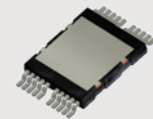


SiC MOSFET

Scalable products

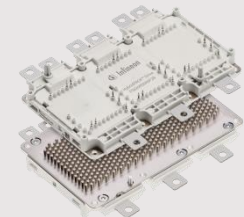


HybridPACK™ Double-Sided Cooling



SiC optimized package solution

Plug-n-Play

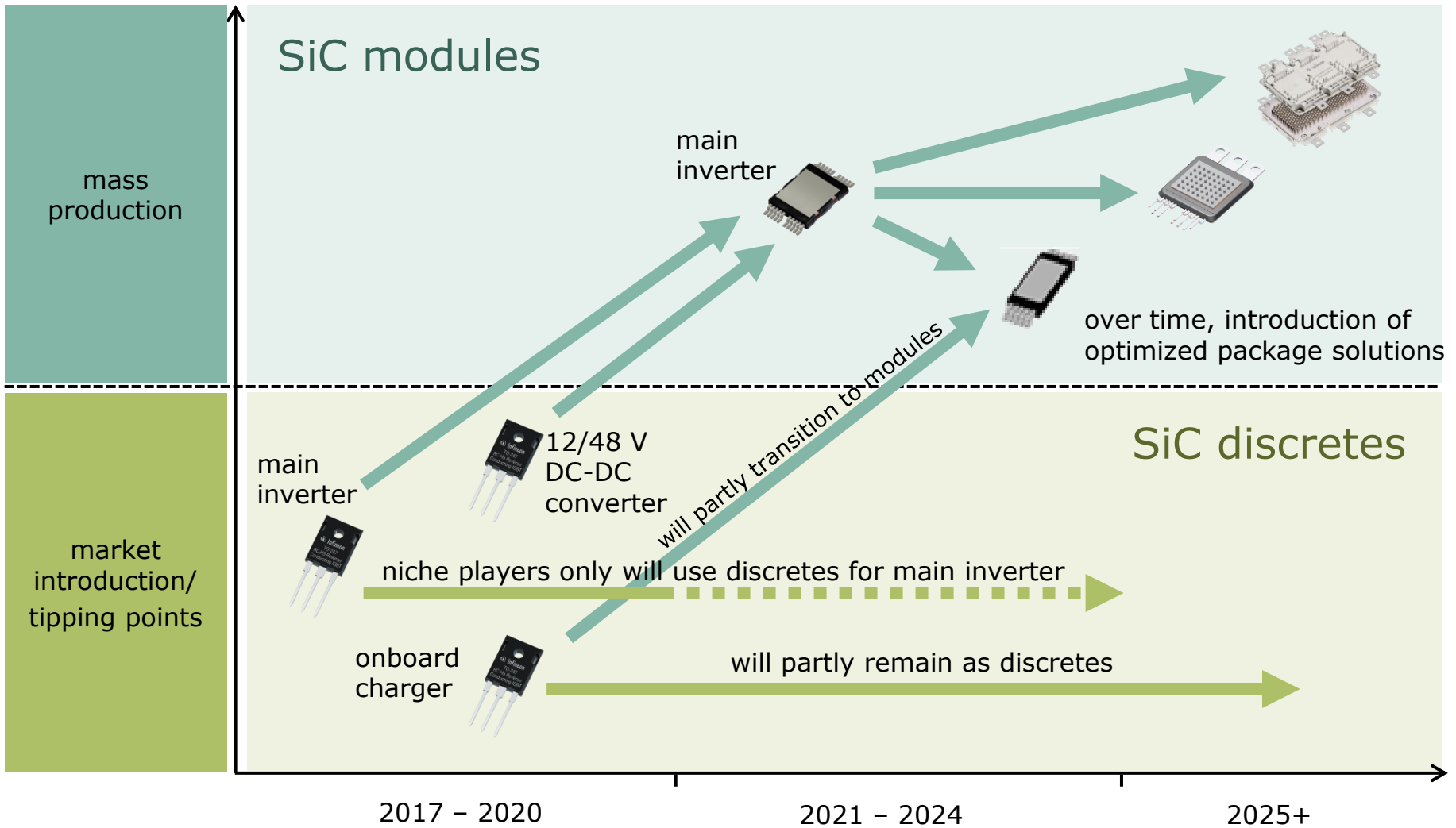


HybridPACK™ solutions



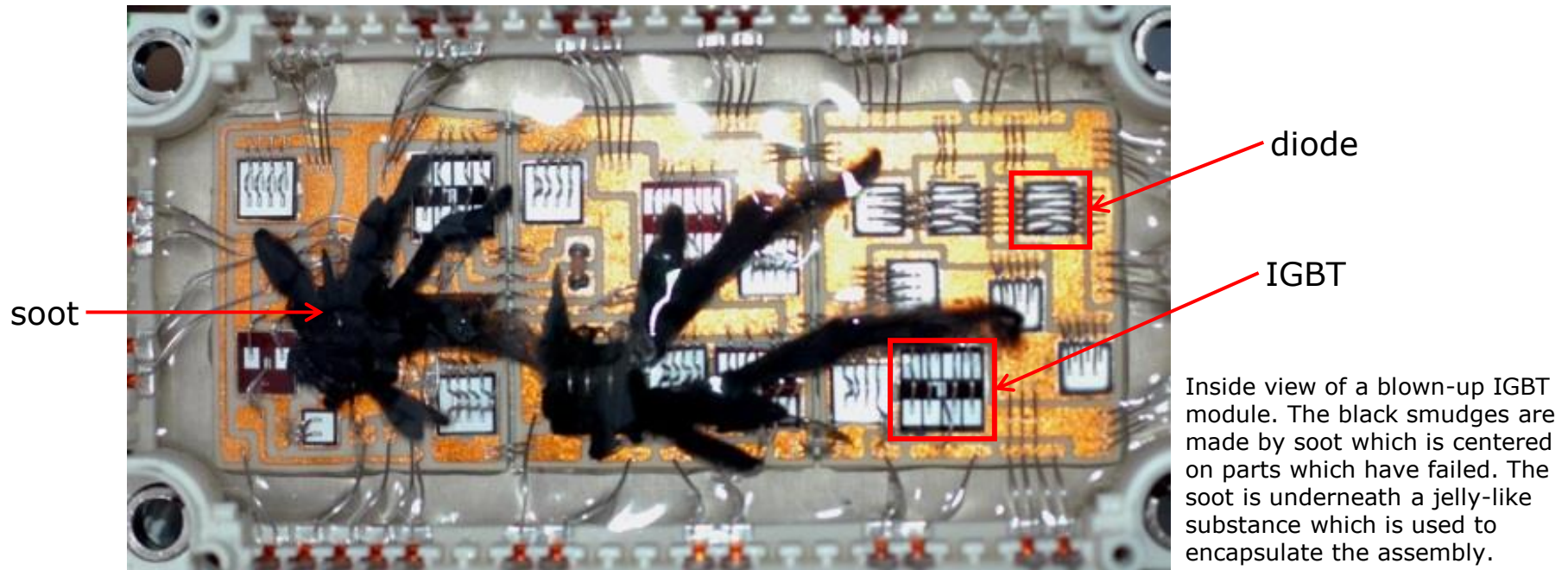
Easy modules

Big business with SiC power semiconductors will be made with modules



Package technology is key to lift full potential of a semiconductor technology

Blown-up power modules are not acceptable in xEV subsystems



Inside view of a blown-up IGBT module. The black smudges are made by soot which is centered on parts which have failed. The soot is underneath a jelly-like substance which is used to encapsulate the assembly.

- › Thermal stress, heat dissipation, degradation over life time etc. must be fully understood.
- › 100% proofed bonding and packaging technology is a must in the automotive industry.
- › The development of SiC modules have to go through the entire process.
- › Due to high switching frequency of SiC, EMI issues must also be addressed.

Infineon first partner in Volkswagen's "TRANSFORM 2025+" strategy program



Peter Schiefer, Division President Automotive at Infineon (left);
Dr. Volkmar Tanneberger, Head of Electrical and Electronic
Development at Volkswagen (Courtesy: Volkswagen AG)

"TRANSFORM 2025+"

- › Volkswagen secures its position in the field of future vehicle innovations such as automated and fully electric driving cars
- › The company is cooperating directly with semiconductor manufacturers to further shorten development and innovation cycles
- › Infineon is Volkswagen's first partner here

- › Cooperation between automotive OEMs and semiconductor manufacturers is becoming increasingly important for further innovation
- › Infineon is strengthening the bond to customers, getting involved even more deeply in the development processes
- › Infineon benefits from longer planning horizon and higher stickiness of the business

All types of xEV will significantly increase power semiconductor content per car

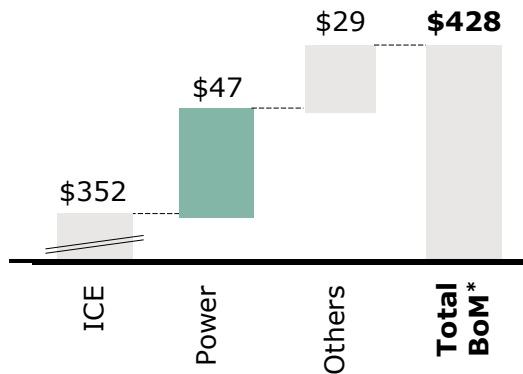


Average xEV semiconductor content by degree of electrification

Mild hybrid / 48 V

In contrast to micro hybrid systems, these systems support aside from start-stop functionality

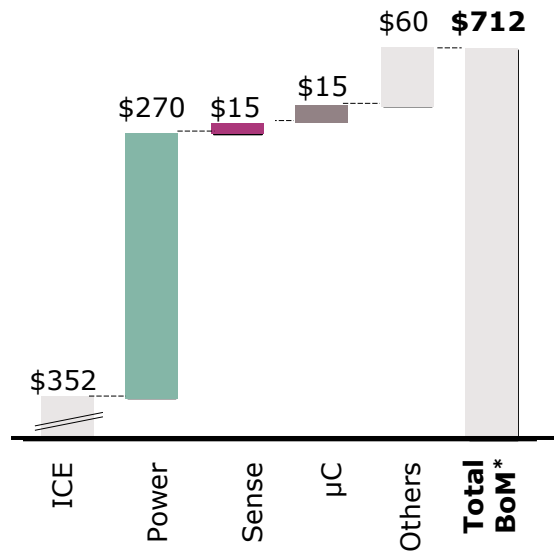
- > DC-DC conversion (12/48 V)
- > recuperation (coasting/sailing)
- > e-motor use
- > auxiliary applications



- > 2016: 0.5m units
- > 2020: 5.6m units
- > 2025: 10 .. 12m units

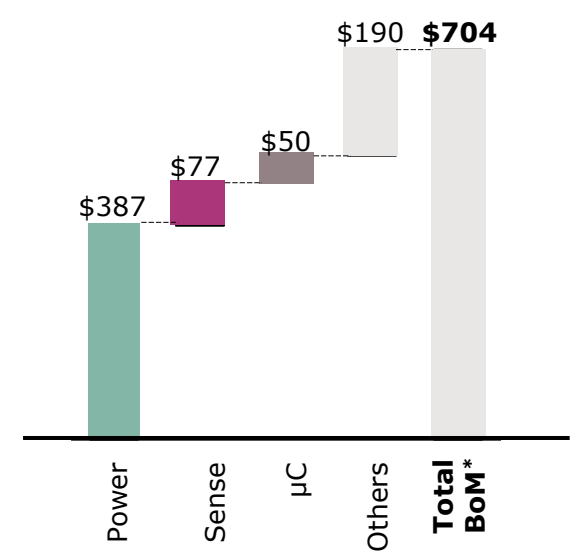
PHEV / HEV

Adder for DC-DC conversion, inverter, onboard charger



- > 2016: 2.4m units
- > 2020: 5.5m units
- > 2025: 9 .. 12m units

EV













- > 2016: 0.6m units
- > 2020: 2.1m units
- > 2025: 4 .. 8m units

Source: IHS Automotive, "Alternative Propulsion Forecast", January 2017; Infineon

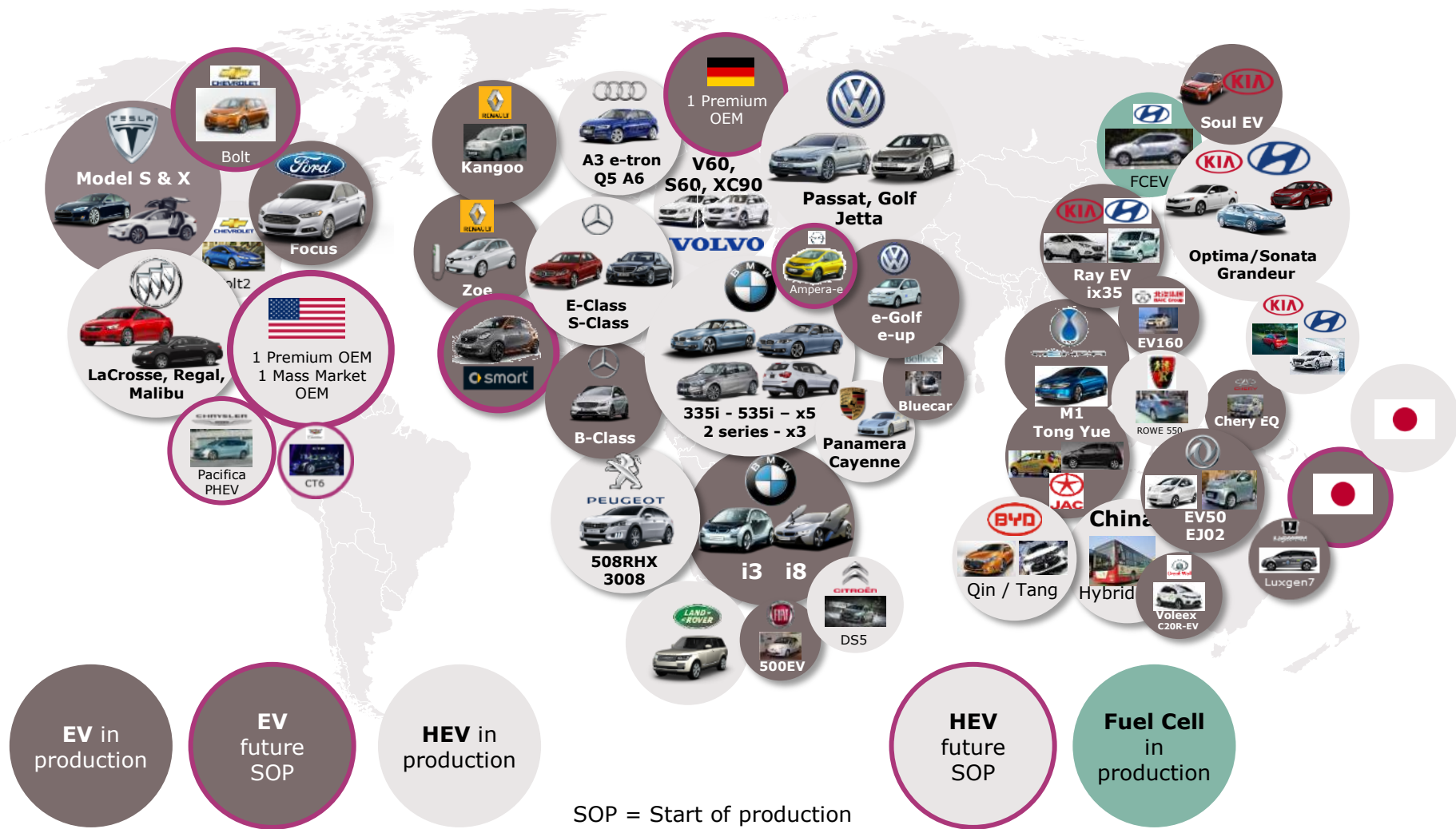
In 2016, 8 out of 10 top selling xEVs were powered by Infineon



World's top 10 selling xEVs	type	Sold cars in 2016	Drivetrain powered by Infineon
 Tesla Model S	EV	50,935	✓
 Nissan Leaf	EV	49,818	✗
 BYD Tang	PHEV	31,405	✓
 Chevrolet Volt	EV	28,295	✓
 Mitsubishi Outlander	PHEV	27,850	✗
 BMW i3	EV	25,576	✓
 Tesla Model X	EV	25,372	✓
 BYD Qin	PHEV	21,868	✓
 Renault Zoe	EV	21,626	✓
 BYD e6	EV	20,609	✓

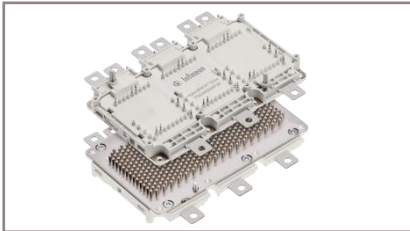
Source: EVvolumes.com, Infineon

Infineon is well positioned globally to benefit disproportionately from xEV boom



SOP = Start of production

Summary: Infineon will expand its leading position in power semi for xEV towards SiC



- › Electro-mobility is a significant growth driver for Infineon's power business: ~\$300 power semi content per PHEV and full EV.
- › In 2017, SiC will see its xEV market introduction for discretes; mass market will be on SiC modules.
- › Infineon has industry's broadest packaging portfolio for xEV applications. To take full advantage of SiC technology optimized modules are required.
- › Infineon is already cooperating with leading volume OEMs and is thus best prepared for mass xEV deployment in 2022+.



Part of your life. Part of tomorrow.



Glossary

AD	automated driving
ADAS	advanced driver assistance system
EV	electric vehicle
EMI	electromagnetic interference
HEV	mild and full hybrid electric vehicle
ICE	internal combustion engine
IGBT	insulated gate bipolar transistor
micro hybrid	vehicles using start-stop systems and limited recuperation
mild hybrid	vehicles using start-stop systems, recuperation, DC-DC conversion, e-motor
PHEV	plug-in hybrid electric vehicle
Si	silicon
SiC	silicon carbide
TAM	total addressable market
V2X	vehicle-to-everything communication
xEV	all degrees of vehicle electrification (EV, HEV, PHEV)