

ENGINEERING
TOMORROW



ELECTRICAL DRIVES
TECHNOLOGIES IN INDUSTRIAL
AND MOBILE APPLICATIONS

Market tendencies within industrial and mobile applications

Mette Simonsen Nordstrøm
Director Strategy, Marketing and
Communications

Danfoss Silicon Power GmbH

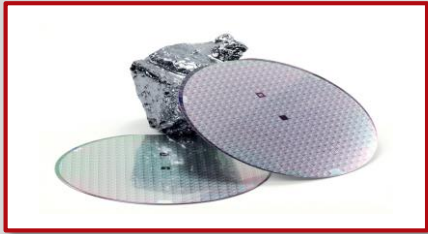


Danfoss has **in house** power module development and manufacturing

Danfoss Silicon Power:

- Offer expertise and experience in innovative design, manufacturing and delivery of highly reliable fully **customized** power electronics and associated cooling concepts
- Has the competences in house to vertically integrate and **customize** development of both power modules and power stacks

Optimization parameters for **customization**



Chips

- Selecting the best semiconductor for the application



Power Module

- Customized or standard housings
- Flexible designs
- Advanced bonding and joining technologies



Cooling

- Superior cooling to maximize life time and reliability
- Improved cooling = higher power density



Assembly Incl. PCB

- Compact design
- Optimized gate drivers



Power stack

- High level of integration
- Cooling, cap-bank, protection etc. included
- Design for fit

Danfoss Silicon Power

serves 3 main industries

■ **Automotive**
(EPS & HEV/EV)

■ **Renewables**
(Solar and wind applications)

■ **Industrial applications**
(Drives for various applications,
incl. Danfoss Drives, grid tied inverters, battery
storage, welding)



Silicon Power **Global Footprint**



The e-mobility industry is moving fast

50%

of all new cars
sold in Europe
after 2025 will
be electric

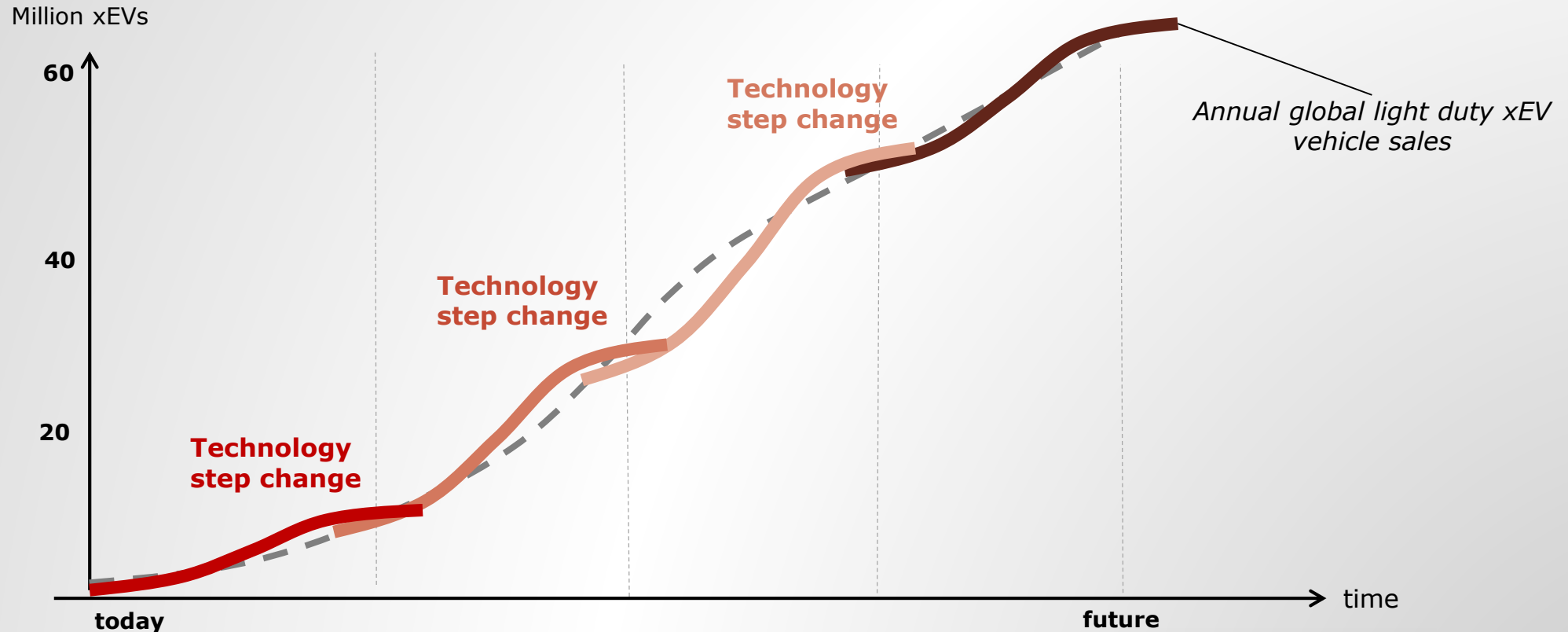
Electric vehicles are changing the transportation industry

- Electric busses for cities, airports etc. are gaining ground due to local regulations
- By 2040, 50% of all cars will be electric – ferries, trucks and other vehicles also going electric
- Charging systems for busses need large AC to DC converters

Consequence? Automotive industry will absorb engineering competences and materials like a **black hole**



...and puts extreme focus on **technology development!**



Customer requirements

- ✓ Full utilization of materials
- ✓ Higher level of integration
- ✓ Efficient cooling

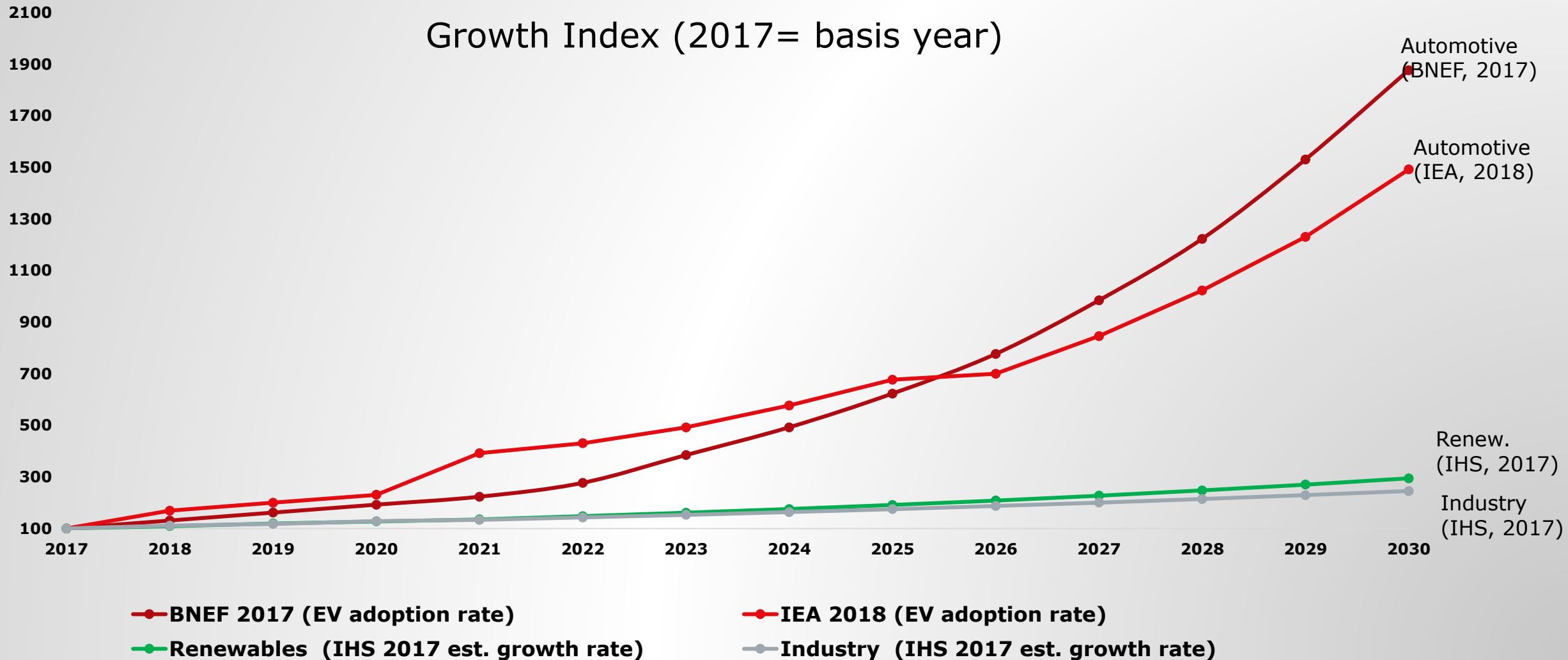
Technology enablers

- ✓ Danfoss Bond Buffer®
- ✓ Molding technology
- ✓ ShowerPower®

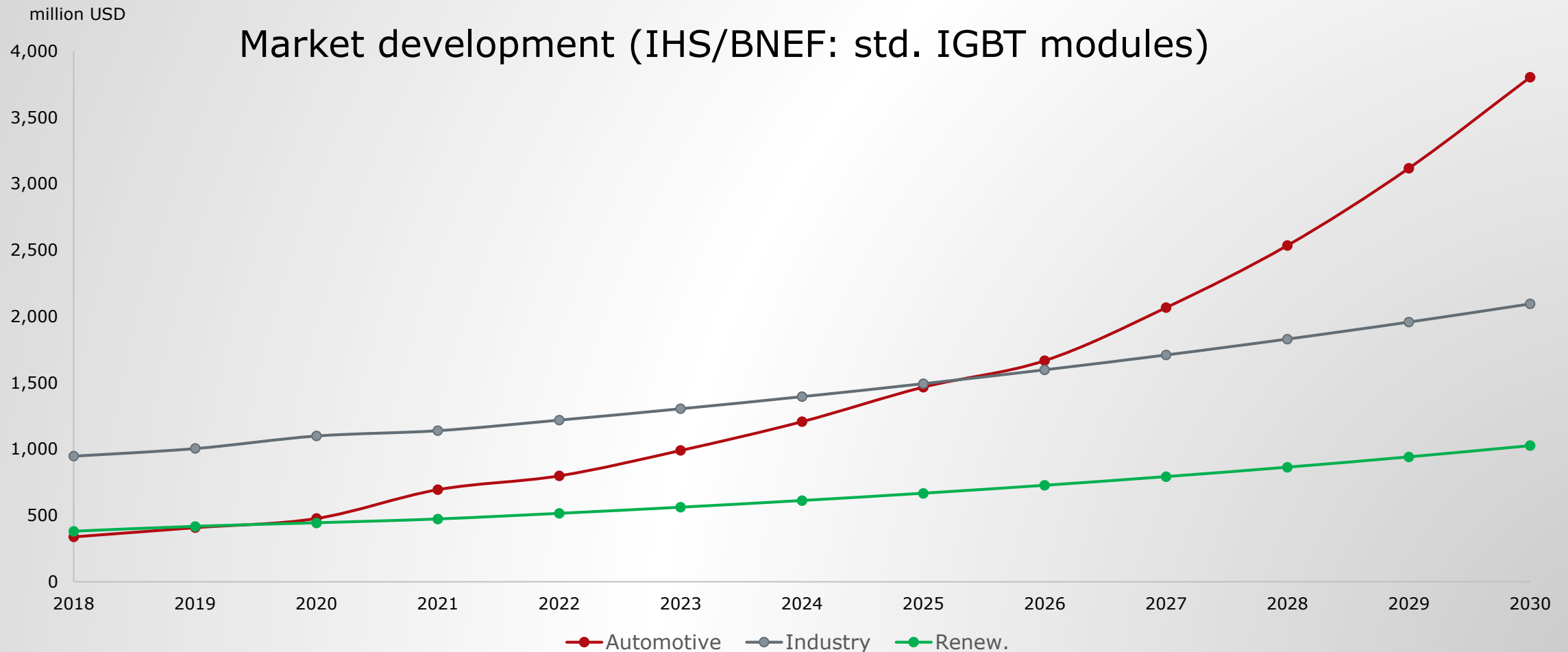
Key values

- ✓ High reliability
- ✓ Robustness
- ✓ Life-time
- ✓ \$/kW

Comparing relative **market growth development**



Automotive market will become the dominant market for power modules



E-mobility combined with **renewable energy** creates new innovative applications



Battery energy storage



Hybridization



Power-to-power



EV Charging



Off-highway



EV Traction

Q:

How to design to the limits of new chip technologies?

How to live up to harsh environments?


Dominating markets drive **chip technology**

Industrial Drives → Renewables → Automotive

Yesterday		Today	Future	
Semiconductor	1700V	Industrial Drives	Renewables + Train traction	
	1200V	Industrial Drives	Renewables	Automotive + Drives
	600-750V	Industrial Drives	Automotive + Drives	Automotive
	SiC/WBG	Solar inverter	BESS + Grid Power	Automotive

Enabling technologies: Cooling and bonding

Making the most out of Silicon



Yesterday		Today	Future	
Technology	Cooling	Indirect air or liquid	Direct liquid	Advanced direct liquid*
	Bonding	Al-wire + solder	Sinter	Top side sinter**
Power density of module	75% w/ current derating	80-100% High utilization	125-150% Best utilization	

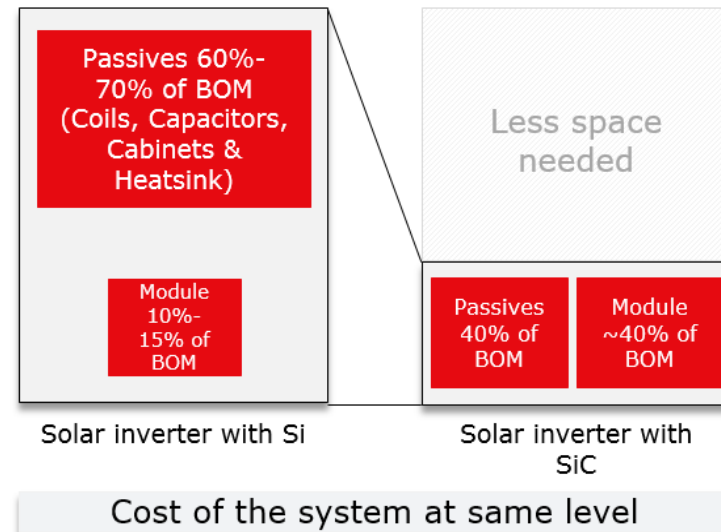
* Danfoss Shower Power 3D®

** Danfoss Bond Buffer®

How **SiC** chips adds value to power system

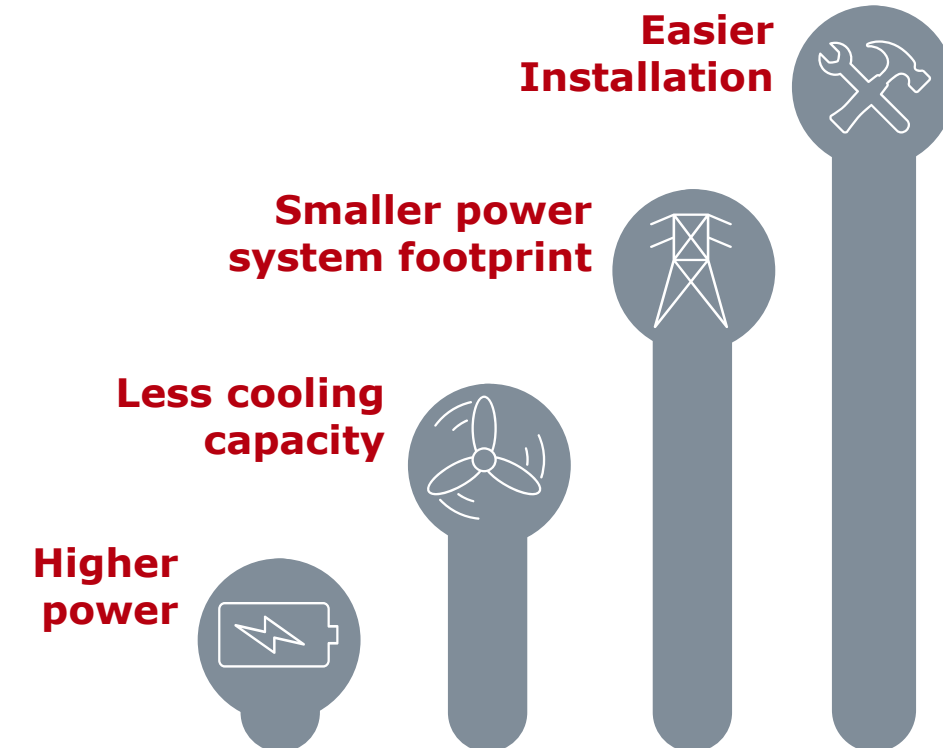
SiC technology reduces the cost for passives in a system, but increases the cost of power semiconductors

Example Solar inverter:



Further Benefits:

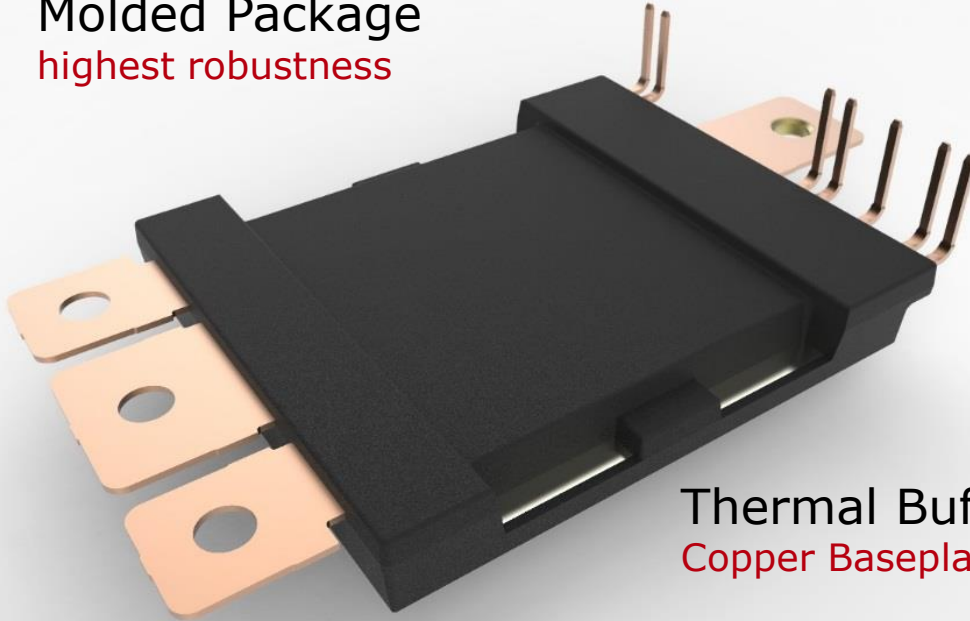
- Higher efficiency
- Higher power density
- Higher quality



By combining Leading Technologies...

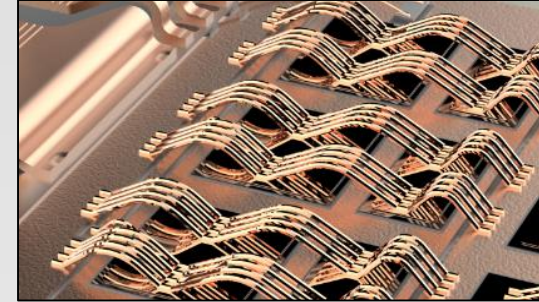
Into the DCM platform for automotive traction applications

Molded Package
highest robustness

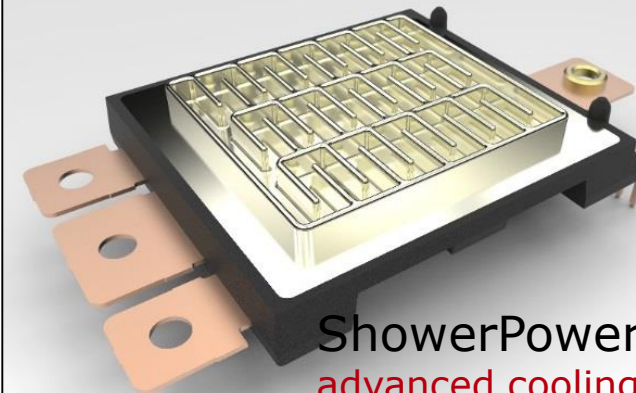


Thermal Buffer
Copper Baseplate

Low Inductance
optimized DC terminals

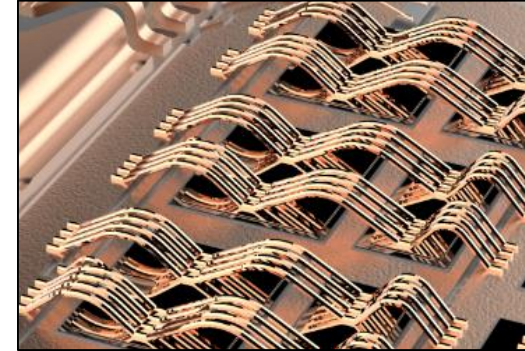
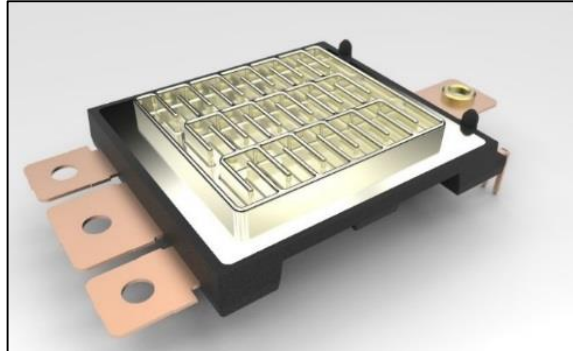
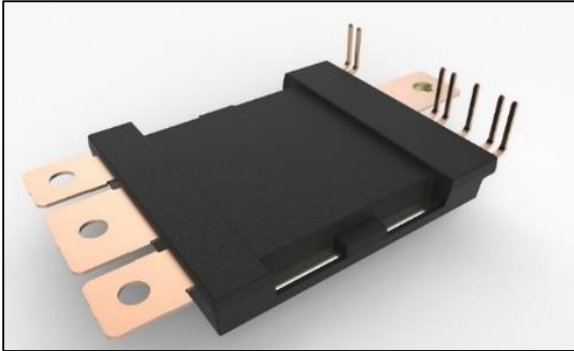


Danfoss Bond Buffer®
Power Cycling made easy



ShowerPower®3D
advanced cooling

DCM1000 enables innovative inverter designs

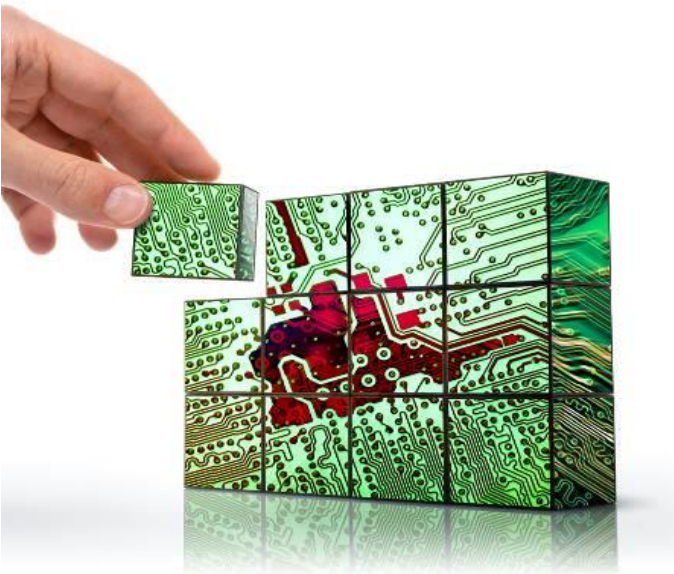


- Danfoss is introducing the next generation **technology platform** „DCM1000“ for automotive traction inverters
- Molded packaging, direct liquid cooling and Danfoss Bond Buffer technologies are combined to make the most out of silicon or SiC
- Target application is automotive drive train in 650/750V or 1200V with currents of 300-700A RMS
- The design is flexible and fully customizable and designed to be wide band gap ready
- Danfoss applications experts support from early design to volume production

Conclusion

- EV/HEV market will explode – putting extreme pressure on power electronic competences, material supply and technology development
- Several technology step changes enables high demand towards power electronic solutions
- Automotive will drive chip technology and power module development
- SiC will play a major role in applications going forward
- Danfoss provides a highly innovative module technology platform enabling transistion in the market

Thank you for your attention!



Contact information:

Danfoss Silicon Power GmbH

Husumer Straße 251

24941 Flensburg, Germany

www.siliconpower.danfoss.com

A better tomorrow is
driven by drives