

Semiconductor Technologies for Energy Storage Integration

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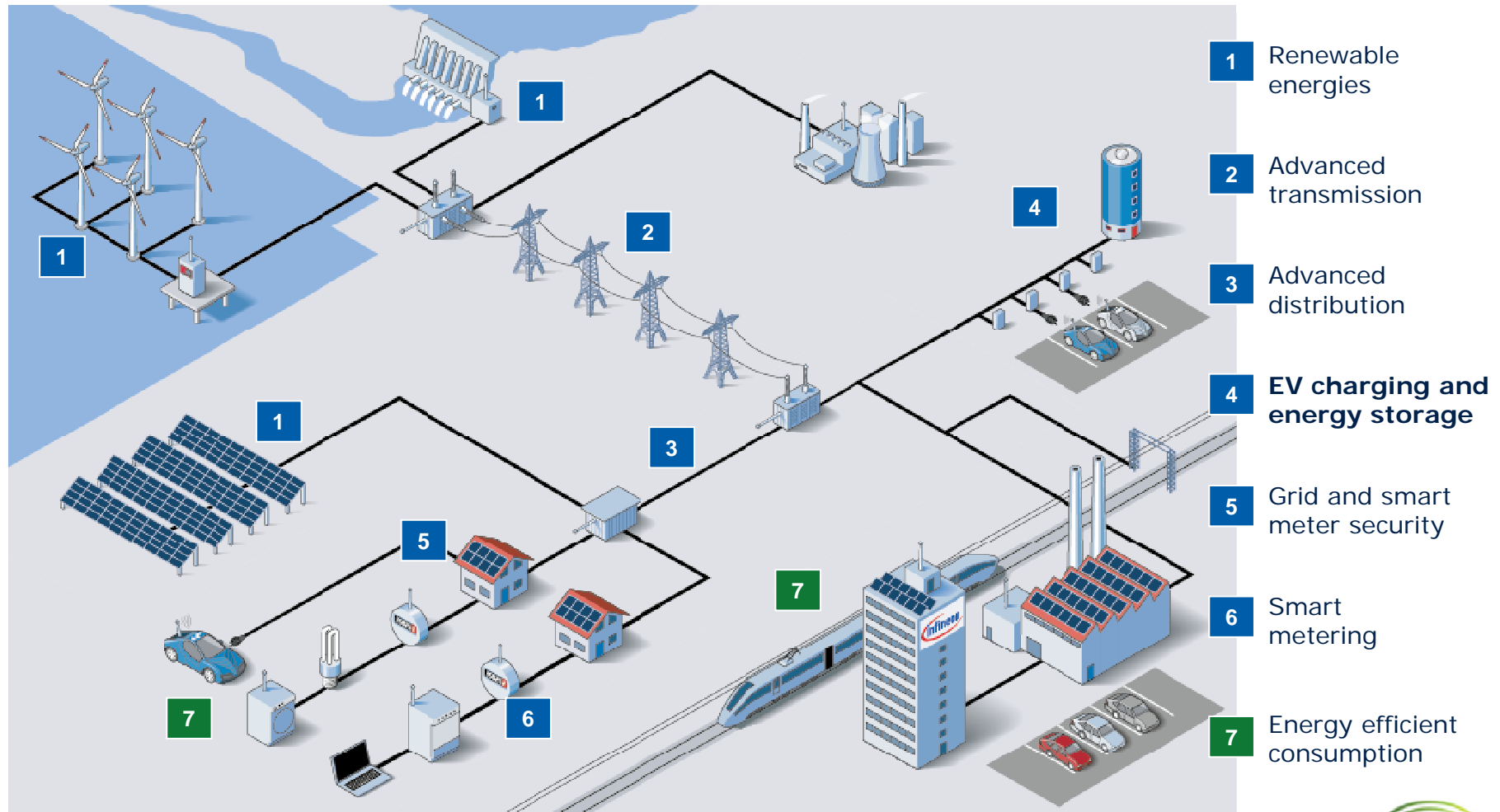


Infineon at a Glance

The Company

- Infineon provides semiconductor and system solutions, focusing on three central needs of our modern society: **Energy Efficiency, Mobility** and **Security**
- Revenue in FY 2011: 3.997 billion EUR
- 26,454 employees worldwide (as of June 2012)
- **15,700** patents and patent applications (as of Sept. 2011)
- More than **20 R&D locations**
- Germany's largest / Europe's second largest semiconductor company
- Market position: **#2 Automotive** - **#1 Power** - **#1 Chip Card**

Infineon's View of the Smart Grid

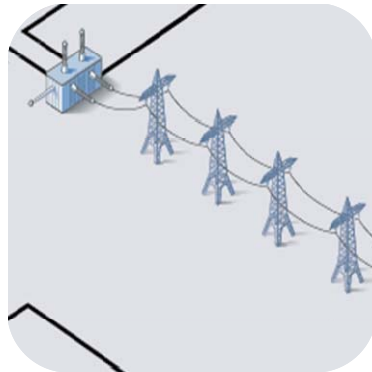


Semiconductor Applications and Products in the Smart Grid

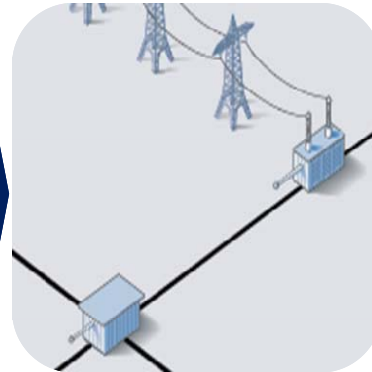
Generation



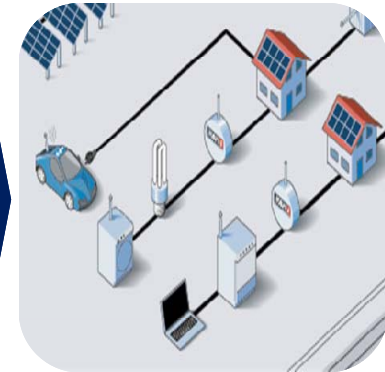
Transmission



Distribution



Consumption



Major Applications

- Renewable energy integration

- Flexible AC Transmission Systems (FACTS)
- High-Voltage DC Transmission Systems (HVDC)

- Energy storage systems
- Advanced sensing
- Solid state switch gear
- Smart transformers
- Advanced metering infrastructure (AMI)
- Micro grids

- Electric vehicle charging
- Energy storage
- Distributed generation
- Smart meters
- Smart thermostats
- Smart appliances
- LED lighting

Major Products

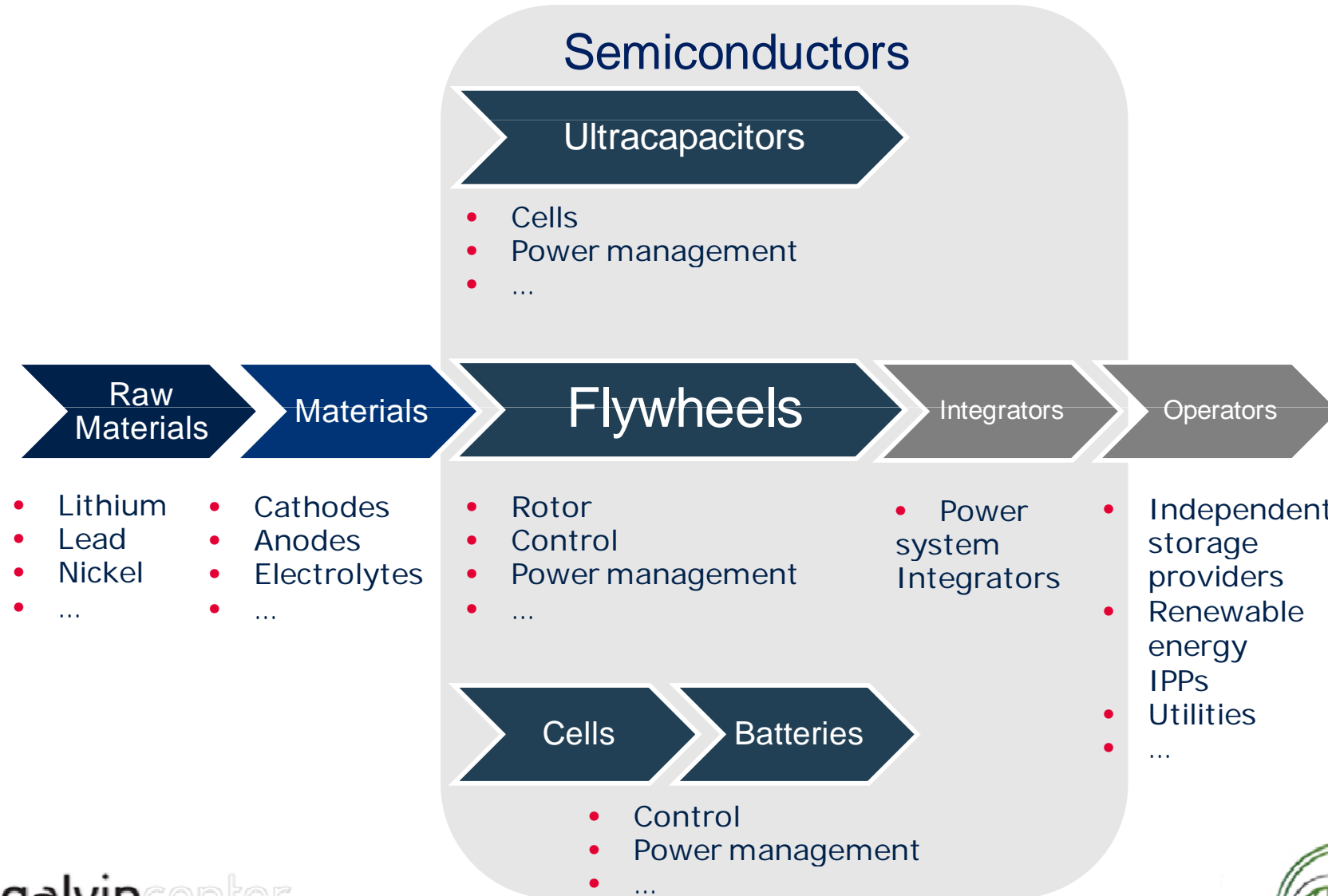
- Power semiconductors
- Drivers & controllers

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- Sensors
- Security ICs
- Communication ICs

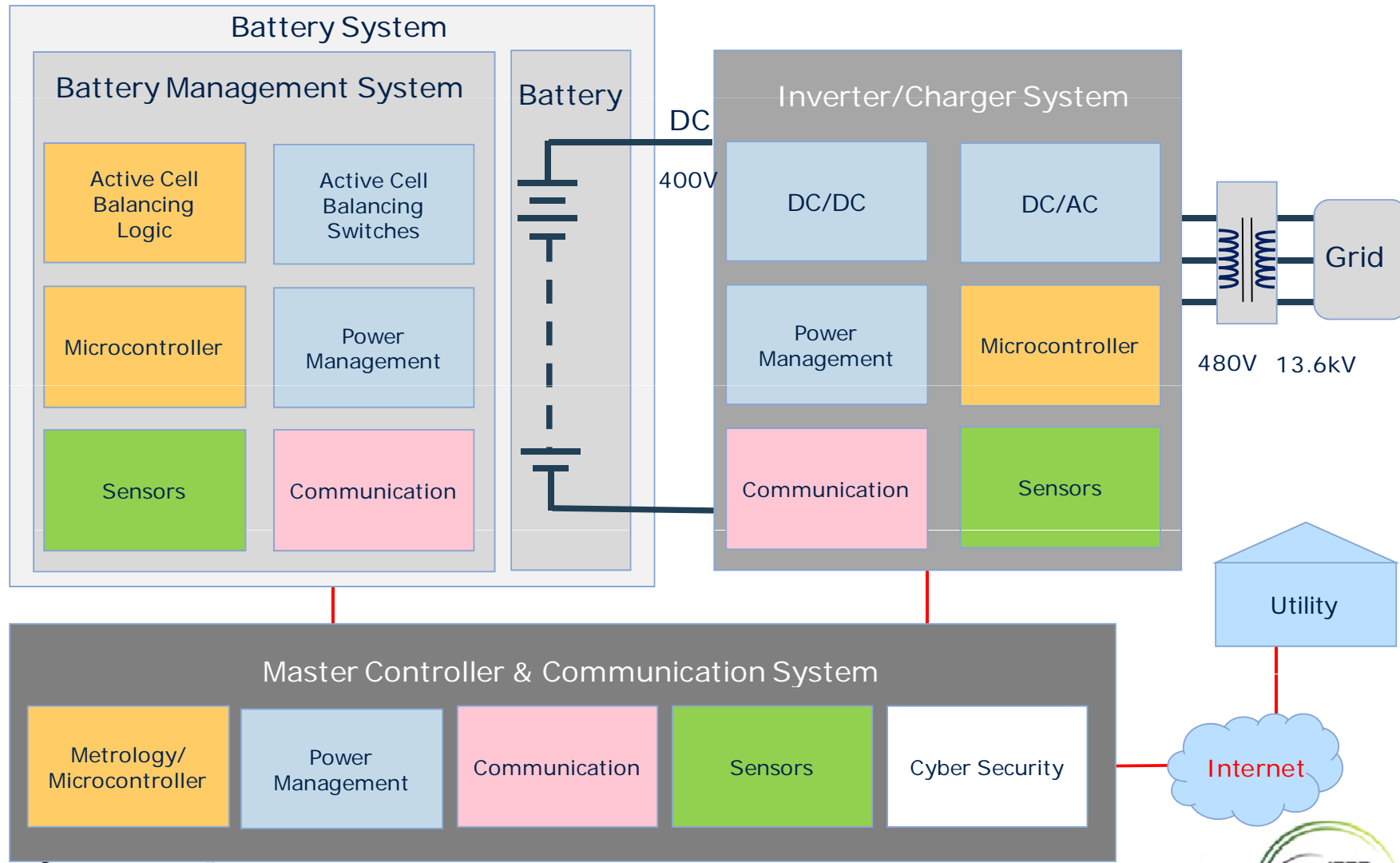
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- Drivers & controllers
- Smart meter ICs
- Sensors
- Security ICs
- Communication ICs

Semiconductors in the Energy Storage Value Chain



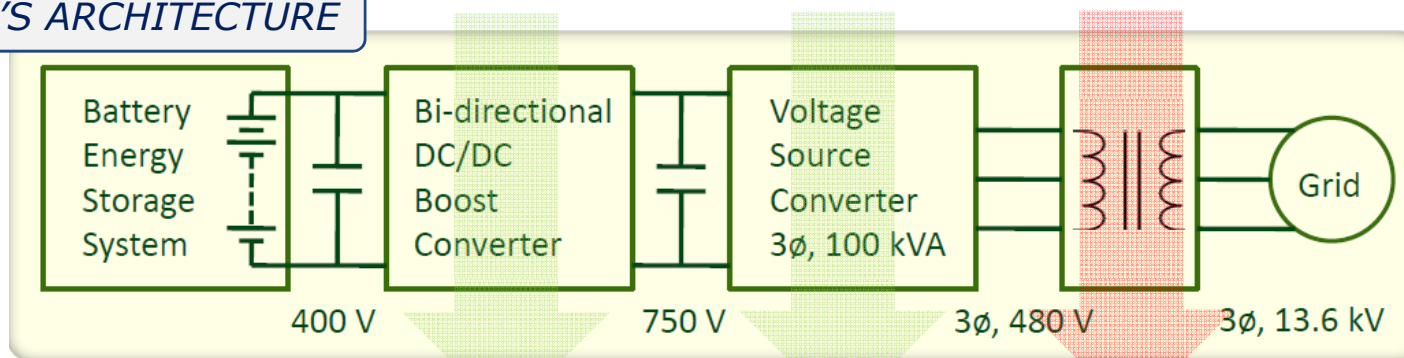
Source: "Energy Storage / Batteries", Natureo Finance, 12/2011

Battery-Based Energy Storage System



Evolving Distribution System Architecture

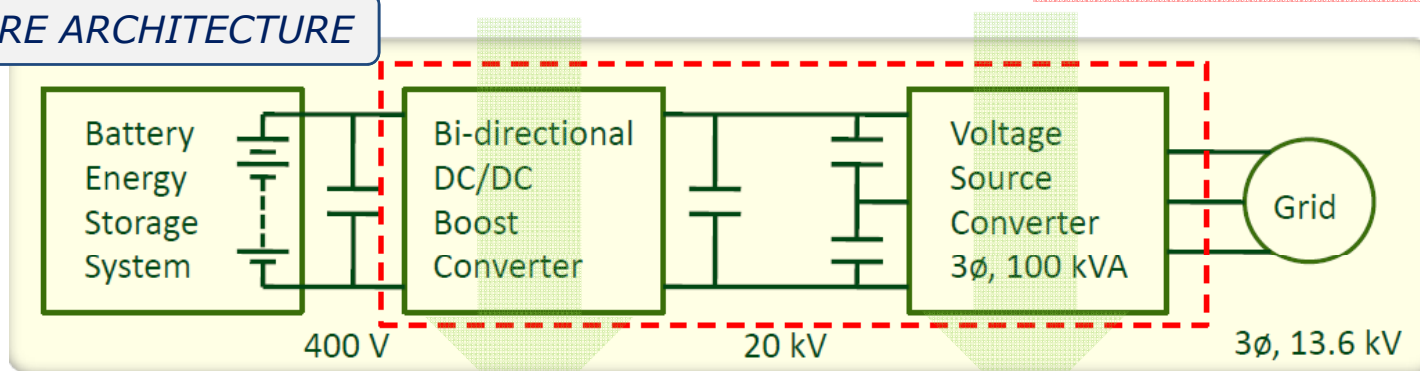
TODAY'S ARCHITECTURE



Inverter/Charger
 •Silicon IGBT/MOSFET ($\leq 1200\text{V}$)

Distribution Transformer
 •Conventional

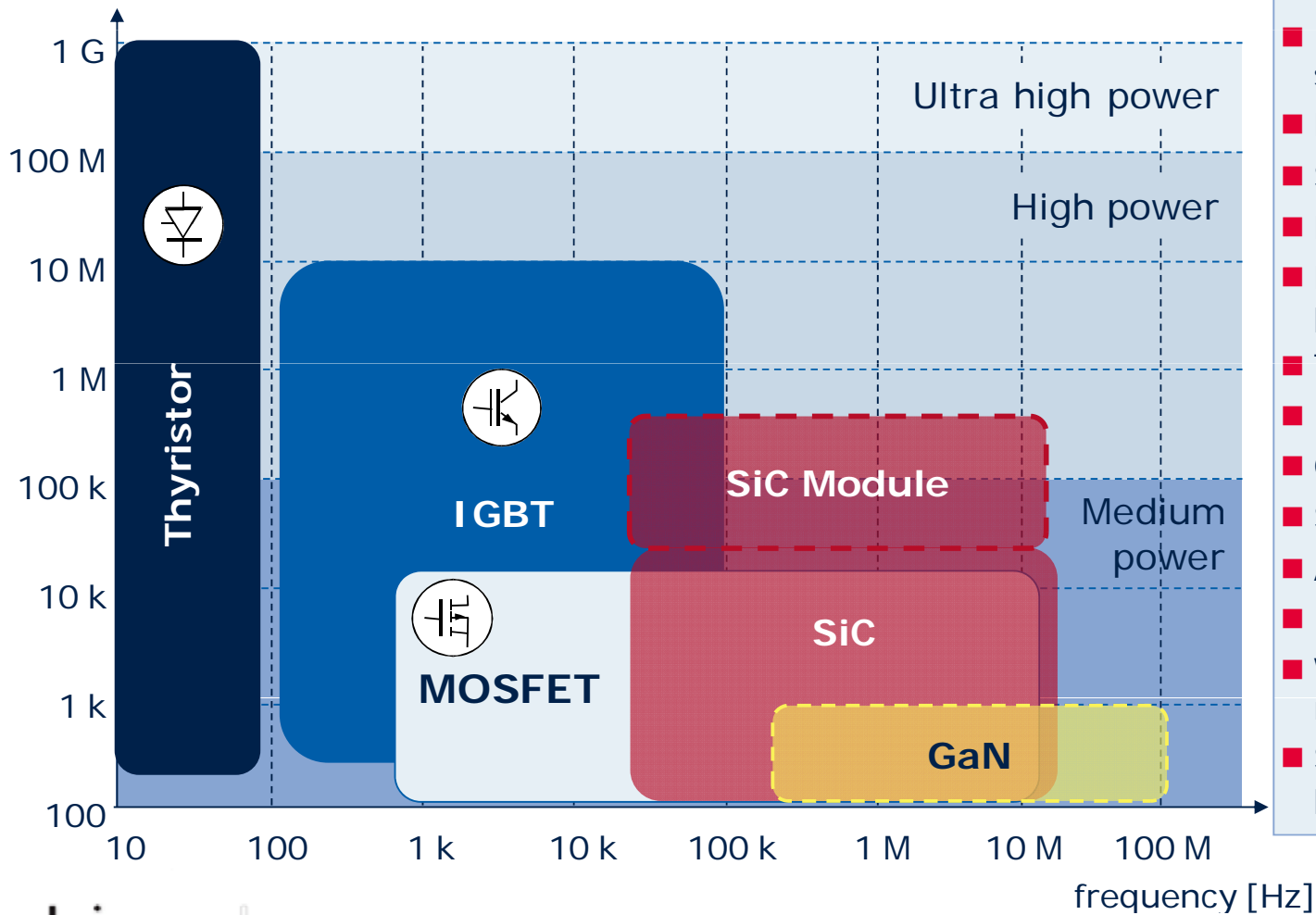
FUTURE ARCHITECTURE



Inverter/Charger/Distribution Transformer
 •Cascaded Silicon IGBTs or SiC IGBT ($\geq 15\text{kV}$)

Overview of Power Semiconductor Technologies

power by application [W]



- HVDC
- High-current-supplies
- Large drives
- Ships
- Locomotives
- Large solar plants
- Trams, busses
- Electric cars
- On-roof PV
- Small drives
- Airconditioner
- Robotics
- Washing machine
- Switch mode power supplies

Semiconductor Smart Grid Requirements



Wafer & Packaging

- Increasing wafer size (4"→5"→6"→8"→12")
- Decreasing wafer thickness
- New packaging technologies



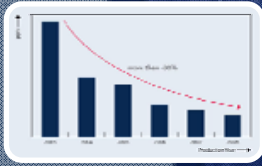
Integration

- Power management
- Sense & control
- Computing



Robustness

- Extended temperature range
- Robust design



Quality & Sustainability

- Zero-defect culture
- Sustainable quality improvement
- Green mindset throughout value chain



Lifetime

- Support of long industry life cycles

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