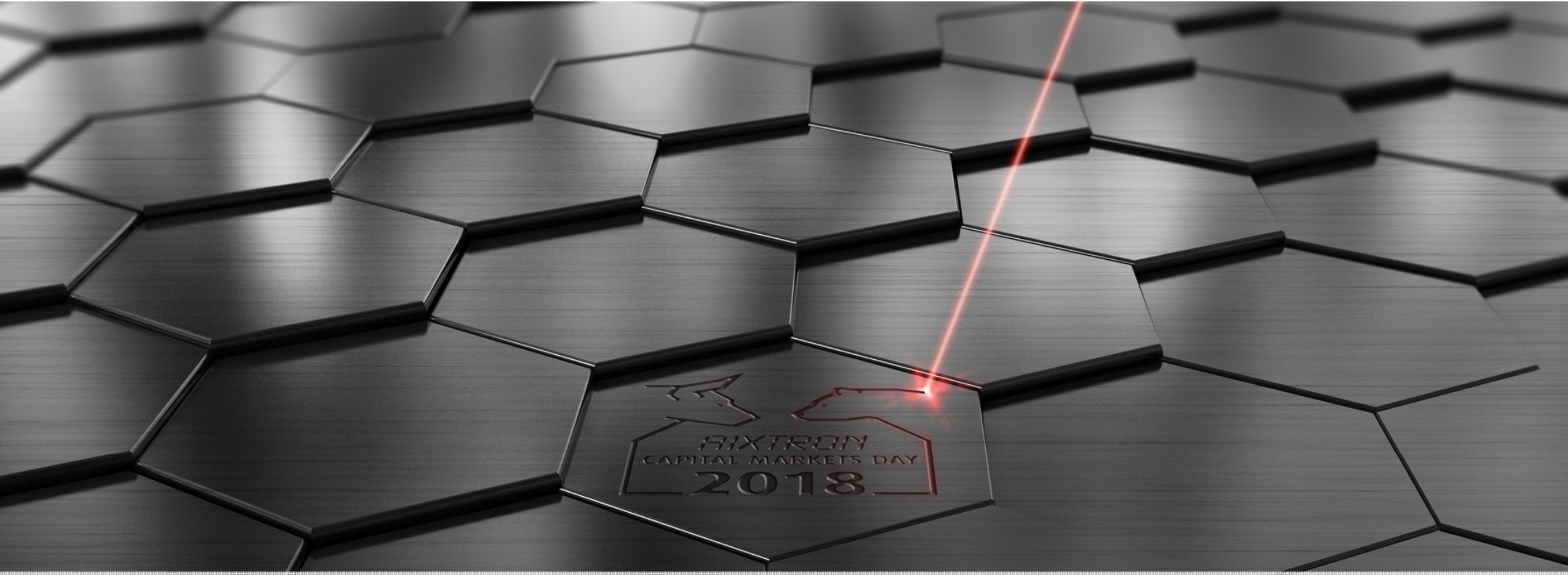

AIXTRON 1. Capital Markets Day

CMD 2018 Presentation 2

(FSE: AIXA, ISIN DE000A0WMPJ6)

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GaN & SiC Power Electronics Market Drivers

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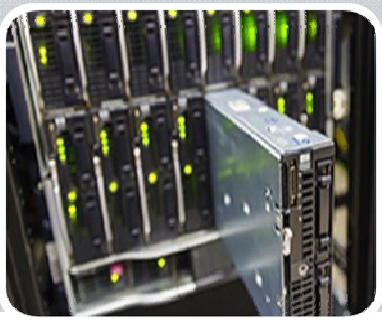
GaN & SiC Power Electronics Market Opportunities

Sources: EPC, Wolfspeed



	(50V)	(<200V)	(650V)	Diode, MOSFET (650, 1.2-3kV)
Device				
Application	• Satellite com, radar • Telecom base-stations • RF Power Amplifier for 5G • Industrial heating	• Wireless charging (AirFuel™ standard) • Powering LiDAR systems • DC-DC power conversion	• Fast chargers for mobile devices • Compact power supplies • On-Board Charger EVs	• Solar Inverter • On-Board Charger • Main Power Inverter EVs • Charging piles
Technology	GaN on Si / GaN on SiC	GaN on Si / GaN on SiC	GaN on Si / GaN on SiC	SiC on SiC

Advantages of SiC Power Electronics Systems

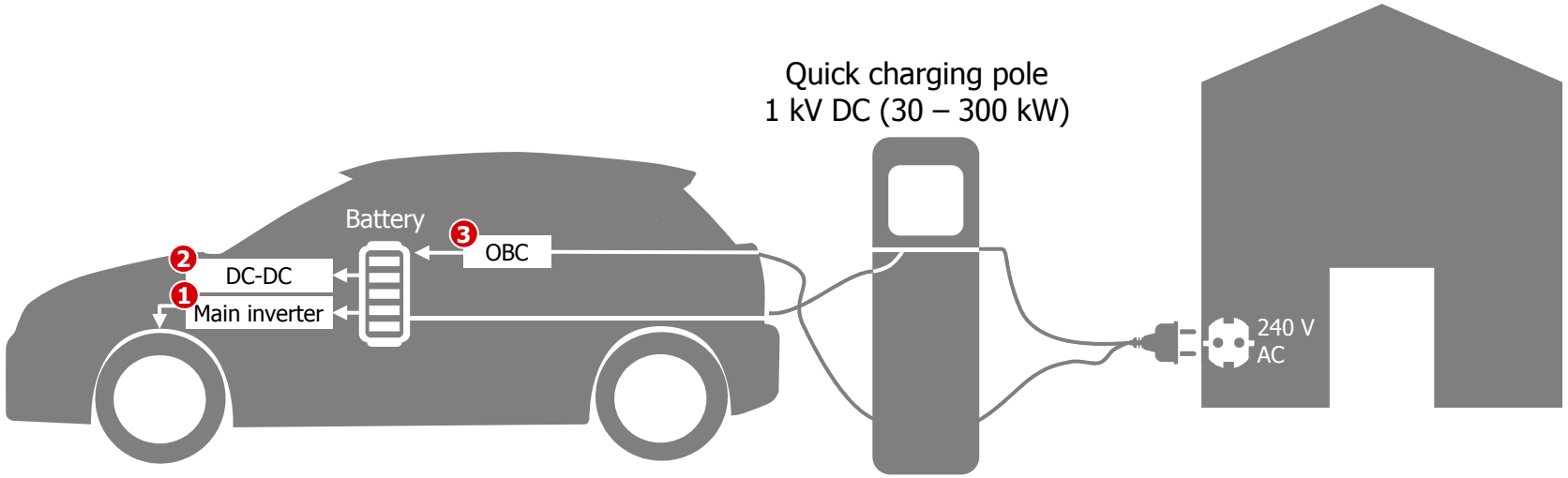
Early adopters:
SiC solar inverter & on-board chargers for PHEV and EV

SiC power electronics systems compared to Si:

- **5x** lighter
- **3x** smaller
- **25%** lower semiconductor losses

Next big opportunity: SiC power inverter in electric vehicles (EVs)

SiC Automotive Market Opportunity is based on the Main Inverter as this consumes > 80% of the wafer area



Component	Power (kW)	Fraction 6" wafer	
Main inverter	20 – 150	0,1 – 0,5	
DC-DC Converter	1 – 3	<0,01	electronics
On Board Charger (OBC)	5 – 30	0,01	Brings 240 V AC energy from wall plug to battery
(Quick) Charging Pole	30 – 300	0,1 – 1	Brings 1–3 kV DC energy directly from grid to battery

Higher efficiency enables
- **Battery size reduction**
- **Cost savings**
- **Range extension**

Rough order-of-magnitude estimates

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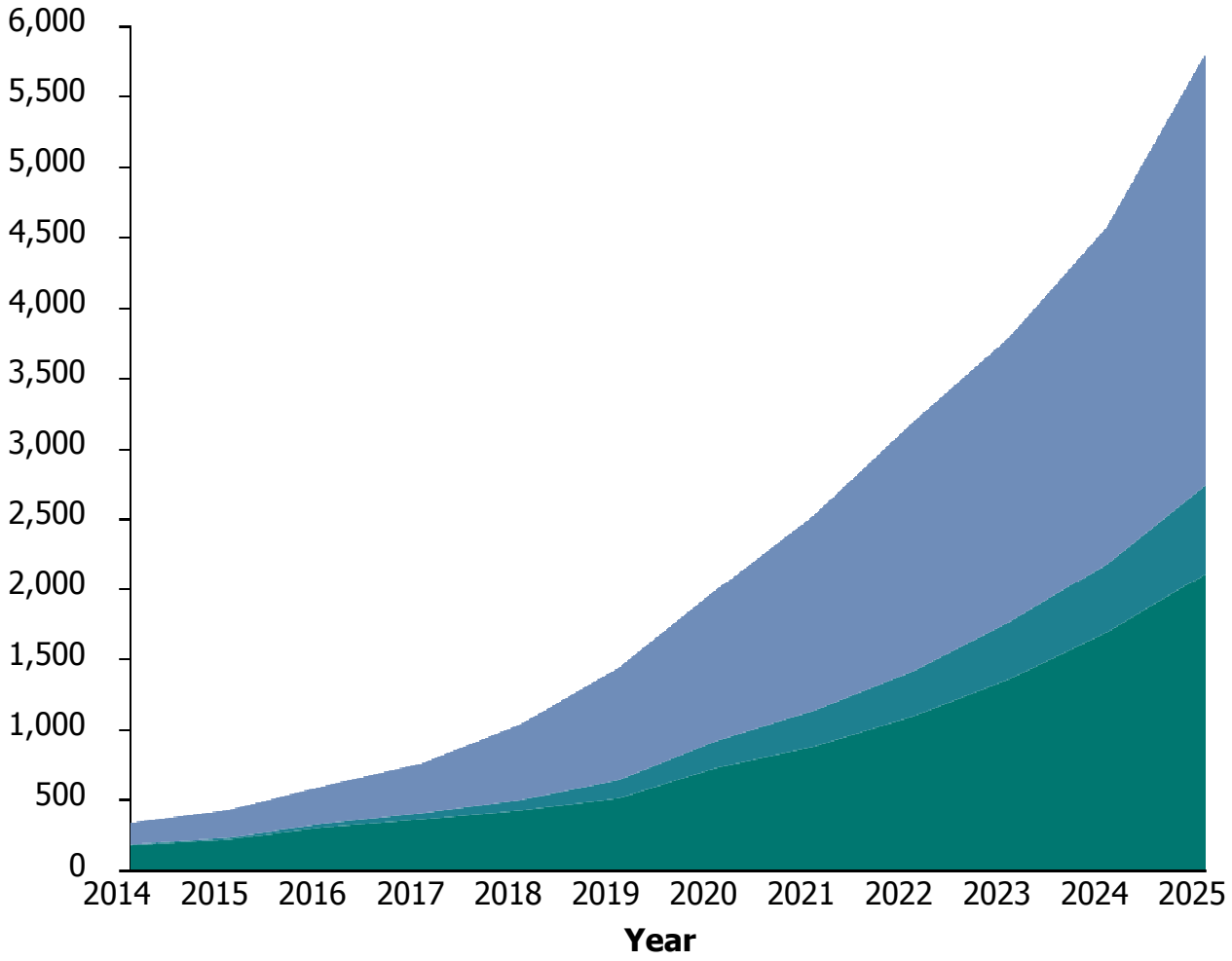
GaN and SiC Device Market Forecast – SiC expected to be largest WBG Power Semiconductor Segment by 2025

Source: IHS 2016; YOLE 2017

IHS: GaN and SiC Semiconductor Device Forecast
YOLE: GaN RF Device Market
in USD Mio



- SiC is expected to be the largest Wide Bandgap Power Market, followed by GaN RF and GaN power
- Largest upside is in the SiC Market with Opportunities in the Electric Drive train of EVs

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AIXTRON's (MO)VPE– Key Enabling Technology for GaN & SiC

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One Platform, two Material Systems, huge Market Opportunities

GaN

AIX G5+ C The Tool of Record for GaN on Si HVM

AIX G5 WW
Batch Reactor Productivity with Single Wafer Performance

SiC

The Enabling Solution

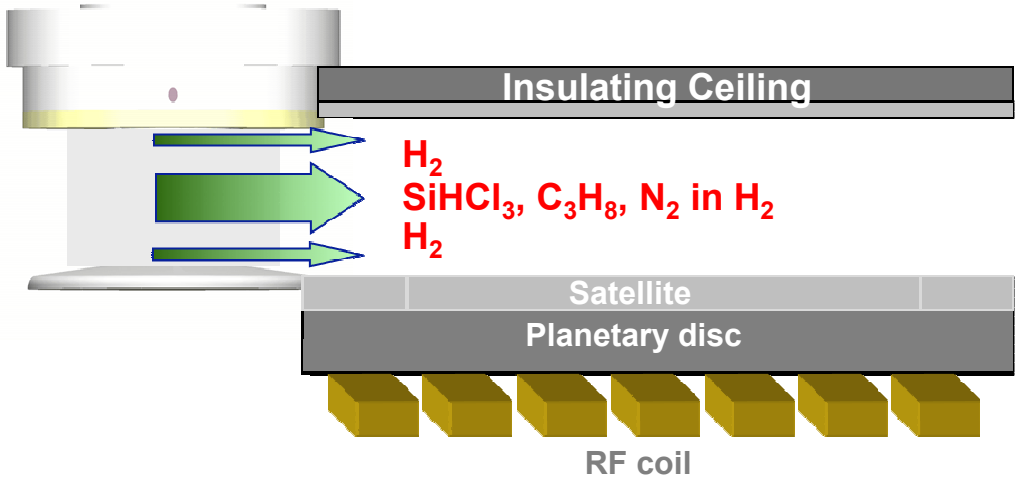
- **Wide Band-Gap Materials – Efficient Power Electronics Applications – Multi Billion Dollar Market Opportunity**
  - Multi-kW systems require large chip areas
  - Market needs HVM solution with high sensitivity to yield, cost and productivity

- **Requirements to (MO)VPE System**
  - Best Deposition Uniformity Control – at wafer level
  - Lowest Cost per wafer
    - High throughput
    - Low cost of consumables B

AIX G5 WW

Highest Yields on 150mm – The Planetary Reactor® Principle

Reactor Principle



SiC Epitaxy Requirements

Device class	Drift layer thickness
650V	6 µm
1200V	11 µm
1700V	16 µm
3.3kV	30 µm
6.5kV	60 µm
10kV	100 µm
15kV	150 µm

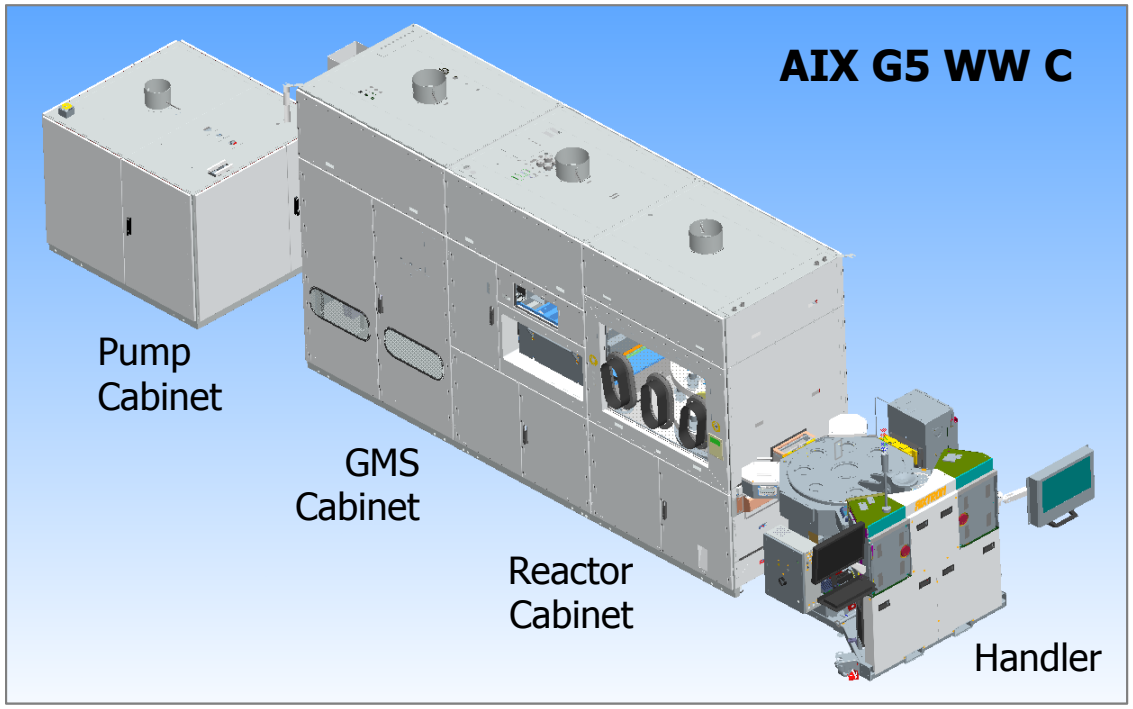
Different layer thickness for different products

Radial symmetric horizontal Planetary Reactor®

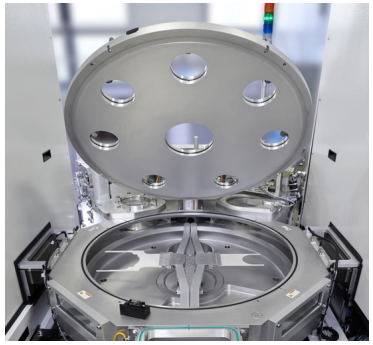
- Individual wafer rotation = best material uniformity
- Individual wafer temperature adjustment = wafer level control/correction
- Laminar flow reactor = wide process window
- High growth rate processes using TCS = high throughput

SiC - New Product with Automation increases Tool Throughput

- **Based on G5 WW 8x150 mm Planetary Reactor®**
- **Full Cassette-to-Cassette Wafer Automation (release to beta customers by Q4/18)**
- **Bay/Chase layout friendly**
- **Throughput gain enabled by hot loading/unloading of wafers**



GaN – AIXTRON is the Tool-of-Record for 150 & 200 mm



G5+ C dual Planetary reactor module cluster with Cassette-to-Cassette wafer handling

- CSindustry awards 2016
- **Fab integration** with 150 & 200 mm wafer cassette-to-cassette handler module
- **Best uniformities** thanks to Planetary concept
- **In-situ Reactor Cleaning** for AlGaN on Si process robustness and yield
- **On-wafer temperature process control** for highest reproducibility and yield

Development of next-gen product ongoing, timing not disclosed yet

Technology. Materials. Performance.

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