THE DRIVE FOR SILICON CARBIDE:
A Look Back and the Road Ahead

Gregg Lowe
CEO, Wolfspeed
Cree to Wolfspeed

Built the world’s first, largest, and only 200mm Silicon Carbide fabrication facility in Marcy, New York

Focused on silicon carbide and gallium nitride materials and devices for power and radio frequency

Applications include transportation, power supplies, power inverters, and wireless systems

Develop + manufacture wide-bandgap semiconductors

Revenue: $922 million (2023)

“What are you doing here?”

John Palmour
Co-founder of Cree Research
The next generation in power semiconductors will be driven by silicon carbide technology.

SiC Inverters are:

- Lighter
- Smaller
- More efficient, 5% - 10% increase in vehicle range

GaN-Silicon Carbide in 5G enables:

- Increased capacity and coverage
- 2X more users per tower
- More than 10X increase in data
“We were full of big plans and high hopes, but we were too young and too stupid to know how hard it was going to be, how long it would take, or if it was even possible.”

John Palmour
On the founding of Cree Research
Manufacturing SiC: Not for the faint of heart

CROSS POLARIZATION (XPOL)
Image shows structural imperfections

CROSS POLARIZATION (XPOL)
Image shows quality improvements

200mm wafer

200mm wafer
“There is no reason anyone would want a computer in their home.”

Ken Olsen  
Founder, Digital Equipment Corporation, 1977
Major semiconductor market changes don't happen often
First silicon carbide MOSFET:

2011

New benchmark for energy-efficient power switches

Initial uses: solar inverters, high-voltage power supplies and power conditioning in industrial power applications

Key building block for more efficient power conversion systems, decreasing size, weight and bill of materials
SiC Inverter:
Higher upfront price but lower system cost

$300-$600 savings in battery costs

Up to $1,000 savings in cooling system costs

$3.50 to $7 return on every dollar for SiC over silicon

— Goldman Sachs, 2019
Accelerating EV adoption is driving $1.2 Trillion+ investment – the secret is out

GLOBAL OEMS AND CORPORATES HAVE MADE SIGNIFICANT COMMITMENTS TO EVS
EVs in Munich
Attractive markets with ample runway to support rapid growth

**SERVICEABLE MARKET OPPORTUNITY (M)**

### POWER DEVICES

- **Auto devices** account for 50% of the opportunity, with a 30% CAGR
- As device cost decreases, industrial markets expand, creating a $40B+ opportunity

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### MATERIALS

- Demand is expected to outstrip capacity
- Overall supply will continue to increase, but nominal impact on overall market share as 150mm to 200mm transition continues to reduce overall wafer cost

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Source: Yole & Company estimates
The car as the solution to the power grid?

Bidirectional EV chargers supply power from an EV car battery to the grid during peak hours.

The EV can charge during off-peak times.

Grid demand more consistent + lower charging costs.
SiC: A powerful sustainability story

GLOBAL OEMS AND CORPORATES HAVE MADE SIGNIFICANT COMMITMENTS TO EVS

Increasing bus voltage from 400V to 800V:

- Reduces total chip area (assumption is by 20%)
- Reduces marginal energy investment by ~1 gj
- Increases Energy Saved on Energy Invested (ESOI) by 85%

400V Si IGBT to 400V SiC MOSFET: 7:1
400V Si IGBT to 800V SiC MOSFET: 13:1
800V SiC MOSFET Taxi/Uber Scenario*: 24:1

*Taxi / Uber scenario increases lifetime miles from 200k to 500k. Image source: MotorBiscuit
Dramatic ESOI for SiC MOSFETs in PV Systems

ESOI FOR 50 kW PV SYSTEM WITH SiC STRING INVERTER

PHOENIX, AZ
77:1
+1,078 kWh/yr

ALBANY, NY
55:1
+738 kWh/yr

BEIJING
63:1
+862 kWh/yr

SHENZHEN
59:1
+797 kWh/yr
A new world of industrial applications
Creating the next generation of jobs

Wolfspeed is a proud member of Power America

Wolfspeed, A&T to establish joint R&D facility to further advance silicon carbide innovation

— North Carolina agricultural & technical state university
The pace of change: Fifth Avenue, New York City

EASTER 1900: FIND THE CAR

EASTER 1913: FIND THE HORSE AND CARRIAGE

Source: US National Archives & George Grantham Bain Collection
Thank you

QUESTIONS?
Thank you

QUESTIONS?