National Manufacturing Day
Innovating the Next Wave of Manufacturing
With Partners:

PowerAmerica

NC Sustainable Energy Association
The Research Triangle Cleantech Cluster (RTCC) is an initiative of business, government, and academic leaders focused on accelerating the growth of the Research Triangle Region’s cleantech economy.
RTCC Board of Directors
North Carolina Cleantech Corridor

- 3-year partnership

- $1.5m Project

- Focus Areas
  - Corridor Committee
  - Cleantech Accelerator
  - Ecosystem Expansion
National Manufacturing Day
Innovating the Next Wave of Manufacturing
Innovating the Next Wave of Manufacturing

Smithy McIntosh
Siemens

Dave Grider
CREE/Wolfspeed

Rob Creighton
Windlift
Innovating the Next Wave of Manufacturing

Smithy McIntosh
Siemens

SIEMENS
Ingenuity for life
Distribution Systems
business unit overview
Our organization
Overview
We will continue
to deploy our innovative technologies to meet America’s greatest challenges, particularly in the fields of:

**Strong U.S. commitment: 2002 to 2017**
Siemens invested more than $35 billion

- Adding more than 3,000 U.S. employees
- Operating 18 U.S. locations
- Investing more than $25 million annually in U.S. research and development

Map shows Siemens’ major U.S. employment hubs

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Trusted partner for multiple markets

**Utility**
- Investor Owned Utilities
- Municipalities
- Co-ops
- Independent Power Producers

**Industrial**
- Chemical
- Food and Beverage
- Automotive
- Oil and Gas

**Construction**
- Data Centers
- Residential
- Commercial
- Airports
- Campuses

**Distributed Energy Systems**

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Siemens operating companies’ business units as of November 2018

**Gas and Power (GP)**
- Power Generation Operations
- Power Generation
- Oil & Gas
- HV Transmission Products
- EPC Projects
- Service & Digital

**Smart Infrastructure (SI)**
- Regional Solutions & Services
- Digital Grid
- Distribution Systems
- Low Voltage Products
- Control Products
- Building Products

**Digital Industries (DI)**
- Factory Automation
- Motion Control
- Process Automation
- Software
- Customer Services
DS U.S. leadership
(Sales, Marketing, Engineering, Operations)

Brian Dula
Vice-President, Distribution Systems

Louise Price
Executive Assistant / IT Coordinator

Kim Blind
Director, Business Excellence

Terry Woodyard
Manager, Product Development and Engineering

Billy Gray
Senior Manager, PLM and Marketing

Brad Patterson
Senior Director, Business Development

Kevin Huffman
Manager, Offers Engineering

Jay Singh
Director, Projects

Jonathan Hill
Director, Orders Engineering

Arup Mazumdar
Senior Manager, Offers Engineering

Smithy McIntosh
Director, Operations

Terry Woodyard
Manager, Product Development and Engineering

Billy Gray
Senior Manager, PLM and Marketing

Brad Patterson
Senior Director, Business Development

Kevin Huffman
Manager, Offers Engineering

Jay Singh
Director, Projects

Jonathan Hill
Director, Orders Engineering

Arup Mazumdar
Senior Manager, Offers Engineering

Smithy McIntosh
Director, Operations

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Siemens is the only company that can offer the full energy value chain.
### Smart Infrastructure’s business units

<table>
<thead>
<tr>
<th>Low Voltage and Products</th>
<th>Distribution Systems Products</th>
<th>Distribution Systems Customer Services</th>
<th>Digital Grid</th>
<th>Control Products</th>
<th>Building Products</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Low-voltage switchgear, switchboards, motor control centers, and panelboards</strong></td>
<td><strong>Air- and gas-insulated medium-voltage switchgear</strong></td>
<td><strong>Power transformer services, monitoring, and diagnostics</strong></td>
<td><strong>Smart metering and communication</strong></td>
<td><strong>IEC switching and protecting devices</strong></td>
<td><strong>Building automation software</strong></td>
</tr>
<tr>
<td><strong>Busway</strong></td>
<td><strong>Low- and medium-voltage motor controllers</strong></td>
<td><strong>Power circuit breaker services</strong></td>
<td><strong>Grid protection, automation and power quality</strong></td>
<td><strong>Solid state starters</strong></td>
<td><strong>Unitary and room automation controls</strong></td>
</tr>
<tr>
<td><strong>Power monitoring</strong></td>
<td><strong>Distribution switches and reclosers</strong></td>
<td><strong>Low-voltage and medium-voltage replacement circuit breakers</strong></td>
<td><strong>Grid control and applications</strong></td>
<td><strong>Monitoring relays</strong></td>
<td><strong>Primary automation controls</strong></td>
</tr>
<tr>
<td><strong>Circuit breakers and switches</strong></td>
<td><strong>Medium-voltage outdoor vacuum circuit breakers</strong></td>
<td><strong>Low-voltage and medium-voltage switchgear</strong></td>
<td><strong>OT/IT integration and data analytics</strong></td>
<td><strong>NEMA switching and protecting devices</strong></td>
<td><strong>Lighting</strong></td>
</tr>
<tr>
<td><strong>Load centers</strong></td>
<td><strong>Mobile substations</strong></td>
<td><strong>High voltage systems and services</strong></td>
<td><strong>Grid consulting, planning and simulation</strong></td>
<td><strong>Commanding and signaling devices</strong></td>
<td><strong>Integration and system tools</strong></td>
</tr>
<tr>
<td><strong>Metering</strong></td>
<td><strong>Distribution transformers</strong></td>
<td><strong>After-market parts</strong></td>
<td><strong>Solutions for distribution automation, microgrids, integration of renewables</strong></td>
<td><strong>Circuit protection</strong></td>
<td><strong>Controllers and meters</strong></td>
</tr>
<tr>
<td><strong>Standby generators</strong></td>
<td><strong>Voltage regulators</strong></td>
<td><strong>Technical training.</strong></td>
<td><strong>Grid cyber security.</strong></td>
<td><strong>Industrial communications</strong></td>
<td><strong>Thermostats and sensors</strong></td>
</tr>
<tr>
<td><strong>Solar microinverters</strong></td>
<td><strong>Photovoltaic central inverters</strong></td>
<td><strong>Solar microinverters</strong></td>
<td><strong>Safety systems.</strong></td>
<td><strong>Pneumatics</strong></td>
<td><strong>Valves and actuators</strong></td>
</tr>
<tr>
<td><strong>E-vehicle charging stations.</strong></td>
<td><strong>E-mobility</strong></td>
<td><strong>Fluence.</strong></td>
<td><strong>Variable frequency drives</strong></td>
<td><strong>Variable frequency drives</strong></td>
<td><strong>Fire and life safety panels</strong></td>
</tr>
</tbody>
</table>

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Distribution Systems product portfolio

SDR recloser
Disconnect switches
Fusesaver™ circuit breaker
CMR

SDV7 outdoor vacuum circuit breakers (OVCB)
Fluence energy storage solutions
SIMOVAC™ medium-voltage motor controllers (MVC)

Air-insulated switchgear (AIS) GM38, GM-SG, GM-SG-AR
Gas-insulated switchgear (GIS)
Generator circuit breaker switchgear (GBS)
Fluence energy storage solutions
AIS, GM38, GM-SG, GM-SG-AR

GBS
SIEBREAK™ load-interrupter switchgear (LIS)

Photovoltaic central inverters

SIELink™

E-mobility

SDR
Disconnect switches
Fusesaver™ circuit breaker
CMR

SDV7 outdoor vacuum circuit breakers (OVCB)

Fluence energy storage solutions
SIMOVAC™ medium-voltage motor controllers (MVC)

Air-insulated switchgear (AIS) GM38, GM-SG, GM-SG-AR
Gas-insulated switchgear (GIS)
Generator circuit breaker switchgear (GBS)

Photovoltaic central inverters

SIEBREAK™ load-interrupter switchgear (LIS)
Distribution Systems products by market segment

**Utility**
- Switchgear
- Medium-voltage generator circuit breaker switchgear (MV GCB)
- Outdoor distribution circuit breakers
- Mobile substations
- Fusesaver™
- Reclosers
- Overhead switching products
- Voltage regulators
- Distribution transformers
- Fluence
- E-mobility
- Photovoltaic central inverters.

**Industrial**
- Switchgear
- SIEBREAK™ family
- 8DJH36
- Medium-voltage generator circuit breaker switchgear (MV GCB)
- tiastar™ LV MCC
- SIMOVAC™ family
- Outdoor distribution circuit breakers
- Distribution transformers.

**Construction**
- Switchgear
- SIEBREAK™ family
- 8DJH36
- tiastar™ LV MCC
- SIMOVAC™ family
- Distribution transformers
- E-mobility
- Photovoltaic central inverters.
Distribution Systems Wendell, NC location
Distribution Systems factory locations

**Heber Springs, AR**
- Overhead switching products

**Wendell, NC**
- Overhead switching products
- U.S. DS HQ
- MCC short-cycle line
- Application engineering
- Orders engineering
- Product development
- Product engineering
- Customer service
- Project management
- PLM and marketing
- CS Organization

**Berlin, Germany**
- Medium-voltage generator circuit breaker switchgear

**Querétaro, Mexico**
- Low-voltage motor control centers
- Medium-voltage motor controllers
- Medium-voltage air-insulated switchgear
- Generator circuit breaker switchgear
- Medium-voltage outdoor distribution circuit breakers

**Jackson, MS**
- Voltage regulators

**Frankfurt, Germany**
- Medium-voltage gas-insulated switchgear (GIS)

**Brisbane, Australia**
- Overhead switching products
Innovating the Next Wave of Manufacturing

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You may not see us, but we're everywhere. We're providing faster, smaller, lighter and more efficient Silicon Carbide and GaN on SiC semiconductor products.
Our Business

Wolfspeed

Products
Materials, Schottky Diodes, MOSFETs, Power Modules, MMICs, Bare Die, HEMTs

Applications
EVs, EV Charging Infrastructure, Solar, Energy Storage, Data Centers, Communications Infrastructure, Radar, Aerospace and Defense

LEDs

Products
LED Chips, XLamp LEDs, High Brightness LEDs, Integrated Lighting Solutions

Applications
High Power General Lighting, Specialty Lighting, Video Screens, Automotive

PATENTS
~3,700 Issued Patents

LOCATIONS
17 Global

INNOVATION
30+ Years of Technology Leadership

CAREERS
~5,300 Employees

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Track Record of Firsts

- **1987**: Cree Founded
- **1991**: Released world’s first commercial SiC wafers
- **1998**: Created industry’s first GaN HEMT on SiC, with record power density
- **1999**: Demonstrated industry’s first 4-inch SiC wafer
- **2000**: Demonstrated industry’s first GaN HEMT MMIC grown on semi-insulating SiC substrate
- **2002**: Released our first 600V commercial SiC JBS Schottky diode

- **2006**: Released industry’s first 1200V SiC MOSFET
- **2007**: Commercial release of 100mm, zero-micropipe SiC substrates
- **2008**: Announced sample release of 90W GaN HEMT
- **2009**: Demonstrated record-efficiency GaN HEMT Doherty amplifier with digital pre-distortion
- **2010**: Developed high-quality 150mm SiC substrates
  - Released industry’s first 1700V SiC Schottky diode
  - Released industry’s first 1200V SiC half-bridge module
  - Released new-generation 50V GaN HEMT technology
- **2011**: Released industry’s first SiC MOSFET
  - Introduced our first 1200V SiC half-bridge module
- **2012**: Created industry’s first 1200V SiC 25mΩ MOSFET
- **2014**: Demonstrated industry’s first 1700V SiC half-bridge module
  - Became Department of Defense Trusted GaN Foundry
  - Released 100mm, zero-micropipe SiC substrates
  - Acquired APEI
- **2015**: Exceeded 2 trillion field hours power
  - Introduced industry’s first 900V SiC MOSFET
  - Introduced the industry’s first 1000V SiC MOSFET
- **2016**: Demonstrated 200mm SiC wafer
  - Acquired Infineon’s RF Power business
  - Introduced a SiC 900V, 10mΩ MOSFET for EV drive trains, enabling reduction of EV drive train inverter losses by 78%
- **2017**: Introduced SiC 1200V, 75mΩ MOSFET with industry’s lowest figure of merit

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The Cree | Wolfspeed Difference: Vertical Integration

Because we innovate at every stage, we’re able to do things other companies can’t:

• Working closely with customers to enable new products with increasing adoption of silicon carbide

• Utilize rapid learning cycles to create devices and drive significant improvements in quality and manufacturing

• Quality end-to-end manufacturing
Powering the Future with Wolfspeed

<table>
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<tr>
<th>Why Silicon Carbide?</th>
<th>Why Wolfspeed Silicon Carbide?</th>
</tr>
</thead>
</table>
| • Moving from Silicon to Silicon Carbide offers:  
  • Higher efficiency  
  • Faster switching  
  • Improved thermal performance  
  • Higher reliability  
  • Lower system costs  
  • Any power design from 600V and up has the potential to benefit from switching to silicon carbide | • Wolfspeed is Investing for the Future  
  #1 Market share in silicon carbide, up to a 30 fold increase in capacity by 2022  
  • Wolfspeed Invented the silicon carbide MOSFET  
  Wolfspeed has 6+ trillion field hours of silicon carbide power  
  • 6+ Years of MOSFET, 17+ Years of Diode Production  
  Thousands of customers with millions of MOSFETs and diodes in use  
  • AEC-Q101 Qualified Factories  
  Products qualified to HV-H3TRB standards |
Investing $1Billion+ Over 6 Years to Expand Silicon Carbide Capacity

**WILL YIELD:**

30x
at least 30x increase in silicon carbide wafer fabrication

30x
increase in silicon carbide and GaN materials production

**WILL LEVERAGE:**

New
480,000 SQ FT
facility

200 mm
equipment

**WILL DELIVER:**

State-of-the-art automotive-qualified production facility

Lower cost of silicon carbide for customers
Investment Supports Silicon Carbide Materials Growth and Wafer Fabrication

Construct the world’s largest, automotive-qualified, highly automated silicon carbide 200mm capable wafer fab in Marcy, NY

Expand materials capability with mega factory expansion in Durham, NC with room for more future expansion in second facility
The automotive industry is investing $350B into the EV market. Are you ready?

Wolfspeed has already invested its silicon carbide technology into the EV market, enabling a power density 50% greater than silicon. Silicon carbide systems can increase range, decrease system size, and reduce cooling requirements.

Are you ready for this investment? We are.
We make renewable energy more renewable.

With more than 30 years of technology leadership, our silicon carbide saves 10 megawatts for each gigawatt installed per year compared to silicon.

It also saves 500 watts for every second in operation, which enables lighter, smaller, quieter and more efficient solar inverters.
High efficiency power.

Silicon carbide will contribute up to 620 billion kWh in energy savings from 2010 to 2020.

Maximize computing capability and efficiency while reducing footprint, electricity consumption, component count, and cost with Wolfspeed’s silicon carbide MOSFETs and Diodes.
Fifteen million devices in the field.

By optimizing efficiency and power amplifications in base stations, our 15 million GaN HEMT devices allow for increased capacity and coverage with:

- **2x** the amount of users per tower
- **10x** the amount of data per user

The gains will only increase with our mMIMO solution for 5G.
Your trusted resource.

Our unmatched reliability has given us the opportunity to be chosen for applications like radar in commercial jets and Lockheed Martin’s Space Fence. The long-term reliability of our GaN HPA technology was recently confirmed at 99% confidence after more than 5,000 hours of stress testing.
Innovating the Next Wave of Manufacturing

Rob Creighton
Windlift
Innovating the Next Wave of Manufacturing

Smithy McIntosh
Siemens

Dave Grider
CREE/Wolfspeed

Rob Creighton
Windlift
THANK YOU
Upcoming Events

Oct. 8-10    NC Delegation to Smart Cities Connect
Oct. 10      NCSEA Gala: Powering Our Future *(see Matt Abele)*
Oct. 16      Triangle Smart Cities Summit
Oct. 30      Cleantech Connect Career Fair
Dec. 3       RTCC Annual Meeting: 2019 Cleantech Innovation Awards
Jan. 28-30   NC Delegation to DistribuTECH
Cleantech Innovation Awards: December 3, 2019

CLEANTECH CHAMPION OF THE YEAR
CLEANTECH COMMUNITY AWARD
TRANSPORTATION INNOVATION AWARD
WATER INNOVATION AWARD
GRID INNOVATION AWARD
CLEANTECH TALENT INITIATIVE AWARD
DIVERSITY IN CLEANTECH AWARD
CLEANTECH IMPACT AWARD

Event sponsorships and individual registration now available