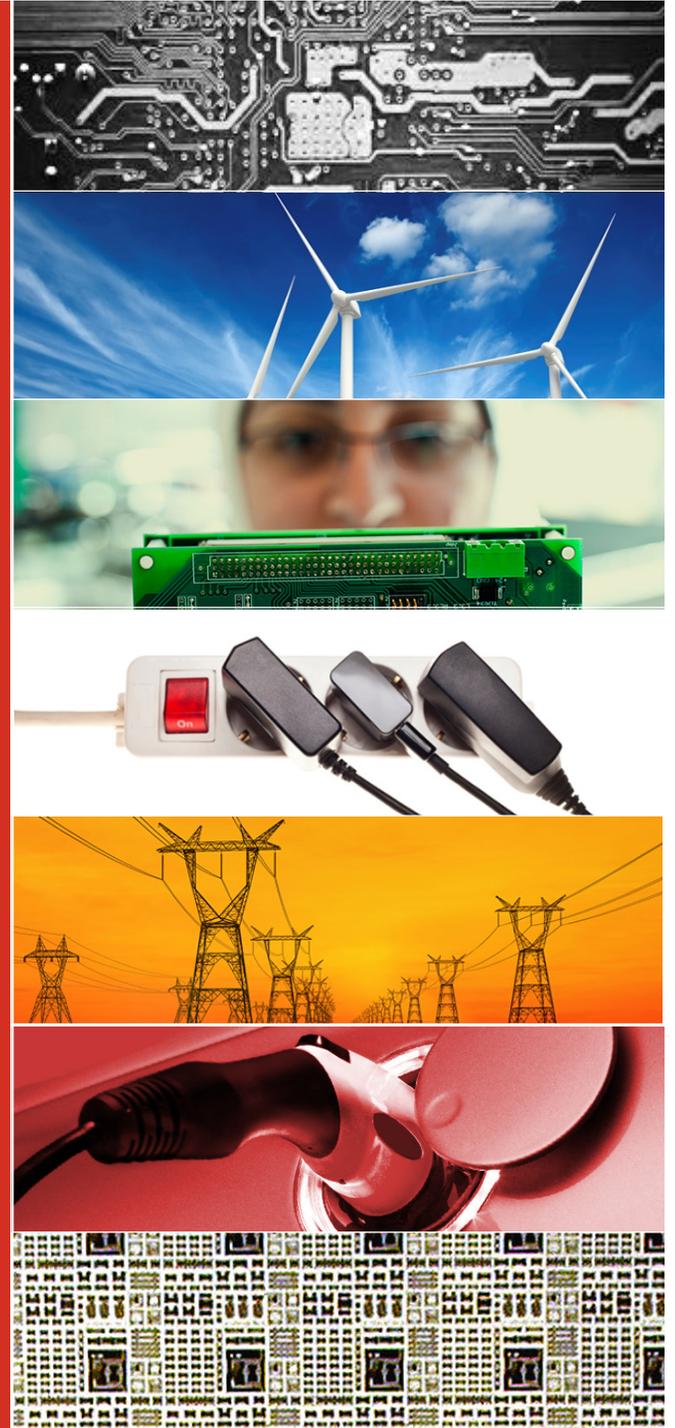


# POWERAMERICA

Next Generation Power Electronics  
Manufacturing Innovation Institute

**NC STATE UNIVERSITY**

North Carolina State University © 2014





POWERAMERICA

President Obama  
announces new  
manufacturing  
institute at NC State

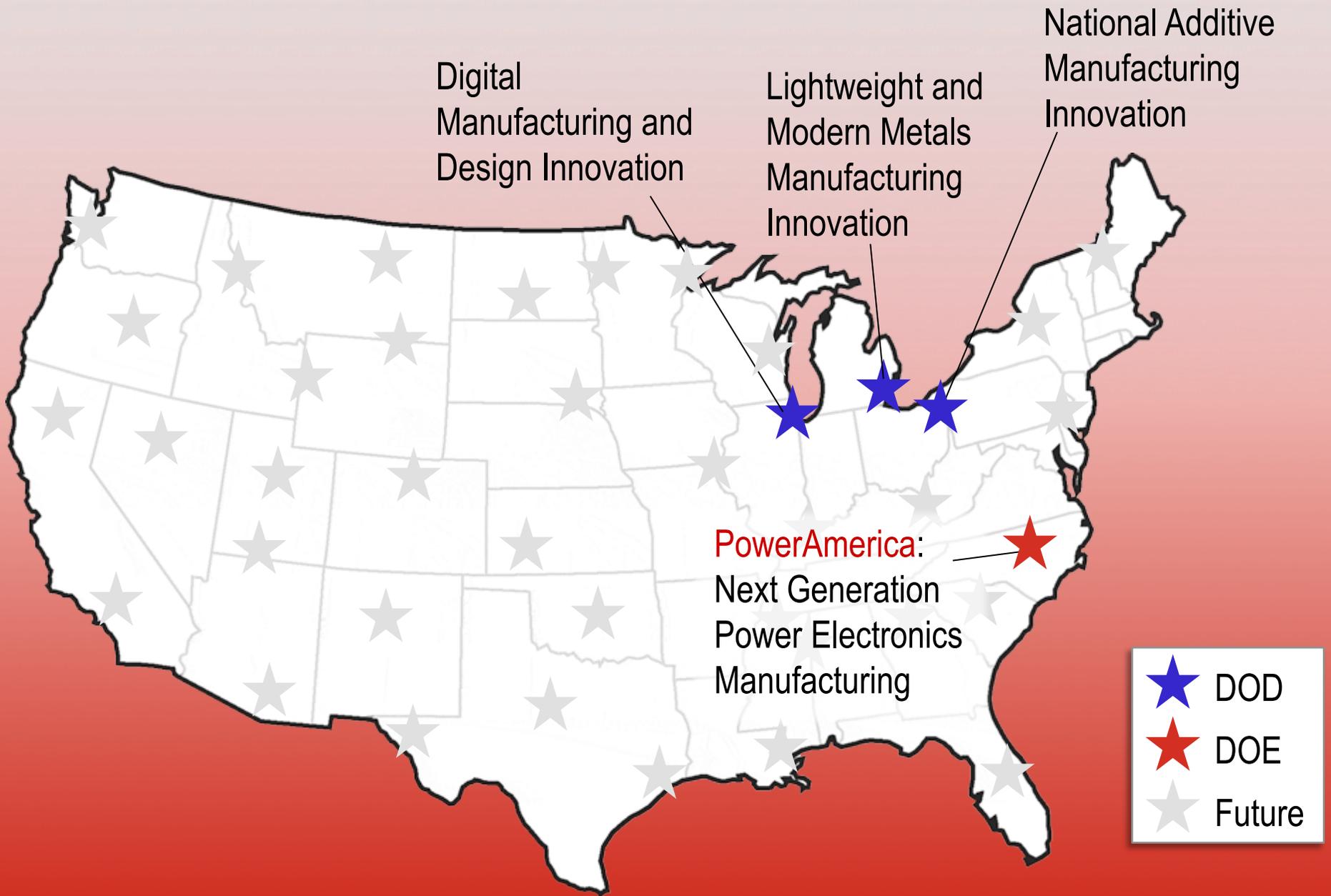


# POWERAMERICA

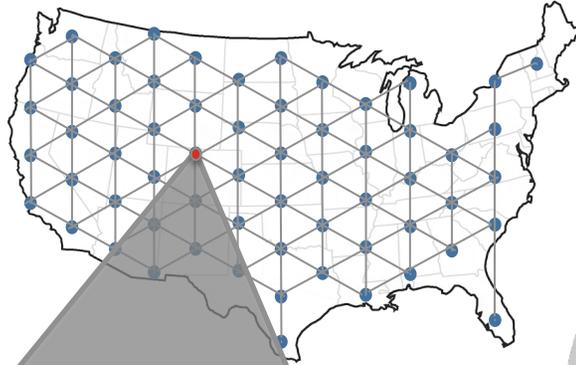
Next Generation Power  
Electronics Manufacturing  
Innovation Institute

Developing advanced manufacturing processes to enable cost-competitive, large-scale production of **wide bandgap** semiconductor-based power electronics, which allow electronic systems to be **smaller, faster** and more **efficient** than power electronics made from silicon.

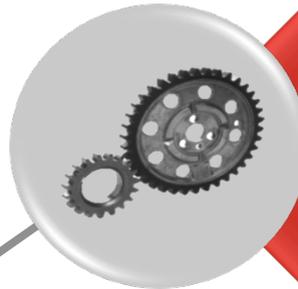
# National Network for Manufacturing Innovation



# National Network for Manufacturing Innovation



Each institute has unique  
Technology Focus



- Small & Medium Enterprises
- Startups
- Large Corporations



- Research Universities
- Regional Colleges
- Community Colleges
- High Schools



- Federal Government
- State & Local Government
- Economic Developers

# Technology Readiness Levels and Manufacturing Readiness Levels

	TRL 1: Basic principles observed and reported	MRL 1: Manufacturing feasibility assessed
	TRL 2: Technology concept and/or application formulated	MRL 2: Manufacturing concepts defined
	TRL 3: Analytical and experimental critical function and/or characteristic proof of concept	MRL 3: Manufacturing concepts developed
NNMI Target	TRL 4: Component and/or breadboard validation in a laboratory environment	MRL 4: Capability to produce the technology in a laboratory environment
	TRL 5: Component or breadboard validation in a relevant environment	MRL 5: Capability to produce prototype components in a production relevant environment
	TRL 6: System/subsystem model or prototype demonstration in a relevant environment	MRL 6: Capability to produce prototype system or subsystem in a production relevant environment
	TRL 7: System prototype demonstration in an operational environment	MRL 7: Capability to produce systems, subsystems or components in a production relevant environment
	TRL 8: Actual system completed and qualified through test and demonstrated	MRL 8: Pilot line capability demonstrated; Ready to begin Low Rate Initial Production
	TRL 9: Actual system proven through successful mission operations	MRL 9: Low rate production demonstrated; Capability in place to begin Full Rate Production

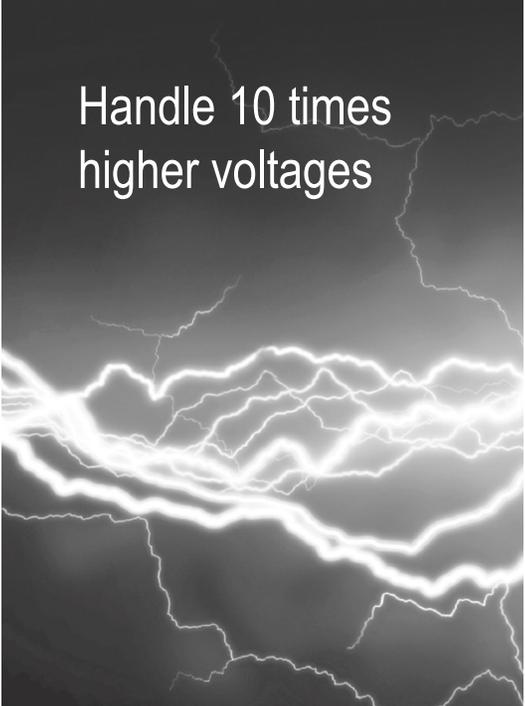
Source: NNMI prelim design report.

Operate above 300 °C compared to 150 °C for Silicon-based devices



# Wide Bandgap Materials

Handle 10 times higher voltages

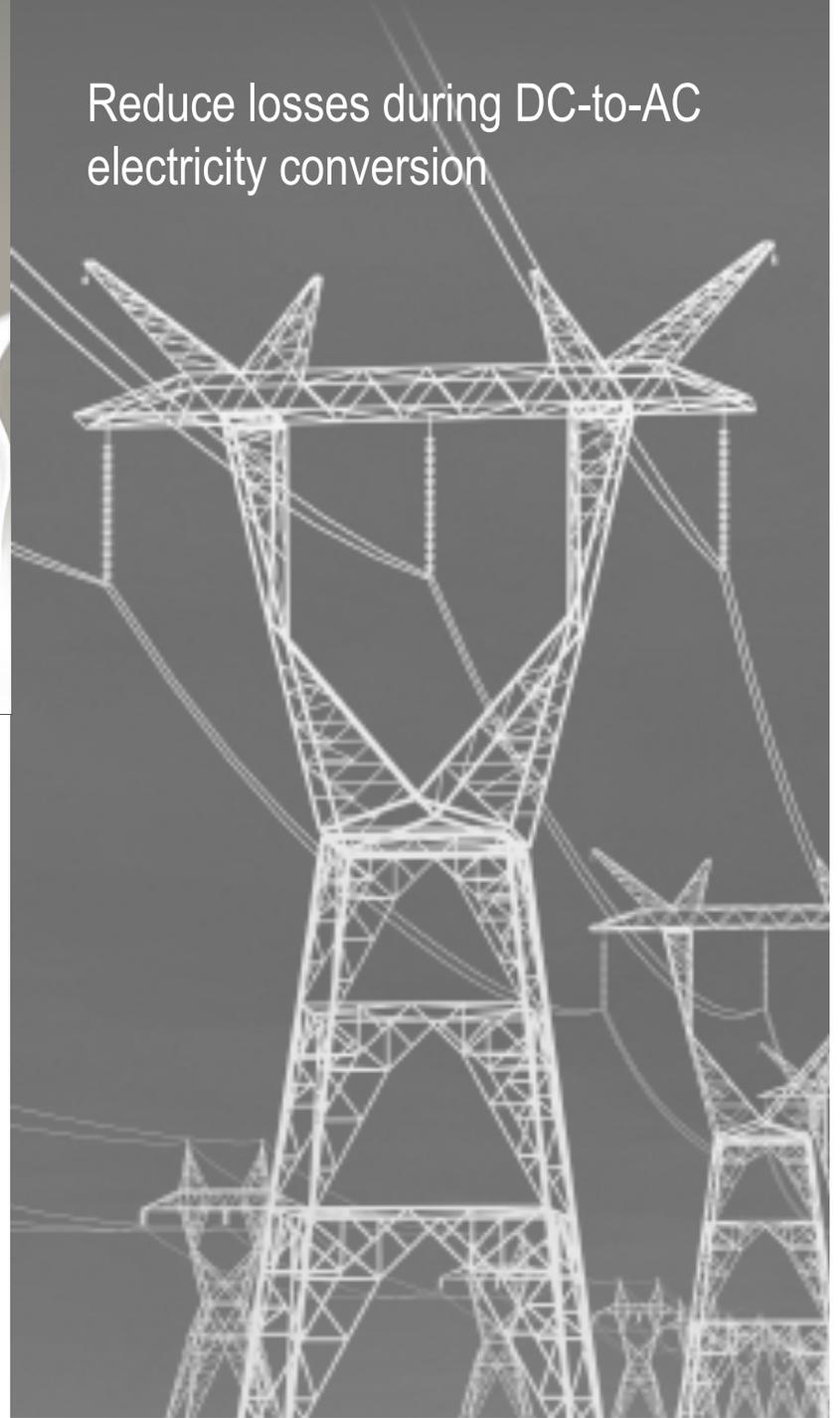


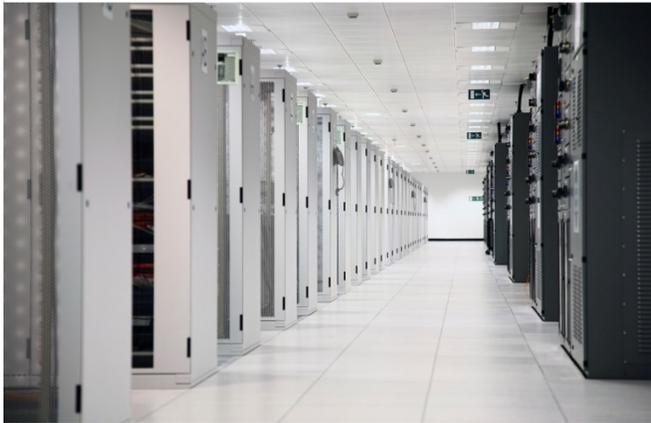
Produce bulbs with 10 times more light that last 30 times longer ...



saving \$250B by 2030

Reduce losses during DC-to-AC electricity conversion





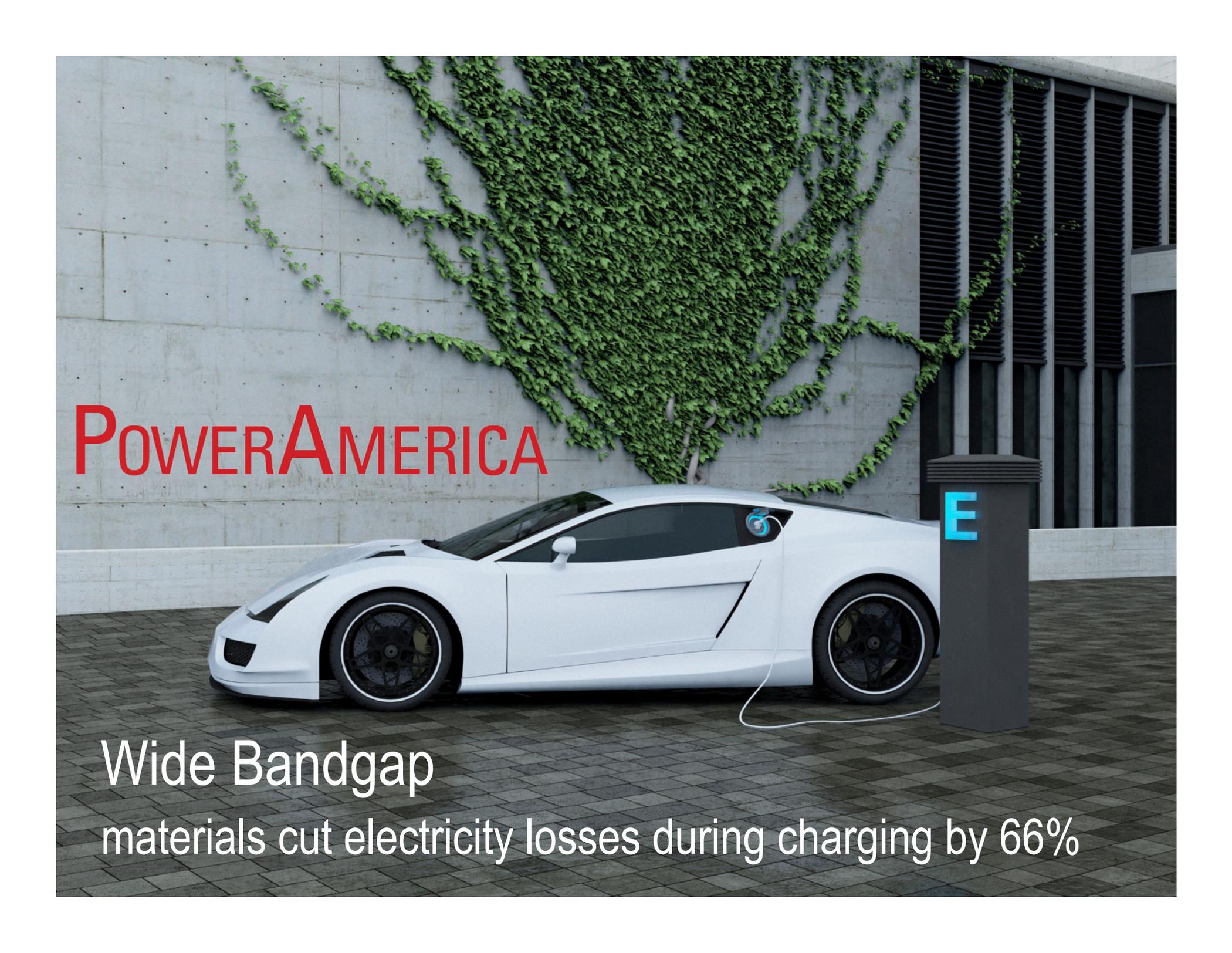
# Applications



The background of the slide is a photograph of three white wind turbines. The turbines are positioned in a row, with the middle one being the most prominent. The sky is a vibrant blue with scattered white clouds. The overall scene is bright and clear, suggesting a sunny day.

# POWERAMERICA

Wide Bandgap  
inverters  
convert  
DC to AC  
electricity while  
reducing losses  
by 50%

A white sports car is shown from a side profile, parked on a paved surface. It is connected to a charging station by a white cable. The charging station is a dark grey pillar with a glowing blue 'E' on it. In the background, there is a concrete wall with a large, stylized green leaf pattern made of ivy. To the right, there are vertical slats of a building facade.

POWER AMERICA

Wide Bandgap  
materials cut electricity losses during charging by 66%

# Wide Bandgap Materials

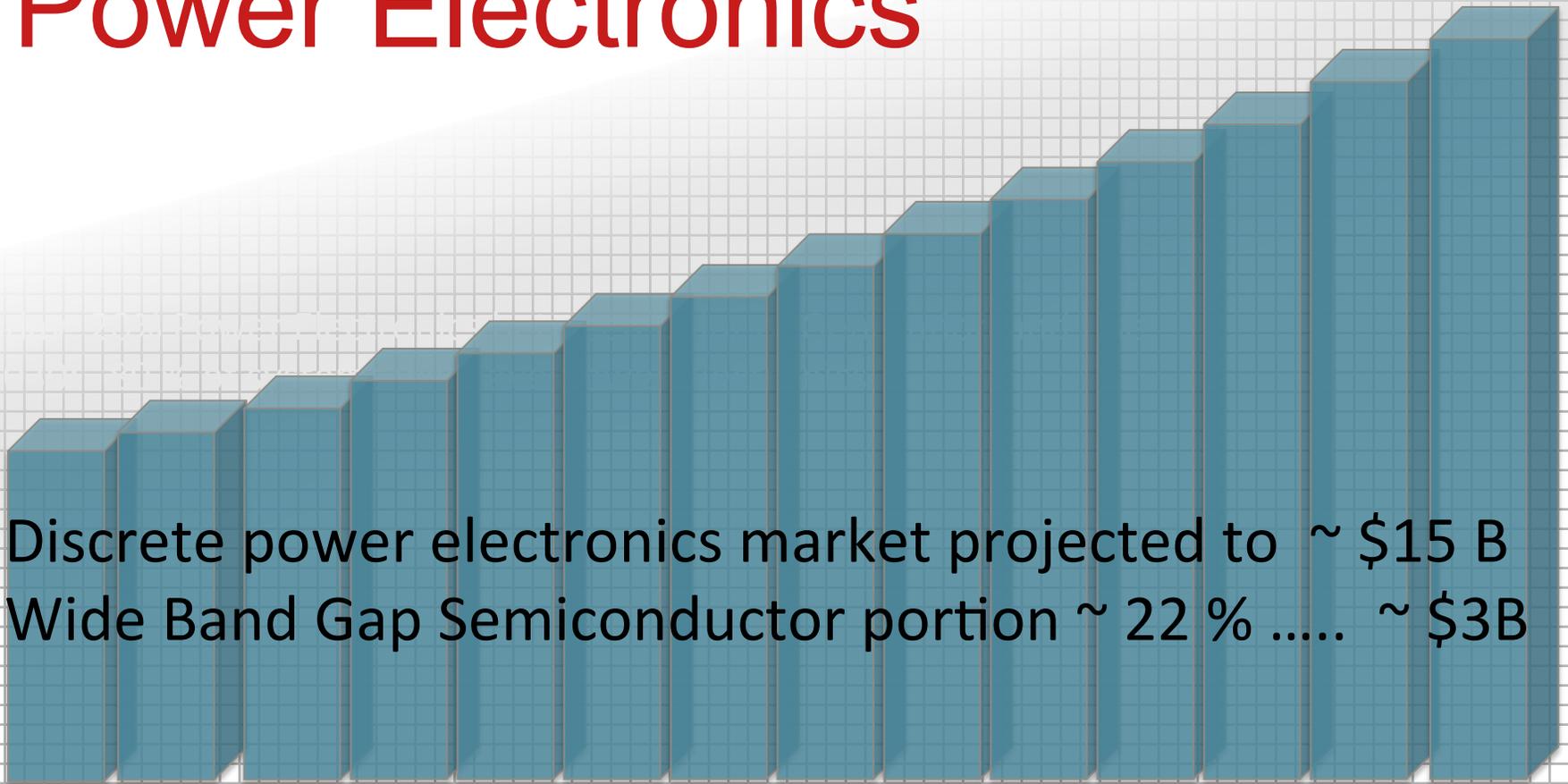
enable higher-efficiency,  
variable-speed drives.

Motor systems use 69%  
of electricity consumed  
in U.S. manufacturing.

# POWERAMERICA



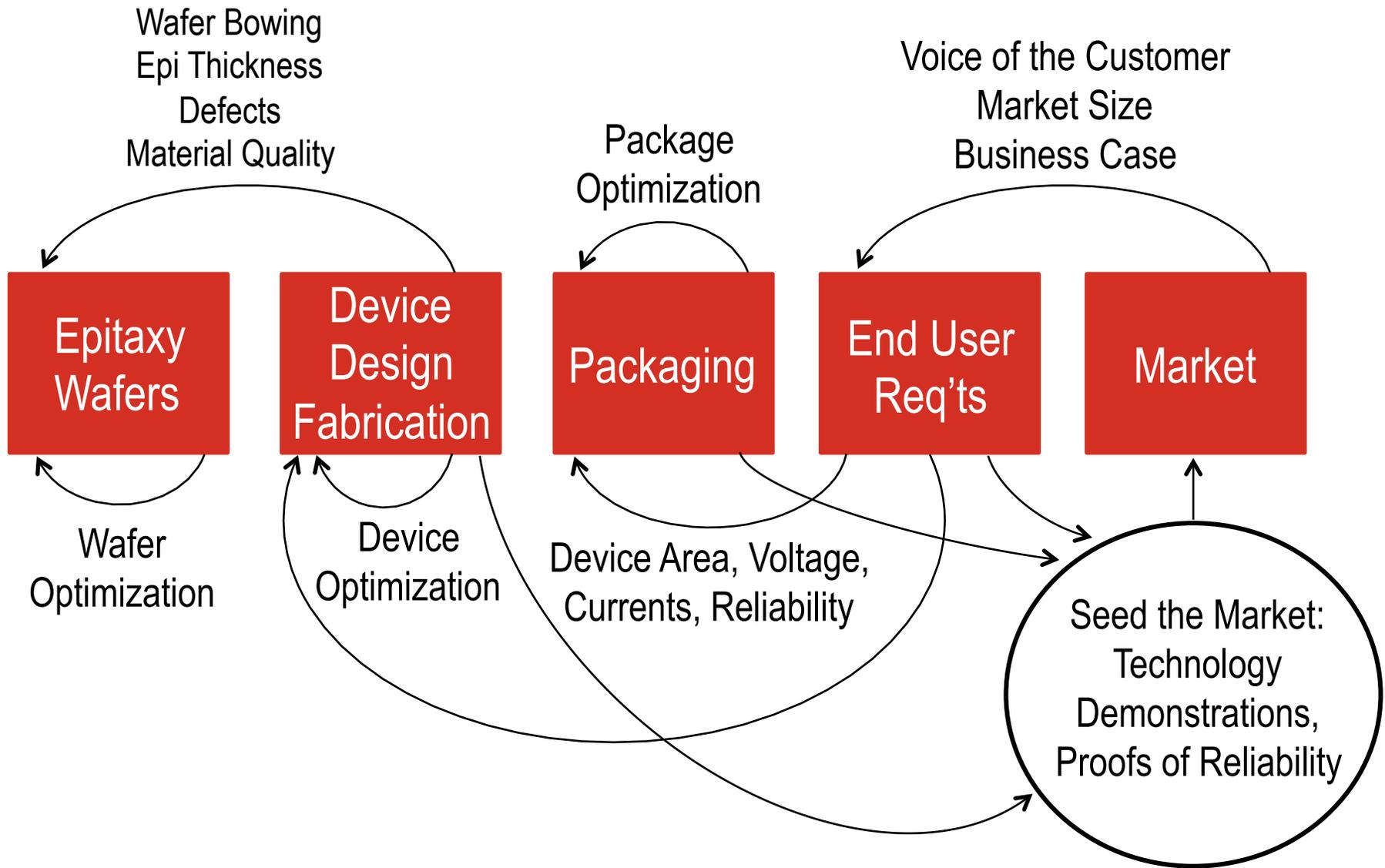
# WBG Market – Power Electronics



Discrete power electronics market projected to ~ \$15 B  
Wide Band Gap Semiconductor portion ~ 22 % ..... ~ \$3B

**Today: 20% Power Electronics between point of Generation and Use**  
**2030: 80 % of systems will have power electronics**





Research,  
Development &  
Demonstration

PRODUCTS

Comprehensive  
Education and  
Workforce  
Development  
Program

TALENT

**POWERAMERICA**

Thriving Power  
Electronics Industry  
Ecosystem

Commercial  
Product  
Acceleration

MARKET DEMAND

Production  
& Packaging  
Foundries

MANUFACTURING PROCESS

**Currently 10X \$**

Low Voltage  
Devices  
(600V to 1700V)

**Currently 10X \$**

Medium Voltage  
Devices  
(3300V to 6500V)

3 years

5 years

**Limited Supply**

High Voltage Devices  
(> 10kV)

10 years

Achieve last 50%  
cost reduction via  
Power Electronics  
Innovation

**POWERAMERICA**

**TARGET:**

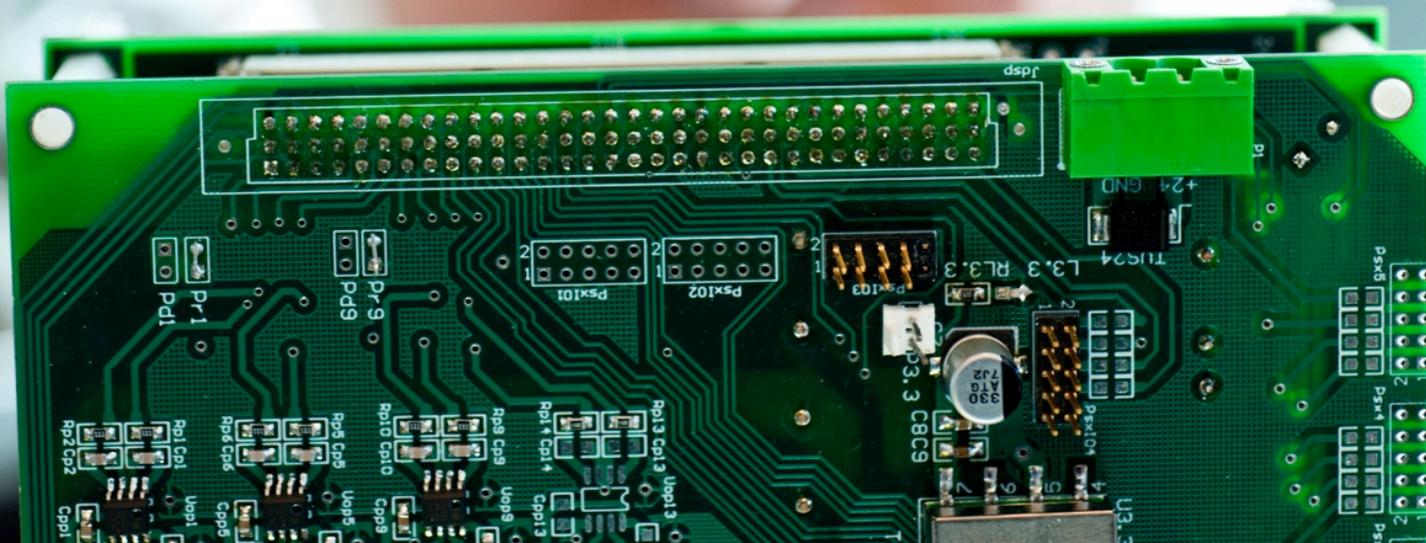
**WBG Costs**

**Reach Parity with Silicon**



# POWERAMERICA

Developing  
Talented  
Workforce



**EEDM**  
ems Center

le Electric Energy  
ement Systems Center

Partner Un  
o Speed  
nergy  
ly Vi

SITY

Help solve our  
energy challenges.



**NC STATE  
UNIVERSITY**

**POWERAMERICA**  
Next Generation Power Electronics  
Manufacturing Innovation Institute

Develop systems that are ...

**SMALLER  
FASTER  
MORE EFFICIENT  
LESS EXPENSIVE**

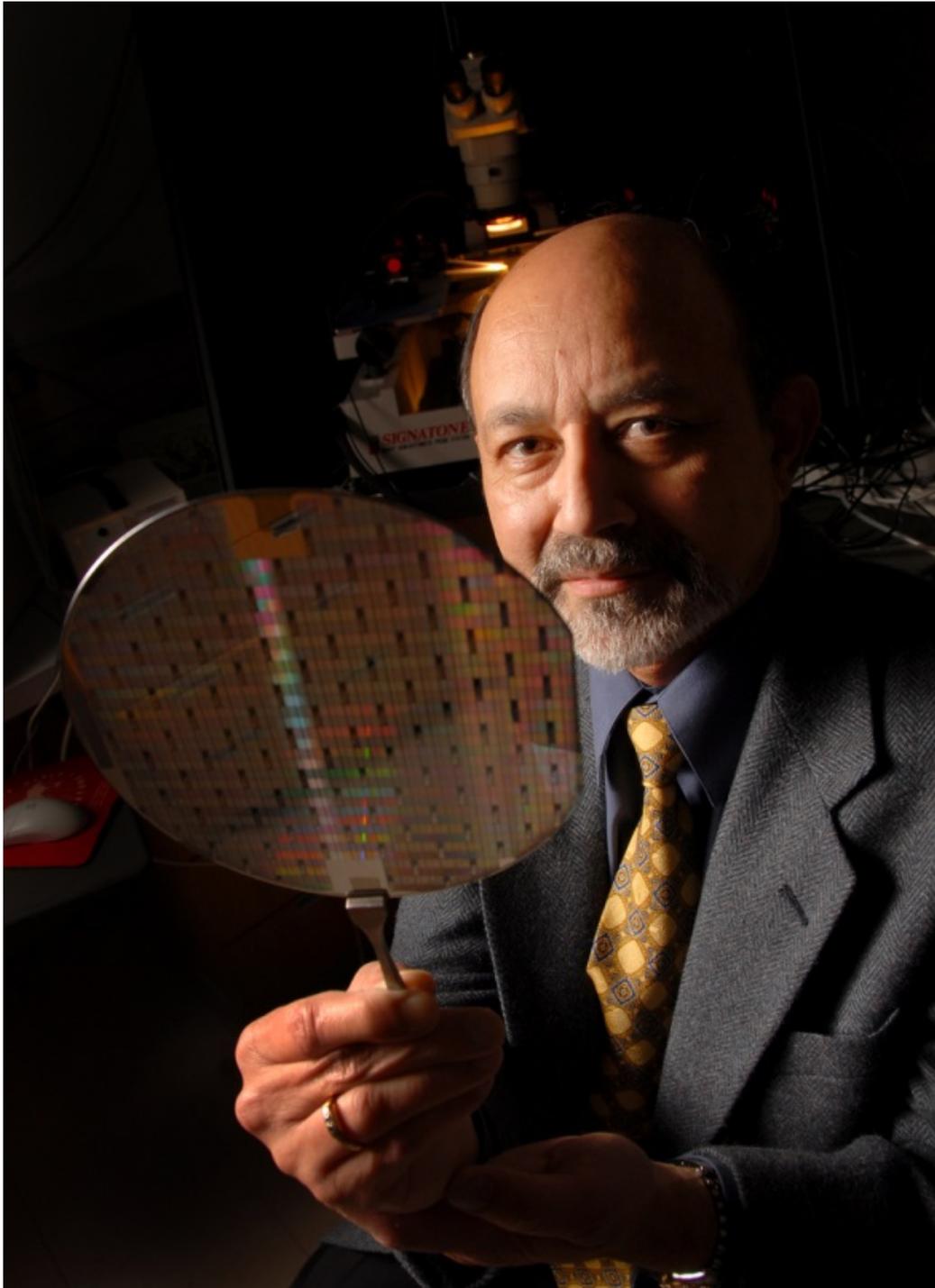


Dr. Peter Caspary



**Charles**  
Charles Wiley  
Assistant Professor  
Engineering Center Fair





## PowerAmerica Expertise



# NC State Specializes in Building Industry Partnerships

NC STATE UNIVERSITY

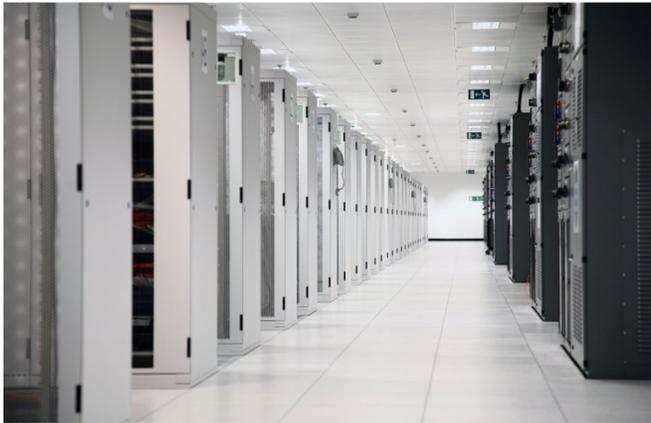


Centers & Institutes draw about 180 partners, including some of the top names in industry.



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# Questions ?

