

Power Electronics and Energy Activities in ECE



**Florida Power Electronics Research Center
Department of Electrical and Computer Engineering**

September 13, 2005



Unconventional Energy Sources - Power Electronics

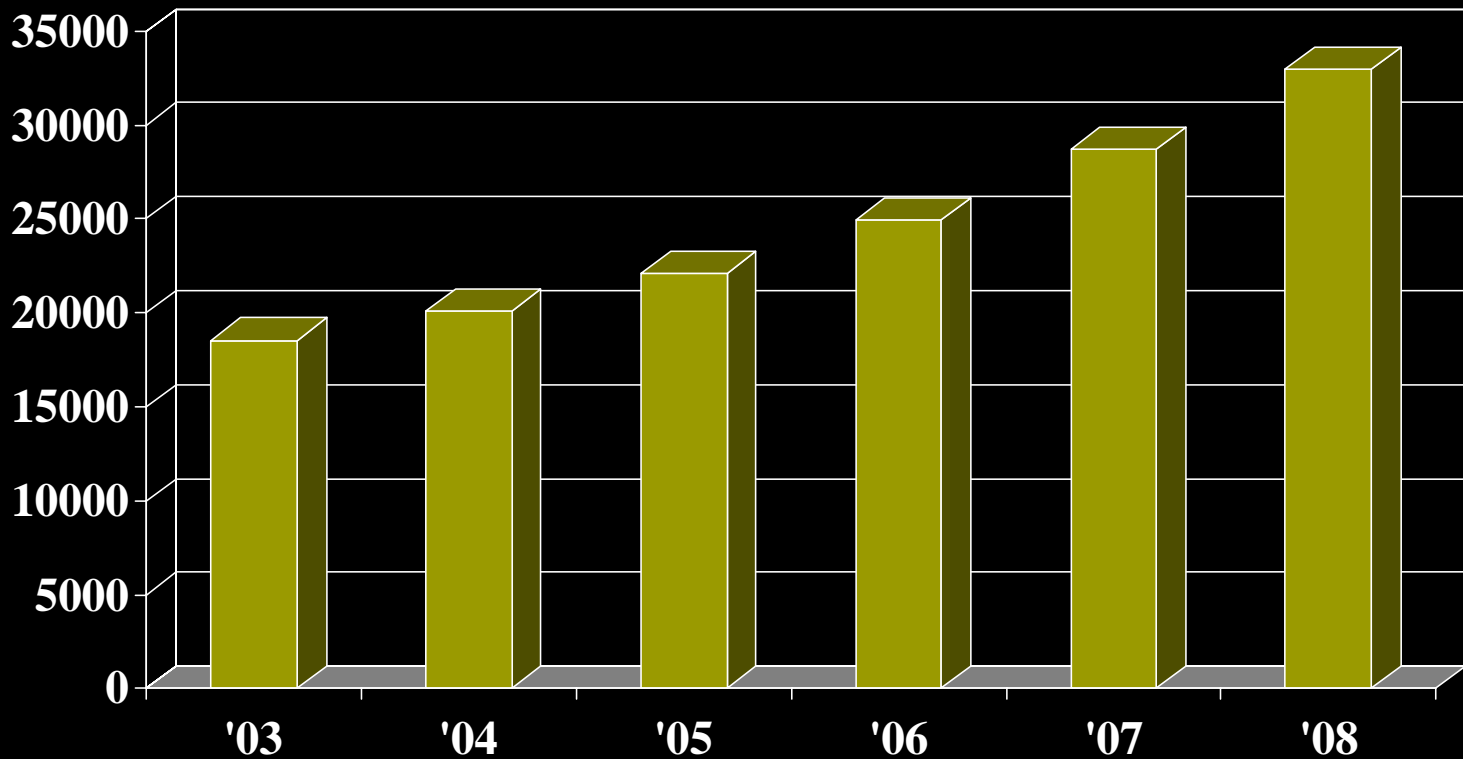
Power electronics is a key enabling technology

- Wind turbines
- Photovoltaics
- Microturbines
- Fuel cells

- Dc-ac Inverters
- Dc-dc converters
- Variable frequency converters
- Variable speed motor drives
- Monitoring and control



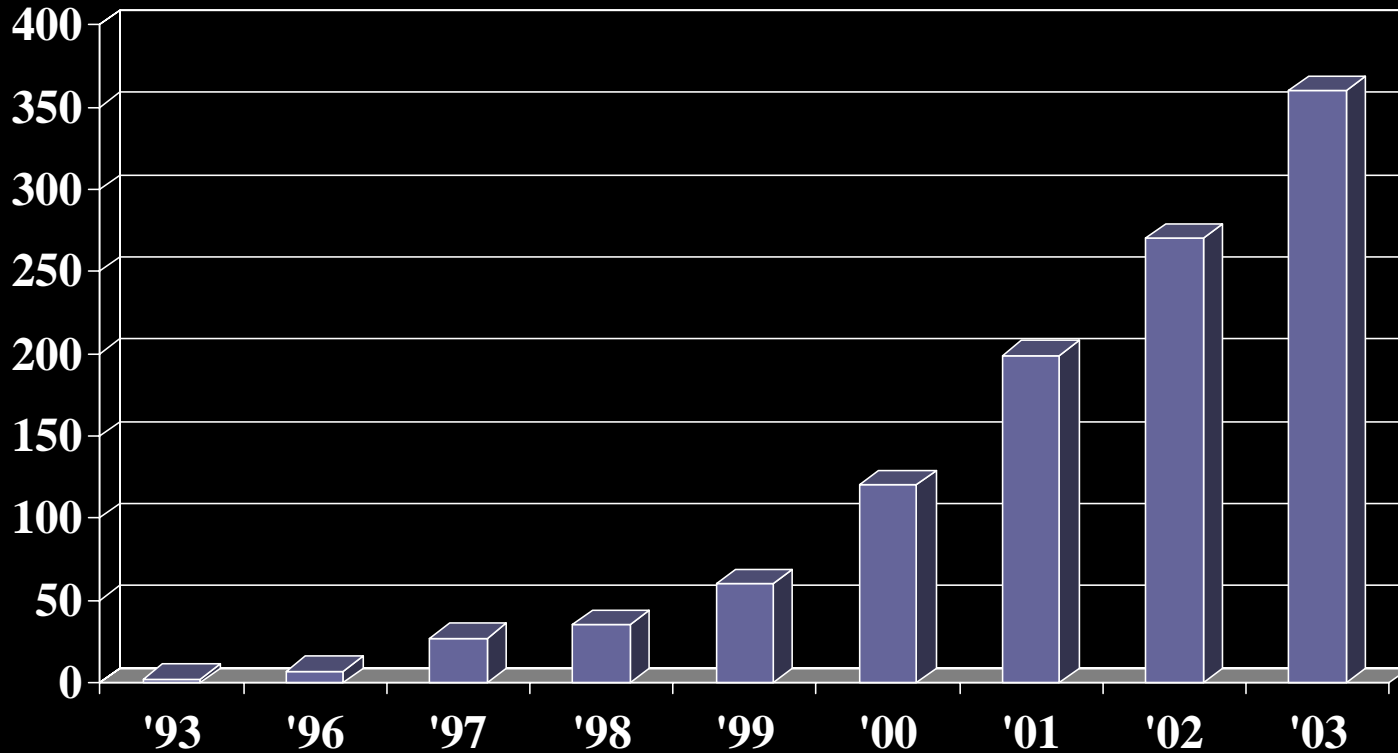
Power Electronics in Renewable Energy



Worldwide sales in MVA



Inverter Market Outlook



Cumulative installed capacity in MW



Florida Power Electronic Center

- The center was established in 1998 at UCF to carry on research and development activities in various areas of power electronics.
- The center is focused on development of high frequency power electronic systems to improve power density, efficiency and performance.
- The center currently has 3 faculty members, 4 affiliate faculty members, and 17 staff members and graduate research assistants.



Florida Power Electronic Center



Director: Dr. Issa Batarseh
Associate Director: Dr. John Shen

Solar-Based Inverter

DC/DC Converter

Power Systems and
Controls

Power Devices





Related Research

- **Power System Control and Stability**
 - Contingency and stability analysis of large-scale power systems
 - Advanced and locally implemented controls for enhancing stability and performance of power systems
 - Innovative design of power generators for harvesting renewable energy.

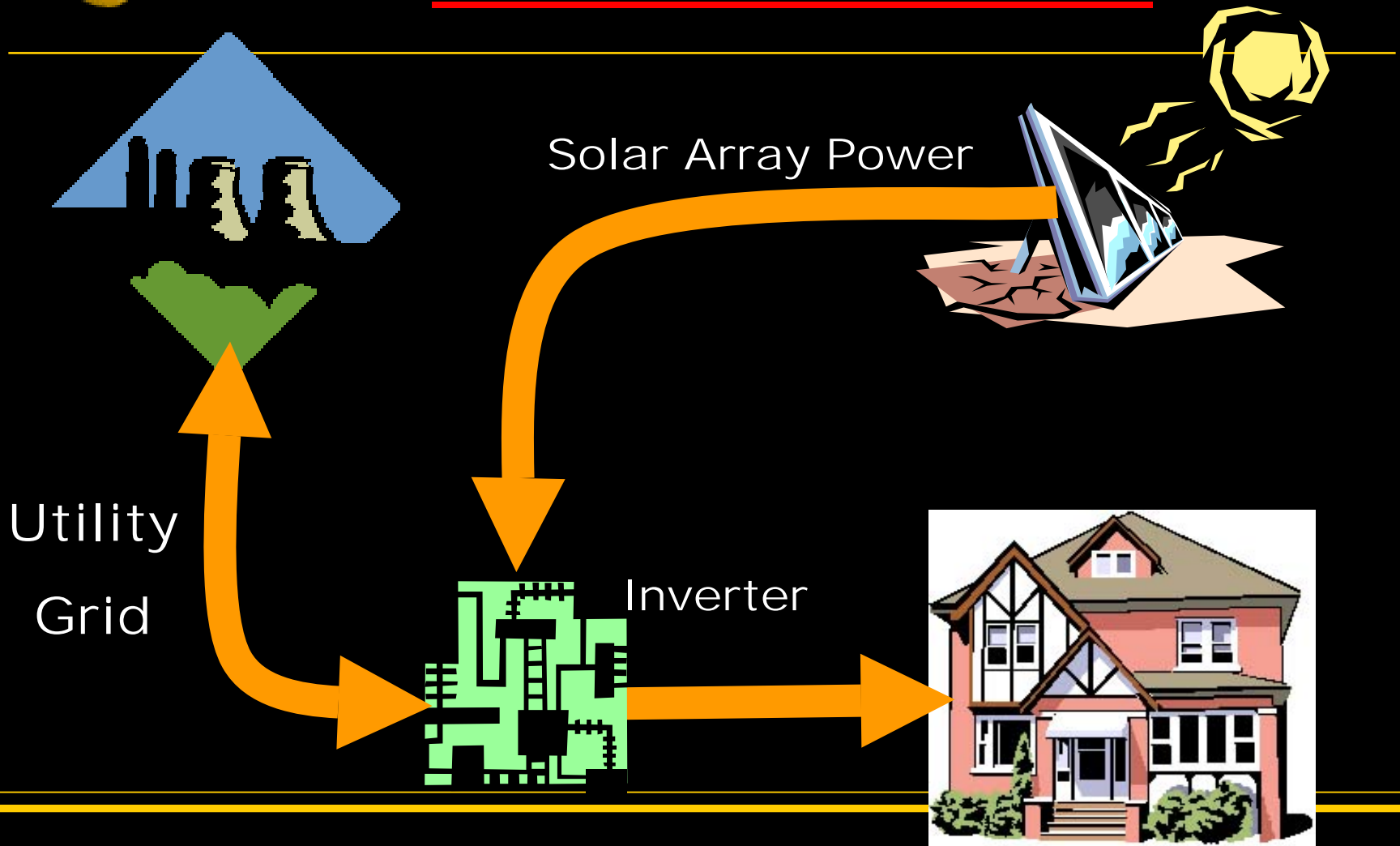
- **Power Electronics**
 - Power Distributed Systems
 - Maximum Power Tracking from PV Systems
 - Grid-tie Inverter Design
 - Development of high frequency dc-dc and ac-dc converters for telecommunication applications

- **Power Devices**
 - Super-junction power semiconductor devices
 - Phase-change cooling of high power modules

- **Partnership for Innovation in Renewable Energy Systems (NSF Pending)**



Renewable Energy Research: Grid-Interactive Inverters





Grid-Interactive Inverters





Grid-Interactive Inverters

- **Use of Maximum Power Tracking Technology**
 - Maximize power budget
 - Provide superior system stability
 - Prevent shading related problems
- **Modularity**
 - Easy Expansion to meet any power requirement
 - Distribution of system resources to avoid central failures



Grid-Interactive Inverters

- **Complete digital control and protection**
 - Rapid and Affordable Development
 - Increase Reliability
 - Increase Warranty: Industry looking forward to 10-20 years warranty in contrast to the current 5 year (or less) standard warranty



Grid-Interactive Inverters

- **Best Design at International Future Energy Challenge, Golden Colorado**
 - International Competition (Australia, Brazil, Germany, Korea, and USA)
 - Sponsored by DOE and IEEE Power Electronics Society



Teaching Initiatives

■ Renewable Energy Systems (RES) Degree Programs

This cross disciplinary curriculum aims at producing renewable energy professionals, with the knowledge and skills to develop, promote and implement renewable energy technologies, and improve the efficiency of existing energy systems.



Teaching Initiatives

Renewable Energy Engineering Curriculum

<i>Key Topics</i>	<i>Department</i>
Photovoltaic Systems Design	Electrical, Mechanical, Civil
Fuel Cell Systems Design	Electrical, Environmental, Chemistry
Power Electronics & Devices for Distributed Generation	Electrical Engineering
Energy System Management and Auditing	Industrial, Electrical
Survey of Renewable Energy Technologies	All
Zero Net Energy Buildings	Mechanical, Civil, Environmental
Renewable Energy Transportation Systems	Mechanical, Civil, Electrical



From Research to Application

- Use Engineering buildings as solar power test Bed on Campus
 - UCF Home grown Inverter testing
 - Partial or Complete Load Demand, using UCF inverters
- Concept could be applied to other buildings on Campus
- UCF Students and Employees awareness program