



## Center for Advanced Power Engineering Research

**CAPER** is a membership-driven consortium among several universities and numerous industry partners created to develop and demonstrate a comprehensive and integrated methodology for grid modernization. With an aging infrastructure, rising demands for cleaner electricity and extreme weather conditions, the nation's utilities are working to meet these operational challenges while maintaining a resilient and reliable grid. As a collaborative effort, **CAPER** will develop, research, and demonstrate advanced technologies to meet the operational and expansion needs under uncertainties and an increased penetration of distributed renewable generation.

**Mission Statement:** To advance, develop, and promote research related to reliable and efficient management of the power grid, including modeling and analysis techniques for generation, transmission, and distribution planning and operation with and without presence of renewable energy resources.

**Vision:** To provide a cooperative industry-university forum to tackle the challenges faced by the power industry in the United States.

### Academics

**CAPER** enables education and experimental learning opportunities, such as undergraduate and graduate research, student exchange, workshops, summer courses, and tutorials.

Participating universities will add various courses to their curricula that will focus on grid resiliency, grid disaster recovery, system protection, as well as control and forecasting of an increasing penetration of distributed renewable resources.

Among the collaborating universities, **CAPER** aspires to have 60 to 100 graduate students annually who will be able to complete their studies across the different facilities in the consortium depending on their interests and skill sets. This strategy is to ensure that the Southeast universities provide maximum value to the energy industry without wasteful replication at individual sites.

**CAPER** offers a platform where universities and industry can work together to conduct research to solve challenges facing the electric energy industry. Industry participants include utilities located in the Southeast region and any private/public entity that works within the industry, such as equipment manufacturers, engineering service companies, laboratories, and consultancies.

### Industry Members

- Duke Energy
- Siemens
- Savannah River National Laboratories

### Collaborating Universities


- Clemson University
- NC State University
- UNC Charlotte

**CAPER** operates under the overall guidance of an Industry Advisory Board (IAB), made up of industry participants. The Board is responsible for research project prioritization, budget, and adherence to schedule. Each member university has a Site Director and several Principal Investigators. The Lead University appoints the Center Director, both of which serve a term of five years.

### Southeast Region as an Energy Hub

The Southeast region of the United States is the fastest growing energy consuming region in the US. With several of the nation's largest utilities headquartered here and major global suppliers and manufacturers situated throughout the region, reliable and economical energy and a technically qualified workforce are necessary requirements to sustain this growth. With an evolving grid that will be subjected to more intermittency, operators must be prepared to deal with these challenges and increase situational awareness to maintain high levels of reliability.





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## Research Themes

**Power Delivery Infrastructure and Systems** – This focus of research deals with the impacts that an increasing penetration of distributed generation resources and a desired resiliency to extreme weather events have on the power delivery system.

**Power Utilization and Energy Efficiency** - Smart distribution systems and energy analytics will be researched to meet increasing customer demands and expectations of energy utilization.

**Power Generation, Storage and Integration** – In this theme of research, optimal strategies to manage diverse distributed resources and storage will be developed and demonstrated.

**Energy Policy, Markets and Economics** – Policy and markets research focuses on the impacts that regulatory policies and requirements place on the planning, design and operations of the grid.

## Current Research Topics

- Impacts of new smart grid technologies and renewable energy integration on transmission system operation
- Fault detection in underground cables
- Energy storage and its market models
- Cyber-security, wide-area monitoring, control and real-time measurements
- Dynamic Performance of Active Distribution Networks with High Penetration Solar Photovoltaic Sources
- Integration of Stochastic Sources and Energy Storage in Microgrids
- Improving Resiliency in Power Systems with Self-healing Microgrids
- Load profile analysis and short-term load forecast for commercial and residential loads
- Stochastic planning considering renewable integration
- Implementation of distributed grid intelligence

## Research Facilities

Clemson University operates a Wind Turbine Drivetrain Test Facility at its Clemson University Restoration Institute (CURI) located in North Charleston, SC. This 15 MW Hardware in the Loop (HIL) Grid Simulator provides a platform for research, testing, and workforce development.

NC State University FREEDM Systems ERC is developing smart grid technology applications that will enable the U.S. to take full advantage of advances in renewable energy for a sustainable future. The FREEDM System is a green energy grid infrastructure that will realize its vision through fundamental research and enabling technology development.

At UNC Charlotte, the Energy Production and Infrastructure Center (EPIC) hosts the Duke Energy Smart Grid Laboratory with its real-time data system simulator, phasor measurements units, various software packages and hardware equipment used to analyze and test system grid conditions.

## For more information, contact

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