



HIGHLIGHTING UNIVERSITY SPONSORED ENERGY INNOVATION CENTERS

NARUC CENTER FOR PARTNERSHIPS & INNOVATION
WEBINAR SERIES

MAY 18, 2022

ABOUT NARUC

- The National Association of Regulatory Utility Commissioners (NARUC) is a non-profit organization founded in 1889.
- Our Members are the state utility regulatory Commissioners in all 50 states & the territories. FERC & FCC Commissioners are also members. NARUC has Associate Members in over 20 other countries.
- NARUC member agencies regulate electricity, natural gas, telecommunications, and water utilities.



ABOUT NARUC'S CENTER FOR PARTNERSHIPS & INNOVATION

- Grant-funded team dedicated to providing technical assistance to members.
- CPI identifies emerging challenges and connects state commissions with expertise and strategies to inform their decision making.
- CPI builds relationships, develops resources, and delivers trainings.



Regularly updated CPI fact sheet with recent publications & upcoming events under Quick Links at:

<https://www.naruc.org/cpi-1/>

NARUC Center for Partnerships & Innovation

Current Activities

Recently Released Publications

- [Public Utility Commission Stakeholder Engagement: A Decision-Making Framework](#) (Jan. 2021)
- [Private, State, and Federal Funding and Financing Options to Enable Resilient, Affordable, and Clean Microgrids](#) (Jan. 2021)
- [User Objectives and Design Options for Microgrids to Deliver Reliability and Resilience, Clean Energy, Energy Savings, and Other Priorities](#) (Jan. 2021)
- [Understanding Cybersecurity for the Smart Grid: Questions for Utilities](#) (Dec. 2020)
- [Artificial Intelligence for Natural Gas Utilities: A Primer](#) (Oct. 2020)
- [Cybersecurity Tabletop Exercise Guide](#) (Oct. 2020)

Recent Events

- Integrated Distribution Systems Planning: NARUC partnered with DOE national laboratories to deliver a [virtual training](#) in Oct. 2020 on forecasting, control and automation, metrics, resilience, PUC practices, and more. The next session will be held for Western state officials beginning Feb. 26, 2021. [Contact Dominic](#)
- NARUC-NASEO Task Force on Comprehensive Electricity Planning. Resources developed by the Task Force will be shared in a [virtual workshop](#) on Feb. 11, 2021. Read the [Task Force fact sheet](#). [Contact Danielle](#)
- National Council on Electricity Policy (NCEP). [Presentations](#) from NCEP's December 2020 Annual Meeting are available as well as an updated [Transmission and Distribution Resource Catalog](#). [Contact Kerry](#)
- Carbon Capture, Utilization and Storage Workshop Webinar Series. [Recordings](#) are available from a Western Interstate Energy Board- and NARUC-hosted six-part webinar series in Sept. and Oct. 2020. [Contact Kiera](#)

Available Virtual Learning Opportunities

- Cybersecurity Training for State Regulatory Commissions: NARUC is hosting a [virtual cybersecurity training](#) on Feb. 23-25, 2021. [Contact Ashton](#)
- National Council on Electricity Policy (NCEP). [Register](#) for a special session on Exploring Optimization through Benefit-Cost Analysis on Feb. 25, 2021. [Learn More](#) about NCEP. [Contact Kerry](#)
- Emergency Preparedness, Recovery and Resilience Task Force: The EPRR Task Force will meet Feb. 5, 2021 to discuss BRIC funding with FEMA. [Contact Will](#)
- Commission Staff Surge Calls. NARUC hosts quarterly calls on which commission staff discuss how different states approach emerging issues in electricity policy. The next call will be held in early Mar., 2021. [Summaries](#) from past calls are available. [Contact Kiera](#)
- Innovation Webinar Series. NARUC hosts monthly webinars for members and the public. **Mar. 11:** Data for the Public Interest: Empowering Energy Equity. **Apr. 15:** Initiative on Cybersecurity in Solar Projects. **May. 13:** Staffing the Evolving PUC Workforce. [Register and find recordings](#) of past events. [Contact Dominic](#)

Join us! NARUC hosts four working groups for members:

- [Performance-Based Regulation](#). [Contact Kerry](#)
- [Microgrids](#). [Contact Kiera](#)
- [Electric Vehicles](#). [Contact Jasmine](#)
- [Grid-Interactive Efficient Buildings](#). [Contact Danielle](#)

www.naruc.org/cpi

PANELISTS



JOHN MORRISON

MODERATOR

President and Chief Executive
Officer

E4 Carolinas



ROBERT COX

Associate Director

Energy Production and
Infrastructure Center (EPIC),
University of North Carolina
Charlotte



KEN DULANEY

Director of Industry and
Innovation

FREEDM Systems Center, North
Carolina State University



JAY WHITACRE

Director

Wilton E. Scott Institute for
Energy Innovation, Carnegie
Mellon University



UNIVERSITY ENERGY INSTITUTE COLLABORATIVE

UEIC is a partnership of U.S. university-based energy institutes formed to address the critical challenges facing America's energy systems.

Vision

To support a low carbon and just energy future.

Mission

To work together as energy institutes to inspire meaningful research, engage scholarship, inform regional and national policy, impact decision-making, and re-imagine energy education to be ready to create the future of energy systems.

Panelists are all members of the University Energy Institute Collaborative
<https://www.ueic.org/>



The Energy Production and Infrastructure Center (EPIC) at UNC Charlotte

Wednesday, May 18, 2022
Dr. Robert Cox
EPIC Associate Director



Founding Mission

EPIC was founded with the support of the energy industry

- Industry needs new energy talent for the future
- Average age of professionals is 55+
- To execute the energy transition, the power industry needs new skills

Professional development and life-long learning of employees

Applied research needs for a safe, reliable, and sustainable energy future

Bottom Line:

Educating future engineering professionals for the energy sector



An Additive Research Center

Typical EPIC Project Structure

- Faculty involvement / faculty PIs
- Day-to-day execution led / supported by professional research staff
- Student involvement in all aspects of projects

Currently ~ \$20MM in total awards under management

Major focus on private / public partnerships



Major Research Thrusts

Power Management

**Advanced Motor
Drives**

**High Power
Density Power
Converters**

Energy Management

**Grid Resiliency &
Modernization**

**Inclusive
Approaches in
Planning**

Energy Infrastructure

**Advanced
Construction**

**Energy Supply
Chain**

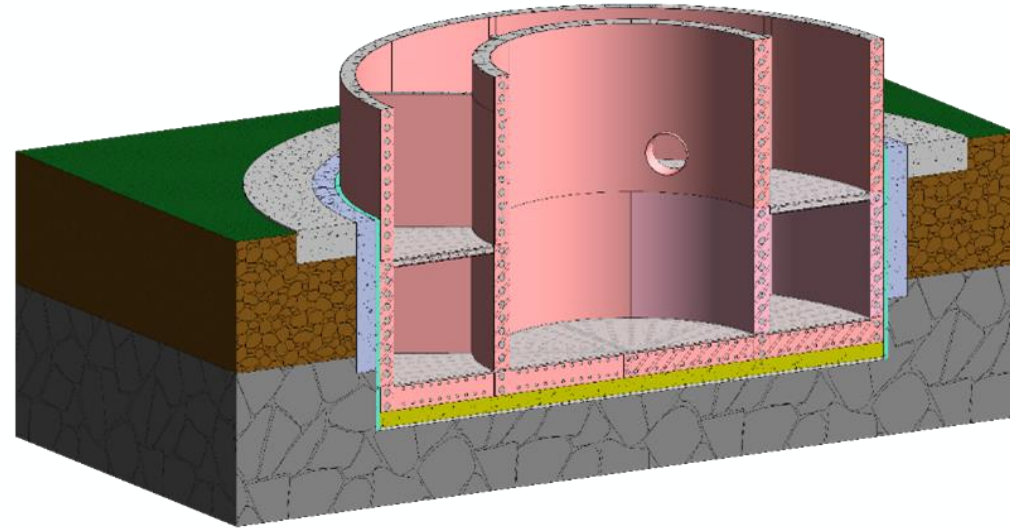
**Transportation
Electrification**

Digital Engineering – Digital Twins

Energy Infrastructure



HITACHI



***EPIC Leading Digital
Twins for Construction
Quality***

Vision: “Advanced Construction”

Apply advanced manufacturing strategies to the overall NPP construction, fabrication, assembly process.

- New nuclear > \$12,000/kW in US
- “More than 50% of costs are civil works”

Transportation Electrification & Public Sector Partnership



Successful product development partnership

Requires interesting regulatory innovation



Grid Resilience & Digital Twin for Planning

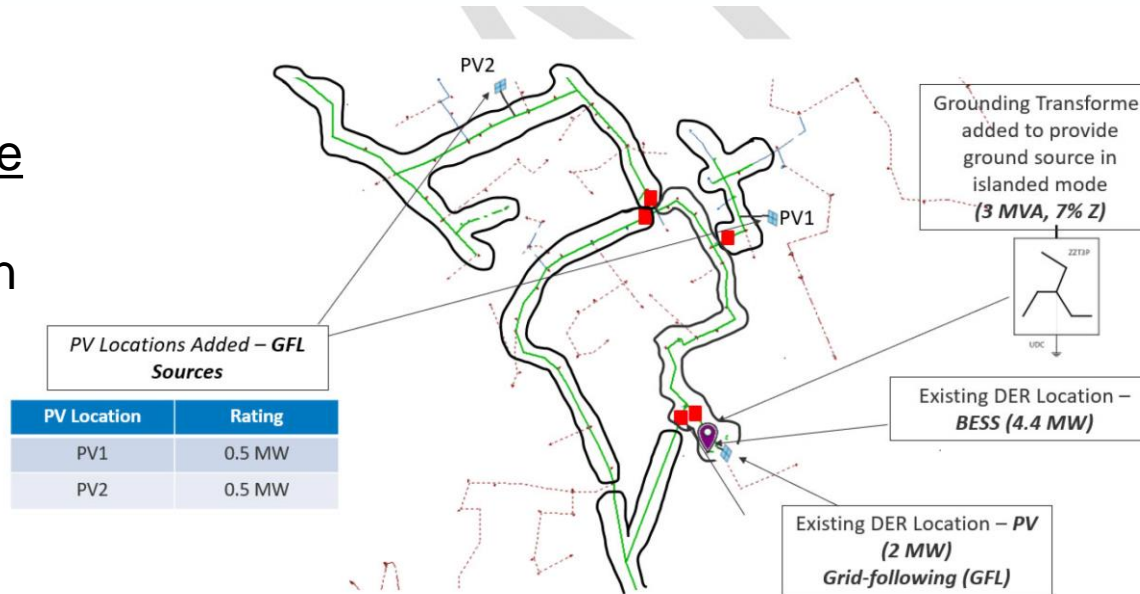


Digital Twin



Integrated Planning for the Future

- Detailed hourly analysis
- Outage & vulnerability prediction
- Reconfiguration
- Advanced protection



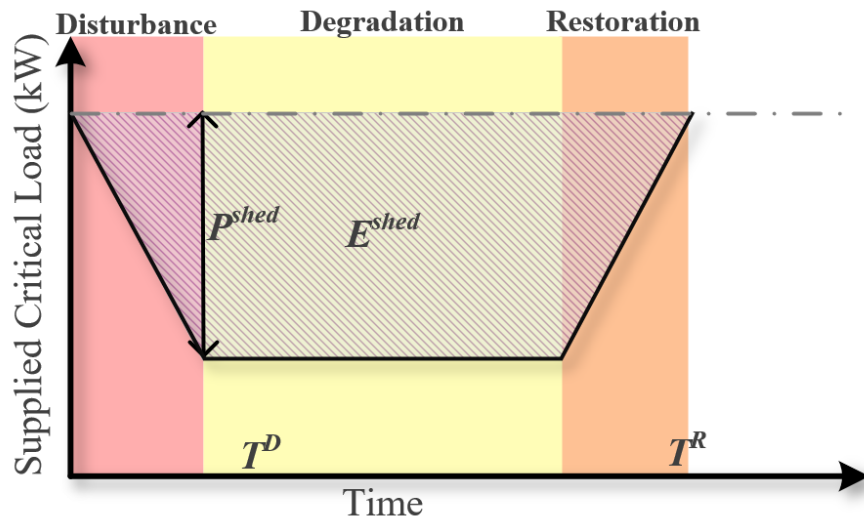
Valuing Resilience

Power System
Impact

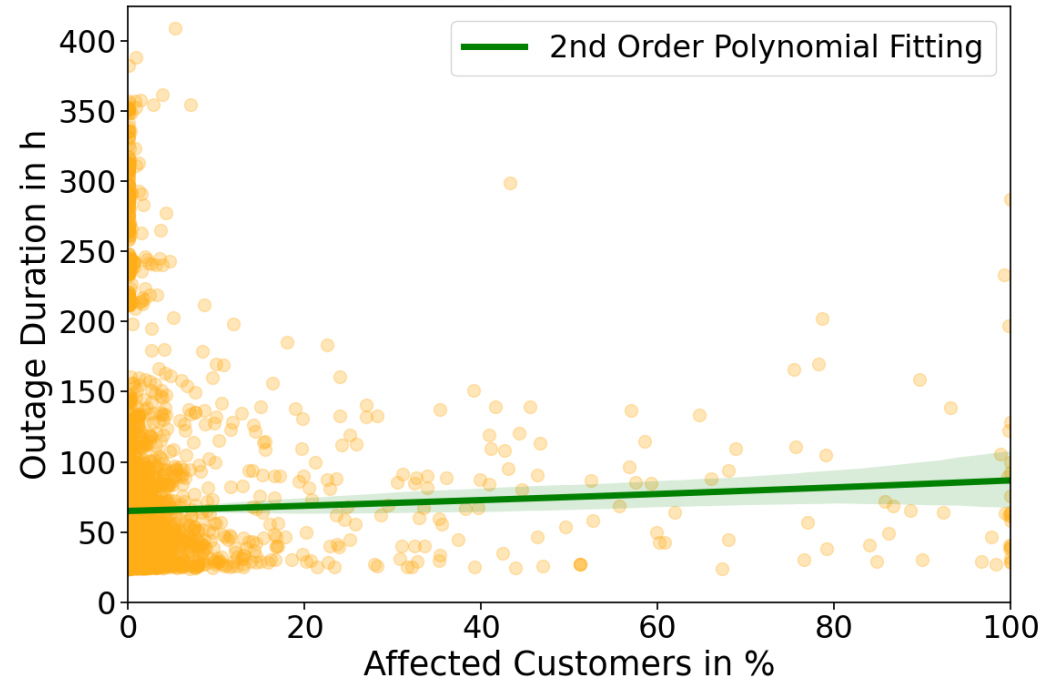
Community
Impact



Inclusive Planning

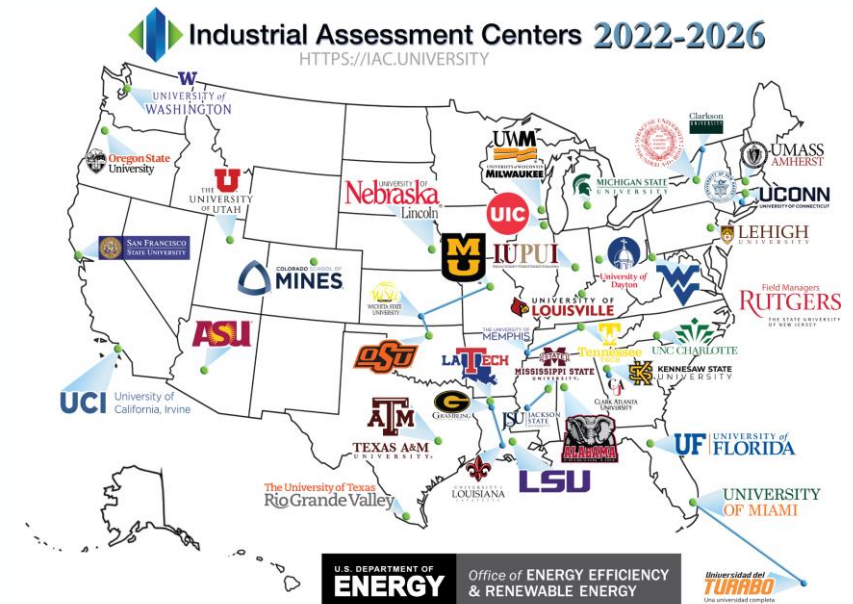


Outage Duration vs Affected Customers for Outages longer than 24 h



Benefits of Shelter With Resilient Power 2 Day Use, 1X per year

Cost Category	Cost
Food damage	\$64,000 / event
Sheltering cost	\$23,800 / event
Self food preparation	\$4,800 / event
Total Annual Benefit	\$92,680 / event
20-Year Benefit	\$1.85M



The background image shows a large, multi-story red brick building with white columns and windows, identified by a sign as 'DUKE CENTENNIAL HALL'. In the foreground, there is a large, abstract, metallic sculpture with curved, interlocking bands and two reflective spheres. The entire image has a dark teal overlay.

Thank You!

Robert Cox
Robert.Cox@uncc.edu



Introduction to FREEDM

Ken Dulaney, Industry Liaison

May 2022

- 36,700 students
- #6 best value among US public universities (#1 in NC)
- \$370 M in sponsored research in 2019
- 190+ Startup companies
- 1,500 active patents
- #5 in commercialization for universities w/o med school
- Top 10 in US for Undergraduate Entrepreneurship
- Centennial Campus
- 50 Research Centers



Future
Renewable
Electric
Energy
Delivery and
Management
Systems
Center



WBG Power Electronics

WBG Devices
SSTs

MV Power Electronics

Low-Voltage High-Performance Power Converters

Electric Transportation

Electric Machines and Drives

Fast Chargers

Wireless Power Transfer

Automotive & Aerospace Power Electronics

Modern Power Systems

FREEDM Distribution System

Distributed Grid Intelligence

System Controls Stability and Cybersecurity

Economic Modeling & Market Mechanisms

Renewable Energy Systems

Distributed Energy Resources

Microgrids

Solar PV & Wind Systems

Renewable Integration into Grid

Full

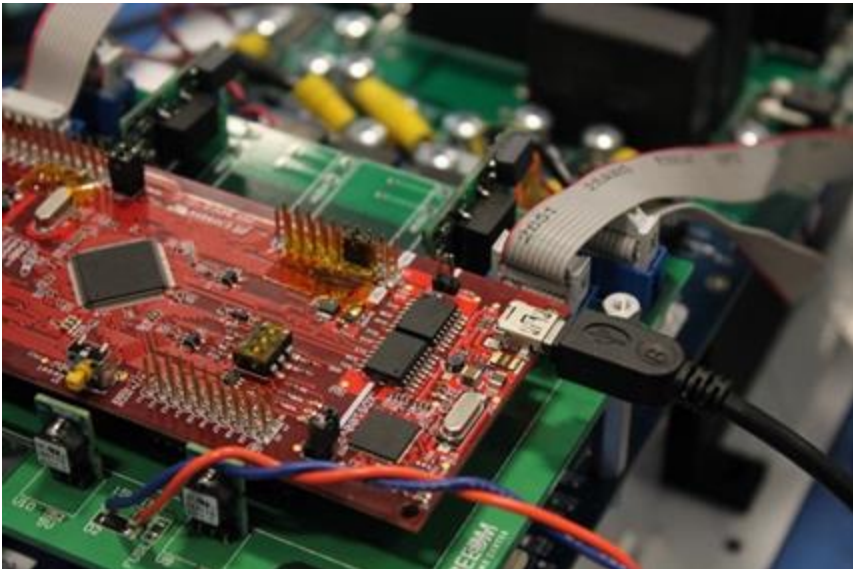
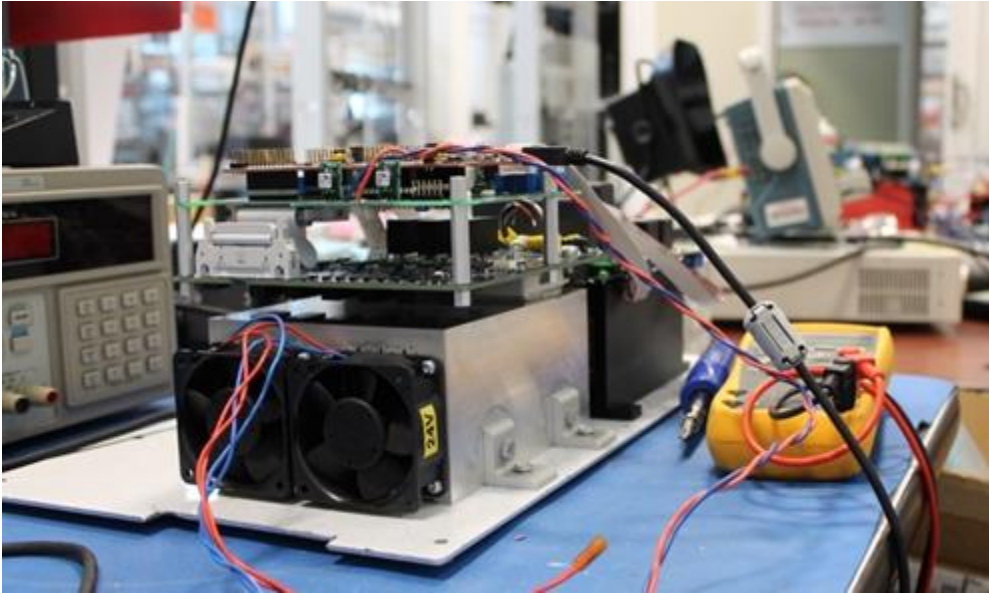


Associate



Affiliate

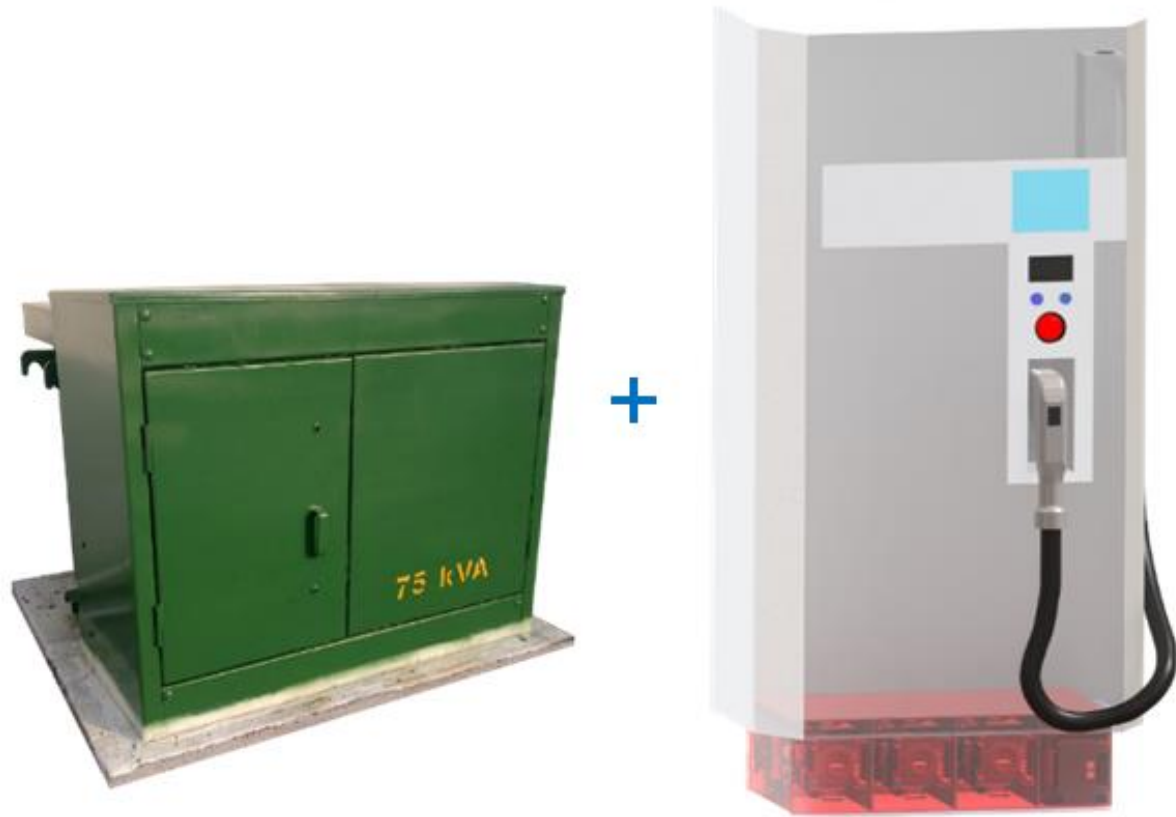




Semiconductor properties (Electron Volts)	
Silicon	1.1
Silicon Carbide	3.3
Gallium Nitride	3.4

- Higher Voltages
- Higher Currents
- Higher Temperatures
- Higher Switching Frequencies
- Reduce Size of Passive Components

DC Fast Charger



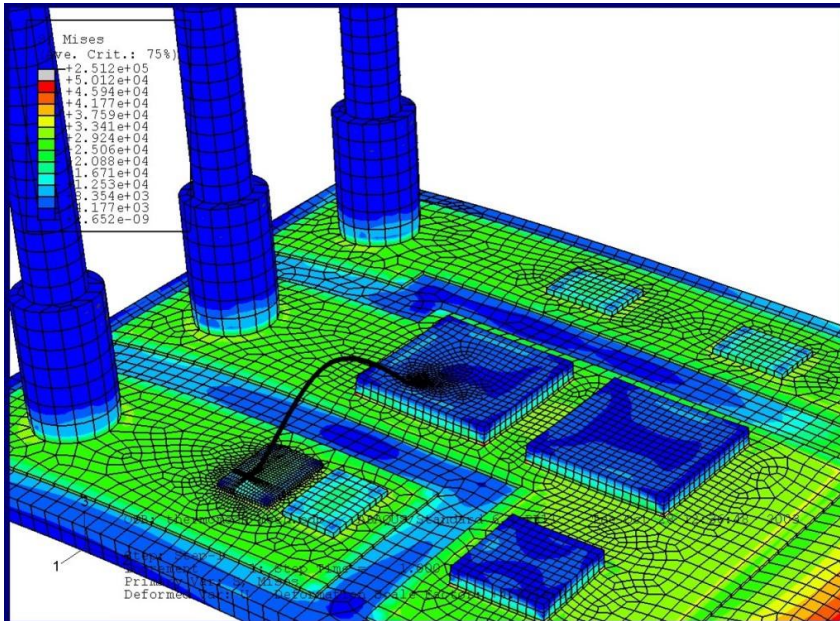
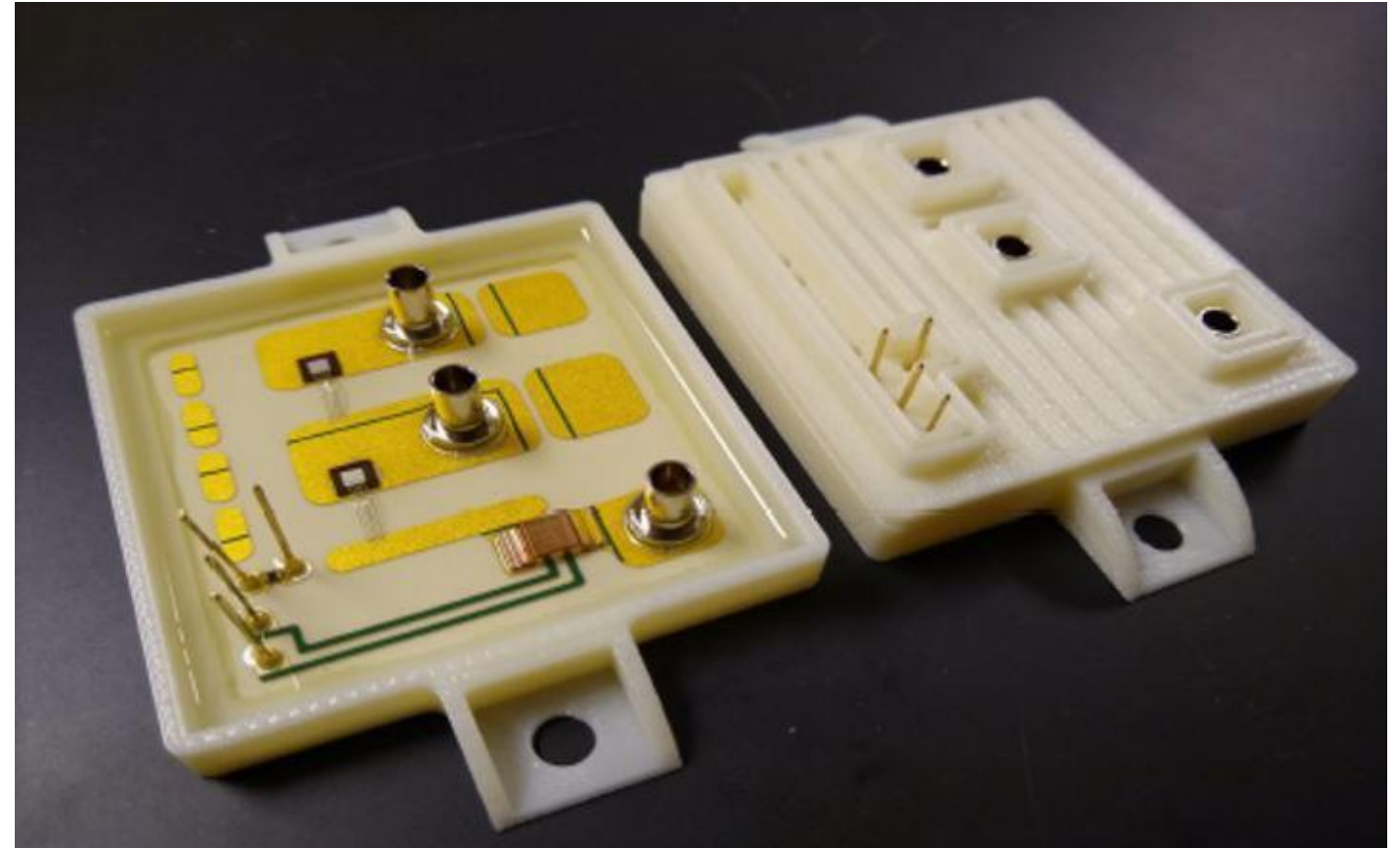
DC Fast Charger



- Impact of Demand Response Programs
- North Carolina Energy Storage Study
- Model Selection for Day Ahead Generation Scheduling
- Using PV to Enhance Grid Resilience
- Cybersecurity for Wide Area Control
- Advanced Magnetics for Transformer Design

- Solar PV
- Energy Storage
- Microgrids





- Switched Reluctance Motors
- Asymmetric Bar Windings
- 3D Airgaps
- FPGA Motor Emulator
- Model Predictive Current Control of PM Synchronous Motors



FREEDM



SYSTEMS CENTER

freedm.ncsu.edu

Ken Dulaney, PE

Director of Industry and Innovation

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Carnegie Mellon University

Wilton E. Scott Institute
for Energy Innovation

Enabling a sustainable energy future.

CMU Areas of Expertise in Energy

1. Energy Technologies – from current state to the future

- High-Performance Renewables
- Transportation Energy, EVs, Infrastructure, and Electrification
- Energy Storage, Batteries, Fuel Cells, and Internet of Things
- Decarbonization, Carbon Capture, Sequestration and Utilization

2. Resource Efficiency, Policy & Strategy, and Analysis

- Efficiency of Traditional Fuels and Resource Recovery
- Environmental Monitoring, Sensing and Treatment
- Energy Policy, Economics and Community
- Enhanced Water Resources

3. High-Tech Energy and Computational Solutions

- Grid Modernization, Energy Planning, System Reliability, and Resiliency
- Building Performance, Urban Planning, Design and Analytics
- Machine Learning, AI, Autonomous Vehicles, and Robotics for Energy Systems
- High-Performance Computing and Data Centers

What We Do



Support and Promote Faculty Research

- 150 Faculty
- CMU Energy Fellows program
- Fund Seed Grants & Faculty Fellowships



Foster Entrepreneurship

- CMU Energy + Cleantech Investor Forum & Startup Showcase
- DOE American-Made Solar Prize - Power Connector
- NREL IN2 Strategic Channel Partner
- CMU VentureWell Energy Hackathon



Form Strategic Partnerships

- CMU Energy Consortium for Industry
- Power Sector Carbon Index:
emissionsindex.org



Host Energy Initiatives

- District-Scale Pilots
- Facilitate academic Centers for specific interest areas



Engage with Industry and the Public Sector

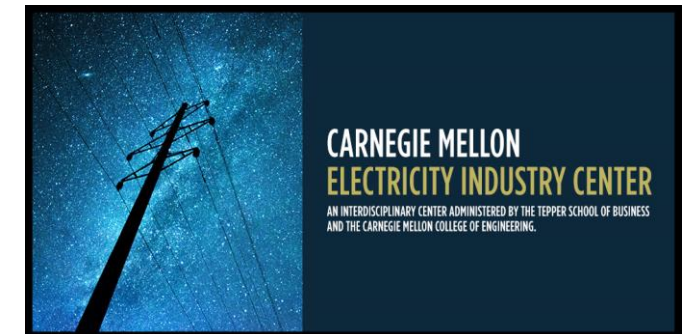
- CMU Energy Week – March 23-27, 2020
- Distinguished Lecture & Seminar Series, Workshop Events, and Programming
- Collaborations with NETL, NREL, City of Pittsburgh, DOE

CMU Core Strengths

- Key Technologies: Energy Storage, Fuel cells, smart sensing, machine learning
- Systems optimization approach to problem-solving and design
- Interdisciplinary collaboration
- Innovative and entrepreneurial faculty, staff, and community
- SW Pennsylvania location
- Proximity to start-up epicenter and ecosystem



Convergence of energy efforts across campus



NARUC Innovation Webinar series

One Thursday each month

All NARUC members and stakeholders are invited



Alleviating the Energy Burden: Regulatory Approaches to Supporting Affordability

- June 16, 2022 | 3:30 - 4:30 PM Eastern

Topics and more webinar information will be added soon!

<https://www.naruc.org/cpi-1/innovation-webinars/>

NARUC thanks the U.S. Department of Energy for its support of this series.