Potential GRAPES Site at University of Wisconsin-Milwaukee (UWM)

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UWM at a Glance

23,031 Undergraduates
3,328 Masters
1,454 Doctoral

27,813 Total Students

94 Undergraduate
60 Masters
34 PhD

188 Degree Programs

3,813 Faculty and Staff
University of Wisconsin – Milwaukee

UWM at a Glance

Schools and Colleges

- Architecture
- Arts
- Business
- Education
- Engineering
- Freshwater Science
- Health Science
- Information Studies
- Letters and Science
- Nursing
- Public Health
- Social Welfare
UWM College of Engineering & Applied Science

Where in the world is UWM?
MILWAUKEE, WISCONSIN

Cooler near the lake!
Urban Setting

City of Milwaukee

- 700,000 POPULATION (2M in metro area)
- 32,000 BUSINESSES
- $20B ECONOMIC OUTPUT
UWM College of Engineering & Applied Science

CEAS AT A GLANCE

- 1,602 Undergraduates
- 211 Masters
- 211 Doctoral
- 2,024 Total Students
- 120 Faculty and Staff
# Foundational Strengths & Cluster Areas

## DEPARTMENTS

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![Image of advanced manufacturing, biomedical, energy, and water clusters]
Strong Industry Partnerships

- **Joint Research Facilities and Projects with Johnson Controls**
- Significant investments in state-of-the-art equipment within CEAS to support research projects. Enhancing the talent pipeline in Energy Storage. Established Endowed Chair in Energy Storage.
Strong Industry Partnerships

- **GE Healthcare Partnership**
  - Exciting partnership to expand frontiers of computational imaging and provide foundation for workforce development
  - GE Healthcare committed more than $3M to support the “first of its kind” talent pipeline for medical imaging software developers and researchers
    - $2 million to establish the Center and fund the classes
    - $1 million to provide research funding for Catalyst Grants
  - Part of a 5-year joint effort between GE and CEAS
CEAS Summary

- Growing and Expanding College
- Strong demand for programs
- Strong demand for graduates
- Critical for University
- Research aspirations
- Enrollment stability
- Student success
- Important for Region
- Feeding talent pipeline
- Spurring innovation
- Aiding economic development
Energy and Sustainability

Center for Sustainable Electrical Energy Systems

- Research on distributed energy systems
- Expertise in power electronics and electric drives
- Demonstration microgrid that includes distributed renewable energy generation with solar PV, wind turbines, biodiesel generators, and energy storage

Industrial Assessment Center

- Focus on industrial energy efficiency
- Aid manufacturers in improving energy efficiency, reducing resource consumption, and decreasing operating costs
- Primarily sponsored by DoE
- Focus on small to medium size companies
Energy and Sustainability

Nanotechnology for Sustainable Energy and Environment
- Synthesis and assembly of hybrid nanomaterials
- Novel applications for solar cells, lithium-ion batteries, as well as numerous sensor applications

Laboratory for Sustainable and Nano-Manufacturing
- Development of advanced theory and technologies for sustainable design and manufacturing
- Nano-materials/structure for energy conversion and storage
Energy and Sustainability

CFD Modeling and Simulation

- Advanced simulation and analysis of computational fluid dynamics for a variety of applications
- Wind energy blade design
- Wind energy power plant configuration
Energy and Sustainability

Actively considering other partners
Center for Sustainable Electrical Energy Systems (SEES)

- UWM power labs have recently moved to USR building. The power electronics lab is a 2000 sq-ft with over 250kVA power supply capabilities. The lab is equipped with 10 work benches and necessary equipment. Full packages of MATLAB/Simulink, dSpace systems, PSIM, PSS/E, and PSCAD for software simulation are available.

- Power system lab is 1500 sq-ft, RTDS system is ordered.

A picture of the power electronics lab
Facilities, Equipment and Resources

• Equipment- The lab is currently equipped with three dSpace systems, TI DSP boards, FPGA boards, and NI Compact RIO and computers. High power AC and DC sources. 500 MHZ, 4 channel Lecroy LT364L oscilloscope with PMA1 power measure analysis software and current probes. Two 4-channel, 250MHz Tetronix 4054 oscilloscopes. Power electronics components including switches, gate drivers, and heat sinks.

50kW dyno with synchronous and DFIG generators

LI Capacitor module with full conversion
It uses actual source hardware with controls modified for microgrid compatibility.

- **100kW PV solar, with Eaton S-Max inverter in voltage and current mode.**
- **12kW wind turbine w/ PM gen.**
- **Two 45kW gas turbine w/ synchronous gen.**
- **50kWh, 25kW Zn-Brom. energy storage**
- **114 kW Li-ion Batt.**
- **Active and Passive Loads**
- **Controls and Monitoring**
Pictures of Microgrid Test Bed Facility

12kW wind turbine

100kW solar PV with inverter.

100kW Two 45kVA NG generators.
David C. Yu, Ph.D., Professor

• Power systems;
• Integration of wind power;
• Distribution system analysis;
• Reliability analysis;
• Application of ANN for intelligent maintenance/monitoring;
• Microgrid analysis in power systems
Rob Cuzner, Ph.D.
Assistant Professor, Electrical Engineering

- **Background:** Over 20 years of experience in performing research and developing systems for power generation, power conversion and variable speed motor drives for both Navy and industrial applications

- **Research Interests:**
  - Development of power electronic topologies and systems that are power dense, fault tolerant and grid compatible
  - DC microgrid protection controls and architectures
  - Shipboard compatible power conversion and distribution
  - AC/DC hybrid microgrid modeling and characterization
  - Development of SiC-based solid state protective devices
  - Power electronics packaging above the module level
  - Characterization of high frequency behavior for EMI mitigation
  - PWM methods for current source and voltage source converters
  - Medium voltage power conversion and distribution
Cuzner-Current Research Projects

- MVDC distribution architectures for Navy shipboard next generation Integrated Power Systems (IPS)
- LVDC and MVDC test beds and instrumentation for fault characterization
- SiC-based Modular Solid State Protective Devices (SSPD) applicable to 380Vdc, 1kVdc, 6kVdc and 20kVdc systems
- Fault mitigating Multi-Terminal Solid State Transformer (MT-SST) for MVDC and LVDC distribution
- SiC-based Drive System for 4160V applications
- Power dense, packaged current source converter-based low horsepower (<30kVA) drives utilizing SiC devices
- 480Vac to 380Vdc Current Source Rectifier for building applications operating in discontinuous conduction mode
- Fault characterization of hybrid AC/DC distribution systems
- Impacts of power converter induced hull currents in shipboard systems
- 100kVA test fixture for the characterization of conducted and radiated EMI from packaged SiC-based drives
- Future community DC microgrid architectures
- DC powered home for study, characterization and education
Lingfeng Wang, Ph.D., Associate Professor

- **Major research areas: Electric Power Systems**
  - Power system reliability and resilience
  - Smart grid cybersecurity
  - Renewable energy integration
  - Intelligent and energy-efficient buildings
  - Grid integration of large-scale electric vehicles
  - Networked microgrids
  - Critical infrastructure protection

- **Recent research activities:**
  - Quantifying the impact of smart grid cyber vulnerabilities on power supply reliability.
  - Optimizing the integration of massive plug-in hybrid electric vehicles (PHEVs) into residential distribution grid.
Adel Nasiri, Ph.D., Professor

- Renewable energy systems
- Distributed generations
- Microgrids
- Grid interface
- Energy storage systems
- Energy security
- Interface and controls
- Vehicle-to-grid
- Electric drives
Nasiri-Current Research Projects

• "Synchronous Generator Modeling under Unbalanced Conditions," Regal Beloit Company.
• "Johnson Controls Hybrid Battery Life Testing," Johnson Controls
• "Cost Effective Uninterruptible Power Supply (UPS) with Load Leveling for CT Systems," GE Healthcare
• “Development of Next Generation Efficient Integrated Power System for Higher Power and Improved Survivability,” M-WERC.
• “Development of Improved Status Estimation Algorithms for Batteries and Ultracapacitors,” Johnson Controls.
• “Planning and Design of Advanced Microgrid Testbed Facility in Milwaukee,” Several sponsors.
• "Energy Storage, Demand Response, and Renewable Energy Interaction at Building, Campus, and District Level," M-WERC.
Committed Members

✓ **DRS Technologies:** Second tier Navy contractor, power systems on ships.

✓ **Eaton Corporation:** Diversified manufacturer, power system Global Research Center and Industrial Controls Division located in Milwaukee.

✓ **American Transmission Company (ATC):** WI and Michigan UP transmission company (above 69kV).

✓ **S&C Electric:** Illinois and WI based distribution equipment and power quality component manufacturer.

✓ **Midwest Energy Research Consortium (M-WERC):** Committed, will join after NSF approval.
Potential Members

✓ **We Energies:** Local utility company, serving most of WI and Michigan UP, Minnesota, and Illinois. Declined last year but interested to take a second look this year.

✓ **Half Moon Ventures:** Renewable energy and energy storage installer, agreed as a small business member, will join after NSF approval.

✓ **Rockwell Automation:** Milwaukee-based power, controls, and automation company. Declined last year. We will approach again.

✓ **Johnson Controls:** Milwaukee-based energy storage and energy efficiency company. Declined last year. We will approach again.