

Center for Microgrid Research

2021 Legislative Request

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Mahmoud Kabalan, PhD – Professor of Electrical Engineering

March 16, 2021

School of
Engineering

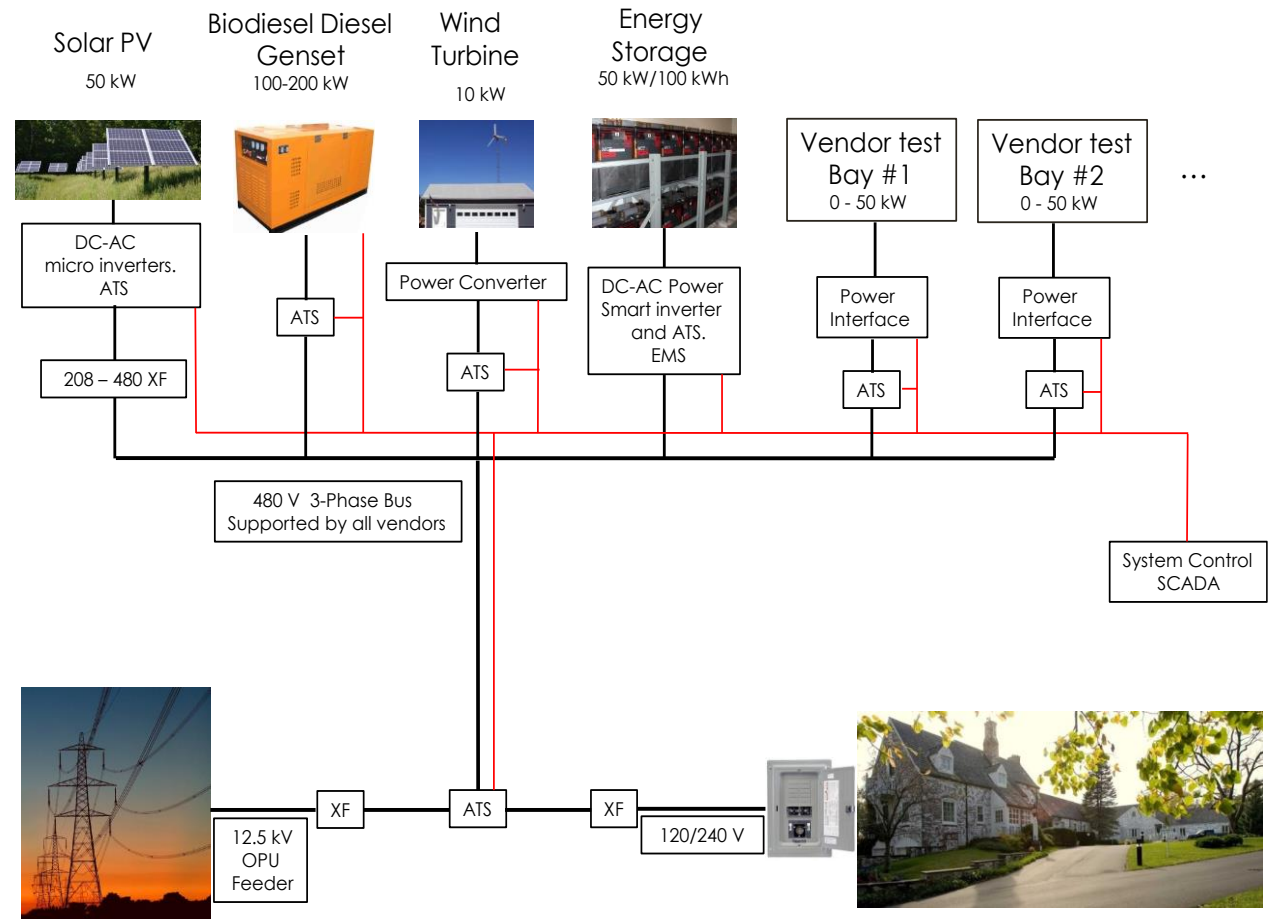


UNIVERSITY OF

St. Thomas

Microgrid History

- RDF funds helped UST install a sustainable, 0.25 MW peak, multi-purpose microgrid
 - 3 year, \$2.15 M program for education and research
 - promotes industry/academic collaboration, attracting national partners
 - provides a platform for power systems and renewable engineering education



Original Microgrid Facility Schematic

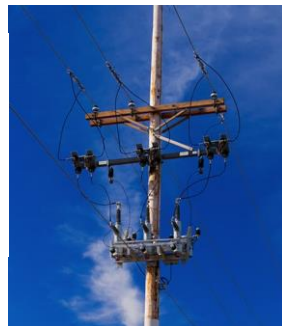
UST Gainey Conference Center, Owatonna

UST Microgrid Successfully Completed

- Location:
 - FDC –Facilities and Design Center Building
 - University of St Thomas St Paul Campus



 **Engineering**
@ **St. Thomas**



13.8 kV Xcel
Energy Feeder

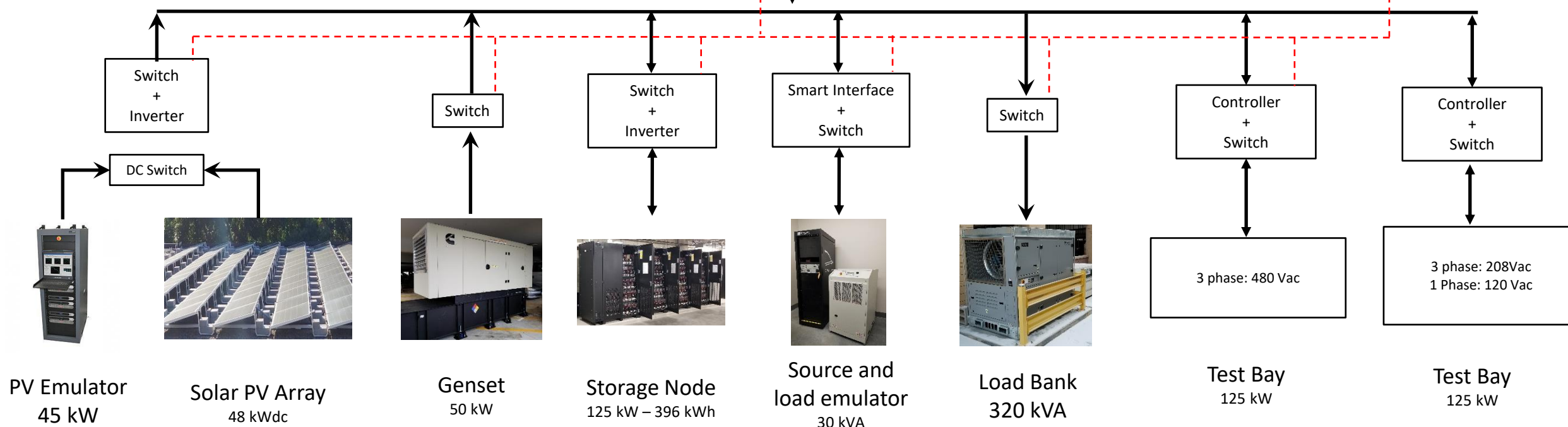
Transformer
+
Switch



Control Hardware:
SEL Relays and Computers



480 V 3-Phase 4-Wire Bus



PV Emulator
45 kW

Solar PV Array
48 kWdc

Genset
50 kW

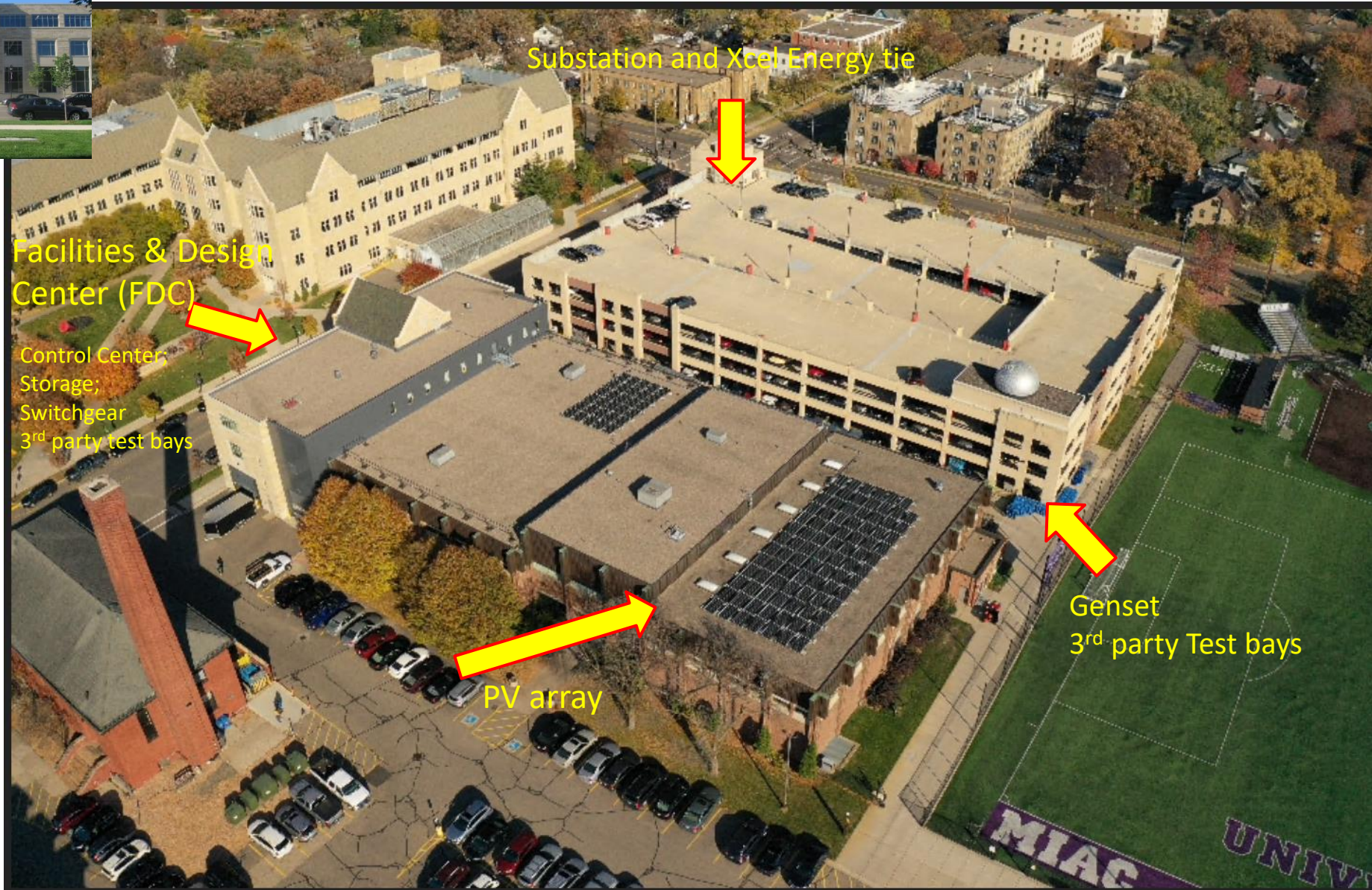
Storage Node
125 kW - 396 kWh

Source and
load emulator
30 kVA

Load Bank
320 kVA

Test Bay
125 kW

Test Bay
125 kW



Ben Fowke, CEO of Xcel Energy Microgrid Commissioning Nov 1st 2019



Partnerships – Examples DOE SETO Proposals



GE Global Research



Pacific Northwest
NATIONAL LABORATORY



UNIVERSITY OF
ARKANSAS



UNIVERSITY OF
St. Thomas



UNIVERSITY OF
CENTRAL FLORIDA



University of Colorado
Boulder



UNIVERSITY OF
St. Thomas



Pacific Northwest
NATIONAL LABORATORY



**OpenDER: An Open-Source BTM Solar and DER
Management Tool for Grid Services**

Budget: \$5.2M

**Mainstream Models, Type Tests and Calibrations for PV
Inverters**

Budget: \$2.7M

Partnerships - Continued



SUNSPEC
— ALLIANCE —



Sandia
National
Laboratories



Massachusetts
Institute of
Technology



An Enduring Asset for Minnesota Renewable Energy Research



Facilities:

Microgrid Test Platform (2-25 kW)
Microgrid Trailer (7 kW)
Microgrid Container (20 kW)



Facilities:

1-MW Grid simulator
Load banks
Diesel generators
PV simulator
DC battery simulator
Lithium-ion batteries
Advanced inverters
Power hardware-in-the-loop



Facilities:

180 kVA AC grid simulator
200 kW PV simulator
100 kW battery simulator
280 kVA/225 kW diesel generator
Power hardware-in-the-loop
Grid-forming inverters
320 VA microinverter test bed



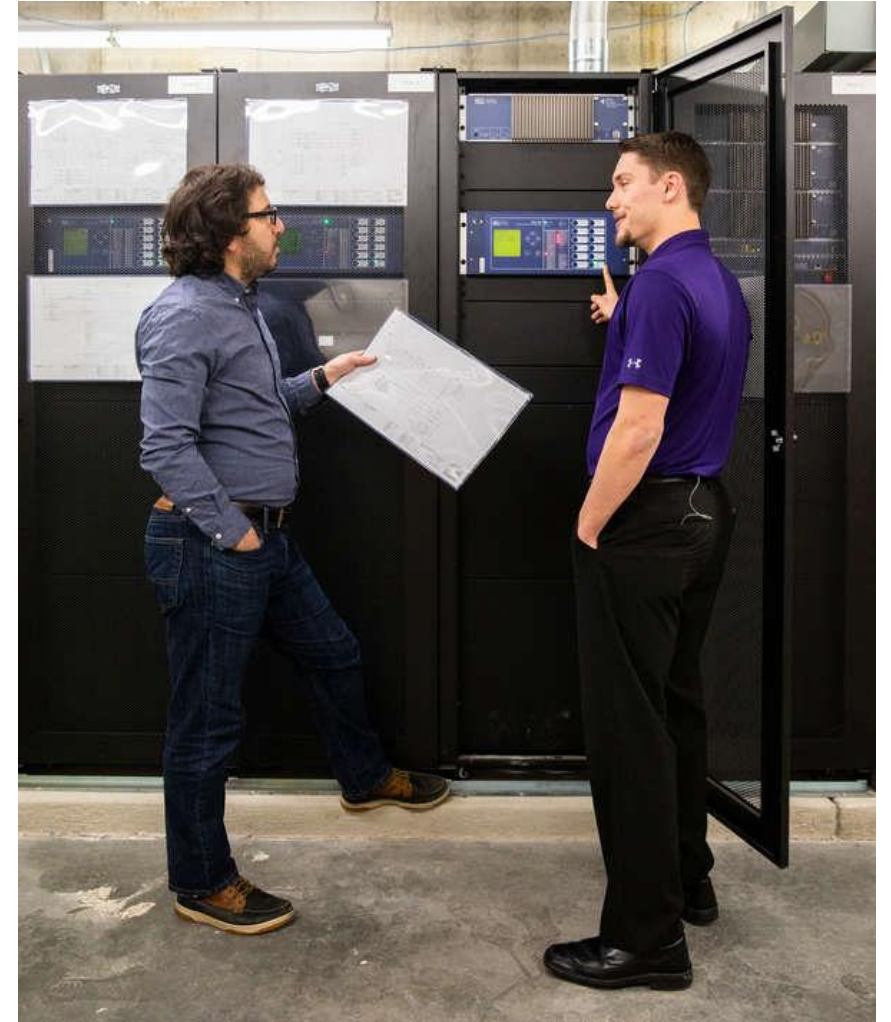
Oak Ridge National Laboratory Microgrid:

Three buses, 480V/240V/208V, three-phase and single-phase
Two inverters, one PV, and one battery with total generation capacity of 160 kW
Programmable R/L load banks

*Facilities and capabilities are rival by top research institutions and national laboratories

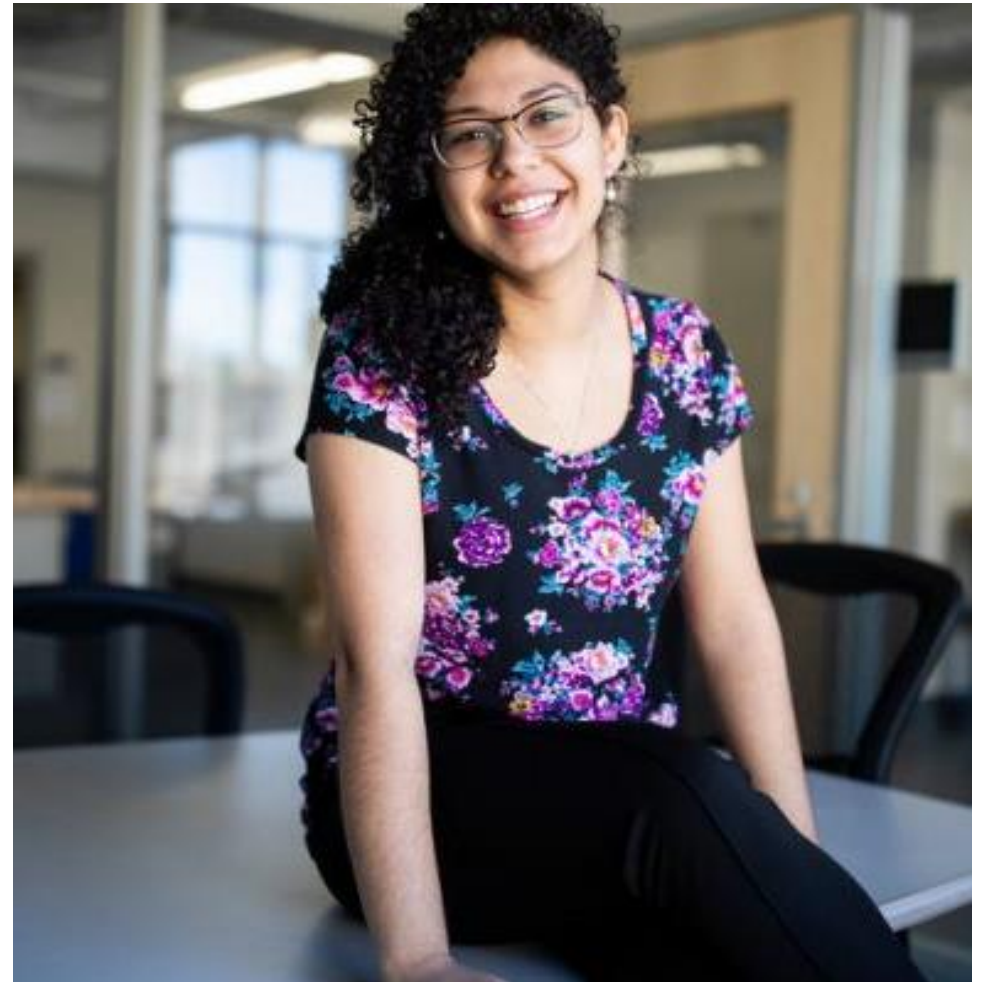
Microgrid: Benefits to Minnesota

- A unique venue to educate and train on renewable energy development and microgrids
- Partnering platform with companies for test and validation of new equipment and controls.
- Hands-on renewable energy research/educational site that is unique in Midwest and rivaled only by top institutions
 - Integrated the microgrid into undergraduate and graduate power system courses



Core Mission: Educating Future Engineers

- "This experience allowed me to see and to work with a power system beyond the classroom setting. The challenges of getting familiar with the power equipment, integrating the different parts of the system, and getting the desired results were unique and rewarding."
- Carol Mikhael, BSEE '19



2021 Legislative Request *\$5.4 million*

1. Expanding the center's operational infrastructure and equipment that allow industry partners to test near-commercial microgrid products on a real-world scale and multiply opportunities for innovative research
2. Procuring advanced equipment and controls to enable the extension of the university's microgrid to additional buildings
3. Expanding hands-on educational opportunities to undergraduate and graduate electrical engineering students and partnerships with community colleges

