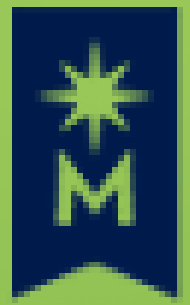

MINNESOTA STATE

HIGHER EDUCATION BLOCK GRANT

HE4-1

MINNESOTA STATE
Energy Center of Excellence

get into energy

- First round projects
- Contracts fully executed
- Implementation is underway on all five projects

Minnesota West
COMMUNITY & TECHNICAL COLLEGE

MSUM-1: UNIVERSAL AND SCALABLE SMART GRID POWER CONVERTER

- Dr. Vince Winstead, PhD, PE
  - Professor of Electrical and Computer Engineering and Technology
  - Minnesota State University, Mankato
- Steve Vietor
  - Wind/Solar/Electrical Instructor
  - Master Electrician
  - Riverland Community College

MSUM-1: UNIVERSAL AND SCALABLE SMART GRID POWER CONVERTER

- *"This project is intended to incorporate concepts from "smart grid" interfacing and protocols, trans active energy (TE) and universal interconnect hardware into a single scalable configurable component. In other words, we intend to develop a device which is configurable (in firmware) and is capable of connecting electrically to a variety of power generation and energy storage devices (i.e. renewable energy generators, battery systems, ultra capacitor systems, hybrid vehicles, etc.) and provide a universal interface to the grid of the future. We can call this the Universal and Scalable Smart Grid Power Converter (USSGPC)."*

MSUM-1: UNIVERSAL AND SCALABLE SMART GRID POWER CONVERTER

- 1) Design a flexible and scalable power conversion system which automatically and efficiently interfaces with the electrical grid and is configurable for “smart grid” interfacing.

- 2) Implement a comprehensive data capture and communication capability for the flexible power converter to allow the converter to communicate energy transfer data via wired and wireless protocols and to enable remote diagnostic/prognostics.

- 3) Verify and validate some configurations of the system in limited testing using stationary solar photovoltaic and small wind driven energy generation typical of the size suitable for residential installations as well as mobile solar and electric vehicle on-board electric energy storage with an integrated USSGPC.

MSUM-2: IMPROVING VERTICAL AXIS WIND TURBINE PERFORMANCE WITH PLACEMENT STRATEGIES

- Dr. Patrick Tebbe, PhD, PE
  - Professor of Mechanical Engineering
  - Minnesota State University, Mankato

MSUM-2: IMPROVING VERTICAL AXIS WIND TURBINE PERFORMANCE WITH PLACEMENT STRATEGIES

- This project will examine understudied aspects of VAWTs with the goal of improving their implementation and performance. Aerodynamic interference caused by terrain, surrounding structures, and other wind turbines can not only decrease efficiency but can also increase efficiency. This research will address how placement affects the performance and efficiency of VAWTs through a combination of numerical and experimental efforts. The unique numerical approach of Leaky Rankine Bodies (LRB) with superposition will be explored as an accessible consumer tool.

MSUM-2: IMPROVING VERTICAL AXIS WIND TURBINE PERFORMANCE WITH PLACEMENT STRATEGIES

- **Goal 1:** Create a numerical tool that can aid in placement of VAWTs to improve their performance and efficiency. Most numerical methods of studying wind turbine flow fields involve complicated and costly fluid dynamics software. A simple, easy to use, low cost alternative would be an advantage to VAWT developers, installers, and consumers.
- **Goal 2:** Produce strategies that improve the performance and efficiency for the placement of VAWTs with regard to their surroundings, other VAWTs, and potentially HAWTs. Proper placement of VAWTs is necessary to ensure adequate electricity production and increased viability of future projects.
- **Goal 3:** Determine areas of high potential for the installation of VAWTs in Minnesota. Most current wind maps indicate speeds at elevations (e.g. 30 m) higher than typical 2 VAWT installation heights. A map that takes into account lower boundary layer flows and advantageous aerodynamic interferences could lead to future development of VAWTs and increase small-scale electricity production.

SCSU-1: MICROBIAL POWER AND BIOPRODUCT PRODUCTION FROM USING FOOD WASTE

- Dr. Matthew Julius, PhD
  - Professor of Biology
  - St Cloud State University

SCSU-1: MICROBIAL POWER AND BIOPRODUCT PRODUCTION FROM USING FOOD WASTE

- This work involves anaerobic digestion of food waste streams for energy production and the utilization of other digester outputs for production of high value algal biomass research. The scientific “heart” of this research will be focused on minimizing waste stream outputs from the anaerobic digester while simultaneously creating an additional revenue stream. Variations organic inputs should illicit changes in anaerobic digester outputs. Researchers working with these variations will track and evaluate digester products as part of a life cycle analysis, quantifying greenhouse gasses, nitrogen, and phosphorus. A model to optimize waste stream reduction and biomass profits will be developed using information from the life cycle analysis data.

SCSU-1: MICROBIAL POWER AND BIOPRODUCT PRODUCTION FROM USING FOOD WASTE

- **Task 1.0 Grow Target Taxa for use as an Inoculate**
- **Task 2.0 Build Four Replicate 10,000L Systems.**
- **Task 3.0 Preserve target algal cultures and sequence barcode genes (SSU, psbC, psaA)**

SCSU-2: NO WASTE: FINE-TUNING DIGESTERS' MICROBIOME TO MAXIMIZE BIOGAS PRODUCTION

- Dr. Ryan Fink, PhD
  - Associate Professor of Biology
  - St Cloud State University

SCSU-2: NO WASTE: FINE-TUNING DIGESTERS' MICROBIOME TO MAXIMIZE BIOGAS PRODUCTION

- The principal scientific goal for this project is to produce a mature microbial community in a digester that is stable in terms of output and that can easily be manipulated through the organic waste input to maximize biogas production or, if needed, nutrient rich digestate for agribusiness.

SCSU-2: NO WASTE: FINE-TUNING DIGESTERS' MICROBIOME TO MAXIMIZE BIOGAS PRODUCTION

- 1. Characterize initial microbial composition from the inoculate and the establishment of a mature microbial community.
- 2. Characterize annual community patterning over a 1-year period.
- 3. Experimental manipulation of input streams. Once the digester's "typical" microbial community will be characterized, we will have the opportunity to perturb the microbes experimentally by varying inputs.

CENTURY-1: INVESTIGATE STRATEGIES TO MINIMIZE NEGATIVE IMPACTS OF SOILING ON PV PANEL EFFICIENCY

- Scott Randall, BSME
  - Solar and Renewable Energy Instructor
  - Century College

CENTURY-1: INVESTIGATE STRATEGIES TO MINIMIZE NEGATIVE IMPACTS OF SOILING ON PV PANEL EFFICIENCY

- Conduct a research study to investigate strategies to minimize the negative impacts of soiling on photovoltaic (PV) panel efficiency and reduce the cost-per-kilowatt hour of electricity produced within the context of Minnesota's mid-latitude, mid-continental climate

CENTURY-1: INVESTIGATE STRATEGIES TO MINIMIZE NEGATIVE IMPACTS OF SOILING ON PV PANEL EFFICIENCY

- Century will design and install a solar array
- Each panel in every row will either receive no treatment (soiling will be allowed to accumulate) or be exposed to selected study treatments
- Data regarding meteorological conditions will be collected continuously through a weather station located near the solar array.
- Data regarding the solar generation performance of each PV panel module will be collected on a continuous basis from an inverter and monitoring gateway located inside Century's Solar Lab. Data for each individual panel will include (a) power production, (b) energy production, (c) selected panels energy consumption related to solar panel heating to melt snow/ice, (d) voltage, and (e) current.

ROUND 2 RFP UPDATE

- Five projects selected for review
- Currently out to the Merit Review team
- Anticipate awards in April with contracts issued in May

QUESTIONS

- Bruce Peterson, Executive Director
  - Minnesota State Energy Center of Excellence
  - bpeterson@sctcc.edu
  - Ph 320-267-8872