

ENERGY CENTER CHRONICLES

PROGRESS THROUGH NCSR AND NPPD COLLABORATION

The Collaboration

The Nebraska Center for Energy Sciences Research (NCSR), chartered in 2006, is a collaboration between the Nebraska Public Power District (NPPD) and the University of Nebraska-Lincoln (UNL). NPPD provides funding for the NCSR.

UNL Office of Research and Economic Development covers most of the Facilities and Administrative costs (F&A) for the NCSR. F&A includes some infrastructure and a variety of other operational expenses.

The NCSR funds enable UNL faculty to conduct innovative research to develop or enhance clean energy technologies.

The NCSR's mission is to conduct energy research that produces new technologies, processes and systems that provide new or significantly enhanced renewable energy sources and improves the quality of life and economic opportunity for all Nebraskans.

Eight summer interns, one faculty sponsor and the NCSR program coordinator traveled to the Cooper Nuclear Station (CNS) on August 3rd to learn about nuclear energy. Thank you to **Roman Estrada** for arranging the tour and to the CNS tour guides and staff for providing this opportunity.

Students commented – “Thank you so much for organizing the CNS tour. I loved seeing the facility and learned so much from the tour. This was definitely a highlight of my summer!”

“I would like to thank you for the opportunity to tour the Cooper Nuclear Station! It was truly amazing. I have since been considering taking electives in nuclear engineering because of this.”

Interns presented posters at the UNL Summer Research Symposium on August 5th. An intern said, “Participating in this internship has helped prepare me for future research

endeavors throughout the rest of my undergraduate degree and beyond. I feel more comfortable with the research process and especially with learning to communicate and present my work to others.

This summer allowed me to create my first poster, and I loved sharing my work with others at the summer poster session. Your support of this internship has helped me become a better researcher, and I could not be more grateful for the knowledge and experiences I have gained as an NCSR summer intern.”

Interns and faculty sponsors provided a thank you and summaries of the summer projects that were provided to NPPD. All of them were extremely grateful for the support of the NCSR, NPPD, and its customers for giving them the energy sciences research opportunity.



Workshop Educates Researchers

Guidance Given on Entrepreneurship and Intellectual Property (IP)



The NCESR collaborated with NPPD, NUtech Ventures and Innosphere Ventures to conduct an Energy Center Entrepreneurship Workshop on August 11 and 12, 2022. UNL research faculty, postdocs and graduate students who have been involved with NCESR funded research projects learned from **Roman Estrada**, NPPD Generation Research Sr. Program Manager and NCESR Liaison about the relationship between NPPD and University of Nebraska-Lincoln (UNL) that created NCESR. NCESR supports innovative research and interdisciplinary collaboration by annually funding competitive two-year seed grants for energy sciences research.

He shared how NPPD wants to continue to grow startups after the two-year grant work is completed; invest to support potential IP/royalties options from this work; keep UNL talent in Nebraska; and get more projects that are focused on supporting specific energy industry advancement and efficiencies. Workshop participants learned from Innosphere Ventures about strategies for starting, funding and being successful with their own company. NUtech presented an overview of IP, how to disclose new inventions to their office, how licensing works and some additional training opportunities. Entrepreneurs within the community served as guest panelists and shared their knowledge and experiences.

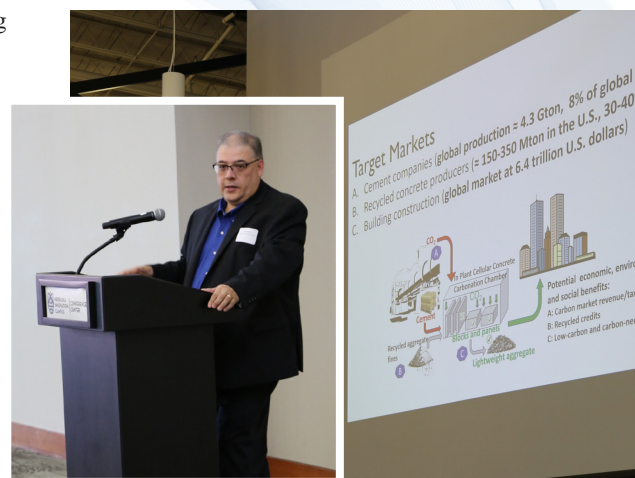
To put into practice some of what they learned, participants received

coaching about creating and presenting a brief pitch deck.

"I just want to thank NUtech and NCESR for hosting this Energy Center Entrepreneurship Workshop," **Jiong Hu** said. "As a researcher, we always want our research products to be applied and used, as it will benefit not just us at UNL, but also the entire society. However, we don't always think from the entrepreneurial viewpoint, which often narrows the opportunities and limits the impact on the larger community."

He added, "The workshop gave us a comprehensive view of how to better position ourselves to put our products on the market. It was also a great experience to pitch our research products in front of the guest panel with local entrepreneurs and funding organizations and receive constructive feedback from the experts. I look forward to opportunities that might present in the near future."

"The unique collaboration between NUtech, Innosphere, and the Energy Center has set a model in place for effective entrepreneurial training," said Jerry Hudgins, interim director of the NCESR. "The focus on the energy sector is of course foundational to economic development in Nebraska and in support of the strategic goals of the University of Nebraska. We look forward to continuing and expanding this successful activity next year."



Roman Estrada (NPPD and NCESR Liaison) was a key speaker at the event. Dr. Hu presented his pitch deck to participants.

Learn more about NCESR, NPPD, NUtech and Innosphere who conducted this workshop.



Dr. Lucia Fernandez-Ballester

Instrumentation Grant Awarded to Dr. Lucia Fernandez-Ballester

NCESR awarded an instrumentation grant in 2022 in addition to the annual two-year seed grants in energy sciences research. The intent of this funding is for an innovative laboratory instrument(s) that will facilitate energy science research and be accessible to all faculty, researchers, and students at UNL. Fourteen proposals competed for this funding. NPPD was part of the review committee that selected **Dr. Lucia Fernandez-Ballester**, Assistant Professor in Mechanical and Materials Engineering to receive the award. The title of her project is Flash Differential Scanning Calorimeter acquisition for novel energy materials and thin films.

Farewells and Introductions to NCESR

Congratulations to Lorraine Moon on her Retirement and Welcome Sue Wesely

Lorraine Moon, NCESR Office Associate retired on July 15, 2022 after working 47 years with UNL. NCESR thanked Lorraine for her many years of service and dedication to UNL and the Energy Center with a plaque and cards sent by many UNL colleagues and external partners.

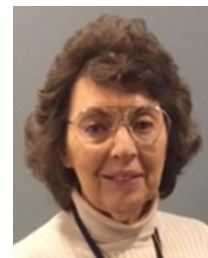
Susan (Sue) Wesely started as the new NCESR Administrative Associate on September 30, 2022. In this role, Sue provides general office support to faculty, staff, and external partners of the NCESR.

She assists with monitoring Energy Center funded-projects, maintaining the website, recording project reporting information, tracking publications and citations related to Energy Center

funding, and assisting with newsletters, meetings and events. Susan came to the Energy Center from the Nebraska Department of Health and Human Services, where she was an office manager for several public health programs. Susan grew up on a farm in Saunders County.

She has an Office Professional Associate degree from Southeast Community College in Lincoln. She is a proud parent of 4 children - Brianna 22, Nathan 18, Tyler 18, and Wyatt 18 (triplet boys).

In her spare time, she enjoys going for walks, working on mind puzzles, reading books, journal writing, and container gardening. She cherishes her family most of all.



Lorraine Moon



Susan Wesely



The Team



NCESR TEAM: *top row*
Dr. Jerry Hudgins, Interim Director
 (Chair, Electrical and
 Computer Engineering)
Dr. Mark Riley, Associate Director
 (Associate Dean, College
 of Engineering)
Brenda Coufal, Program Coordinator
Susan Wesely, Administrative
 Associate

NPPD PARTNERS: *bottom row*
Tom Kent, President & CEO and NCESR
 External Advisory Committee Vice Chair
Jerry Chlopek, Board of Directors Chair and
 NCESR External Advisory Committee
Mary Harding, Board of Directors and NCESR
 External Advisory Committee
John McClure, Executive Vice President
 External Affairs & General Counsel

John Swanson, Director of Generation
 Strategies & Research and NCESR Liaison
Roman Estrada, Generation Research Sr.
 Program Manager and NCESR Liaison
Alan Dostal, Part-time Director of Research
 and NCESR Liaison
Tannon Asche, Community Engagement
 & Public Relations Lead
Jan Modelski, Assistant Secretary to the Board



Cycle 17 NCESR Projects

New projects bring new purpose

Six new UNL research projects were selected for funding by the Energy Center in its 17th annual research grant competition. The faculty selected for the awards are Professors:

THE PROJECTS

Co-application of Biochar and Biosolids for Carbon Sequestration and Sustainable Soil Management in Urban-Agricultural Landscapes



Relates to NPPD Low-Carbon Initiative (Carbon Sequestration)

PRINCIPAL INVESTIGATOR (PI)
Dr. Michael Kaiser,
Department of Agronomy &
Horticulture

The implementation of sustainable soil management strategies in urban-rural transition zones has the potential to improve soil health and resource efficient food production and to decrease the carbon footprint of municipalities located in regions of high agricultural intensity. This project will determine the effects of biosolids, processed wastewater solids, and/or biochar application to farmland managed under no-till and cover crops on critical soil health indicators such as carbon sequestration as well as nitrate and water retention. The outcome of this holistic approach will help to guide farmers and municipalities in improving soil ecosystem services in urban-agricultural landscapes.

Additive Manufacturing of Advanced Magnets for Power Systems ((AM)²PS)



PI
Dr. Jeff Shield,
Department of Mechanical and
Materials Engineering

Electrical motors account for approximately half of the U.S. use of electricity. Improved motor efficiencies, even of a few percent, would profoundly impact society. Permanent magnets are critical components of motors, and developing new materials and processing routes are the key to better motors. This project will develop additive manufacturing (3D printing) approaches for high-energy permanent magnets. Using additive manufacturing will reduce waste of critical materials and allow new motor designs which will improve efficiency of motors and generators, enhancing battery life and reducing electricity usage.

Photocatalytic Corrosive Nanostructured Electrode to Split Water



Relates to NPPD Low-Carbon Initiative (Alternate Fuels)

PI
Dr. Ravi Saraf,
Department of Chemical and
Biomolecular Engineering

Hydrogen generation from water using solar radiation is an attractive clean energy source. The challenge has been to efficiently generate free-energy gradient to split water into hydrogen and oxygen, respectively. Recently, the efficiency photo-electrocatalytic process has been enhanced by conjoining the traditional semiconductor electrode with metal nanoparticles. In this research, an electrode composed of necklaces of gold nanoparticles nano-cemented with semiconductor material will be developed to obtain multi-junction metal/semiconductor coupling for enhanced catalysis. The electrically conducting nanoparticle necklace network will be a “corrosive” electrode with oxidation and reduction on the same electrode with large metal/semiconductor interface area per volume.

Smart Grid cybersecurity Enhancement using Smart Authentication and Intelligent Threat Detection



PI
Dr. Byrav Ramamurthy,
School of Computing

The energy network is becoming increasingly complex, evolving into a Smart Grid cyberinfrastructure relying on the Internet for connectivity and customer equipment and other Internet of Things (IoT) devices for efficient operation. This poses operational risks for energy companies and increases the security perimeter now vulnerable to malicious attackers from across the globe. Intelligent responses are required in the form of automated and AI/ML based solutions for smart authentication of end-user devices and real-time traffic analysis informed by distributed threat intelligence frameworks. Cybersecurity education focusing on Smart Grid security is imperative for training the next generation of the energy workforce.

Biohydrogen Systems for Electricity and Transportation



Relates to NPPD Low-Carbon Initiative (Alternate Fuels)

PI
Dr. Paul Blum,
School of Biological Sciences

Microbes ferment renewable agricultural waste feedstocks to produce green energy gases including molecular hydrogen (H₂) and methane (CH₄). This project seeks to increase the availability of renewable biohydrogen using specialized microbes and unique research approaches. The project outcomes will increase overall renewable hydrogen availability and complement other technologies notably wind-generated electricity that powers water electrolysis. This project addresses the latest NCESR research topics and fits directly within two major pieces of Federal energy legislation that mandate increased national hydrogen production. Consequently there are unique opportunities to commercialize the proposed technologies leading to benefits in Nebraska and across the United States.

Reducing energy to produce corn ethanol by optimizing fermenter operation and off gases treatment



Relates to NPPD Low-Carbon Initiative (Alternate Fuels and Reduced Carbon)

PI
Dr. Bruce Dvorak
Department of Civil and Environmental Engineering

Gaseous emissions from corn ethanol fermentation and the drying of wet distillers grain in ethanol plants are regulated, require treatment, and use 6-12% of a plant's energy. This project builds on recent studies and on-going field data collection to optimize ethanol plant operations when innovative air emission practices are applied. Implementing innovative air emission abatement approaches may reduce ethanol production costs by 2 to 4%, reduce energy needs by 5 to 20%, and Carbon Intensity (CI) (1-3 gCO₂E/MJ). This proof-of-concept study will help direct and justify further ethanol plant implementation and grant-funded research.



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