Nebraska Center for Energy Sciences Research
Benefits Review

NPPD Board of Directors Meeting
Strategic Business Matters
April 10, 2025

George Gogos
Director, NCESR
University of Nebraska

John Swanson
Director of Generation
Strategies & Research

NEBRASKA CENTER FOR ENERGY SCIENCES RESEARCH

Nebraska Public Power District
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IN OUR GRIT, OUR GLORY™

Organizational Chart

External Advisory Committee (EAC)

University of Nebraska-Lincoln

- **Rodney Bennett –** Chancellor; EAC Chair
- **Jennifer Nelson –** Interim Vice Chancellor for Research & Innovation

Nebraska Public Power District

- **Thomas Kent –** President and CEO; EAC Vice-Chair
- **Jerry Chlopek –** Chair, NPPD Board of Directors
- **Ron Mogul –** Operations Committee Chair, NPPD Board of Directors

UNL

Rodney Bennett – Chancellor

Jennifer Nelson – Interim Vice Chancellor for Research & Innovation

NCESR

George Gogos – Director
Mark Riley – Associate Director
John Swanson – NPPD Liaison
Roman Estrada – NPPD Liaison
Alan Dostal – NPPD Liaison

Executive Council

- **Tala Awada -** Agricultural Research Division
- **Karrie Weber -** Biological Sciences
- **Alexander Sinitskii -** Chemistry
- **George Gogos -** Mechanical & Materials Engineering
- **Mark Riley -** Biological Systems Engineering
- **Shireen Adenwalla -** Physics and Astronomy
- **John Swanson -** NPPD
- **Roman Estrada –** NPPD
- **Alan Dostal** - NPPD

Mission

*To **conduct energy research** that produces new technologies, processes and systems that **provide new or significantly enhanced energy sources** and **improve the quality of life and economic opportunity for Nebraskans***

(Energy Center Charter Document)

NPPD's research funding at UNL is impactful to NPPD customers and all Nebraskans

To Accomplish the Mission

- Train Students
- Fund Research in Energy Efficiencies and Sustainable forms of Energy
  - Seed projects in promising new areas
  - Facilitate interdisciplinary collaborations
- Have Economic Impact & Leverage Funding
  - Attract external funding from federal agencies, foundations and other public or private entities
  - Work with NPPD to identify problems that Nebraskans and the nation face and provide solutions
  - NEW Vision to expand Energy Center
- Efficient and Effective Operations

Student Opportunities

Darrell J. Nelson

Darrell J. Nelson Summer Undergraduate Internships

- Annual summer internships in energy sciences research
  - Internships started in 2014
  - 8 internships are available annually with a maximum $6,000 stipend
    - with a $1,000 travel fund for the intern to present at a relevant conference
  - Program attracts outstanding students interested in energy science
- NCESR & NPPD will host a Meet & Greet for interns and faculty sponsors May 19, 2025
- Interns & Faculty Sponsors will tour Cooper Nuclear Station in the Summer of 2025
- Interns will present posters displaying the results of their work at the Summer Research Symposium early August 2025
- Interns' reports are due September 30, 2025

Darrell J. Nelson

Summer Internships Testimonials

- “The NCESR Summer Research Internship is a very valuable experience for any aspiring scientist to participate in. Whether or not someone is passionate about the energy industry, it is undeniable that there is great value to energy research and the NCESR Summer Research Internship gives great exposure to students for becoming great scientists and problem solvers. NCESR and NPPD care about giving the interns a great experience and have been very beneficial in my growth as someone getting an engineering degree. ”

- “With this grant, I was able to fund an amazing summer research experience with an environmental and energy focus. We were also able to go on an exciting, guided tour of the Cooper Nuclear Station here in Nebraska which I never would have been able to experience otherwise. This program has helped me develop skills such as data analysis, efficient experimental design, and unique microbiological lab techniques with methanogens that will be useful in the bioenergy field. I would absolutely recommend this program to students interested in getting involved with energy sciences and research. ”

- “Throughout the NCESR internship, I was able to learn from graduate students and professors in my lab as well as about nuclear energy through a visit to Cooper Nuclear Station. These experiences have been vital for me to get experience in a lab and learn more about the energy we rely on as a society. Going to the nuclear station opened my eyes to how strict of a regiment they run and that safety for the public is of utmost importance.”

Poster Presentations at UNL Student Research Days

- 20 posters relating to Energy Center funded projects were presented March 26 - 27, 2024
  - 5 Undergraduate Student Posters
  - 15 Graduate Student Posters
- The next UNL Student Research Days will be April 15 - 16, 2025

2024 Undergraduate Students Group with Dr. Gogos and Roman Estrada
(One student wasn't available for the group photo.)

2024 Graduate Students Group with Dr. Gogos and Roman Estrada

The Research

Process – Schedule/Timeline

up to 6 NPPD Executives & Board Members participate

- **Cycle 19** (2025 – 2026)
  - 22 Preproposals were received by 5/15/2024
  - 10 Full Proposals were received upon invitation by 7/31/2024
  - 5 projects were selected and started on 1/1/2025
  - Progress Reports are due by 7/31/2025
  - Progress Review Meeting is on 10/15/2025
    - This review will determine proposals to be funded for Cycle 19 Year 2

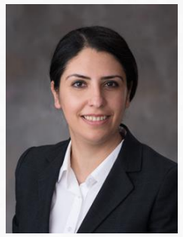
Cycle 19 Grant Recipients (5 total)

Focus Area	PI	Proposal Title
Electric Utility Priorities	**Bai Cui**	Advanced manufacturing of high-temperature alloy components for small modular reactors (SMR)
Electric Utility Priorities	**Mona Bavarian**	Innovative Approaches to Sustainable Agriculture: Greening Ammonium Sulfate Production
Electric Utility Priorities	**Yongfeng Lu**	Enhanced Hydrogen Generation and Utilization using Femtosecond Laser-Nanostructured $NiCo_2O_4$ Electrocatalysts
Multiple Focus Areas (Electric Utility, Energy use in transportation and electricity generation, Carbon and Nebraska's Bioeconomy)	**Nicole Buan**	Enhanced CO_2 transport for high-efficiency biological carbon capture and biofuel fermentation
Other Category	**Graham Kaufman**	Innovative Solutions for Data Center Thermal Management: Oxide-Free Femtosecond Laser Processed Copper Surfaces

Cycle 19 Grant Recipients (5 total)

Enhanced CO_2 transport for high-efficiency biological carbon capture and biofuel fermentation

Nicole Buan, Professor
Biochemistry

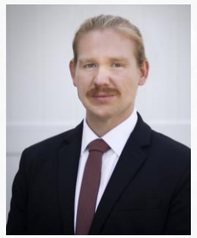


Innovative Approaches to Sustainable Agriculture: Greening Ammonium Sulfate Production

Mona Bavarian, Assistant Professor
Chemical & Biomolecular Engineering

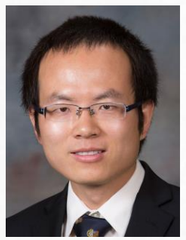
Enhanced Hydrogen Generation and Utilization using Femtosecond Laser-Nanostructured $NiCo_2O_4$ Electrocatalysts

Yongfeng Lu, Lott Distinguished University Professor
Electrical & Computer Engineering



Innovative Solutions for Data Center Thermal Management: Oxide-Free Femtosecond Laser Processed Copper Surfaces

Graham Kaufman,
Research Engineer, Research Assistant Professor
Electrical & Computer Engineering



Advanced manufacturing of high-temperature alloy components for small modular reactors (SMR)

Bai Cui, Professor
Mechanical & Materials Engineering

Process – Schedule/Timeline continued…

up to 6 NPPD Executives & Board Members participate

- **Cycle 20** (2026 – 2027)
  - ➢ **Request for Preproposals** (RFP) **Released 3/17/2025**

Research Focus Areas (selected with NPPD's guidance)

Electric utility priorities:

- Integration of renewables with fossil fuels
- Electric system reliability and resiliency – modeling tools
- Energy storage with potential for use at utility scale
- Advanced renewable energy technologies including next-generation solar and utility scale geothermal
- Energy generation using hydrogen, nuclear, ammonia and biofuels
- Basic science to support nuclear fusion development
- Hydrogen production including geologic extraction as a clean and cost-effective fuel source
- Use of ammonium sulfate in agriculture and other productive uses
- Artificial Intelligence (AI)-driven predictive analytics to optimize energy production, transmission, distribution, and consumption
- Small Modular Reactors (SMRs): compact, scalable nuclear reactors with enhanced safety features
- Zero carbon electricity generation

Energy Efficiency:

- Prevention of corrosion of center pivot irrigation system components
- Improve electrical efficiency of data centers and bitcoin mining technologies
- Energy efficiency in buildings
- Electric vehicles – energy issues related to efficiency, charging, batteries, and others

Energy use in transportation and electricity generation:

- Ethanol as a component of sustainable aviation fuel (SAF) or for electricity generation
- Electric powered off-road vehicles for agriculture, commercial and recreational use
- Hydrogen based vehicles including agricultural equipment
- Hydrogen detection equipment and related instruments

Carbon:

- CO_2 capture and sequestration and other productive uses of carbon/carbon dioxide
- Decarbonization processes for heavy industries
- Carbon measurement instrumentation and tools to ensure compliance with applicable standards
- Biochar production and utilization
- Prevention of methane release to the atmosphere
- Prevention of N_2O release to the atmosphere
- Circular energy systems – recycling waste materials into energy-generating systems

Nebraska's Bioeconomy:

- New approaches to utilize Nebraska's agricultural and natural resources to advance the local bioeconomy (for example: sustainable aviation fuel, and other energy related materials applications)
- Efficient use of water, energy and other critical feedstocks for production agriculture
- Agrivoltaics (farming amongst solar farms)
- Cellulosic biomass for aviation fuel
- New usage and approaches to utilize Nebraska based corn stover for generation or industrial setting
- Ethanol based electricity generation and/or hydrogen production

Energy literacy:

- Engages the public to increase knowledge of timely energy topics including energy sources, generation, storage, transmission and current limitations of technologies
  - Nuclear SMR and clean biofuels and carbon capture

Contact the NCESR Director to discuss consideration of any idea(s) that can enhance energy efficiency and/or contribute to the development of cost effective, sustainable forms of energy that may not be included in the above list.

Process – Schedule/Timeline continued…

up to 6 NPPD Executives & Board Members participate

- Cycle 20
  - Preproposals will be reviewed by Executive Council (EC) on 6/13/2025
  - A select number will be invited to submit Full Proposals by 7/31/2025
  - Subject matter experts outside of UNL will review the Full Proposals
  - Principal Investigators will present Full Proposals to EC in November 2025
    - This is scheduled once Faculty on the EC know their fall teaching schedule
    - EC will determine which projects to recommend to External Advisory Committee (EAC) for Funding
  - EAC will Select Projects for Funding on 12/9/2025

The Impact

ENERGY CENTER CHRONICLES

January 31, 2025 — *NE Center for Energy Sciences Research-Progress Through NCESR and NPPD Collaboration*

Director's Corner

Dr. George Gogos, NCESR Director highlights NCESR research success of faculty and students in the Director's Corner. Read here the first highlighted story about Dr. Shudipto Konika Dishari. Continue reading...

Nicole Buan, Mona Bavarian, Yongfeng Lu, Graham Kaufman, Bai Cui

NCESR is Honored to Announce the NEW Cycle 19 Funding Awards

Cycle 19 funding started January 1, 2025. Learn about who was awarded funding and their projects. Continue reading...

Xiaoshan Xu, Eric Markvicka, Jian Wang, Siamak Nejati

Joseph Turner, Moe Alahmad, Francis John Hay, Seunghee Kim, Wei Niu

Cycle 18 Progress Resulted in Year 2 Funding

See who received Cycle 18 Year 2 funding and read how it is determined. Continue reading...

ChemE Cube Team Competes in Direct Air Capture Competition

NCESR Newsletter

Started the *Energy Center Chronicles* in 2022

- This is an outcome of the external review of the Energy Center for increased communications
  - Starting in 2025, the newsletter highlights success stories that fulfill NPPD/NCESR's mission
- The frequency of the e-newsletter is 3 times per year
- It is disseminated to:
  - UNL faculty and students involved with NCESR
  - NPPD leadership, staff & customers
- The newsletter and subscription are available on the NCESR and NPPD websites
- NPPD also posts on social media

Thank You *to the many individuals from NPPD and UNL who provide content and edits.*

Return on Investment

Return on Investment

Description	As of March 2025
External Funds Awarded to Recipients of NCESR-funded Seed Grants: **Cycle 1 through Cycle 18***	$ 136.85 million
Other External Funds Awarded to UNL and Administered through NCESR: **Cycle 1 through Cycle 18*** *(Excludes cycle funding, only includes special projects)*	$ 7.28 million
Total External Funds	$ 144.13 million
NCESR-funded Seed Grants: Cycle 1 through Cycle 18* *(Includes Instrumentation Funding)*	$ 17.43 million

Overall Return on each $1 invested . . . $ 8.27

*Cycle 19 is not figured in these numbers since those projects are only a few months into their work & external funding is minimal.

Return on Investment continued…

Overall Return on each $1 invested . . . $ 8.27

Economic development report compiled by Tripp Umbach, a national consulting firm

https://news.unl.edu/article/nebraskas-flagship-is-an-economic-driver-for-cornhusker-state [news.unl.edu]

"For every $1 the state invests in the University of Nebraska, we generate $10 in economic activity — an extraordinary return on investment."

Jeffrey P. Gold
NU president

By the Numbers (as of March 2025)

- **143 Research Projects funded for Cycles 1-19**
  - Includes seed & instrumentation funding
- **599 Publications with 35,212 Citations**
  - Includes Cycles 1-18 and the Water, Energy & Agriculture Initiative (WEAI)

    (Cycle 19 isn't included since it started on 1/1/2025 & the first PI reports won't be received until July 2025)
  - Includes journals, books & conference presentations that have been published
  - Plus, there are another 1,018 conference presentations and poster presentations not published
- **753 Students working with Cycles 1-18** (counting students each time they worked on a different cycle, etc.)

  (Cycle 19 isn't included since it started on 1/1/2025 & the first PI reports won't be received until July 2025)
  - Includes a student each time if reported on multiple cycles / was a summer intern more than once / worked on a cycle as an undergrad, then another cycle as a grad student or postdoc
  - Includes students from PI reports (undergrads, grad students, postdocs) & summer interns

By the Numbers (as of March 2025) continued…

- **$ 18.10 M investment from NPPD (Cycles 1-18) and $18.58M (Cycles 1-19 year 1)**
  - Includes seed & instrumentation funding, special projects, summer interns
- **13 patents awarded and 6 pending from NCESR Researchers**
  - Information is received from NUtech
- $136.85 M Total External funding for Cycles 1-18
  - *Cycle 19 is not figured in these numbers since those projects are only a few months into their work & external funding is minimal.*
- **$100's M economic benefit to Nebraskans**

Current Activities of NCESR

1. **Biochar**
   - **NPPD introduced biochar as a focus area for research several years ago**
   - **NCESR funded (4 projects) – a cluster of biochar researchers at UNL was the result**
   - **NCESR organized two major workshops**
     - Multi-state participation
     - USDA participation
   - **NCESR supported a Midwest Biochar Conference organized by NCESR funded researchers**
   - **NCESR is currently providing leadership for a large proposal to be submitted to USDA**
     - $10 million – Eastern Redcedar as biochar source
     - NE, IA & KS – proposal participants (Nebraska is leading this multi-state effort.)
     - Use biochar for soil health improvement in agriculture
     - Stakeholders:
       - **NPPD**
       - **Beneficiaries in all three states: Farmers, Ranchers (removal of redcedar), Biochar producers, Municipalities, Nebraska Biochar**
   - **NCESR funds research on biochar addition to concrete**

Current Activities of NCESR continued…

2. **Nuclear Engineering Certificate in the College of Engineering**
   - Teaching and research in collaboration with NPPD's Cooper Nuclear Station

3. **Orano, a company that safely stores and monitors used nuclear fuel for NPPD**
   - NCESR facilitated research collaborations with UNL to improve Orano's operations

4. **Tenka Solar, a $7.5 billion revenue company headquartered in Europe**
   - Supported ISI (a Nebraska EPC) to establish Tenka Solar USA
     - $250 – 300 million investment
     - About 400 employees
     - Location: Central City, NE
   - NCESR facilitated research collaborations with UNL to keep Tenka Solar competitive

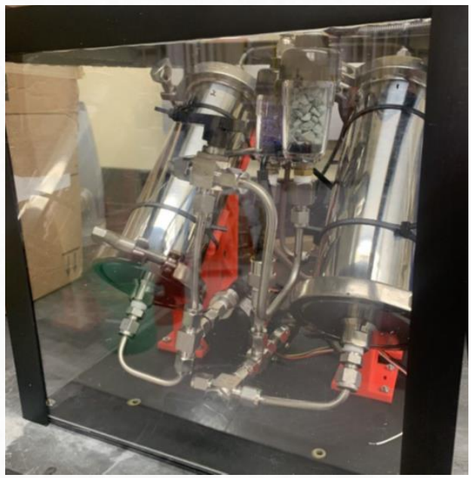
5. **Prevent corrosion of center pivot irrigation**
   - Responded to Director Troester's request
     - Identified two UNL researchers with expertise in corrosion
     - Developed a research proposal
     - Research plan to work with industry to benefit Nebraska Companies (Lindsay/Zimmatic, Valmont/Valley, Reinke, T-L Irrigation) and Nebraska farmers

Current Activities of NCESR continued…

6. UNL ChemE Cube Project Sponsorship

- UNL ChemE Cube Team is with the University of Nebraska-Lincoln American Institute of Chemical Engineers (AIChE) student chapter
- The Team consists of about 25 chemical & biomolecular engineering students ranging from freshmen to seniors
- They contacted Roman Estrada at NPPD, and he connected them with the Energy Center
- Energy Center provided a $5,000 Sponsorship to build their project and compete at the AIChE student conference in San Diego, CA in October 2024
- **The competition requirement was to build a one cubic-foot box that will perform direct CO_2 air capture using adsorption and present a business pitch about the design**

- **Their unique design aimed to capture CO_2 onto activated carbon, specifically activated carbon made from corn stover and other agricultural byproducts from Nebraska**



The Operations

NCESR and NPPD Team

The Team

NCESR TEAM: *top row*
Dr. George Gogos, *Director (Professor and Associate Chair for Research and Graduate Studies, Wilmer J. and Sally L. Hergenrader Chair of Mechanical & Materials 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*
Ron Mogul, *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, *Associate Director of Research and NCESR Liaison*
Kathy Fadschild, *Communication Specialist*
Jan Modelski, *Assistant Secretary to the Board*

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Questions?

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