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Northwestern | CENTER FOR ENGINEERING SUSTAINABILITY AND RESILIENCE

CESR Newsletter, February 7, 2025

CESR NEWS

Jamboree Sparks New Vision for University-Wide Water Research

Interdisciplinary event united faculty to tackle water challenges and sustainability

By Brian Sandalow, McCormick Engineering News 1/31/25

During the Northwestern Water Jamboree held January 28 at Nona Jo's Café inside the Walter Athletics Center, a poster titled "NU Water: The Past, Present, and Future," displayed important milestones in water research and related developments at the University with yellow sticky notes.

Following the jamboree, Northwestern faculty are confident there will be plenty of future entries on the poster.

"We want this timeline to be a living one," said **Sera Young**, professor of anthropology at the **Weinberg College of Arts and Sciences**, who co-organized the event. "While we have key [events] up there, the future lies at our feet."

Hosted by the **Center for Water Research** (CWR) and the **Center for Engineering Sustainability and Resilience** (CESR), the jamboree brought together an interdisciplinary group of faculty for an interactive meeting geared toward the early development of a new, University-wide vision for water-related research, education, and impact at Northwestern. Twenty-seven professors, including 10 with primary appointments at Northwestern Engineering, shared their research focuses during one-minute lightning talks.

Read the Complete Article

ANNOUNCEMENTS and ACCOMPLISHMENTS of CESR FACULTY AFFILIATES

Stormwater Pollution Sucked Up by Specialized Sponge

Scientists reimagine lifecycle for non-renewables like metal, phosphates

By Win Reynolds, McCormick Engineering News 2/5/25

As more waterways contend with algae blooms and pollution caused by minerals from agricultural runoff and industrial manufacturing processes, new methods to remove pollutants like phosphate, copper, and zinc are emerging across fields.

While solutions exist, they tend to be costly and can be used just once. But a specialized sponge created by Northwestern Engineering researchers at Northwestern University that works to slurp up pollutants, and then release them as desired, may present a reusable, low-cost solution.

The sponge, coated with nanoparticles that have an affinity for pollutants, can collect metals like zinc and copper, as well as phosphate, and in previous iterations has successfully pulled lead from water, and microplastics and oil from lakes and oceans. It then releases these valuable resources when it is exposed to different pH's.

In a paper **published Feb. 5 in the American Chemical Society journal Environmental Science & Technology Water**, researchers define a method to tailor their platform to specific

Chicago pollutants and then selectively release them, giving resources that typically must be mined a potential for a second life.

“The technology can be used as a universal sorbent or ‘catch-all,’ or it can be tailored to certain groups of contaminants like metals, plastics, or nutrients,” principal investigator **Vinayak Dravid** said.

Read the Complete Article

A ‘Volume Dial’ for Missed Signals Produced by Our Bodies

System that monitors contaminants in drinking water now sensitive enough to detect tiny nucleic acids

By Win Reynolds, McCormick Engineering News 1/13/25

An unplugged electric instrument may function, but it sounds much better when it is connected to an amplifier and pedals. Similarly, toxins and other small molecules at low concentrations in the environment or human body may emit quiet signals that are undetectable without specialized lab technology.

Now, thanks to a “cool trick in biochemistry” used to adapt a sensing platform already being deployed by Northwestern Engineering scientists to measure toxins in drinking water, researchers can detect and even measure chemicals at low enough concentrations to have use outside the lab. By attaching circuitry akin to a volume knob to “turn up” weak signals, the team opened the door for the system to be applied to disease detection and monitoring in the human body for nucleic acids like DNA and RNA, as well as bacteria such as E. coli.

The results, which describe a system that is 10 times more sensitive than previous cell-free sensors built by the team, **were published** January 13 in the journal Nature Chemical Biology.

Read the Complete Article

RECENT PUBLICATIONS

Neal Blair, Professor of Civil and Environmental Engineering and Earth and Planetary Sciences

Title: **"Molecular-level exploration of spatiotemporal dynamics of fluvial particulate organic carbon sources during storm events: Using a high-temporal resolution multi-biomarker approach"**
Authors: Jieun Kim, Neal E. Blair, A.N. Thanos Papanicolaou
Publication: Science of the Total Environment, February 1, 2025

Giuseppe Buscarnera, Professor of Civil and Environmental Engineering

Title: **"Role of the particle size and shape dispersion on stress transmission and strain energy storage"**
Authors: Yang Li Giuseppe Buscarnera
Publication: Géotechnique Letters, January 10, 2025

Jian Cao, Associate Vice President for Research; Cardiss Collins Professor of Mechanical Engineering and (by courtesy) Civil and Environmental Engineering and Materials Science and Engineering; Director, Northwestern Initiative for Manufacturing Science and Innovation (NIMSI)

Kornel F. Ehmann, Professor Emeritus of Mechanical Engineering

Title: **"Effect of Closed-Loop Coaxial Melt Pool Temperature Control on Thermal History and Microstructure of Nickel Alloy 718 in Directed Energy Deposition"**
Authors: Samantha Webster, Jihoon Jeong, Jon-Erik Mogonye, James Zuback, Shuheng Liao, Julian Rocher, Kornel Ehmann, Jian Cao
Publication: Journal of Materials Processing Technology, January 17, 2025

Bin Chen, Research Assistant Professor of Chemistry

Ted Sargent, Lynn Hopton Davis and Greg Davis Professor of Chemistry; Professor of Electrical and Computer Engineering; Co-Executive Director, Paula M. Trienens Institute for Sustainability and Energy

Title: **"Carboxyl-functionalized perovskite enables ALD growth of a compact and uniform ion migration barrier"**
Authors: Deokjae Choi, Donghoon Shin, Chongwen, Yuan Liu, Abdulaziz S.R. Bati, Dana E. Kachman, Yi Yang, Jiachen Li, Yoon Jung Lee, Muzhi Li, Saivineeth Penukula, Da Bin Kim, Heejong Shin, Chiung-Han Chen, So Min Park, Cheng Liu, Aidan Maxwell, Haoyue Wan, Nicholas Rolston, Edward H. Sargent, Bin Chen
Publication: Joule, January 9, 2025

Gianluca Cusatis, Professor of Civil and Environmental Engineering and (by courtesy) Mechanical Engineering

Title: **“Transformation and regression statistics of the size-effect method for determining fracture energy and process zone size in quasi-brittle materials”**
Authors: Madura Pathirage, Gilles Pijaudier-Cabot, David Grégoire & Gianluca Cusatis
Publication: Materials and Structures, January 15, 2025

Title: **“Integrated cyclic fiber-bridging model encompassing buckling characteristics of both steel and PE fibers”**
Authors: Yingwu Zhou, Arslan Shamim, Zhongfeng Zhu, Gianluca Cusatis, Feng Xing
Publication: Engineering Structures, January 20, 2025

Vinayak Dravid, Abraham Harris Professor of Materials Science and Engineering; Founding Director, Northwestern University Atomic and Nanoscale Characterization (NUANCE) Center; Founding Director, Soft and Hybrid Nanotechnology Experimental (SHyNE) Resource, an NSF-NNCI Node

Title: **“Chromatin conformation, gene transcription, and nucleosome remodeling as an emergent system”**
Authors: Luay M. Almassalha, Marcelo Carignano, Emily Pujadas Liwag, Wing Shun Li, Ruyi Gong, Nicolas Acosta, Cody L. Dunton, Paola Carrillo Gonzalez, Lucas M. Carter, Rivaan Kakkaramadam, Martin Kröger, Kyle L. MacQuarrie, Jane Frederick, I Chae Ye, Patrick Su, Tiffany Kuo, Karla I. Medina, Josh A Pritchard, Andrew Skol, Rikkert Nap, Masato Kanemaki, Vinayak Dravid, Igal Szleifer, Vadim Backman
Publication: Science Advances, January 10, 2025

Title: **“Rinse, Recover, Repeat: pH-Assisted Selective Extraction of Phosphate and Metals with a Sponge Nanocomposite”**
Authors: Kelly E. Matuszewski, Benjamin Shindel, Vikas Nandwana, Vinayak P. Dravid
Publication: ACS Environmental Science and Technology Water, February 5, 2025

David Dunand, Professor of Materials Science and Engineering

Title: **“Ti2AlNb microlattices via 3D ink-extrusion printing and sintering of precursor powders”**
Authors: Ya-Chu Hsu, David C. Dunand
Publication: Additive Manufacturing, February 5, 2025

Title: **“Microstructure and creep properties of Al-7Ce-3Ni-8Mg alloys fabricated by laser powder bed fusion of powder blends”**
Authors: Hyeji Park, Clement N. Ekaputra, David C. Dunand
Publication: Materials Science and Engineering: A, February 3, 2025

David Dunand, Professor of Materials Science and Engineering

Jeffrey Lopez, Assistant Professor of Chemical and Biological Engineering

Title: **“Hierarchically Porous SnO2/Cu Composites via Freeze Casting and Selective Cu Reduction”**
Authors: Jean Pascal Fandré, Samuel Pennell, Sapna Lalitha Ramesh, Jeffrey Lopez, Ralph Spolenak, David Christophe Dunand
Publication: Advanced Engineering Materials, January 23, 2025

Omar Farha, Charles E. and Emma H. Morrison Professor in Chemistry; Chair, Department of Chemistry

Title: **“Thorium metal–organic framework crystallization for efficient recovery from rare earth element mixtures”**
Authors: Madeleine A. Gaidimas, Courtney S. Smoljan, Zi-Ming Ye, Charlotte L. Stern, Christos D. Malliakas, Kent O. Kirlikovali and Omar K. Farha
Publication: Chemical Science, January 31, 2025

Omar Farha, Charles E. and Emma H. Morrison Professor in Chemistry; Chair, Department of Chemistry

Randall Q. Snurr, John G. Searle Professor of Chemical and Biological Engineering

Title: **“Lowering Linker Symmetry to Access Zirconium Metal–Organic Frameworks for Inverse Alkane/Alkene Separations”**
Authors: Dr. Chenghui Zhang, Dr. Filip Formalik, Dr. Daofei Lv, Dr. Fanrui Sha, Dr. Kent O. Kirlikovali, Dr. Xiaoliang Wang, Dr. Xianhui Tang, Shengyi Su, Dr. Haomiao Xie, Dr. Yongwei Chen, Prof. Zhibo Li, Prof. Randall Q. Snurr, Prof. Omar K. Farha
Publication: Angewandte Chemie, January 20, 2025

Julius Lucks, Professor of Chemical and Biological Engineering

Title: **“A cell-free biosensor signal amplification circuit with polymerase strand recycling”**
Authors: Yueyi Li, Tyler Lucci, Matias Villarruel Dujovne, Jaeyoung Kirsten Jung, Daiana A. Capdevila & Julius B. Lucks
Publication: Nature Chemical Biology, January 13, 2025

G. Jeffrey Snyder, Professor of Materials Science & Engineering

Title: **“Effective reduction of matrix thermal conductivity through composite softening”**
Authors: Jiajing Huang, James Patrick Male, Yandong Sun, Ramya Gurunathan, Pochung Huang, Gerald Jeffrey Snyder, Yue Lin
Publication: Newton, January 14, 2025

George Wells, Associate Professor of Civil and Environmental Engineering

Title: **“Integrating Biological Phosphorus Removal with High-Rate Activated Sludge for Enhanced Settleability and Nutrient Management at Short Solids Retention Times"**
Authors: Chengpeng Lee, Hau Truong, Khoa Nam Ngo, Ahmed AlSayed, Emily Karen Kin, Stephanie Fuentes, Xiaojue Chen, Haydée De Clippeleir, George Wells
Publication: ACS ES&T Engineering, January 14, 2025

Title: **“Fluoride-induced stress shapes partial denitrification granules to sustain microbial metabolism”**
Authors: Shenbin Cao, Jinxin Fang, Konrad Koch, Xiaoyan Fan, Hussein E. Al-Hazmi, Rui Du, George F Wells

FUNDING OPPORTUNITIES

National Science Foundation
Infrastructure Systems and People
Amount: Not specified
Deadline: Proposals accepted anytime (Proposers are encouraged to email a one-page project summary to the ISP Program Officers before submitting a full proposal)

Infrastructure systems comprise complex connections between physical components, organizational structures and operational methods that support the needs of people and communities at the local, regional, national, and global scales. Such systems form the backbone of society, providing essential services as well as ensuring public health and welfare, economic prosperity and national security, and are expected to function under all operational conditions. Meanwhile, infrastructure systems are capital intensive and vulnerable to disruptions from extreme events, including natural disasters, social crises, and malicious attacks. Disruptions in one system can have cascading impacts on others in space and over time. Moreover, short- versus long-term trade-offs, unintended consequences, and maladaptation are not often accounted for. How systems function at the “extreme,” which can be due to disruptors from the introduction of innovation, the convergence of technologies, sudden changes to their utilization and access, dramatic changes in operating environments, and changes to demand during crises are of particular interest. To ensure the efficiency, sustainability, and resilience, and user-equity of infrastructure systems, it is important to continuously improve and optimize their design, operations, system monitoring and performance assessment in dynamic, uncertain and sometime unknown environments. While functioning at extremes is of interest, the program also supports infrastructure systems research under the full range of operating conditions, across a variety of hazards, and in urban, suburban, and rural communities. The program particularly encourages interdisciplinary and

multidisciplinary exploration that will open new research frontiers and significantly broaden and transform relevant research communities.

Department of Energy
Aligning Manufacturability & Pre-production Design (AMPD) for Storage Technologies
Amount: $2,000,000
Deadline: March 17, 2025

Aligning Manufacturability & Pre-production Design (AMPD) for Storage Technologies The AMPD NOFO is soliciting applications to improve the manufacturability of energy storage technologies through pre-production design innovations, setting the stage for manufacturing scale-up to meet the energy storage needs of American consumers.

Department of Energy
Scientific Discovery through Computing (SCiDAC): Partnerships in Basic Energy Sciences
Amount: up to $10,000,000
Deadline: April 25, 2025

The DOE SC programs in **Basic Energy Sciences (BES)** and **Advanced Scientific Computing Research (ASCR)** announce their interest in receiving applications from interdisciplinary teams to establish partnerships under the **Scientific Discovery through Advanced Computing (SciDAC)** program in specific targeted topic areas that relate to the BES and ASCR missions. Targeted topics are described in the Supplementary Information section below.

This Announcement invites new research applications for the SciDAC Partnerships in BES that enable or accelerate scientific discovery employing **DOE High-Performance Computing (HPC)** facilities. For the purpose of this Announcement, the term “DOE HPC” has been expanded to include the high-performance production computational systems at the **National Energy Research Scientific Computing Center (NERSC)**, the **Argonne Leadership Computing Facility (ALCF)**, the **Oak Ridge Leadership Computing Facility (OLCF)**, or

similar DOE computing facilities. DOE HPC includes the exascale machines **Frontier** and **Aurora**.

CONFERENCES and SEMINARS

Designing Water's Future: Urgent Strategies for a Water Insecure World
Presented by: Circle of Blue, Northwestern Institute for Policy Research and Medill School of Journalism
Date: Wednesday, February 12th, 2025
Time: 10:00 AM – 11:30 AM
Location: Online
RSVP
Space is limited. Please contact stephen.pedersen@northwestern.edu if you are unable to RSVP and wish to join

Water insecurity ranks among the greatest risks to global economic stability, environmental resilience, supply chains, and food and energy security, according to Eurasia Group and the World Economic Forum. By all metrics, we are failing to meet **UN Sustainable Development Goal #6**: ensuring access to clean water for all.

From wildfires in California to droughts in the Colorado River basin, and urban centers like Mexico City, Bogotá, Tehran, Hyderabad, and Bangalore approaching "Day Zero" scenarios, the world is facing a mounting water crisis. With political instability and escalating environmental pressures, we must ask: **What will it take to change our dangerous course for the world's fresh water?**

Join this exclusive virtual discussion, where leaders from finance, development, policy and universities will share groundbreaking insights and key takeaways, including from the January 2025 World Economic Forum Annual Meeting in Davos. Confirmed speakers include Henk Ovink, Renee Lertzman, Justin Worland, Jordan Fabyanske and others. This timely event will provide an overview of the critical water challenges ahead in 2025 and explore the bold actions needed to forge a transformative path for water management.

This conversation will tackle critical questions:

- Are we prepared for the tumultuous year ahead?
- How can we reverse the trajectory of escalating water crises?
- What must be done to align innovation, finance, and policy to create an “enabling environment” for meaningful action?

There will be brief presentations by thought leaders, followed by breakout groups with discussants. Please specify which breakout group you'd like to join in the registration form for this event.

Environmental Humanities Congress: Indiana Dunes, Calumet Region & The Great Lakes
Host: Indiana University
Dates: June 19 – June 22, 2025
Location: Chesterton, Indiana
Call for Individual Project Abstracts (Due March 3rd)
Registration

This Congress will be more than a conventional academic conference with panels and keynotes: For one, the agenda will involved active engagement with local communities, organizations, and activists as a regular feature throughout the long weekend. Non-academics will be included in the panels, run the surrounding events (tours, public fora), and participate in the plenary sessions. In addition, scholars will be encouraged in various ways to focus their thinking on the specific issues that ground environmental health and justice in the Great Lakes. In other words,

applied research and case studies focused on the region will be encouraged in various ways. Finally, the venues and events of the meeting will bring attendees in direct contact with the Indiana Dunes in memorable ways. Instead of being just an attractive location for a conference, the region will be the subject matter of the Congress.

This means that the event will understand environment in an encompassing sense — the ways in which its geology, biology, and ecology are thoroughly intertwined and shot through with economics, culture, and politics. The environmental history of the region is one with the histories of First Nation tribes, urban industrialism, and tourism. A main purpose of this event in to bring together multi-disciplinary energies to encourage interdisciplinary dialogues. This feature that is already attracting great attention to the Congress is that it is an unavoidably, genuinely, and elaborately interdisciplinary event. The theme is so fully anchored in the unique material, historical, scientific, political, cultural facets of this specific place on earth; you have historical giants from far distant disciplinary and cultural locations all involved — Carl Sandburg, Jens Jensen, Richard Daley, Henry Cowles, Paul Douglas, Dorothy Buell, Frank Lloyd Wright; you have the active involvement of directly affected communities such as First Nations citizens, the Parks Service, and local environmental organizations; to the original core of environmental philosophy scholars and continental philosophy circles have been added the strong interest of major environmental humanities programs from five states, and major commitments for both undergraduate and graduate participation in the Indiana system; while the event itself is reflecting this diversity of interests in its construction, with an artist-in-residence, a counsel fire ring, talks by parks rangers, Native American elders, and community activists; and a geologic-botanical-limnologic-historical-cultural-architectural bus tour.

JOB OPPORTUNITIES

Tenure Track Faculty – Civil/Environmental Engineering
University of Iowa
Deadline: April 1, 2025

The Department of Civil and Environmental Engineering at the University of Iowa invites applications for a full-time tenure-track faculty position to begin in Fall 2025. We are conducting a broad search for innovative scholars in hydraulics, hydrology, hydrometeorology, and water resources. All ranks will be considered. The faculty member would also hold a research center affiliation at IIHR - Hydroscience and Engineering.

Our program has strengths in hydraulics, hydrology, and water resources in areas of hydrologic forecasting and prediction, hydrologic remote sensing, hydroinformatics, hydrometeorology and hydroclimatology, environmental water resources, computational fluid dynamics, atmospheric boundary layer process, and flow measurement and sediment transport. We welcome applicants who complement or enhance these strengths, including research that advances broadly understood hydrologic knowledge including flood prediction, disaster management and resilience, and sustainable water resource infrastructure, and those who can lead us in new directions.

U.S. DEPARTMENT OF ENERGY | OFFICE OF ELECTRICITY

Grid Controls and Communications Team
Department of Electricity
Deadline: February 10, 2025

The U.S. Department of Energy (DOE) Science, Technology, and Policy Program is designed to provide opportunities for students, postgraduates, established scientists, and faculty to participate in programs, projects, and activities at the Department. Fellows will receive hands-on experience that provides an understanding of the mission, operations, and culture of DOE. As a result, fellows will gain deep insight into the federal government's role in the creation and implementation of energy technology policies; apply their scientific, policy, and technical knowledge to the development of solutions to issues of importance to the DOE and continue their education and involvement in areas that support the DOE mission either in a technical or policy-related appointment.

STUDENT OPPORTUNITIES

Summer Undergraduate Research Assistant
Institute for Policy Research, Northwestern University
Online Application

Earn money and gain hands-on research experience at the **Institute for Policy Research** as a Summer Undergraduate Research Assistant. Learn about the research process with IPR faculty experts and work on real studies.

- Pay is $18 per hour.
- Students typically work 35 hours per week for 10 weeks, but schedules can be flexible.
- Those majoring in social science fields are preferred, but all majors are welcome.

- There is some possibility of continued work with professors during the academic year.
- Previous research experience is a plus but not required.
- At the beginning of the program, students will participate in a training session on statistical methods and computing and receive tips on being a good research assistant.

There is no application deadline. However, the application opens on Feb. 1, and students are advised to apply early, as faculty members can begin reviewing applications at any time. Offers are made on a rolling basis until early June.

To subscribe, please send your name and email to engineeringsustainability@northwestern.edu

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