

# SCHOOL OF Sustainable Engineering and the Built Environment

Fostering **Infrastructure Resilience**  
in the Face of **Disruption...**



**2021**  
The Year  
In Review

**ASU** Ira A. Fulton Schools of  
**Engineering**  
Arizona State University

# The Ira A. Fulton Schools of Engineering at Arizona State University Offers



**25 undergraduate programs and  
50 graduate programs in its seven schools**



## **SSEBE**

School of  
Sustainable  
Engineering  
and the Built  
Environment

*Ram Pendyala,  
Director*

## **SCAI**

School of  
Computing  
and  
Augmented  
Intelligence

*Sandeep Gupta,  
Director*

## **ECEE**

School Of  
Electrical,  
Computer  
and Energy  
Engineering

*Stephen Phillips,  
Director*

## **SEMTE**

School for  
Engineering  
of Matter,  
Transport and  
Energy

*Lenore Dai,  
Director*

## **SBHSE**

School of  
Biological  
and Health  
Systems  
Engineering

*Marco Santello,  
Director*

## **TPS**

The  
Polytechnic  
School

*Ann McKenna,  
Director*

## **SMSN**

School of  
Manufacturing  
Systems and  
Networks

**ASU named #1 in innovation  
for 7<sup>th</sup> consecutive year.**

**#1 in the U.S.  
for innovation**

**ASU ahead of MIT and Stanford**

— U.S. News & World Report, 6 years, 2016–2021



## Research Centers



**National Science Foundation  
Engineering Research  
Centers (ERCs)**



**Center for Bio-  
mediated and Bio-  
inspired Geotechnics  
(CBBG) – Lead, ASU**



**Nanotechnology  
Enabled Water  
Treatment Systems  
(NEWT) – Partner, ASU**

## Additional Research Centers

Arizona Center for Algae Technology  
and Innovation (AzCATI)

Biodesign Center for Environmental  
Health Engineering

Biodesign Center for Health Through  
Microbiomes (BCHTM)

Center for Environmental Security (CES)

Center for Negative Carbon Emissions (CNCE)

Center for Teaching Old Models New Tricks (TOMNET)  
a USDOT Tier 1 University Transportation Center

Metis Center for Infrastructure and  
Sustainable Engineering

National Center of Excellence on SMART Innovations

Swette Center for Environmental Biotechnology

Water & Environmental Technology Center (WET)

Science and Technologies for Phosphorus  
Sustainability (STEPS)





## School of Sustainable Engineering and the Built Environment

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[ssebe.engineering.asu.edu](http://ssebe.engineering.asu.edu)

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**ASU is a comprehensive public research university, measured not by whom it excludes, but by whom it includes and how they succeed; advancing research and discovery of public value; and assuming fundamental responsibility for the economic, social, cultural and overall health of the communities it serves.**

## Mission

**Demonstrate leadership in academic excellence and accessibility**

**Establish national standing in academic quality and impact of colleges and schools in every field**

**Establish ASU as a global center for interdisciplinary research, discovery and development by 2020**

**Enhance our local impact and social embeddedness**

It is with a deep sense of pride and humility that I write this message for our 2021 Annual Report, which highlights many activities and accomplishments of our award-winning faculty, staff, and students. During the past year, we continued to navigate the challenges presented by the pandemic while advancing our mission on all fronts. Our school is now home to nearly 2000 master learners and 70 instructional and research faculty spread across our various degree programs, is conducting \$20 million in sponsored research annually, and is driving the future of our profession through the advancement of a diverse workforce capable of harnessing the power of technology to engineer a smart, sustainable, and socially responsible future. Our infrastructure systems are aging, under stress, and being asked to prove their resilience in the wake of increasingly intense and frequent extreme events. **The School of Sustainable Engineering and the Built Environment (SSEBE)** at Arizona State University is at the forefront of reinventing and reimagining infrastructure futures through the advancement of transdisciplinary solutions to the multitude of grand challenges confronting communities around the world.

Our academic programs are thriving and providing many opportunities for students to explore and critically evaluate alternative solutions to wicked problems. In the past year, all of our undergraduate programs went through accreditation visits, the fledgling undergraduate environmental engineering program continued to grow and foster a diverse student body, a new **Master's degree program in Environmental Engineering** was launched, and the **Del E. Webb School of Construction's (DEWSC)** programs experienced a surge in enrollment with students attracted by and greatly benefiting from DEWSC's strong connections to industry. Our benefactors, including the **DEWSC Industry Partner Circle** and the **Friends of Civil and Environmental Engineering**, continue to engage in significant ways and we are grateful for their support. Our continuous improvement processes ensure that students are learning the latest concepts, methods, and tools, and are embedded in curricula that embody the sustainability imperative embraced by the institution. It is no surprise that we are being recognized for excellence, with many of our students winning numerous awards and all of our programs ranked very highly by various entities including **US News and World Report**.

The latest Intergovernmental Panel on Climate Change (IPCC) report makes it clear that nations are not doing enough and are not moving fast enough to combat the risks presented by global climate change. Cities and communities are under threat with record droughts and rising waters, devastating fires and hurricanes, and intense heat and deep freezes imperiling livelihoods and quality of life around the world. Our research endeavors are addressing these global challenges while protecting and enhancing human health, wellbeing, and prosperity. **Lackner's Center for Negative Carbon Emissions** is developing and deploying the world's first mechanical tree that is capable of sucking more carbon dioxide from the air than a natural tree. **Chester** and **Allenby**, through the work of the **Metis Center for Sustainable Infrastructure**, are



developing new paradigms for infrastructure futures – characterized by a focus on resilience, adaptation and mitigation, and cybersecurity. **Lamanna** and **Denetdale** are leading a collaborative project funded by the CDC Foundation to improve clean water access for the Navajo Nation. **Krajmalnik-Brown's Biodesign Center for Health through Microbiomes** is identifying and tracking gut microbes to develop microbial interventions for better human health, leading to a patent for groundbreaking work in this area. **Halden's Center for Environmental Health Engineering** is continuing to harness the power of wastewater-based epidemiology to track and curtail the spread of COVID-19 in cities across the United States, while **Conroy-Ben** is leading large-scale efforts sponsored by the National Science Foundation (NSF) and the National Institutes of Health (NIH) to deploy this technology in multiple tribal communities. **Ariaratnam** is working with utilities to enhance the resilience of underground infrastructure elements and has been recognized with numerous awards for his pioneering work in this domain. Our hydrosystems faculty group is leading efforts to predict, model, and manage water resources in the arid southwest that is experiencing unprecedented drought conditions. Their recent move into the **Rob and Melanie Walton Center for Planetary Health**, the home of the **Julie Ann Wrigley Global Futures Laboratory**, will enable SSEBE to play an integral role in advancing the institution's aspirations to design a better tomorrow for all creatures that inhabit the planet.



Our many research centers continue to push the frontiers of science and engineering in search of transformative solutions to vexing problems. SSEBE is home to the **Arizona Center for Algae Technology and Innovation (AzCATI)**, which is the recipient of a \$3.2 million Department of Energy (DOE) award to advance algae-based bioenergy technologies. An environmental engineering faculty group led by **Westerhoff** is playing a pivotal role in a new NSF-sponsored **Science and Technology Center called STEPS** that aims to stem the phosphorus problem. The USDOT-sponsored **TOMNET University Transportation Center** led by **Pendyala** is engaged in multiple NSF-sponsored research efforts aimed at understanding the future of work and human activity-mobility patterns, while the **NSF Engineering Research Center on Bio-mediated and Bio-inspired Geotechnics (CBBG)** led by **Kavazanjian** continues to advance exciting technological solutions using mechanisms and processes found in nature. Our **National Center of Excellence for Smart Materials** is building a consortium of government and industry partners to advance sustainable pavements and mitigate urban heat island effects, while **Neithalath** advances 3D manufacturing of concrete structures through a \$2 million NSF-funded AccelNet grant spanning a dozen institutions around the world. And the list goes on...and on...! I hope you will take a moment to read about the amazing work of our SSEBE community in the pages that follow.

All of what we do would not be possible without the support and engagement of our industry partners, donors, alumni, sponsors, and patrons. I would like to take this opportunity to honor and recognize several longstanding benefactors who are no longer with us, including **Wink Ames, Geza Kmetty, Matthew Witczak, and George Graef Jr.** In mourning their passing, we remain inspired by their deeds, are grateful for their service, and resolve to build upon the legacy that they leave behind.

The time is now. We do not have the luxury to move slowly and advance incrementally. What is the world that we will pass on to future generations? The Infrastructure Investment and Jobs Act (IIJA) creates many opportunities for reinventing and reimagining our infrastructure systems, and we welcome the opportunity to partner with you in our quest to educate the next generation workforce and forge a more secure, sustainable and socially just future for all. ***Please join us in this journey. Thank you for your support.***

A handwritten signature in blue ink that reads "Ram Pendyala".

**Ram M. Pendyala, PhD**

*Professor and Director*

School of Sustainable Engineering and the Built Environment

# Program Chair Updates



## Civil, Environmental, and Sustainable Engineering (CESE)

**Keith D. Hjelmstad, PhD**

**President's Professor • CESE Program Chair**

This past year we transitioned from nearly everything being remote to getting back into classrooms, working directly with our students and other stakeholders. As we have cautiously moved back to some level of normalcy in our activities, we have sought ways to capitalize on some of the technologies we were only vaguely aware of a couple of years ago. We emerge with a new sense of possibility.

This past fall we hosted ABET for our accreditation visit. The (remote) visit went well—the official outcome to be announced later this year. Our program evaluator was particularly impressed with our strong connection to our professional community. Preparing for an accreditation visit is a lot of work but it reminded me how strong our civil engineering program is and how hard our faculty works to advance our educational mission.

Our *Friends of Civil and Environmental Engineering* (FOCE<sup>2</sup>) group has stepped up to help us raise funds to support an effort to advance our senior capstone design experience to a whole new level. It is exciting to see the enthusiasm building for an initiative that holds so much promise to elevate the abilities of our students while at the same time responding to core needs of the profession.

Each year we find new ways to bring significant impact to the world around us. I am confident that the coming year will be another great one!



## Construction Engineering (CNE)

**Samuel T. Ariaratnam, PhD, PE, PEng, FASCE, FISTT, FCAE, NAC**

**Professor • Beavers-Ames Chair in Heavy Construction**

**CNE Programs Chair**

It is great to see our students back on campus with in-person classes. I always enjoy walking down the hallway and hearing the sounds of students rushing between classes or interacting with their peers. As an industry, construction was not impacted as much as some industries, which meant that our students were able to find excellent internships and full-time jobs upon graduation this past year.

The big news for 2021 was that the Construction Engineering Program underwent our Accreditation Board for Engineering and Technology (ABET) site visit and review. This occurs every six years and is necessary to maintain our accreditation. I would personally like to thank our dedicated faculty, staff, and students for their assistance during this process. In addition, this could not have been possible without the valuable input and insight of my Industry Advisory Board. Our exit interview from ABET indicated that our program was very strong with no concerns or issues.

The passing of the Infrastructure Investment and Jobs Act will result in an even more increased demand for our students to help deliver these projects. Our program continues to emphasize planning, design, and management for the construction of infrastructure including roads, bridges, airports, pipelines, and other systems that are vital to our nation's economy. Construction Engineering graduates from ASU continue to address domestic and global infrastructure needs to keep up with aging systems and rapidly increasing populations.

I am looking forward to continuing to grow our nationally and internationally recognized Construction Engineering Program. Thank you for all your support during these trying times!





## Environmental Engineering (EVE)

**Treavor H. Boyer, PhD**  
**Professor • EVE Programs Chair**

The Environmental Engineering (EVE) undergraduate program at Arizona State University is continuing to grow with over 180 students enrolled in the program. For context, the largest Environmental Engineering programs in the U.S. have around 200 students. The EVE program offers a Bachelor of Science in Engineering (BSE) degree in Environmental Engineering and recently completed its first ABET accreditation visit (more below).

The mission of the EVE program is to educate tomorrow's engineers to solve complex environmental problems and design systems at the human, urban, and planetary scale. The EVE program includes courses that span introductory concepts, fundamental principles, and engineering design. Several new EVE courses have been added to the curriculum: Statistics and Probability for Environmental Data, Data Science for Environmental and Civil Engineers, and Materials in the Environment. The courses provide EVE students with quantitative skills in data analysis and improved understanding of material uses and flows.

The EVE program had its first ABET accreditation visit held virtually in September 2021. The ABET Program Evaluator met with faculty, students, and the external advisory board. The visit went well, and the EVE program made a positive impression on the site visit team. The official ABET accreditation decision will be made by August 2022 and will be shared widely. Finally, like everyone, the EVE program has had to adapt to COVID-19 impacts. In August 2021, students and faculty returned to in-person learning, and this has continued for the Spring 2022 semester. It has been enjoyable to be teaching and learning together in person.



## Del E. Webb School of Construction (DEWSC)

**Anthony J. Lamanna, PhD, PE, FACI, FASCE**  
**Associate Professor • DEWSC Programs Chair**

This last year has been another growth year for the Del E. Webb School of Construction. In addition to continued steady growth in the undergraduate program, we've seen explosive growth in our in-person masters' program. Many of our international graduate students have multiple years of experience in the civil engineering, construction management, or architecture industries.

Our Del E. Webb School of Construction Executive Committee has launched our Industry Partner Circle (IPC); a convenient way for our industry supporters to contribute to all aspects of the operations of our school. A financial contribution coupled with the gift of time is a great way to impact the next generation of construction leaders; come guest lecture, recruit from our career fairs, or even offer to teach an entire 3 credit hour course for our growing student population!

As things are reopening from the pandemic, our students are once again competing in student competitions and attending industry events in person! Please reach out if you would like to sponsor a student competition team, or if you have an event and would like construction students or faculty to attend.

Our Construction Alumni Chapter is becoming more and more active; please follow at <https://www.linkedin.com/showcase/del-e-webb-school-of-construction> to stay engaged. Our next Del E. Webb School of Construction Alumni Family Picnic will be January 21st 2023 at Kiwanis Park, so save the date!



## Graduate Programs

**Narayanan Neithalath, PhD**  
**Professor • SSEBE Graduate Programs Chair**

The graduate degree programs in the School of Sustainable Engineering and the Built Environment (SSEBE) encompass Civil, Environmental and Sustainable Engineering (CESE), Construction Management (CON) and Construction Engineering (Con Eng.). We offer PhD and MS degrees in CESE and CON, and MS degrees in Environmental Engineering and Construction Engineering. Our graduate enrollment has been rising, attributable to a significant growth in the construction management program. The PhD programs are also experiencing robust growth, thanks to the large number of research-active faculty in SSEBE, increased funding success, and a number of research centers that are part of SSEBE. ASU's civil engineering graduate program is ranked #26 and environmental engineering #20 in the nation by U.S. News and World Report. We continue to recruit graduate students from all parts of the globe, engage alumni and industrial partners, and contribute to research endeavors around key aspects of national and global interest including climate change and infrastructure. We have continued to engage in efforts to increase the number of students from under-represented groups in our graduate program. The pandemic and the ensuing disruption have slowed some of our efforts in recruiting and in-person student engagement, but as always, our faculty and staff are up to the challenge in devising suitable and efficient alternatives to ensure a valuable experience for our students.

The new MS program in Environmental Engineering is growing and complements our growing undergraduate Environmental Engineering degree program. New online MS degree programs in civil engineering and construction engineering are in the works and are expected to be offered sometime in 2022. We already have online Master's programs in Construction Management and Sustainable Engineering, and with the introduction of the two new online degree programs, SSEBE will have a large presence in the online Masters' degree space. We are currently ranked #5 by U.S. News and World Report in the Civil online Master's program. Our aim is to make SSEBE online programs the preferred choice for students and professionals seeking advanced education and credentialing.

We hope that, with the support of all our constituents, well-wishers, and contributors, SSEBE will have an excellent year ahead in graduate education and research, contributing to solutions to some of the vexing problems facing humanity.



## Construction Management and Technology Graduate Programs

**Kristen Parrish, PhD**  
**Associate Professor • DEWSC Graduate Programs Coordinator**

The Construction Management and Technology graduate programs continue to grow, as we enrolled our largest graduate class to date in the fall of 2021. This growth allows us to serve the needs of the construction industry in Arizona and beyond. In 2021, we officially launched our new core curriculum areas, Construction Technology and Project Management & Control.

We continue to grow our in-person and online course offerings, adding courses in Construction Field Leadership and Construction of High-Tech Facilities, among others, to meet our students' needs. Moreover, we have continued to diversify the types of applied projects our students complete, ensuring that the culminating experience from our MS program meets our students' needs and helps them develop the skills and competencies required for their careers as construction managers. Finally, we remain committed to the teaching practicum in our PhD program, so our doctoral graduates are able to perform in classrooms, whether it is in the higher education environment, the K-12 environment, or in continuing education.

We continue to recruit students from across the globe into our programs and love to engage our industry partners and alumni in these efforts; please reach out if you are interested in helping to grow the pipeline and pathways for the next generation of construction managers!



### Samuel Ariaratnam

**Samuel Ariaratnam**, professor and chair of the construction engineering program in the Del E. Webb School of Construction has been named the Beavers-Ames Chair in Heavy Construction. The **Beavers-Ames Chair in Heavy Construction** was established to bolster construction management and engineering education for undergraduate students and to promote the heavy construction industry.

Ariaratnam was recently named this year's winner of the **American Society of Civil Engineers (ASCE) Stephen D. Bechtel Pipeline Engineering Award**, for "his contributions to advancements in pipeline engineering through service to industry, educational initiatives and outstanding research accomplishments in the area of horizontal directional drilling."

Ariaratnam is among the leading experts in the development of trenchless construction methods and technologies used in underground construction. He is particularly prominent in the area of horizontal directional drilling, which enables subterranean building and installation to be done with minimal disturbance to the surface.



### Otakuye Conroy-Ben

**Otakuye Conroy-Ben**, an assistant professor of civil, environmental and sustainable engineering in the School of Sustainable Engineering and the Built Environment is the principal investigator **on two research projects funded by the National Science Foundation and National Institutes of Health** led by ASU to support tribal nations in combatting coronavirus and improving local resources.

A member of the Oglala Lakota Nation, she has always felt inspired to apply her technical expertise to advance the status of indigenous communities. Conroy-Ben says the scientific focus of these projects applies wastewater-based epidemiology to detect coronavirus in reservation sewer systems.

Conroy-Ben is a recipient of the **AISES Professional of the Year Award** and a **Technical Excellence Award** from the **American Indian Science and Engineering Society**. The Technical Excellence Award is presented to an indigenous professional who has made contributions to the STEM fields—science, technology, engineering and math—by developing a product or a solution that is actively involved in the Native American community.



### Enrique Vivoni

**Enrique Vivoni**, a professor in the School of Sustainable Engineering and the Built Environment and the School of Earth and Space Exploration and associate dean of graduate initiatives in the Graduate College at ASU is the recipient of the **2021 AZ Water Association Quentin Mees Research Award** which celebrates academic achievements by recognizing authors of exceptional research papers. In addition, the award is an effort to bring research in water-related technology to the level of practical use.

Vivoni's research focuses on interactions of water in the lithosphere, biosphere and atmosphere, with his scientific and engineering work conducted in urban and natural settings of the southwestern U.S. and Mexico. Over the course of his career, Vivoni has established long-term research collaborations on topics related to advancing numerical models, water resources management, climate change and sociopolitical interactions with natural resources.

In addition to the **Quentin Mees Research Award**, Vivoni has won a number of local and national awards, including the **Fulbright Fellowship, Leopold Leadership Fellowship, Huber Prize for Civil Engineering Research**, and the **Presidential Early Career Award for Scientists and Engineers**.



Bruce Rittmann  
Environmental Biotechnology

### Bruce Rittmann

Arizona State University Regents Professor **Bruce Rittmann** has been named the **2021 recipient** of the **WEF Camp Applied Research Award**, bestowed by the **Water Environment Federation**.

"Dr. Rittmann is recognized for his body of work, from membrane biofilm reactors to membrane capture of CO<sub>2</sub>," according to a WEF Award statement.

The award was created in honor of Thomas R. Camp, "an outstanding educator, consultant and writer whose contributions to applied research have guided design criteria in many aspects of water pollution control."

Rittmann is the director of the **Biodesign Swette Center for Environmental Biotechnology**, a Regents Professor of environmental engineering at ASU and one of the world's foremost leaders in the field. Rittmann's broad research interests involve the management of microbial communities to provide services to society. These endeavors include remediation of environmental pollution, water and wastewater treatment, capture of renewable energy and technologies for the improvement of human health.

The honor from WEF will be added to a lengthy list of prizes and accolades Rittmann has received for his pioneering work, including the **2018 Stockholm Water Prize**, which has been described as the Nobel Prize of water research.





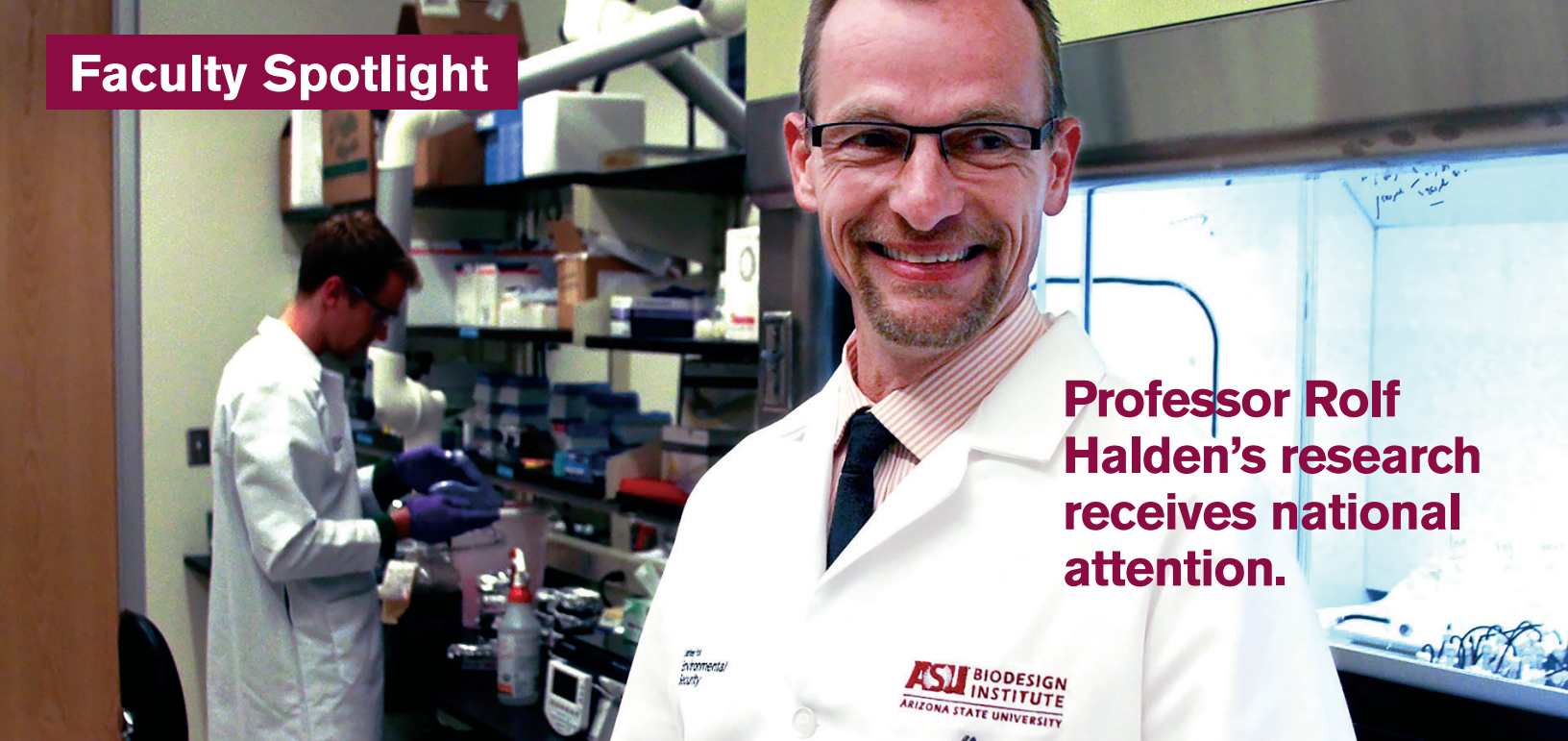
### Rebecca Muenich

**Rebecca Muenich** received a **2021 Outstanding Faculty Mentor Award** from the **ASU Faculty Women's Association** for her outstanding mentorship. The FWA recognizes faculty members who are great leaders through the FWA Awards Program. Muenich says that she benefited from having excellent mentors throughout her career and she wants to do what she can to give back.

Muenich is an assistant professor of civil, environmental and sustainable engineering. Her research focus is to apply her environmental modeling and analysis expertise to evaluate trade-offs at the food-energy-water nexus. She is currently working on projects to assess the environmental impacts of agriculture and to evaluate the trade-offs between urban and agricultural land uses.

Muenich is also a recipient of **the American Society of Agricultural and Biological Engineering's (ASABE) Robert E. Stewart Engineering and Humanities Award** and was named a **New Face of ASABE** in 2020.





### Professor Rolf Halden's research receives national attention.



Chemical & Engineering News  
September 26, 2021

#### **Weighing wastewater's worth as a COVID-19 monitoring tool**

Consumer Reports August 5, 2021

#### **How to Get Rid of Stuff at Home**

Professor Rolf Halden, director of **ASU's Biodesign Center for Environmental Health Engineering**, points out that chemicals in the containers of household products could become dangerous if they leak into soil.

Men's Health April 21, 2021

#### **Sewers may hold the secrets to making us healthier**

Halden and his research team are part of growing efforts to examine wastewater to track the spread of diseases such as COVID-19 and the flu, and the use of opioids in various communities.

Green Matters July 16, 2021

#### **Heat Waves Are Taking a Toll On PNW Drinking Water**

M.Live.com Public Interest

#### **We're eating and drinking Great Lakes plastic. How alarmed should we be?**

Halden warns about the "soup" of microplastics growing thicker and more widespread and making it much more challenging to reduce the volumes of them to safer levels in our environment.

Chemical & Engineering News  
March 21, 2021

#### **Can microbes save us from PFAS?**

Halden says there should be a focus on finding ways to make use of PFAS safer, so that large-scale remediation operations won't be needed to prevent harm to environments.

Slate August 28, 2021

#### **Are You Entitled to Privacy Over Your Pee and Poop?**



Salon July 17, 2021

#### **What is microplastic anyway? Inside the insidious pollution that is absolutely everywhere**

Professor Rolf Halden is among engineers, scientists and others warning of the impacts of plastics used for food packaging and a vast number of other products, including automobile tires.

USA TODAY October 14, 2021

#### **Fact check: Plastic water bottles left in hot cars don't release dioxins, do leach other chemicals**

ABC 15 News - Phoenix  
August 9, 2021

#### **Tempe expands wastewater COVID data program thanks to CDC grant**

The State Press June 22, 2021

#### **Tempe leans into wastewater analysis as fewer people seek COVID-19 tests**



## New Faculty Join SSEBE



### Hamed Khodadadi Tirkolaei

Assistant Professor  
Center for Bio-mediated  
and Bio-inspired  
Geotechnics (CBBG)  
PhD, Eastern  
Mediterranean University,  
Cyprus

**Research Interests:**  
Sustainable Geotechnics

*Joined SSEBE in  
August 2021*



### Jeffrey Vann

Beavers-Ames Lecturer in  
Heavy Construction  
Del E. Webb School of  
Construction (DEWSC)  
PhD, Arizona State  
University

**Research Interests:**  
Expansive Soils,  
Post-tensioned slabs,  
Unsaturated soil  
mechanics

*Joined SSEBE in  
August 2021*



### Mahmut Selim Ersan

Assistant Research  
Professor  
PhD, Clemson University

**Research interests:**  
Water treating and water  
reuse applications

*Joined SSEBE in  
August 2020*



### Emmanuel Salifu

Presidential Postdoctoral  
Fellow  
PhD, University of  
Strathclyde, Glasgow UK  
and University of Naples  
Federico II, Italy

**Research interests:**  
Biogeotechnical  
Engineering

*Joined SSEBE in  
September 2021*



### Shyamsunder Loukham

Assistant Research  
Professor  
PhD, Arizona State  
University

**Research interests:**  
Computational and  
experimental mechanics,  
composites and finite  
element analysis

*Joined SSEBE in July 2021*



### Steven Polzin

Research Professor  
TOMNET University  
Transportation Center  
PhD, Northwestern  
University

**Research interests:**  
Transportation policy  
analyses

*Joined SSEBE in July 2021*



## Faculty Honors and Awards



**Klaus Lackner**, director of ASU's **Center for Negative Carbon Emissions**, has been named one of **America's Greatest Disruptors: Hall of Famers**. Lackner first floated the idea of removing carbon directly from the air as a way of putting the brakes on climate change in 1999, and he has been devoted to figuring out how ever since. Lackner, is lauded for his leadership in developing carbon capture technologies and systems that could absorb or otherwise remove greenhouse gases in the Earth's atmosphere and keep those gasses from contributing to global warming and climate change that could pose potentially devastating threats to our environment and our own health.



**Barzin Mobasher**

**Barzin Mobasher** has been awarded the **2021 American Concrete Institute's (ACI) Charles S. Whitney Medal**, bestowed specifically "in recognition of outstanding contributions to the design and analysis of fiber-reinforced concrete through his enthusiastic committee

leadership and advocacy for new ACI design guides for structural applications."



**Rolf Halden**

**Rolf Halden's** Tempe Wastewater COVID-19 Dashboard Wins a **2021 SMART 50 Award** honoring the 50 most transformative smart projects each year. Smart 50 Awards, in partnership with Smart Cities Connect, Smart Cities Connect Foundation, and US Ignite, annually recognize global smart cities projects, honoring the most innovative and influential work.



**Claudia Zapata**

**Claudia Zapata**, associate professor of geotechnical engineering, has been awarded the **2021 Dr. William Yslas Velez Outstanding STEM Award** sponsored by the Pete C. Garcia Victoria Foundation.

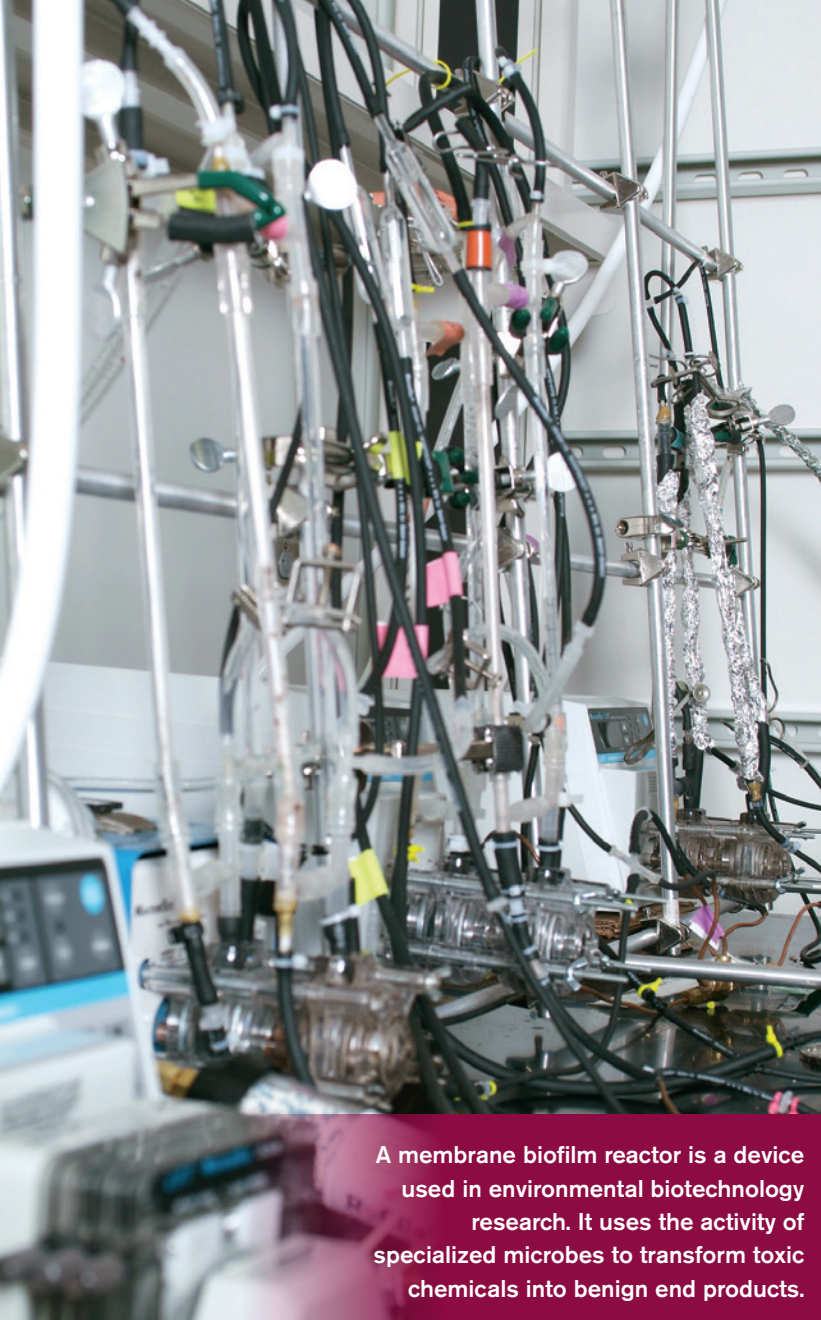


**Richard Standage**

**Richard Standage**, lecturer in the Del E. Webb School of Construction has been awarded the 2021 **William W. Badger Endowed Lecturer in Leadership Commercial Building Education Award**.



## Faculty Honors and Awards



A membrane biofilm reactor is a device used in environmental biotechnology research. It uses the activity of specialized microbes to transform toxic chemicals into benign end products.



Bruce Rittmann



Rosa Krajmalnik-Brown

Researchers at the ***Biodesign Swette Center for Environmental Biotechnology*** (BSCEB) and their colleagues have been awarded the **2021 Rudolph Hering Medal** from the American Society of Civil Engineers. The prestigious award recognizes the best paper of the preceding year from the Journal of Environmental Engineering.

The research selected for the Hering Medal describes new approaches to one of the thornier issues surrounding environmental contamination: how to rid ecosystems of a stubborn, pervasive and dangerous chlorinated chemical known as trichloroethene, or TCE.

The winning paper was written by **Bruce Rittmann**, director of the BSCEB; **Rosa Krajmalnik-Brown**, director of the newly formed Biodesign Center for Health Through Microbiomes; **Chen Zhou**, assistant research professor in the BSCEB; Yihao Luo, an environmental engineering PhD student in BSCEB as well as Boya Wang and Youneng Tang, both now at Florida State University.



Paul Westerhoff

Since joining the SSEBE faculty in 1995, Regents Professor **Paul Westerhoff** has had a distinguished career of research, education and leadership. Among the many accolades he has earned throughout his career, Westerhoff was most recently named the **2021** recipient of the **Daniel Jankowski Legacy Award**. The Jankowski Legacy Award is one of the highest distinctions a Fulton Schools faculty member can achieve. It recognizes engineering faculty members with unparalleled contributions to education, research and public service with longstanding, demonstrated impact on advancing the mission and values of the Fulton Schools.

Westerhoff's research in water quality has earned him the distinguished **2019 Clarke Prize Laureate** title by the National Water Research Institute along with being named an International Water Association Fellow in 2018.

# Faculty Honors and Awards



Kristen Parrish

**Kristen Parrish**, associate professor and **Anthony Lamanna**, associate professor and Del E. Webb School of Construction Programs Chair co-authored a paper “Identifying and Categorizing Risks Incumbent in US Nuclear Power Plant Construction” which was selected for the **ASCE Journal Editor’s Choice Collection, Journal of Construction Engineering and Management**.



Anthony Lamanna



Otakuye Conroy-Ben

**Otakuye Conroy-Ben**, assistant professor, has been selected to serve on an ad hoc committee of the **National Academies of Sciences, Engineering, and Medicine** which will identify emerging scientific and technological advances from across a broad range of disciplines that the U.S. Environmental Protection Agency (EPA’s) Office of Research and Development (ORD) should consider in its research planning to support EPA’s mission for protecting human health and the environment.

**Mounir El Asmar**, associate professor, completed the **Arizona State University’s Leadership Academy** — a yearlong leadership experience hailed as authentic and perspective-changing by participants — graduated its eighth cohort in May and passed a milestone of more than 240 faculty and staff participants. The Leadership Academy focuses on developing leadership skills, supporting individuals in advancing impactful projects, and creating a diverse community of leaders.



Mounir El Asmar



Yingyan Lou

**Yingyan Lou**, an associate professor specializing in transportation systems modeling and analysis, especially interdisciplinary research in the area of connected and autonomous vehicles and intelligent transportation systems, received an **Honorable Mention** from the **American Society for Engineering Education’s (ASEE) Best Card Competition** for her entry “How is the Yellow Interval Determined for a Signalized Intersection?” Lou also received the **Outstanding Educator Award** from the **Institute of Transportation Engineers (ITE)** Mountain District in 2020.



## **Mohammed Albuaymi**

*Implementation of AASHTOWare Pavement ME Design in Saudi Arabia*

Chair: Kamil Kaloush

## **Omar Alrehaili**

*System Level and Microfluidic Devices to Lower Energy Requires for Selective Desalination*

Chair: Paul Westerhoff

## **Sooraj Kumar Ambadi**

### **Omanakuttan Nair**

*Mechanics of Soft Solids: Theory and Applications in 3D Printing of Concrete*

Chair: Narayanan Neithalath

## **Ana Barrios**

*Structure-Function Relationships of Nanomaterials and their Applications for the Development of Sustainable Environmental Engineering*

Chair: François Perreault

## **Denise Capasso da Silva**

*Disruptions in Transportation: Understanding Attitudinal and Behavioral Implications*

Chair: Ram Pendyala & Sara Khoeini

## **Farshid Damirchilo**

*Use of Machine Learning and Data Science on Infrastructure Transportation and Construction Projects*

Chair: Elham Fini

## **Caitlyn Hall**

*Biogeochemical Modeling of Microbially Induced Desaturation and Precipitation*

Chairs: Bruce Rittmann & Edward Kavazanjian

## **Alysha Helmrich**

*Alternative Design Approaches for Advancing Infrastructure Resilience*

Chair: Mikhail Chester

## **Varun Kelkar**

*Monitoring Contaminants of Emerging Concern in Global Wastewater Using Sewage*

Epidemiology  
Chair: Rolf Halden

## **Tai Hooie Kim**

*Integrate Transportation Planning Models with Machine Learning Algorithms: A Computational Graph Framework in a Data-Rich Environment*

Chair: Ram Pendyala & Xuesong Zhou

## **Peiyuan Li**

*Biogenic Impact of Urban Vegetation on Heat and Carbon Dynamics in the Built Environment*

Chair: Zhihua Wang

## **Kimberly Martin**

*Field-Scale Implementation of Enzyme-Induced Carbonate Precipitation (EICP) as a Ground Improvement Technology*

Chair: Edward Kavazanjian

## **Diana Calvo Martinez**

*Syngas Fermentation in Membrane Biofilm Reactors*

Chair: Bruce Rittmann & César Torres

## **Sunny Anand Natekar**

*Treatment of Emerging Chemical and Microbial Contaminants in Water using Advanced Reflective UV Technology*

Chair: Morteza Abbaszadegan

## **Laurel Passantino**

*Successful Failures and Failed Successes: Untangling the Obstacles Facing Collaborative Proposal Writing*

Chair: Thomas Seager

## **Arvind Ramachandran**

*Studying the interactions and dissolution of interstitial hydrogen atoms in niobium using first principle methods*

Chair: Klaus Lackner & Houlong Zhuang

## **Tiyasa Ray**

*Leveraging Advanced Sensing and Computing Technologies to Automatically Inform Infrastructure Condition Status in Support of Field Operation and Maintenance with Terrestrial Collected Data*

Chair: David Grau Torrent

## **Rain Richard**

*Understanding the Impacts of Building Design and Use on Potable Water Quality Through Enhanced Monitoring*

Chair: Treavor Boyer

## **Daniella Sietta**

*Advancing the Implementation and Adoption of Urine Diversion Systems in Commercial and Institutional Buildings in the United States: A Focus on Control of Urea Hydrolysis*

Chair: Treavor Boyer

## **Shivam Sharda**

*Multidimensional Models to Understand Travel Behavior Implications for Transport and Household Energy Use*

Chair: Ram Pendyala

## **Naushita Sharma**

*Occurrence and Speciation of Bromine and Iodine in Drinking Water Sources*

Chair: Paul Westerhoff

## **Elizabeth Young**

*Fluid Flow through Granular Soils Treated with Microbial Induced Desaturation and Precipitation*

Chairs: Claudia Zapata & Leon van Paassen



# 2021 Scholarships and Fellowships

**Kareem Abdelkarim**

*Del E. Webb School of Construction Scholarship (CEAS)*

**Thomas Alexander**

*Tom and JoAnn Prescott New American University Scholarship*

**Noor-Ui-Huda Ali**

*Charles and Nancy O'Bannon Scholarship for Construction, Dave Clifton Memorial and ASPE Chapter 6 Scholarship*

**Shalee Allison**

*Construction in Indian Country Native American Scholarship, Daniel and Katherine Mardian Scholarship*

**Cleo Andaya**

*Del E. Webb Foundation Women in Construction Scholarship, Opus West Construction Corporation Undergraduate Scholarship*

**Gloria Appiah Nsiah**

*Fulton Fellowship*

**Michael Austin**

*Ron Pratte Scholarship*

**Colton Blakley**

*Eric and Jennifer Butler New American University Scholarship*

**Carter Bode**

*Del E. Webb Memorial Scholarship*

**Keyla Bonilla**

*GerLonnie A. Moore Scholarship*

**Harrison Borgman**

*Desert Star Construction Excellence in Luxury Home Building Scholarship*

**Nate Bradford**

*Eric and Kristina Petrie Scholarship*

**Tannis Breure**

*Martin H. Rosness Memorial Scholarship*

**Solomon Brooks**

*CFMA Joseph J. Quigley Memorial Scholarship*

**Samuel Castro**

**Brockman**  
*Dr. Matthew W. Witczak Scholarship*

**Jacob Chaddick**

*Stephen and Therese Pisarcik Scholarship*

**Olivia Chapin**

*Terry Bourland Memorial NAMU Scholarship*

**Lawrence Chapman**

*AGC Construction ASU Student Scholarship, FNF Construction, Inc. Scholarship*

**Heidi Chretien**

*Edd and Gail Gibson M&G Leaders Scholarship, Robert H. Johnson Undergraduate Scholarship*

**Amelie Clark**

*Marvin Sheldon Memorial Scholarship*

**Merritt Dailey**

*Dean's Fellowship*

**David D'Ambrosio**

*Ben C. Griggs Memorial Scholarship*

**Jack Deniger**

*John G. Colton Construction Study Fund*

**Coral Dober**

*Charles and Nancy O'Bannon Scholarship-Civil, Elyse and Paul Johnson Maroon & Gold Leaders Scholarship, Dr. Matthew Witczak Scholarship*

**Ryan Downes**

*Frank M. Chandler Memorial Scholarship*

**Aletta Oswald Dsouza**

*Betty Hum Graduate Assistantship*

**Patrick Fajen**

*Robert J. Wheeler Memorial Scholarship*

**Micah Franzel**

*PENTA Building Group Scholarship*

**Erica Garcia**

*Anderson Family Scholarship in Memory of Lola Ann Andrews*

**Dawson Gardiner**

*Dr. Matthew Witczak Scholarship*

**Quimbie Gonnies**

*Ben C. Griggs Memorial Scholarship, FNF Construction Scholarship*

**John Goodin**

*Robert H. Johnson Undergraduate Scholarship*

**Audelo Gutierrez**

*Briston Veteran Advancement Scholarship*

**Ashley Hall**

*Rod J. McMullin SRP Water Resource Scholarship*

**Alexander Hall**

*Rod J. McMullin SRP Water Resource Scholarship*

**Jeremiah Harris**

*Robert H. Johnson Undergraduate Scholarship*

**Andrew Haslett**

*D.L. Withers Construction Scholarship*

**Kelsie Herzer**

*Fulton Fellowship*

**Katrina Hinsberg**

*LC Jacobson Graduate Fellowship*

**Nathan Hopkins**

*Jim Bebout Scholarship*

**Derek Hogue**

*Phoenix/Scottsdale Groundwater Contamination Scholarship for Environmental Science*

**Aaron Huerta**

*Associated Minority Contractors Association NAMU Scholarship, Del E. Webb Foundation Undergraduate Student Scholarship*

**Sean Inanc**

*Andrew Hanneman Scholarship*

**Alexander Jablon**

*Del E. Webb Foundation Finance and Accounting Scholarship*

**Dakota Jensen**

*Construction in Indian Country Native American Scholarship, Jan Bennett Endowed Scholarship*

**Robsan Jigayo**

*The Ames Family Scholarship*

**Kidtiyod Kanjana**

*Richard E. Mettler Residential Graduate Scholarship*

**Deepesh Karmacharya**

*Edward and Amelia Kavazanjian Fellowship*

**Mason Knappe**

*Del E. Webb School of Construction Scholarship (CEAS)*

**Jacob Kopitske**

*Del E. Webb Memorial Scholarship*



# 2021 Scholarships and Fellowships

**Nathaniel Kronert**

*Del E. Webb School of Construction Scholarship (CEAS)*

**Jeff Larson**

*Pulte Home Corporation Scholarship*

**Sarah Le**

*Dr. Matthew W. Witczak Scholarship*

**Cesar Lopez-Rodriguez**

*Team DSC Scholarship for Excellence in Craftsmanship*

**Kevin Lucas**

*Jason McElroy Memorial Scholarship*

**Isabelle McCarthy**

*Dr. Sandra L. Weber Memorial Scholarship*

**Colin McCaughey**

*Eric and Kristina Petrie Scholarship*

**Carlos Mendez Aceves**

*Paragon Structural Design, Inc. Scholarship*

**Marc Murillo**

*Carl L. and Jean Wolcott Meng Memorial Scholarship, Stantec Scholarship*

**Abby Noel**

*Anderson Family Scholarship in Memory of Lola Ann Andrews*

**Cameron Ott**

*Samuel F. Kitchell Undergraduate Leadership Award*

**Conner Ottinger**

*AGC Construction ASU Student Scholarship*

**Alexander Owen**

*Jan Tuma Memorial Scholarship, Structural Engineers Association of Arizona Scholarship*

**William Owens**

*The Beavers Heavy Construction Scholarship*

**Kevin Perreault**

*Del E. Webb Memorial Scholarship, Terry Bourland Memorial NAMU Scholarship*

**Madison Platt**

*Dave Clifton Memorial and ASPE Chapter 6 Scholarship*

**Kristin Pond**

*James Fann Memorial Scholarship*

**Marcos Putnam**

*James Grose New American University Scholarship*

**Kellen Rhoads**

*AGC Construction ASU Student Scholarship*

**Cain Ridgeway**

*D.L. Withers Construction Scholarship*

**Valentina Rivera**

*Arizona Society of Civil Engineers Scholarship, Panhuse Engineering Scholarship*

**Cesar Romero**

*CFMA Joseph J. Quigley Memorial Scholarship*

**Matthew Russo**

*Del E. Webb Foundation Undergraduate Student Scholarship*

**Arturo Salgado**

*Andrew Hanneman Scholarship*

**Meyah Sanchez**

*Associated Minority Contractors Association NAMU Scholarship*

**Karl Schranz**

*DeTommaso Endowment (NAMU), R.Glen Schoeffler Scholarship*

**Nora Shapiro**

*Fulton Fellowship*

**Isaac Sheppard**

*DeTommaso Endowment (NAMU)*

**Kieren Smith**

*Del E. Webb Foundation Graduate Student Fellowship*

**Sophia Smith**

*Robert J. Wheeler Memorial Scholarship*

**William Snitzer**

*Del E. Webb Foundation Undergraduate Student Scholarship*

**Gabriella Stadler**

*Dr. Matthew Witczak Scholarship, Structural Engineers Association of Arizona Scholarship*

**Laura Stueve**

*Jerry King Scholarship*

**Joshua Thomas**

*Del E. Webb Foundation Undergraduate Student Scholarship, DeTommaso Endowment (NAMU)*

**Boderik Thorson**

*Andrew Hanneman Scholarship*

**Vedika Tripathi**

*Terry Bourland Memorial NAMU Scholarship*

**Maggie Tsosie**

*Construction in Indian Country Native American Scholarship, The Beavers Heavy Construction Scholarship*

**Benjamin Warren**

*Samuel F. Kitchell Undergraduate Leadership Award*

**Noah Warren**

*The Beavers Heavy Construction Scholarship*

**Aubrey Wells**

*James Grose New American University Scholarship (NAMU), William A. Pulice Scholarship Endowment*

**Hrag Yessaian**

*Robert H. Johnson Undergraduate Scholarship*

**Wyatt York**

*Del E. Webb Memorial Scholarship*

**Julia Zimmerman**

*Amy Geiser and Kent Geiser Honorary Scholarship, Rod J. McMullin SRP Water Resource Scholarship*

**Francisco Zuleta**

*The Beavers Heavy Construction Scholarship*





A binational group of students and faculty from U.S.-Mexico TEAM at a groundwater supply well in a large coastal desert valley that provides water for tourism, agricultural and domestic uses.

## ASU graduate students focus on sustainable agriculture in desert landscapes

### US-Mexico project inspires cross-cultural cooperation, knowledge exchange

Arizona State University graduate students and faculty recently traveled to Puerto Peñasco, also known as Rocky Point, in Sonora, Mexico, to obtain real-world experience with water systems in the arid U.S.-Mexico border region as part of a **TEAM grant, funded by the U.S. State Department**.

The collaborative effort between ASU and the Instituto Tecnológico de Sonora (ITSON), is focused on sustainable agriculture in the desert landscapes of North America. The TEAM program and its curriculum are administered by the ASU Graduate College.



Enrique Vivoni

"We selected Puerto Peñasco as it is a growing urban and agricultural area in an arid region along the U.S.-Mexico border where water is an important resource," said professor **Enrique Vivoni**, and the lead faculty member of this program. The trip addressed four main themes: water management; municipal governance of natural resources and tourism development; ecological sites and preservation; and ecological tours of coastal and ocean systems.

#### Real-world experience

While in Puerto Peñasco, students and faculty met with city officials to learn about the agricultural strategies and challenges of the area, toured water supply sources, water and wastewater treatment operations as well as ecological sites.





Students and faculty at the Intercultural Center for the Study of the Deserts and Oceans in front of a 17-meter female baleen whale skeleton. Photo courtesy of Luisa Orci Fernandez

## Promoting collaboration

In February, students formed four binational project teams researching the vulnerability of agricultural systems to drought, sustainable nitrogen fertilizer use, identification of crop water stress from satellites, and cultural differences in attitudes towards water. Each team consisted of students from both universities.



## About TEAM

The U.S.-Mexico Training in Environment, Agriculture and Management (TEAM) program is the result of a 100,000 Strong in the Americas Innovation Award, the U.S. Department of State's signature hemispheric-wide initiative to champion the power of education to transform societies, provide opportunity and stimulate economic prosperity. The objective of the grant is to improve student competencies and provide real-world training for the future workforce in sustainable agriculture. This program is also funded by the Babbitt Center for Land and Water Policy.



# Student Honors and Awards

## Spring 2021

### Outstanding Senior Award:

Edward Apraku  
Lucas Crane  
Alexis Torres  
Keoni Kabza  
Damian Nguyen

### Leadership and Service Award:

Grayson Weinberger  
Keoni Kabza

### 4.0 Award:

Marisela Arias  
Lucas Crane  
Manuela Hiche Schwarzhaupt  
Linck, S.C  
Joshua Silberman

### Engineer-In-Training Certification:

Marisela Arias  
Stephen Bosak  
Amanda Clarke  
Koa Dey  
Xandrian McMacken  
Liam Orourke  
Alia Raderstorf  
Grayson Weinberger  
Julia Zimmerman

## Fall 2021

### Outstanding Senior Award:

Laurel Wright  
Karissa Gund  
Alexander Jablon  
Kellen Rhoads

### Leadership and Service Award:

Tannis Breure  
Kristin Pond

### 4.0 Award:

Alexander Jablon

### Engineer-In-Training Certification:

Priscilla Armenta  
Joseph Fisher  
Sydney Riddell  
Laurel Wright

## Meet the Spring 2021 Outstanding Graduates



**Edward Apraku**  
*Civil Engineering*



**Lucas Crane**  
*Environmental Engineering*



**Damian Nguyen**  
*Construction Engineering*



**Alexis Torres**  
*Construction Mgt. & Tech*

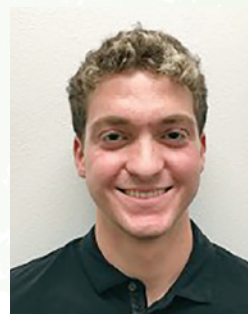
## Meet the Leadership and Impact Award Winners



**Jeremy Guerrero**  
*Environmental Engineering (Impact Award)*



**Andrea Russell**  
*Environmental Engineering (Impact Award)*



**Grayson Weinberger**  
*Civil Engineering (Leadership Award)*



**Keoni Kabza**  
*Construction Mgt. & Tech (Leadership Award)*

## Meet the Fall 2021 Outstanding Graduates



**Laurel Wright**  
*Civil Engineering*



**Karissa Gund**  
*Environmental Engineering*



**Alexander Jablon**  
*Construction Mgt. & Tech*



**Kellen Rhoads**  
*Construction Engineering*



## Creating a diverse engineering environment at ASU

“Our commitment to embracing a more diverse and inclusive future of engineering research and education is exemplified by this outstanding group of female PhD students who have graduated with their doctoral degree in the past few years,” says professor **Ram Pendyala**, director of the School of Sustainable Engineering and the Built Environment. “These graduates are highly accomplished scholars who serve as outstanding role models for women in STEM and will undoubtedly contribute to advancing their chosen profession in significant and meaningful ways.”



## Ana Barrios

'21 PhD in environmental engineering

National Research Council postdoctoral fellow, National Institute of Standards and Technology

## Daniella Saetta

'20 PhD in environmental engineering

Postdoctoral researcher, University of South Florida

## Caitlyn Hall

'21 PhD in environmental engineering

Assistant professor of practice, University of Arizona

## Kimberly Martin

'21 PhD in civil engineering

Senior engineer of innovation and sustainability, Keller

## Anjali Mulchandani

'20 PhD in environmental engineering

Assistant professor, University of New Mexico

## Laurel Passantino

'21 PhD environmental engineering

Assistant dean for research, The Grainger College of Engineering, University of Illinois at Urbana-Champaign



## Shalee Allison

ASU construction management undergraduate **Shalee Allison** was awarded a **National Academy of Construction (NAC) 2021 national scholarship.**

The scholarship program provides financial support for outstanding students who are on track to earn construction or construction-related degrees, have high grade-point averages, are demonstrating leadership and participating in extracurricular activities.

**Samuel Ariaratnam**, professor in the School of Sustainable Engineering and the Built Environment, nominated Allison for the scholarship. An NAC committee selected Allison and four others from among 30 nominees from across North America.



# Student Honors and Awards



An irrigation canal running near agricultural fields in the Phoenix metropolitan area. Arizona State University civil, environmental and sustainable engineering doctoral student Xin Guan is studying the connection between food, energy and water in Phoenix and the surrounding agricultural land as temperatures change and water shortages loom. This work, which will help local policymakers optimize decisions that affect these vital resources, earned Guan a competitive Central Arizona Project Award for Water Research. Photo courtesy of Shutterstock

## Simulating a sustainable future of water, energy and food in Phoenix

### Doctoral student Xin Guan's excellent work addressing local water issues earns Central Arizona Project Award for Water Research

Phoenix is a rapidly growing metropolitan area in a desert. As the population increases, it will be more and more challenging to supply water, food and energy — three essential resources that are interconnected in complex and competing ways.

“Water supply in the region is energy-intensive. Energy generation needs water, and food production needs energy and water in the form of irrigation for agriculture in this hot and dry climate,” says **Xin Guan**, a civil, environmental and sustainable engineering doctoral student who is studying hydro systems engineering and the food-energy-water nexus in the Phoenix area.

For the past four years, Guan has been studying the food-energy-water nexus through an integrated simulation approach. This method allows Guan to thoroughly understand the interconnections between each sector and observe feedback from one sector to another as various climate and policy factors change.

This research earned Guan the **first-place 2021 Central Arizona Project Award for Water Research** — a competitive award from the water resource development and management organization that recognizes water research excellence from undergraduate and graduate students at Arizona's colleges and universities. The award is given to unpublished research that addresses water issues in Arizona associated with the Central Arizona Project and the Colorado River.



Xin Guan





Bruce Rittmann



Biogas captured from wastewater treatment is delivered to these three ponds, where it is used to grow algae. The ponds were designed at ASU's Arizona Center for Algae Technology and Innovation. Photo by Andy DeLisle.

## Zero wastewater

When you think about wastewater — if you do at all — you probably think of reeking, worthless sewage that you flush down the toilet or sink and never think about again. When Bruce Rittmann thinks about wastewater, he sees potential.

Regents professor **Bruce Rittmann** is leading a three-year project funded by the **Department of Energy** to generate electricity and create biofuel using the greenhouse gases produced from wastewater treatment. Rittmann and a team of ASU researchers are working with the city of Mesa's Northwest Water Reclamation Plant to capture and deliver methane and carbon dioxide to ASU's Arizona Center for Algae Technology and Innovation. There, the biogases help grow microalgae, which can be used in a variety of products.

"The city of Mesa has anaerobic digesters, is located close to ASU, is always eager to try out advanced technologies, and has been a great research and development partner with our center for some years," says Rittmann, a Regents Professor in the School of Sustainable Engineering and the Built Environment and director of the [\*Swette Center for Environmental Biotechnology\*](#) at the Biodesign Institute.

Rittmann has been involved in research using gas-transfer membranes — the basis for this project — for 20 years and has been using this technology with microalgae for over a decade. By pairing up with the city and getting access to their anaerobic digesters, which treat wastewater, his team has been able to scale the project up massively.

Not only does wastewater smell bad, it's also a major problem for the environment. Wastewater treatment produces biogas made up of methane and carbon dioxide ( $\text{CO}_2$ ), the biggest contributors to climate change.

Typically, wastewater treatment facilities burn the biogases they produce. This eliminates the methane, which converts to carbon dioxide in the burning process.

"So now you're just emitting  $\text{CO}_2$ . Of course, I think we're all familiar now with  $\text{CO}_2$  being a problem," says **Justin Flory**, an associate director of research in ASU's [\*Center for Negative Carbon Emissions\*](#) and project manager of the trial. "It's less of a problem than methane, but it's still a problem."

People are not going to stop producing wastewater. In fact, as the population grows, we're probably only going to produce more of it. But the very problem that wastewater treatment creates could provide value instead.

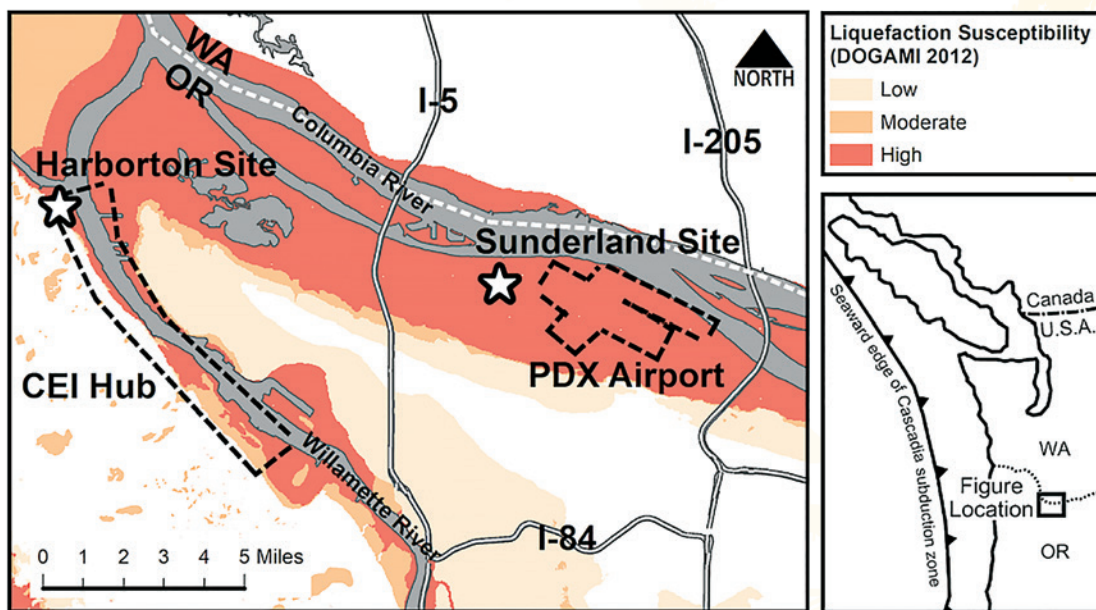
This project proposes a better solution with no burning required. The researchers take the carbon dioxide produced by treating wastewater and feed it to microalgae, which can then be turned into a variety of products. The process also takes the methane produced and generates purer biomethane, which is a high-value product.



## Research and Innovation



Recent ASU civil engineering doctoral graduate Elizabeth Stallings Young (second from the right) is shown with Portland State University students and staff members involved in characterizing soils near the Portland International Airport, one of two main sites for a major soil liquefaction research project supported by the National Science Foundation. *Photo by Leon van Paassen*



The map shows two sites in the vicinity of Portland International Airport and the Port of Portland Critical Energy Infrastructure hub that are test sections for the research to develop techniques for reducing soil damage as a result of earthquakes.

*Map courtesy of Portland State University*



## Sustaining solid ground

### ASU team has key role in award-winning project to reduce impacts of earthquakes on soils

A team of faculty members and students in the School of Sustainable Engineering and the Built Environment (SSEBE) contributed to a major geotechnical engineering field research project recently recognized with a **2021 Western States Seismic Policy Council Award in Excellence**.

Associate Professor **Leon van Paassen** led the group from SSEBE's **Center for Bio-mediated and Bio-inspired Geotechnics**, in a collaboration with researchers from Portland State University and the University of Texas at Austin. The endeavor has been funded by the Natural Hazard Engineering Research Infrastructure program of the National Science Foundation.

Van Paassen and Professor **Edward Kavazanjian**, Director of the Center for Bio-mediated and Bio-inspired Geotechnics, have collaborated on projects to reduce the impact of earthquakes on soils. One of these aftereffects is liquefaction, or the process by which soil saturated with water loses strength, which can lead to ground failure.

The multi-university project involves microbially induced desaturation — called the MID technique — for mitigation of earthquake-induced liquefaction in silty soils.

### Seeking earthquake and engineering solutions

The work has included treating two test sections located within the Port of Portland Critical Energy Infrastructure hub (the Harborton site) and adjacent to Portland International Airport (the Sunderland site).

The Center for Bio-mediated and Bio-inspired Geotechnics team provided technical and logistical support to the Portland State University team that led the overall project. The center's support also included advising on the layout of the installation for the two test sections, developing the treatment solution and treatment regimen, installing downhole sensors for soil moisture content and salinity, and data interpretation.

Fulton Schools alumni **Elizabeth Stallings Young** and **Caitlyn Hall** have been integral members of the project team. Earlier this year, Stallings Young earned a doctoral degree in civil engineering and Hall earned a doctoral degree in environmental engineering.



Associate Professor Leon van Paassen takes samples of extracted water at the site of the project to test microbially induced desaturation for mitigating earthquake induced liquefaction in soils. Photo by Arash Khosravifar/Portland State University





Anca Delgado (left), assistant professor of environmental engineering, and Aide Robles, an environmental engineering doctoral student, look at samples of microcosms used to test bioremediation techniques as part of their research to develop advanced methods of cleaning up sites contaminated by industrial solvents. Photos in this article are archival images taken before ASU's social distancing and face covering recommendations went into effect. Photographer: Marco Alexis-Chaira/ASU

## Bio-based process promises better contaminant cleanup

### Researchers use mixtures of microorganisms in a new approach to neutralizing toxic solvents in the environment

Solvents are used extensively in the construction, engineering, printing, plastics, rubber, textile and dry-cleaning industries, as well as in pharmaceutical and paint manufacturing.

But for all of their advantages, the longtime widespread use of some solvents has had a serious drawback: they are among the most common and troublesome environmental contaminants in soils and groundwater.

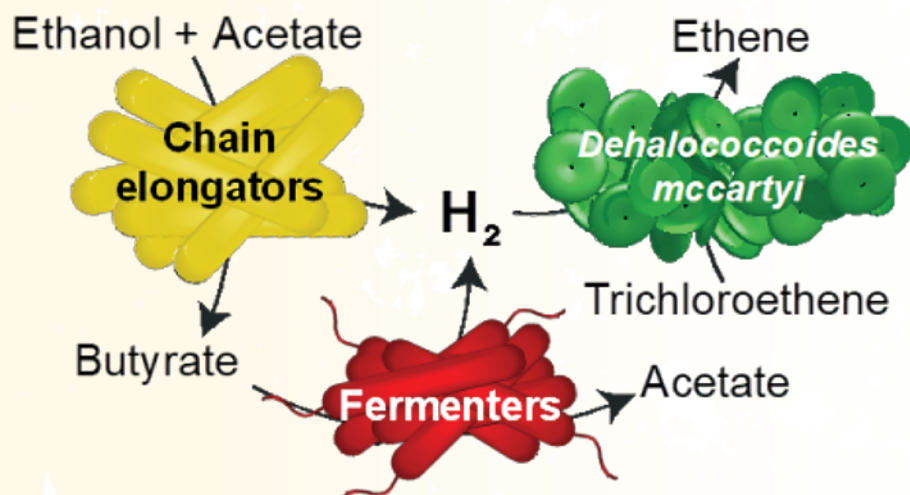
Chlorinated solvents are especially problematic, says **Anca Delgado**, an assistant professor of environmental engineering and researcher in ASU's Biodesign Swette Center for Environmental Biotechnology.

"For many decades they've been used very extensively, and during much of that time there has been a lack of regulation," Delgado says. "So, these solvents were simply disposed of in the ground, poured down drains or accidentally leaked from storage systems."

Despite the environmental safeguards used today, many older industrial and agricultural sites remain where these solvents have seeped deep into soils, sediments and groundwater reservoirs.

The challenges involved in the remediating sites contaminated by solvents such as perchloroethylene and trichloroethylene — chlorinated compounds used extensively in the past, especially in dry cleaning operations and metal degreasing processes — is the topic of a paper Delgado and members of her lab team recently published in the research journal **Environmental Science & Technology**.





The schematic shows how chain elongating and fermenting microorganisms provide hydrogen to the bacterial strain *Dehalococcoides mccartyi*. The hydrogen is the energy source for a process to detoxify chlorinated solvents. The process is the focus of a new research paper in the journal *Environmental Science & Technology* by faculty and student researchers in the Ira A. Fulton Schools of Engineering. *Graphic: Aide Robles/ASU*

Trichloroethylene is a carcinogen — a cancer-causing substance — and many of the places containing such chlorinated solvents are groundwater aquifers that serve as sources of drinking water, or water designated for agricultural and industrial uses, Delgado says.

“There are many of these contaminated sites, many that we will still need to deal with for decades to come,” Delgado says.

Her team’s research to find more effective ways to decontaminate these areas has come from the National Science Foundation, or NSF, through ASU’s Center for Bio-mediated and Bio-inspired Geotechnics, or CBBG, an NSF Engineering Research Center. The center is directed by ASU Regents Professor **Edward Kavazanjian**, who, like Delgado, teaches in the School for Sustainable Engineering and the Built Environment.

Delgado and the paper’s co-authors — **Aide Robles**, **Sayalee Joshi** and **Srivatsan Mohana Rangan**, graduate students in the civil, environmental and sustainable engineering program, along with undergraduate student **Theodora Yellowman** — have been working on a chlorinated solvent treatment solution that harnesses the ability of microorganisms to activate a biotechnological process called chain elongation.

The team’s research paper describes ways in which naturally occurring microorganisms can be directly stimulated in the soil and groundwater, or be grown in the lab, and then applied at contaminated sites to perform bioremediation — using microorganisms to treat contaminants.

**Haley & Aldrich**, a nationwide environmental and geotechnical engineering consulting company, is interested in applying Delgado’s new remediation technology in the field at one or more of their project sites, says **Nasser Hamdan**, CBBG’s industrial collaboration and innovation director. Haley & Aldrich, one of CBBG’s major industry collaborators, is funding the center’s study to prepare for a field deployment test of the technology.



## Getting a greener grid

### ASU engineering experts point to priorities for expanding clean energy infrastructure

As Congress advances legislation to invest \$550 billion in national infrastructure projects, the specific priorities in each industry category remain undefined. For example, the proposed framework directs \$65 billion to foster greater use of renewable energy sources within America's power grid, but it doesn't exactly define how that will happen.

High-voltage lines cross cities, counties and states, and there is no single federal authority to secure the necessary permissions to build new ones. Additionally, they cost a lot of money. To address these hurdles, the infrastructure framework now before Congress includes establishment of a new Grid Development Authority to finance and facilitate new transmission lines.

Laying this literal groundwork is crucial to building new wind energy sites. But it's also important for expanding the number of commercial solar energy facilities, since solar farms operate in similarly isolated regions. For example, the Agua Caliente Solar Project outside Yuma, Arizona, and the Solana Generating Station near Gila Bend, Arizona, cover more than 4,000 acres in the open desert.

Much attention has turned to advancing battery technology as a means to balance out the fluctuating nature of power generated by wind and solar sites. But many experts say batteries are too expensive to encourage more commercial-scale renewable energy generation.

"Batteries are great for short cycles of loading and unloading. They can work for storing grid energy from morning to evening. But their capital cost is too large to sit on electricity for six months," says **Klaus Lackner**, a professor of environmental engineering in the School of Sustainable Engineering and the Built Environment.

By contrast, Lackner says the cost of storing and moving energy in liquid form is negligible. Think of all the energy on tap at gas stations across the country. Also consider that a single gallon of gasoline represents the daily kilowatt usage of a typical American household.

"The power we can run through pipelines dwarfs what we can get through transmission lines," Lackner says. "We can move gigawatts through a single pipe."

But how do we practically transform energy generated by wind and solar farms into liquid fuel? The answer could be the technology of capturing carbon from the air.

Lackner is director of the ***Center for Negative Carbon Emissions***, which researches technology to capture carbon dioxide from the atmosphere to both combat the adverse effects of climate change and help advance sustainable energy infrastructure.

Central to their work is the development of a "***mechanical tree***" system that harvests CO<sub>2</sub> from the air. While still at prototype stage, application of the new technology includes concentrating the carbon dioxide for commercial use in carbonating beverages, filling fire extinguishers and making dry ice.

"We also can combine that CO<sub>2</sub> with hydrogen produced through the electrolysis of water using renewable energy like solar. And through that combination, we can create gasoline or diesel or jet fuel," Lackner says. "The necessary technology already exists, but it needs to get cheaper through a little more innovation and expanding scale. My prediction is that it will happen in the next five years."

Fuel literally created from the air could offer the storage medium needed to solve the intermittency issue impeding greater adoption of wind and solar energy generation technology. It could also attenuate fossil fuel extraction and processing for transportation. If carbon from the atmosphere can power our planes, trains and automobiles, there may be no need to drill into the earth for more petroleum.

This innovation seems like a pivotal opportunity to arrest the greenhouse gas accumulation driving climate change; and carbon capture is explicitly listed as a new technology priority in the infrastructure framework before Congress.

But Lackner and colleagues at the Fulton Schools point out that averting greater ecological adversity requires more than recycling atmospheric carbon. Additional volumes need to be prevented entirely, and that likely means electrifying transportation.





*Top:* Klaus Lackner

*Bottom:* Renewable energy generation technologies are capable of supplying a greater share of national power demand. But making that happen requires investment in fundamental transmission and distribution elements of the electricity grid.

*Image courtesy of Shutterstock*





### Pavement lab officially accredited

**The Arizona State University Advanced Pavement Laboratory (APL)** is now officially accredited by the **American Association of State Highway and Transportation Officials (AASHTO)** thanks to generous donations which

enabled upgrades to the lab. A special thank you to Solterra Materials, HollyFrontier, Western Emulsions and Southwest Asphalt for their generous donations.


The renovation project began in 2019 with a mission and goal *“To upgrade our laboratory to a first-class pavement research facility to better serve Arizona’s pavement industry, agencies and support their operations with strategic, implementable research and training when needed”*.

The APL is housed inside of a state-of-the-art, Leed Silver certified **Interdisciplinary Science and Technology 2 (ISTB-2)** building on the Tempe Campus. The equipment housed in this laboratory allows for full characterization of asphalt concrete mixtures, asphalt binder, and unbound materials. The APL is adjacent to the Advanced Geotechnical Laboratory, the Structural Mechanics Laboratory, and Cementitious Materials Laboratory, which together provide for comprehensive study of pavements. The APL is considered one of the best and most advanced laboratories in the United States and occupies more than 4000 square feet of space. The entire testing laboratory is comprised of six main sections.

The ASU Pavements and Materials program addresses pavement performance analysis, management, and design; advanced material testing and characterization; development of new and more efficient construction materials; and the development and dissemination of sustainable pavement practices. The current program consists of three core faculty members as well as several associated faculty from within Arizona State University. The core curriculum offers degrees at the Masters and Ph.D. levels as well as undergraduate and Postdoctoral opportunities.







Modern infrastructure systems serve multiple purposes. Pipelines are a means to move liquids, but they also represent networks of sensors and information conduits connected to the wider world. Such advanced functionality demands more advanced security. *Graphic courtesy of Shutterstock*

## ASU engineering experts reframe infrastructure security



**Mikhail Chester**

"Infrastructure has always been a target in warfare. Think about military aircraft dropping bombs on bridges or railroad lines," says **Mikhail Chester**, an associate professor of civil and environmental engineering and Director of the ***Metis Center for Infrastructure and Sustainable Engineering***. "But battles today are not just army versus army. They are society versus society, and this change means we need to change how we think about infrastructure."

Chester points to the recent ransomware attack that shut down one of America's largest fuel pipeline networks.

The incident sparked surges in the price of gasoline, panic buying and several days of shortages across the southeastern United States.

"This kind of problem is growing, and it can't be solved through remedial repairs to old infrastructure," Chester says. "We need to take a step back and ask what a pipeline is in 2021 or in 2100. Yes, it's a means to move fuel. But it's also a network of sensors and an information conduit, and that integrated purpose makes it both valuable and vulnerable amid intensifying global competition and conflict."

Chester and his faculty peers believe broader perspectives need to be part of the current debate about improving America's infrastructure systems. One issue is the way we frame our thinking about security.



**Brad Allenby**

"It's a multi-domain factor," says **Brad Allenby**, a professor of civil, environmental and sustainable Engineering. "It's not a power grid issue, nor a drinking water issue nor an issue for fuel pipelines. It's a factor everywhere, and that's the problem. It's not addressed as it should be because nobody 'owns' it."

Allenby says the time has arrived for the United States to create national cybersecurity requirements for infrastructure development. As part of those requirements, he says any new civil engineering project supported by federal money needs to have a cybersecurity assessment.

Chester says this kind of cross-disciplinary collaboration is vital to advancing resilience in the power, transportation, water and other systems that enable society to function. But alongside research and development, he says we need to expand our view of engineering education.

Chester and Allenby say that engineering's core competencies now need to include cybersecurity.





In response to the COVID-19 pandemic, the Indian Health Service, tribal authorities and other partners have worked to expand access to clean water across Navajo Nation land. Additionally, Arizona State University engineering faculty and the Construction in Indian Country program are applying new funding from the National Science Foundation and the National Institutes of Health to combat coronavirus through innovative wastewater analysis tools that can better inform action by multiple tribal governments.

*Photo courtesy of Navajo Nation COVID-19 Water Access Coordination Group*

## ASU launches tribal coordination center to battle COVID-19

COVID-19 has imposed a heavy toll on the entire United States, but the pandemic has been particularly brutal among indigenous communities. According to the [\*Centers for Disease Control and Prevention\*](#), Native Americans are nearly twice as likely as white, non-Hispanic populations to contract the coronavirus and four times as likely to be hospitalized following infection.

These disparities exist even as tribal governments have instituted mitigation measures like face-mask mandates and lockdowns with greater diligence than many state governments. Consequently, the statistics point to long-term issues that have placed a disproportionate disease burden on reservations, such as inadequate investment in education, infrastructure and health care services. Recognizing these gaps, the [\*National Science Foundation\*](#) and the [\*National Institutes of Health\*](#) are funding engineering research and community outreach led by Arizona State University to support tribal nations in combatting coronavirus and improving local resources.

**Otakuye Conroy-Ben**, an assistant professor of environmental engineering is the principal investigator on both the NSF and NIH projects. A member of the **Oglala Lakota Nation**, she has always felt inspired to apply her technical expertise to advance the status of indigenous communities.

Conroy-Ben says the scientific focus of these projects applies wastewater-based epidemiology to detect coronavirus in reservation sewer systems.

Conroy-Ben says the ASU Biodesign Institute [\*research group\*](#) of her colleagues and co-principal investigators **Rolf Halden**, a professor of environmental engineering and **Kerry Hamilton**, an assistant professor of environmental engineering, are working to develop a new method to quantify the proteins of the coronavirus rather than its RNA. "Proteins are relatively stable within the environment," Conroy-Ben says, "so we can investigate whether they represent a more practical way to measure the presence of the virus within a wastewater matrix."

"One key partner in this project is the **Inter-Tribal Council of Arizona**, which serves as a planning and development hub for 21 tribes in the state," says **Marcus Denetdale**, the program manager for CIIC and a member of the Navajo Nation. "The ITCA will help us to connect with tribes through the Tribal Water Systems training program they conduct for utilities operators in different communities."



Otakuye Conroy-Ben



Kerry Hamilton



Rolf Halden



Marcus Denetdale





Twenty percent of homes within the Navajo Nation lack indoor plumbing, meaning residents drive 10 or more miles to fill tanks at transitional water loading points. Courtesy of a new grant from the CDC Foundation, ASU is leading a project to build multiple permanent stations that will improve clean water access for thousands of people. *Photo courtesy of Navajo Safe Water*

## CDC foundation funds new ASU-led project to expand clean water access for the Navajo Nation

Access to clean water is a dire challenge for one third of the world's population, including people living in the southwestern United States.

Approximately 20% of households in the Navajo Nation lack indoor plumbing, meaning thousands of residents haul water in tanks they fill from a mixture of regulated and unregulated sources. The latter are susceptible to contamination and, therefore, pose a threat to human health, so more safe water sites are desperately needed.

Toward that end, the CDC Foundation, an independent nonprofit that supports the work of the Centers for Disease Control and Prevention, **has awarded \$1.8 million through the Arizona State University Foundation to Construction in Indian Country, or CIIC**, which operates within the Del E. Webb School of Construction and supports infrastructure development on tribal land as well as expanded construction management capabilities within Native American communities.

The funds will be used to install new permanent water loading stations across the Navajo Nation as part of COVID-19 response efforts. "We started the project in mid-October, and we're targeting completion by the end of 2022," says **Marcus Denetdale**, program manager for CIIC and an enrolled member of the Navajo Nation and doctoral student of civil, environmental and sustainable engineering.

Denetdale says CIIC designated a native-owned construction management firm called Kenēw to acquire contractors and direct the actual work in the field. Other partners include water quality engineers from Montana State University and the University of Arizona, as well as Fulton Schools faculty members, including **Tony Lamanna** and **Treavor Boyer**.



Marcus Denetdale



Tony Lamanna



Treavor Boyer





Most of the phosphorus applied to crops as fertilizer is lost into the soil or as runoff to nearby canals, rivers, lakes and estuaries. This inefficiency represents environmental, economic and even national security challenges. ASU is working with a new national science and technology center focused on addressing these issues and reducing agricultural reliance on phosphorus extracted from the earth. *Top: Photographer: Erika Gronek/ASU*  
*Bottom: Photo courtesy Adobe Stock*







Paul Westerhoff



Treavor Boyer



Bruce Rittmann



Rebecca Muenich

## Taking steps to solve the wicked problem of phosphorus

Food production depends on phosphorus. It's an essential nutrient for crops of every kind. And as commercial agriculture has expanded during the past 70 years to feed a growing global population, so has the mining of phosphate rock to produce fertilizers.

Unfortunately, the application of these fertilizers is very inefficient. Only 20% of the phosphorus poured onto fields is taken up by plant roots and moved through the food chain. The rest gets chemically locked in the soil or spilled into the canals, rivers, lakes and estuaries where farm irrigation ultimately flows. This build-up in water systems gradually causes eutrophication or the growth of harmful algae blooms that kill fish and other marine life.

"It's a wicked problem," says **Paul Westerhoff**, a Regents Professor of civil, environmental and sustainable engineering. "At one level, it's an environmental pollution issue. But it's also about the cost of food. Simply cutting back on the use of phosphorus in fertilizer could decrease crop yields and raise the price of almost everything at the supermarket." Westerhoff says dependence on mined phosphates also represents a national security concern. While the United States has significant reserves of phosphate rock in Florida and North Carolina, the current trajectory of extraction could exhaust them within a generation. Most global reserves of phosphate rock are found outside of North America, and mainly in Morocco, which makes international relations a factor in long-term food production.

To address the complex ecological, economic and sociopolitical challenges predicated by the rapidly expanding use of mined phosphorus in agriculture, the **National Science Foundation** has announced the creation of a major new research center. The ***Science and Technologies for Phosphorus Sustainability Center***, or STEPS, brings together an interdisciplinary team of experts to pursue a "25-in-25" vision. They are seeking to reduce human dependence on mined phosphorus by 25% and to reduce current losses of phosphorus to soil and water resources by 25% within the next 25 years.

**Funded by an initial five-year, \$25-million grant** and headquartered at North Carolina State University, the STEPS Center involves faculty, staff and students from eight other partner institutions across the country, including ASU. "Moving toward greater sustainability with this issue requires convergence research," says Westerhoff, who is a co-deputy director of STEPS.

Evaluating the new materials, technologies, processes and practices developed by STEPS will happen primarily at three field test areas. Rural ecosystem work will take place at an agricultural research station in eastern North Carolina. Aquatic ecosystem research will occur across sites in central and southern Florida. Urban ecosystem work will happen through ASU's **Central Arizona-Phoenix Long-Term Ecological Research**, or **CAP LTER**, program.

Working alongside Westerhoff, a diverse team of other ASU experts will play key roles for the new STEPS center:

**Treavor Boyer**, a professor of environmental engineering and a senior sustainability scientist, **Bruce Rittmann**, a Regents Professor of environmental engineering and director of ASU's **Biodesign Swette Center for Environmental Biotechnology**, **Rebecca Muenich**, an assistant professor of civil, environmental and sustainable engineering and **Christopher Muhich**, an assistant professor of chemical engineering in the Fulton Schools.





The increasing frequency and severity of natural disasters and other societal disruptions have inspired a new National Science Foundation project to re-engineer urban systems in ways that better maintain public well-being and economic prosperity through future calamities. Researchers from the Ira A. Fulton Schools of Engineering at Arizona State University and peers at three other major institutions will collaborate to create tools that make society more adaptable before the unexpected happens. *Illustration courtesy of Shutterstock*



Ram Pendyala

## ASU engineering research supports new national effort to make urban systems more adaptable and resilient

How can urban businesses and transportation systems demonstrate resiliency and deliver efficient service through significant disruptions such as a hurricane or a pandemic? What knowledge, mechanisms and tools are needed to design a truly adaptable society?

Answering these questions is the purpose of a new **National Science Foundation** project called **“Re-engineering for Adaptable Lives and Businesses,”** funded by the Leading Engineering for America’s Prosperity, Health and Infrastructure, or LEAP-HI, program.

Researchers from the School of Sustainable Engineering and the Built Environment at Arizona State University, the University of Washington, the University of Notre Dame and the University of North Carolina at Charlotte will collaborate during the next four years to explore how key societal systems can switch between alternative operating modalities. They want to equip people with tools that will help them adapt to dramatic situations, while maintaining public well-being and economic prosperity.

**The \$2 million research effort** seeks to advance knowledge at the intersection of multiple disciplines including urban planning, controls and optimization, human behavior and transportation systems analysis. Equally important, the project integrates people, businesses and transit into a network, thus enabling a better understanding of how society can adapt to different disruptions.

Two project case studies will address the vibrancy of small to mid-scale food systems in Phoenix and Seattle, focusing on challenges encountered by communities that include disproportionately large shares of frontline workers and public transit users.

“We saw that food systems such as restaurants and farmers markets were severely disrupted during the pandemic. Many of them had to close and people were out of work — especially among the marginalized communities most impacted by disruptions of this nature,” says **Ram Pendyala**, professor and director, and a co-leader of the LEAP-HI project.

“At the same time, food systems represent an adaptable enterprise. We saw the repurposing of sidewalks and street space for outdoor dining, ramping up take-out and delivery services and implementing social distancing in farmer’s markets,” Pendyala says. “It’s in this context that we see food systems as an adaptable system that connects key entities of interest: small businesses, frontline workers, transit services and marginalized communities.”

Pendyala and his peers also say the project takes account of our societal approach to efficiency. Maximizing efficiency has long been a driving force for economic growth and industrial expansion, but it often results in systems that are unable to adapt to external disruptions, as demonstrated by many natural disasters.





Photo courtesy of Adobe Stock

## High schoolers get to SEE engineering's bigger picture

For high school juniors and seniors, the **Ira A. Fulton Schools of Engineering** offers a weeklong immersive experience called **SEE@ASU** to explore the 25 fields of engineering the Fulton Schools offers as **undergraduate majors**.

Students explored engineering disciplines through hands-on projects taught remotely by six faculty members from across the Fulton Schools. Each session helped participants learn about opportunities available in specific areas of engineering.

**Mackenzie Boyer**, a lecturer of civil and environmental engineering led a water filtration activity. Boyer's project — a camp favorite — introduced the lesser-known discipline of environmental engineering. Students were encouraged to collect a water source from an area around their homes, or create their own dirty water source, which they then learned to purify. "That project highlighted a whole realm of engineering related to agriculture and water applications," which were familiar to many of the migrant students, said Nina Loughman, coordinator of undergraduate recruitment and K-12 engineering research.



Mackenzie Boyer



## 3 new members of the National Academy of Construction include alumni, longtime supporters of Del E. Webb School of Construction

The National Academy of Construction recently inducted three new members with longtime, active ties to the Del E. Webb School of Construction, part of the School of Sustainable Engineering and the Built Environment. NAC membership recognizes exceptional construction industry leaders who have records of outstanding accomplishments in the profession. ASU Engineering alumni Jeffrey Ehret and Janaka Ruwanpura and community leader Robert “Bo” Calbert are strong supporters of engineering education and are now among 16 NAC members who have had close ties to Del E. Webb School of Construction.



**Jeffrey Ehret**, chairman and CEO of **The PENTA Building Group**, earned a construction degree at ASU in 1976 and a master's degree in business administration at ASU three years later. His success in construction earned him the Del E. Webb School Distinguished Alumni award in 2007. He is currently an ASU trustee, a member of the **Fulton Schools Industry Engagement Catalyst** and on the executive boards of the Del E. Webb School's Industry Advisory Council and **Construction in Indian Country** program.



For more than three decades **Robert “Bo” Calbert** helped make McCarthy Building Companies one of the most successful building contractors in the Southwestern United States while also becoming an industry and community leader and a strong supporter of construction and engineering education. Calbert, now retired, worked in the construction industry for more than 35 years, rising to president of the Southwest division of **McCarthy Building Companies** and overseeing major building projects for multiple industries throughout Arizona, Nevada, New Mexico, Colorado and Utah. In 2018, Calbert was inducted into the Hall of Fame of the Del E. Webb School of Construction.



**Janaka Ruwanpura**, a former U.S. Fulbright scholar, earned a master's degree in construction management from the Del E. Webb School of Construction, followed by a doctoral degree in construction engineering and management from the **University of Alberta**. He then joined the faculty of the **University of Calgary**, where he is now a professor and a senior leadership team member. Since 2020, he has also been serving as the associate vice president for research. He was named a distinguished alumnus of the Del E. Webb School in 2019.





## ASU alum builds rewarding construction career from ground up

**Tiffany Sharp**, an Arizona State University construction management alumna, worked her way up in the Phoenix construction industry, then took a chance on herself and started her own company, Sharp Construction. Sharp earned her master's degree in construction management at the Del E. Webb School of Construction. Chosen from nearly 450 applicants, Sharp has been recognized as one of the **Phoenix Business Journal's 40 Under 40** for 2021.

## ITE Young Member of the Year for 2021

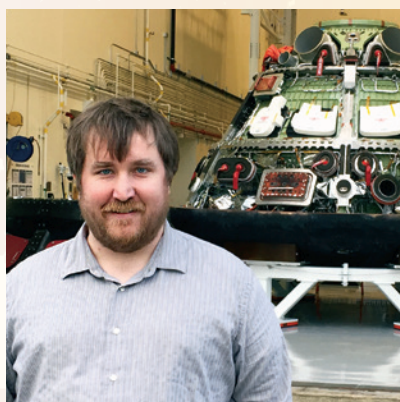
**Yung Koprowski, P.E., PTOE, RSP1 (M), Y2K Engineering, LLC** was chosen as The Institute of Transportation Engineers (ITE) Young Member of the Year for 2021 from the group of **Young Leaders to Follow**. Her professional, ITE, and community accomplishments are remarkable at this early stage of her career. Yung earned a degree in civil engineering from ASU in 2008.



## NASA Early Career Achievement Medal

**Zachary Pirtle** is pictured in 2015 in front of an Orion spacecraft after it was launched into a high energy Earth reentry as part NASA's 2014 Exploration Flight Test-1 mission. Pirtle observed the capsule being dismantled and evaluated. Photo courtesy of Zachary Pirtle

Recently, Pirtle was awarded the **NASA Early Career Achievement Medal** for "outstanding leadership in helping formulate NASA's deep space exploration programs, with innovative application of the program management discipline." He is currently a program executive and engineer for the Exploration Science Strategy and Integration Office, or ESSIO, in NASA's Science Mission Directorate. Pirtle received a master's degree in civil and environmental engineering at ASU in 2007 followed by a doctoral degree in systems engineering at George Washington University in 2019. He joined NASA in 2010 and began working his way into more senior positions.



## 2021 ASCE Distinguished Member

**Kelvin C.P. Wang, Ph.D., P.E., Dist. M.ASCE (PhD Civil, 1992)** was honored as a **2021 ASCE Distinguished Member**. **Distinguished Membership** is the highest honor ASCE can bestow. It is reserved for civil engineers who are either ASCE Members or Fellows.





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**Friends of Civil & Environmental Engineering**

*The Friends of Civil & Environmental Engineering (FOCE<sup>2</sup>)* is an industry advisory committee that includes leaders from the professional community, and the School of Sustainable Engineering and the Built Environment (SSEBE) faculty and staff, all focused on facilitating partnerships and improving the quality and outcomes of the student experience.

Through the efforts and direction of the steering committee, and four dedicated subcommittees, FOCE<sup>2</sup> focuses on developing and sustaining ways for practitioners to directly participate in the educational experience, enhance the learning experience, bring professional development and employment opportunities to students, and foster relationships among students, faculty, alumni and industry practitioners by addressing relevant issues in civil and environmental engineering, and improving the public understanding of contributions of the profession to society.

Also, in collaboration with SSEBE and the ASU Foundation, FOCE<sup>2</sup> launched a Professor of Practice campaign, to raise funds to hire and support a dedicated industry practitioner to be 100% committed to the SSEBE undergraduate capstone course.

Please accept our invitation to join FOCE<sup>2</sup> in our mission to support educational programs of the civil, environmental and sustainable engineering (CESE) program.

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The *Del E. Webb School of Construction Industry Partner Circle* membership contributions are discretionary in nature and will be used by the DEWSC to continue providing world-class education to our students. There are several additional support opportunities for donor directed funds which may be of interest to your company.

We continue to evolve to meet the changing needs of the construction industry. This fall semester we had 504 undergraduate students and 383 graduate students, for a total of 887 students! This represents a 12% increase in undergraduate student and an 88% increase in the graduate student populations!

Over the years, our donors have helped us become a leader in construction education. Some of the activities made possible by our donors include awarding over 50 undergraduate scholarships each year, sending student teams to national competitions, hosting international construction conventions, and appointing endowed professorships and chairs.

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# Faculty Expertise



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Abbaszadegan**

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NSF WET Center**

PhD, University of Arizona

**Expertise:** Health-Related Water Microbiology



**Braden  
Allenby**

**President's Professor**

PhD, Rutgers University

**Expertise:** Sustainable Engineering



**Absar  
Alum**

**Assistant Research Professor**

PhD, University of Arizona

**Expertise:** Pollution Science, Biotechnology



**Samuel  
Ariaratnam**

**Professor and Construction Engineering  
Programs Chair**

PhD, University of Illinois at Urbana-Champaign

**Expertise:** Underground Construction



**Steven  
Ayer**

**Associate Professor**

PhD, The Pennsylvania State University

**Expertise:** Visualization Technologies



**Mackenzie  
Boyer**

**Lecturer and Assistant Research  
Professor**

PhD, University of Florida

**Expertise:** Water Conservation



**Treavor  
Boyer**

**Professor and Environmental  
Engineering Programs Chair**

PhD, University of North Carolina at Chapel Hill

**Expertise:** Water Treatment



**Efthalia (Thalia)  
Chatziefstratiou**

**Lecturer**

PhD, The Ohio State University

**Expertise:** Engineering Education



**Mikhail  
Chester**

**Associate Professor and Director,  
Metis Center for Infrastructure and  
Sustainable Engineering**

PhD, University of California, Berkeley

**Expertise:** Sustainable Infrastructure



**Oswald  
Chong**

**Associate Professor**

PhD, University of Texas at Austin

**Expertise:** Energy and Resource Management



**Otakuye  
Conroy-Ben**

**Assistant Professor**

PhD, University of Arizona

**Expertise:** Endocrine Disruption



**Thomas  
Czerniawski**

**Assistant Professor**

PhD, University of Texas at Austin

**Expertise:** Computer vision and digital modeling of the built environment



**Paul  
Dahlen**

**Assistant Research Professor**

PhD, Arizona State University

**Expertise:** Hydrocarbon Remediation



**Wanda  
Dalla Costa**

**Associate Professor**

MA, University of Calgary, MDR, Southern California Institute of Architecture

**Expertise:** Indigenous Architecture



**Anca  
Delgado**

**Assistant Professor**

PhD, Arizona State University

**Expertise:** Soil Microbial Processes



## Faculty Expertise



**Mounir  
El Asmar**

**Associate Professor**

PhD, University of Wisconsin-Madison  
**Expertise:** Construction, Infrastructure



**James  
Ernzen**

**Associate Professor and PENTA  
Building Group Chair**

PhD, University of Texas at Austin  
**Expertise:** Concrete Materials



**Mahmut  
Ersan**

**Assistant Research Professor**

PhD, Clemson University  
**Expertise:** Water Treatment  
❖ **New Faculty**



**Elham (Ellie)  
Fini**

**Associate Professor**

PhD, University of Illinois at Urbana-Champaign  
**Expertise:** Sustainable Materials



**Peter  
Fox**

**Professor**

PhD, University of Illinois at Urbana-Champaign  
**Expertise:** Groundwater Recharge



**Matthew  
Fraser**

**Professor and Associate Director**

PhD, Caltech  
**Expertise:** Air Quality  
❖ **FSE Top 5% Teaching Award**



**Margaret  
Garcia**

**Assistant Professor**

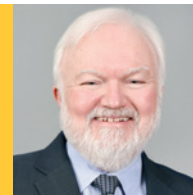
PhD, Tufts University  
**Expertise:** Water Resources



**Sergio  
Garcia-Segura**

**Assistant Professor**

PhD, University of Barcelona, Spain  
**Expertise:** Electrochemical Water Treatment



**G. Edward  
Gibson, Jr.**

**Professor and Sunstate Chair**

PhD, Auburn University  
**Expertise:** Front-End Planning, Construction Safety, Earned Value Management Systems



**David  
Grau**

**Associate Professor**

PhD, The University of Texas at Austin  
**Expertise:** Systems Engineering



**Rolf  
Halden**

**Professor and Director, Biodesign  
Center for Environ. Health Eng.**

PhD, University of Minnesota  
**Expertise:** Water and Health



**Nasser  
Hamdan**

**Assistant Research Professor and  
Industrial Collaboration Director, CBBG**

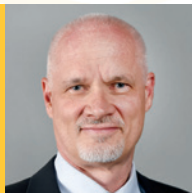
PhD, Arizona State University  
**Expertise:** Biogeotechnics, Biogeochemistry



**Kerry  
Hamilton**

**Assistant Professor**

PhD, Drexel University  
**Expertise:** Microbiology and Risk



**Keith  
Hjelmstad**

**President's Professor and CESE  
Program Chair**

PhD, University of California, Berkeley  
**Expertise:** Structural Engineering



**Christian  
Hoover**

**Assistant Professor**

PhD, Northwestern University  
**Expertise:** Fracture Mechanics



# Faculty Expertise

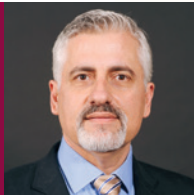


**Kristen Hurtado**

**Assistant Research Professor**

PhD, Arizona State University

**Expertise:** Project Management

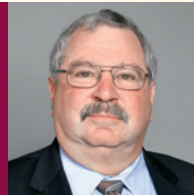


**Kamil Kaloush**

**FORTA Professor**

PhD, Arizona State University

**Expertise:** Pavements and Materials



**Edward Kavazanjian, Jr.**

**Regents Professor and Director, Center for Bio-mediated and Bio-inspired Geotechnics**

PhD, University of California, Berkeley

**Expertise:** Geotechnical Engineering



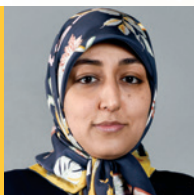
**Hamed Khodadadi Tirkolaei**

**Assistant Professor**

PhD, Eastern Mediterranean University, Cyprus

**Expertise:** Sustainable Geotechnics

♦ **New Faculty**



**Sara Khoeini**

**Assistant Research Professor**

PhD, Georgia Institute of Technology

**Expertise:** Transport Modeling



**Rosa Krajmalnik-Brown**

**Professor and Director, Biodesign Center for Health Through Microbiomes**

PhD, Georgia Institute of Technology

**Expertise:** Microbial Ecology Management



**Barry Kutz**

**Lecturer**

MS, Arizona State University

**Expertise:** Preconstruction delivery



**Klaus Lackner**

**Professor and Director, Center for Negative Carbon Emissions**

PhD, Heidelberg University, Germany

**Expertise:** Carbon Sequestration

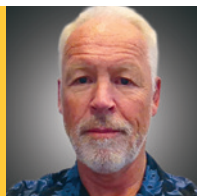


**Anthony Lamanna**

**Associate Professor and Sundt Professor of Alternative Delivery Methods and Sustainable Development, DEWSC Programs Chair**

PhD, University of Wisconsin

**Expertise:** Sustainable Construction



**Peter Lammers**

**Research Professor**

PhD, Portland State University

**Expertise:** Biotechnology & Bioenergy

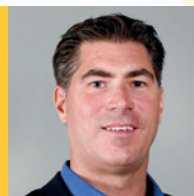


**Jean Larson**

**Assistant Research Professor and Education Director, CBBG**

PhD, Arizona State University

**Expertise:** Engineering Education



**Christopher Lawrence**

**Senior Lecturer**

PhD, Arizona State University

**Expertise:** Geotechnical Engineering



**Yingyan Lou**

**Associate Professor**

PhD, University of Florida

**Expertise:** Transportation Modeling



**Shyamsunder Loukham**

**Assistant Research Professor**

PhD, Arizona State University

**Expertise:** Computational and experimental mechanics

♦ **New Faculty**



**Michael Mamlouk**

**Professor**

PhD, Purdue University

**Expertise:** Pavement Materials



## Faculty Expertise



**Giuseppe  
Mascaro**

**Assistant Professor**

PhD, University of Cagliari, Italy

**Expertise:** Stochastic Hydrology



**Barzin  
Mobasher**

**Professor**

PhD, Northwestern University

**Expertise:** Composite Materials



**Rebecca  
Muenich**

**Assistant Professor**

PhD, Purdue University

**Expertise:** Watershed Modeling



**Narayanan  
Neithalath**

**Professor and Graduate  
Programs Chair**

PhD, Purdue University

**Expertise:** Materials Science



**Hasan  
Ozer**

**Associate Professor and Director,  
National Center of Excellence on  
SMART Innovations**

PhD, University of Illinois, Urbana-Champaign

**Expertise:** Pavements and Sustainability



**Kristen  
Parrish**

**Associate Professor**

PhD, University of California, Berkeley

**Expertise:** Construction Management

❖ **FSE Top 5% Teaching Award**



**Ram  
Pendyala**

**Professor and Director of SSEBE,  
Director, TOMNET University  
Transportation Center**

PhD, University of California, Davis

**Expertise:** Transportation Systems



**François  
Perreault**

**Assistant Professor**

PhD, University of Quebec, Canada

**Expertise:** Environmental  
Nanotechnology



**Steven  
Polzin**

**Research Professor**

PhD, Northwestern University

**Expertise:** Transportation Policy Analyses

❖ **New Faculty**



**Subramaniam  
(Subby) Rajan**

**Professor**

PhD, University of Iowa

**Expertise:** Finite Element Analysis  
Computational and Experimental Solid  
Mechanics



**Jafar  
Razmi**

**Associate Research Professor**

PhD, University of Maryland, College Park

**Expertise:** Structural Mechanics and  
Geotechnical



**Bruce  
Rittmann**

**Regents' Professor and Director,  
Biodesign Swette Center for  
Environmental Biotechnology**

PhD, Stanford University

**Expertise:** Environmental Biotechnology



**Emmanuel  
Salifu**

**Presidential Postdoctoral Fellow**

PhD, University of Strathclyde and  
University of Naples Federico II, Italy

**Expertise:** Biogeotechnical Engineering

❖ **New Faculty**



**Thomas  
Seager**

**Associate Professor**

PhD, Clarkson University

**Expertise:** Infrastructure Systems



**Shahnawaz  
Sinha**

**Assistant Research Professor**

PhD, University of Colorado-Boulder

**Expertise:** Drinking Water Treatment



# Faculty Expertise



**Richard  
Standage**

**Lecturer**

PhD, Arizona State University

**Expertise:** Concrete Specialist



**Peter  
Stopher**

**Research Professor**

PhD, University of London

**Expertise:** Transportation Planning



**Kenneth  
Sullivan**

**Professor**

PhD, University of Wisconsin-Madison

**Expertise:** Procurement and OCM



**Junliang  
(Julian) Tao**

**Associate Professor**

PhD, Case Western Reserve University

**Expertise:** Bioinspired Geotechnics



**Jeffry  
Vann**

**Beavers-Ames Lecturer in Heavy  
Construction**

PhD, Arizona State University

**Expertise:** Expansive soils, post-tensioned  
slabs, unsaturated soil mechanics

♦ **New Faculty**

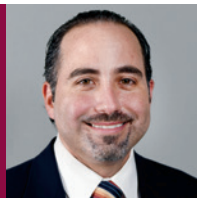


**Leon van  
Paassen**

**Associate Professor**

PhD, Delft University of Technology

**Expertise:** Geotechnical Engineering



**Enrique  
Vivoni**

**Professor and Associate Dean  
Graduate College**

PhD, Massachusetts Institute of Technology

**Expertise:** Hydrologic Science



**Kristen  
Ward**

**Senior Lecturer**

PhD, University of Arizona

**Expertise:** Structural Engineering



**Zhihua  
Wang**

**Associate Professor**

PhD, Princeton University

**Expertise:** Urban Environment



**Paul  
Westerhoff**

**Regents' Professor**

PhD, University of Colorado

**Expertise:** Water Treatment



**Avi  
Wiezel**

**Associate Professor and Assistant Dean  
for Facilities**

PhD, Technion-Israel Institute of Technology

**Expertise:** Human Aspects of Management



**Tianfang  
Xu**

**Assistant Professor**

PhD, University of Illinois, Urbana-  
Champaign

**Expertise:** Groundwater Sustainability



**Claudia  
Zapata**

**Associate Professor**

PhD, Arizona State University

**Expertise:** Unsaturated Soils



**Ruijie  
Zeng**

**Assistant Professor**

PhD, University of Illinois, Urbana-  
Champaign

**Expertise:** Hydrologic Modeling



**Xuesong  
Zhou**

**Associate Professor**

PhD, University of Maryland

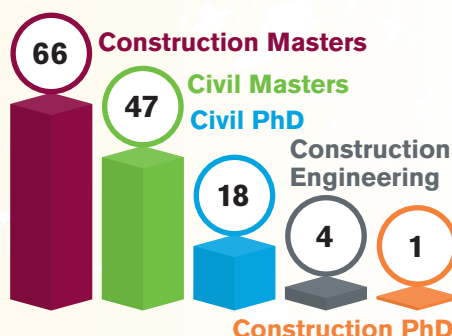
**Expertise:** Multimodal Network Planning



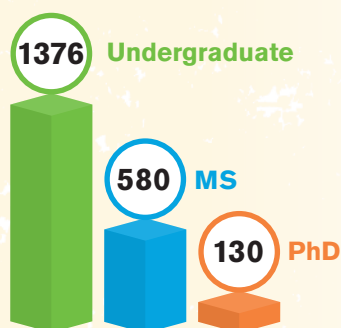
## Undergraduate Degrees Conferred



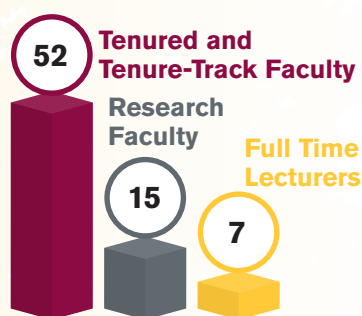
## Graduate Degrees Conferred



## Enrollment



## Faculty



## 2022 US News and World Report Program Rankings

Undergraduate	Graduate
#17 Civil Engineering	#26 Civil Engineering
#17 Environmental Engineering	#20 Environmental Engineering

## Total Scholarships and Fellowships Awarded 2021

**\$303,272**

## SSEBE Research Expenditures

**\$19,895,872**

## National Academy of Engineering Members

Edward Kavazanjian, Jr.  
Bruce Rittmann

## ASCE Distinguished Members

G. Edward Gibson, Jr.  
Edward Kavazanjian, Jr.  
Bruce Rittmann

## National Academy of Construction Members

Samuel T. Ariaratnam  
William Badger (emeritus)  
G. Edward Gibson, Jr.

## Canadian Academy of Engineering Member

Samuel T. Ariaratnam

## Emeritus Faculty

William W. Badger, PhD  
Howard H. Bashford, PhD  
Allan Chasey, PhD  
Apostolos Fafitis, PhD

Sandra Houston, PhD  
William Houston, PhD  
Paul Johnson, PhD  
Larry Mays, PhD

T. Agami Reddy, PhD  
Avinash Singhal, PhD  
Matthew Witczak, PhD

## Farewell

We thank the following faculty for their service and wish them well.

**Kraig Knutson**, Senior Lecturer left ASU August 16, 2021 after 24 years at ASU.

**T. Agami Reddy**, Professor retired May 16, 2021 after 13 years at ASU.

# SCHOOL OF **Sustainable Engineering** and **the Built Environment**

## **Fulton Schools of Engineering places five undergraduate programs in the top 25**

Undergraduate programs in civil, computer, electrical, environmental and mechanical engineering in ASU's Ira A. Fulton Schools of Engineering are among the nation's best according to U.S. News. Students at the nation's largest engineering school benefit from a deliberate focus on innovation and excellence.

## **Overall undergraduate engineering program climbs six spots in the 2022 U.S. News rankings**

The Fulton Schools of Engineering's nationally ranked undergraduate engineering programs and specialties include:

**#17 Civil engineering**

**#17 Environmental engineering**

**#20 Computer engineering**

**#21 Mechanical engineering**

**#22 Electrical engineering**

**#29 Bioengineering/biomedical engineering**



Fostering **Infrastructure Resilience**  
in the Face of **Disruption...**



**ASU** Ira A. Fulton Schools of  
**Engineering**  
Arizona State University

[ssebe.engineering.asu.edu](https://ssebe.engineering.asu.edu)