



CEE
NEWSLETTER

fall 2021

A photograph of two women in a professional setting, likely an office or laboratory, leaning over a desk and looking at a laptop screen. The woman on the right is wearing glasses and has her hand near her face, appearing to be in a state of deep thought or listening. The woman on the left is also looking intently at the screen. The entire image is overlaid with a semi-transparent red filter. The text is centered in the lower half of the image.

**Collaborating to
engineer solutions
for a resilient,
sustainable future**

NOTE FROM CHAIR

Our Future

Warm greetings to all of you as we celebrate our 2021 graduates and optimistically look forward to the post-Covid era! Over the past year, the inventiveness and resilience of our Civil & Environmental Engineering department have shone brightly, as our faculty and staff have creatively met the unprecedented challenges of online teaching and remote research. We are enthusiastically planning for a return to our Y2E2 home, and to in-person teaching, in Autumn.

In this newsletter, we bid a fond farewell to six long-time members of our CEE community who have retired: Professors Jim Leckie, Ray Levitt, and Len Ortolano as well as longstanding staff colleagues Brenda Sampson, Duc Wong, and Teddie Guenzer. We introduce you to three new CEE faculty, and spotlight the accomplishments of two alumni.

This newsletter also highlights two recent examples of CEE's amazingly diverse research activities: Ali Boehm's development of a methodology to track trends in community prevalence of COVID-19 via wastewater monitoring, and the successful effort by Mike Lepech and Kincho Law to create an international Center, in collaboration with South Korea, focusing on technologies and new paradigms for smart cities of the future.

For me, one of the most impactful lessons from the past year has been the importance of effectively communicating scientific knowledge, and its uncertainties, to the public. It is heartening to me that so many of our CEE faculty and instructors have been open to being interviewed about their work! Here are just a few of the stories and interviews you may enjoy, all of which can be found online at cee.stanford.edu/news/2021:

- **Catherine Gorle**, “How Cityscapes Catch the Wind”
- **Meagan Mauter**, “How Freshwater Supply is Becoming More Circular”
- **Martin Fischer**, “Bringing BIM to the Modern Built Environment”
- **John Barton**, “Ask an Architect”
- **Ram Rajagopal**, “How the Grid is Becoming More Human-Centric”
- **Nick Ouellette**, “What Flocks of Birds Can Tell Us About Engineering”
- **Anne Kiremidjian**, “Cities Built to Endure Disaster”
- **Mark Jacobson**, “A Renewable Future”
- **Sarah Billington**, “How We Shape Our Buildings – and How They Shape Us”
- **Craig Criddle**, “Redefining Waste Treatment”
- **Lynn Hildemann**, “What Pollutants Are Lurking in our Indoor Spaces”
- **Anthony Kinslow**, “How to Close the Energy Divide”

If you would like to know what else we have been doing, please explore the newsfeed on our website, cee.stanford.edu. And we would be delighted to hear from you and learn about what you've been doing since your time at Stanford—please feel free to send us an email, at cee-deptchair@lists.stanford.edu.



Lynn Hildemann,
*Department Chair of Civil and
Environmental Engineering*

FEATURE

The Department of Civil and Environmental Engineering has opened the doors of a new research center in South Korea that will focus on new paradigms for “smart cities” of the future.

Stanford Center at the Incheon Global Campus

The [Stanford Center at the Incheon Global Campus](#) is a collaboration between Stanford, the South Korean government and the Incheon Free Economic Zone. It will be headquartered in Songdo, itself a smart city that was built from scratch over the past decade along Incheon’s waterfront.

The goal of the center, which opened in early June, is to develop not just new technologies but new financial and organizational models that cities around the world can replicate.

“This is a unique and essential opportunity to study smart city implementation in collaboration with a smart city that was built in Asia,” says Michael Lepech, the center’s director and a professor of civil and environmental engineering at Stanford. “Over the coming years, we can work to generalize those lessons to other areas of the globe.”

The new center launched with an opening ceremony held in early June with at least ten fulltime researchers who work alongside a Stanford-based counterpart, the [Center for Sustainable Development and Global Competitiveness](#), which is part of CEE. Professor Kincho Law, also of CEE, is Lepech’s co-investigator on the project.

The seemingly modest size belies the new center’s powerful champions. South Korea’s Ministry of Trade, Industry and Energy will supply most of the funding, in part because South Korean leaders see smart city expertise as a competitive edge for the nation’s giant industrial corporations. The new center also has close ties to top South Korean research universities.

At Stanford, the center will work closely with the department of Civil and Environmental Engineering, as well as with nine interdisciplinary centers that deal with sustainability, urban infrastructure, finance and information technology.

Indeed, says Lepech, the idea of focusing on implementable models rather than technology alone was

inspired by the Precourt Institute for Energy at Stanford. Precourt has been a leader in identifying the incentives and strategies that spur communities to actually adopt more energy-efficient technologies.

“When I use the word ‘model,’ I mean it in the sense of a business model for providing value to citizens in exchange for tax revenue or fees,” he says. “We are looking for models that can be replicated elsewhere.”

One of the key ideas, says Lepech, is to foster an information “metastructure” that sits on top of a city’s physical infrastructure and enables new opportunities to improve sustainability, efficiency and the quality of life.

One likely early project, called Sphinx, aims to combine sensor networks with advanced computational modelling in order to map out the future financing needs for repairs to bridges and other infrastructure. Stanford researchers, for example, have developed sensors that can be embedded in reinforced concrete and detect chemical indicators of corrosion caused by seawater. As envisioned, the sensors would transmit data continuously, using a novel low-power radio network, and computer models would use the data to predict the pace of deterioration years before it became dangerous.

Lepech and colleagues at Korean universities are also exploring new approaches to optimize traffic lights and reduce congestion. At the moment, cities often rely on traffic data from sensors embedded under streets or from cameras mounted at intersections. A cheaper alternative, says Lepech, could be to mount cameras on a relatively small number of self-navigating vehicles that roam the city. Hyundai, the Korean car manufacturer, has expressed interest. Another possibility would be to analyze data from smartphones and ride-sharing apps.



Michael Lepech

The new center has been years in the making. In 2017, South Korean President Moon Jae-In proposed a smart-city pilot project that would draw on expertise from every part of the government. Korean officials reached out to Stanford, hoping in part to tap into the university's experience in technology, sustainable systems and high-tech entrepreneurship.

Stanford and its South Korean partners finalized plans for the center in 2020, but the COVID-19 pandemic delayed the center's operational launch until this summer. The center has already leased space in the Incheon Global Campus's downtown tower, and Lepech says the construction work is ongoing. Lepech, who will remain based at Stanford, has already recruited an executive director and a director of research, and is now hiring a managing director and a team of Korea-based researchers.

The project has strong support from the South Korean government as well as research partnerships with leading Korean universities and industrial corporations. Korean authorities are providing funding to get the center started, with ambitious plans to grow and become self-sufficient in the coming years.

Stanford alumni in South Korea have also championed the venture. One key supporter is Daeje Chin, who earned a Ph.D. in electrical engineering from Stanford and went on to become a top executive at Samsung and later Minister of Information and Commerce. Another is Saehong Hur, a graduate of Stanford's Graduate School of Business who is now chief executive

officer of [GS Caltex Corporation](#), a major Korean petrochemical refiner.

More broadly, Lepech says, South Korea is a democratic republic with a modern market economy. In contrast to top-down nations like China or Singapore, which are both active on smart-city projects, South Korea presents the political and financial conditions that are more likely to resemble those in a broad array of nations. "If you're going to study these issues in China, you can't take that model to Africa or to European democracies," says Lepech.

By contrast, Lepech says South Korea, and the smart city of Songdo in particular, offer several advantages in developing templates for smart cities in many countries around the world.

On a practical level, Songdo was envisioned as a smart city and already has a high-tech infrastructure. In effect, says Lepech, that makes it an ideal laboratory for integrating new streams of data and new analytical tools into a city's governance and institutions.

"Stanford has great laboratories, but I need a lab that's a city and this center provides that," Lepech says. "That's a gamechanger for us."

For more stories and news about the SCIGC, please navigate online to cee.stanford.edu/news/korea.

FEATURE

A team of engineers help identify a new method that detects the virus in wastewater samples — and tracks whether infection rates are trending up or down.

Wastewater

Wastewater can help identify changes in community COVID-19 infections

By Michelle Horton / December 07, 2020



Alexandria Boehm

Accurately identifying changes in community COVID-19 infections through wastewater surveillance is moving closer to reality.

A new study, published in *Environmental Science & Technology*, identifies a method that not only detects the virus in wastewater samples but also tracks whether the infection rates are trending up or down.

Testing wastewater — a robust source of COVID-19 as those infected shed the virus in their stool — could be used for more responsive tracking and supplementing information public health officials rely on when evaluating efforts to contain the virus, such as enhanced public health measures and even vaccines when they become available.

The test works by identifying and measuring genetic material in the form of RNA from SARS-CoV-2, the virus that causes COVID-19. “This work confirms that trends in concentrations of SARS-CoV-2 RNA in wastewater tracks with trends of new COVID-19 infections in the community. Wastewater data complements the data from clinical testing and may provide additional insight into COVID-19 infections within communities,” said co-senior author Alexandria Boehm, a Stanford professor of civil and environmental engineering.

As the U.S. grapples with record-breaking daily transmission rates, obtaining more information to track surges and inform public health policies in local communities remains key to managing the deadly virus. COVID-19 can be particularly hard to track, with many asymptomatic or mild cases going undetected. Those who do get tested can still spread the infection before they receive test results, inhibiting quick identification, treatment and isolation to slow the spread. Faster identification of case spikes could allow local officials to act more quickly before the disease reaches a crucial tipping point where transmission becomes difficult to contain and hospitalizations overwhelm the local health system.

Tracking COVID-19 through wastewater surveillance of RNA is gaining steam across the country and could alert decision-makers about potential outbreaks days before individuals recognize symptoms of the virus. The viral RNA can be isolated from sewage in wastewater treatment facilities and identified through a complicated and highly technical recovery process, with the relative amounts in wastewater correlating to the number of cases. Anyone with a toilet connected to a sewer system could be depositing these biological samples on a regular basis, making wastewater sampling an inclusive source of information about COVID-19 in a community.

With this in mind, the researchers sought to advance the effectiveness and accuracy of wastewater surveillance for COVID-19 by comparing the ability to detect the virus in two forms of wastewater — a mostly liquid influent or a settled solid (sediment settled in a tank). Most current research focuses on influent samples; however, the team notes many viruses have an affinity for solids and expected higher concentrations of the virus in these samples, which could improve detection and consistency.

The researchers found the settled solid samples had higher concentrations and better detection of SARS-CoV-2 compared to the liquid versions. “These results confirmed our early thinking that targeting the solids in wastewater would lead to sensitive and reproducible measurements of COVID-19 in a community. This means that we can track upward trends when cases are still relatively low,” said co-senior author Krista Wigginton, an associate professor in civil & environmental engineering from the University of Michigan. Wigginton and Boehm co-lead the research.

The researchers then tested about 100 settled solid samples from the San Jose-Santa Clara Regional Wastewater Facility from mid-March to mid-July 2020, tallying daily concentration numbers. Using statistical modeling they compared these concentrations with COVID-19 confirmed cases provided by the county. Their results tracked the trend of the county’s cases, decreasing in both May and June and peaking in July.

The research presents a possible way to identify new outbreaks, find hotspots, confirm the decrease of cases and inform public health interventions. As schools reopen, the technology could be implemented by districts to identify whether community virus circulation is decreasing. It also has the potential to be used in areas lacking the resources for robust individual clinical testing, such as testing sites in Illinois that reportedly closed early after running out of tests.

There are still pieces of information needed to better understand the limitations of wastewater testing and improve what can be gleaned, the researchers note. The virus’s rate of decay in wastewater, the extent and timeline of viral RNA shedding when sick and varying operations of different wastewater plants all have the potential to impact results. Future studies on these factors could lead to better insights about case trends.

The team is launching a new pilot this month to sample up to eight wastewater treatment plants within California daily, with a 24-hour turnaround time. The pilot aims to better understand what types of almost real-time data are useful to public health officials. Implementing the methods and framework developed by the team and pilot study could also be used in the future to monitor wastewater for pathogens beyond COVID-19 circulating within communities.

The research presents a possible way to identify new outbreaks, find hotspots, confirm the decrease of cases and inform public health interventions. As schools reopen, the technology could be implemented by districts to identify whether community virus circulation is decreasing.

Additional authors are: Katherine Graham, Stephanie Loeb, Marlene Wolfe, Sooyeol Kim, Lorelay Mendoza and Laura Roldan-Hernandez, Stanford Civil & Environmental Engineering; David Catoe, SLAC National Accelerator Laboratory; Nasa Sinnott-Armstrong, Stanford School of Medicine; Kevan Yamahara, Monterey Bay Aquarium Research Institute; Lauren Sassoubre, University of San Francisco, Engineering; Linlin Li, County of Santa Clara Public Health Department; Kathryn Langenfeld, University of Michigan, Civil & Environmental Engineering. Payal Sarkar, Noel Enoki and Casey Fitzgerald from the City of San José Environmental Services Department also contributed to the project.

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STUDENT STORY

CEE Sustainable Design & Construction

Graduate Students Form Kit Switch Group to Promote Adaptive Reuse for Affordable Housing



KIT SWITCH

Adaptive Reuse for Affordable Housing



Alexandra Diabré



Anusha Krishnamurthy



Armelle Coutant



Candice Delamarre



Samantha Liu

Kit Switch offers energy efficient, prefabricated interior kits-of-parts to convert underutilized commercial buildings into sustainable and affordable housing units.

Kit Switch is a group of all-female Stanford graduate engineers and architects which includes Armelle Coutant, Alexandra Diabré, Anusha Krishnamurthy, Candice Delamarre and Samantha Liu, from the Sustainable Design and Construction Program. They are mission-driven, value community engagement and align themselves with social justice initiatives to create diverse and thriving mixed-use and mixed-income communities. Their women-led team, interdisciplinary backgrounds, and shared passion sets them apart. The team has domain expertise in the built environment, sustainability and leveraging digital tools for industrialized construction.

Eighty percent of the buildings that will exist in 2050 have already been built. In the U.S., where retail and office value has been declining, it is important to think through not only building anew, but also sustainably reusing what we have. This is an exciting time for Kit Switch to meet the housing demand within the U.S.,

as it specializes in the adaptive reuse of underutilized commercial buildings into affordable housing through integrated design services and an off-site manufactured kit of parts.

Kit Switch offers an energy efficient, prefabricated interior kit-of-parts for property owners to convert their underutilized commercial buildings into sustainable and affordable housing units. Their unique offering in terms of energy efficiency, affordability, and time and cost-effective conversions make them an ideal fit when compared to traditional general contractors. By leveraging and converting existing infrastructural resources they realize a significant reduction in energy consumption, waste, costs, time and CO2 emissions associated with demolition and ground-up construction processes. With their services, property owners of commercial real estate will have a stable source of income and approximately 12% return on investment, the public will have more affordable housing options, and cities will have a seamless and cost-effective, long-term solution for affordable housing.

Kit Switch originated from the Stanford Venture Creation for the Real Economy course in Spring 2020, during which

their common interests brought them together. Since then, the team has leveraged core courses from the SDC program to validate their value offering. They carried out a production system optimization on the on-site assembly process by leveraging the Managing Fabrication & Construction course. Kit Switch was also a project sponsor in the Life Cycle Assessment course during which they compared traditional built walls to prefabricated wall panels. Kit Switch innovation analysis has shown to be 5 times cheaper and 1.2 times lesser in CO2 emissions when compared to traditional wall construction. Besides, its assembly process is particularly quick with 10 housing units installed in less than a week. After winning the Hack-a-House competition hosted by Ivory Innovations and being awarded the 2020-2021 Stanford TomKat Innovation Transfer Grant for Energy Efficiency, they have enough funds to begin prototyping their product and developing a proof of concept.

To learn more about their work and upcoming milestones, visit their website at kitswitch.com or email them at contact.kitswitch@gmail.com.

STUDENT COMPETITION



VIRTUALLY NO PROBLEM: Stanford wins 1st place at the 2021 Regions 6&7 ASC Open Competition

For the fifth consecutive year, Stanford University's two teams earned top recognition in the Integrated Project Delivery category at the regions 6 & 7 ASC student Competition.

TEAM #2 / consisting of the following graduate students: Awoe Mauna-Woanya (Captain), Julia Lind, Wes Miller, Vasu Patel, Shihua Xie, Javier Castellanos, and Matt Henderson (alternate), won first place due to the overall competition performance.

TEAM #1 / consisting of Louis Lubow (Captain), Christina Du, Sophie Stern, Fauzan Maulana, Piero Urrutia, Meredith Lee, and Jingling Duan (alternate), winning the "Most Innovative Use of Technology" Award.

Due to the COVID-19 pandemic, the competition was held entirely virtually instead of the usual Reno, Nevada. Despite this challenging and novel environment, both Stanford teams performed incredibly well, showing their determination, collaboration, and creativity under stressful situations. This collective success reflects the team's hard work and the program's commitment to helping students succeed.

Both teams would like to recognize Darryl Goodson, Jane Lin, Peter Worhunsky, Brian Sedar, and past alumni for their continued support and coaching throughout the preparation phase leading up to the competition.

STUDENT AWARDS

The Earthquake Engineering Research Institute awarded its 2020 Graduate Student Paper Award to CEE doctoral student Sabine Loos (M.EERI, 2016), with co-authors for the paper, "G-DIF: A geospatial data integration framework to rapidly estimate post-earthquake damage." Sabine's co-authors include David Lallemand, Jack Baker (M.EERI, 2004), Jamie McCaughey, Sang-Ho Yun, Nama Budhathoki, Feroz Khan, Ritika Singh.



Sabine Loos

Ph.D. Candidate, Stanford Urban Resilience Initiative (SURI), Disaster Analytics for Society Lab (DASL, Singapore)

She uses statistical learning techniques that bridge engineering with the natural and social sciences to develop tools to support effective and equitable disaster recovery. The transdisciplinary nature of her work has led her to collaborate with Kathmandu Living Labs, the World Bank,

NASA-JPL, Humanitarian OpenStreetMap Team, and others. She also co-chaired the recent Natural Hazards Center Researchers' Meeting devoted to ethical usage of data for disaster research and co-hosted the Risk & Resilience DAT/ Artathon focused on developing data visualizations using disaster data. In the final year of her Ph.D. from Stanford University, she holds a master's degree in Sustainable Design & Construction from Stanford University (2018) and a bachelor's degree from The Ohio State University (2016).

STUDENT STORY

SSI selected by NASA to send experiment to International Space Station

By Tom Quach, Stanford Daily

Stanford's Student Space Initiative (SSI) will send its experiments to the International Space Station in 2022 as part of NASA's [Student Payload Opportunity With Citizen Science](#) program. They join four other schools – Arkansas State University, Columbia University, University of Idaho and University of New Hampshire at Manchester – in conducting research focused on bacteria resistance or sustainability.



SSI's Mars Bricks subteam, co-led by Phoebe Wall '23 and William Koski '19 M.S. '21, plan to test how microgravity and zero-gravity affect the formation and durability of a concrete substitute material called Bio-Bound Soil Composites (BSC).

Laboratory and NASA's Ames Research Center, SSI's experiment in the International Space Station will include 24 "miniscule-sized" bricks studied over 30 days.

Upon arrival on the space station, 12 valves will automatically operate and infuse the BSC dirt compound with water. Dehydrating the solution will activate the protein to stick with the dirt and create a version of concrete, allowing the SSI team on Earth to analyze how zero-gravity affects the brick formation process.

In preparation for the launch, NASA has awarded the 13-member Mars BRIC group, a subteam of Mars Bricks dedicated entirely to this project, up to \$20,000 to purchase equipment to study the materials and how they might be utilized for habitat construction on other planets and the Moon.

Wall and Koski hope that data collected from this experiment will aid future space researchers to create habitable environments on Mars and other terrestrial surfaces with "in-situ resource utilization" (ISRU), a technique of extracting raw resources already present on a planet or moon.

Andrew Lesh '20 currently serves as the systems lead for this research endeavor. He founded SSI's Mars Team a few years ago, which oversees several subcommittees, including the Mars Bricks group.

"We are developing a technology to create bricks out of existing dirt on Mars," Wall said, adding that their "very economical and simple to manufacture" design sets them apart.

BSC, which contains a type of protein commonly used in medicine called bovine serum albumin, will allow for the microscopic binding of lunar or martian soil and form solids, such as bricks.

"The crucible of space requires us to design circular economies, think about 'cradle to cradle' systems and use very little energy," said Michael Lepech, an SSI faculty advisor and civil engineering professor who, alongside NASA's David Loftus, discovered the BSC that the Mars Bricks team uses in their project.

Building on protein powder and Martian regolith (unconsolidated rocky material) research performed in collaboration with Stanford's Blume Earthquake



The bio-bound soil composite material, Lesh explained, can be “directly applicable towards any kind of granular soil,” including lunar regolith and even Earth’s dirt and beach sand. It could be a possible sustainable alternative to normal concrete.

Lepech agreed, adding that “the materials that we are developing for upcoming long duration space missions may someday become the most sustainable building materials used here on Earth.”

Lesh added that because the water used to construct the brick does not become part of the structure, it can be used over and over again. “That is why NASA and the government is really interested,” Lesh said. “This is helping combat climate change and it is not just a fun space thing.”

On Earth, the materials could be used to construct temporary shelters for those in need around the globe. Currently, pouring water over the substance dissolves it, though Wall said that this could be an advantage. “We could build structures very quickly in areas like refugee camps,” they said. “Those buildings can also be taken down with little environmental impact.”

Additionally, a critical part of the NASA collaboration is an emphasis on citizen involvement and outreach. Along with submitting their findings to scientific publications and presenting at confer-

ences, the Mars Bricks team will partner with the Chabot Space and Science Center in Oakland to introduce live educational workshops aimed at six to 12 year olds. In addition, the group intends to engage with the San Mateo County Office of Education to develop a science curriculum with an emphasis on this experiment.

Perhaps the most direct “citizen” contribution to the Bio-Bound Soil Composite project will lie in several East Palo Alto high school classrooms, Wall said. Under supervision from the Mars Bricks team student-leaders, the high schoolers will help make BSC bricks that serve as the control group, identical to the 24 samples orbiting around Earth for 30 days. After conducting CT scans of the classroom samples, Wall, Koski and their team aim to partner with the Girl Scouts to help analyze those images and compare the impact of Earth’s gravity and the zero-gravity of space.

The group leaders said this opportunity has allowed them to find new resources to produce a space project while educating the younger generation about their research.

“If it hadn’t been for NASA,” Wall said, “we never would have had \$20,000 to send something up to space.”

NEW FACULTY SPOTLIGHT



Q&A with Meagan Mauter research director of \$100-million program to develop new sources for usable water

By Mark Golden and Michelle Horton

A new and ambitious research project looks to develop affordable devices to recycle most of the water we now throw away, as well as to desalinate saltwater. The project's research director describes the project's vision and operation

In fall 2019, the U.S. Department of Energy announced a \$100 million research grant to the National Alliance for Water Innovation (NAWI) to lead an Energy-Water Desalination Hub. Meagan Mauter, who had just joined CEE as associate professor, is NAWI's research director.

The five-year project will research and develop cost-competitive and energy-efficient technologies to desalinate nontraditional water sources for diverse end uses from agriculture to municipal drinking water. "Desalination" in this project is much broader than removing salt from seawater. It includes removing contaminants — many of which are salt compounds — from industrial wastewater and sewage, among other sources.

Led by Lawrence Berkeley National Laboratory's Peter Fiske, NAWI includes four DOE national labs, 19 universities and 10 industry partners. Here, Mauter explains how this very large and potentially transformative project will work, and Stanford's role in the work.

What does NAWI hope to achieve in the coming years?

We believe that a circular water economy is essential to securing the U.S. water supply. Our 10-year goal is

to develop the technologies that enable 90 percent of nontraditional water sources to be reused at the same cost and energy intensity as traditional water sources. Our team has identified six critical technology barriers to distributed water desalination and reuse that will motivate the research agenda for the hub.

That's a lot to unpack. Let's start with a "circular water economy." What does that mean?

Our water systems today are for the most part linear: Extract freshwater, treat to a uniform standard, use, treat wastewater and dispose. This approach has been highly successful in the context of the 20th century when population centers were smaller, industrial water demands were better aligned with water availability and freshwater aquifers were more abundant. Today's reality is different. As we see in California, we have large population growth in arid regions, less natural water storage in snowpack and depleted aquifers.

While economies of scale and sunk infrastructure costs mean that large municipal systems are here to stay in most areas, many nontraditional water sources are underutilized in this conventional paradigm. To tap those sources — from brackish groundwater to brines (water highly concentrated with salt compounds) from power plants, oil production, saline aquifers used to sequester carbon dioxide, paper mills and beverage and food processing — we need technologies that will allow us to transform a linear water economy into a circular one in which we minimize freshwater withdrawals by reusing wastewater.

And why is it important that your solutions be dispersed and modular?

One of the key features of a distributed water infrastructure system is that every source of water will be slightly different. So, instead of designing a huge, custom-built, central water-treatment plant, we hope to deliver a water treatment unit that functions as a kitchen appliance. Okay, a large kitchen appliance. Seriously, though, we envision mass-produced, prefabricated water-treatment systems that can be paired to provide flexible water treatment solutions. This will allow us to keep treatment and re-use of the water as local as possible.

How can you transform industrial wastewater into a water source that is competitive with more traditional sources?

Much of the cost and energy intensity of industrial wastewater management is actually embedded in the transportation of wastewater via pipeline or truck. This is especially true of distributed industrial water use, for instance in oil and gas development or agricultural wastewater treatment, where users pay both to source freshwater and dispose of wastewater.

Our strategy is to cut water transportation substantially by developing technologies that enable cost-effective distributed treatment and reuse. Even if the treatment costs are slightly higher per gallon, these costs will be more than offset by the lowered transportation costs and the simultaneous provision of clean water.

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Will all the research be performed by current NAWI partners?

We will have open requests for proposals that solicit early-stage research that is aligned with the NAWI mission. DOE specifically requested that we focus R&D efforts on technology readiness level 2-4 research, which is essentially focused on moving basic research into the early piloting phase.

This is an exciting stage of technology development to be focusing our efforts on because it will leverage the diverse skills of academia, national laboratories and industry. I'm particularly excited about leveraging the fantastic modeling, synthesis and characterization facilities at the national labs for this important mission. This includes the SLAC National Accelerator Laboratory here at Stanford, though it isn't one of the founding national labs.

The more diverse the people and assets that contribute to this effort, the more likely NAWI is to achieve its ambitious goals.

Stanford has several faculty members doing related work in water reuse. Do you see Stanford researchers playing a significant role in NAWI?

Stanford will definitely be a key partner. I'm very excited to be directing this research from a university so committed to sustainability and the environment, and from a state highly motivated to address the water crisis. I just arrived at Stanford at the beginning of September, so I'm still getting the lay of the land when it comes to the diverse scientific community that I hope will participate in this hub.

That said, I have many fantastic colleagues in civil and environmental

engineering who have been researching water reuse solutions for some time. For instance, the ReNUWit energy research center is very focused on urban infrastructure systems that facilitate water reuse. Also, the Codiga Center has been a tremendous platform for studying the science and engineering challenges associated with municipal water reuse. But that is really just scratching the surface of water-related research at Stanford.

Plus, I really want Stanford alumni working in the water industry — whether at large companies or start-ups — to join NAWI, a process they can start on our website, <https://www.nawihub.org>.

NEW FACULTY SPOTLIGHT



Haeyoung Noh

Associate Professor

As an engineer, I work on a concept called 'structure as a sensor.'

We usually think of things like buildings and bridges as passive lumps of concrete and metal, but every structure moves and vibrates as people walk around it. Even when you're sitting still at a desk, your breathing and heartbeat create vibrations. My lab looks for ways to use that information to improve the lives of a building's inhabitants.

In healthcare settings, we might be able to detect if someone has fallen down based on tiny spikes in building vibration, or even know how a disease is progressing over weeks or months based on people's walking patterns. Is a patient favoring one foot or the other? Has their activity level changed? It could provide a way to monitor patients' health no matter where they are in a building. We can even tell if doctors are washing their hands before seeing patients, measure how long they're washing, and detect if they're using soap — all from different building vibrations. That could be really useful during the COVID-19 pandemic.

I've always loved this sort of interdisciplinary problem-solving. Becoming a scientist was my dream job when I was a kid in Korea. I actually went to a science-focused high school there, but came to the U.S. during my first year of high school because I wanted to be an astronaut. I went to Cornell Aerospace for graduate school, but then discovered that becoming an astronaut requires a ton of physical exercise — like military-level training — so I decided maybe it

wasn't for me. Instead, I got interested in how big objects interact and vibrate and switched to earthquake engineering at Stanford to study, and that sort of got me into what I do now.

Along the way, I really just followed my interests, even if they didn't turn out how I expected. I always tell new students to do the same. Don't be afraid to explore new ideas. Don't be limited by saying, 'Oh, I'm a civil engineer. I can only do buildings and bridges,' or, 'Oh, I'm a computer scientist, I shouldn't touch what the mechanical engineers do.' If you start limiting your thoughts, that will also limit your ability as well. Make a point to step outside of your familiar boundaries. It may be scary at the beginning because you have to deal with something unfamiliar, but failing will actually give you an excellent lesson. Research in general can't happen without learning something you didn't know before — so you're bound to fail at some point. Embrace it: It's a blessing.

NEW FACULTY SPOTLIGHT

Sarah Fletcher

Assistant Professor

I've always wanted to find solutions to problems that were really going to help society, like making sure people have access to affordable, reliable, clean drinking water.



We know climate change has a profound impact on the water cycle, and that the places and uses we have for water are constantly evolving. Today I work to develop water supply strategies that make sure we have enough for people, the environment and the economy.

We use models that look at different performance metrics, like water reliability, but it's important that we expand on that, and ask questions like "Reliability for whom?" When we have water shortages, or cost increases, or water quality issues, who bears the brunt of those burdens? We know a million people in California don't have access to a water supply that's clean, affordable and reliable, and that climate change disproportionately burdens marginalized communities. If we decide to

build a new desalination plant, for example, which is something that's talked about a lot in California, it will certainly give us more water volume to help us be resistant to droughts in the future, but it comes at a cost; desalination is very expensive. If you're building it in a place where water users are struggling with affordability, then it might actually reduce safe drinking water access, because it might raise the price of water such that more people lack affordable water. I want to make sure that the strategies we use to make our water systems more resilient are serving everyone.

For me, engineering means using tools from math and science to solve problems in the world, but also working to expand the definition of what it means to be an engineer. It's easy to think of engineering as simply creating a technology that's going to solve problems. But we know now that technology doesn't exist in a black box by itself; it interacts with society in all kinds of different ways. As engineers, we have a responsibility to make sure those interconnections are really helping, and not exacerbating other problems or leading to unintended consequences.

Engineering can be intimidating as a field, but anyone can be an engineer; anyone can learn the math and science if they want to, and one bad experience or a tumble along the way isn't a sign that you can't do it. What's more important is finding a problem in the world you want to solve. If you focus on that, all the other things will be a little bit easier."

STAFF

STAFF ANNOUNCEMENTS

School of Engineering Staff Service Awards

Every year the School of Engineering recognizes staff members for their outstanding contributions to the mission of the school. The School of Engineering Staff Service Awards honor staff members based on nominations by faculty, students, and staff colleagues. Awards are also given in recognition of years of service at Stanford.

In 2019, **Brenda Sampson**, Student Services Manager, and **Duc Wong**,

Administrator for the Stanford Center for Sustainable Development and Global Competitiveness, were presented with awards for their 40 Years of Service.

Carmen Torres, Administrative Associate, was honored with the Client Service Award, which recognizes exemplary customer service. She is known for her "commitment and dedication to serving the students and faculty of the department, her warm and engaging personality, and her willingness to go 'the extra mile' to ensure that things get done."

Jill Filice and **Carmen Torres** were presented with awards for their 30 Years of Service and 20 Years of Service,

respectively. **Jack Chiueh** and **Diana Lin** were presented with awards for their 5 Years of Service.

Kay Bradley Award

The Kay Bradley Award recognizes a staff member in the School of Engineering who serves students with professionalism, friendliness, integrity, and devotion. Selection is based on letters of support submitted by students. In 2020, **Kimberly Vonner** was selected for this award. Kim has been with the Civil and Environmental Engineering Department for 17 years and has been with Stanford for a total of 27 years.



Brenda Sampson
Student Services Manager



Duc Wong
Administrator for the Stanford
Center for Sustainable Development
and Global Competitiveness



Teddie Guenzer
Center for Integrated Facility
Engineering (CIFE)

STAFF

Retirements

Brenda Sampson and **Duc Wong** retired in November 2019 and August 2020, respectively. Brenda worked at the Stanford Medical Center for 11 years before joining

Engineering for 30 years, totaling 41 years of service at Stanford. Duc Wong has been with the Civil and Environmental Engineering Department at Stanford

for all of her 40 years of service. **Teddie Guenzer** retired in July 2021 just shy of 24 years of service with the Center for Integrated Facility Engineering (CIFE).

STAFF SPOTLIGHT



Jill Filice

Student Services Specialist

Stanford was my second job out of college but I've been here 31 years — and every single one of those has been spent in SoE in the Civil and Environmental Engineering department. I just think so much of our department. I really fell in the right place. All the groups at Stanford are awesome but

it's truly amazing to find one you click with so well.

I loved my college experience and now I love working in academia supporting students. As part of Student Services, I help students with their degree progress. This means anything — from navigating the complex university system to changing their academic status, or making sure they have everything squared away for degree conferral. I also assist with course records and scheduling for faculty as well. Every day there's a new thing and — between the students and the faculty — I'm never bored.

The pandemic was really rough for students, so I tried to bring extra empathy to my role. We worked very hard to get them the resources they needed, whether it was answering questions

about remote learning or assisting them in taking a leave of absence if they were struggling to adapt. It was so gratifying to see students find ways to do their best. I worked with one student who was really suffering from the separation from their peers but was able to pull through it, which I was so happy to see. Another student was very challenged by family responsibilities and extreme technology issues plus the demands of a top-notch university. But they still persevered. Seeing that really makes you feel like rejoicing with them.

Pandemic or not, I've always seen my job as making the experience with our department a positive one and enjoying the interaction with students. It's kind of like magic for me.

STUDENT

STUDENT AWARDS

2020

Zachary Clayton

Stanford Award of Excellence

Sahar El Abbadi

Centennial TA

Ernestine Fu

Eisenhower Fellowship,
2020 ACM CHI Best Paper Honorable
Mention

Yijie Gao

ASCE SEI Scholarship

Maeve Givens

Tau Beta Pi,
Phi Beta Kapa,
Stanford Award of Excellence

Lin Htet Kyaw

AGC of California College Scholarship

Amber Levine

Phi Beta Kapa

Marie Payne

Tau Beta Pi

Yi-Lin Tsai

Centennial TA

Joel White

Stanford Award of Excellence

Joanna Jiaqi Zou

Fulbright Fellowship

2021

Sahar El Abbadi

2021 JEDI Service Graduation Award

Kiara Bacasen

Award of Excellence from The Stanford
Alumni Association,
James W. Lyons Award for Service

Stephanie Bachas-Daunert

VPGE Graduate Feminist Scholar Award

Michel Bakhom

Member of winning team for the NAIOP
32nd Golden Shovel Channel April 2021

Juliana Berglund-Brown

Scholarship award from the Structural
Engineering Institute (SEI) of the American
Society of Civil Engineers (ASCE)

Juan Miguel Navarro Carranza

Fulbright Scholar

Elise Celestin

Award of Excellence from the Stanford
Alumni Association

Aakanksha Dilip Chaudhary

Scholarship award from ThinkSwiss
Research Award from SERI (State
Secretariat for Education, Research
and Innovation,
Threshold Venture Fellowship,
ILP (Initiative for Principled Leadership)
Fellowship

Paula Garza

Award of Excellence from The Stanford
Alumni Association

Adam Nayak

James W. Lyons Award for Service



FACULTY

FACULTY AWARDS

2019

Professor **Jack Baker** was a co-recipient of the Helmut Krawinkler Award. The Helmut Krawinkler Award, awarded by the Structural Engineering Association of Northern California, recognizes outstanding leadership in implementing state-of-the-art research into practice. Baker was recognized as a co-founder of HB Risk, which addresses the need to produce software tools to allow advanced design and assessment methods to be implemented in everyday practice.

Assistant Professor **Rishee Jain** received a 2020 National Science Foundation (NSF) Career Award. The award recognizes early career faculty who show equal dedication to research and education within their departments and institutions. Jain leads the Urban Informatics Lab, where he and his team develop socio-technical and data-driven solutions to sustainability challenges facing the urban built environment. He was recognized for his proposal, *An Urban Energy Management Operating System for understanding and co-optimizing building, energy and human systems at multiple scales*. The overarching goal of this research is to develop an Urban Energy Management Operating System (UrbanEMOS) that integrates methods from engineering, data science, and urban design/policy to understand and optimize building, energy, and human system interactions at and across multiple scales.

Associate Professor **Christian Linder** was selected to receive one of the 2019 Presidential Early Career Awards for Scientists and Engineers (PECASE). The PECASE is the highest honor bestowed by the United States government to outstanding scientists and engineers who are beginning their independent research careers and who show exceptional promise for leadership in science and technology. Linder was cited for advancing computational modeling to create a leap forward in the design of stretchable materials.

2020

Professor **Jeffrey Koseff** joined the ranks of the Academy Fellows in the California Academy of Sciences. The Academy Fellow is a governing group of more than 450 distinguished scientists and other

leaders who have made notable contributions to science or science education and communication. Nominated by their colleagues and selected by the Board of Trustees, the Academy Fellows are partners and collaborators in the pursuit of the Academy mission to explore, explain, and sustain life.

Professor **Anne Kiremidjian** was selected as an Honorary Member of the Earthquake Engineering Research Institute (EERI). One of the highest honors from the institute, Honorary Membership is awarded to members who have made sustained and outstanding contributions to the field of earthquake engineering and to EERI. **Kiremidjian** was appointed as the next C.L. Peck, class of 1906 Professor in the School of Engineering. The C.L. Peck, Class of 1906 professorship was endowed in 1982 with a gift from Clair Peck, Jr. in honor of his father, and is intended to support a senior faculty member in civil engineering working in construction, earthquake engineering, technology, structural engineering, or related fields. Special consideration is given to candidates who have been unusually successful in inspiring students to dedicate themselves to high standards of professional achievement.

Professor **Nicholas Ouellette** and Research Engineer **Kyle Douglas**, were among twelve school-wide winners of the 2019-2020 Tau Beta Pi Teaching Honor Roll to recognize engineering instructors for excellent teaching, commitment to students, and great mentoring.

2021

Associate Professor **Meagan Mauter** was nominated for the Walter L. Huber Civil Engineering Research Prize. Award recipients are selected based on the impact of their research, both on their chosen subdisciplines, as well as on the field of civil engineering more broadly. **Mauter** was awarded the 2012 American Chemical Society Sustainable Chemistry and Engineering Lectureship Award. This award recognizes the research contributions of scientists in three geographical regions, working in green chemistry, green engineering, and sustainability in the chemical enterprise.

Professor **Eduardo Miranda** was selected to deliver the prestigious Rosenblueth Lecture by the Mexican Society of Earthquake Engineering. **Miranda** was also elected to the Mexican Academy of Engineering.

FACULTY SPOTLIGHT



Anne Kiremidjian

Professor

2021

Professor **Anne Kiremidjian** has been elected to the 2021 Class of New Members and International Member of the National Academy of Engineers. Election to the National Academy of Engineering is among the highest professional distinctions accorded to an engineer. Academy membership honors those who have made outstanding contributions to “engineering research, practice, or education, including, where appropriate, significant contributions to the engineering literature” and to “the pioneering of new and developing fields of technology, making major advancements in traditional fields of engineering, or developing/implementing innovative approaches to engineering education.”

FACULTY RETIREMENTS

James O. Leckie

C.L. Peck, Class of 1906 Professor in the School of Engineering, Emeritus.

Raymond Levitt

Kumagai Professor in the School of Engineering, Emeritus.

Leonard Ortolano

UPS Foundation Professor of Civil Engineering in Urban and Regional Planning, Emeritus.

ALUMNI

ALUMNI
SPOTLIGHTS**Kate Gasparro**

PhD '19

Civil & Environmental Engineering

May 2019

I'm actually a third-generation civil engineer.

My grandfather and both of my parents studied civil engineering, but I initially wanted to study public policy. I wanted to do something that would have an impact on communities, and I thought going into policy was the best way to do that. The more I learned about civil engineering, however, the more I realized how much infrastructure and policy coexist, and found my own niche in engineering.

My research focuses on innovative ways to pay for infrastructure projects. I specifically study crowdfunding and how you can crowdfund infrastructure. Think of a Kickstarter or Indiegogo for roads, water systems, parks and civic buildings — that's what I work on. For instance, let's say a community wants to build a bike lane; people would pitch their idea and aggregate interest and funds online. As you can imagine, there is a lot of red tape with crowdfunding infrastructure because it's a public service that is typically delivered by the government. But that's what I enjoy most, researching new ways to manage the process.

The best part of my research is that I get to do a lot of grounded theory work, which means I get to talk to the people behind these crowdfunded projects. Most of them don't get asked to talk about themselves very often, and they really light up when I speak with them about a really difficult project that they were able to put together. Someone might create an entire crowdfunding campaign around a mile-long bike lane or an urban park, and it may seem like something

so small in the grand scheme of urban development and technology, but it's really meaningful to them. We live in the world where Uber, Lyft and Airbnb are the norm, and all these things require infrastructure, and sometimes infrastructure isn't big and flashy, but it makes a difference in people's lives.

I hope that today and in the future, engineers continue to grow and take advantage of new tools while still remembering the ethical and human side of things. Civil engineers sit at the intersection of technology and humanity, and we have to make sure that communities are given a chance to use technology in ways that let them decide what works best for them.

**Anthony Kinslow**

PhD '19

Civil & Environmental Engineering

January 2021

I first became interested in combating climate change in high school, after watching *An Inconvenient Truth*.

That really inspired me — and today, as an engineer, I work on energy efficiency as one of the necessary components to combating global warming.

Usually, people think about energy efficiency only in mechanical terms, like designing a better machine or building. But on a fundamental level, energy efficiency is driven by human behavior. When we get home, we turn on lights; when we leave, we turn them off — and that behavior is in turn shaped by social and cultural factors, like if you have kids in the house or if you don't.

There's also a racial component to energy efficiency. Non-white Americans, for example, are wildly underserved when it comes to making their homes and businesses energy efficient. Part of that is because existing programs often require a credit score or home ownership to qualify, which causes huge inequities.

This year, I'm co-teaching a course at Stanford called *Racial Equity and Energy*. Its goal is to have important conversations about race and energy, and help a new generation understand that you can't come up with solutions without taking into account existing injustices.

Right now seems like an ideal time to have these sorts of conversations. In the past year, we've seen powerful hurricanes in the Gulf, huge tornadoes, and massive fires out West, so climate change is really visceral. At the same time, we have Black Lives Matter and police violence and institutional, systemic racism, which are also visceral. It's important to talk about how they're interconnected.

The best advice I can offer students is this: Talk to people who have a different background than yours, and listen to what they have to say. One of our biggest problems as a society right now is that we don't listen to people who experience the world differently than we do, and that causes deep misunderstanding and division.

As engineers, it's also important to realize that our work isn't just about steel and concrete, or water runoff, or electronics. On a fundamental level, people and their experiences are inextricably tied to anything you design.

ALUMNI
REUNION EVENTFriday,
October 22, 2021Join us for an on-campus
alumni reunion event!

The new department chair will discuss our plans for the future and host a panel discussion with faculty and alumni addressing water and sustainable cities, followed by a reception.

More details to be announced. Please check our website, cee.stanford.edu, for updates.

STAY CONNECTED

Please visit our website at cee.stanford.edu for up-to-date information about the department, including faculty, students, research programs, and teaching initiatives.

We welcome your suggestions regarding the department's directions and activities and encourage you to visit us on campus to learn more about our facilities and programs firsthand.

We hope that you will remain an active member of the department's alumni community by keeping us apprised of your activities and whereabouts. You can log on to the School of Engineering Alumni Update page to update your contact information or send a note to cee-deptchair@lists.stanford.edu.

CEE

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INSIDE THE CEE NEWSLETTER



The **Stanford Center at the Incheon Global Campus** is a collaboration between Stanford, the South Korean government and the Incheon Free Economic Zone.



Haeyoung Noh spotlight

We usually think of things like buildings and bridges as passive lumps of concrete and metal, but every structure moves and vibrates as people walk around it.



Sarah Fletcher spotlight

I've always wanted to find solutions to problems that were really going to help society, like making sure people have access to affordable, reliable, clean drinking water.



Jill Filice spotlight

I've always seen my job as making the experience with our department a positive one and enjoying the interaction with students. It's kind of like magic for me.