Engineering

The Magazine of the Penn State College of Engineering

PENN STATE

Fall/Winter 2020

An Investment in INNOVATION

Facilities plan to keep College of Engineering on leading edge

Also in this issue:

That Martin sound: World-class acoustics expertise aids a legendary Pennsylvania company

Lasting work: Penn State engineers help NASA go to Titan for mission 'Dragonfly'

The future of nuclear engineering at Penn State and beyond

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FALL/WINTER 2020
Vol. 34, No. 2

Engineering Penn State is published twice yearly by the College of Engineering Department of Communications.

Telephone 814-865-5544

Printed on recycled paper.

U.Ed. ENG 20-222

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"It is a future where we are optimally positioned to engineer solutions to humanity's greatest challenges."

the **DEAN'S MESSAGE**

Updating & upgrading:
Transforming the College of Engineering

The Penn State College of Engineering will dramatically expand and improve its facilities over the next decade as part of our master plan implementation. But we are looking well beyond the next 10 years as we transform our college infrastructure from where it is today to where it ultimately needs to be.

With this letter, I am addressing one of the most-asked questions concerning the plan that I receive: Why now?

I answer with my own question: Why wait? There is a fierce urgency of the now because our vision for the future of engineering at Penn State is fiercely ambitious. It is a future where we are optimally positioned to engineer solutions to humanity's greatest challenges.

To do so, we need to address the needs of today's students and faculty and the needs of future generations of students and faculty.

Today, our student population—more than 12,000—is more than 40% larger than it was in 2008. We will continue to strategically grow, particularly at the graduate level. Our faculty, too, has grown by nearly 25% during that same period and we have ambitious hiring plans for the years ahead.

Yes, we are adding space to better align with our present and anticipated size, but the amount of space we have only reflects one aspect of our infrastructure needs. The very nature of engineering education and research continues to evolve. It is more hands-on and collaborative than ever, demanding new skills, approaches, and technologies. Our facilities must be supportive of this evolution.

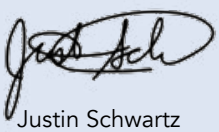
Through this initiative, we are modernizing and consolidating around central engineering husb on campus. We are building the type of classroom, lab, meeting, and maker spaces required to foster interdisciplinary collaboration.

From innovating disease-fighting technologies to developing sustainable infrastructures and impacting energy, environmental, and transportation systems, our community will ideally be situated to cross the traditional boundaries of engineering to build desperately needed solutions.

From autonomous vehicles to the security of information systems to robotic elements to human health informatics and biodevices—these will transform human health and life across the coming century. That kind of impact is at the heart and soul of what we're trying to do, and you simply can't accomplish goals this big without the facilities that support such work.

The implementation of this plan is one of the most exciting parts of my job. This work will transform the College of Engineering, and Penn State in a number of ways. Over the next 25 years alone, these efforts will directly impact well over 50,000 undergraduate students and likely over a thousand faculty members. The decisions and investments we're making today are going to have an incredible long-term impact on Penn State and the world beyond. It does not get more exciting than this.

For the Glory,



Justin Schwartz
Harold and Inge Marcus Dean of Engineering

Alumnus and Penn State invest in service enterprise engineering

Charles R. Schneider and Penn State are partnering on a nearly $9 million investment to greatly expand the College of Engineering's focus on improving processes and efficiencies across the service sector of the economy, a field known as service enterprise engineering.

The funds will support a scholarship, two professorships, a faculty chair, two program support funds, and funding for a program director and director of industry consortia and technology transfer, all in the area of service enterprise engineering within the Harold and Inge Marcus Department of Industrial and Manufacturing Engineering.

Schneider's gift, along with the University's investment, will enable the department to create three new degree offerings: a bachelor of science dual degree in industrial engineering and service enterprise engineering, a bachelor of science in service enterprise engineering, and a master of science degree.

College of Engineering programs rank in U.S. News 'Best Global Universities'

Several programs in the College of Engineering have made a strong showing, nationally and worldwide, in U.S. News & World Report's "Best Global Universities" for 2020. Among U.S. public universities, Penn State's overall engineering programs rank at No. 10.

According to U.S. News, these rankings focus on institutional research through reputation surveys and research metrics. The survey encompasses the top 1,500 institutions across 81 countries and measures factors such as global and regional research reputation, publications, and citation impact.

Overall, Penn State's programs in engineering rank at No. 16 among U.S. institutions, and 68 worldwide; with mechanical engineering at No. 9 nationally and 51 worldwide; civil engineering at No. 10 nationally, 62 worldwide; and computer science at No. 23 nationally, 94 worldwide.

Former faculty member and spouse commit $4 million to electrical engineering

Former Penn State faculty member **Raj Mittra** and his wife, Jeannette Mittra, recently committed $4 million to the Department of Electrical Engineering.

This gift will create opportunities for faculty and students alike, as the funds will be used for the creation of four endowments: the Raj and Jeannette Mittra Enhancement Fund for the Department of Electrical Engineering; the Raj and Jeannette Mittra Endowed Chair in Electrical Engineering; the Raj and Jeannette Mittra Faculty Development Professorship in Electrical Engineering; and the Raj and Jeannette Mittra Graduate Fellowship in Electrical Engineering.

Mechanical engineering professor awarded Presidential Early Career Award for Scientists and Engineers

Tak-Sing Wong, the Wormley Early Career Professor of Mechanical Engineering, was named a recipient of the Presidential Early Career Award for Scientists and Engineers (PECASE) by President Donald J. Trump.

According to the White House, 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."

Wong's lab, the Laboratory for Nature Inspired Engineering, seeks to translate phenomena found in nature in order to develop innovative technology, with the ultimate goal of improving the quality of human life.

Penn State to study integration of automated driving systems into work zones

The Thomas D. Larson Pennsylvania Transportation Institute (LTI) will lead a group of Penn State researchers studying how to safely integrate automated driving systems into work zones. The Pennsylvania Department of Transportation, universities, and public sector organizations received the $8.4 million grant from the U.S. Department of Transportation to study connectivity, visibility, and high-definition mapping technologies in relation to automated vehicles (AVs).

The four-year project, slated to begin in 2020, will examine the connectivity between AV and traffic control devices, construction workers, and construction vehicles. The use of innovative coatings in work zones, such as on pavement markings, also will be tested during the course of the project.

The team includes **Eric Donnell**, director of LTI and professor of civil engineering; **Sean Brennan**, professor of mechanical engineering; **Vikash Gayah**, associate professor of civil engineering; and **S. Ilgin Guler**, assistant professor of civil engineering.

New associate director named for Penn State's Institute of the Neurosciences

Patrick Drew, Huck distinguished associate professor of neural engineering and neurosurgery, has been appointed associate director of the Institute of the Neurosciences at Penn State.

Drew has a joint appointment between the Departments of Engineering Science and Mechanics and Neurosurgery, and a courtesy appointment in the Department of Biomedical Engineering. He has been involved with Penn State's neuroscience community since 2010.

New Multicultural Engineering Program director named

Lauren Griggs, a biomedical engineer by training, has been selected to direct Penn State College of Engineering's Multicultural Engineering Program (MEP). The program is open to all engineering students with the goal of fostering community for traditionally underrepresented students in the field.

MEP is housed within the Center for Engineering Outreach and Inclusion (CEOI), which includes several programs designed to support students as they navigate their undergraduate and graduate engineering studies.

New agricultural engineering shop underway at Fruit Research and Extension Center

A new agricultural engineering shop at Penn State's Fruit Research and Extension Center will enable the fabrication and testing of machinery and other technologies aimed at helping growers improve efficiency, reduce costs, and overcome labor shortages.

Among the scientists whose research will benefit from the ag engineering shop is **Long He**, assistant professor of agricultural and biological engineering. He studies machinery and automation for orchard operations such as pruning and harvesting, as well as sensor-based precision technologies for irrigation and pest management.

Engineering professor named founding director of Global Building Network

Esther Obonyo, associate professor of engineering design and architectural engineering, has been named director of the Global Building Network (GBN). She will work as part of the Institutes of Energy and the Environment.

The GBN is an initiative of Penn State and the United Nations Economic Commission for Europe, which aims to advance building science, construction processes, and building management in order to create an international framework that will make buildings more sustainable, more efficient, and healthier for people.

Don't miss a thing...

For the latest news and information from the College of Engineering, including alumni spotlights, research from our faculty and graduate students, and more, visit engr.psu.edu and follow us on social media.

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@PSUEngineering
@penn-state-engineering

START Lab awarded $6 million to develop national experimental turbine

With industry support, the Department of Energy's National Energy Technology Lab has awarded the Penn State Steady Thermal Aero Research Turbine (START) Lab $6 million to spearhead the development of a National Experimental Turbine (NExT) rig, an initiative to help modernize the nation's energy infrastructure.

Under the START Lab's leadership, NExT will be a turbine testing platform focused on U.S. technology advancement, designed in collaboration with four turbine manufacturers—Honeywell, Pratt & Whitney, Solar, and Siemens—in partnership with Agilis, a turbine design firm.

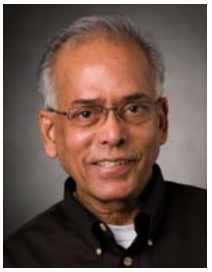
In this collaboration, the NExT rig will become a common design that can be used quickly and relatively inexpensively by these collaborating companies to advance their turbines.

Through the development of the NExT rig, according to Karen Thole, director of the START Lab and principal investigator of the project, new and innovative pathways for future gas turbine research will be possible in the START Lab and around the nation.

Newly established director of student transitions and pre-college programs named

Tracy Peterson was named the director of student transitions and pre-college programs in Penn State College of Engineering's Center for Engineering Outreach and Inclusion.

Peterson will develop College of Engineering support structures for compliance with the University's youth policies. He will establish regional and national outreach and engagement through pre-college programs, developing programs to enhance college readiness and increase the participation and support of underrepresented, low-income, and first-generation students.



Industrial engineering professor addresses U.S. Congressional Caucus

On July 11, **Soundar Kumara**, Allen E. Pearce and Allen M. Pearce Professor of Industrial Engineering, spoke at a briefing in Washington, D.C., hosted by the House Manufacturing Caucus, co-chaired by U.S. Reps. Tim Ryan (D-Ohio) and Tom Reed (R-N.Y.).

The briefing, "Artificial Intelligence and Manufacturing: The Power to Make Anything Anywhere Quickly," focused on applying artificial intelligence and manufacturing to revolutionize, strengthen, and expand the manufacturing capacity of the United States.

New director named for Facilities Engineering Institute

Mark Bodenschatz has been selected to head the Penn State Facilities Engineering Institute (PSFEI), effective Oct. 1. Interim director since Nov. 2018, Bodenschatz was selected as the new director for the institute following a national search.

Bodenschatz is tasked with building sustainable growth in the pillar areas of energy, education, engineering services, and facility condition assessments. His vision for PSFEI includes assisting clients in all ways that improve planning and meeting client demands for services with measured, responsive, and sustainable growth.

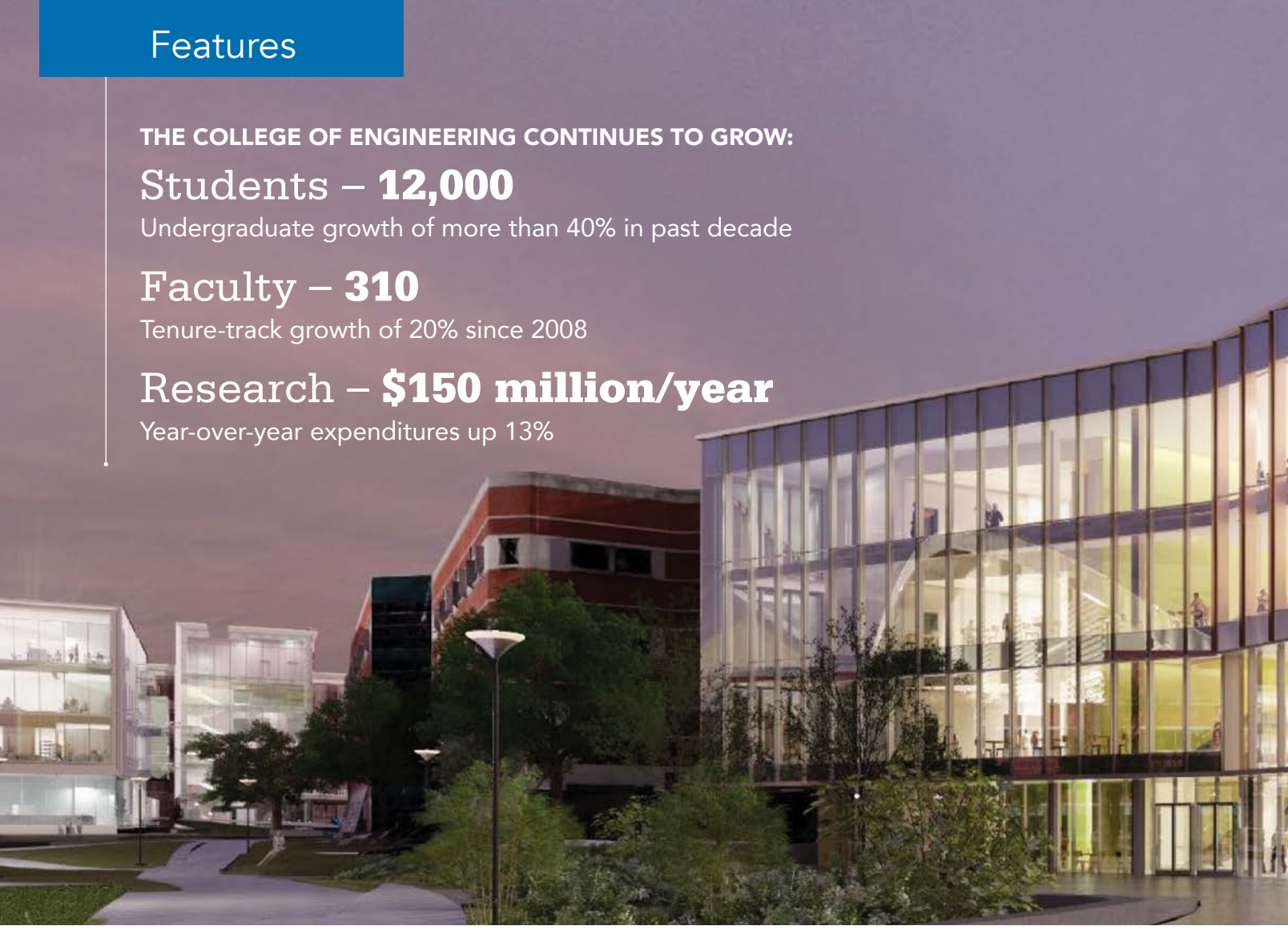
An Investment in INNOVATION

Facilities plan to keep College of Engineering on leading edge

by Andrew Krebs and Ashley WennersHerron

"What we're doing today—the decisions and investments we're making—are going to make a long-term trajectory of impact in a positive way on not just Penn State, but on the world. **It can't get more exciting than that.**"

– Justin Schwartz, Harold and Inge Marcus Dean of Engineering



THE COLLEGE OF ENGINEERING CONTINUES TO GROW:

Students – **12,000**

Undergraduate growth of more than 40% in past decade

Faculty – **310**

Tenure-track growth of 20% since 2008

Research – **$150 million/year**

Year-over-year expenditures up 13%

Design work is progressing for the first stage of a proposed decade-long, multi-phase plan that will transform the Penn State College of Engineering and its footprint on the University Park campus.

The initial five-year phase of the plan includes two new buildings that will serve as anchors to a new central engineering hub to the west of North Atherton Street, adding 377,000 gross square feet to the college's infrastructure. Phase one, which is projected to conclude in 2023, also includes proposed renovations to Sackett Building and demolition of Hammond Building along College Avenue and the Engineering Units behind Hammond.

In Feb. 2019, the Penn State Board of Trustees' Committee on Finance, Business and Capital Planning approved Payette, of Boston, Massachusetts, to design the two new buildings on West Campus. The final design plan for the first building is expected to go to the Board of Trustees for review in fall 2020, with Board review of the design for the second building expected in spring 2021.

"This undertaking represents a critical investment that will help to keep Penn State on the leading edge of innovation, with a focus on finding solutions to challenges that affect people in Pennsylvania and around the globe," said Executive Vice President and Provost Nicholas P. Jones. "The planned facilities will enable current and future students, faculty, and staff to engage in experiential

The design of the buildings focuses on fostering collaboration between students, faculty, and staff, with extensive hands-on maker spaces.

learning while continuing critical and inspirational work—such as the Dragonfly mission to Saturn's moon, Titan—and the development of renewable energy technologies for use here on Earth. These projects and others advance the University's strategic priorities and have a significant impact beyond Penn State."

The total estimated cost for phase one design, construction, renovation, and demolition is projected at $370 million, with the University and the Commonwealth of Pennsylvania as primary funding sources. Additionally, a capital campaign is underway to provide further project support.

"This planned expansion represents an unprecedented transformation of the College of Engineering," said **Justin Schwartz**, Harold and Inge Marcus Dean of Engineering. "We're doing more than just adding buildings—we are enhancing the ability of our students and faculty to impact engineering and technology through research- and education-centered physical facilities. The new infrastructure is vital to keep us on the cutting-edge of engineering education and research."

"This is going to be a place where all of our students are going to experience ... the culmination of their experience regardless of which campus they've come from ... I think when these new buildings are put in, we'll be able to say **that is where the heart of the College of Engineering is**."

– Sven Bilén
Head of the School of Engineering Design, Technology, and Professional Programs

Engineering alumnus makes $2.5 million commitment to facilities expansion

by Ashley WennersHerron

Civil engineering alumnus **Andrew Kartalis** and his wife, Katherine, have made a $2.5 million estate commitment to the College of Engineering's planned facilities expansion.

The funds, which include $1 million to be dispersed over the next five years, will support the construction and build-out of two new research and teaching spaces for engineering on West Campus, as well as a major renovation for historic Sackett Building.

"The new space is going to provide numerous excellent opportunities for students from several disciplines to work together and collaborate," Andrew Kartalis said. "When students from various engineering majors work together to solve a challenge, they begin to think differently. That's invaluable."

In 2013, the Kartalises committed $1.5 million to support American military veterans studying engineering through a program called VETS, as well as program and laboratory support for the Bernard M. Gordon Learning Factory.

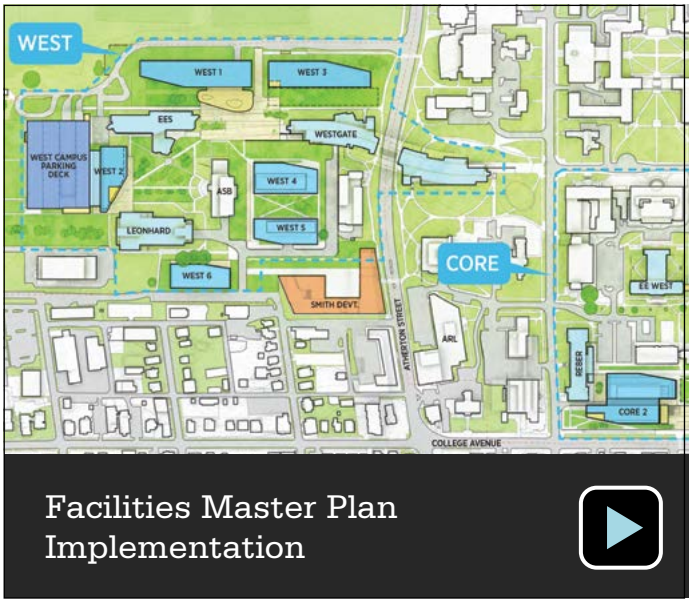
A necessary expansion

The College of Engineering at University Park, which is spread across nearly 50 campus buildings, is the largest college at Penn State and one of the largest colleges of engineering in the nation. Over the past decade, student enrollment in the college has increased by more than 40% and the number of tenure-track faculty has increased by nearly 25%. Currently, there are more than 12,000 undergraduate and graduate-level engineering students and more than 300 tenure-track faculty.

"We have grown as a college and will continue to strategically do so, particularly in the areas of graduate enrollment and through faculty recruitment," Schwartz said. "This tremendous growth in people, and the corresponding growth of our research enterprise that now totals almost $150 million annually, has highlighted a need for increased and modernized facilities that are better consolidated on campus."

In 2018, Penn State engaged Payette to develop a master plan and framework to increase the quantity, improve the quality, and optimize the distribution and organization of the college's physical space across two budgetary funding cycles: 2018-23 and 2023-28.

The Engineering Core maintains the College of Engineering's footprint on central campus, while opening up the space between campus and College Avenue. The new buildings will improve how students, faculty, staff, and visitors previously used the space occupied by Hammond Building and the Engineering Units.



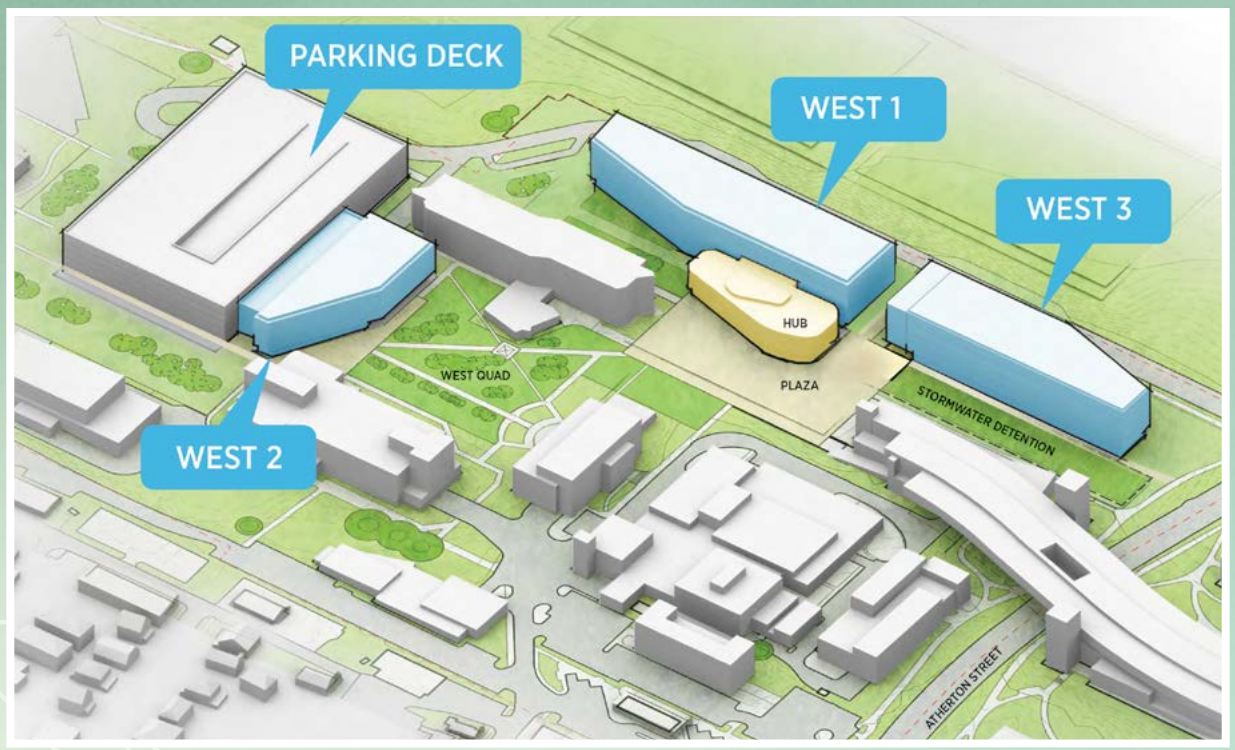
Facilities Master Plan Implementation

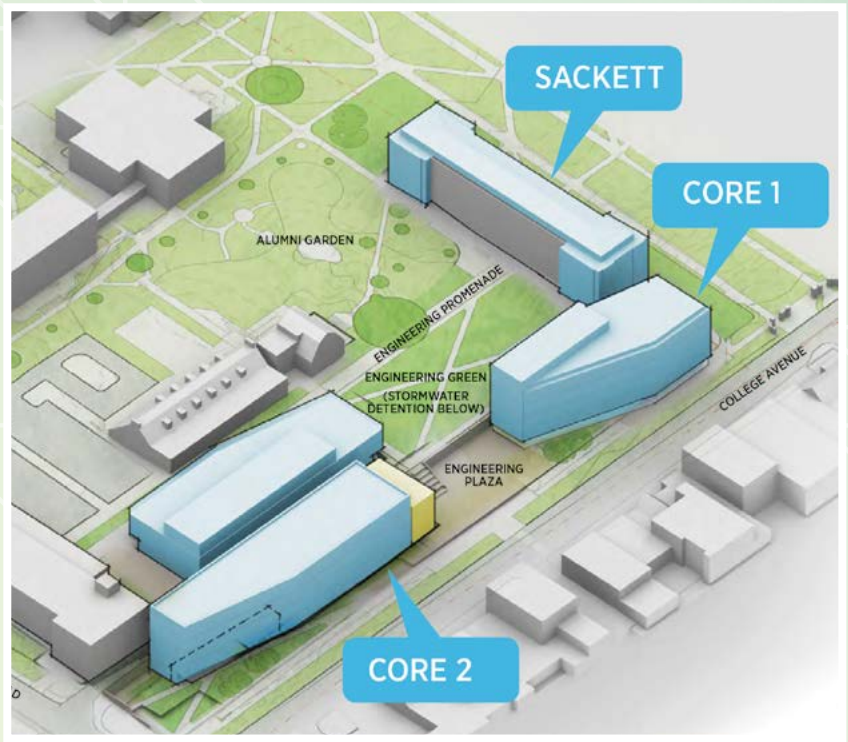
Learn more in this video about the implementation of the facilities master plan directly from Dean Justin Schwartz, Payette Architect Jeff Gregorio, and others impacted by this growth.

"The facilities master plan is a **direct bullseye hit** on the college's vision of 'Inspiring Change. Impacting Tomorrow.' It's going to provide more space and better functioning space for us. Most importantly, it's going to elevate our ability to deliver a world-class education to our engineering students, both undergraduate and graduate."

– Patrick Fox, department head
civil and environmental engineering

Facilities implementation plan





The ten-year facilities master plan for the College of Engineering includes several new buildings on West Campus (top image), as well as a reimagining of the current engineering footprint near Old Main Lawn (bottom image).

Phase 1: The first phase includes a parking deck, two new buildings (West 1 and West 2) that will serve as anchors for a reinvigorated West Campus, and a renovated Sackett Building. This phase will conclude with the demolition of Hammond Building and the Units.

Phase 2: The second phase includes a third building on West Campus, as well as two new buildings on the space where Hammond and the Units previously stood.

The West Campus expansion will not only provide space and tools for the Penn State engineering community, but for the entire University, according to Schwartz. Rendering of West 2 shown on the left.

An engineering hub on West Campus

The two new engineering buildings currently in design—West 1 and West 2—will house flexible classrooms, multi-use design studios, maker spaces, high-bay research labs, faculty offices, and research cores to benefit multiple engineering academic departments.

West 1, the larger of the two buildings at 279,000 gross square feet, also will house a knowledge commons with collaborative student workspaces, departmental administrative and faculty offices, and research laboratories, as well as food service and pedestrian connections, positioning the building as a welcoming and active University hub.

Both buildings will become part of a re-imagined West Quadrangle, defined by Leonhard Building to the south, Applied Science Building to the east, and Earth and Engineering Science Building to the north.

Beyond 2023

After the planned conclusion of phase one, the master plan recommends a second five-year phase that includes construction on the footprint of the demolished Hammond Building and Engineering Units, further renovations to Sackett Building, and the addition of a third building to West Campus.

This second phase, which will require Trustees approval before moving forward, has a projected cost of $479 million and would likely also be funded by Penn State, the Commonwealth, and philanthropy.

"These initiatives clearly represent a significant investment in engineering by Penn State," Schwartz said. "We will be optimally positioned as a leader in engineering education and research, with the resources and facilities to help our students and faculty collaborate and innovate as they address society's largest challenges." ■

"West Campus will really become the **hub of technology and innovation**. I predict that with West Campus being built up, we will see a shift toward recognizing how significant the engineering program is here at Penn State. West Campus will become a place where students go to hang out, invite their colleagues from other departments, and work on broader projects that interact together."

– Amy Pritchett
department head, aerospace engineering

That Martin Sound

Penn State's world-class acoustics expertise aids a legendary Pennsylvania company

by Dave Pacchioli and Emily Kissinger

Acoustics has long been an area of strength at Penn State. Expertise in acoustics is a core competency of the University's Applied Research Laboratory (ARL), one of the top defense-related research labs in the nation. The College of Engineering's Graduate Program in Acoustics dates to 1965 and remains the only program in the U.S. that offers a doctorate in the subject. The interdisciplinary Center for Acoustics and Vibration fosters partnerships with industry, bringing all that expertise to bear on practical problems.

Micah Shepherd, assistant research professor of acoustics, and a team of Penn State acoustics experts worked with Martin Guitar to develop a method to analyze acoustic properties of guitars and components—to understand the science behind the variance in sound produced by different guitars and guitar components.

Balancing tradition and innovation

C.F. Martin & Co.®, the family-owned guitar maker in Nazareth, Pennsylvania, has been making acoustic instruments since the 1830s and has always relied on a balance of tradition and innovation to remain the most sought-after acoustic guitar brand in the world.

Partnering with Penn State is one example of the ways in which Martin continues to innovate.

After ARL's Dave Swanson, an avid guitar player as well as an acoustical engineer, toured the Martin factory a few years ago, he approached Martin representatives to show them how Penn State could help Martin bring a scientific approach to evaluating the sound of its guitars.

"They have talented musicians who listen to and score guitars on certain metrics—based purely on the sound," Shepherd said. "What we could offer was a supplement to their current evaluation process—a tool that provides quantitative data that allows them to evaluate whole guitars, as well as guitar components."

Intrigued, Martin representatives brought several of their high-end guitars to ARL's anechoic chamber, a cavernous sound-dampened room. There, Shepherd and others wired the instruments with shakers and sensors, buzzed them with white noise, and rapped them with force hammers, carefully measuring the ensuing vibrations. The data they collected established a "vibro-acoustic fingerprint" for each guitar.

"We're interested in understanding the dynamic properties of both finished instruments and raw materials, and how that affects tonal qualities," said Josh Parker, a Penn State alumnus and research and development technician at Martin.

The science of sound

"These real-world applications of our research serve as a win-win for us as faculty members, our students, and our business and industry partners," Shepherd said. The project—applying Penn State research in a practical setting for an industry partner—fit perfectly with the outreach mission of the Center for Acoustics and Vibration.

For Shepherd and his colleagues, working with musical instruments presented new challenges. Most of the center's corporate partners, he explained, are looking for ways to minimize vibration.

In the case of a guitar, however, vibration is a good thing—and Martin guitars, in particular, are famous for their resonance.

In part, it is traced to the types of wood Martin has traditionally used: Sitka spruce for the top and rosewood

for the sides and back. But, as a leader in environmental stewardship, the company understands the scarcity of these precious tonewoods and is always in search of sustainable alternatives. The trick, Parker said, is to find a combination that can match that classic sound.

"How you cut the wood, the grain, the moisture content, all of these things have to be accounted for," Shepherd said. "They all affect the amount of vibration."

"No two pieces of wood are exactly the same, which means no two guitars sound exactly the same," Parker said. To complicate things even more, a guitar is what engineers call "a coupled system." A change in any one of its interconnected components will impact the whole.

A complement to craft

After the initial evaluations at ARL, Shepherd and his colleagues put together a system to enable Martin's sound engineers to continue testing on their own. That meant recommending the necessary equipment, advising on the set-up of a mini-anechoic chamber at the factory in Nazareth, and developing the custom software Martin would need to collect and process vibration data. Parker has been using the system ever since, not to replace the old qualitative approach, but to complement it.

Modal analysis has allowed him to compare Martin's current line to competitors' guitars and to the vintage instruments displayed in the company's museum. Dating to the 1930s, these Pre-war Martins, as they are known, "are really that quintessential Martin sound," Parker said. "This technology can help us as we try to replicate elements of that."

He is also testing individual components, measuring the effect of substituting a mahogany top for spruce, say, or altering the shape of an internal brace. Soon he plans to start evaluating raw materials. The database he's building, he hopes, will help guide design decisions as Martin adapts to changing circumstances.

Micah Shepherd in the anechoic chamber demonstrating the testing used to determine the vibro-acoustic fingerprint for a Martin Guitar.

"Eventually, the idea is to be able to accurately model guitars on the computer," Parker said. And while both he and Shepherd know that a computer model will never replace the knowledge accrued over two centuries of craftsmanship, "It's fun to think about how this kind of innovation can help move our design into the future," he said. "It's actually kind of mind-blowing when you consider all the possibilities."

C.F. Martin & Co. is a corporate sponsor of Penn State's Center for Acoustics and Vibration. ■

Jack Langelaan, Jose Palacios, and Sven Schmitz are posed with the rotor and blade they are testing in a chamber that can reach minus 145° Celsius, only about 50 degrees warmer than the surface of Saturn's largest moon.

LASTING WORK

Penn State engineers help NASA go to Titan for mission 'Dragonfly'

by Ashley WennersHerron

Jack Langelaan, an associate professor of aerospace engineering at Penn State, was uncharacteristically animated.

"The Egyptians built the pyramids; medieval Europeans built the cathedrals," he said, taking a breath and leaning back in his chair. He gestured to his colleagues sitting on either side of him.

"And our society builds space vehicles."

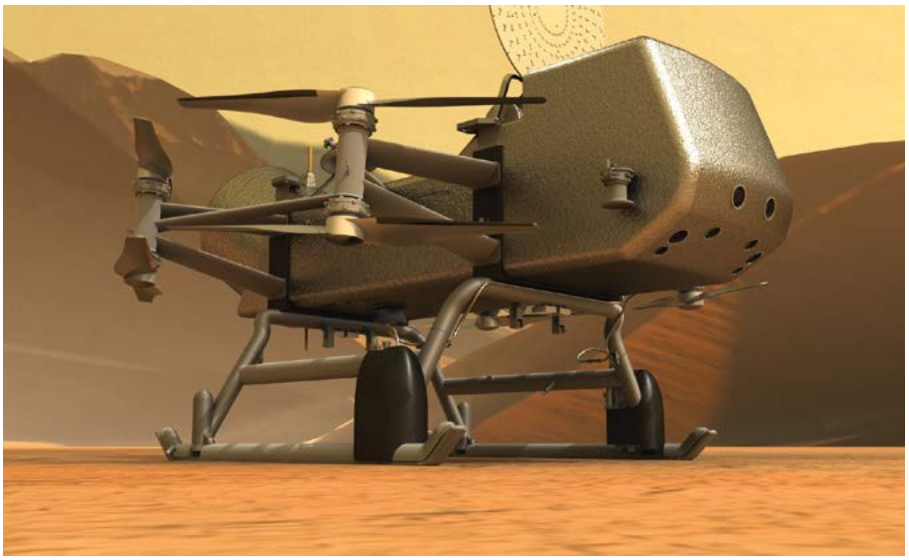
Sven Schmitz and **Jose Palacios**, both associate professors of aerospace engineering at Penn State, nodded in agreement.

These three engineers are leading the Penn State team on an $850 million NASA mission spanning at least the next two decades. The Johns Hopkins University Applied Physics Laboratory (APL) leads the endeavor—dubbed "Dragonfly"—to investigate surface and atmospheric conditions of Saturn's largest moon, which in many ways appear to be similar to Earth's primordial state.

In June, NASA announced that Dragonfly would be the fourth mission under its competitive New Frontiers program, which funds projects that shed light on scientific mysteries of the solar system. Dragonfly is scheduled to launch in 2026 and reach the surface of Titan around New Year's Eve in 2034.

For engineers who built their careers by understanding how vehicles fly on Earth, the opportunity to develop a vehicle that will explore Titan is almost unbelievable.

"They wanted to go to space, and they needed helicopter people." – Jack Langelaan



The proposed Dragonfly drone will be slightly larger than a Volkswagen Beetle, with the autonomous control to fly and land on its own. (Image credit: Johns Hopkins APL)

The phone call

Penn State is home to one of three Vertical Lift Research Centers of Excellence designated by the United States Army, Navy, and NASA. A collaborative effort between academia and government, the centers provide resources to advance vertical lift research while training the next generation of flight engineers. Langelaan, Palacios, and Schmitz are affiliated with the center, where they specifically focus on helicopter design and advancement.

"Three years ago, APL called us for help on this project," Langelaan said. "They wanted to go to space, and they needed helicopter people."

The team at APL envisioned something more than the traditional land rovers that roam Earth's Moon and Mars. A flying probe couldn't capture the samples and conduct the science they wanted. They needed a drone.

Zibi Turtle, the Dragonfly principal investigator at APL, said that Dragonfly was designed to be a rotorcraft to explore Titan because "it's the best way to travel and be able to make science measurements in multiple locations in Titan's environment."

Titan has a deep liquid water ocean in its interior and an Earth-like surface with sand dunes, lakes and seas on the surface. But at Titan's surface temperature of minus 180°C, the sand is organic, and the lakes and seas are filled with liquid methane—methane even forms clouds and rain. With conditions that may replicate aspects of Earth's chemistry before life developed, Titan could offer a glimpse into how chemistry becomes biology, according to Turtle.

"They needed a drone that could land, collect samples, run experiments, and fly again," Schmitz said. "Those requirements pose unique design problems in Earth's atmosphere. On Titan, where it's minus 180°C, things can get more complicated. We were interested."

The real thing

The Penn State team, responsible for the aerodynamics and rotorcraft design portions of the drone, developed a 45% scale prototype. The actual Dragonfly drone will be a little larger than the slim prototype.

"It's bulkier because it has to do a lot more," Palacios said. "It has to carry the equipment to conduct science, but it also has to be sleek because it has to fly. It's not a rover that rolls along at half a mile an hour. It can't have antennae sticking out."

This challenge exemplifies the difficulty and beauty of the relationship with the researchers at APL, according to the team. The engineers want to build the best flying machine, while the scientists need to investigate the organic chemistry of Titan's surface.

"There's a lot of back and forth to make sure we're accounting for their science while also making sure the thing can fly," Langelaan said. "We're learning a lot from each other. It pushes us to be more innovative in our design."

The team is also responsible for helping to develop the flight control systems. Since GPS can't be used for navigation, and Titan is too far away from the sun to be solar powered, it's being designed to use a Multi-Mission Radioisotope Thermoelectric Generator system—the same power source used by Curiosity on Mars—to charge its systems. Each charge could power about 13 miles of flights.

"Dragonfly needs to be as close to autonomous as possible," Langelaan said. "It needs to be able to assess information about where it's landing and follow directions from Earth about where to go next. Dragonfly will have to make decisions, and we need to provide the tools for it to do that."

The future

The researchers, with the support of Penn State's Department of Aerospace Engineering, will also begin teaching helicopter-rotor design graduate courses this fall focused on applying vertical-flight concepts to space vehicles. They expect this to attract the top students.

"We're developing this tool that could ultimately provide solutions for Earth with information gathered a billion miles from home," Langelaan said. "That's as cool as it gets."

During Dragonfly's development, engineering faculty and students will solve innumerable problems. They will make discoveries and improve the materials and controls of flight vehicles.

"The pyramids lasted; the cathedrals lasted," Langelaan said. "Dragonfly? That's work that will last." ■

THE FUTURE OF NUCLEAR ENGINEERING

at Penn State and beyond

by Ashley WennersHerron

The Ken and Mary Alice Lindquist Department of Nuclear Engineering is newly named, once more independent, and under new leadership.

The department, formally established in 1959, joined with the Department of Mechanical Engineering in 1997. The two departments were separated in the summer of 2019, the year after nuclear engineering received an endowment from Ken and Mary Alice Lindquist. **Jean Paul Allain** joined Penn State from the University of Illinois at Urbana-Champaign to lead the department. Allain also holds the Lloyd and Dorothy Foehr Huck Chair in Plasma Medicine in the Huck Institutes of the Life Sciences. He is also an Institute for Computational and Data Sciences faculty co-hire and professor of biomedical engineering by courtesy.

"The future nuclear engineer will think globally and have a keen appetite for learning with an entrepreneurial mindset to bring about transformational innovations in nuclear technology." – Jean Paul Allain

Engineering Penn State sat down with Jean Paul Allain, department head of the Ken and Mary Alice Lindquist Department of Nuclear Engineering, to discuss the future of the department and its role in shaping the future of nuclear engineering across the world.

Engineering Penn State (EPS): What is nuclear engineering at Penn State? What areas does it encompass?

Jean Paul Allain (JPA): Penn State nuclear engineering has a prestigious history in the field and, in particular, in nuclear power and nuclear safety. Nuclear engineering is one of the most multidisciplinary areas in all of engineering, especially when you think about where the heart of the discipline was born—the study of how radiation interacts with matter. Nuclear science is the convergence of classical and quantum physics and exploiting the manipulation of changes in the nucleus of an atom. Beyond nuclear power, radiation is used in medicine to treat cancer and as radio tracers to identify disease, and in food science to disinfect materials we'll consume. Nuclear power and nuclear energy are links to sustainability, which requires policy and regulation. The Ken and Mary Alice Lindquist Department of Nuclear Engineering and Penn State as a whole are key players in determining the huge impacts nuclear power will have on our future and beyond.

EPS: In which areas will the department grow to support this future work?

JPA: For many decades, nuclear engineering at Penn State has focused on nuclear power and areas aligned with nuclear power, such as nuclear safety analysis. Those are still critical areas, and they'll be a major part of our portfolio, which we plan to expand in complementary areas. For example, we're exploring more compact nuclear reactors. These aren't just smaller, but more modular. These are reactors that can be built at a factory and transported where they're needed. I'm particularly excited about the prospects of molten salt reactors and the innovation around micro reactors. These could one day address issues in climate change, poverty, water desalination, and industrial heating to scale; transforming emergent economies across the globe. We're also expanding our research into advanced technologies in plasma and nuclear space physics, such as nuclear fusion, plasma medicine, and space nuclear propulsion.

EPS: How will the expanded research portfolio change the student experience?

JPA: For undergraduate students in particular, they're joining the discipline as it is transforming itself nationally and internationally. The future nuclear engineer will think globally and have a keen appetite for learning with an entrepreneurial mindset to bring about transformational innovations in nuclear technology. Our undergraduate program will have more practical experiences in all sectors of nuclear engineering, including policy and law. Our students will have these experiences at Penn State as well as across the country in national labs and even abroad. We'll begin to prepare students for these experiences with advanced labs that encourage learning by doing, with hands-on practicums integrated into lectures. Innovation and entrepreneurship will be integrated into courses to encourage students to

International leaders convene at Penn State to map future of nuclear power

by Erin Cassidy Hendrick

To continually support the safety and efficiency of the world's power supply, international leaders in nuclear safety and regulation convened at Penn State on July 1 to establish and guide an upcoming research project in the Department of Mechanical Engineering (ME).

Fan-Bill Cheung, the George L. Guillet Professor of Mechanical Engineering and professor of nuclear engineering who also serves as the director of the Global Nuclear Power Safety Center, presided over the meeting, aimed at providing input on his research project, "Advanced Reflood Thermal-Hydraulics for Uncertainty Resolution" (ARTHUR).

Recently funded by the United States Nuclear Regulatory Commission (NRC), this project will perform reflood tests, emergency cooling mechanisms deployed during potential instances of failure in a nuclear power plant, to provide experimental and code evaluations. A five-year, $4.3 million project, the code evaluations derived in ARTHUR will add additional security to currently operating nuclear reactors and help prevent incidents like those that occurred in Chernobyl and Three Mile Island, in the future. In addition, these code validations will also support the high standard of safety needed to create the advanced reactors of the future.

Penn State's Applied Research Laboratory and ME command the only facility in the world capable of this experimental work, the Rod Bundle Heat Transfer Test Facility.

The results of this experiment will be submitted to the NRC, who will be responsible for disseminating the appropriate information to the 11 international partners participating. ■

BIOGRAPHY:

Jean Paul Allain

Jean Paul Allain joined Penn State to lead the Ken and Mary Alice Lindquist Department of Nuclear Engineering in July 2019. Previously, he was a professor and the associate head of graduate programs in the Department of Nuclear, Plasma, and Radiological Engineering at the University of Illinois at Urbana-Champaign, where he also led the Radiation Surface Science and Engineering Laboratory.

Prior to joining Illinois as a faculty member in 2013, Allain held a faculty position at Purdue University and served as a staff scientist at Argonne National Laboratory, a U.S. Department of Energy multidisciplinary science and engineering research center.

An author of more than 140 peer-reviewed scientific papers, Allain conducts experimental and computational modeling work in the area of particle-surface interactions. He works internationally to provide guidance and advice with concern to energy needs. He currently participates on a presidential think tank for his native Colombia.

Allain has received numerous awards for his work and teaching, including Argonne National Lab's Distinguished Performance Award (2003-06), Best Teacher Award in 2008 at Purdue University and 2013 at Illinois, the Department of Energy Early Career Award in 2010, the Research Excellence Award in 2011, the Fulbright Scholar Award in 2015, Faculty Entrepreneurial Fellow in 2016 at UIUC, Dean's Excellence in Research Award in 2017, and the 2018 American Nuclear Society Fusion Energy Division Technology Accomplishment Award.

Allain earned his bachelor's degree in mechanical engineering from California State Polytechnic University and his master's and doctoral degrees in nuclear engineering from Illinois. ■

understand what it means to actually practice in nuclear engineering. We'll also encourage students to approach nuclear engineering with a multidisciplinary view: students should collaborate with peers from other fields, such as liberal arts and business, so they can work together to solve highly complex problems from a variety of perspectives. We will also encourage all undergraduates to work in a research lab with fellow grad students and world-renown faculty.

For graduate students, their experience will be tightly linked to the faculty we recruit. We expect the graduate cohort to double from about 50 now to about 100 in five years, as we recruit exceptional faculty and they grow their research programs. For both students, and recruiting and retaining faculty, a major focus is on our facilities. The Radiation Science & Engineering Center, which houses the Breazeale Reactor, is a world-class facility and we will continue to partner in new initiatives creating a unique ecosystem of engagement for students and faculty members from across all of Penn State.

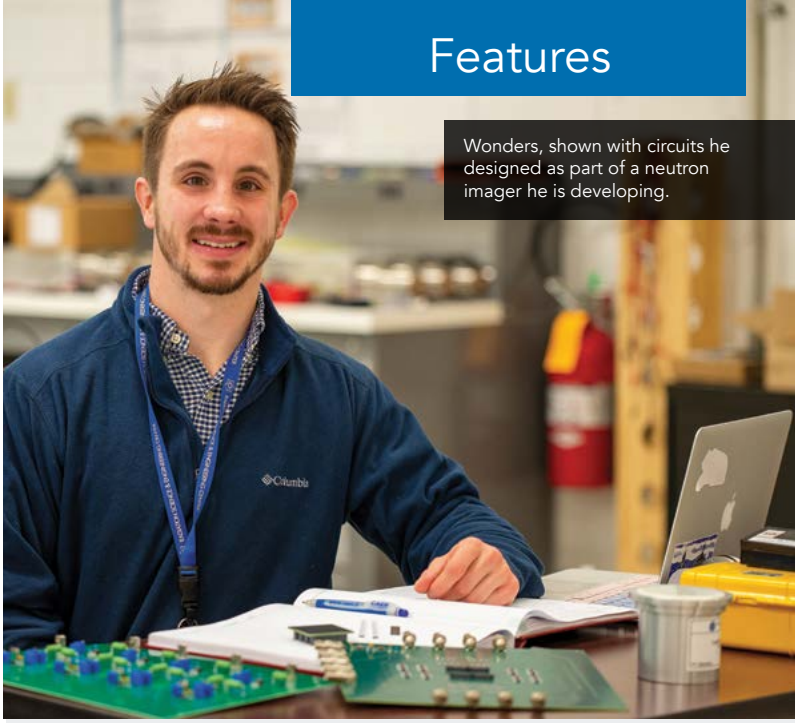
EPS: Beyond Penn State, what are your plans for developing the department and building continuing relationships with alumni?

JPA: Our responsibility is to engage with Penn State alumni and encourage them to become mentors, advocates, teachers, and partners with our students and faculty. We're identifying opportunities for alumni and friends to engage with the department, with the goal of assembling a world-renown alumni and advisory board to engage with all stakeholders and help guide large-scale strategic planning as we shape the vision of the department. They bring ideas of innovation and entrepreneurship, and the ability to train our students to be equipped with these ideals. Industry is also incredibly important to our department. We want to increase our footprint with industry partners, both for the importance of how industry influences our curriculum to provide our students with real experience, as well as for faculty and students to have that facetime with industry.

EPS: With the department's new name, and your appointment as the head of the department, this has been referred to as the department's inaugural year. What does that mean?

JPA: It means we're cherishing our history and establishing our new identity for the 21st century. The department history dates back to the 1950s and

"We expect the graduate cohort to double from about 50 now to about 100 in five years, as we recruit exceptional faculty and they grow their research programs."



Wonders, shown with circuits he designed as part of a neutron imager he is developing.

> "My ultimate goal is to bring this department to the next level, to bring a variety of vantage points to the forefront of our innovation, and to enable us to be the top nuclear engineering program in the country."

includes the visionary work of such scholars as Forrest Remick, Anthony Foderaro, Larry Hochreiter, and more. Our legacy is unique, with so many people who have contributed to our rich history. We're not forgetting that—we're building on it and expanding to shape and define our future. This year of new opportunities, including new leadership and a generous gift from the Lindquists, is our first year of transformation.

When you think about the importance of energy to the world, and a sustainable solution to provide energy, nuclear generation is a critical component. We need to rethink how nuclear power and nuclear engineering is perceived, and that includes the technology, the policies, the economics, the regulation. How we shape the definition of nuclear energy and sustainability will determine how humanity uses this incredible source of energy to achieve carbon-free goals by 2050 and beyond. Nuclear power is not the only answer, but we are certainly a critical part of the future.

EPS: What is your ultimate goal as department head?

JPA: My first goal is also my challenge. The perception of nuclear energy, and, by extension, nuclear engineering, carries a lot of history. I want to address that narrative, and help people understand the true nature and potential of nuclear science and engineering.

This includes navigating the current state of nuclear energy to get young people excited about the discipline. It also means educating the public by communicating the vast multidisciplinary nature of nuclear science and engineering. My vision for nuclear engineering at Penn State is one that extends beyond where nuclear has been and driven by what nuclear can become. By working together with faculty, we are defining nuclear engineering not just for the next 25 years, but for the next century.

As a department head, my position is one of service. I'm here to serve the faculty, the students, and the alumni. Our discipline is intrinsically global. It's imperative that we seek inclusive and diverse perspectives that enrich our learning, research, and innovation. My ultimate goal is to bring this department to the next level, to bring a variety of vantage points to the forefront of our innovation, and to enable us to be the top nuclear engineering program in the country. ■

Nuclear engineering graduate student selected to advocate in Washington, D.C.

by Ashley WennersHerron

Marc Wonders, a Penn State graduate student earning his doctorate in nuclear engineering, was one of 15 students from across the country who participated in the annual Nuclear Engineering Student Delegation (NESD) this summer. He was sponsored by the Ken and Mary Alice Lindquist Department of Nuclear Engineering.

The NESD was established in 1994 by nuclear engineering students after federal funding for nuclear research reactors was eliminated by Congress. The delegation serves as a week-long introduction to policy for students, while also exposing legislators to nuclear-related research. The students develop a policy statement to communicate their stance on issues they find important, engage with nuclear policy-related groups, and meet directly with the students' legislative offices.

This year, the delegation met with the Nuclear Energy Institute, the Nuclear Regulatory Commission, RAND Corporation, Third Way, ClearPath, the Department of Energy's Office of Nuclear Energy—including Rita Baranwal, the assistant secretary for nuclear energy—and national laboratory scientists on assignment with the Office of Science and Technology Policy and the Office of the Secretary of Defense for Policy. The students also met Craig Piercy, the American Nuclear Society's (ANS) Washington, D.C. representative, and Alyse Huffman, a congressional staffer and an ANS Congressional Fellow. ■

CALL OF THE WILD

Advancing robotics with help from the natural world

BO CHENG is working to push the boundaries of advanced robotic technology. To do so, the assistant professor of mechanical engineering turns to the natural world for inspiration. Last fall, research related to the landing maneuvers of flies from Cheng and his colleagues appeared in the journal Science Advances. Work with fish and hummingbirds earned grants totaling more than $2 million from the National Science Foundation and the Office of Naval Research, respectively.

Landing Flies

by Erin Cassidy Hendrick

"Through this work, we sought to understand how a fly executes the maneuvers of landing upside down in the blink of an eye," Cheng said. "Ultimately, we want to replicate that in engineering, but we have to understand it first."

Along with Penn State's Jean-Michel Mongeau, assistant professor of mechanical engineering, and Pan Liu, doctoral student in mechanical engineering, Cheng aims to understand the biomechanical and sensory processes that flies use to land on different surfaces like ceilings and moving objects.

"Within the blink of an eye, these flies can totally invert their body and land, which is quite spectacular," Mongeau said. "We see it all the time happening around us, but we've demonstrated the complexity of the maneuver. There is a lot of interest for robots to be able to do the same."

Read more

Swimming Fish

by Erin Cassidy Hendrick

As part of a $1.2 million grant from the National Science Foundation, Cheng and Asok Ray, distinguished professor of mechanical engineering, received $550,000 as the principal investigators to develop a bio-inspired robot fish platform and the corresponding learning algorithm to control and optimize its movements in underwater environments.

"We essentially want to study locomotion in fluids, by learning how fish swim and then use that fundamental knowledge to optimize robotic swimming," Cheng said. "The high-level objective is to understand how structure can move efficiently in water."

Ray explained similar problems are studied extensively in the aerospace industry, where aircrafts contend with the fluid dynamics of the atmosphere and wind patterns.

"However, there is less work exploring the impacts in underwater technology," he said. "There will be significant technical differences and challenges, but the knowledge can be applied to many other disciplines."

Read more

Escaping Hummingbirds

by Sarah Price

The extraordinary ability of hummingbirds to perform complex escape maneuvers is being explored for its potential to enhance the field of robotics and micro aerial vehicles, thanks to a $923,483 grant from the Office of Naval Research.

"Our biggest motivation is to understand how the best flying machine in nature works," Cheng said. "To me, hummingbirds are the best and they're super maneuverable."

The knowledge gained from the research will potentially have broad impacts on both aerial and underwater systems that are designed to achieve high agility in fluid environments by solving perception and locomotion control problems. ■

Read more

Ryan Fair, doctoral candidate in materials science and engineering, conducted research into cold sintering in the lab of the Gomez Group at Penn State.

Building a better BATTERY

by Jamie Oberdick

By discovering a way to combine lithium salts with ceramics, researchers in the Penn State College of Engineering and the Penn State Materials Research Institute may have created a new class of materials for longer-lasting batteries. According to researchers, the composite nature of the batteries could make recycling easier, reducing landfill waste.

Enrique Gomez, professor of chemical engineering and materials science and engineering with a co-appointment in the Materials Research Institute, led the team, which published its work in Advanced Functional Materials.

Safe, reliable, and high-capacity batteries are needed for electric cars, implantable biomedical devices, and storage of power generated by renewable energy sources, such as solar or wind. Discarded batteries also pose a solid-waste problem due to the possibility of toxic heavy metals leaching into the environment, as well as their tendency to cause landfill fires.

The search for 'magical materials'

"Battery materials need to excel in a lot of ways," Gomez said. "They need to be highly conductive, highly resistant, have good mechanical properties, and more. Finding the magical material is really hard. Once we find it, making this magical material recyclable is a crucial challenge."

Gomez and his team have developed a potential "magical material" through a process called cold sintering, which blends a ceramic and an organic salt to create a new hybrid material. The composite combines the conductive properties of the ceramic with the flexible mechanical properties of the organic salt. The batteries made with this material would be more conductive, last longer, and be easier to recycle.

"Using our new approach, you could recover these composite battery materials, grind them up, and simply make a new component," Gomez said.

Cold sintering is the key

The process of traditional sintering turns a powder into a solid via extreme heat of more than 1,000° Celsius. Cold sintering achieves the same result with significantly lower temperatures of only 100 to 200° Celsius. This process was unveiled in a 2016 Advanced Functional Materials paper from a team of Penn State researchers led by Clive Randall, professor of materials science and engineering.

The cold sintering temperatures are below the combustion rate of organic materials. Since organics are not destroyed during cold sintering, this could lead to new types of organic-ceramic hybrid materials, such as the battery materials Gomez and his research team are developing. ■

Faster Recharging Batteries

by A'ndrea Elyse Messer

Electric vehicle owners may soon be able to pull into a fueling station, plug their car in, go to the restroom, get a cup of coffee, and in 10 minutes, drive out with a fully charged battery, according to a team of engineers.

"We demonstrated that we can charge an electrical vehicle in ten minutes for a 200- to 300-mile range," said **Chao-Yang Wang**, William E. Diefenderfer Chair of Mechanical Engineering, professor of chemical engineering, and professor of materials science and engineering. "And we can do this maintaining 2,500 charging cycles, or the equivalent of half a million miles of travel."

The researchers had previously developed their battery to charge at 50° Fahrenheit in 15 minutes. Charging at higher temperatures would be more efficient, but long periods of high heat also degrade the batteries.

Wang and his team realized that if the batteries could heat up to 140° Fahrenheit for only 10 minutes and then rapidly cool to ambient temperatures, lithium spikes would not form and heat degradation of the battery would also not occur. In October, they reported their results in Joule. ■

Read more

New polymer aids lithium ion batteries

by Erin Cassidy Hendrick

Research published in Nature Communications represents a critical step forward for many technologies that rely on rechargeable lithium ion batteries, including electric vehicles and smartphones.

"Silicon has been identified as a promising anode material for the next generation of lithium ion batteries," said **Donghai Wang**, professor of mechanical engineering and chemical engineering. "But research has shown the material becomes very unstable during the energy cycling."

As the battery completes its power cycle, silicon in the battery anode significantly expands and contracts, which limits its potential for commercial adoption.

These repeated volume changes during the charging and discharging process eventually results in structural damage within the cell. Over time, the effects of this degradation could contribute to instability, such as explosions, and decreased battery life.

However, the researchers adopted a new strategy that allows the silicon to retain the elasticity that enables superior energy transfer, while also maintaining the ultimate integrity of the battery's electrode.

"We found that if you surround the silicon-based anode with a cushion of a supremely-elastic gel polymer electrolyte (GPE), it allows the silicon to remain stable, so the particles won't displace within the electrode," Wang said. ■

Read more

Led by Scarlett Miller and Jason Moore, a multi-disciplinary and multi-institutional research team aims to develop an innovative robotic training system to reduce the number of complications associated with central venous catheter placement.

Decreasing complications of catheter procedures

by Samantha Chavanic

Each year, more than five million central venous catheters (CVC) are placed in a large vein in the neck, chest, or groin to provide patients with fluids, blood, or medications.

The thin, flexible tubes empty their contents into or close to the heart, providing almost immediate treatment. Of these five million patients, close to 1.7 million experience some sort of complication related to the catheter insertion—that is one in every three patients.

A Penn State-led, multidisciplinary and multi-institutional research team aims to develop an innovative robotic training system to reduce the number of complications associated with CVC placement.

Through a five-year, $2,233,411 grant recently awarded by the National Institute of Health's (NIH) National Heart, Lung and Blood Institute, principal investigators **Jason Moore**, associate professor of mechanical engineering, and **Scarlett Miller**, associate professor of engineering design and industrial engineering, will lead a team of engineers, medical professionals, and graduate students to build upon their previous dynamic haptic CVC work supported by the NIH.

The new project will use the team's innovative concept of dynamic haptic robotic training (DHRT), where a programmable robot is used to apply force to a surgical resident's hand to replicate the feeling of inserting a needle into a patient's body, to develop and implement an entire CVC procedural training system. The new DHRT+ system will integrate a mixed-reality smart tray, advanced testing surface, high-functional fidelity virtual ultrasound imaging, and real-time, adaptive feedback assessment.

"We can make it (training) be much more effective for the user and help eliminate some of the patient complications that we see," Moore said. "If somebody is trained with the DHRT+, we hypothesize this will have a strong impact on patient well-being at the end of the day."

Miller explained that by focusing on the process from beginning to end, the team will decrease not only mechanical complications but also infectious complications. Infections can happen from not using appropriate sterile techniques, both before and after the central line placement.

"As engineers and engineering designers, we are constantly trying to create innovations," she said. "We always say, 'It could be you in the hospital setting having this procedure done.' The training of that person leading up to that moment is really important. It's not just you—it could be your family member or close friend having this done. The reason that drives me to improve our health care system for this procedure that is done so commonly, but has such a high complication rate, is that opportunity to have that impact on people's lives." ■

Exploring the link between pollution and neurological disease

by A'ndrea Elyse Messer

A consensus is building that air pollution can cause neurological diseases such as Alzheimer's disease and Parkinson's disease, but how fine, sooty particles cause problems in the brain is still an unanswered question. Now a team of Penn State researchers, using mice, has found a possible way, but more research is still needed.

The researchers looked at how cerebrospinal fluid, the liquid that flows around the brain and spinal cord, flows out through the nose, and what happens when the flow of fluid is stopped.

> "More and more it is realized that it does not just cushion the brain, but may also transfer stuff out of the brain and spinal column area."

"There has been a lot of interest in understanding cerebrospinal fluid movement in the last five years," said **Patrick Drew**, Huck Distinguished Associate Professor of Neural Engineering and Neurosurgery. "More and more it is realized that it does not just cushion the brain, but may also transfer stuff out of the brain and spinal column area."

The researchers suggest in a recent issue of eLife, "that damage to olfactory sensory neurons (such as from air pollution) could contribute to altered CSF turnover and flow, providing a potential mechanism for neurological disease." They also state that "reduced CSF turnover may be a contributing factor to the buildup of toxic metabolites and proteins that cause neurodegenerative disorders." ■

Read more

Unlocking the PTSD puzzle

by Jamie Oberdick

A team of Penn State and University of Puerto Rico School of Medicine researchers is attempting to answer a question that has long puzzled experts.

Why do some individuals suffer post-traumatic stress disorder (PTSD) after experiencing trauma, and others do not?

The research, led by **Nanyin Zhang**, professor of biomedical engineering and Lloyd & Dorothy Foehr Huck Chair in Brain Imaging at Penn State, explores whether individual vulnerability to PTSD is due to pre-existing conditions or to a response to trauma exposure.

The team used the predator scent model of PTSD in rats and longitudinal design, which involves repeated observations of the same subject over a period of time.

"The outcomes of the research can potentially be translated to human studies," Zhang said. "For instance, a biomarker predicting a vulnerability to stress-induced disorders will help determine the risk of assigning an individual to a highly stressful environment, such as combat." ■

Read more

Studying the impacts of Alaska's eroding coastline

by Ashley WennersHerron

As temperatures rise, the frozen ground of the Arctic coastline is melting, wrecking havoc on the infrastructure and communities of the coast. (Photo credit: Benjamin Jones, University of Alaska Fairbanks)

The Arctic sea is consuming Alaska's coastline. Since 1955, the rising water has eroded more than 300 meters of permafrost—the frozen soil that helps protect the Arctic's delicately balanced ecosystem. It also serves as the foundation upon which hundreds of villages and thousands of people exist.

A collaboration of universities, led by Penn State's **Ming Xiao**, associate professor of civil and environmental engineering, is now working to understand exactly how the degradation will immediately affect the Alaskan communities and, eventually, the rest of the world. The National Science Foundation awarded the project $3 million, with a third of that going to Penn State. Xiao's Penn State team includes **Christopher McComb**, assistant professor of engineering design and mechanical engineering.

"What happens in the Arctic does not stay in the Arctic," Xiao said. "Permafrost contains double the carbon currently in our atmosphere. As it melts and degrades, that carbon can be released, causing more melting and degradation, affecting even more of the globe."

The problem is so dire that the National Science Foundation established "Navigating the New Arctic" (NNA) as one of its Ten Big Ideas. Through the NNA, the NSF awarded $35 million in grants to researchers across the United States focused on understanding the impacts of global warming in the Arctic this year.

"Our project has three main focuses," Xiao said. "We are working to understand how the ground is changing as it thaws, how the changing ground affects the infrastructure along the Alaska coast, and how these changes influence the social system of the people living in these areas."

Each university involved will develop individual predictive models of how one factor may evolve as temperatures and sea levels continue to rise. Xiao and his team at Penn State will combine the individual models into one, which researchers can use to explore how one factor can influence the others, or how multiple factors can have different effects when compiled together.

"We are working to understand how the ground is changing as it thaws, how the changing ground affects the infrastructure along the Alaska coast, and how these changes influence the social system of the people living in these areas."

"In Alaska, the ice used to be thick enough for people to drive across it," Xiao said. "That is not the case anymore. People have fallen through the ice and have never been recovered. The people who live there, their homes are falling into the ocean as the coast erodes. Their way of life is disappearing." ■

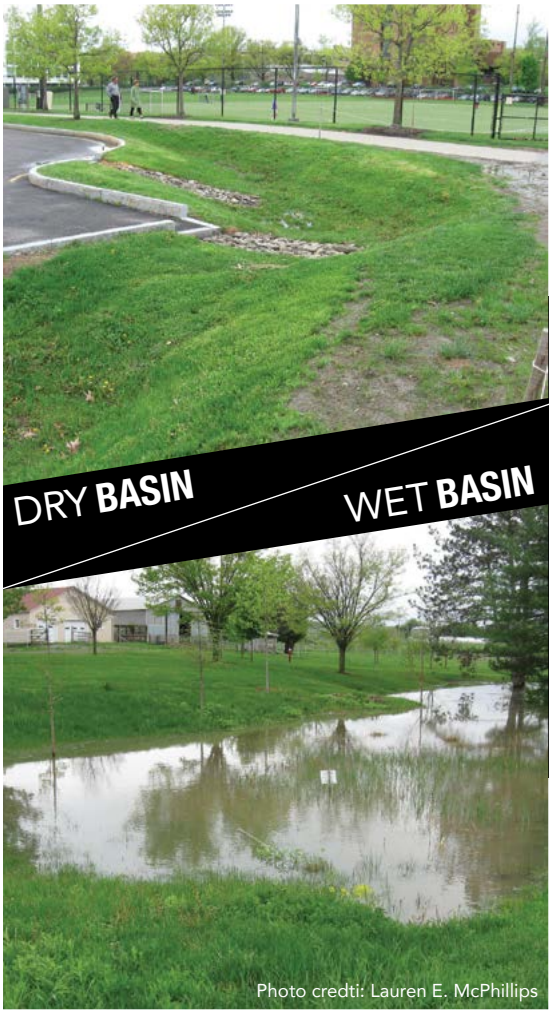


Photo credti: Lauren E. McPhillips

Optimizing detention basins

by A'ndrea Elyse Messer

Stormwater detention basins intended to control the flow of rainwater and runoff might help in controlling nitrogen runoff into rivers and lakes, according to **Lauren E. McPhillips**, assistant professor of civil and environmental engineering at Penn State.

Speaking in August at the annual meeting of the Ecological Society of America in Louisville, Kentucky, she explained that she and colleagues at Cornell University looked at stormwater detention basins in the area around Ithaca, New York.

Controlling runoff from rain and trapping sediment has always been a goal of these ubiquitous basins, but new techniques may make them suitable for removing nitrate from the water as well. The basins the researchers examined are in urban and suburban areas, and nitrate comes from atmospheric deposition on roads, car combustion, and lawn fertilizers.

"Typically, the basins are designed to be dry, but as sediment from runoff and vegetation that grows in the basins builds up, they can become wet basins," McPhillips said.

They found that the capability of producing gaseous nitrogen was higher in wet basins than dry basins. However, they also found that partial conversion produced nitrous oxides and that consumption of organic matter produces methane, both greenhouse gases. The wet basins showed higher levels of the gene that allows complete conversion of nitrate to gaseous nitrogen.

According to McPhillips, designing the basins to hold water from the beginning could decrease production of nitrous oxides, because the longer the basins hold the water, the more complete the conversion from nitrate to gaseous nitrogen. ■

Read more

Expedition explores ocean carbon dioxide

by Erin Cassidy Hendrick

Matthew Rau, assistant professor of mechanical engineering at Penn State, spent 10 days cruising north of Oahu, Hawaii, in the summer of 2019. But it wasn't for a vacation—Rau was conducting foundational research that could aid the understanding of carbon dioxide absorption within the Pacific Ocean and its potential impact on climate change.

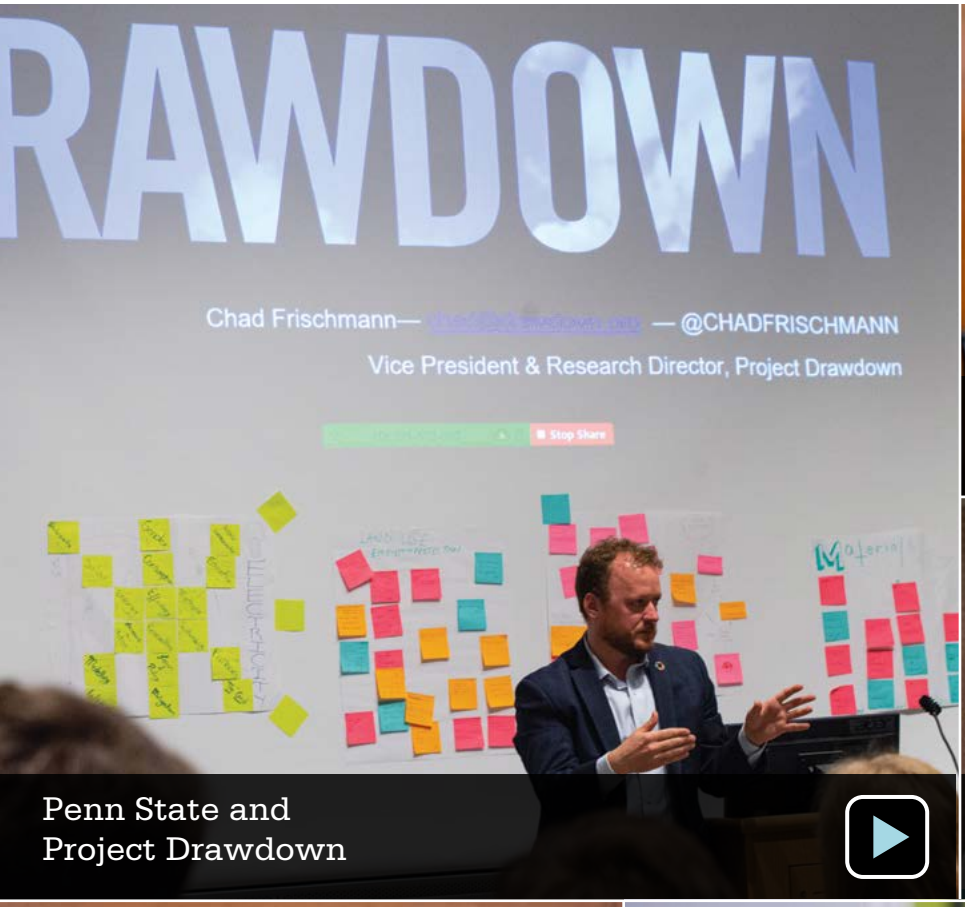
"The ocean is full of particulate matter, like clay, sand, microplastics, but it's mostly organic matter like plankton," he said. "These particulates often end up clumping together and the bigger they get, the deeper they can settle in the water."

This has some benefits, mainly that the carbon dioxide naturally absorbed into these particulates also sinks further into the ocean. An effect of this phenomena is carbon sequestration, which is the long-term storage of the gas that can help moderate climate change and ocean acidification.

"This is a small piece of a really big puzzle," Rau said. "Through this work, if we can make better predictions on how the ocean sequesters carbon, our predictions for carbon dioxide uptake from the atmosphere and its role in our changing climate will be better." ■

Read more


Matthew Rau (left), assistant professor of mechanical engineering, and his fellow scientists conduct field work north of Oahu, Hawaii.



Penn State and Project Drawdown

Your impact goes beyond me

Professor leads national workshop on cybersecurity

Global engineering students meet with President Barron

An eye to the future: Penn State Chemical Engineering

MEP Robotics SeAL Challenge 2019

Thank you from Justin Schwartz, Harold and Inge Marcus Dean of Engineering

Bigger. Better.
Penn State Biomedical Engineering

Summer camp: Anything is possible for girls in electrical engineering

WEPO Design Competition 2019

Students use refreshable Braille coding to work with 3D printing

Designing intelligent and adaptable battery packs

Leaving a legacy of impact

Computer science summer camp: Dancing with robots

Wezi Mkandawire's early love of instruments like the piano and the clarinet led to his interest in composing instrumental music when he was in high school. (Photo credit: Jeff Rice)

First-year engineering student creating

SOUNDTRACKS ON THE SIDE

by Jeff Rice

Wezi Mkandawire is studying chemical engineering in his first year at Penn State. But the Schreyer Honors Scholar hasn't abandoned his longtime love of music or the compositions that are earning him national notice.

Mkandawire produces music for film and television soundtracks, combining his abilities with the guitar and piano with a growing set of production skills. Videos featuring his songs have received as many as 45,000 views on Ambient, a YouTube channel that collects music designed for films, relaxation, and more.

Creating music that has a soothing effect is no accident for Mkandawire, who enjoys listening to various film soundtracks for inspiration and cites Thomas Newman—famous for the scores of films including "The Shawshank Redemption," "Road to Perdition," and "Finding Nemo"—as an influence.

"I usually think of a story that would go along with the music, then name the songs based off that," Mkandawire said. "I always name them after I can listen to some form of the finished product, so that I can see how it makes me feel and what comes to my mind when listening."

Mkandawire was drawn to Penn State and the Schreyer Honors College because of the opportunities for research and "it was close to home." He is eager to explore the engineering industry while continuing to create music. ■

Engineers Without Borders partners with Namutamba community in Uganda

by Ashley WennersHerron

Undergraduate students from the Penn State chapter of Engineers Without Borders have launched a collaboration with the Namutamba community in Uganda to improve the community's access to potable water.

Under the mentorship of **John Regan**, professor of environmental engineering, and Brian Thiede, assistant professor of rural sociology, sociology, and demography in the College of Agricultural Sciences, the group signed a five-year partnership agreement with the community and the Mityana Rotary Club, the local branch of the American nonprofit group.

"The goal of this first trip was to lay the groundwork for a long-term partnership with the Namutamba community, as well as commence work aiding the community with water security," said **Noelle Ihanainen**, a senior studying environmental systems engineering and president of Penn State's Engineers Without Borders.

The Namutamba community consists of about 3,900 members in 796 households, but the region as a whole does not have the infrastructure nor the resources in place to maintain a consistent water supply.

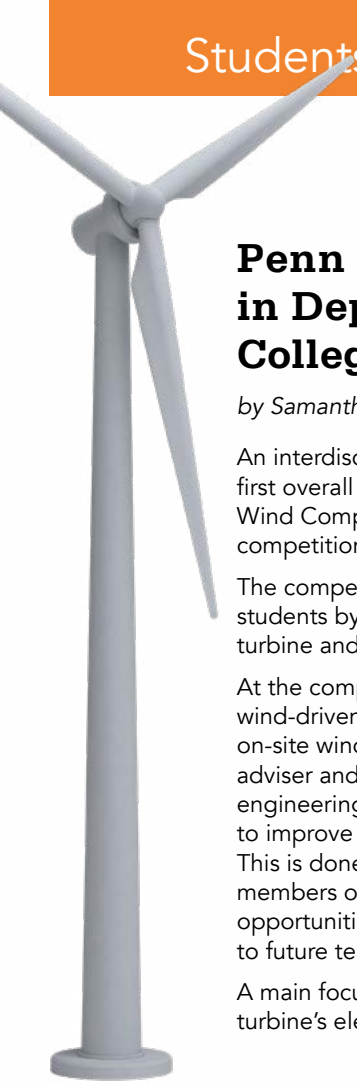
During their trip, the students learned that even during the wet season, when water is more available, it is not always safe.

The group spent two days visiting three of the community's current water sources where they tested the water quality. They will use these tests as a baseline to track improvement in water quality throughout their project. With the help of James Ssonko, the local district water engineer, the students met with Henry Kiggundu, a senior hydrogeologist, who helped coordinate a hydrogeological survey to determine if there was water underground. The survey determined water to be located approximately 60 meters underground during Namutamba's dry season.

The result determined the team's plan moving forward. They will drill a borehole down to the source, install a pump to extract the groundwater, and distribute it to the community through underground piping where it can then be stored in an elevated tank.

Now, the team members are drafting their technical design for the system, educating new chapter members, and fundraising to support their future work. They plan to return to Uganda after their finals in May 2020 to implement the next steps in the project. ■

Undergraduate students and John Regan, professor of environmental engineering (center, in hat), meet with local district water engineers from Mityana, Uganda, to assess potable water accessibility. (Photo credit: Kyle Pelegrin)



Penn State team places first in Department of Energy Collegiate Wind Competition

by Samantha Chavanic

An interdisciplinary team of 17 students recently placed first overall in the 2019 Department of Energy Collegiate Wind Competition—Penn State's fourth victory in the competition in the last six years.

The competition creates real-world experiences for students by asking them to design, build, and test a wind turbine and plan and financially analyze a wind plant.

At the competition, student teams presented a unique, wind-driven power system and tested the turbine in an on-site wind tunnel. **Susan Stewart**, lead strategic team adviser and associate teaching professor of aerospace engineering, said the team is always looking for ways to improve the turbine's design from year to year. This is done to provide team members, comprised of members of the Wind Energy Club, with new learning opportunities and to carry on the knowledge of the team to future team members.

A main focus of the system redesign for 2019 was the turbine's electrical system. The controller and load were rebuilt to more effectively accomplish the tasks of the 2019 competition.

The team (left to right): Angela Paul, energy engineering; Jeff Horst, energy engineering; Mannie Samuels, energy, business and finance; Sean Rich, aerospace engineering; Adam Proulx, mechanical engineering; Connor Haney, electrical engineering; and Susan Stewart.

Efforts also were made to investigate a new blade design, using a different airfoil, a redesigned pitching system, and a different type of servo actuator. The team has a strong core aerodynamic design, but these tasks serve as a great opportunity to transfer knowledge to the next cohort of team members.

The students also were tasked with conducting a financial analysis for a utility-scale wind farm. In doing so, the competition mimics real-world experiences students will see once they enter the wind-industry workforce.

In addition to the team's first place overall award, the team received first place in the technical design contest for its report and presentation, first place in the turbine design contest, and fourth place for its project development. ■

Architectural engineering students secure historic win

by Erin Cassidy Hendrick

Undergraduate students earned first place in all five core categories at the 2019 Architectural Engineering Institute Student Design Competition, including the top honor for building integration.

Held at Penn State on April 5, the student design competition highlights the collaboration of multidisciplinary architectural engineering student teams, showcases the knowledge and application of design and construction principles to a real-world project scenario, and prepares students for a successful career in their chosen industry.

In addition to the Building Integration award, the students also won top honors in Construction, Lighting/Electrical, Mechanical, and Structural Design.

The comprehensive challenge pushed the team to conceptualize and design a large-scale proposal for a high-performance musical arts center. Named the Jack H. Miller Center, the theoretical project was located in Hope College in Holland, Michigan, and was allocated an overall budget of more than $23 million.

Uniquely prepared for this project, the students commanded knowledge from a third-year experience in integrated building solutions, where a similar project is assigned. Weaving together five core classes in structural, acoustical, mechanical, lighting/electrical, and construction engineering, the students were tasked with creating an all-encompassing building design across the course sections.

The final design showcased this dexterity and creativeness within their design and earned them first-place honors in: Building Integration, Construction Management and Development, Electrical Systems Design, Mechanical Systems Design, and Structural Systems Design, a first for Penn State.

Historically, Penn State architectural engineering has reached the finals in every year it has entered the competition. ■

The 2018-19 officers of the IISE Penn State chapter: Front (L-R): Brady Bobbitt, Sophia Dyke, Pawornwan Thongmak, Alejandra Ayala; Back (L-R): Alejandro Salaverria, Aaron Meier, Gabriel Di Biase, Dongyoung Choi (Photo credit: Brady Bobbitt)

Student chapter wins fourth consecutive national industrial engineering award

by Miranda Buckheit

The Penn State student chapter of the Institute for Industrial and Systems Engineers (IISE) has been honored with the organization's Gold Award for the fourth consecutive year.

To determine award recipients, IISE rates each student chapter using the University Chapter Activity Report (UCAR). The UCAR scoring system allows student organizations to track their progress in order to make improvements for each academic year. The UCAR also makes it so the organization's accomplishments can be publicly recognized.

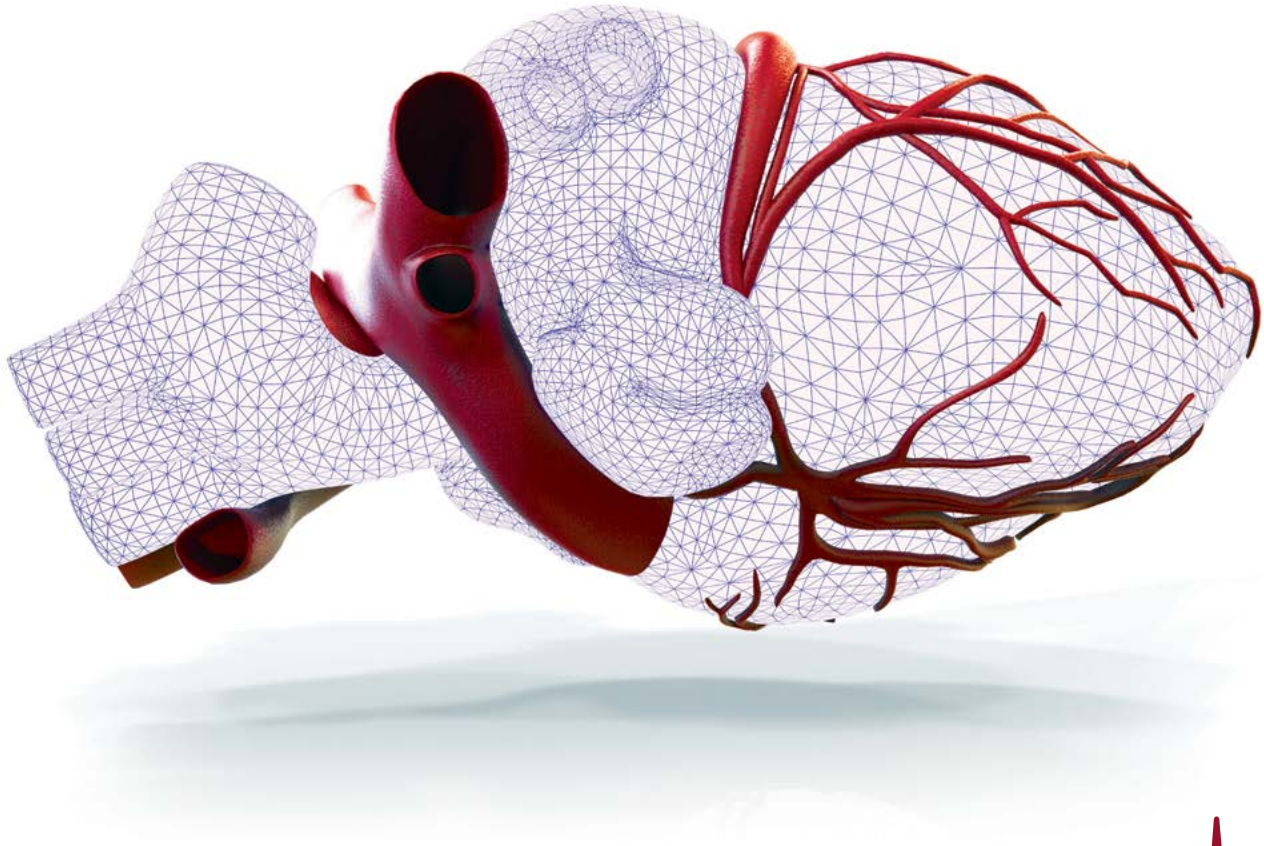
Gold, Silver, and Bronze awards are awarded based on the number of UCAR points received by student chapters. The Gold Award is the highest honor in the professional organization's University Chapter Recognition Program.

"Our mission for the year was to make new opportunities for members, but [to] still carry on the traditions of the organization," said **Brady Bobbitt**, industrial engineering student and 2018-19 Penn State IISE student chapter president.

Some of the traditional activities planned by the chapter for Harold and Inge Marcus Department of Industrial and Manufacturing Engineering students include a career fair, a Six Sigma Greenbelt training, workshops with potential employers, an award banquet, and a family day. Members of the student chapter also attended the IISE regional annual conference and national annual conference.

Bobbitt also credits the organization's win to the creation of new events, such as Career Days 101, a collaboration with the National Organization of Business Engineering that provided students with opportunities to prepare for the career fair and interviewing process through a mentoring talk, recruiter panel, résumé review, mock interview, and a headshot photoshoot.

In addition, the group organized Consulting 101, a collaborative effort with Penn State Industrial and Manufacturing Engineering Society to provide students with a panel of consultants with varying backgrounds to give insights to the life of consulting. ■



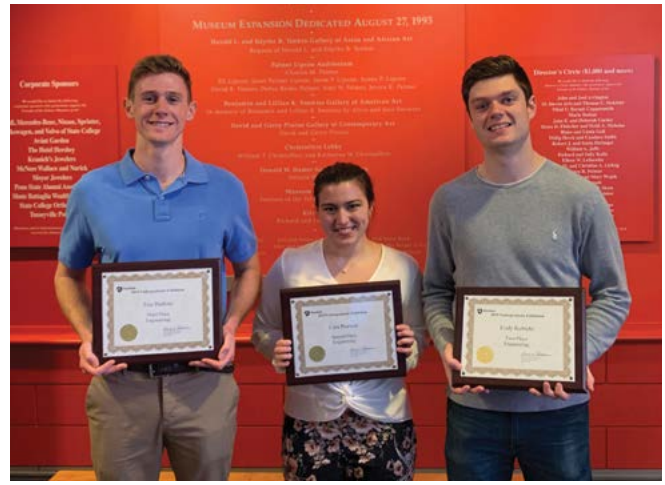
Artificial heart lab demonstrates the impact of undergraduate research

by Jamie Oberdick

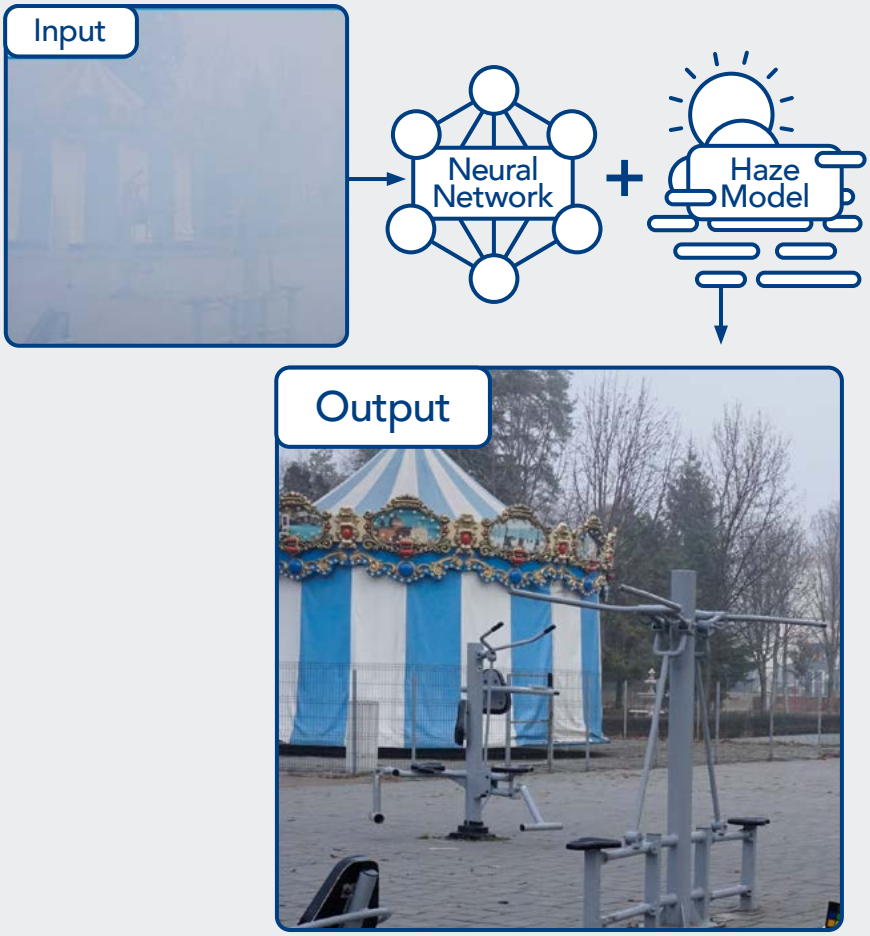
While graduate students and faculty are known for their research work, undergraduates also make significant contributions to the Department of Biomedical Engineering's research portfolio.

Students in the Artificial Heart and Cardiovascular Fluid Dynamics Lab, headed by **Keefe Manning**, associate dean of the Schreyer Honors College and professor of biomedical engineering, recently were recognized for their work at the Undergraduate Exhibition, held annually at the end of the spring semester on the Penn State University Park campus. The exhibition showcases undergraduate research and artistry across many disciplines at the University. At the 2019 event, four of Manning's students produced award-winning posters focused on various ways to improve artificial hearts and make them safer for patients, highlighting the impact that undergraduate research can have on society.

In the "Engineering" category, students involved with the Artificial Heart and Cardiovascular Fluid Dynamics Lab nearly swept the top three awards. The first-place winner was **Cody Kubicki**, class of 2019, mechanical engineering; second place was **Cara Pearson**, class of 2019, biomedical engineering, and a Schreyer Honors College graduate; and tied for third place was Tice Harkins, class of 2019, premedicine, from the Eberly College of Science, and a Schreyer Honors College graduate. **Brady Houtz**, rising biomedical engineering senior and a Schreyer Honors College student, took first prize in the University Libraries' "Undergraduate Research Award: Excellence in Information Literacy" category. ■



Penn State biomedical engineering undergraduate students Tice Harkins, left, Cara Pearson, center, and Cody Kubicki with their Undergraduate Exhibition awards. (Photo credit: Keefe Manning)



Penn State takes first and second place in international image-dehazing challenge

by Sarah Small

A team of graduate students, led by **Vishal Monga**, associate professor of electrical engineering, won first place in a worldwide image dehazing challenge, with another Penn State team placing second in the competition.

The challenge was hosted by the New Trends in Image Restoration (NTIRE) Conference in conjunction with the 2019 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), the world's premier vision conference, according to CVPR's website. In addition to the image dehazing challenge, in which the Penn State teams placed first and second, the NTIRE image restoration and enhancement challenges have several other tracks, including image denoising, image super-resolution, image enhancement, and image colorization.

Image dehazing involves taking an image that is hazy or foggy and making it much clearer in a matter of seconds using a mathematical algorithm. The participating teams submitted their algorithms to the judges, who then applied the algorithms to a set of hazy images to test for quality and speed of the dehazing. Of the 275 teams from universities, research institutions, and corporations who competed, only 22 were selected as the top teams to be invited to compete further in the challenge.

A few members of the team will attend the 2019 CVPR Conference from June 16-18 in Long Beach, California, to present their work and receive their awards.

This research was funded in part by a grant from the National Science Foundation. ■

Penn State Society of Women Engineers wins top prize for sixth consecutive year

by Tessa M. Woodring

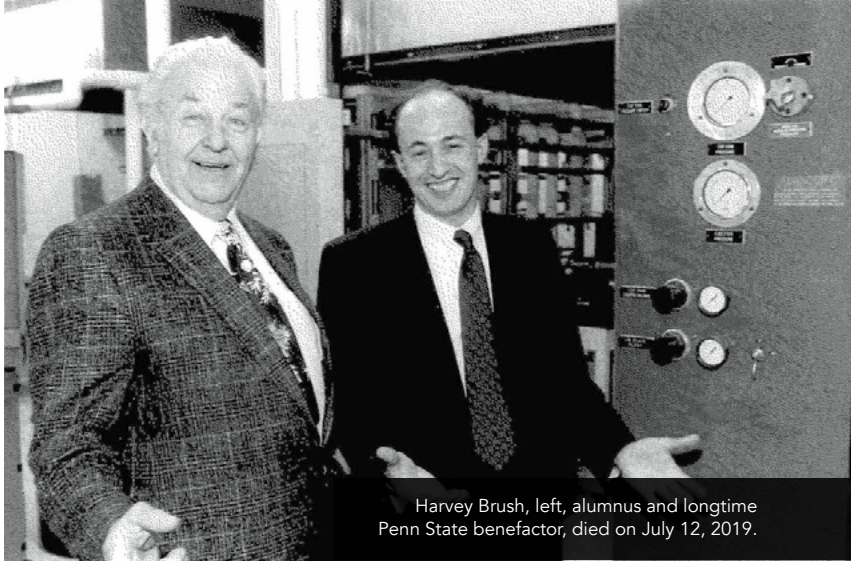
The Penn State Society of Women Engineers received the 2019 Outstanding Collegiate Section (OCS) Gold Mission Award for the sixth consecutive year at the WE19 National Conference on Nov. 8. This award is the highest possible collegiate recognition within the Society of Women Engineers (SWE).

Penn State SWE was also recognized at WE19 for excellence in "Best Practices" for two categories: professional development and global. These awards were given for specific events that Penn State SWE held in the past year: Study Abroad 101 and its "STAR!" interview technique event. ■

Penn State Society of Women Engineers members pose outside of the WE19 National Conference at the Anaheim Convention Center, where they received the 2019 Outstanding Collegiate Section (OCS) Gold Mission Award.

Penn State engineering alumnus, benefactor remembered

by Tessa M. Woodring



Harvey Brush, left, alumnus and longtime Penn State benefactor, died on July 12, 2019.

Harvey F. Brush, 99, alumnus and longtime Penn State benefactor, died on July 12, 2019. Brush, who earned his bachelor's degree in chemical engineering in 1942, contributed more than $2 million to the College of Engineering and the College of Education over the years.

His work with the College of Education was in memory of his late wife, Geraldine Brush, who died in 1988, and resulted in the Geraldine Brush Faculty Fellowship, Geraldine Brush Graduate Assistantship in Education, and the Geraldine W. Brush Endowment for Excellence in the College of Education. In 1989, he established the endowed Harvey F. Brush Chair in the College of Engineering to support a faculty member focused on interdisciplinary research and education.

"I will very much miss Harvey," said **Steven Schiff**, Harvey F. Brush Chair in the College of Engineering. "I will miss my conversations and visits with him. He gave me my career."

Schiff first met Brush in 2006 when Schiff was appointed to the chair position.

"His support touched the lives of so many of our graduate students who had limited resources and helped give them the education and future careers that they deserved," he said.

Brush's endowment helped to sustain research projects and funded stipends for graduate students. It also helped to support the seed funding to start the Center for Neural Engineering and a new graduate program in neural engineering in the Department of Engineering Science and Mechanics.

Schiff credits Brush for his help on numerous projects over the last several years that allowed him to advance his research in controlling infectious diseases in infants in developing countries.

"I used his endowment to explore new ways of melding engineering with medicine, as well as to explore ideas at early stages, well before any funding agency would think that the work was far enough along to warrant grant support," Schiff said.

Schiff received the National Institutes of Health (NIH) Director's Pioneer Award in 2015 and a second NIH Director's Award in 2018 for his work.

"We are going to continue to accomplish a lot of good for our students and society with what his endowment has enabled," Schiff said. "Harvey had an amazingly rich and long life. He believed strongly in Penn State, stood behind that belief with major support, and remained involved with us until the end." ■

Nuclear engineering alumnus receives Alumni Fellow Award

The Penn State Alumni Association honored 16 Penn Staters on Oct. 23 with the Alumni Fellow Award, the highest award given by the Alumni Association. Among the honorees was **Kenneth O. Lindquist** ('67 M.S. NucE, '71 Ph.D.).

The Alumni Fellow program is administered by the Penn State Alumni Association in cooperation with the University's academic colleges, campuses, and the Office of the President. Alumni are nominated by a college or campus as leaders in their professional fields and accept an invitation from the president of the University to return to campus to share their expertise with students, faculty, and administrators. ■

Isett Professorship to advance civil and environmental engineering

by Jennifer Matthews

The Department of Civil and Environmental Engineering has received a $1 million estate commitment to establish the Barry and Shirley Isett Professorship in Civil and Environmental Engineering. This gift comes from the generosity of **Barry Isett**, a 1958 Penn State alumnus in civil engineering, and his wife, Shirley Isett, of Perkiomenville, Pennsylvania.

The endowment will be used to provide vital financial support to an outstanding department faculty member to further their scholarly contributions to teaching, research, and public service. This support can be used for research expenses; to develop new courses and programs; for education and travel expenses; for administrative assistance; and to provide support for undergraduate and graduate students.

Barry Isett is a member of the National Society of Professional Engineers and the American Society of Civil Engineers. He was named a Fellow Member of the National Society of Professional Engineers (NSPE) in 2005 and served as the northeast regional vice president for NSPE from 2004 to 2006. For this, he was honored with the NSPE Distinguished Service Award in 2014. He was the state chairman of Professional Engineers in Private Practice and served as president of the Pennsylvania Society of Professional Engineers (PSPE) in 1995. He was honored with the Penn State College of Engineering Outstanding Alumnus Award in 2007; the Distinguished Alumni Award from Parkland High School in 2016; and the Engineer of the Year Award by the Pennsylvania Society of Professional Engineers (PSPE)—Lehigh Valley Chapter in 1989. ■

Civil engineering alumnus who helped create Nittany Lion Shrine also accomplished WWII veteran

by Michael Garrett and Col. Thomas Fasnacht

Col. David E. Pergrin, a Penn Stater who helmed the committee that commissioned the Nittany Lion Shrine, was also a veteran who served in one of the most decorated U.S. Army units of World War II.

At the time of the statue's dedication, on Oct. 24, 1942, Pergrin was training the unit he would lead in combat: the 291st Engineer Combat Battalion.

Under Pergrin's command, the 291st Battalion went on to become the single most decorated Army engineer unit of World War II, receiving the Presidential Unit Citation "for extraordinary heroism and outstanding performance of duty in action." Pergrin himself received the Silver Star for valor under fire and the Purple Heart for wounds received in combat, as well as receiving the Croix de Guerre from the French and Belgian governments.

The legacy of the 291st Battalion was established during two of the most influential battles of the war: the Battle of the Bulge and the Battle of Remagen, in which Pergrin and his unit's efforts were indispensable to Allied victory.

Pergrin chronicled his experiences during World War II in two books: "First Across the Rhine" and "Engineering the Victory: The Battle of the Bulge." The courageous exploits of the 291st Battalion have also been the subject of multiple documentaries, including the History Channel's "Unsung Heroes of WWII."

Pergrin enjoyed a long and successful career as a railroad executive upon his return to civilian life. He passed away on April 7, 2012, at the age of 94. ■

In this photo from his book "First Across the Rhine," Pergrin, third from the right, stands in front of the bridge he and his unit constructed under heavy enemy fire during the Battle of Remagen—the longest such bridge constructed during World War II. (Photo credit: Retired Col. Thomas Fasnacht)

Penn State alumnus leads effort to restore the Chesapeake

by Jamie Oberdick

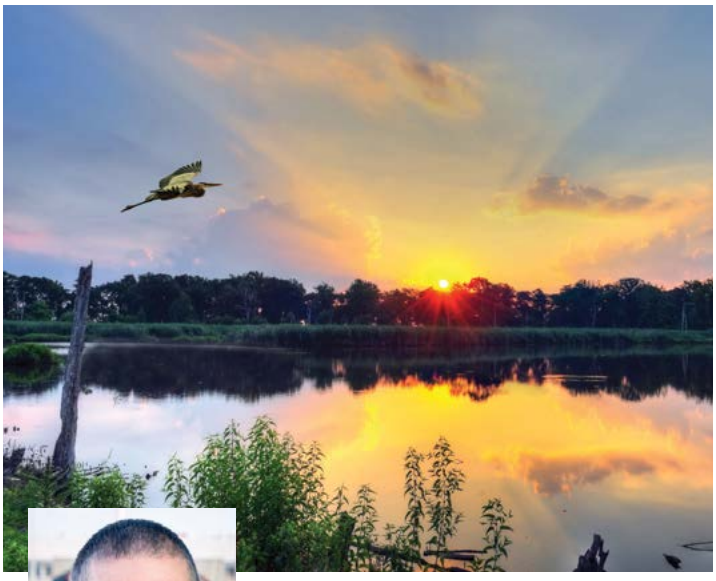
Dana Aunkst, armed with his Penn State chemical engineering degree, has taken on the biggest challenge of his career so far: restoration of the Chesapeake Bay.

The Environmental Protection Agency (EPA) named Aunkst as the new director of the EPA's Chesapeake Bay Program Office (CBPO). As director, Aunkst strategically plans and coordinates activities for restoration in the Chesapeake Bay watershed.

Watersheds act as catchalls for stormwater runoff from all land areas that enters creeks and rivers as it makes its way to the estuary. This runoff also delivers sediment, phosphorous, and nitrogen to the bay.

That's a major problem, especially considering that the Chesapeake watershed is home to more than 3,600 species of fish, plants, and animals, and it encompasses thousands of rivers, streams, and creeks. Eventually, the stormwater runoff results in the creation of "dead zones"—areas in the water with low oxygen caused by excessive nutrients.

"Actions taken by the CBPO partners at the federal, state, and local levels have made a significant and positive impact," he said. "However, significant challenges, including changing environmental conditions and other stressors linked to the growing population and climate change could adversely impact the pace of restoration of both the Chesapeake and the rivers and streams that feed it."



"My Penn State degree in chemical engineering prepared me for a career in solving complex problems."

According to Aunkst, Penn State is a critical component of his ability to take on this project.

"My Penn State degree in chemical engineering prepared me for a career in solving complex problems," he said. "Whether those challenges were related to the science of protecting the environment or the development of policies and strategies for implementation of sound solutions, my engineering degree provided me with the foundation that continues to allow me to be successful as I advance in my career." ■

Engineering alumnus' decades-old work has stood the test of time

by Miranda Buckheit

As an industrial engineering graduate student in the late 1970s, **Muhammad Nawaz** was deep into collecting relevant literature to prove an idea for his minor thesis project. He didn't expect it would continue to resonate nearly four decades later.

To date, Nawaz has accumulated nearly 2,400 citations for his thesis on how to organize an order of tasks, or jobs, for maximum efficiency. His work, titled "A Heuristic Algorithm for the m-Machine, n-Job Flow-shop Sequencing Problem," led to the creation of a widely used research algorithm. Nawaz, who graduated from Penn State in 1980 with a master of engineering degree, was recently recognized by both the editors of Omega, the International Journal of Management Science, and the directors of Elsevier for his high citation count.

"The heuristic was well ahead of its time," said **Soundar Kumara**, Allen E. Pearce and Allen M. Pearce Professor of Industrial Engineering. "This is truly a remarkable achievement. Faculty may not get 2,400 citations for all their publications in their career."

From 1979 to 1980, Nawaz worked tirelessly as a graduate student on his project under the supervision of former professors of industrial engineering E. Emory Enscore Jr. and Inyong Ham. The theory in his paper is popularly known as the "NEH algorithm" for Nawaz, Enscore, and Ham. In addition to the high citation count, the algorithm has become a research topic itself with numerous articles dissecting the practical method.

From jobs in manufacturing plants, aircrafts waiting for landing clearance, customer orders in fast-food restaurants, and programs to be executed within a computer, Nawaz's work has proven to be useful across fields and disciplines. ■

FROM YOUR PRESIDENT

New year, new opportunities: Tailor your PSEAS experience to fit your interests

I hope you and your loved ones had a wonderful holiday season! It is hard to believe that we are in 2020.

With the start of the new year, now is the perfect time to become involved in the Penn State Engineering Alumni Society (PSEAS). There are so many opportunities for College of Engineering alumni to support students at both the college and departmental levels in ways that are hands on, as well as through leadership and strategy. Some examples include mentoring undergraduate students, volunteering at programs and events, participating in speakers bureaus, and serving on the Industrial Professional Advisory Council and the college's Center for Engineering Outreach and Inclusion Advisory Board.

I am proud to highlight that the Penn State Industrial and Manufacturing Engineering Alumni Society recently received the Ned Brokloff Endowment for Alumni Association Affiliate Group Award for Innovation at the Penn State Alumni Association's Volunteer Awards Banquet for its job shadowing program.

Also, I am excited to share that on Dec. 16, Michelle Schafer joined the college's development and alumni relations as director of alumni relations and events. She joined the team after many years of experience in the University's donor relations office.

As director of alumni relations and events, Michelle manages alumni and volunteer engagement efforts for the college and will be closely involved with PSEAS and our Affiliate Program Groups by providing leadership, activity oversight, and strategic growth. She will also lead the planning and execution of current and future college alumni awards and recognition processes such as the Outstanding Engineering Alumni Awards and our PSEAS Awards.

Email alumni@engr.psu.edu if you are interested in getting involved with PSEAS. We hope you will join us as we help the College of Engineering inspire change and impact tomorrow.

For the Glory,

Jane Hrehocik Clampitt

Jane Hrehocik Clampitt, '79 BS ChE
President, Penn State Engineering Alumni Society
clampittjh@verizon.net

THE PENN STATE ENGINEERING ALUMNI SOCIETY

Building an active, engaged community of engineering alumni since 1959

The alumni society provides:

- Membership in a worldwide network of 100,000 engineering alumni.
- Fellowship among engineering alumni, faculty, staff, and students.
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We want to hear from you! **Visit PSEAS** on the web to submit your latest news and to learn more about becoming a member.

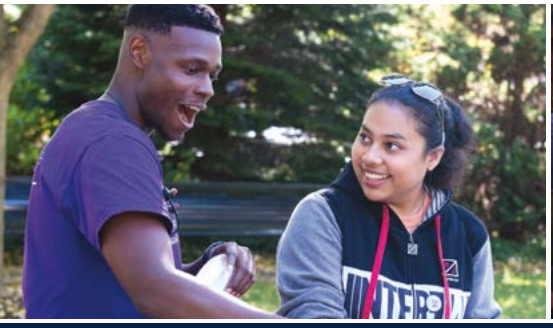
FOR MORE INFORMATION, CONTACT:

Events and Volunteer Engagement
101 Hammond, University Park, PA 16802
alumni@engr.psu.edu

PennState
College of Engineering

The Pennsylvania State University
101 Hammond Building
University Park, PA 16802-1400

Calendar of Events



Feb. 9-15	Engineers Week
Feb. 21	Penn State Engineering Alumni Society Board Meeting
Feb. 21-23	Interfraternity Council/Panhellenic Dance Marathon
Mar. 8-14	Spring Break
Apr. 5-6	Outstanding Engineering Alumni Awards
Apr. 17-19	Blue-White Weekend
Apr. 24-26	Industrial and Professional Advisory Council Meeting
Apr. 30	College of Engineering Design Showcase
May 8-10	Spring Commencement
Jun. 19	Penn State Engineering Alumni Society Board Meeting
Jun. 19-21	We Are Weekend

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JUST BEGINNING

When you include a gift to the Penn State College of Engineering in your will or other estate plans, you create opportunities for generations of engineering students, faculty, and alumni. Our Gift Planning team can help you define your enduring legacy on our campus, create a brighter future for our college, and ensure your estate and your heirs receive the full tax benefits of your gift. To learn more, please contact Penn State's Office of Gift Planning at 888-800-9170 or GiftPlanning@psu.edu, or visit www.giftplanning.psu.edu.