ENGINEERING SOLUTIONS

A PUBLICATION OF THE FRANCIS COLLEGE OF ENGINEERING

ENGINEERING FOR THE ENVIRONMENT

Helping to Preserve Our Planet for Future Generations

FALL 2018
Dear Alumni, Colleagues and Friends,

It is hard to believe that five years have passed since I joined the Francis College of Engineering at UMass Lowell. We published our first issue of Engineering Solutions that fall of 2013 to inform you of the groundbreaking research and high-impact work of our students, faculty and alumni.

Our college has changed significantly since that inaugural issue—an 80 percent increase in bachelor’s degrees awarded, a 40 percent increase in graduate degrees awarded, a 25 percent increase in full-time faculty and more than doubling our research expenditures. Against the backdrop of rapid change and growth, our drive to solve the pressing problems of today and tomorrow while serving as an economic engine for the commonwealth and beyond has not wavered, as highlighted in the pages of this magazine. We are proud to share the stories of how our students, faculty and alumni are impacting the world.

We hope you enjoy reading about them, for we are proud to share the stories of how our students, faculty and alumni are driving to solve the pressing problems of today and tomorrow while partnering with the Francis College of Engineering. I look forward to hearing from you.

Sincerely,

Joseph C. Hartman, Ph.D., P.E.
Dean, Francis College of Engineering

ON THE COVER
The amount of fresh water on earth is limited, and its quality is under constant pressure. According to the World Health Organization, in 2015, about 1.2 billion people worldwide lack access to safe water. UML researchers are tackling a number of important issues—such as identifying drinking water and planning for cleaner water in the future—to ensure the safety and quality of water for drinking and domestic use.

IN THIS ISSUE

1 New Environmental Engineering Degree
2 Clearing a Path to Clean Water
3 Bean Fertilizer from Shell Waste
4 Biogas from Wastewater Sludge
5 REMADE Plastics Recycling Program
6 All-Day Solar Cell
7 Student Gets the Lead Out
8 Attracting Women to STEM Majors
9 An Energy Ambassador
10 Alumna Engineers Success at Nitsch
11 College Highlights

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First-year engineering student Adriyanna Albert is passionate about preserving natural resources and wants a career where she can make a difference in protecting the environment. That’s why she enrolled in the Francis College of Engineering’s new bachelor of science in environmental engineering program.

“Due to my love of the environment, I decided that I wanted a major and a career that was meaningful,” says Albert, a 2018 Lowell High School graduate who was among the first group of students to begin the program when it launched in September. The program will prepare students like Albert for jobs in which they’ll address some of the world’s most pressing problems, from protecting water and air quality to figuring out how to remediate hazardous waste sites.

The program, the first and only public undergraduate degree program of its kind in the state, is taught by faculty who are top-notch researchers in their fields.

“Undergraduate students have opportunities to participate in cutting-edge research alongside graduate students and faculty members,” says Prof. Pradeep Kunap, chair of the Civil and Environmental Engineering Department, whose own research expertise includes intelligent sensing of organic and inorganic contaminants in soil, water and air.

Prof. Clifford Bruell, senior director of the Environmental Engineering B.S. program, led the effort to develop the new degree.

“By applying engineering principles, soil science, biology and chemistry to protect water, soil and air, environmental engineers develop solutions that make an impact on people’s lives,” Bruell says. “When clean water is flowing, we all take it for granted, but when something goes wrong, most likely the person who will feel the problem is an environmental engineer.”

Working with Bruell and Kunap on the proposal was Prof. Xiaoyu (Sally) Zhang and Asst. Prof. Shwee Papajun. Bruell says job opportunities in environmental engineering are on the rise due to population growth around the world, particularly in areas where people are living with limited resources. In the United States, environmental engineering jobs are expected to grow 8 percent between 2016 and 2026, according to the U.S. Bureau of Labor Statistics.

“Private companies, municipalities and government organizations need environmental engineers to solve complex problems related to water treatment, waste disposal and air pollution prevention to improve public health,” Bruell says. “They also solve environmental challenges related to climate change.”

For Albert, the degree will help prepare her to address those challenges.

“This career path is important to me because I understand that we’re harming the earth,” she says. “There are countries that lack clean water and even small parts of our own country that have been introduced to varied types of pollutants. Everyone needs clean water and land to survive; therefore, my job will always be needed.”

In addition to foundation courses in writing, math and sciences, the program will include classes in energy and sustainability, groundwater hydrogeology and remediation, biological processes in environmental engineering, air quality, and solid waste engineering. During their final semester, seniors will complete an in-depth capstone design project that solves an environmental problem.

Examples of possible projects include teams of students producing a conceptual design of the components in a biological wastewater treatment plant or designing a groundwater remediation system to clean an aquifer.

Students in the program will gain professional experience through the university’s networking partnerships with numerous national and local environmental engineering firms.

Students are expected to find internships, co-op placements and job opportunities with Massachusetts environmental firms such as CDM Smith, Weston & Sampson, Woodard & Curran, TGE & Bond, Kleinfelder, Santee and GDA GeoEnvironmental Inc. and others. Possible public sector employers in the area include the U.S. Environmental Protection Agency Region 1, the U.S. Army Corps of Engineers and the Massachusetts Department of Environmental Protection.

Photo above: Civil and environmental engineering graduate student Connor Sullivan collects and tests water samples from a site in Massaehwitts where groundwater has been contaminated with heavy metals.

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UML Launches First Public Environmental Engineering Bachelor’s Program in Massachusetts

Karen Angelo
While working on her thesis in the central Philippines in 2004, Sherie Pagsuyoin watched villagers walk for miles to collect water for drinking, cooking and washing. These living in more remote areas had to wait for water to be delivered via indigenous dugout canoes called “banka.” Although access to clean drinking water has since improved significantly in the Southeast Asian nation, there is still a lot of work to do to deliver reliable and safe water to a greater number of people, says Pagsuyoin, now an assistant professor in UMass Lowell’s Civil and Environmental Engineering Department.

That’s why she decided to dedicate her life to researching ways to improve access to safe, clean water.

“I want to contribute to solving this universal problem,” says Pagsuyoin, who has a master’s degree in environmental engineering from the University of the Philippines, Diliman, and a doctorate in civil and environmental engineering from the University of Virginia.

“Water problems don’t recognize political or geographic boundaries; a problem in one area impacts another in many ways,” she notes.

In fact, in 2010, the U.N. General Assembly recognized access to safe, clean water and sanitation as a basic human right.

But according to the World Health Organization, in 2015, at least 2 billion people worldwide use drinking water sources contaminated with human waste, which can transmit infectious diseases such as cholera, diarhrea, hepatitis A, typhoid and polio. Drinking contaminated water is estimated to cause more than 500,000 deaths, many of children, due to diarrhea each year. In addition, waterborne parasites, toxic chemicals and radiological hazards pose serious threats to drinking water.

In response, Pagsuyoin, along with teams of other faculty researchers from the Francis College of Engineering—led by Prof. Pradeep Kurup and Asst. Prof. Onur Apul of civil and environmental engineering and Asst. Prof. Ertan Agar of mechanical engineering—have embarked on projects that combine sustainability with cutting-edge technology to address these problems and help provide people with clean, easily accessible water.

Pagsuyoin is exploring the use of the seeds of Moringa oleifera, a fast-growing, drought-resistant tree widely cultivated in the tropical and subtropical regions of Africa, Asia and Latin America, for treating drinking water. Agar, Apul and Pagsuyoin are also designing an electrochemical system for removing trace pollutants in drinking water. These projects are in collaboration with Prof. Hongwei Sun of mechanical engineering and Earl Ada, Ph.D., of the university’s Materials Characterization Laboratory.

Very Persistent Chemicals

Americans enjoy one of the cleanest, safest and most reliable supplies of drinking water in the world. Yet traces of contaminants can still lurk in tap water from public water systems. These can range from microorganisms to disinfectants and disinfection byproducts, inorganic and organic chemicals and radionuclides.

A Sustainable, Eco-friendly Way of Disinfecting Water

In many parts of the world, untreated water from streams, rivers, ponds, lakes and the ground is the primary source of drinking water, particularly in low-income regions, according to Pagsuyoin.

“In these communities, the need for a low-cost, readily accessible water treatment method is especially critical in reducing incidences of waterborne diseases,” she says.

Pagsuyoin collaborated with researchers from De La Salle University in Manila, the Philippines, and George Washington University in Washington, D.C., to investigate the use of crushed moringa seeds for treating and disinfecting contaminated water via adsorption.

“Moringa seeds are known to contain proteins that have antibacterial and antifungal properties,” she says. “One tree will produce enough seeds to purify about 6,000 liters [1,600 gallons] of water. They are as effective as alum, and can reduce hardness and arsenic in water.”

However, the seeds also contain soluable organic matter that are released into the treated water and can serve as food for pathogenic microorganisms, causing them to regrow.

“The downside is that water treated by powdered moringa seeds cannot be stored for long periods of time,” notes Pagsuyoin. To address this issue, researchers tested carbon-based adsorbent materials—activated charcoal, rice husk ash and ceramic beads—that would bind the used protein tightly onto the materials’ surfaces and keep the unwanted organics from being released into the water.

“We observed the highest adsorption capacity with activated charcoal, followed by rice husk ash and then ceramics,” says Pagsuyoin. The team also used a nontoxic organic form of E. coli bacteria to show that the immobilized seed protein still retained its antibacterial property.

“The seed protein/activated carbon adsorbent combination can be used as a filter medium for creating a low-cost, portable biofilter,” says Pagsuyoin. This application is still under development.

Pagsuyoin and graduate student Alarayan Rojasanuran are currently investigating other low-cost adsorbent membranes for removing trace pollutants in drinking water. These projects are in collaboration with Prof. Handewi Sun of mechanical engineering and Earl Ada, Ph.D., of the university’s Materials Characterization Laboratory.

Continued

Photo above: Civil and environmental engineering Asst. Prof. Sherie Pagsuyoin, right, and PH.D. student Alarayan Rojasanuran use liquid chromatography tandem mass spectrometry to analyze water samples for traces of organic pollutants.

Photo top right: The seeds from the Moringa oleifera tree contain proteins that can be used to clarify drinking water and kill harmful microorganisms.
A TASTE FOR SENSING DANGER

Kurup, who chairs the Department of Civil and Environmental Engineering, cites the recent issue of Flint, Mich., as an example of how even developed countries can face problems with water contamination. The problem in Flint was caused by insufficient corrosion treatment of the water supply, which allowed lead to leach from lead water pipes into the city’s drinking water, exposing more than 100,000 residents to the neurotoxin.

Flint’s drinking water had levels of lead hundreds of times higher than the EPA limit,” Kurup says.

Waste products from refining and industrial manufacturing as well as heavy use of pesticides have resulted in the accumulation of heavy metals in surface water, groundwater and soils in many cities and farms across the country. Long-term exposure to these pollutants through direct contact or food supply has been linked to health problems involving the skin, liver and also as the gastrointestinal tract and central nervous system.

To address the need to develop effective technologies for the effective removal of PFOS and PFOA from natural water, Kurup and geotechnical engineering Ph.D. studentsConnor Sullivan and Susom Dutta will use the electronic tongue to rapidly test and analyze traces of heavy metals, on-site and in real time.

The E-tongue uses arrays of highly sensitive microelectrodes coupled with artificial intelligence to “taste” water and soil samples and to detect—and identify—heavy metals present, such as arsenic, cadmium, copper, chromium, lead, manganese, nickel, silver, thallium and zinc.

Research and development of E-tongue has been supported with grants from the National Science Foundation totaling nearly $740,000. "The E-tongue will be simpler, faster, safer and more cost-effective compared with the traditional methods," says Kurup. “It should cut the cost associated with field sampling and lab analysis by more than 50 percent.”

"Our team will lead the exposure of lab personnel to contaminated soil and water by avoiding the need for drilling and collecting samples. Since site investigators will get the test results more quickly, they can provide regulatory agencies with critical information needed for taking appropriate actions,” says Kurup. The researchers will use the funds to prove their concepts and to further test the technical and economic feasibility of their design.

UML Lowell won funding for its proposal to create safer, effective and nontoxic fertilizer from an abundant resource—in this case, the shell waste produced by processing crustaceans such as crabs, lobsters and shrimp. The group will develop a hydrothermal process to make chitin, a natural enhancer for agricultural applications. According to the UML team, shell waste consists of more than 100,000 residents to the neurotoxin. amount of energy needed to produce ammonia, a key ingredient in making synthetic fertilizers.

Wong and his students hope that their hydrothermal reactor system can be used to address these issues and convert crustacean shell waste into high-value, nitrogen-rich “bacterial” soil enhancer for agricultural applications. "Our goal is to improve the lives and advance the economy of seafood processors and agricultural farmers by introducing a new source of revenue based on shell-derived fertilizers, as well as to help preserve the environment by reducing landfill and energy consumption," Wong says. This year’s P3 award winner showcased their projects at the National Sustainable Design Expo, held in April during the USA Science and Engineering Festival in Washington, D.C.

The other P3 winners include teams from Cornell University, Georgia Tech, Purdue University, the University of California Davis and UC Riverside, the University of Texas, Arlington and the University of Washington. Their projects range from harnessing solar power to disinfect drinking water to using beetle larvae to break down Styrofoam into a hydrothermal reactor system can be used to address these issues and convert crustacean shell waste into high-value, nitrogen-rich “bacterial” soil enhancer for agricultural applications. According to the UML team, shell waste consists of more than 100,000 residents to the neurotoxin. amount of energy needed to produce ammonia, a key ingredient in making synthetic fertilizers.

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Biogas Production

BREAKTHROUGH INVENTION WILL INCREASE BIOGAS FUEL PRODUCTION FROM WASTEWATER SLUDGE

By Edwin L. Aguirre

Each year, the United States produces more than 12 million tons of sludge—the thick mixture of solid and liquid matter left over from processing wastewater and raw sewage in treatment plants. And it costs taxpayers roughly $2 billion annually to safely handle, treat and dispose of the unwanted byproduct. Massachusetts alone produces 620,000 tons of sludge every year and uses up to 10 million watt-hours of energy to process the waste.

Massachusetts alone produces 620,000 tons of sludge every year and uses up to 10 million watt-hours of energy to process the waste. There is a lot of wastewater sludge in the country, and it is very expensive to deal with it,” says Asst. Prof. Onur G. Apul of the Department of Civil and Environmental Engineering.

According to Apul, only half of the sludge gets converted to biogas fuel (mainly methane); the rest is disposed of in incinerators and landfills. Apul and a team of UML researchers have invented a more environmentally friendly, efficient and potentially revenue-generating alternative. They have developed a single-step thermal treatment technique that increases biogas production by up to 300 percent while reducing the amount of residual sludge that goes into landfills by 20 to 30 percent.

“The technology—which uses microwave radiation together with nanofiber additives—is new, and we applied for a patent for it this year through the university’s Office of Technology Commercialization,” says Apul. “We can contribute to clean-energy production and also help treatment plants to discharge less waste because more sludge can now be converted to biogas.”

Aside from Apul, the research team includes Prof. Xiaoqi (Jackie) Zhang of the Department of Civil and Environmental Engineering, Ph.D. student Arsalan Khalid (see page 12) and undergraduate student Ritchie LaFaille.

The project, which is funded with a one-year, $65,000 grant from the Massachusetts Clean Energy Center’s Catalyst Program, is a collaboration with the Lowell Regional Wastewater Utility, which serves the city of Lowell as well as the surrounding towns of Chelmsford, Dracut, Tewksbury and Tyngsboro.

“The Deer Island Wastewater Treatment Plant on Boston Harbor features a dozen 130-foot-tall, egg-shaped digester tanks where anaerobic bacteria break down the sludge’s organic matter and convert it to methane. About half of the sludge produced is digested by the bacteria, and the remaining sludge goes to a landfill.

The researchers’ method calls for heating the sludge with microwave radiation (similar to what is used in kitchen microwaves) before it goes to the digester. The radiation breaks down the cell walls of microbes, making them more susceptible to water and decreasing dumping of the cells. The freed sludge then goes to the digester.

To make the process more efficient, the team adds carbon-based dielectric (nonconducting) nanofibers to the sludge, dramatically speeding up the microwave heating. The high temperature increases the sludge’s concentration of soluble organic compounds that get converted to methane in the digester.

AN INNOVATIVE SOLUTION

In a treatment plant, the wastewater is first treated with biological methods, using aerobic microorganisms in a process called activated sludge. Gravity then separates water from the waste sludge, and the water is disinfected to kill any pathogens. The treated, clean water is typically discharged to a nearby river or lake.

The sludge is sent for further processing into a digester; a huge tank where anaerobic bacteria break down the sludge’s organic matter and convert it to methane. About half of the sludge produced is digested by the bacteria, and the remaining sludge goes to a landfill.

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“Aside from improving the digester’s methane production by these times, our method offers other advantages, including low-energy requirement and safe and easy-to-display microwave irradiation, and no additional chemicals are needed,” says Apul.

He says the microwave-nanofiber treatment method may reach, and even surpass, the efficiencies of other commercial techniques that are currently used to hydrolyze sludge—with ultrasound, ozone, alkaline/acid chemicals and thermal (non-microwave) treatment, among others.

REVENUE-MAKING POTENTIAL

At treatment plants, the methane produced is captured and used to heat the digesters and keep the tanks at the appropriate temperature. Any excess methane is usually burned off into the atmosphere.

The high-tech Deer Island Wastewater Treatment Plant on Boston Harbor, operated by the Massachusetts Water Resources Authority (MWRA), does not burn off surplus methane, according to Apul. “This one-of-a-kind facility in the state has a system where excess methane is piped to boilers to heat buildings onsite and generate about 3 million watts of electricity via steam turbine generators,” he says. “This saves the MWRA approximately $15 million annually in heating and electricity costs.”

The team’s vision is to turn the business of wastewater treatment into a self-sustaining, and even profit-making, enterprise by selling the surplus methane-generated electricity to the local power grid. Aside from municipal sewage treatment plants, other sources of sludge that contain high organic carbon include the sugar industry, manure from farms, agricultural discharges and the food-waste industry.

“There is a huge revenue potential for our microwave-nanofiber treatment method,” says Apul. “Depending on the market needs and technology readiness, our team can start a spinoff company or license the technology to an existing microwave application company.”

THE DEER ISLAND WASTEWATER TREATMENT PLANT ON BOSTON HARBOR FEATURES A DOZEN 130-FOOT-TALL, EGG-SHAPED DIGESTER TANKS WHERE ANAEROBIC BACTERIA BREAK DOWN THE SLUDGE’S ORGANIC MATTER AND CONVERT IT TO METHANE GAS AND OTHER BYPRODUCTS.

Image 1: Edwin L. Aguirre
INCREASE PLASTICS RECYCLING

BY KATHARINE WEBSTER

When it comes to recycling, getting people to participate is just the first challenge. Turning that recyclable waste into high-quality products is a much bigger problem.

Assoc. Prof. Meg Sobkowicz-Kline of the Department of Plastics Engineering is tackling that challenge as the university’s representative to the REMADE (Reducing Embodied Energy And Decreasing Emissions) Institute.

“We’re trying to increase the recyclability of plastic waste streams,” Sobkowicz-Kline says.

The REMADE Institute was created two years ago under the Manufacturing USA initiative, which brings together universities, corporations and government agencies on research projects that involve innovation in manufacturing.

REMADE recently awarded its first round of grants, including $200,000 to Sobkowicz-Kline and researchers from Michigan State University, the National Renewable Energy Laboratory, the American Chemistry Council and Unilever. They plan to study whether layered films, like those used for packaging food, can be separated into their component materials for recycling, or whether chemical processing and high-speed extrusion can turn some of the films into recycled products, such as adhesives and coatings.

Improvements in plastics recycling are especially urgent because China banned nearly all imports of recyclable plastics at the beginning of the year, saying the blocks of crushed bottles and containers from other countries were too often contaminated with other undesirable materials, such as glass and metal.

The U.S. sends about one-third of its recyclable materials overseas, and China was the biggest consumer before Jan. 1. So now American companies are scrambling to find other markets—and increase the U.S. market, too. In the meantime, some of the plastics Americans put in their recycling bins have been showing up in Chinese landfills.

But the amount of waste generated is enormous, since virtually every instrument is covered in plastic that’s discarded after each procedure and patient.

“Medical packaging holds a lot of promise,” Sobkowicz-Kline says. “It’s a very clean waste stream.”

Sobkowicz-Kline says she is looking for more partners in the health care industry, as well as UMass Lowell researchers, to come up with proposals for REMADE that meet the institute’s goal: reducing the waste stream by recycling more materials using energy-efficient methods. REMADE isn’t limited to plastics—the institute is also seeking proposals for better recycling of metals, electronic waste and fibers.

“This is a huge opportunity,” she says. “Anybody can apply for this.”

To learn more about issues in plastics recycling, visit Sobkowicz-Kline’s educational website, www.plasticsfacts.com.

Sobkowicz-Kline’s educational website, www.plasticsfacts.com

"In plastics, our paradigm has been: Collect it, melt it down and reuse it," Sobkowicz-Kline says.

Other plastics are compounds made by mixing materials. Still others are layered, often with paper or foil, like the food wrappings used for many grocery products. These are nearly impossible to recycle using current technology.

Finally, there’s the problem that China complained of: contamination. Even the best-quality plastics are difficult to recycle if they’re not thoroughly sorted and other materials end up in the mix.

Sobkowicz-Kline says high-speed extrusion may keep some mixed materials together or reduce the impact of contamination, compared to the standard extrusion process now used by most manufacturers. High-speed extrusion also uses less electricity, reducing emissions from fossil fuels and reducing energy costs for manufacturers, she says. That’s key to getting industries to adopt it.

Out of REMADE, Sobkowicz-Kline and plastics engineering Asst. Prof. Javier Vera-Soriano have obtained an $18,000 grant from the Health Care Packaging Recycling Council for a test project to see if they can apply high-speed extrusion to recycling the plastic wrap that hospitals and medical offices use to keep medical instruments sterile. The wrap never touches patients, but the amount of waste generated is enormous, since virtually every instrument is covered in plastic that’s discarded after each procedure and patient.

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Professor to Create An All-Day Solar Cell

Invention Will Provide Electricity Day and Night

Solar energy is the cleanest, safest and most abundant renewable source of energy available. And solar cells, also called photovoltaic (PV) cells, can convert this free and unlimited radiant energy from the sun directly into electricity to power our lights, electronics and household appliances. But how do you harness solar energy at night or when it’s cloudy? The most common solution is to store the electricity generated by the solar cells in rechargeable batteries for later use.

Mechanical engineering Assoc. Prof. Fuqiang Liu thinks he can make solar energy more attractive to homeowners and businesses by simplifying the energy generation/storage process, improving its efficiency and reducing cost. His solution? An all-day solar cell that generates and stores electricity simultaneously during the day. This allows it to power lights for up to five hours at night, without the need for an external storage battery.

“Our portable, compact all-day solar cell relies on a dual-function electrode that generates and stores electricity at the same time,” says Liu. “This eliminates the need for expensive rechargeable batteries used in conventional PV systems, which steeply increase the dollar-per-watt price of the electricity produced. Our proposed solution will significantly reduce both the capital and operating costs as well as improve the system’s safety and reliability.”

To provide electricity under darkness for longer than five hours, more materials (i.e., larger PV panels) can be used with the solar cell, he says.

Because of the cell’s unique electron-storing mechanism, the electronics’ storage (charge) and release (discharge) can be automatically triggered by ambient light condition.

“This maintenance-free feature of the all-day solar cell would be useful in the electrification of remote rural areas,” notes Liu.

Liu anticipates a 30 percent reduction in cost compared to traditional PV systems. For example, for a 5-kilowatt solar system, he estimates that a homeowner will save more than $9,000 in installation with the all-day solar cell system compared to a traditional PV system. If successful, he plans to collaborate with public agencies and private industry to expand and scale up the capability of the technology and bring it to market.

Liu’s work is funded with a five-year, $416,000 “CAREER” award from the National Science Foundation (NSF). This highly competitive annual program recognizes the nation’s best young university faculty-scholars “who most effectively integrate research and education within the context of the mission of their organization.”

Liu also received a one-year, $15,000 grant from the NSF to explore the commercial potential of his new solar cell.

Last year, the Massachusetts Clean Energy Center awarded Liu $65,000 through its Catalyst Program, which enables early-stage researchers to develop promising products and technologies in the fields of clean energy and clean water and help bring them to the marketplace.

“As renewable energy sources become more prevalent, the ability to store solar energy can provide a sustainable solution to the world’s growing energy shortage.”

Liu calls his all-day solar cell an “all-vanadium photo-electrochemical storage cell.”

“Unlike conventional rechargeable batteries, which convert solar energy first into electricity and then store this electricity into chemical energy for later use, our all-vanadium photo-electrochemical storage cell stores solar energy directly in the form of chemical energy, increasing its efficiency and capacity,” he says. “At night, the stored energy is converted to electricity using a flow battery.


Assisting him with the lab research are postdoctoral associate Zi Wei and Ph.D. students Husain Almakram and Guangzhou Lin. Liu is also collaborating with UMass Lowell mechanical engineering Asst. Prof. Ertan Agar as well as Prof. Krishnan Rajeshwar of the University of Texas at Arlington.

As renewable energy sources become more prevalent, the ability to store solar energy can provide a sustainable solution to the world’s growing energy shortage. Our research, if successful, can effectively change the way we utilize the inexhaustible energy from the sun,” says Liu.
Lead Ex-Filter, which uses nanotechnology to remove lead from the water. Designed by research partner Lewis Rowles, the technology was inspired by the fact that lead from old pipes corroded in the water supply of Flint, Michigan. The nanomaterial, called a fibrous, nanocomposite material, is highly efficient at removing lead from water, and its fibrous structure allows for easy attachment to water pipes. The technology has the potential to be used in a variety of applications, including in homes, schools, and hospitals.

A DISCIPLINED AND ORGANIZED RESEARCHER

Khalid, a research and teaching assistant in the Department of Civil and Environmental Engineering, is a Ph.D. candidate in civil engineering. He earned his master’s degree in chemical engineering from King Fahd University of Petroleum & Minerals in Saudi Arabia and a bachelor’s degree in polymer and petroleum chemical engineering from NED University of Engineering & Technology in Pakistan. He arrived at UMass Lowell in September 2017, and works as a research assistant with Onur Apdu, assistant professor of civil and environmental engineering.

Khalid says he is passionate about solving problems and improving the environment. His research focuses on developing new technologies to remove lead from drinking water. He believes that nanotechnology can be a powerful tool in addressing this issue, and he is excited about the potential of his research to make a real impact in the community.

Khalid’s research is funded by a National Science Foundation grant, and he hopes to continue his work in this field after he graduates. He is also involved in a number of other projects and activities, including volunteer work and teaching. He is currently working with a team of researchers to develop a new technology for removing lead from water, and he is excited about the potential of this work to make a real difference in the lives of people who are affected by lead contamination.

Khalid’s research is just one example of the innovative work being done at UMass Lowell. The university is home to a number of talented and dedicated researchers, and it is committed to supporting their work and helping them to make a positive impact on the world. The university is well-positioned to continue its tradition of excellence in research and to continue to make important contributions to the fields of science, technology, and engineering.
John Lavelle ’83 Leads GE’s Offshore Wind Energy Business

“Offshore wind is the fastest-growing renewable technology out there. It’s grown five times larger in just the past 20 years and will increase another five times by 2030.”

“Y”ou’re killing your career,” John Lavelle ’83 remembers friends telling him in 1986, when he accepted a post in his early days with General Electric to go to Schenectady, N.Y., to overhaul turbines and trouble-shoot problems. The role was “a lot like a mechanic,” he says. He was three years out of UMass Lowell with a bachelor’s degree in mechanical engineering, and had spent all three of those years working on company projects in small industrial cities like Lynn, Mass., and Rotterdam, N.Y. “It must have seemed that I’d go into that job—and that I’d earn my way to something bigger.”

But looking back, Lavelle says, he’s pretty sure he made the right choice: “I got to see things, early on, from the customers’ perspective. That was critical for me later. I learned a ton those two years in Schenectady.”

The company must have seen it that way, too. For most of the 35 years since, Lavelle’s GE postings have been far more ambitious and way farther afield: China, Indonesia, Singapore and France, interspersed with periods in Atlanta and Houston. Moving across much of Asia through the 1990s, he managed the company’s energy interests first in Taiwan, then in all of China—where he opened new offices throughout the country, expanding GE’s presence several-fold—and finally in Southeast Asia, where he had the same success.

During his posting in Atlanta as general manager of global marketing for GE Energy Services, beginning in 2003, that sector’s business increased from $2 billion to $7 billion in the space of six years. Then, from 2008 to 2012, as vice president of global projects operation for GE Energy, he managed a $75 billion portfolio of customer sites, building power plants in every major country in the world.

And the country was only four years removed from the Tiananmen Square student protests. In Jakarta from ’95 to ’99, he had to work within a system riddled by rampant corruption. All of it, he says today, was “a definite eye-opener for a 30-something, blond-haired, blue-eyed guy from Holyoke, Massachusetts.”

Always, though, the one big constant was movement: a family that kept growing—he and Lisa, and four kids born in different countries—and a job that wouldn’t stay put. “Taiwan, Jakarta, Singapore, always somewhere else. I’m gone 200 days a year.” He wishes sometimes it could be different, but with customers in every major country in the world, there’s not much chance of that. “I’ve got to be able to say to them, ‘I’m where you need me to be.’ That’s the only way it works.”

Outside of his instincts on customer service, Lavelle says, there may be no factor more key to his success than the years he spent at UMass Lowell. “Some of the best engineers in the world come to GE—from Stanford, MIT, Caltech, all over,” he says. “But with the training I had at UMass Lowell and the knowledge it gave me, I never for a minute felt I couldn’t hold my own with the best of them.”

Lavelle is based today in Nantes, France (though you’ll rarely find him there, or anywhere else, he says, “for much more than three days at a time”), facing what seems his most ambitious challenge yet. As CEO since 2016 of GE Renewable Energy’s Offshore Wind business, he leads the company’s mission to pay a $400 million investment into the deployment of the world’s largest and most powerful offshore wind turbine: the Haliade-X 12 MW, which rises 260 meters above sea level, roughly four-fifths the height of the Eiffel Tower. One Haliade-X 12 MW turbine, with its three 107-meter-long blades, would be capable of providing clean power to up to 16,000 European homes.

The key question, of course, is whether the world is ready for it. John Lavelle believes it is. “It’s going to be a long-cycle project,” he concedes, but change is definitely coming—and offshore wind is the fastest-growing renewable technology out there. “It’s grown five times larger in just the past 20 years and will increase another five times by 2030.”

Coal as an energy source, he says, “is definitely on the decline. Nuclear, too. Look at what’s happened with China. Over the past four years or so, there’s been a noticeable change in the environment there—less coal, more wind, more solar. It’s picking up every year. No one would have predicted this pace of change, but it’s happening.”

Image: GE Renewable Energy
Nitsch Engineering provides civil, structural and transportation engineering services, and was recognized by the Massachusetts Department of Transportation for its research on "flexible electronics for transportation" with the Massachusetts Medical Device Development Center. The company has launched a low-cost diagnostic platform for accurate gait analyses and body movement measurements. Nitsch Engineering is leading the UML effort on the Center for 3D Printing of 3D Materials (3DP3M) project, in partnership with the University of Connecticut, the University of Maine, the University of Massachusetts Lowell, the University of Connecticut, and in partnership with the University of California-based ExThera Medical (Redwood City, Calif.). The company has received a $2.5 million grant to a consortium of research institutions, including UMass Lowell, the University of Maine, the University of Connecticut, and in partnership with the University of New Hampshire and the Massachusetts Clean Energy Center.

Faculty Highlights

Alumni Focus

Building better communities

Engineering:When a great design meets a great engineer.

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