The University of Texas at Austin
Hildebrand Department of Petroleum and Geosystems Engineering
Cockrell School of Engineering

ENERGY•ONE

2023

POWERING TOMORROW
ALUMNI AND STUDENTS ON THE LEADING EDGE OF ENERGY

PAGE **12**

CHAIR'S CORNER
LEADING
THE WAY

The Hildebrand Department of Petroleum and Geosystems Engineering celebrated a successful fall semester, with faculty and students continuing to attain recognition for their research. Our professors won three of the Society of Petroleum Engineers' most prestigious international awards *(page 9)*, and several graduate students were recognized at conferences across the country *(page 6)*. We also welcomed 120 freshmen to UT PGE in September; hosted our annual Distinguished Alumni Awards in November *(page 20)*; and retained our position as the No. 1 undergraduate petroleum engineering program in U.S. News & World Report's latest rankings. (Our graduate petroleum engineering program is still ranked No. 1 as well.)

The department's momentum continues unabated this spring. We recently hosted our third annual Energy AI Hackathon *(page 16)* in which students solve a real-world energy problem using engineering data analytics and collaborate with expert judges and mentors. Faculty members are launching research projects funded by new grants and industry-sponsored partnerships in carbon capture, utilization and storage (CCUS), methane emissions reduction, and more *(page 10)*. And we're finalizing a UT PGE summer study abroad trip to Croatia, our first since the COVID-19 pandemic began.

As you'll see in this issue of *Energy One*, UT PGE continues to educate petroleum engineers who go on to become innovators and experts in not only oil and gas, but also new technologies that are quickly becoming part of the evolving global energy landscape. I feel certain, now more than ever, that the research and teaching done in our labs and classrooms — in our legacy CPE building and the new Gary L. Thomas Energy Engineering Building — will continue leading the way to sustainable, abundant and reliable energy for the future.

Hook 'Em and Enjoy Reading!

JON E. OLSON, DEPARTMENT CHAIR
LOIS K. & RICHARD D. FOLGER LEADERSHIP CHAIR
COCKRELL FAMILY CHAIR IN ENGINEERING #17

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STILL NO. 1 ... TIMES 2

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Assistant Professor Wen Song has received a prestigious CAREER Award from the National Science Foundation.

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Alumna in Residence Karen Hagedorn (BSPE 1986) discusses her 30-year career, why she loves mentoring students and what's next for the energy industry.

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DEEP DIVE

Jacob Mehr (BSPE 2023) started SCUBA diving when he was 10. He and his dad would spend long afternoons among the carp and catfish in the quarries near their home in Dallas, Texas. Six years ago, Mehr decided to take his hobby a flipper kick further when he began exploring underwater caves.

While diving itself requires extensive practice and mastery of a unique set of skills, cave diving adds new challenges. Though cave systems have been around for thousands of years, they are fragile environments that can shift or collapse with little warning. Large, open areas flowing with crystal-clear water can narrow into intricate networks of pitch-black passages. Even with flashlights, clay or silt can make it impossible to see. And if anything goes wrong, the trek to the surface can take hours.

Sound risky?

It depends on how you look at it, says Mehr.

"It's arguably the most dangerous kind of diving. But it isn't about risk taking — it's about risk management," he says. "You spend hours and hours training so you know all the protocols backwards and forwards."

Mehr usually carries a minimum of 150 pounds of diving equipment, plus a heavy-duty mirrorless camera, a wide-angle 16-millimeter lens and several strobes to photograph cave geology and aquatic life, like limestone stalactites, blind salamanders and pigment-less fish. "Unlike how Hollywood portrays it," he says, "there are no sharks lurking in the caves searching for divers to eat."

In addition to diving for fun, Mehr has worked with Jackson School of Geosciences Professor **Bayani Cardenas** as his dive partner on research tracking seasonal water turnover in Lake Travis to assess the lake's health. In fact, Mehr understands better than most the ecological connections between an underground or underwater ecosystem and the humans who live, work and build above it. That's partly why he chose to major in petroleum engineering.

"In the oil and gas industry, it's crucial to preserve groundwater aquifers from contamination," he says. "That means solid engineering when it comes to all processes, from drilling and completions, to production, and eventually the plugging and abandonment of wells."

Not to mention preserving the underlying geology for future explorers. ■

"IT'S ARGUABLY THE MOST DANGEROUS KIND OF DIVING. BUT IT ISN'T ABOUT RISK TAKING — IT'S ABOUT RISK MANAGEMENT."

—Jacob Mehr (BSPE 2023)

PGE UPDATE

HILDEBRAND DEPARTMENT OF PETROLEUM AND GEOSYSTEMS ENGINEERING

STILL NO. 1 ... TIMES 2

The Hildebrand Department's undergraduate petroleum engineering program maintained the No. 1 position in the 2022–2023 U.S. News & World Report rankings released in September. Undergraduate engineering program rankings are based solely on the results of peer assessment surveys.

UT PGE's graduate program in petroleum engineering also ranked No. 1 in the graduate rankings released in March, a position the program has held continuously since 2003. Graduate engineering specialty rankings are based on peer assessments by department heads in each specialty area.

The University of Texas at Austin's Cockrell School of Engineering ranked No. 9 among the nation's undergraduate engineering programs in the most recent report. In addition to petroleum engineering, its aerospace, chemical, civil, computer, environmental, mechanical and software engineering undergraduate programs all ranked in the top 10. The Cockrell School rose to No. 6 in overall graduate engineering program rankings, with all programs in the top 25.

STUDENTS RECOGNIZED FOR RESEARCH

Three UT PGE graduate students recently took home top prizes at national and international conferences for their energy research. Congratulations to the following winners and their faculty advisors!

Student: Sheila Gerardo (MSPE 2021, PhD PE 2024)
Paper: "From Ashes to Riches: Microscale Phenomena Controlling Rare Earths Recovery from Coal Fly Ash"
Conference: 2022 Clean Energy Education and Empowerment (C3E) Symposium
Award: Best Poster Presentation
Supervisor: Assistant Professor **Wen Song**

Gerardo's research was also published in the multidisciplinary journal *Environmental Science and Technology* (ES&T) in October.

Student: Isa Silveira de Araujo (PhD PE 2024)
Paper: "Quantifying Interfacial Interactions Between Minerals and Reservoir/Fracturing Fluids"
Conference: 63rd Annual Society of Petrophysicists and Well Log Analysts Symposium
Award: Best Poster Presentation, 2nd place; 2022–2023 SPWLA Distinguished Speaker
Supervisor: Associate Professor **Zoya Heidari**

Student: Moisés Velasco-Lozano (PhD PE 2023)
Paper: "Modeling of Transport of Chemical Tracers in Two-Phase Flow in Porous Media for Oil Recovery Applications: Solutions for Advective- and Capillary-Dominated Systems"
Conference: 2022 Society of Petroleum Engineers International Annual Technical Conference and Exhibition
Award: Best Paper, PhD division, 2nd place
Supervisor: Professor **Matt Balhoff**

STEM TEACHERS BECOME STUDENTS AT ESTI

About 20 Texas high school STEM teachers spent five days collaborating over the summer for UT PGE's annual Energy Science and Technology Institute led by Associate Professor of Instruction **Hilary Olson.** Over the course of the week, teachers participated in hands-on activities and labs, faculty-led discussions, and peer brainstorming and breakout sessions on energy topics including the global energy marketplace, enhanced oil recovery, and carbon capture and storage. They also experienced ESTI's new Energy Excursions curriculum, a series of free online courses that align with Texas Essential Knowledge and Skills (TEKS) and College Board standards. The series was developed by UT PGE subject matter and educational experts specifically for high school STEM students and teachers. Toward the end of the week, ESTI participants toured Weiss Energy Hall at the Houston Museum of Natural Science and the Ocean Star Offshore Drilling Rig Museum and Education Center in Galveston.

"Even having some experience teaching environmental science, I learned a lot at the institute and plan to implement much of it into my school through some hands-on workshops in the spring," says Brownwood ISD Secondary Curriculum Coordinator **Kristina Owen** *(center)*. "My favorite part of the week was the debate. We utilized all our knowledge gained from prior lessons to determine what energy sources we would keep, change or get rid of in Texas to be more efficient using and producing less water."

HAGEDORN JOINS ALUMNI IN RESIDENCE PROGRAM

Karen Hagedorn (BSPE 1986) joined UT PGE last fall as part of the Alumni in Residence program, which brings experienced alumni to campus to mentor and teach students. Hagedorn, a longtime Exxon executive who retired as president of ExxonMobil Alaska Production, held office hours with students to talk about her experiences living and working abroad, adapting to industry challenges, the importance of internships and more. She also hosted "Uncertainty and Opportunity — Reflecting on a Career in Energy," a panel with fellow Class of 1986 alumni **John Hicks, Kirk Houston, Jon Hughes** and **Dianna Sommer.**

Hagedorn became a Society of Petroleum Engineers Distinguished Member in 2014. She was named a UT Austin Cockrell School of Engineering Distinguished Graduate in 2019 and an Outstanding Young Engineering Graduate in 2004, and she is a founding member of the UT Austin Women in Engineering Program Advisory Committee. She has also served on the UT PGE External Advisory Committee and received a 2013 UT PGE Distinguished Alumni Award.

"Karen's service to the university as well as her professional accomplishments make clear her dedication to excellence and innovation," says UT PGE Chair **Jon Olson.** "We're extremely pleased to have her as our Alumna in Residence so that she can forge connections with our students as she shares her industry knowledge and experience."

UT PGE WELCOMES
CLASS OF 2026

The Hildebrand Department welcomed 120 freshmen to campus in August as part of its annual two-day First-Year Fall Retreat. Incoming students met with peer mentors, participated in panel discussions with young alumni and faculty members, learned about how to get involved through student organizations and internships, heard from Chevron's General Manager of Wells Execution **Steve Hassmann** (BSPE 1990), and got to know each other with icebreaker games.

UT PGE has 367 currently enrolled undergraduates, including 34 percent from typically underrepresented communities and 21 percent who identify as female, and 141 currently enrolled graduate students. Among graduate students, 83 percent are international students and 23 percent identify as female.

LESSONS FROM THE LAB

Seven undergraduates from across the Cockrell School of Engineering spent the summer conducting innovative energy research under the supervision of UT PGE faculty members as part of SURI, the Hildebrand Department's paid 10-week Summer Undergraduate Research Internship program. From capturing CO_2 and storing it in the subsurface to generating clean energy from underground hydrogen storage, SURI students tackled tough and exciting energy problems that will ultimately help create a sustainable and equitable energy future for the world. "So much work went into the plan and execution of my SURI project," says aerospace engineering senior **Robert Eric Estrada** *(right)*, whose research focused on natural gas turboexpander technologies and was supervised by Professor **Mukul Sharma.** "Coming to strong results at the end made it all worth it."

FACULTY FOCUS

Mohanty, Balhoff, Sepehrnoori

UT PGE FACULTY WINS BIG AT SPE

Three Hildebrand Department faculty members — professors **Matt Balhoff, Kishore Mohanty** and **Kamy Sepehrnoori** — received prestigious international awards from the Society of Petroleum Engineers (SPE) at its Annual Technical Conference and Exhibition in October. These awards recognize significant technical and professional contributions to the petroleum engineering profession and to the worldwide oil and gas industry.

Balhoff received the Lester C. Uren Award for Technical Excellence, which recognizes distinguished achievement in the technology of petroleum engineering. Balhoff's research focuses on modeling, understanding and validating fundamental flow and transport behavior of subsurface fluids with applications to hydrocarbon recovery, carbon sequestration, groundwater remediation and nuclear waste storage.

Mohanty received the John Franklin Carll Award for Distinguished Professionals, which recognizes distinguished contributions in the application of engineering principles to petroleum development and recovery. Mohanty's research focuses on transport of simple and complex fluids in complex microstructured materials for applications in energy, environment and biotechnology.

Sepehrnoori received SPE's major technical award, the Anthony F. Lucas Gold Medal for Technical Leadership, which honors distinguished achievement in the identification and development of new technology and concepts that enhance the process of finding or producing petroleum. Sepehrnoori's research focuses on the development and application of reservoir simulators for enhanced oil recovery, naturally fractured reservoirs, unconventional resources and CO_2 sequestration.

Song

SONG AWARDED NSF CAREER AWARD

Assistant Professor **Wen Song** was awarded a Faculty Early Career Development award from the National Science Foundation (NSF) in July to investigate the recovery of rare earth elements (REEs) from clays. The CAREER awards are among the NSF's most prestigious offerings in support of early career faculty who have the potential to serve as academic role models in research and education, and to lead advances in their institutional and departmental missions.

Song's research group specializes in understanding the reactive transport of fluids within nanoporous materials that control energy materials recovery. One area of their research focuses on the extraction of REEs, which are critical components in nearly all technologies that enable the transition toward a low-carbon energy future. This five-year, $510,000 CAREER award will enable Song and her team to explore the fundamental micro- and nanoscale multiphase reactive transport phenomena that control the leaching of REEs from unsaturated, unconsolidated nanoporous clays using seawater as an environmentally benign reagent.

Follow Song on Twitter @SongLabUT.

LOPEZ MANRIQUEZ
JOINS FACULTY

*UT PGE welcomed **Alberto Lopez Manriquez** to the faculty as an associate professor of practice last fall.*

Lopez Manriquez is teaching Resource Economics and Valuation and Geosystems Engineering Design and Analysis, in addition to helping coordinate undergraduate recruiting activities. He has 24 years of industry experience specializing in the characterization of unconventional reservoirs, completion operations, drilling design, pore pressure prediction, geomechanics and hydraulic fracturing. He also served as a mentor for the Society of Petroleum Engineers for six years.

Lopez Manriquez taught previously at Texas A&M University–Kingsville as a visiting assistant professor and an associate professor, and at The University of Texas Permian Basin as an assistant professor. No stranger to the Forty Acres, he received his PhD in petroleum engineering from UT Austin in 2003.

LIVESCU CO-AUTHORS TEXAS GEOTHERMAL REPORT

Associate Professor **Silviu Livescu** is one of 13 authors of "The Future of Geothermal in Texas: The Coming Century of Growth & Prosperity in the Lone Star State," a multiyear, multidisciplinary collaboration among researchers at five Texas universities, the University Lands Office and the International Energy Agency. The 15-chapter study includes analyses of the location and quality of Texas geothermal resources; evaluations of technology developments; the role of the oil and gas industry in achieving growth and scale; and environmental, regulatory, economic and legal issues pertinent to the growth of the geothermal industry, both in Texas and globally. Funded by the Cynthia and George Mitchell Foundation, The Educational Foundation of America, and Project InnerSpace, the report provides a scientific basis for informed decision-making as geothermal development begins across the state.

Livescu

RAVIKUMAR TO CO-DIRECT EMISSIONS LAB

Research Associate Professor **Arvind Ravikumar** is co-director of the new Energy Emissions Modeling and Data Lab (EEMDL), a multidisciplinary research and education initiative that will

Ravikumar

address the growing need for accurate, timely and clear accounting of greenhouse gas emissions across global oil and natural gas supply chains. Ravikumar and Professor Dave Allen from the McKetta Department of Chemical Engineering will run EEMDL from the Forty Acres and collaborate with colleagues from Colorado School of Mines and Colorado State University. Several major energy companies — including initial partners Cheniere, EQT and Williams — are sponsoring EEMDL, which will be a $50 million project.

Follow Ravikumar on Twitter @arvindpawan1.

Daigle

DAIGLE RECEIVES NSF GRANT

Associate Professor **Hugh Daigle** is the principal investigator on "Collaborative Research: Neogene History of Mass Transport Deposits Offshore North Carolina," a three-year partnership between The University of Texas at Austin and Columbia University that received nearly $750,000 in funding from the National Science Foundation last April. Daigle and his team will spend about four weeks at sea in the spring collecting 2D seismic data over the Cape Fear and Cape Lookout submarine landslides. They'll image those landslides in great detail, as well as older landslides that have occurred in the area, and collect sediment samples to analyze in Daigle's lab on campus. The hypothesis, Daigle says, is that very large, potentially tsunamigenic submarine landslides have occurred off the U.S. east coast periodically over geologic time. He aims to develop a greater understanding of what causes them and how frequently they occur.

Follow Daigle on Twitter @hugh_daigle.

OKUNO TO LEAD CARBON STORAGE INITIATIVE

Okuno

Associate Professor **Ryosuke Okuno** has been named primary investigator for the newly funded Energi Simulation Industrial Affiliate Program on Carbon Utilization and Storage. The three-year project will support strategic research and development efforts focused on the energy transition, including carbon capture, conversion, utilization, storage and transportation; hydrogen generation, storage and transportation; and renewable energy resources. Research already underway includes novel carbon carriers such as formate species and CO_2 nanobubble dispersion; electrification of CO_2 conversion processes; and economic analysis of potential transition-related value chains. The program is funded by Canada-based nonprofit Energi Simulation.

FACULTY FOCUS

UT PGE FACULTY FUNDED BY ENERGIZE PROGRAM

The Hildebrand Department and UT Austin's Energy Institute have collaborated with the Southwest Research Institute (SwRI) to launch the Energize Program focused on energy research, including oil and gas, renewable resources, hydrogen, carbon storage, and geothermal energy. In its first year, the program funded five projects, including two by UT PGE faculty:

DiCarlo

Prodanović

Associate Professor **David DiCarlo** and Professor **Maša Prodanović** are working with SwRI's Angel Wileman and Sarah Stuart to study CO_2 foams in an effort to improve long-term carbon storage in depleted oil and gas reservoirs. Assistant Professor **Yingda Lu** is collaborating with SwRI's Kevin Supak, Jordan Nielson and Kelsi Katcher to study CO_2 pipeline flow behaviors as part of a larger effort to facilitate large-scale carbon capture utilization and storage (CCUS).

Lu

TORRES-VERDÍN NAMED TEACHING FELLOW

Professor **Carlos Torres-Verdín** was named to the 2022 Provost's Teaching Fellows Cohort, which empowers UT Austin's best and brightest professional teaching faculty to create cultures of change in their departments and colleges. Selected through a rigorous application process, fellows advance education through individual initiatives that improve teaching and learning, and through participation in campus-wide events that promote the quality of education and its status in the campus culture. Torres-Verdín's two-year fellows project explores alternative ways to appraise effective teaching and learning beyond traditional student evaluations. ■

Torres-Verdín

POWERING TOMORROW

ALUMNI AND STUDENTS ON THE LEADING EDGE OF ENERGY

Energy. Who has it? Who needs it? Where does it come from? And how do we get more? It's a problem for the ages. Literally.

No matter how you look at it — and everyone from engineers to entrepreneurs to environmentalists have spent countless hours examining the problem — global demand for energy continues to rise. In fact, some estimates indicate energy use will increase almost 50 percent by 2050.* Developed countries will require as much energy as ever and developing countries will need even more as they try to improve their economies and standard of living.

For petroleum and geosystems engineers who tackle this problem head-on every day, the ultimate goal is this: power tomorrow by providing energy that's affordable, sustainable and clean.

Here's how UT PGE alumni and students are making it happen.

*"EIA projects nearly 50% increase in world energy use by 2050, led by growth in renewables," U.S. Energy Information Administration, Oct. 7, 2021.

DOUG McMASTER

Of the 117 recipes **Doug McMaster** (BSPE 2013) made while homebound during the COVID-19 pandemic, biang biang noodles is his favorite. Named for the sound the noodles make when they're stretched and bounced on a counter, "this dish is fun to make, pure joy to say and packed with flavor," he says.

McMaster got interested in cooking when Professor **Maša Prodanović** introduced him to *Modern Cuisine: The Art and Science of Cooking* during his senior year. After he graduated, he took a job as a reservoir engineer with Pioneer and enrolled in culinary school, going to cooking class from 6 to 9 a.m. before heading into the office. Just as he experimented in the kitchen, McMaster worked in various parts of Pioneer's oil and gas business — production, completions, asset development, budget and planning — before discovering a passion for data analytics.

"In oil and gas, you have to make good economic decisions, whether you have a dollar or a billion dollars. Data analysis helps you decide where to spend your money next," he says. "Where should you locate new wells, how do you optimize existing ones, and what's the best way to reach your decarbonization goals?"

McMaster spent two years writing software to answer those questions at Pioneer before becoming vice president of product at ComboCurve, which offers energy companies cloud-based software tools that can consider thousands of variables in a matter of minutes. His team of 75 data scientists, software developers and petroleum engineers are responsible for designing and refining ComboCurve's data models.

It's like a Lamborghini, he says. "Everyone wants to drive the sexy machine learning model, but nobody in the industry has the time or resources to build and improve it. That's what we do. It's critical to clean, organize, measure and maintain the model to keep it running at maximum efficiency."

McCarthy

Maximum efficiency means maximum results — for the industry and the world. "Oil and gas has always relied heavily on data, but managing high data volumes and maintaining veracity has become increasingly difficult," says **John Eric McCarthy** (BSPE 2022), who joined McMaster's team at ComboCurve last summer. "While data analytics and AI aren't a panacea, they're the key to innovative software solutions that are crucial to a sustainable future."

McCarthy and McMaster first met when ComboCurve hosted an on-campus coding workshop and sponsored UT PGE's annual Energy AI Hackathon *(see story, page 16)*. Besides McCarthy, the company has hired **Hyeok Kong** (BSPE 2022), **Travis Salomaki** (BSPE 2022), and **Ben Sullivan** (BSPE 2020, MSBA 2022), as well as several student interns.

Exceptional petroleum engineers with solid data chops are rare, but McMaster knows the country's No. 1 petroleum engineering program is the place to find — and mentor — them. "I always advise the PGE students I meet to be relentless about learning new things," he says. "You'll hit a critical mass where you can be successful and really set yourself apart" — whether it's making scrumptious biang biang noodles or helping meet the ever-growing demand for efficient, affordable energy.

YUANRUI ZHU

When **Yuanrui Zhu** was accepted to the PGE PhD program in 2021, she wasn't sure what her dissertation would be about or which professors would be a good match for her research interests. But she knew she was coming to the No. 1 petroleum engineering program in the U.S. and something good was bound to happen. Rather than wait for it, though, she turned to a hashtag. #EnergyTwitter to be exact.

Through the popular hashtag, which is how top energy scientists, engineers, policy analysts, journalists and other experts communicate on social media, Zhu connected with Research Associate Professor **Arvind Ravikumar** before either one of them actually arrived on the Forty Acres. Zhu was in Beijing, having just completed her master's degree in petroleum engineering from China University of Petroleum, and Ravikumar was wrapping up as an assistant professor at Harrisburg University of Science and Technology.

Fast-forward a year and a half, and Zhu is now one of six PhD students conducting research in Ravikumar's Sustainable Energy Transitions Lab. She's completing a first-of-its-kind geospatial life cycle analysis of the U.S. liquefied natural gas (LNG) supply chain and incorporating methane emissions measurements into the life-cycle assessment framework. When she can't find site data, she's traveled to the source to conduct measurements using state-of-the-art aerial systems so she can better model realistic emissions scenarios.

What she's found so far is that methane emissions intensity varies significantly across LNG supply chains — where gas is sourced affects the carbon intensity of U.S. LNG exports. Why? Because other recent measurements across upstream production and processing stages have shown large variation: One recent study found methane leakage in the Permian Basin to be significantly higher than in the Marcellus Shale play. Ultimately, Zhu hopes to use all the data she has amassed to create a cloud-based model to track methane emissions in real time across all facilities in the U.S. LNG supply chain. Along the way, she'll be able to compare the effectiveness of various emissions monitoring technologies like satellites, aircraft and drones.

"I've spent hours preparing, collecting and dealing with emissions data to be able to incorporate into our model," says Zhu, who was selected to present her work at the American Geophysical Union fall meeting in December. "With that information combined with the emissions data from these new technologies, we can help operators find out which facilities are the biggest emitters — and how they can take action to reduce emissions and make a cleaner product."

Sounds like Zhu is ready for an #EnergyTwitter thread of her own.

CARLOS FIGUEROA-DIAZ

Carlos Figueroa-Diaz (BSPE 2024) dims the lights in his apartment and starts his favorite Spotify playlist, heavy on the Tame Impala. He grabs a bag of trail mix and settles into a puffy gray office chair. But it's not time to game on his PC — it's time to work.

Figueroa-Diaz is one of seven undergraduates who participated in last summer's SURI, UT PGE's 10-week paid Summer Undergraduate Research Internship program that pairs selected students with faculty members conducting cutting-edge energy research. He determined which depleted or semi-depleted hydrocarbon reservoirs in the Gulf of Mexico could potentially be used to store carbon dioxide with Associate Professor **Nicolas Espinoza,** who collaborates with ExxonMobil, Chevron, UT Austin's Energy Institute, the U.S. Department of Energy, and Saudi Arabia's King Abdullah University of Science and Technology on carbon geological storage projects.

"Carbon capture is an emerging technology that is a net positive for the environment. We can take CO_2 that would otherwise be going into the atmosphere and store it somewhere instead," says Figueroa-Diaz. "The question is, where do we keep it and how do we make sure it stays there?"

To answer that question, he first looked at production data from about 30 reservoirs to figure out how much oil and gas had been produced, initially plugging data into a spreadsheet and then using Python to automate the process. Then, he used a tool called Prism to capture location data for the reservoirs. "Think Google Earth but for oil and gas," he says.

With the production and location data cleaned and captured, Figueroa-Diaz began determining how much CO_2 each reservoir could hold. After working the problem manually for a while, he eventually developed a fully automated multiple-regression-based tool that could estimate the CO_2 mass density at each reservoir as a function of its pressure and temperature, and figured out how much CO_2 could be stored using mass balance.

Figueroa-Diaz, who learned the bulk of his coding skills the summer after he graduated high school through an online Python course offered by MIT, had honed his skills in UT PGE's two required data analytics courses and a handful of personal projects. "I'd been coding in Python for a good minute, but when Dr. Espinoza essentially said, 'Turn this into a multivariate calculus project in Python,' there were times I really didn't think I could do it," Diaz says. "But he just knew I could. His confidence helped me push through."

Now, Figueroa-Diaz's model is ready for others to build on. Next steps include adapting it to calculate the CO_2 storage capacity of hybrid oil/gas reservoirs and figuring out ways to incorporate seismic and reservoir petrophysical data.

"I am a very small part in a giant network trying to turn carbon storage into reality," Figueroa-Diaz says. "Research like what we're doing in Dr. Espinoza's lab is really going to move CCUS in a positive direction." ◼

WHAT THE HACK?

UT PGE's second annual Energy AI Hackathon is about to begin.

Hackathon co-hosts Pyrcz and Foster spend the next few hours giving a crash course in Python, a computer programming language often used to analyze and organize large volumes of data. The students in the room, some who have used Python before and others who are brand new to it, will need these coding skills to solve the Hackathon problem — given a challenging multivariate, spatial dataset, where should an energy company drill its next three wells to maximize production?

Fueled by more mountains of breakfast tacos and endless caffeinated beverages, the students will spend the next 36 hours building data science workflows, coding, calculating and recalculating their solutions. If they get stuck, they'll confer with volunteer mentors from Chevron, Pioneer, ExxonMobil, IBM, ComboCurve and other industry juggernauts who are on site to share their expertise. At the end, each team will present its work to a panel of machine learning experts from companies like Amazon, BP and Dell.

There's more on the line than bragging rights. The 20 teams — undergraduate and graduate students from engineering, geosciences, business, natural sciences and other programs across campus — are also competing for $9,000 in prize money. Not to mention, there's the opportunity to connect with industry leaders who could become career mentors and help secure internships and jobs down the road.

But for right now, fingers click-click-click as students type notes about parameters and hyperparameters. Dr. Pyrcz cracks a *Bayesian* joke, provoking a *frequentist* retort from Dr. Foster. More soda bottles fizz open. Here we go.

*It's 4:57 on a Friday evening when 100 or so students arrange themselves and their laptops in the tiered rows of CPE 2.208. The building is quiet, except for a couple of soda bottles fizzing open and some crinkling breakfast taco wrappers. Associate Professor **Michael Pyrcz** ambles up to the whiteboard in his red Chuck Taylors while Associate Professor **John Foster** doublechecks the hackathon GitHub repository and twirls his handlebar mustache.*

SATURDAY, 9:04 A.M.
Each team settles into the quiet classroom or study carrel they've set up as their home base. They plug in their computers and snap off the lids of whiteboard markers.

SATURDAY, 11:22 A.M.
Students are knee-deep in the data, evaluating the given information, brainstorming solutions and planning prototypes. Mentors sit with each team to answer questions and help troubleshoot. "The problem is hard, and you're given a lot of data," says **Ivan Feng** (MSPE 2022). "It's like someone handing you a bunch of lumber and nails and telling you to build a house. Without a plan, you don't even know where to start. You need to break the problem down into parts that you can combine into a solution."

SATURDAY, 4:47 P.M.
Coding is in full swing. Dr. Foster explains an AI concept to a couple of students while others revisit their strategies and bounce new ideas off their mentors. Teams test and refine their computer models as the setting sun filters through the Caudle Lounge windows. "After hours of planning, we thought we had an excellent strategy," says **John Eric McCarthy** (BSPE 2022). "But we quickly realized there were obstacles we had failed to address. We had to create a new approach on the fly, and the industry mentors really helped us improve our answers."

SATURDAY, 9:35 P.M.
Most teams are still hard at work. The snack table gets replenished and somebody's fingers drum a quiet beat on their water bottle. A couple of students turtle into their hoodies and sneak in a quick power nap.

SUNDAY, 10:16 A.M.
The final push. Teams finesse their models, work through last-minute hiccups and practice their presentations. "Besides a cup of coffee, the pressure and deadline kept me focused," says **Lei Liu** (MSPE 2020, PhD PE 2024). "We knew we couldn't give a 100 percent correct answer because there just wasn't enough time, but we made a presentation we were proud of that showed all the work we had collaborated on over the two days."

SUNDAY, 1:52 P.M.
Go time. Each team presents their solution in front of the other hackathon participants, the team mentors and the panel of judges. "The final presentation was perhaps the part I personally enjoyed the most because it was a chance to communicate our thought process to the judges," says **Valeria Vallejo** (MSPE 2023). "We shared all the work we did, our results, the lessons we learned and what we would do differently next time."

SUNDAY, 4:30 P.M.
EOF — "that's a wrap" in Python speak. The HackBros team — Feng, his brother **Richard** (BSEE 2023, BBA 2023), **Tesleem Lawal** (MSPE 2020, PhD PE 2024), and **Dongyoung Yoon** (PhD PE 2023) — win the $5,000 first-place prize. "We were not certain we had the best solution," Feng says, "but we were certain that our solution was the best we could have produced in the limited time we had." After the awards are handed out, everyone snags a few leftover breakfast tacos and heads home for a nap, dreaming of salsa and strings of code. ■

Feng

McCarthy

Liu

Vallejo

THIRTYSOM

REFLECTIONS ON THREE DECADES IN OIL AND GAS — AND WHAT COMES NEXT

*Karen Hagedorn (BSPE 1986) spent nearly 30 years in the oil and gas industry working across the globe from Angola to Alaska. She's done it all, from reservoir engineering and enhanced oil recovery to asset development, research and field testing, and business analysis. Last year, after retiring from ExxonMobil, she accepted an invitation from UT PGE Chair **Jon Olson** to meet and mentor students as part of the Alumni in Residence program. Here, she discusses her distinguished career, what's next for the industry, and why petroleum engineers are critical for a sustainable energy future.*

What projects or experiences are you most proud of in your career?

I've worked on many exciting projects in almost 30 years, but at the end of the day, the thing that makes any project successful is the people. I am most proud of my focus on developing people, particularly giving chances to those that others may overlook for whatever bias or reason. Seeing people succeed beyond everyone else's expectations was my greatest reward.

Any funny moments to share from your career?

My biggest travel mishap actually turned into a great opportunity. I was taking a charter flight back to Angola and it was cancelled for mechanical reasons. This was on a Wednesday, and there wasn't another until the following Monday, so I was stuck in Houston. This was 2017 and happened to be during the World Series when the Astros were playing the Los Angeles Dodgers. I half-jokingly posted on Facebook that I was stuck and did anyone have an extra World Series ticket — and a friend from high school said yes! I ended up getting to go to games 4 and 5!

Knowing what you know now, what would you tell your fresh-out-of-college self?

Spend more time in the field — really talk to the people working there. They know way more than you do.

What do you think is the most significant challenge facing new petroleum engineering graduates today? The most significant opportunity?

I think the fundamental challenge is the same as it's always been — the uncertainty of a commodity industry and its cycles. The specific dynamics change, but uncertainty is the only certainty in our business. There's also the opportunity to solve what is probably the most important challenge in modern times — people need energy to improve their lives. You only have to visit villages in Alaska, Africa or many other places to see what we take for granted. However, the ways of the past are unsustainable. We need more than aspirations and opinions; we need lasting solutions that don't hurt those most in need. That's the opportunity: to work as an engineer on such an important dual challenge.

Some say the oil and gas industry is on the decline and can't thrive in a net-zero economy. How do you respond to that?

Realistically, oil and gas will need to be a part of the energy mix for quite a long time, even if its fraction of the mix declines. But remember that oil and gas fields decline in production over time, so there is always a growth business to just maintain production or even mitigate the natural decline. Even if oil and gas declines overall from a demand standpoint, there is still a need for growth in supply that will make the industry dynamic for a long time to come.

What does it mean to you to be part of the UT PGE community as an alumna and advisor?

I'm proud to be a second-generation UT PGE graduate and to continue to be involved in the No. 1 petroleum engineering program in the country. I've had the most incredible opportunities to travel, live all over the world, and meet and work with the best people because of what started in UT PGE. If I can share some of my experiences with today's students to help them have a great career, that makes me happy. ■

ETHING

"If I can share some of my experiences with today's students to help them have a great career, that makes me happy."

STAGE PRESENTS
From left, emcee **Russell Parker** (BSPE 2000) and Chair Jon Olson *(far right)* celebrate with UT PGE's 2022 Distinguished Alumni Award recipients Professor **Larry Lake; Ken Nelson; Myra Dria;** Martha MacDonald, widow of **Bob MacDonald; Will Hickey;** and **Chuck Farmer.**

2022
DISTINGUISHED ALUMNI

Even the cold, wind and rain couldn't keep a sold-out crowd from coming to campus to celebrate the most recent recipients of UT PGE's Distinguished Alumni Awards on Friday, Nov. 11. At a ceremony and dinner in the Engineering Education and Research Center, **Myra Dria** (PhD PE 1988); **Chuck Farmer** (BSPE 1981); Professor **Larry Lake** (PGE faculty member since 1978); **Ken Nelson** (BSPE 1970, MSPE 1973); and the late **Robert MacDonald** (MSPE 1970, PhD PE 1972) received the 2022 Distinguished Alumni Award, and **Will Hickey** (BSPE 2009) was named 2022 Rising Star. The awards are given annually to alumni leading the way in oil and gas — educators, executives, innovators and entrepreneurs with unmatched industry expertise.

Visit bit.ly/da2022pge
TO READ MORE ABOUT THE RECIPIENTS AND SEE PHOTOS FROM THE EVENT.

HONORING ARLETTA

When longtime undergraduate coordinator **Arletta Tompkins** passed away a year ago, UT PGE set up an undergraduate scholarship to honor her memory and decades of selfless service to students. Now, the $50,000 endowment required to activate the Arletta Tompkins Memorial Scholarship in Petroleum Engineering is almost two-thirds of the way to being fully funded!

"We are humbled by the generosity of those who have given," says Chair **Jon Olson.** "We're asking for others to consider being a part of this effort to remember a woman who was truly the heart of the UT PGE undergraduate community."

Donate today at bit.ly/arlettafund.

IN THE NEWS

JEFF HILDEBRAND (MSPE 1985), executive chairman and founder of Hilcorp Energy Company, was inducted into the Texas Business Hall of Fame in November. This distinction is awarded annually by the Texas Business Hall of Fame Foundation to honor six transformational business leaders in the state and celebrate their impact in both business and the community.

STEVEN PRUETT (BSPE 1984), was appointed 2022–2024 board chairman of the Independent Petroleum Association of America (IPAA) in December. Pruett, who is president and CEO of Elevation Resources, most recently served as IPAA vice chairman. IPAA is a national upstream trade association representing independent oil and natural gas producers and service companies across the United States.

TARA SHARMA (BSPE 2015), vice president of RedOaks Energy Advisers, was named in October to Hart Energy's *Oil and Gas Investor* 2022 Forty Under 40 list, which showcases the best young professionals in the oil and gas industry. Honorees represent upstream, service, acquisitions and divestiture, midstream, and finance, and are furthering the goals of their organizations and the industry through their initiative, intelligence and persistence.

TAIL ME ABOUT IT

Dogs, babies, pompoms, cornhole, barbecue, temporary tattoos — the UT PGE alumni tailgate had it all!
Hundreds of alumni, students, faculty members and families gathered on the lawn in front of the Chemical
and Petroleum Engineering building before the Longhorns took on Texas Christian University Nov. 12.
Did you miss it? Don't worry — check out more of the fun at bit.ly/pgetailgate22.

FUTURE FoCCUS

ERLINDA CHEW (BSPE 2022)

Even with 52,000 students, it turns out that The University of Texas at Austin is a small world. Just ask **Erlinda Chew** (BSPE 2022).

On a trip to Midland last spring with the Society of Petroleum Engineers student chapter, she mentioned to friend **Ram Disabar Jr.** (MSPE 2023)* that she was still in the thick of the job hunt. Two weeks later, Disabar emailed her with a lead — he'd heard about an opening at GHD, an energy engineering consulting firm where classmate **Divya Shah** (MSPE 2023) was interning. Chew applied, got the job, and in July started as a full-time reservoir engineer.

As a member of GHD's Future Energy team, Chew works primarily on carbon capture, utilization and storage (CCUS). She spends her days assessing oilfields, calculating their capacity to store CO_2 and researching the latest CCUS technologies for her team's projects. She also helps craft bids for new projects.

"It's so great to have this chance to explore the field of CCUS. I'm using all my reservoir engineering skills but applying them in a slightly different way — and every day is an opportunity to keep learning," she says. "With the political climate right now and everyone wanting to go net zero, this is a smart position to be in, and I know what I'm doing will have big benefits in the future."

In addition to the technical content she learned in the classroom, Chew finds soft skills are also key to excelling in her new job — things she picked up as a student collaborating on group projects; holding study sessions in the Caudle Center; and serving in leadership roles for SPE's UT student chapter (she was freshman representative, vice president of internal relations and director of communications).

"Being able to work with different personalities, verbalize what I'm doing, and ask for help when I need it has made things so much easier," she says. "Those skills have been really valuable and have probably helped me the most."

Thanks to her undergraduate experience, Chew knows she can be successful, whether she works in CCUS, hydrogen storage, natural gas or something more traditional. "I feel like I can make a positive impact in the industry," she says. "There are so many new topics and new ideas out there; it's really exciting to be part of it all." ■

*Editor's Note: **Ram Disabar Jr.** passed away in December. As described in this story, he was a valued member of the UT PGE community whose passion for the department, his research and his colleagues is sorely missed.*

When twin brothers **Lucas and Miguel Mejia** (BSPE 2016, MSPE 2018, PhD PE 2022) arrived on the Forty Acres from Medellin, Colombia, in 2012, they'd never set foot in the Lone Star State.

"We'd been accepted to the university, knew UT was a prestigious school, and had heard great things about Austin," says Lucas. "We decided to go for it." And despite arriving smack in the middle of the brutal Texas summer, they stayed — for a decade.

They joined the Society of Petroleum Engineers student chapter, got undergraduate research assistantships and were inducted into Phi Epsilon Theta, the petroleum engineering honor society. And they played a lot of intramurals — "soccer, basketball, volleyball, everything we could. It was a great way to meet people, especially people from other countries who were also trying to figure out visas and housing and living in a new country," says Miguel.

Encouraged to stay on for their master's degrees and PhDs by Professor **Matt Balhoff,** Lucas and Miguel dove into their graduate research. Lucas built micromodels to observe physical phenomena in porous media with Dr. Balhoff and collaborated with Professor **Kishore Mohanty,** while Miguel focused on chemical-enhanced oil recovery using surfactants and polymers with Dr. Balhoff and Professor Emeritus **Gary Pope.**

"All the faculty are well-known in industry, but they're great teachers, too," says Miguel. "You learn a lot working with them. At first, they are holding your hand, but they help you get to where you're working independently and doing things you never thought you'd do."

Lucas and Miguel also found a support system among their peers in the UT PGE graduate program, where 83 percent of students are from other countries. The brothers competed on the department's PetroBowl quiz team, placing first in the North America regional qualifier and advancing to the international competition. Lucas also served on the Graduate Engineering Council, and Miguel was president of the Petroleum Engineering Graduate Student Association.

When they graduated with their PhDs in May, "it felt like the end of a really long, but really good book," says Lucas. And now they've started a new chapter — Lucas is a research and development engineer at Schlumberger and Miguel is a reservoir engineer at Oxy.

"We'd like to stay in the industry and see new energy technologies brought to market," says Miguel. "Our petroleum engineering skills translate into so many other areas beyond what we're doing right now — everything applies." ■
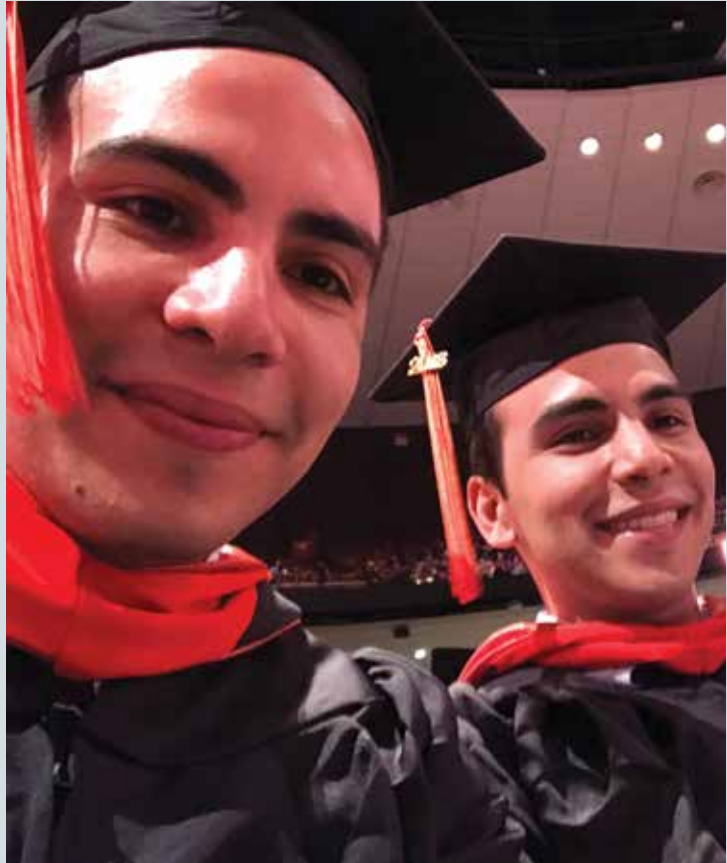
THE TRIPLE DOUBLE

LUCAS AND MIGUEL MEJIA (BSPE 2016, MSPE 2018, PHD PE 2022)

RETURN SERVICE REQUESTED

PAPER PERFECT

Rock, Paper, Scissors ... 1, 2, 3, go! During the First-Year Fall Retreat in August, more than 100 incoming freshmen, their upperclassmen mentors, and several faculty members and alumni battled it out in an epic game until only two were left standing, Associate Professor **David DiCarlo** and **Olle Lorehn** (BSPE 2004). In the final set, DiCarlo bested Lorehn by throwing rock for the big win. And we'd be remiss if we didn't congratulate DiCarlo with one of the dad jokes he's famous for among his students — rock on, Dr. DiCarlo!

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