TEXAS A&M
UNIVERSITY

2020

HAROLD VANCE DEPARTMENT OF

# PETROLEUM ENGINEERING

# LETTER FROM THE DEPARTMENT HEAD

The question on many minds is whether pursuing a degree in petroleum engineering is still a smart move. The answer is yes.

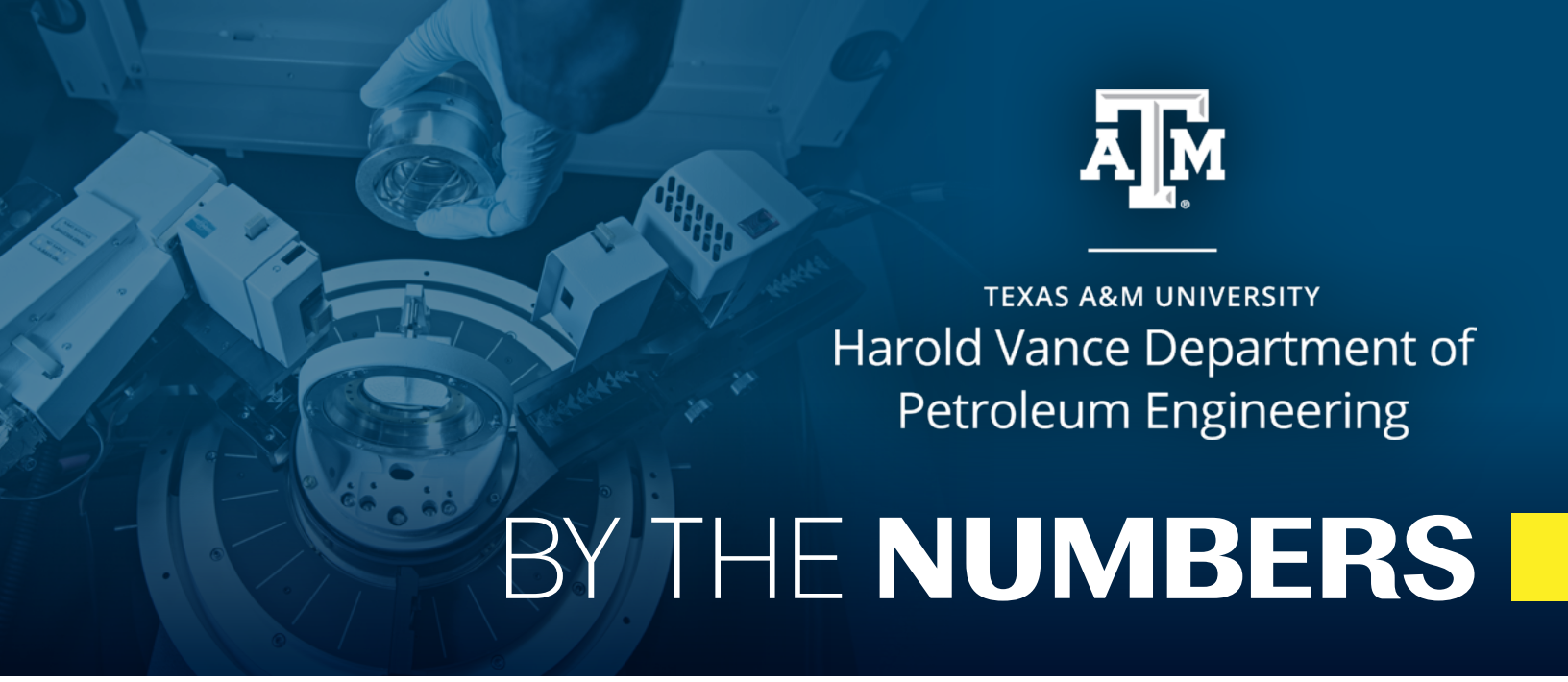
Employment cycles are not unique to the oil and gas industry, but it's hard not to notice the current market downturn sparked by unexpected and far-reaching events. However, hydrocarbons currently provide the vast majority of our global energy demand and will remain a significant source of energy throughout a long transition to more renewable sources. These energy demands will be met through the exploration, development and production of increasingly difficult reserves requiring the next generation of smart petroleum engineers.

Future petroleum engineers will face difficult but rewarding challenges in continuing to meet this global demand. Whether for mature reservoirs in decline or newly found reservoirs in complex, environmentally sensitive regions, we need engineers who will excel at innovation and creative thinking, embrace cutting-edge technology and methods, and initiate cooperative efforts in research and development.

My mission is to ensure that the Harold Vance Department of Petroleum Engineering at Texas A&M University continues to produce these highly qualified, sought-after engineers at both the undergraduate and graduate levels. We will do this by attracting the world's best students, recruiting and retaining the largest and most accomplished faculty, and continuously improving our facilities. And we will continue to increase our close ties to the local and global petroleum industry to develop our resources, define our research efforts and provide jobs to our graduates.

Sincerely,

**Dr. Jeff Spath**
Department Head
Director, Crisman Institute for Petroleum Research



TEXAS A&M UNIVERSITY

Harold Vance Department of Petroleum Engineering

# BY THE **NUMBERS**

## RANKINGS

**#1** Undergraduate Program Ranked No. 1 (Public)
(*U.S. News & World Report*, 2021)

**#2** Graduate Program Ranked No. 2 (Public)
(*U.S. News & World Report*, 2021)

## ENROLLMENT*

(FALL 2020)

**390** Undergraduates

**178** Graduates

**preliminary*

## FACULTY (FALL 2020)

**37** Faculty, including

**17** Society of Petroleum Engineers Distinguished Members

**5** Society of Petroleum Engineers Honorary Members

**2** National Engineering Academy Members

## DEGREES AWARDED

(FALL 2019-SUMMER 2020)

**135** B.S. **30** M.S.

**23** M.E. **25** Ph.D.

## DIVERSITY

**18.5%** Female **81.5%** Male

## SCHOLARSHIPS (2020-21)

**188** Undergraduate Scholarships Awarded

**$590,500** Total Scholarship Amount

## FELLOWSHIPS (FALL 2020)

**13** Graduate Fellowships Awarded

**$246,000** Total Fellowship Amount

# SYSTEM RADICALLY **IMPROVES DRILLING**

Dr. Eduardo Gildin, in collaboration with E-Spectrum Technologies, created a two-part advanced advisory system that accurately depicts underground conditions in real time during drilling operations. The ability to visualize downhole occurrences as they happen allows drilling operators to react quickly to reduce equipment failure, avoid accidents and reduce the time it takes to drill a well.

E-Spectrum's robust hardware package, installed behind the drill bit, is built for extreme environments. This unit uses algorithms provided by Gildin to gather and filter data from bit vibrations, speed or sound changes, and temperature or pressure changes so it can send this information to the second unit above the ground.

The dysfunction detection system on the surface uses open source software and Gildin's programming to sift through information and notify operators of surface conditions. This programming utilizes machine learning, meaning the system records operator responses in every situation to catalog behavior patterns.

The Department of Energy Small Business Innovation Research Program initially funded the project to improve geothermal drilling capabilities. E-Spectrum and Gildin plan to apply for additional funding to prepare the surface system to go beyond monitoring subsurface conditions. They will use machine learning to develop suggestions that assist the operator more efficiently without compromising accuracy.

The system pinpoints drill bit position and unusual behavior faster and with better accuracy than current methods. As companies gather more data, the software can learn and adapt to future drilling applications in other environments.

"No matter what hardware system is in the hole, the downhole algorithms and surface system functions can use gathered data and machine learning to improve the drilling process," said Gildin. "This can advise in any drilling application, whether using drill bits or water jets, on the Earth, or even remotely in space."

# OVERCOMING ORGANIC BARRIERS REAPS IMPROVED OIL RECOVERIES

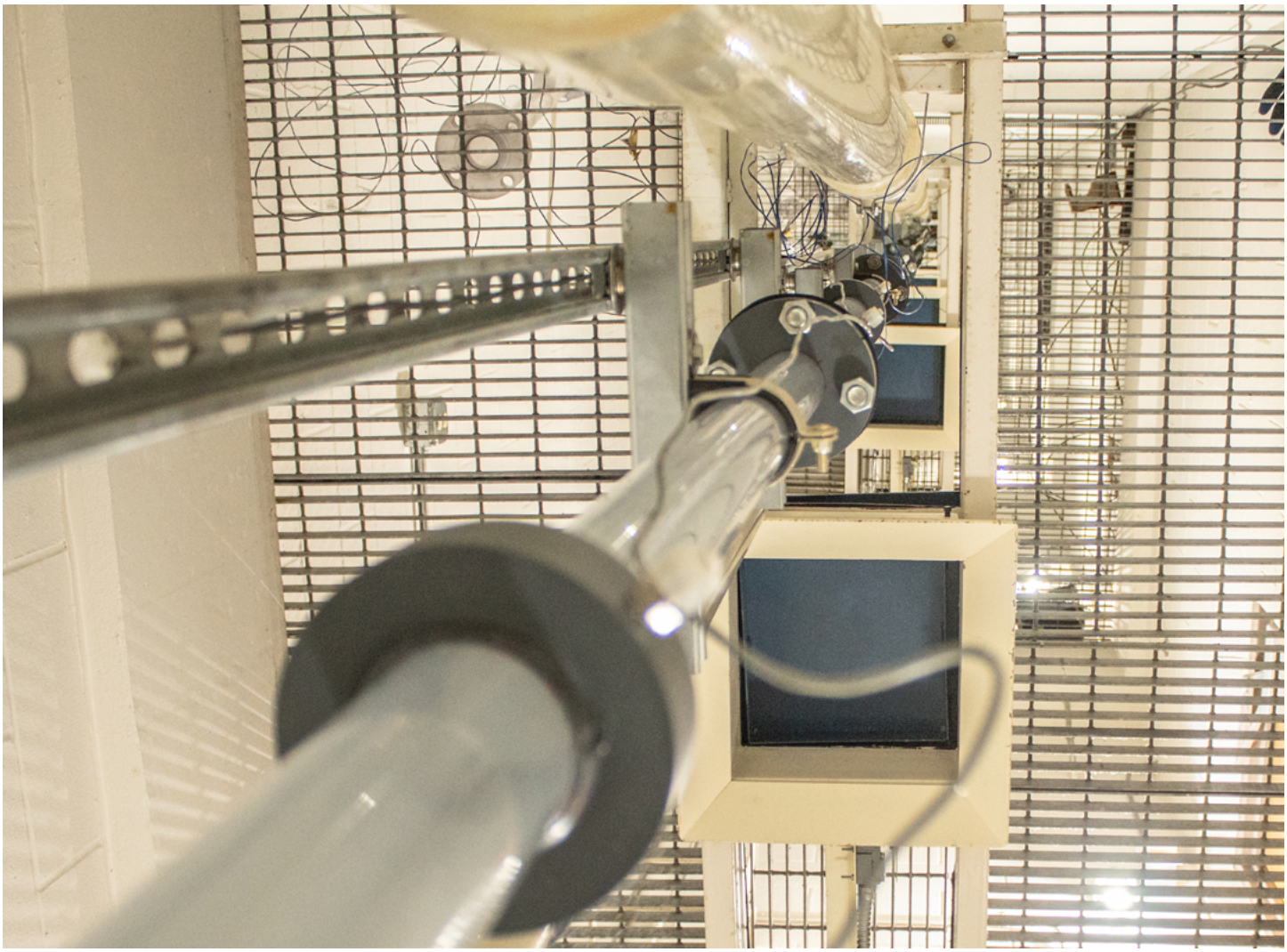
Injecting carbon dioxide into shale reservoirs should accomplish two critical results: storing an unwanted greenhouse gas safely underground and improving the flow of oil and gas for better recovery. Unfortunately, current use of CO2 injections in reservoirs has not met the expected levels of sequestration or recovery predicted in lab experiments.

Dr. Maria Barrufet determined that models of CO2 behavior in a shale reservoir are inaccurate because most current research only focuses on the gas' ability to move through shale rock. She believes a realistic forecast includes the interaction of CO2 with other factors present inside a shale reservoir, namely reservoir fluids, inorganic and organic materials, and high temperatures and pressures.

Through lab experiments, Barrufet found the slow fluid flow properties of the organic mineral kerogen acted as a barrier to initial injections of carbon dioxide. Her work revealed that injection pressures had to be maintained at a high level to force kerogen to absorb greenhouse gas. Barrufet applied extended soak times, keeping the pressures high for long periods of time, and recorded the results. She found CO2 eventually moved through the kerogen and beyond, reaching previously untouched areas of the shale samples. Duplicated in a reservoir, the results mean initial theories about CO2 injections for recovery and storage benefits were not wrong, simply misapplied.

"It is a fine, delicate balance," said Barrufet. "Injections are critical to recovery and storage, but work best if applied with an understanding of the complexities within the reservoir."

# REVITALIZED LAB PROVIDES **BLOWOUT ANSWERS**



Doctoral student Omer Kaldirim led an intensive upgrade of the Tower Lab, a 142-foot vertical assembly of pipes, pumps, tanks and other equipment hidden within the core of the Joe C. Richardson building on the Texas A&M University campus.

The lab's height and equipment help petroleum researchers understand how compressed gasses react if they manage to escape from a subsurface reservoir and invade the different types of muds circulating in an oil well during the drilling process. Since these gasses expand, and can potentially explode in a blowout if they travel up through the mud and reach a drilling rig, the goal is to improve mud circulation methods and blowout prevention techniques.

The lab features clear two- and four-inch diameter pipes so that gas behaviors can be visually studied and measured.

Experiments are scaled to match the actual drilling conditions of using 19- to 22-inch diameter pipes in 1- to 12-kilometer depths. The upgrade produced the higher flow rates and accuracy needed in scaled gas expansion and flow experiments for managed pressure drilling research in offshore applications that include riser conduits between the ocean floor and drilling rigs.

Kaldirim belongs to a team working jointly with Louisiana State University on a project to improve deepwater drilling safety by investigating dangerous offshore drilling blowout situations. The project began in 2018, funded with a $4.9 million award from the Gulf Research Program of the National Academies of Sciences, Engineering and Medicine. The upgrade was paid for with a portion of the award.

# FACULTY RECEIVE INTERNATIONAL AWARDS

Several faculty members received international awards from the Society of Petroleum Engineers (SPE).

**Dr. Dan Hill** was awarded honorary membership, the highest honor given by SPE, for a lifetime of technical and service contributions.

**Dr. Yucel Akkutlu** will receive the Lester C. Uren Award. This honor recognizes his high achievements in petroleum engineering technology. He will also receive distinguished membership jointly with the award.

**Dr. Hisham Nasr-El-Din** was awarded the Anthony F. Lucas Gold Medal for his distinguished achievement in the identification and development of new technology and concepts. The award comes with an automatic distinguished membership. Nasr-El-Din's family accepted his award in light of his death in July.

**Dr. Marcelo Laprea-Bigott** will receive distinguished membership due to his distinctive achievements in both the petroleum industry and the academic community.

**Dr. Stephen A. Holditch** will posthumously receive the inaugural Stephen A. Holditch Visionary Leadership Award, the first SPE major award established in more than 50 years. The award honors exceptional leadership and momentous impact to the industry.

"These are all very significant achievements," said Dr. Jeff Spath, department head. "I'm very proud of each of them, and I'm proud to be part of such a distinguished and recognized faculty."

All international award recipients were recognized during the 2020 SPE Annual Technical Meeting and Conference held in October.

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engineering.tamu.edu/petroleum

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# AREAS OF FOCUS

### Advanced Drilling Technologies

Well Control, Optimized Drilling Performance, Horizontal Drilling, Dual Gradient Drilling, Applied Drilling, Offshore Drilling Risks

### Advanced Well Completion Technologies

Downhole Diagnostic Measurements, Intelligent Completions, Wellbore Models, Oil and Gas Recovery, Fluid/Gas/Foam Behavior

### Gas Hydrates

Data Investigation, Crystal Growth, Behavior Modeling and Prediction, Gas Hydrate Systems

### Predictive Models for Unconventional Reservoirs

Geologic, Fracture Propagation, Reservoir Simulation, Risk Assessment

### Reservoir Modeling

Simulator Development, Optimization, Upscaling, Numerical Analysis

### Unconventional Reservoir Development and Assessment

Pore-Scale Rock Physics, Diagnostic Technologies, Nanotechnologies

### Well Stimulation

Hydraulic Fracturing Methods, Materials, Models, Matrix Acidizing, Acid Fracturing, Injections, Nanotechnology, Thermal Applications, Refracturing, Sand Transport