Dr. William “Bill” Rooney ’87, a plant scientist with the Texas Agricultural Experiment Station, says sorghum is just about an ideal crop for cellulosic biofuels.
The classroom is buzzing this Friday morning. Backpacks are slung over chairs. Battalions are opened to the crossword puzzle. Laptops are humming in startup mode. At the front of the class, the professor finds her spot in the middle of the floor. With the teacher in position, students’ heads start to turn to meet her eyes. This is a new course. Dr. Christine Ehlig-Economides teaches it every Monday and Friday. It’s new, but not new to her. She helped develop it because “students should learn about energy and how it affects their lives,” she said.

Engineering 101 focuses on energy of all kinds—coal, natural gas, oil, nuclear fission, solar, water and wind. It includes all students, no matter their field of discipline.

There’s a movement on campus to teach about energy, and Ehlig-Economides and petroleum engineering department head Dr. Stephen Holditch ’69 are at its base, growing and encouraging it to completion.

It’s the topic of the year, the link that connects economists, scientists and consumers to a unified question—how can the world get better, cleaner, easier and all around more energy? Texas A&M University has a few suggestions.
“The hallmark of a good university is that it’s innovative,” Holditch said. Innovativeness means discoveries are being made, a different path is being forged, and new technologies are being taught.

Research in petroleum engineering is exploding, and research in the department is alive and making a difference. But “we have two arms of deliverables,” Holditch said. One is the department’s research projects, its reports and software, their theses and dissertations.

But what’s more important, he said, are the students.

The department turns out master’s and Ph.D students, he said. Texas A&M turns out educated adults who keep producing, keep making a difference.

“Petroleum engineering is still very relevant and is critical to fulfilling the needs of energy,” Holditch said.

There are other types of energy, but right now, “the energy that’s running the planet is oil, gas and coal,” he said. As such, America has to learn how to find it, extract it, and how to operate in a more environmentally friendly manner.

That’s where the majority of research is headed in petroleum engineering, Holditch said, so that’s what they are teaching students.

“We have a contest that students can enter called disappearing roads,” he said. Oil is often found and extracted from rural areas. Holditch said instead of building a permanent road that would serve no purpose after drilling is complete, engineers are now building roads that can be removed. That lessens the process’s impact on the environment. The winning idea was a road of mats, he said. Innovative universities produce and are produced by innovative students.

Back in the 1970s and early 1980s, Holditch said, Texas A&M didn’t put much value on being a research institute. Time changed the University’s research stance.

The importance of research at a university is sometimes misunderstood.

The StarRotor engine, designed by a Texas A&M professor of chemical engineering, has the potential to be three times more efficient than the conventional internal combustion engine.
Sometimes people think a “research university” isn’t a teaching university. Or that a “research university” doesn’t focus on students. A different kind of learning comes from professors who actively seek advancements in their field.

The Power Of Agriculture

Research done by the College of Agriculture and Life Sciences, Texas AgriLife Research, and Texas AgriLife Extension is changing what it means to grow fuel. Together, these University affiliates are developing oilseed feedstock crops that can be made into fuel but do not compete with food or feed.

It is called bioenergy, said Robert Avant, Jr. ’75, Texas A&M’s Bioenergy Program director, and projects center on getting results “from the field to the fuel tank.”

Bioenergy is most easily defined as renewable energy made from natural sources, said Dr. Gaylon Morgan ’96, a small-grains researcher and member of the Texas A&M AgriLife project team. The most popular examples are ethanol, or biodiesel, but research is proving the field is much wider than many think. “There seems to be quite a bit of potential in biodiesel from algae,” Morgan said.

It’s an emerging technology being considered especially for jet fuel, Avant said, and researchers are working on making the crop economical.

Chosen for its high oil content, algae is a different crop than most agriculturalists are used to working with, he said. As such, researchers are learning the best ways to plant and harvest, along with designing systems to help before encouraging Texas’ farmers to plant the first big crop.

“That’s why we conduct research, to solve challenging issues like this,” Avant said. “This is one that is very exciting.”

Under the right conditions, algae has the potential to produce up to 100 times more oil per acre than a terrestrial oilseed crop like soybeans.

The group watching with highest hopes at algae’s possible entry into energy is the U.S. military and government. “The U.S. military uses a lot of jet fuel, so it has strategic importance,” Avant said. “There are a number of
federal government agencies that are looking at the development of algae for transportation fuel.”

Texas is already thought of as an energy state, Morgan said. The state has large amounts of petroleum reserves and has the majority of the nation’s biodiesel processing plants. “They’re down along the Texas Gulf Coast,” he said.

There are hundreds of bioenergy projects going on within Texas A&M, Avant said. Flax as an oilseed is posed for a comeback, and sorghum, sunflower, grasses and energy cane are being pursued. As a producing state, Texas has an opportunity to be a leader in the energy field, Morgan said. “The exciting thing is the unknown in the sense that we’re not sure how far we can go with this,” he said. “We don’t know where the ceiling is.”

If Texas A&M can make it work, Morgan said, energy independence will see a major boost and there could be immense environmental benefits.

Industry and government look to Texas A&M for guidance in many of these issues, Avant said. “We have a reputation as being a leader in applied research.”

**The Power of Chemistry**

A fuel cell is just as it reads—a cell that uses fuel to produce power. But unlike other forms of energy, the only byproducts from a fuel cell are water and heat. It is, by definition, a battery that will never run dead as long as fuel is provided. Make one big enough, and it can provide energy for nearly anything. And that’s where Dr. Perla Balbuena’s research comes into play. She’s a professor in the chemical engineering department.

“A fuel cell has three parts,” Balbuena said—two electrodes sandwiched around an electrolyte. “Specifically what I study are the fuel cell electrodes,” she said. If you can imagine it, both electrodes hold something differ-
ent, Balbuena said. One has hydrogen, and the other oxygen. In between the two is a liquid or polymer solution, she said.

There is no reaction until the hydrogen gets to work. When hydrogen passes over one electrode and oxygen passes over the other, the hydrogen atom splits into a proton and an electron, each of which has a charge. The result is the generation of electricity, she said. Since starting at a South Carolina university in 1997, Balbuena has used her research to develop new materials in which the chemical reactions can take place.

Fuel cells provide a great amount of energy, but Balbuena said some challenges still exist. The batteries need to be stronger and more durable. “That is one of the current problems,” Balbuena said. The battery could have a very active catalyst—the name for what causes a chemical reaction—but it could not last. Scientists know how to cause the chemical reactions but need more information on how that reaction takes place on certain surfaces. “The (U.S.) Department of Energy is investing a lot of resources into that,” she said.

Texas A&M is a beneficiary of that investment. Other than the visible competitive grants and other financial assistance, Balbuena said, Texas A&M is looked to for leadership. “I think that we have a place in the community, some recognition in the community,” she said. Companies respond to Texas A&M’s findings, they ask for help, and industry lauds scholarly publications by Aggie faculty and graduate students as something that will make a difference.

“We use some tools that are known as computational chemistry,” she said. Aggie researchers are currently trying to understand the structure of materials at the electronic level, and how the electrodes will be conducted into certain materials. “We solve equations that are given to us by the laws of physics and chemistry,” she said. “They are not new equations but old ones we are solving.”

The new idea is computing the exact composition of catalysts, and they do so through computer simulations. Research results, once again, put Texas A&M in the forefront of energy exploration.

The Power Of Collaboration

University research in other departments includes the College of Architecture working both to produce new technologies and to prepare students to make new construction energy-efficient, while the College of Engineering studies how to reach new oil reservoirs and even turn garbage into fuel. A professor in the chemical engineering department is working to use the bacteria E. coli as a energy source. The College of Science has the Institute for Quantum Science and Engineering, and has proposed the establishment of a Center for Renewable Energy and Sustainable Technology at TAMU.

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