

utah

ENGINEERING



**FUELING
INNOVATION**

STUDENTS KEEP ON TRUCKIN'

By the time Eric Eddings and Kevin Whitty are done modifying a black 1986 Chevrolet pickup to run on wood chips for a new undergraduate class, it's going to look more like a souped-up roadster from an apocalyptic "Mad Max" movie than a plain truck.

Eddings, a University of Utah chemical engineering professor and the College of Engineering's associate dean for research, is an expert on combustion and fuels who also loves restoring cars. His colleague Whitty, an associate professor, is an authority on biomass fuels. Ten years ago, the two imagined what it would be like if they combined their interests into one inventive class. After a decade of busy schedules the two finally realized their dream, and the result is the university's first wood-fired automobile class, a passion project in which 12 students are tasked with converting a truck from a gasoline guzzler into a vehicle that runs on wood pellets.

"We have a process that is called gasification where those wood pellets are partially oxidized, partially burnt ... and it produces a gas that is still a fuel because it's not completely burned to carbon

dioxide and water," Eddings explained. "It is primarily converted to carbon monoxide and hydrogen with some methane and minor hydrocarbons."

The product of this gasification process is synthesis gas or "syngas," a carbon-neutral fuel that will power the truck instead of gasoline. In order to do that, Whitty, Eddings and the students are building a gasifier that sits on the bed of the truck. Modified 55-gallon drums are used — one for the hopper and gasifier that will contain and burn the wood pellets, and another for a heat exchanger that cools the gas. The newly-created fuel then goes through a second heat exchanger to take out water, and a third barrel is used to filter out particulates such as ash. The gas is then clean enough to go through PVC pipes to the truck's engine.

Work on the gasifier and truck was funded by a donation from Washakie Renewable Energy, along with equipment donated by Opto 22. The project is being carried out at the university's Industrial Combustion & Gasification Research Facility in Salt Lake City. The facility's director, Andrew Fry, is also teaching the class with Eddings and Whitty, and the trio is getting help from two visiting scholars from Hungary, Zsolt Dobo and Helga Kovacs.





Whitty said wood-fired fuel is not a new process. “It’s actually been around since the 1800s. London used it for town gas. A lot of people in World War II were doing this exact type of project — converting their cars to operate on wood — because in Europe a lot of petroleum was going into the war effort.”

Running cars on wood chips is not practical, however. It’s messy and not efficient, but it is considered a sustainable fuel like other forms of agricultural waste where it is replenishable. Despite that, the professors realized the one-year class would be an innovative way to teach students the gasification process as well as working together on a big project, one of the most important skills in the workplace. Along the way, they’re also learning about project management, scheduling, budgets, adversity and computer-aided design.

“For undergraduate engineers in particular, a lot of their courses are often fairly prescribed,” Eddings said. “But this is one really large project where they

work in teams . . . and they’re learning if one team falls behind it impacts everyone else. That is very much a mirror of what life will be like when they get out into industry.”

The students hope to finish converting the truck in April or May, then they will take it to the Miller Motorsports Park in Tooele to see how fast it can go. Their goal: to beat the world record for a wood-gas vehicle set in 2011 on the Bonneville Salt Flats when a truck reached 73 mph.

Regardless of how fast their truck goes, Whitty says they plan to continue teaching the class. Future students can improve the design of the gasifier by making it smaller, more efficient and more powerful.

“We will start from where we left off with this. We are not going to build a whole new car,” he said. “But we could teach this class for 20 years.”

You can view the class progress at treemobile.chemeng.utah.edu.

PARTNERSHIP WITH PAKISTAN

Due to global climate change, mismanagement, politics, inadequate technology, rapid population growth, and economic hardships, Pakistan's water crisis could go from bad to worse.

The Middle Eastern country nestled between Afghanistan and India could become a "water-starved" country in the next six to seven years, according to the country's minister for water and energy. University of Utah civil and environmental engineers are working to change that.

The United States Agency for International Development (USAID) announced earlier this year that the University of Utah has partnered with the Mehran University of Engineering and Technology in Jamshoro, Pakistan, to create a center to research and develop solutions for water problems plaguing Pakistan.

The USAID-funded Partner Center for Advanced Studies in Water will be headquartered at the U with another office in Mehran University. U Civil & Environmental Engineering Associate Professor Steven Burian will become director of the center, which is receiving \$10 million in funding over five years. Research from the center has already begun.

"This is the most exciting project that I will likely work on in my career, and it's because of the fact we are representing the university and the United States," Burian said. "We have so many people involved from across campus, and engineering is

the lead. We are doing things where we will see real impact. It's going to be incredible."

The center's research will focus on topics such as treating and reusing wastewater, desalination, storage and irrigation efficiency, flood control, and community-based solutions. But it also will look at how the country's social, economic and political factors affect the country's water resources. Michael Barber, chairman of the U's civil and environmental engineering department, who also will be working at the center, says research they do to aid Pakistan will also benefit the rest of the world.

"Desalination is a worldwide problem, and we want to help them develop technologies that might be applicable to anywhere," he said. "Yes, it will help Pakistan, but yes, it could help Southern California."

Meanwhile, the center also will have an educational component. A curriculum in water research will be developed, and there will be student exchange programs between both offices, as well as scholarships and community outreach programs.

While the U's civil and environmental engineering department will lead the operation of the center, it will involve faculty from many disciplines, including researchers in biology, geology, geophysics, law, political science and public health. In all, 17 University of Utah professors will be involved, including four from civil and environmental engineering.



ALUMNA SPOTLIGHT

COLETTE MULLENHOFF

Colette Mullenhoff grew up marveling at movie special effects.

She was awed by the stained-glass knight that jumped to life in “Young Sherlock Holmes,” and she was amazed by the surreal mix of cartoon characters and human actors in “Who Framed Roger Rabbit.”

It was then she realized Hollywood special effects would be her destiny. Over the next two decades, her hard work and perseverance would pay off. The University of Utah computer science graduate would forge a path to Hollywood’s most renowned visual effects house, Industrial Light & Magic, as a software and research-and-development engineer. Now, she can add an Oscar to her list of accomplishments. She and three other ILM colleagues — Cary Phillips, Nico Popravka and Philip Peterson — recently received a scientific Academy Award for their development of ILM’s Shape Sculpting System, software that allows digital artists to make transformations of CGI characters as quickly and easily as possible. It was used, for example, to help Bruce Banner (played by actor Mark Ruffalo) morph into the colossal Hulk in the blockbuster “The Avengers.”

“It’s really exciting and rewarding to work on movies and be a part of the movie making process,” said Mullenhoff, who graduated from the U with a master’s in computer science in 1998.

Mullenhoff received her bachelor’s in computer science at the University of California, Santa Barbara and moved to Salt Lake City to attend the University of Utah’s famed computer science department for her master’s degree.

She credits her time at the U’s School of Computing for introducing her to the basics of computer graphics, computer-aided design, scientific visualization and writing software. She also learned the importance of



working on a team and developing software for a large computing system.

“It was confirmation that I was pursuing the right passion and meeting the right people,” she said.

After graduating, she worked at a Salt Lake City video game company as well as at Evans & Sutherland where she helped create environments for the company’s flight simulators. After she moved to California, her first stint with a Hollywood effects firm was with ESC Entertainment, the visual effects company that worked on “The Matrix” films. Then she joined ILM in San Francisco, the legendary effects house started by George Lucas for his “Star Wars” films, in 2003 as a software engineer.

“It’s great to work with the artists,” she said about her collaboration at ILM. “You know that whatever they ask for they’re going to use, and it’s going to make the images you see on the screen. And it’s great that the audiences react in such a positive way.”

IN BRIEF

UTAH NEEDS ENGINEERS

In Utah, engineering programs can grow the workforce. Engineering and computer science graduates are needed to fill an ever-growing list of open jobs.

So this year, the Utah Legislature is giving the state's engineering programs a helping hand. Lawmakers approved \$4.5 million (\$3.5 million ongoing and \$1 million one-time) to fund an engineering initiative to produce more graduates for the state's tech industry.

According to a new study by the Utah Technology Council (UTC) released this month, a sample of 40 of Utah's high-tech companies said they alone have more than 525 positions currently open that require at least a bachelor's degree in engineering or computer science, compared to 320 in 2012. These same companies expect that to grow to more than 1,840 openings in the next year.

The University of Utah's College of Engineering is trying to meet the state's demand for qualified graduates. Last year, it awarded 753 undergraduate and graduate degrees, more than double the number in 1999. But U College of Engineering Dean Richard Brown said local universities need to do more.

"As a state-supported university, the U has an obligation to try to meet the workforce needs of Utah employers. Our success in increasing the number of engineering and computer science graduates has been a factor in attracting companies to our state," Brown said. "But as the UTC survey shows, industry has a need for these graduates that far exceeds the number available."

To help increase the flow of new graduates, the U's College of Engineering has an outreach program that introduces about 40,000 K-12 students to engineering each year. Alumni and friends of the university also donate money that provides more than 450 scholarships each year. And the college is developing high school engineering courses to help students make the transition to the U.



BROOKLYN NOBLE RECEIVES FELLOWSHIP

University of Utah mechanical engineering graduate student Brooklyn Noble was awarded a four-year, national nuclear security agency fellowship for her research on an ultra-thin lubricant, the first student at a Utah university and the first mechanical engineer in the nation to receive the award.

"It's such an honor. I didn't think I would get it, but it's absolutely amazing that I did," says Noble.

There are five recipients each year of the Department of Energy National Nuclear Security Administration Stewardship Science Graduate Fellowship, which pays for four years of tuition, a yearly stipend, additional funding for professional development, and provides an internship at a national laboratory.

Noble is researching the properties of a thin lubricant called perfluoropolyether which is typically used to coat the spinning disks in harddrives as well as in small sensors such as those in automobiles. Her advisor is U mechanical engineering assistant professor Bart Raeymaekers.

The 22-year-old student is in her first year toward her doctorate degree in mechanical engineering at the U and wants to pursue an academic career or conduct research at a national lab or company, she says.



MAKING SENSE OF ALL THAT DATA

University of Utah School of Computing Associate Professor Feifei Li understands the value of crunching data. He knows that analyzing statistics can unlock vital secrets from countless research fields.

That's why Li is developing online software that takes unrelated data — also known as “heterogeneous spatial and temporal datasets” — and mines it for new statistics. This online engine can approximate results when pairing sets such as weather or transportation figures with social media data. Li is also working with researchers in the social sciences and the U's medical school to derive health and social index values.

“In our research and many projects we have worked on, a significant challenge is to deal with data stored in different formats and data management systems,” Li said about the need to develop such software. “And often times, we don't need exact analytical results, yet existing systems don't provide us with the ability to stop data processing early and trade for approximate results.”

The engine can work with any kind of database, including transportation data or sensor information, to social media data such as Instagram posts, Li said. For example, his software can allow a user to zoom in on a map to see what is trending on Twitter by region. “We really want to build

a platform that's open to anybody who wants to get their own data into it,” he said.

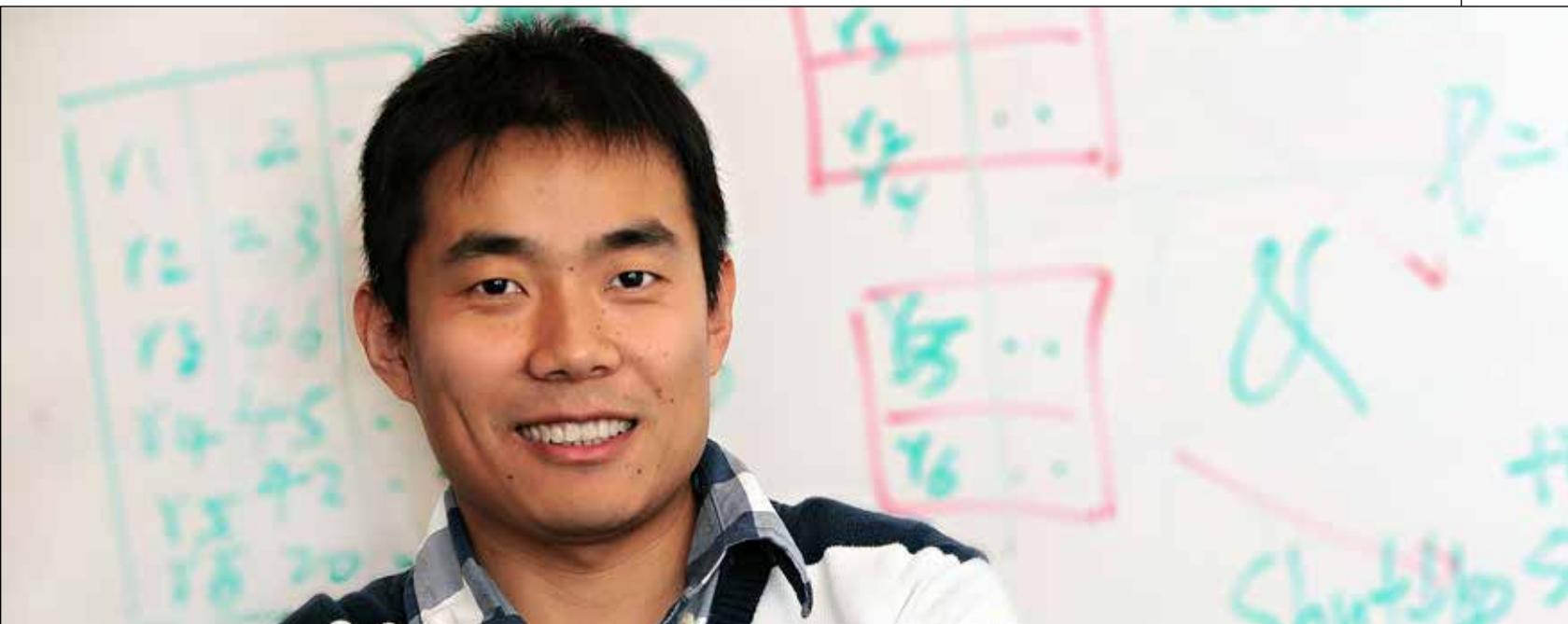
His idea has become even more critical today as mobile devices such as cell phones track more and more information from their users.

“We hope that institutions and businesses as well as individual users will benefit from using our software and systems,” he said. “We are also developing a mobile app that is able to collect data easily so that users can use our system to integrate and explore their offline and online data seamlessly.”

Li's research has become so valuable, it's gotten noticed by the leader in online services, Google. This year, the California-based search engine honored Li with the \$57,000 Google Research Award for his online engine.

“This is a very competitive award,” Li said. “It not only gives you money for research but exposure to Google researchers and engineers and all the other faculty members who get this award from different universities across the world.”

The Google Research Awards are given out to university faculty in support of research in areas ranging from computational neuroscience and human-computer interaction to security, privacy and database management.





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STUDENT LIFE

TEAM PLAYER

In a way, Austin Eastman saw similar lessons in playing basketball for the University of Utah as he does in studying to be a mechanical engineer.

An important one is teamwork, said the 21-year-old senior who is both majoring in mechanical engineering and was a guard on the Utes nationally-ranked basketball team, which made it to the Sweet 16 in this year's NCAA tournament before losing to Duke. There's also dedication and a strong work ethic. He even says the sharp thinking he needs to excel in engineering benefitted him on the basketball court.

"There's the intellectual aspect in engineering where you're always thinking," he said. "And in basketball, I see that from a different perspective, and it's really helpful."

Eastman is yet another example that you can exercise your mind and your body while attending the U, spending his days and nights playing basketball while working on an engineering project that one day could help teach braille to the blind. With mechanical engineering assistant professor Andrew Merryweather as their advisor, Eastman and a team of five other students are designing a refreshable braille display that works with voice recognition. Say a word into the device and the display produces the word in braille with its protruding mechanical pins.



Eastman first tried out for the basketball team early in his college career but didn't make it, so he asked to become a team manager while waiting for an opening. In the fall of 2013, that's exactly what happened.

"They first told me there wasn't much of a chance to get on the team," he said. "But I figured that in 20 years, I didn't want to look back and say, 'Why didn't I give it a chance?' I just wanted to be a part of the team and waited for my opportunity."

He only averaged a minute or two on the court each game, but Eastman became a fan and team favorite with the crowd chanting his name when he walked on. When he finishes his undergraduate studies, he plans to get an MBA at the U so he can "take projects from start to finish."

"I just want to do something that can really help people," he said. "That is what is most exciting to me."