Summer 2016

vector



contents

Letter From The Editors

Between these covers is a wealth of information about the green initiatives on campus. Our staff has covered a gamut of topics on sustainability from the UT Austin microfarms and on-campus posting to cutting-edge research on energy and carbon sequestration. We've also brought back our Ask Alec column, featuring your questions and Alec's thought-provoking answers.

As we are wrapping up the year, we would also like to reflect on the growth of our magazine's leadership and staff. We've significantly increased our readership (that's you!) and visibility on campus. It has been an exciting year for us, full of late Wednesday night staff meetings. Our 30 members on staff have become better writers, layout designers, and photographers since September.

We'll see you on the other side of the summer. If you're itching to join our team or submit content for publication, send us a hello at vector@sec.engr.utexas.edu

- DM and LZ

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OUT OF CHARGE?

why we are still reliant on gas if electric cars are the future

written by
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Electric cars have risen in popularity in recent years. Environmentalists claim that they are greener than normal cars, and we need to consider the state of the planet we leave for future generations. But in comparison to conventional cars, not everything is perfect with these machines.

Comparing electric cars to conventional ones, the main differences are in range, convenience, and emissions.

The first main difference between the two types of cars is their range, which is how far the car can travel on a single charge or tank of gas. Consider this: a mid-sized sedan like the Honda Accord can optimally get 350 miles on a single tank of gas. Hybrids such as the Lexus ES 300h or a Toyota Avalon hybrid can go over 650 miles on a single tank. However, the most talked-about electric car on the market, the Tesla Model S, can only go 240-270 miles on a single charge, which is more than enough for driving around the neighborhood, but for a camping trip with friends or long-distance trips, it just doesn't cut it.

It's not just the range, however, that makes electric cars logistically poor for long trips. These cars need dedicated charging stations, and there just aren't as many of them around as there are gas stations. In cities such as Austin, you can see them in many places, but not if you're driving between cities. You can get a charging station installed in your home, which is a nontrivial bill. And on top of that, it will take several hours for your car to fully charge. If you forget to plug your car in like you sometimes do with your phone, you may not get to work on time in the morning.

However, Gary Hallock, electrical engineering professor and sponsor of the UT Austin solar vehicle team, said that in terms of convenient charging, while we're not completely there yet, we are making progress. For example, there are already charging stations that can fully charge a battery in 30 minutes.

"There are systems that can charge batteries very quickly, and that's one of the areas that is being intently worked on in engineering," Hallock said.

But let's forget long trips and charging and just talk about emissions. Clearly the electric car should win; it burns no fossil fuels! But generating the electricity you charge the car with does. Roughly 2 lbs of CO_2 are emitted for every KWh produced, so to charge an 85 KWh battery, like in a Tesla, generates 170 lbs of CO_2 emissions. Obviously this is better than the 19 lbs of CO_2 generated by burning one gallon of gasoline, but still not zero as some people think.

However, Hallock made the math easier by comparing the efficiencies of power plants and car engines.

"Even if you're using fossil fuels to generate the electricity, there's still a win," Hallock said. "It's not as big as maybe you'd like, but there's still a win 'cause power plants can generate electricity more efficiently than an internal combustion engine can burn fossil fuels."

And while this makes perfect sense, there's another hidden cost with electric vehicles, and according to mechanical engineering professor Ronald Matthews, that's the manufacturing process.

"The big deal is manufacturing the batteries," Matthews said. "The manufacturing process for the electric vehicle ends up producing more emissions than you save by driving a vehicle with no tailpipe emissions."

It seems as if there's a toss-up between how the math works out in the end, for or against electric cars. We can address this the same way we did the range/charging argument: we're not there yet, but we're getting there.

"We will need **better** batteries. It's as **simple** as that."

Gary Hallock

So what does it actually take to get there? According to Matthews, we need better batteries. Agreeing, Hallock said, "In principle, if you solve the battery problem, there are no other important systems in a electric vehicle that still need large amounts of development. We are basically there except for the fuel equivalent system, i.e. the battery."

In addition to consumer interest, an important factor contributing to the success of the electric vehicle is the battery.

"GM first came out with an electric vehicle a couple decades ago, but there weren't enough customers to keep that concept alive," Matthews said. "Tesla did change the game using a completely different battery technology."

Studies into new battery technologies or improving the manufacturing process of current models is of critical importance to the advancement of electric cars. If we really want to change our environmentally harmful ways and become greener, more research and breakthroughs need to happen in this field. Gary Hallock said, "I do believe that our future is with electric vehicles."

WEBBER ENERGY GROUP

written by Crystal Huang
layout by Emily Hood
photos by Emily Crowell-Stevens and Peter Zhang

How much energy can a solar panel generate based on how intense the sunlight is today? Can oil companies use natural gas that would otherwise be wasted to treat fracking wastewater? These are the questions the Webber Energy Group tries to answer.

"Our goal is to think about problems in a systems point of view: how they fit together, how a technology can be adopted," said Michael Webber, mechanical engineering associate professor.

High on the very windy and very sunny roof of ETC, mechanical engineering junior Yuval Edry maintains the weather equipment of the Solar Water Energy Air (SWEAT) lab. Funded partially by the UT Austin Green Fee, the ETC roof is home to a solar tracker, a rain gauge, a model home's roof, and various weather equipment.

The roof is a demo, showing what a future sustainable home could look like and collecting data to develop sustainable technology.

"We're going to install solar panels and compare the amount of electricity generated versus the intensity of the sun that day," Edry said. "Additionally, the model roof will collect rainwater and eventually water rooftop plants. Using the rain gauge, we plan on having a system where an automated pump will water the plants if it's not raining."

As Edry investigates reusing water from the sky, civil engineering graduate student Yael Glazer studies alternative uses for water from the ground wastewater from fracking processes.

"After graduating from UC Berkeley, I was working in the biotech industry, which consumes enormous amounts of high quality water," Glazer said." Compared to developing countries, it was like night and day."

NERGY
ROUP

Glazer evaluates the seven most prolific oil and gas reservoirs in the U.S., and considers factors such as energy intensity needed, water produced, how to capture the gas, and water storage. Ideally, fracking sites could have on-site wastewater treatment plants that would have zero energy needs.

"Fifty years in the future, our children will say, why did we flare that resource?" Glazer asks.

In addition to working on sustainability problems, Webber also recognizes that mindsets are important. He teaches the tech elective, Energy Technology and Policy, and has also published the course for free, through EdX, a Massive Open Online Course platform.

"We need people to think about energy," Webber said. "We need better answers which come from research. Then researchers need to communicate answers to the people, who are not aware of the better solutions."

Through research and education, the Webber group is working to address problems in food, water, energy, and environment.

"I'm really humbled to be a part of this group of bright people who cares deeply about the environment," Glazer said. "It makes me feel confident and a little more at ease [that] such a group is working on these problems and will then go out and change the world."

See real time weather data collected from the SWEAT lab at webberenergygroup.com/sweatlab

"Fifty years in the future, our children will say, why did we flare that resource?"
-Yael Glazer

CO_2 SEQUESTRATION

written by Crystal Huang ~ layout by Emily Hood ~ photo by Emily Crowell-Stevens

Encased and unseen, supercritical CO2 flows through a sedimentary rock core under 3000 psi of pressure in the CPE basement oven. Rafael Longoria is a postdoctoral fellow working at the Center for Petroleum and Geosystems Engineering (CPGE). His research gathers fundamental data needed for carbon sequestration, an increasingly important field of technology that can combat climate change.

Carbon sequestration covers an umbrella of technology that seeks to capture, compress, and inject CO2 created by human activity. The Cockrell School conducts research at the beginning and end of this process: capture and injection. Chemical engineering professor Gary Rochelle and various other individuals in CPGE are working on this today.

Rochelle's group explores amine scrubbing, a method of absorbing CO2 waste from a coal-fired power plant with an amine solvent, then sending it to a high-temperature stripper where CO2 is cleanly desorbed. The challenge is finding an amine with a high rate of reaction to allow for smaller reactors to be built.

Chemical engineering sophomore Rohan Small works in Rochelle's group. Small changes the initial pressure, temperature, and amine concentration to try and optimize the amount of CO2 absorbed.

Small is not the only member in Rochelle's group who has a personal interest in helping the environment. The issue hits close to home for his graduate student supervisor.

"Many of the graduate students I work with come from countries like China, so they are driven by a passion to change their country," Small said.

Once captured, the gas needs to be compressed and flowed to an injection well. This is where the petroleum department's research comes into play.

"Petroleum engineers have decades of experience putting CO2 into the ground," explained David DiCarlo, petroleum engineering associate professor. No other industry has the commercial need. The oil and gas industry uses CO2 for enhanced oil recovery, where CO2 displaces and dissolves oil that stubbornly clings to reservoir rocks.

Longoria's work seeks accurate, consistent measurements of relative permeability, which is correlated to how much CO2 a volume of rock can hold.

Despite the foresight and action on the research side, politicians have yet to enact legislation that encourages the growth of CO2 injection companies.

"Currently there are no large-scale injection projects using anthropogenic CO2. Oil and gas companies use CO2 from geologic sources, which are natural reservoirs of CO2," DiCarlo pointed out.

DiCarlo said, regarding the importance of preserving the environment for future generations, "By 2050, when I'm 80, the concentration of CO2 in the atmosphere will be 450 ppm. At concentrations over 500 ppm, cognitive function decreases."

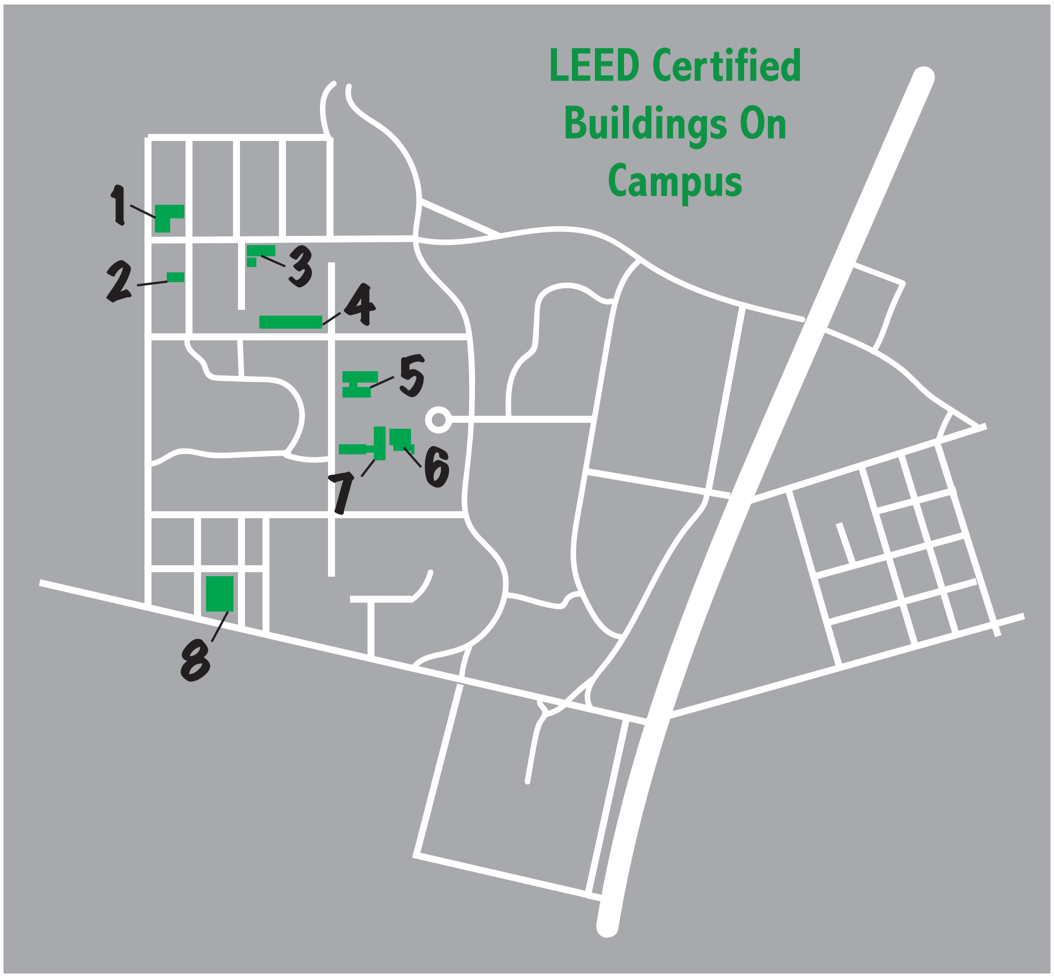
Dr. David DiCarlo

LEED-ing the way

Measuring the sustainability of UT Austin's buildings

written by Tyler Michael Stern
layout by Ashley Stuber

1. **Belo Center for New Media**
2. **William Randolph Hearst Building**
3. **Biomedical Engineering Building**
4. **Norman Hackerman Building**
5. **Gates Dell Complex**
6. **Liberal Arts Building**
7. **Student Activity Center**
8. **AT&T Executive Education and Conference Center**



How sustainable is our campus? Sometimes it's hard to answer a question so broad. How do you measure something with so many components?

A good start, when looking at a campus, is the buildings. LEED, which stands for Leadership in Energy & Environmental Design, is a nationally recognized measure of the sustainability of a building. The system was designed by the U.S. Green Building Council, a non-profit coalition based in Washington D.C. and composed of construction industry leaders, to promote cost effective measures to decrease the negative environmental impact of new construction. LEED standards are recognized across the nation. There are four tiers to LEED certification: certified, silver, gold, and platinum. In order to earn one of these statuses, a building must have a specific number of LEED "credits" in the categories of sustainable sites, water efficiency, energy and atmosphere, materials and resources, and indoor environmental quality.

The University of Texas at Austin has nine buildings on campus with gold certification, including the Student Activity Center and the Biomedical Engineering South Expansion. There are three buildings already constructed on campus with silver certification, the Biomedical Engineering Building, the Gates-Dell Complex, and the Geology Bbuilding Renovation. However, a number of projects currently in construction, including the new Engineering Education and Research Center are expected to receive silver level certification. In all, UT Austin's campus includes 13 LEED certified buildings, and 5 more are under construction.

The University of Texas at Austin is somewhat competitive with other universities with regards to LEED certification. However, there is much that can be done. Colorado State University, for reference, has 13 LEED Gold Certified buildings, with several in construction. The University of North Texas, among several other universities, has pledged to only construct new buildings with a LEED Silver Certification or better.

Hyperloop

the Fifth Mode of Transportation

Transporting goods and people from Austin to Dallas in just 15 minutes.

written by by Sarika Sabnis
layout by Sena Esrefoglu

Which city has the worst traffic? Some say downtown Austin has it bad, others say the commute from Newark to New York City takes the crown. Traffic in the Washington, D.C. area delays commuters a total of 204.4 million hours annually. Now imagine getting from Los Angeles to San Francisco – normally a six-hour drive – in just 30 minutes. Or even Austin to Dallas, a three-hour drive, in only 15 minutes. This is the future of transportation in the 21st century: Hyperloop.

The Hyperloop is a transportation system proposed by Elon Musk, CEO of Tesla Motors and SpaceX, who first thought of the idea when he was stuck in LA traffic on his way to give a talk. So in the true spirit of The Digital Age, he released his theory behind the Hyperloop on an open source platform, open for anyone to improve upon or modify to optimization. In late January, over 180 university teams from all over the world competed in the SpaceX Hyperloop Pod Competition Design Weekend, held in Aggieland – College Station, TX.

Two UT Austin groups, 512 Hyperloop and Texas Guadaloop, were approved by SpaceX to continue improving their promising pod designs and enter the competition in June if they receive enough funding. Both 512 Hyperloop and Texas Guadaloop have a mix of students from different years and specializations.

Khushbu Patel, aerospace engineering senior and 512 Hyperloop project lead, said that her team is comprised of a diverse group of 70 undergraduate students.

"We have every Cockrell engineering major represented on our team, as well as business, RTF, and journalism majors," Patel said.

Held at Texas A&M's Kyle Field football stadium, the pod design weekend attracted teams of students from around the world, from the University of Pisa (Italy) to Technische Universität München (Germany), to Shiv Nadar University (India). Each team presented to a series of judges from SpaceX and other private companies looking to invest in what many are referring to as the "fifth mode of transportation" in addition to the four existing modes: boats, planes, trains, and cars. The competition was split into three categories: Subsystem, Design Only, and Design & Build.

A closer look at 512 Hyperloop's design:

The 512 Hyperloop design consists of multiple modules that fit together to create one cohesive unit. It will combine the concepts of forced-flow axial compressor systems, high-speed air bearing technology, and associated control features. The aluminum air bearings technology can support up to 200 pounds of frictionless movement by maintaining a small gap of air between the bottom of the pod and the track surface.

Patel stated the design was both incredibly light, weighing in at 4800 pounds, and cost effective, with an estimated cost for pod design at just $35,000.

"Our design is very feasible, very modular," Patel said. "It's different from other teams' designs because all of our products will be commercial off-the-shelf. The design has centrifugal compressors and air bearings system. If we wanted to add more compartments to our design, we would add another suspension bearing system that we would then balance out with the center of mass."

A closer look at Texas Guadaloop's design:

Texas Guadaloop uses compressed air bearings, a more cost-effective alternative to magnetic levitation, as well as a network of computers running a robotic operating system in a high-speed communications platform. As compressors are often heavy and expensive, the air will be supplied to

photo courtesy of Texas Hyperloop

the pod by simple compressed air tanks. The pod is calculated to move at the minimum 175 mph, but the team says it can go faster, if optimized without compromising safety.

“What makes the major difference between air bearings and mag-lev is the availability of the power source,” said Patryk Radyjowski, a PhD student in Mechanical Engineering. “In order to use maglev, you need to pack heavy magnets on a board, which are not only heavy and power hungry, but extremely expensive.”

Theoretically, the Hyperloop can reach speeds up to 767 mph! That is equivalent to 340 meters per second, or the speed of sound!

Radyjowski added that air bearings, which used compressed air, are much more compact, lightweight, and will produce little to no drag since there is no electromagnetic field slowing down the pod. Texas Guadaloop is one of only a few startup teams to work with Airfloat, the founder of which actually invented air bearing technology.

“Our pod will implement navigation vectors and safety features without the need for a driver,” said Vik Parthiban, graduate student in Electrical and Computer Engineering.

Parthiban said the strength of the pod structure was designed and optimized with help from their civil engineering team.

“We utilized urethane diaphragms with superior air resistance to minimize drag, eliminate friction, and generate up to 18,000 pounds of lift, while floating on a thin slice of air,” Parthiban said.

All in all, Texas Guadaloop has designed their pod to be made at under $25,000, making it a key selling point to companies interested in partnering with the team. Their use of simple design concepts to optimize the speed, structure, and safety of transportation, have turned their model into a game-changing contender to the collection of pods invited to the June test track.

What’s Next

Both Texas Guadaloop and 512 Hyperloop have stated that there are many challenges that lie ahead on the road to developing Hyperloop.

“I think one of the biggest challenges for us is presenting the concept of air bearings to investors in a marketable manner, since the technology is still being optimized,” corporate director of Texas Guadaloop Kaelin Hooper said.

During Elon Musk’s surprise visit at the end of the SpaceX Pod Competition Design Weekend, he admitted the whole idea of hyperloop came to him on a whim, which he has shared to drive the conversation of innovations in transportation technology.

“What I really intended to do with the hyperloop was spur interest in new forms of transportation,” Musk said. “I’m starting to think it’s really going to happen. With this level of attention, it’s clear the public and the world want something new and I think [these students] are going to bring it to them.”

Both teams are now working hard to crowd-source their pod designs into completion to test on the SpaceX Hyerloop Test Track in the summer. You can donate to Texas Guadaloop through their GoFundMe page (www.gofundme.com/texasguadaloop) and to 512 Hyperloop through their Horn Raiser page (https://hornraiser.utexas.edu/project/1513), as well as follow these teams on Facebook. We at Vector are wishing both teams the very best of luck!


UT
MICRO
FARM
THURSDAY 3-5
SUNDAY 9-12

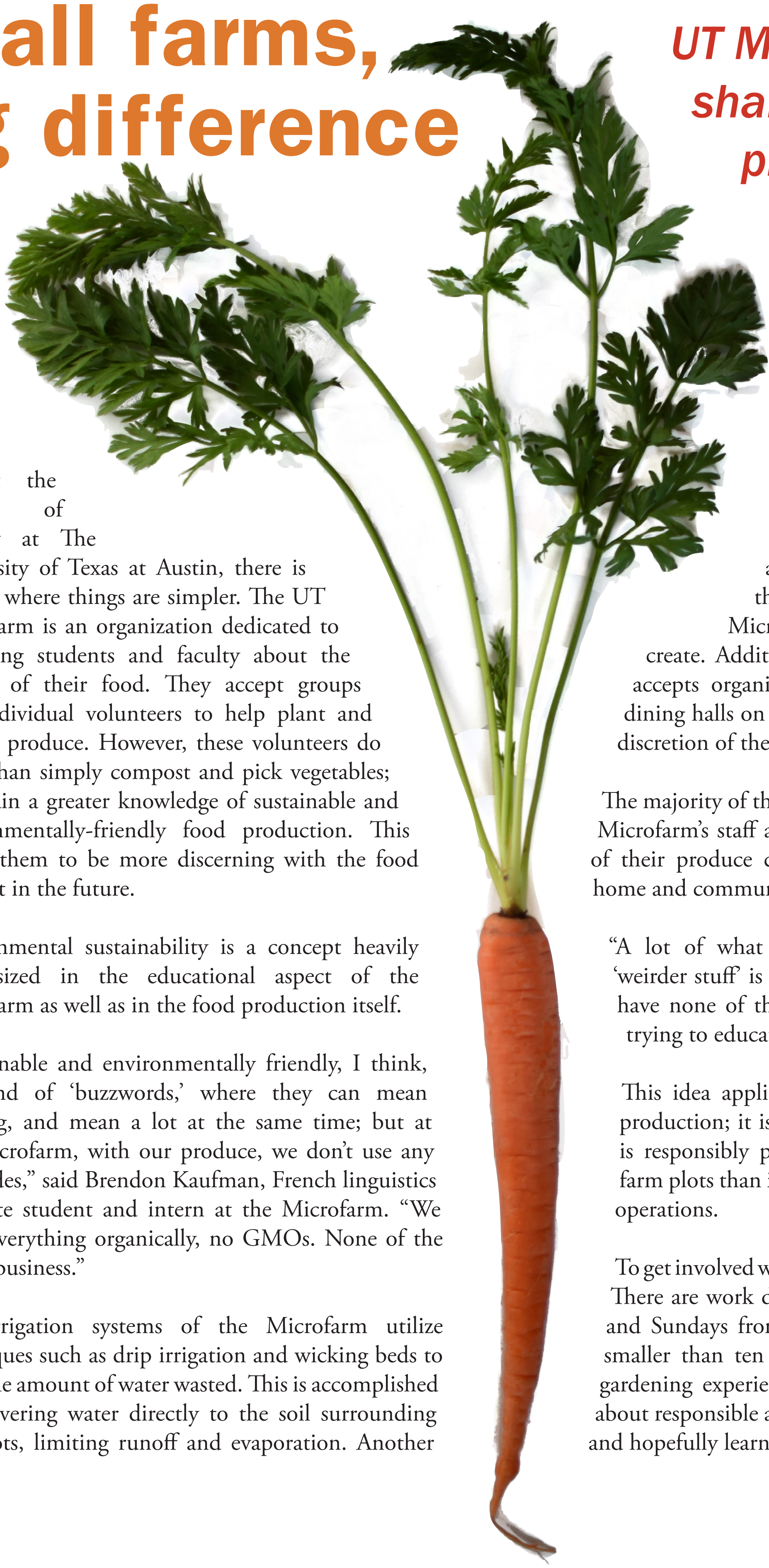
growing our own

Tucked away on Leona street half a mile west of campus is the UT Microfarm, which buzzes with students gardening and learning about food production sustainability every Sunday and Thursday. Through hands-on practice, students of all gardening experience levels learn about the importance of mulching, using fertilizer, and practicing crop rotation. Each Sunday at the Hope Farmer's Market and Monday on the West Mall, the general public can purchase the microfarm's produce, which includes cucumbers, butternut squash, and purple hull peas during the summer months.

small farms, big difference

UT Microfarm shares fresh produce and fresh facts

written by Tyler Michael Stern
layout by Ashley Stuber
photos by Parisa Maesumi



Amidst the flurry of activity at The University of Texas at Austin, there is a place where things are simpler. The UT Microfarm is an organization dedicated to educating students and faculty about the origins of their food. They accept groups and individual volunteers to help plant and harvest produce. However, these volunteers do more than simply compost and pick vegetables; they gain a greater knowledge of sustainable and environmentally-friendly food production. This allows them to be more discerning with the food they eat in the future.

Environmental sustainability is a concept heavily emphasized in the educational aspect of the Microfarm as well as in the food production itself.

"Sustainable and environmentally friendly, I think, are kind of 'buzzwords,' where they can mean nothing, and mean a lot at the same time; but at the Microfarm, with our produce, we don't use any pesticides," said Brendon Kaufman, French linguistics graduate student and intern at the Microfarm. "We grow everything organically, no GMOs. None of the funny business."

The irrigation systems of the Microfarm utilize techniques such as drip irrigation and wicking beds to limit the amount of water wasted. This is accomplished by delivering water directly to the soil surrounding the roots, limiting runoff and evaporation. Another important initiative is the composting system. By reusing all non-produce organic matter as compost to fertilize the plots, the staff and volunteers at the Microfarm reduce the waste they create. Additionally, the compost system also accepts organic waste from a number of the dining halls on campus and other sources, at the discretion of the Farm Leadership.

The majority of the techniques implemented by the Microfarm's staff and volunteers in the production of their produce can actually be accomplished in home and community gardens.

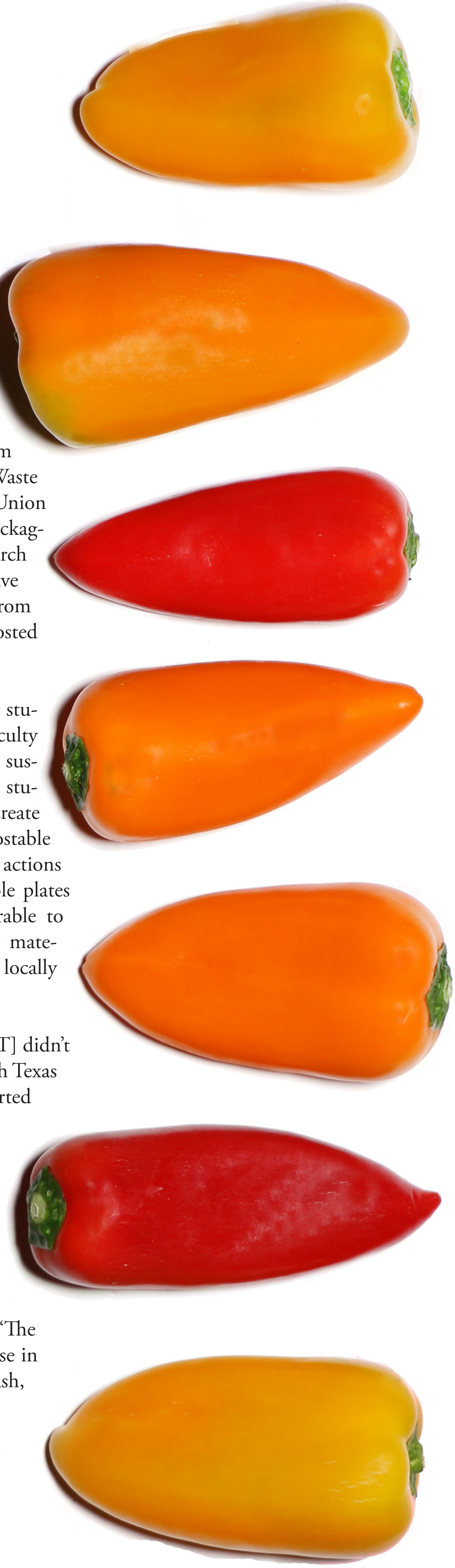
"A lot of what motivates bigger farms to use 'weirder stuff' is demands for production, and we have none of those," Kaufman said. "We're just trying to educate people."

This idea applies just as well to at-home food production; it is much easier to ensure that food is responsibly produced in smaller gardens and farm plots than it is when dealing with larger scale operations.

To get involved with the UT Microfarm is very easy. There are work days on Thursdays from 3-5 p.m. and Sundays from 9 a.m.-12 p.m., when groups smaller than ten can show up and, without any gardening experience, assist in sharing knowledge about responsible and sustainable food production--and hopefully learn something themselves.

Composting ON CAMPUS

written by by George Zhou
layout by Sena Esrefoglu
photo by Parisa Maesumi



As the world increases its trash production, The University of Texas at Austin is reducing its on-campus waste generation. Initiatives by the Office of Sustainability include encouraging and educating about decreasing usage of non-compostable material, and increasing proper disposal of trash around campus.

The Office of Sustainability started the Zero Waste Program recently with the goal of diverting 90% of waste from landfills through methods such as composting.The Zero Waste Coordinator, Jennifer Hobson said, "I work with the Union on composting, reducing contamination in their food packaging, and animal bedding composting in some of the research buildings as well." For example, Norman-Hackerman have shavings from animal beddings that the program diverts from the landfill. As of 2015, UT Austin has already composted 700,000 pounds of material.

Another program, Green Events, focuses on encouraging student organizations and faculty events to dispose of trash sustainably. They work with students and/or faculty to create a plan to use more compostable materials. This includes actions such as selling compostable plates or cups at prices comparable to those of non-eco-friendly material, and recommending locally grown food.

Sustainability Coordinator Neil Kaufman, said "They [UT] didn't always have food composting services." UT partnered with Texas Disposal Systems nearly four years ago and has since diverted much more food waste from landfills.

In dining facilities such as Jester City Limits, bins with separate bins for compost, recyclable material, and trash have been installed. The compost bins have a larger hole to encourage people to throw trash in compostable slots whenever possible. Still, it is unclear sometimes what material is compostable and what isn't. Finance and Business Honors Program junior, Chelsea Young, said, "The things I know are recyclable, I make an effort to put those in the [recycle bin], but when it comes to compost and trash, it's whichever I come to first."

Getting Lit at UT A

Behind the Scenes at UT Austin's Power Plant

written by Marshall Tekell • *layout by* Audrey Gan • *photos by* Brendan Towlson

In 1994, an earthquake cut off power for over half the city of Los Angeles. Bewildered residents began to call local astronomical observatories to report a "giant silvery cloud" hanging ominously over the city. That cloud was the Milky Way - the galaxy Earth has called home for billions of years.

The Angelinos' confusion showcases the extent to which reliable electricity has changed the way we interact with the world. We replaced starry skies with ambient light from unending cycles of production and consumption, and we didn't even notice the difference.

The University of Texas at Austin, as a modern research institution, cannot escape this reality. The university must provide reliable power to over 160 buildings that service over 50,000 professors and students. Normally, universities connect their properties to the public electric grid and purchase electricity from a local energy utility. However, for UT Austin, which consumes more electricity annually than several small countries, purchasing energy from the publicly-owned utility is neither the most cost-effective nor the most efficient way of meeting campus power needs. Instead, the university generates and distributes its own electricity on its independent microgrid. Housed in several buildings between Speedway and San Jacinto on 24th street, the Hal C. Weaver Power Plant provides buildings on campus with heat, air-conditioning and electricity, in addition to a variety of other specialized services. Even if the Austin energy grid were to collapse, the Weaver Power Plant retains the capacity to meet 100% of the university's power needs. Having this source of centralized power is one of the university's most remarkable yet seldom-mentioned assets. Many large institutions generate power and steam on-site, but very few meet their energy demand independently. For example, the Texas A&M power plant, which has about one-third the capacity of the Weaver plant, only satisfies half of the university's demand, forcing the institution to make up the difference with energy purchased from the local utility.

Weaver's plant operations manager, Clay Looney, has an office that looks out into a three-story chamber housing natural gas boilers, electric generators, steam turbines, and a web of piping. Looney explained that the main goal of the power plant operations is safety and reliability.

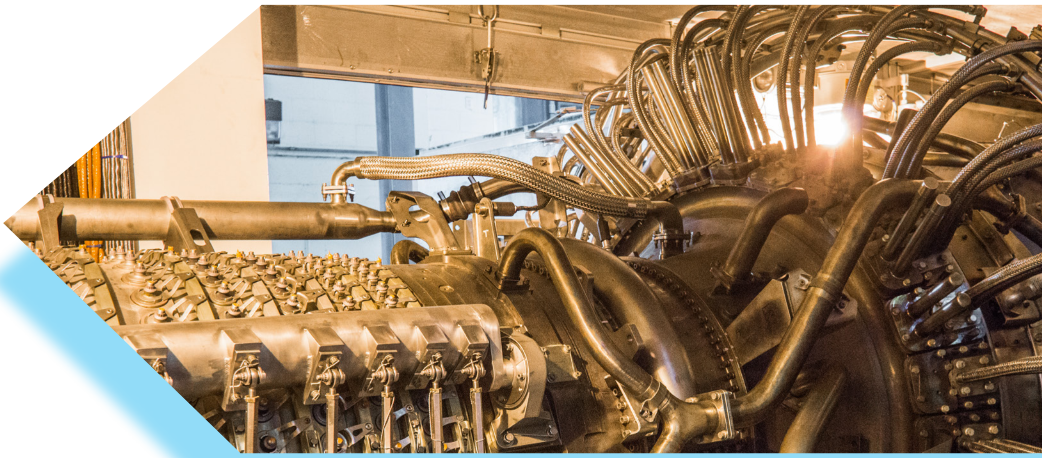
"As a utility you don't want anybody to know that you are there," Looney said. "Even if everything on our side goes haywire, in a perfect world, nobody on campus even realizes that we have had problems." In fact, the plant has achieved a reliability of 99.9998% over the last 35 years. To the outsider, the plant seems to operate effortlessly and seamlessly.

However, inside the plant, the scale and complexity of operations are immediately overwhelming. Ear plugs are needed to diminish the deafening roar created by generators and turbines. Pipes carrying steam, water and natural gas criss-cross the ceilings and the spaces beneath the metal grating under your feet. Men in hard-hats climb into machinery and work on convoluted repairs. Various pressure gauges and control boards adorn the sides of equipment. Looney explained that much of the current equipment was installed in the mid-nineteenth century and that their controls and measurements have since been digitized. "If something wacky happens overnight, I can come in the next morning to find a historization graph showing exactly what happened," Looney said.

Part of Looney's job involves optimizing plant operations to achieve maximum efficiency. The Weaver Plant is a combined heat and power plant, which means the excess heat from the burning of natural gas is utilized to chill water and create steam. The water and steam and are then distributed to every building on campus to be used in air-conditioners and heaters, respectively. This process improves overall efficiency, saving money that would otherwise be spent on more natural gas.

While the Weaver Power Plant does a remarkable job of producing and distributing power efficiently, it still

Austin



relies upon energy obtained from natural gas, a fossil fuel which contributes to greenhouse gas emissions. Due to sustainability efforts on behalf of the UT Austin Department of Utilities and Energy Management, the amount of natural gas used in Weaver Plant operations has actually decreased over the past decade despite consistent growth in campus energy demand. As of 2013, annual carbon emissions have returned to 1970s levels.

Improvements in power generation efficiency certainly help reduce carbon emissions and the campus' environmental footprint, but are there opportunities to incorporate renewable sources of energy into the microgrid?

"Once you have such a highly efficient system, there's not much you can do on a large scale," said chemical engineering professor Thomas Edgar, who researches power plant optimization. "The best opportunities for renewables will be if power needs increase ten years from now, when renewables become cost-competitive. It would be a very expensive proposition to expand current power production."

As the university constructs new buildings like the Dell Medical Center, power needs may outgrow the power production of the Weaver Plant. In the case of this eventuality, solar energy production on the rooftops of campus buildings may provide the energy needed to make up the difference. For now, however, engineers and scientists working at the Weaver Power Plant will continue to look for new ways to optimize the burning of natural gas to reduce carbon emissions.

The tower bathed in burnt orange light signifies student and staff achievements, and, among other things, a victory over Texas A&M. None of our accomplishments would be possible without efficient and reliable energy production from the Weaver Power Plant. One extended power outage could ruin a professor's research decades in the making. And yet, we often fail to consider the importance of plant operations as the driving force behind every laboratory and every power outlet. So, as you look up at the tower, remember that that light is only possible because of whirring generators in an unassuming building on 24th street.

UT Solar Car

written by
George Zhou

layout by
Sena Esrefoglu

photo by
Justin Zhong

Nearly 30 years ago, the Solar Vehicle Team formed at The University of Texas at Austin and has developed considerably since. They have, to this day, built five cars, two of which have been capable of driving across several states.

Their projects typically cost thousands of dollars each, and one cost nearly $120,000 for parts. Alejandro Silveyra, electrical engineering senior and project manager for mechanical systems, said the cost of building the car could amount to magnitudes more if they were to account for labor costs.

"If we were to pay people to do it, it could reach upwards of 300, 400 thousand dollars," Silveyra said. "We average about six or seven people working full-time; if you get 2,000 hours per person working on it a year and the average salary of an an engineer is about $70,000, it gets pretty expensive." A large portion of their funding comes from companies that want to attract talented engineering students.

The annual solar vehicle team competition is split into two stages—a preliminary and a national competition. The preliminary competition is a three-day racing event at the Formula 1 track in Austin, where teams race to complete the most laps when the sun is out. The teams that complete the most laps move on to the national competition, during which teams race across seven states stopping at checkpoints such as national parks or historic sites.

Fred Engelkemeir, electrical and computer engineering graduate student and Electrical Systems lead said teams are allowed to tilt their cars at an angle to charge their battery with solar energy as the sun sets.

"The only energy you are allowed to use is solar energy once you start the race," Engelkemeir said.

The UTSVT car has been designed for maximum efficiency.

"There's no transmission, because the motor tends to be connected directly to the rear wheel," Alejandro said. "The reason we do this is [so] you don't lose any kind of energy on gears, because every time you have a gear you have the potential of losing three or four percent of energy consumption." Moreover, their solar arrays are around 25 percent efficient, which is about as efficient as some of the most advanced arrays on the market.

Electrical Engineering professor Gary Hallock said his team builds their own basic systems instead of buying them.

"One of the things I am really proud of is that our team develops the solar car components rather than relying on commercial systems like the car electronics [and the] solar array. Various other systems are all made from basic electrical, mechanical components as opposed to buying complete motor controllers and power trackers and so forth," Hallock said.

Engineers for a Sustainable World

A closer look at the innovative, interactive, and awesome green projects at UT Austin's ESW club.

written by Sarika Sabnis

layout by Dmitri Mirakyan

photos by Somya Agarwal

Aquaponics

"Aquaponics is the idea of combining aquaculture (raising fish) and hydroponics (growing plants in water) into one synergistic system. The basic principle behind this science is using fish waste to fertilize plants, and using plants to purify the fish's water. In this way, the fish and the plants form a mutually beneficial relationship that allows them to thrive more than they could living apart. The purpose of our project is to design, build, and operate an aquaponics system to teach ourselves and the UT [Austin] community about the sustainable benefits of this technology. We've designed and built two systems so far; a floating raft system and a media bed system. Both are housed in the greenhouse behind Painter Hall. Floating raft aquaponics is where the plants float on rafts and their roots dangle into the nutrient-rich water. Media bed aquaponics is where the water from the fish tank percolates through a bed of rocks, and the plants grow in this rock bed."

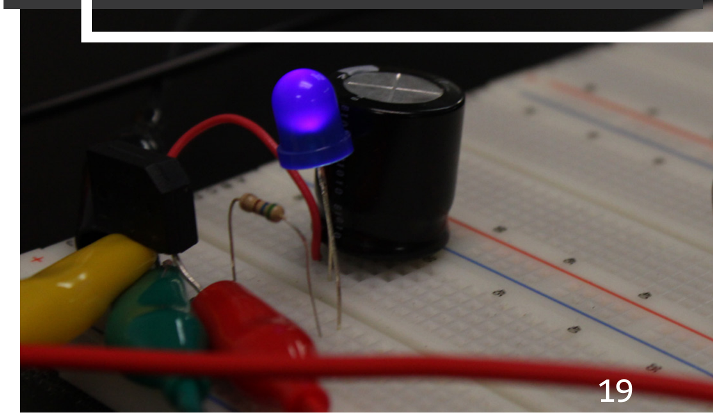
Project Lead: Andy Bussing

Solar-Powered Smoothies

"The Solar Powered Smoothie Cart ...consists of a solar panel hooked up to a battery, and can power anything that can be plugged into an outlet--not just blenders! The majority of our sales are smoothie sales, where the blenders are powered by the solar panel, but this spring we introduced tea and hot chocolate sales, using an electric kettle. Sometime in the near future we have plans to renovate the cart to improve its physical framework."

Project Lead: Caroline Kung

Project Piezoelectric



"Project Piezo is student-run research, [designed] to further explore the concept of piezoelectricity, which is generating electrical energy in response to applied mechanical stress. Our focus is exploring different forms of piezoelectricity through a variety of transducers. One transducer generates voltage through vibrations, while another [does so] by incrementally applying stress. With our research, we've learned there are still plenty of factors that piezoelectricity can be improved on, such as efficiency and cost. Our goal is [to] bring exposure to piezoelectricity by creating a physical prototype that can be showcased, as well as an in-depth report on all our findings from testing piezoelectric elements. It will be a box with LEDs on top, with the circuits on the inside, and we crank a gear to continuously hit the transducers, [which will] generate power. By creating the physical prototype, we can show students piezoelectricity in action. With the report, people can further learn about piezoelectrics and how different transducers manipulate the mechanical energy we apply."

Project Lead: Eric Wang

"The UT Micro Farm is full of little critters like this lovely lady bug."

EMILY CROWELL-STEVENS

Barton Creek Greenbelt

"Fun Fact: Texas produces the most wind energy of all of the states in the U.S., and wind energy accounts for 9% of the electricity generated in the state!"

PARISA MAESUMI

West Texas Windfarm

"The preservation of natural spaces is a key aspect in being environmentally conscious. National parks are my favorite places to appreciate the outdoors and understand the world around me."

ALLIE RUNAS

Fungi in Muir Woods

"Nature at its finest. Dandelions never fail to impress!"

SOMYA AGARWAL

Dandeloins

"The Barton Creek Greenbelt preserves some of the natural elements of nature, and has lots of trails following the flowing streams."

BERRILL BEHRENS

Barton Creek Greenbelt

"To me, the most fascinating eco-friendly trend in our modern society is the practice of putting plants on rooftops. When you visit these SAC gardens, please take care to remember that you are three stories up despite the confusing field of greenery."

BRENDAN TOWLSON

Green 2-2

human nature

Nature through the eyes of Vector photographers

The Ultimate Texas Longhorn

the story behind our beloved mascot

Written by Marshall Tekell | Layout by Rachel Scott | Photo courtesy of Kimberly Krockover

Bevo is more than a cow, or even a champion longhorn. Bevo is the physical manifestation of the Texas Longhorn Silhouette, which was recently named the most iconic logo in all of college sports by USA TODAY. When students make the Hook 'em hand sign, their pinky and index fingers transform into the exceptionally large horns jutting from either side of Bevo's head. Bevo embodies Texas tradition and roots the spirit of The University of Texas at Austin in our state's pioneering ranching history.

Sadly, after the passing of Bevo XIV, our university is without its beloved mascot, and the search is on for the next longhorn to be declared Bevo XV.

According to Ricky Brennes, President of the UT Silver Spurs Alumni Association, Bevo XV must not only be the best of the breed, but he must also have the right personality to take on several large responsibilities. Bevo XV will be a celebrity, a fixture on national television every Saturday, and a constant photo opportunity. Last year, the Longhorn Network even aired a five-hour-long Christmas special of footage of Bevo set to Christmas music.

Bevo also gives back to the Austin community. Every year, thousands of alumni contribute generously to the Silver Spurs to help pay for Bevo's care and travel expenses. The Silver Spurs use the remaining funds for their Neighborhood Longhorn program, which helps Austin's economically disadvantaged schoolchildren reach academic success.

Bevo XIV faithfully served the university in this capacity for over a decade, but as veteran rancher and longhorn breeder Susan Young said, "The Bevo from twenty years ago would not make it in the show world today." Young is the owner of Ranger, a longhorn who has won numerous Grand Champion honors, and whom Young believes is qualified to be the next Bevo.

> *Bevo is the physical manifestation of the Texas Longhorn Silhouette, which was recently named the most iconic logo in all of college sports.*

In order to be considered the best of his breed, Bevo XV must meet a long list of desirable characteristics set by the Texas Longhorn Breeders Association of America (TLBAA). According to TLBAA, in addition to mild temperament and horns over six feet long, Bevo XV must have "sound, dense bones" and an "elliptical shaped body for heat adaption." And, of course, Bevo's coat must be an aesthetically pleasing combination of burnt orange and white.

As Bevo remains absent from the sidelines of football games and other sporting events, students should take time to reflect on the exceptionalism of this tradition. Bevo is the ultimate Texas Longhorn, and the most beautiful specimen of a remarkable breed of animals. He represents the strength and the integrity with which all longhorns pursue their goals. In the words of Susan Young, even in the wild, "Nobody messes with a longhorn."

●●●○○ UT Eng 3D 4:01 AM 76%

Ask Alec

@Alec Will the new engineering building have more research facilities and places to eat? Getting tired of Taco Joint three times a day.
-Hungry

214

@Hungry The Engineering Education and Research Center, set to finish construction in Fall 2017, is going to be equipped with state of the art collaborative research spaces. These spaces are intended to be used for undergraduate classes and research, graduate and faculty research, and collaboration with researchers from other institutions, industries, and disciplines. The building is designed to be a livable space for engineering students, with places to study and do homework, labs for prototyping and design, and a cafe to fuel it all.

321

@Alec I'm pretty sure my TA is playing favorites. I'm really desperate for those extra points. How do I become his favorite?
-Not with the program

234

@Not with the program Okay, maybe you've heard this a million times, but it's true: office hours. Going to office hours is the single best way to get to know your TAs and professors. And a lot of them are really desperate for somebody to come fill that time; they're required to sit in their office for that time each week, and it is a lot more interesting if there's a student there with a question.

161

@Alec Why do the bathrooms in CPE smell?
-Juicebox

895

@Juicebox After a whole lot of research, some googling, and a detailed investigation, I have determined that it might be possible that people poop in there. Still waiting for peer review.

532

Submit your questions to vector@sec.engr.utexas.edu.and look out for Alec's answers in our next issue

787

AngryBusinessStudent is typing ●●●

photo by Christina Cuellar-Nelson