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wisconsin engineer

APRIL 2011 VOLUME 115, NUMBER 3

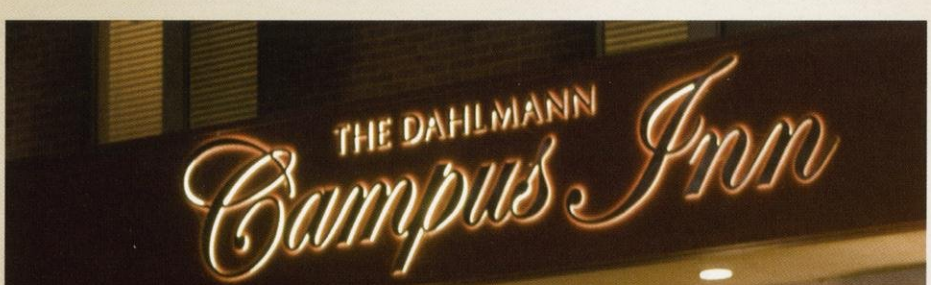
Photo Contest

Check out our contest winners on p. 11

The New York Times, Chicago Tribune and *Michael Sievers* agree...

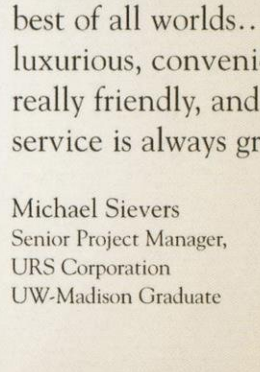
"The **Dahlmann Campus Inn** *offers a touch of boutique refinement in the heart of the campus, with rich wood furniture and floral tapestries."*
—The New York Times, July 5, 2009

"A quiet respite from a busy college town...The elegant touches begin in the lobby, with marble, mahogany and original artwork..."
—Chicago Tribune, October 25, 2009



"I stayed at another downtown hotel for years, then I started staying here. The Campus Inn is the best of all worlds... luxurious, convenient, really friendly, and the service is always great."

Michael Sievers
Senior Project Manager,
URS Corporation
UW-Madison Graduate



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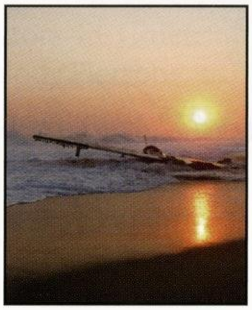
Feature

General



Cover photo by Ivan Diaz

Commentary

Letter from the editors

This year we received more than double the entries for our annual photo contest (see page 11) than ever before. The first thing I wanted to do in this issue is thank everyone who participated for helping us make the event such a success! Because of the photo contest excitement, the April issue was a lot of fun to work on. In appreciation of our staff's eager efforts to develop an excellent final product, we decided to print it in full color to showcase their hard work.

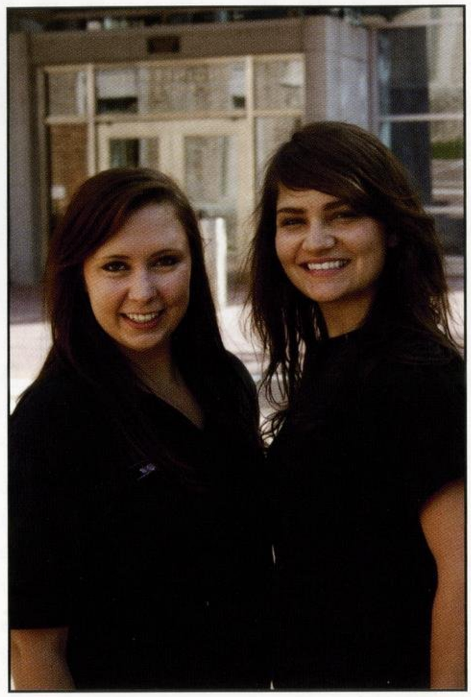
Not only is this April exciting for our magazine, but for the entire southwest end of campus. With the grand opening of the new Union South on April 15 (see page 14) and the biannual Engineering Expo the same weekend, there is more hustle and bustle around the engineering campus than usual.

The large amount of resources put into the development of the new union appears to reflect an effort to bring more visitors and campus community members to the west end of campus. What used to be that dooming block of Dayton Street with a coal plant, scary two-story apartment "complex", rundown computer science buildings and void of absolutely any green space is now home to a multi-million dollar research facility, an undeniably beautiful and state of the art entertainment center for students and a Subway®. I must say, it's about time the Engineering and computer sciences campus gets the attention and cuisine it deserves.

In general, UW-Madison has had a reputation across the nation for its political atmosphere and liberal arts disciplines. With the most common major on campus being Communication Arts, it's no secret that there is a major difference in the amount of students that are in Engineering Hall versus the Humanities building at any single point in time. There is probably a good amount of students that don't even know that there is a nuclear reactor in the Mechanical Engineering building (see page 22).

If there is anything I have become more aware of in my three years with the magazine, it is the amazing amount of ground-breaking research on this campus. It is refreshing to see the people who run UW-Madison take actions to encourage visitors and students of all disciplines that tend to gravitate towards State Street to instead, move west near the homely block of Engineering Drive. WE

By Melody Pierson



Melody Pierson

COLLEGE OF ENGINEERING UNIVERSITY OF WISCONSIN-MADISON

THE UNIVERSITY of WISCONSIN MADISON

The *Wisconsin Engineer* magazine, a member of the Associated Collegiate Press, is published by students at UW-Madison. Philosophies and opinions expressed in this magazine do not necessarily reflect those of the College of Engineering and its management. All interested students have an equal opportunity to contribute to this publication.
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DIAMONDS
A Researcher's Best Friend

The concept of birthstones—twelve luxurious jewels assigned to each month of the year—dates back thousands of years. Older yet, is the diamond, denoted as the birthstone of April and among the most desirable gemstones. Their name, originating from the Greek word adamas, means invincible. Diamonds are the hardest and most wear-resistant material known to man. They are a unique form of carbon in which its atoms arrange themselves in an abnormally confined crystal structure. At standard pressure, a diamond will convert to common graphite after a few billion years. This eternality of the dazzling gems alludes to their extensive use in the jewelry industry and validates the statement "diamonds are forever." However, this astounding jewel has also caught the eye of researchers. With a striking array of properties, including high thermal conductivity, electrical resistivity, chemical inertness, biocompatibility and a low coefficient of friction, diamonds are no longer only fit for one's ring finger!

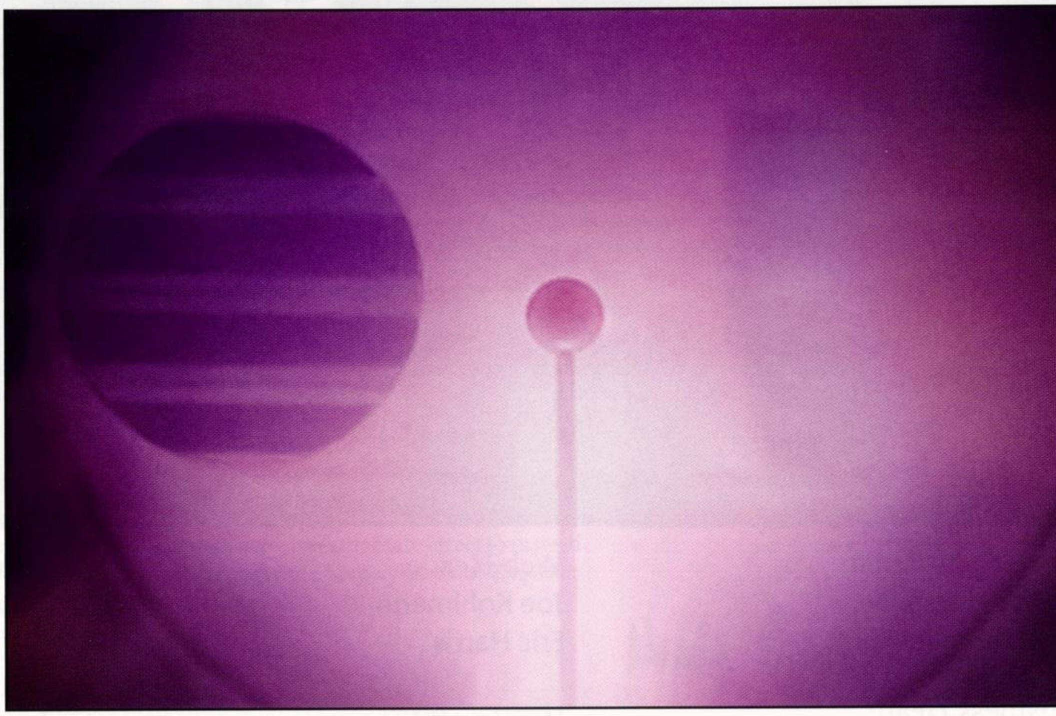


Photo courtesy of: Dr. Sridharan

Photograph of acetylene plasma used as precursor of deposition of diamond-like carbon films.

Along with these astounding properties comes one major drawback: rarity. At least until recently, that is. In the 1980's, Japanese scientists developed a process of creating a "diamond-like" carbon (DLC) using a technique called chemical vapor deposition. This process entails a chamber heating a hydrocarbon precursor and an excess amount of hydrogen gas using a hot filament. As the molecules of these substances break apart, carbon atoms deposit themselves as thin films of graphite and diamond on the bottom of the chamber. Hydrogen plasma is also created, which etches away the graphite and leaves behind a layer of DLC only a few-hundred nanometers thick. Interestingly, the Japanese initially used sake as the source of hydrocarbons and later General Electric reproduced this feat using Jack Daniels whiskey. Suddenly, a material almost identical to diamond in structure and properties was being produced with relative ease and cost efficiency, revolutionizing this material in the same manner that materials such as steel and plastics have been in the past. This discovery sparked world-wide interest among researchers and compelled them to investigate the potential applications DLC might have.

One of the researchers quick to investigate the uses of this material was Kumar Sridharan, a distinguished research professor of engineering physics at UW-Madison. In the early 1990's, Sridharan was part of a research team that developed a method of applying a coating of DLC to three-dimensional surfaces using a plasma-based process developed by John Conrad, retired distinguished professor of engineering physics at UW-Madison. This application technique "…allowed [them] to take a three-dimensional object, like a sphere, and coat all sides of it uniformly, rather than only coating what is in the line-of-sight," Sridharan says. He asserts this UW research team was the first to pair this method with diamond-like carbon material: "We have always deposited thin films on materials, but never had this non-line-of-sight method been used to deposit DLC coatings on objects." This advance is notable because Sridharan and collaborators are now able to use this method on nanoscale technology.

Recently, Sridharan collaborated with researchers from the University of Pennsylvania and IBM to further investigate the uses of DLC. The results? Not only did they discover another application for this incredibly strong material, but the researchers also forged a simple and efficient process of manufacturing nanoscale tools made entirely of diamond-like carbon. IBM researchers first etched miniscule, pyramid-shaped molds on silicon microcantilevers. Sridharan then accurately filled these nanometer scale pits with silicon-doped diamond-like carbon, casting nanoscale tips that have advantageous applications in the areas of atomic-force microscopy, nanolithography, data storage, and nanomanufacturing.

Sridharan and his collaborators were especially interested in how this new material wears in comparison to the current standard for nanomanufacturing, silicon. By performing a series of tests on these tips, they were able to observe fric-

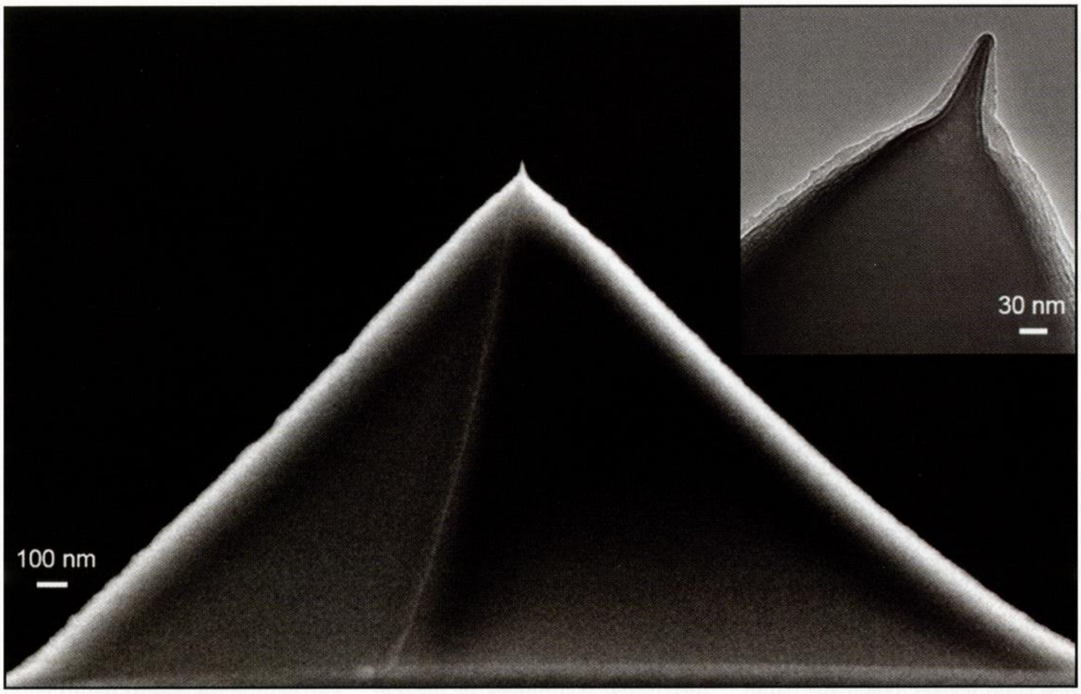


Photo courtesy of: Dr. Sridharan

High magnification image of a monolithic Si-DLC tip with potential uses nanofabrication.

tion at a fundamental level. "One often does not see the very elementary mechanism of wear… The cracks and defects that contribute to the wear process is what one normally sees. One never understands the wear process on a very fundamental scale, because of the inherent defects in materials. Once you create a tip like this—which almost reaches a width of a few atoms at the tip—then wear can actually be observed, atom by atom." Sridharan and his collaborators found the silicon-containing diamond-like carbon tips to be approximately three thousand times more wear-resistant than the silicon tips, which he says is "…very effective in comparison to the current standard."

Nevertheless, researchers at UW-Madison are still striving to hone the cutting edge of this new application method. "How precisely diamond-like carbon coating is deposited to a surface is very critical—if we use the wrong parameters, graphite might develop or the film may not adhere to the surface," Sridharan says. Alongside Sridharan, Frank Pfefferkorn, associate professor of mechanical engineering, is investigating this concern for deposition of nanocrystalline diamond coatings. "The bottom line revolves around how we prepare the surface that we want to grow the diamond on," Pfefferkorn says. Currently, most cutting tools are made of tungsten carbide, of which there is always cobalt at the grain boundaries. "Cobalt reacts chemically with diamond and fosters the formation of graphite." Traditionally, an acid is used to etch away this cobalt layer. However, such minute tools are severely weakened by this acid. "And this is where [Sridharan] comes in. He uses a method of bombarding the tungsten carbide surface with carbon ions using the same process he uses for depositing DLC films," Pfefferkorn says. This method has been successful in improving the adhesion of nanocrystalline diamond to the tungsten carbide surface, though the reasoning behind why is not yet fully understood. The researchers speculate that the carbon ions either react with cobalt to make carbide, or push it below the surface. "We are not perfect at doing this, but we are improving. It is certainly a work in progress," Pfefferkorn says.

Moreover, researchers are finding an array of appealing uses for this synthetic diamond. For instance, it is now being used to improve micro-cutting tools. These tools have the potential to one day create the constantly shrinking machinery used in all manufacturing industries. "Because we're putting down material atom by atom by atom," Sridharan says, "DLC coatings are very amenable to coating very small devices such as micro-electromechanical machines."

Beyond coatings for machine tools, Sridharan sees potential for synthetic diamond coatings in medical applications. He explains that diamond as a biomaterial "exhibits high biocompatibility and positive bioactivity," giving it the potential to be used as a coating for non-biocompatible implants and surgery tools.

Furthermore, diamond is the best conductor of heat in existence. This property is being exploited in synthetic diamond computer chips, which rapidly shed the heat they produce while operating, allowing the chips to be arranged closer and more efficiently. Synthetic diamond computer chips could one day be found in everyday devices like phones, cars and appliances.

Clearly, researchers have unleashed the endless potential of diamond to be a revolutionary gem in areas such as industrial technology, nanomanufacturing, and bioengineering. A potential that leaves one thing is certain—April's birthstone is no longer simply a girl's best friend or an ornament for her finger. WE

Article by: Melly Meyer
Design by: Elizabeth Jurgens

Art and Engineering no longer **black** & white

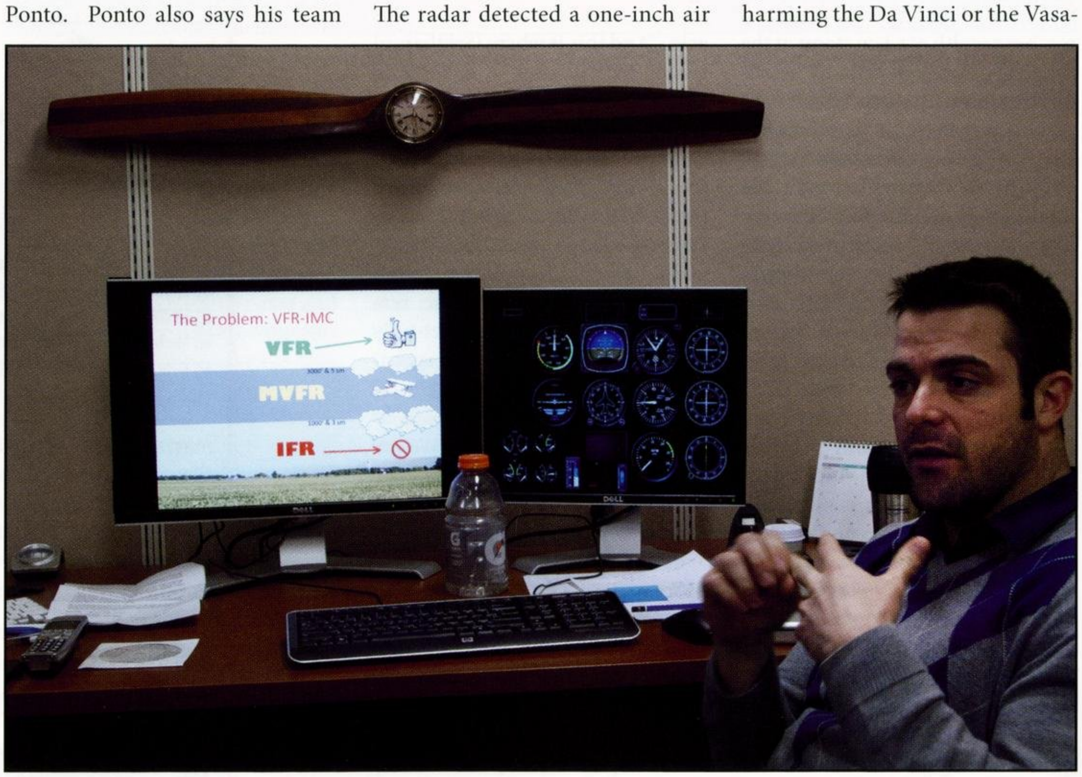
Art and engineering, initially the two words seem like paradoxes. Art is most often associated with creative thinking and freedom of expression, whereas engineering conjures images of bridges and concrete, analytical thinking. Yet the unique combination of the two disciplines has started to become more common than one might think. In Italy, at the Palazzo Vecchio, a group of engineers are using technology to uncover a Da Vinci painting thought to have been lost forever. In Madison, a group of art majors and computer science majors have enrolled in the first virtual reality course to be offered at UW-Madison. The course is allowing the students to gain exposure to creating and interacting virtual realities. Virtual reality technology has already started to become a valuable resource to the field of research and has enormous potential to improve many fields of research. At UW-Madison, a flight simulation lab already employs the use of virtual reality to improve pilot training. The fields of art and engineering are no longer as conflicting as black and white, instead they have blended and merged two fields that most consider polar opposites.

The Lost Leonardo - Italy

Five hundred years ago, Leonardo Da Vinci painted a beautifully violent scene depicting the clash of the Milan and Florence armies - The Battle of Anghiari, a priceless work of art which is widely believed to have been destroyed just fifty years later, when Giorgio Vasari remodeled the Palazzo Vecchio. Maurizio Seracini, a diagnostician of Italian art, does not agree. He does not think the lost Leonardo is lost at all, he believes the painting remains unharmed behind the wall painting of Vasari. Seracini has been working for over thirty years to prove The Battle of Anghiari still exists. Kevin Ponto, a PhD candidate at UW-Madison, had the opportunity to take part in the search while earning his Master's degree at UC-San Diego in art and engineering, an exclusive degree that was offered for a very limited time. The obstacle is that the Vasari painting is painted on a brick wall. "We needed a technology powerful enough to look through a painting and a brick wall, but not too powerful as to bypass a painting behind the brick wall," Ponto says.

Seracini has compiled a large amount of evidence that makes a person wonder whether the lost Leonardo is lost at all. Giorgio Vasari had a history of preserving the works of other artists. And Vasari had good reason to fear the painting would be otherwise destroyed because the ruler in Florence at the time had expressed his disapproval of the Da Vinci painting since it honored the former government. Vasari may have even left a trail behind to lead future artists to the painting. "On one of the flags in the painting the words Cerca Trova are written which translates to 'Seek and ye shall find,'" says Ponto. Ponto also says his team discovered techniques in the Vasari painting on the opposite wall which seemed to mimic those of Da Vinci. "It was as if Vasari was looking over his shoulder at the Da Vinci while he painted his first piece. The piece depicts weapons that would not have been used in this time period," Ponto says.

Through the use radar equipment, microwaves were shot at the walls. The radar detected a one-inch air gap behind the Vasari painting on the East wall, although there were no air gaps detected behind any other walls in the Palazzo Vecchio. Seracini believes the air gap was left by Vasari with the intention of preserving the Da Vinci painting. This mysterious gap is hard to explain but does not prove there is a priceless piece of art lying behind the wall. "They now have the ability to move the brick wall without harming the Da Vinci or the Vasa-



PhD. candidate Chris Johnson uses real-time weather data to improve the quality of flight simulators to increase pilot adaptability while decreasing training costs.

Johnson walks a user through the flight simulators life-life interface.

ri painting," Ponto says, "but this process would cost an unbelievable amount of money. For this reason, they need to be certain the Da Vinci is there before they move any walls." Proving what lies behind a brick wall without the ability to see through brick walls can become a frustrating task. In fact, Ponto tells a story of a man who became so frustrated with the task that he decided to cut a hole right through the Vasari painting. Unfortunately, the man was largely misinformed as he cut a hole in the West wall rather than the East wall. Since then the painting has been repaired but Ponto says he could still see where the painting had been amended.

Ponto believes the latest plan to prove the lost Da Vinci lies behind the wall may finally provide substantial evidence. Seracini has developed a tool that can detect neutrons that bounce back after having collided with hydrogen atoms. It is known that Da Vinci used unique materials such as linseed oil and resin, both of which are organic materials and contain an abundance of hydrogen. Seracini plans to send a beam of neutrons through the Vasari painting, hoping it will indicate the presence of hydrogen behind the wall.

At present the search is at a standstill. Frequent changes in government have caused a lot of problems for Seracini and his team. Though, Ponto clarified, none of the funding for the project has come from the government. All of the funding has come from private donors hoping Seracini will eventually solve a five hundred year mystery. They are all hoping that cutting-edge engineering technology is the answer to finally recovering the finest piece of artwork from the Renaissance period.

The Flight Simulator

"I wouldn't call this virtual reality. The issues I am working with are very much real. I would call it more of a virtual experience," says Chris Johnson, a PhD candidate, who works in the flight simulation lab at UW-Madison, where he is working to improve flight simulation techniques. Originally, flight simulators were used to determine the most efficient design of cockpit displays, and until recently, the research focus has been on the technology behind the simulators. The research project Johnson is working on lies outside of previous scopes. He is looking at how pilots react to changing weather conditions. Johnson believes weather is an important factor that a lot of people overlook when simulating flight. When pilots are working toward their license they are not readily exposed to potentially dangerous weather conditions. If visibility is less than ideal students are not taken out to fly.

At present, most simulators are designed so the weather conditions the pilot experiences during the simulation are controlled by the instructor and are somewhat of an afterthought. In fact, the weather radio in these simulators has no real function. The flight instructor must wait until they see the pilot tune to the correct radio station and then recite the fictional forecast into a microphone in the back of the room. Not only does this distract the instructor from observing the pilot, it also takes away from the reality of the simulation. "The thing about virtual reality is that it isn't real," Johnson says, "and the pilots that come in here know that, they know they can't actually get hurt. It is my job to suspend that disbelief." Johnson uses historical weather data to generate realistic and unpredictable weather patterns. The radio in his simulator is programmed to provide accurate weather forecasts and uses an automated radio voice. The natural weather patterns help to make the experience more realistic for the pilot, along with the motion of the simulator which shakes you around as if you may actually crash.

> "The thing about virtual reality is that it isn't real... It is my job to suspend that disbelief."
>
> - Chris Johnson

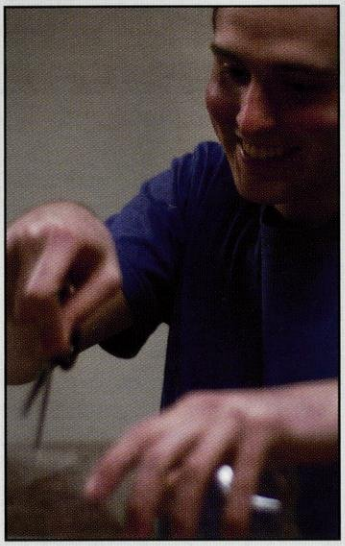
Johnson has had nearly all of the pilots in a hundred mile radius come to use his simulator and has, for the most part, seen the results he expected. Most pilots panicked and made errors when the weather changed. Johnson, a pilot himself, admits most pilots are alpha-males, meaning they walk into the lab overly confident they can handle anything. Yet, Johnson says there have been several cases where pilots have not been able to land the plane and were forced to quit. And the best part is he captures all of their panicked motions and frightened expressions on a webcam mounted on the front of the simulator.

Overall, simulation has improved pilot performance, decreasing the number of accidents while at the same reducing the costs of training. Pilots in training are no longer taking their first flight behind the controls of a real plane; using simulation takes away the risk of crashing a real plane. Johnson will be at UW-Madison for another year and a half, during which he hopes to do more research to continue to improve flight simulation. He also mentioned the prospect of a partnership with the medical simulation lab at UW-Hospitals. The idea is that together they can simulate helicopter emergency medical services which require unique teamwork between the flight team and the medical team. WE

Article: Kelsey Coleman
Design: Linc Han
Photography: Sean Metcalf

GreenHouse

Living green under one roof



Move over American's Next Top Model, some students on campus are hitting the runway with wrinkle-creased sweatshirts, diced jeans, and used baggy T-shirts cut in geometric patterns. Does your residence hall make trips to the local Dig & Save to buy ten pounds a piece of recycled clothes for fashion shows? If you haven't walked down a runway wearing jeans with sewn-on cloth flora, you probably don't live in UW-Madison's newest learning community, the GreenHouse. We've all heard about the learning communities like Chadbourne or Bradley, but if you haven't picked up a housing packet in a while, you might be surprised to find out the GreenHouse is based on living sustainably and going green.

Located on the first floor of Cole Residence Hall, the GreenHouse community looks like any other floor in a dorm. It opened for the first time this year to all ages of residents offering an environmentally friendly community. Residents have held hands-on activities such as fashion shows from recycled or old clothing, weekly craft nights, composting in their own rooms, bonfires, and canoe trips on Lake Mendota.

The GreenHouse offers one credit environmental seminars on global meals, environmental justice and engineering. The global meal seminar, according to resident Dayna Hashemi, has made her think about "eating the right food. It involves knowing where your food comes from, and taking time to make your own food." Last semester, one of the GreenHouse classes put up a solar panel on the roof of a gardening shed. Giri Venkataramanan, a professor in electrical and computer engineering, partnered with the GreenHouse this year. Giri says that gardeners at night "couldn't work in the shed and people clamored to return tools" because of the lack of lighting. Taking the initiative, GreenHouse students rose to the challenge. By researching materials, constructing a design and spending many hours in the machine shop, a solar panel was created. Looking back on the experience, Giri says the GreenHouse students received "a hands on experience on construction: cutting going shopping for hardware, or running electricity." Students made an impact on the gardening community in Eagle Heights and Giri says that the new solar panel "is a resource of the community and will be there for decades."

Back to the GreenHouse in Cole itself, even the couches in the den were picked out with sustainability in mind. One of the residents there, Mara Taft, says the couches are made from seventy percent recycled materials. Mara, who is an upperclassmen living in the GreenHouse, thinks that "It's a good environment for residents to encourage each other to be environmentally friendly."

What stands out most in the GreenHouse are the committed, driven individuals who live behind every door. Lucas Boyle, who serves as RA in the community, says that his residents are "all really motivated students that are grander scheme environmentalists." For ex-

Reusing plastic bottles is just another project for the "GreenHousers" who are also working on a wind turbine, keeping Camp Randall clean, and compostable toilets.

ample, last semester one of the residents noticed a lot of waste at football games. That resident brought it to Lucas' attention. Soon after, fifteen "GreenHousers," (Lucas' nickname for his residents) started to help restore Camp Randall after football games. Also along these lines, ever think of sharing that two foot fridge in your dorm with someone other than your roommate? Some residents have come up with the idea to share fridges between rooms to save energy.

To keep busy this semester, the GreenHousers will finish painting a mural in their GreenResource Room. Michael Babcock, a resident who has used the room , says the GreenResource room already serves as a hangout spot where residents can relax, meet with their GreenHouse leaders, or find some "books and resources about environmental subjects." While the mural project is indoors, the GreenHouse is already planning outdoor projects to take advantage of the spring weather. One of the seminars will even involve working on creating a compostable toilet. It doesn't stop there. GreenHouse students will make changes to a wind turbine in Madison's West Agricultural field station. One of the PBC blades, which keep the turbine running, broke off. Now it's up to a few of the GreenHouse students, working side by side with other engineering students, to fix them. Students will be working on "redesigning the blades to make them light and strong," says Giri.

No doubt, residents in the GreenHouse have a unique community overflowing with opportunities. The seventy residents who make up this tight-knit community support each other in making environmental decisions. With their first year coming to a close, we can only await what new projects the GreenHouse residents will take on next and what influence living there for a year will have on their futures. WE

Article by: Rachel Feil
Design by: Jessica Braun
Photography by: Danielle Dewitt

News, Meet Science.

With public interest bouncing back and forth between unrest in the Middle East and unrest in the Midwest, early March had enough news stories to overwhelm just about everybody. Where are Wisconsin's 14 senate democrats? Is Sarah Palin running for President? These two stories alone could consume hours upon hours and pages upon pages of news stories. Fingers crossed nothing else would happen before the media could get to the bottom of them. March 11th, however, brought the kind of news story that immediately takes center stage, the BAD kind.

A record earthquake and 30 ft wall of water rocked Japan's eastern coast. An unprecedented natural disaster caused catastrophic damage and claimed thousands of lives.

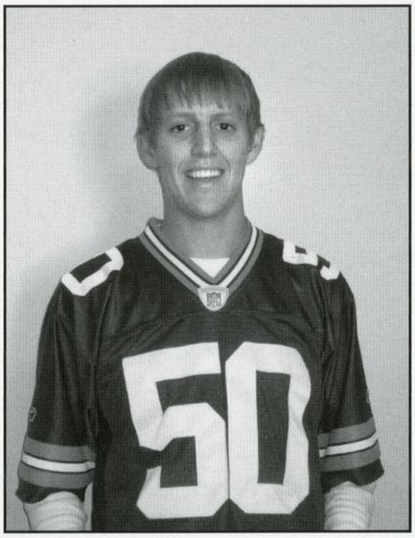
The Fukashima Dai-ichi Nuclear Power Plant also fell victim to the disaster when key backup safety systems were wiped out, providing enough bad news to outlast the story of thousands of missing Japanese citizens. Despite the fact that the reactors were immediately shut down once the large seismic activity had been detected, the need to remove decay heat (equivalent to six percent of total power) was still present. Unfortunately, the backup power systems required to remove the heat were inoperable and improvisation would be needed to keep the reactors cool.

As the workers at the plant began taking action to remove the heat and stop any melting that may be happening within the cores, something else fell victim to the disaster, the news coverage.

With a knack for delivering doom, news organizations brought the bad news without context and occasionally without facts. Banners read "Nuclear Explosion at Japanese Plant" despite the fact that nuclear chain reactions had been successfully halted days prior. Hosts qualified the reports by stating that they weren't sure if the explosions happened within the reactor containment buildings or not, causing the minds of viewers to run wild. Experts could provide a simple explanation for the explosions, which were actually caused by hydrogen gas, as well as their actual locations (not reactor containment), but the damage had already been done. Radiation levels were repeated without mention of their consequences, if any. One mile out to sea, levels of radioactive iodine were over 3,000 times their limit. Terrible, right? Wrong. Radioactive Iodine becomes harmless in a few weeks and the only way it would be causing harm is if the there were herds of fishermen within sight of the troubled power plant catching fish and rushing home for dinner. That last part didn't make the news, however.

Historically anti-nuclear organization spokespeople were invited onto news shows to explain why nuclear power was "just too dangers" and why they "didn't trust the reports that were coming out of Japan," speculating that the situation was actually much worse.

News today is an explosion without details and radiation levels without context, not excessive hydrogen buildup and limited health impacts. Bad news gets the ratings and sells papers, and news organizations know this.



In an industry so heavily influenced by public perception, comments like these can be truly devastating. Nothing exemplifies that fact better than the actions taken in response to the news stories that broke as the disaster continued to unfold.

Public overreaction took off within minutes and could be seen happening all over the world. In the U.S., there was a laughable spike in Geiger counter sales and the shelves of pharmacies were wiped of their supply of Iodine tablets. In Germany, seven reactors were shut down for review, costing energy companies an estimated $800 million. This was especially telling considering the revival of Germany's nuclear industry was set into motion just two years earlier by the very same Chancellor, Angela Merkel, who would bring it screeching to a halt.

Of course the world should learn as much as it can from this terrible tragedy and take all opportunities to improve upon the nuclear industry's already stellar safety record. For example, a potential improvement on the use of spent fuel pools is currently under review in the U.S. Common sense improvements that take into account actual (not perceived) risks should be considered and implemented if deemed necessary to ensure public safety.

Overreaction needs to be avoided. We cannot abandon the "nuclear renaissance" or add unnecessary costs that do not actually improve safety. Expansion of nuclear power is still seen as the only reasonable way to reduce carbon emissions without increasing the costs of electricity to unacceptable levels. If license renewals for nuclear plants in California and New York are denied, we will be forgoing the extremely cheap and clean electricity that these plants can provide for an additional 20 years. Meanwhile, the U.S. continues to operate decades-old coal plants that provide us with enough pollution to cause 24,000 premature deaths per year.

If news organizations would have treated this subject with the amount of caution and sensitivity that the members of its industry utilize on a daily basis, a much more logical approach to our energy challenges would be possible. Until it becomes commonplace for news organizations to take their time before doling out another helping of doom, an entire industry will be left at the whims of irrational fears. WE

Editorial by: Marcus Hawkins

The Wisconsin Engineer's

4th Annual Photo Contest

Grand Prize - Winner

Oaxaca, Mexico

Ivan Diaz

According to locals, this airplane was shot down by the Mexican army because it was carrying drugs. It was just left there and is becoming buried little by little.

Grand Prize - Runner up

Rachel

Kat Cameron

My little cousin and I were never really good friends until she discovered that I liked to take pictures and I discovered that she liked to have her picture taken.

Thai Pavilion

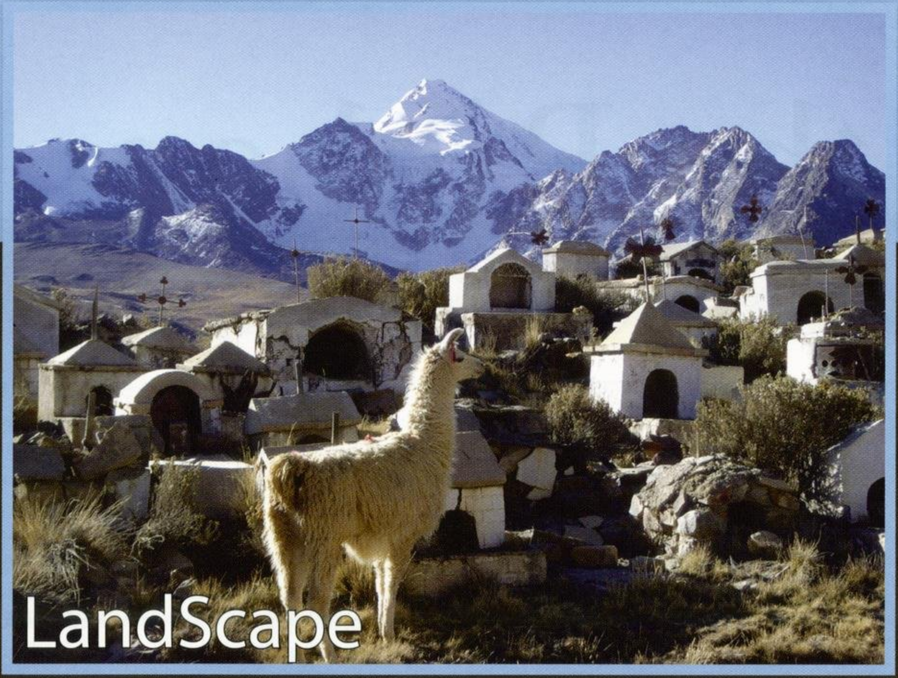
Andrew Findora

This shot of the Thai Pavilion in Olbrich Botanical Gardens actually required a composite of two exposures to balance the brightness of the building and reflection. The pool of water is usually quite still, but a child happened to fall in while I was taking the bracketed exposures for this shot, causing the distorted reflection in the water. Image taken with a Pentax K-20D, composited and processed in Adobe Photoshop CS5.

Abe Lincoln

Vasishta Ganti

Most of us UW students see him everyday. But how many of us feel for poor Lincoln sitting in Madison without a winter jacket? Actually, he enjoys it a lot. That is the reason he doesn't budge from his place. A different perspective of our very own Abraham Lincoln on Bascom Hill during a snow storm.



Miner cemetery

Ivan Diaz

This picture was taken in the high plains of Bolivia. The miner cemetery on the way to the base camp of Huyana Potosi (19,974 ft), the mountain in the background.

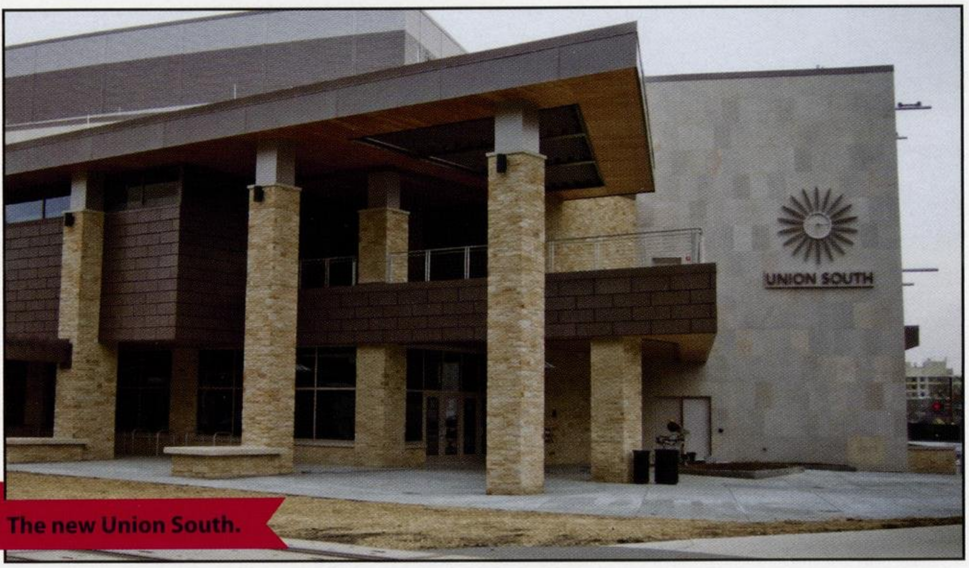
One Last Stand

Thai Nguyen

I was on a bus ride from Da Nang to Hue which is where my family is from. The bus stopped for a break and to refuel. As the bus was stopped, this boy who was probably no older than 5 years old came riding up to us on a water buffalo. In Vietnam, everyone will do everything possible to make a little money for their family because this region is quite poor. This ranges from selling lottery tickets, packs of gum, or simply begging. This courageous kid decided to ride on his water buffalo to wow us instead.

Cutting the Ribbon

New Union South: A Badger's dream house



The new Union South.

Mark your calendar. The hour is nigh. On April 15th, 2011, UW-Madison's new Union South opens its doors.

In 2006, as a result of UW student votes, the Union Building Project was instated. The idea was to restore Memorial Union and keep ties to past and tradition, as well as completely demolish and redo Union South in order to push towards the future. The new Union South is modern and chic. Every detail has been considered in devising the optimal student hang-out.

Last year, a campus-wide competition was held to come up with a name for the new union on the south end of campus. Over 500 names were submitted, including Badger Burrow, Union Shmunion and Varsity Union. In March, the Associated Students of Madison, UW's student government organization, narrowed the list down to four potential names. The Union South won, after a campus wide vote. Notably, Randall Union came in second place with 6,427 votes.

The building is located on 1308 W Dayton. 1308 is the name of the art museum that is cleverly placed near windows to show off the art pieces to outside pedestrians along with inside observers.

Senior civil engineer Brian Meister accompanied me on a pre-opening tour around the building. "We are so lucky that the new union is right next door to engineering campus. I wish it had opened sooner, but the place looks great. All it's missing is a lake!" says Meister. Maybe this area won't be notoriously referred to as Nerd-Land any longer.

The student lounge area has been named THE SETT. A Sett is a Badger's den and the inspiration to the multileveled, spacious and tunnel-like union. The three story fun zone has a rock climbing wall, eight bowling lanes, pool tables, a massive stage and, of course, food and beer! Part of the old Kohl Center floor is appended to the wall: a strong reminder of the distinguished UW athletic programs and, more so, the proud campus.

The Venetian maroon, dark blue and burnt ochre colored walls provide an up-class, yet homey, feel to the first floor. Along with an elegant coffee house and wine bar, there are three Union-run restaurants on this floor, a pizzeria, Pan Asian, and a sandwich shop. Huge windows let in glorious amounts of natural light: which will be appreciated during those limited daylight hours in the winter.

There are three fireplaces, one of which is twelve feet long! Moreover, there is outdoor and indoor seating. The patio is named "The Roost" because of the roosting pigeon statue mounted on the second floor outside seating. Hopefully, Badgers won't try and eat it.

Union South was designed to be sustainable, as well as economically and environmentally friendly. LEED (Leadership in Energy and Environmental Design) is a certification program that helped mediate the design and creation of a Green Union South. LEED has different levels of sustainability and Union South, as it is now, has been designated as LEED Gold. In order to obtain this level the building was designed to use about 40% less water and 37% less energy use than the average building of its size. A few of the sustainable features include: natural ventilation, natural storm water reservoirs, high performance glass and optimized wall and roof insulation. During the design process, there was an emphasis on using local materials to reduce transportation cost, as well as keeping the money local. Most of the wooden floors are recycled wood from old Wisconsin barns, much of the furniture is recycled from around campus and the beige stone on the central, dominant fireplace comes from Mosinee, Wisconsin (less than two and a half hours away).

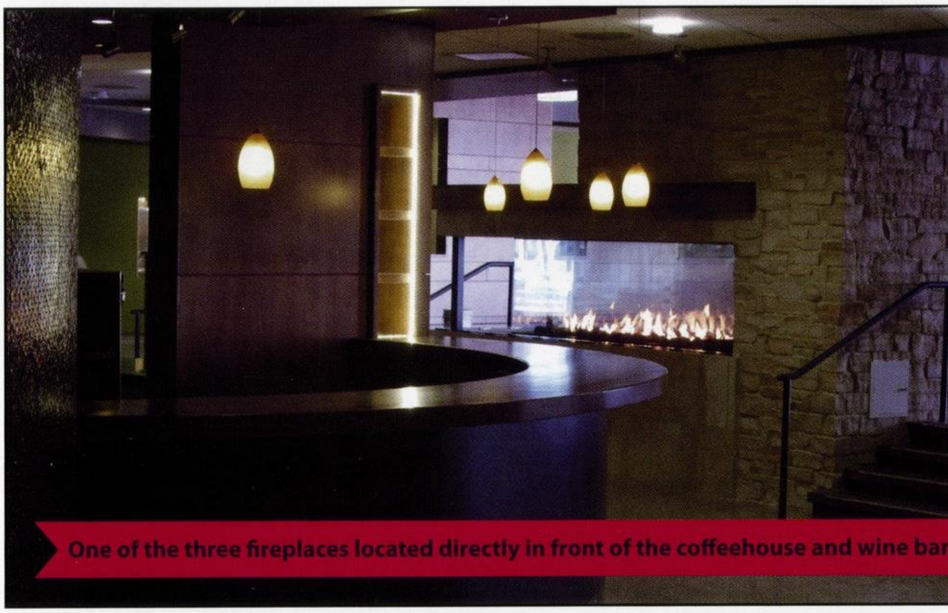
There is only one other student union that reaches the LEED Gold level: the University of Vermont's.

The building is designed to aid student life. A Do-IT Help Desk and lounge, on the second floor, will have a troubleshooting desk and an area to do homework. There are seventeen meeting rooms that are designed for student organizations, along with a movie theater filled with Badger-red seats.

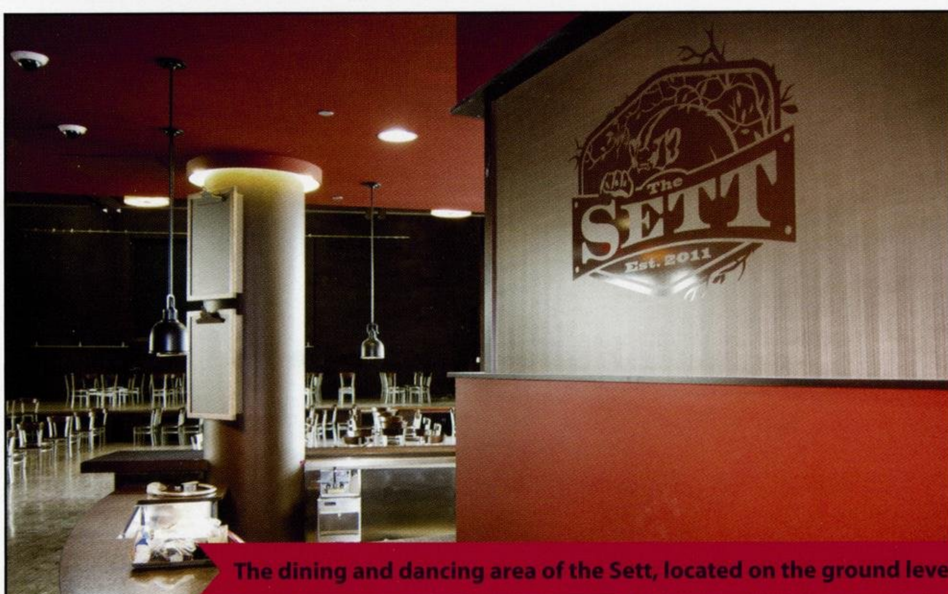
The Union South is home to these restaurants.

An 11,000 sq ft banquet room and hotel are also present, but hidden. They will remain fairly unknown and are mostly designed for visiting guests and large events.

Taralinda Gunshue gave us an in depth tour. Through her, the hard work and amount of thought put into making Union South was evident. She explained design touches that illustrated the amount of thought in every detail, such as the laborious placement of 20,000 screws in the grand staircase, and the meticulous time-consuming work in placing the wallpaper in the badger market. This place was not easily made, but thanks to the dedicated designers, workers and students, it has become a reality. And, now, IT'S OPENED! So Ready, Sett, Go! WE



One of the three fireplaces located directly in front of the coffeehouse and wine bar.



The dining and dancing area of the Sett, located on the ground level.

Article by:
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Photography by:
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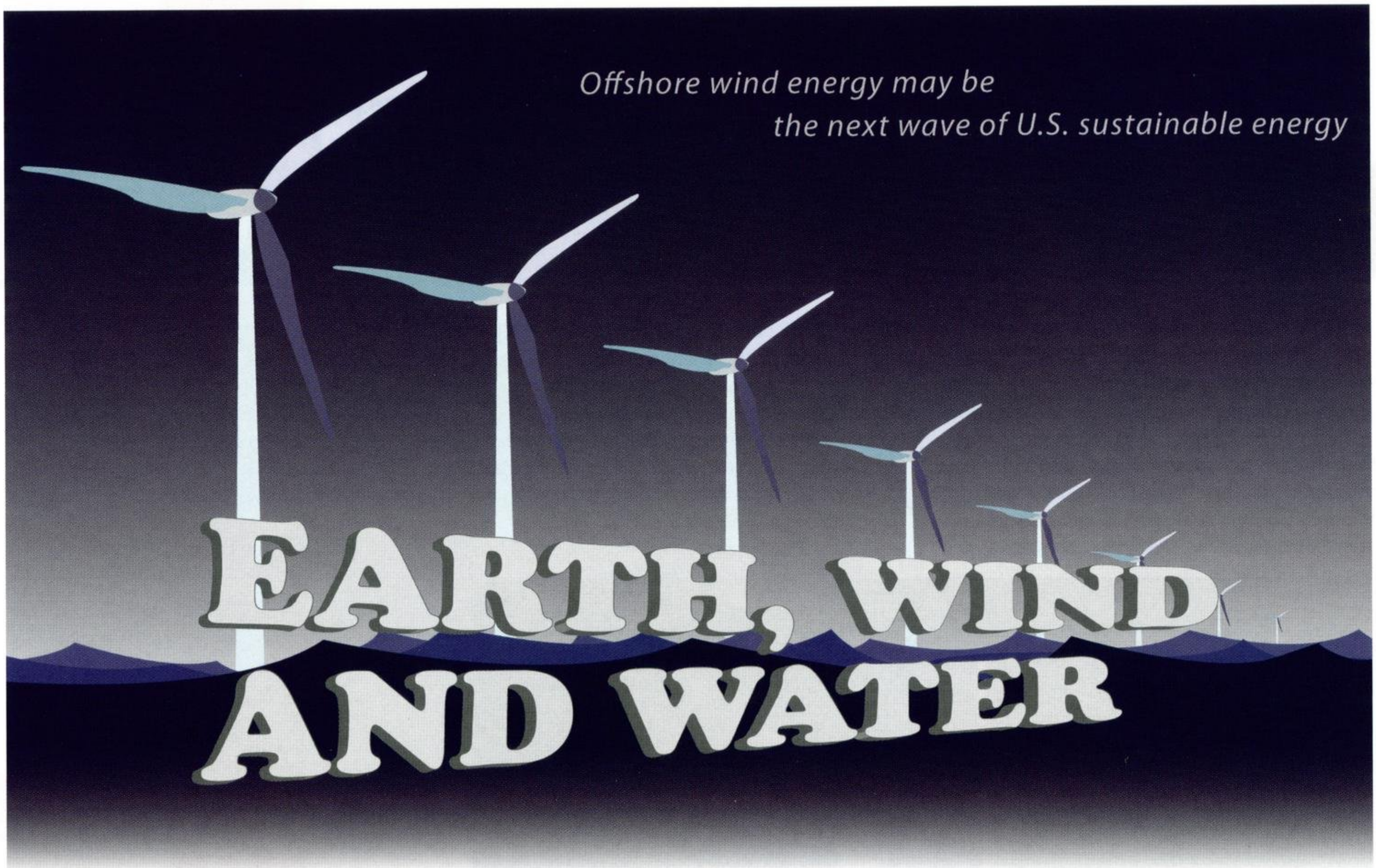


Offshore wind energy may be the next wave of U.S. sustainable energy

EARTH, WIND AND WATER

The Great Lakes possess a number of unique ecological features. Collectively, the Great Lakes contain the largest surface area of freshwater in the world. The world's largest freshwater dunes border Lake Michigan, and the Great Lakes provide the last remaining habitat for certain species, such as the white catspaw pearly mussel. However, the Great Lakes have not always prospered from interactions with its human neighbors. Several invasive species, such as zebra mussels, arrived in via cargo boats, which have caused an estimated five billion dollars in damage. Likewise, some environmental groups have expressed concerns about the next man-facilitated visitor to Lake Erie, whose presence will set another milestone in the Great Lakes. Around 2012, Lake Erie will become the site of the first freshwater offshore wind turbines in the world.

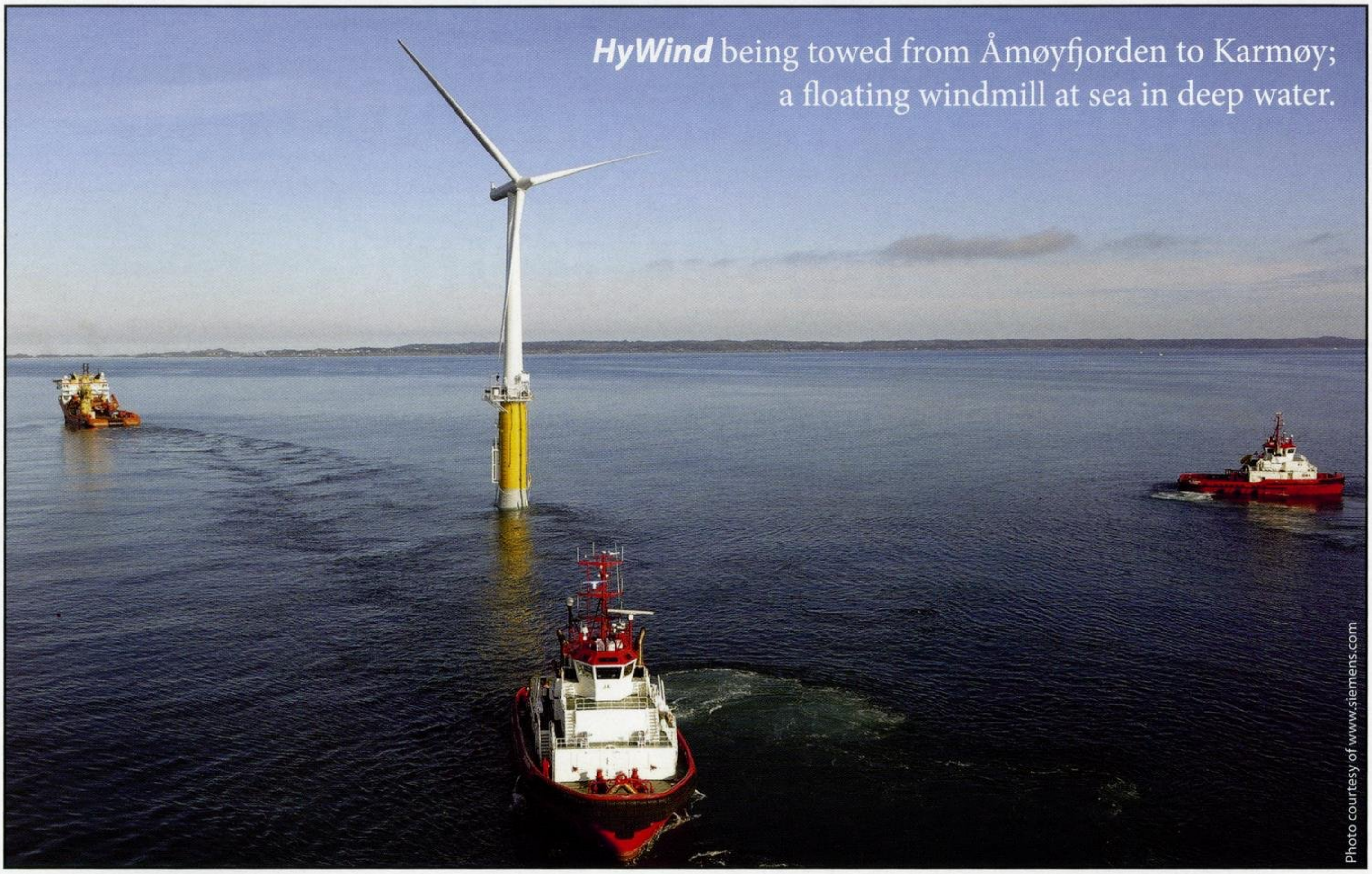
The proposed project in Lake Erie, a collaboration between General Electric (GE) and Lake Erie Energy Development Company (LEEDCo), consists of five direct-drive wind turbines based on a technology that GE acquired from a Norwegian company named ScanWind. Situated six miles north of the Cleveland Browns Stadium, the 250 foot tall turbines will supply enough power for 6,000 homes with an estimated construction cost of $80-100 million. LEEDCo hopes to increase the generating capacity from 20 megawatts in 2012 to 1000 megawatts by 2020. The project will help lead other sites of U.S. offshore wind energy projected to operate within the next few years. One of the largest projects, Cape Wind, will generate 486 megawatts with 130 turbines located in Nantucket Sound, Massachusetts. Various other propositions along the Eastern Coast of the U.S. and the Gulf of Mexico remain in preliminary stages.

Despite these future prospects, the U.S. trails the rest of the world in offshore wind energy. The U.S. currently has no operational offshore wind turbines, in contrast to a large presence of this technology in Europe. In 2009, the U.K. generated 1.3 gigawatts from offshore wind turbines, more than the rest of the world combined. Other top contributors to offshore wind energy generation include Denmark at 854 megawatts and the Netherlands at 249 megawatts. With more countries such as the United States and China joining Europe to adopt offshore wind energy, worldwide capacity is expected to grow from 3.16 gigawatts in 2010 to 75 gigawatts in 2020.

The slow response of the U.S. in implementing offshore wind energy can be primarily attributed to weaker government incentives. Several European governments such as Belgium, France, and the Netherlands invested money to guarantee high buyback prices for electricity produced by offshore wind energy, with fixed prices up to ten years. In contrast, the U.S. currently lacks a national buyback scheme for offshore wind energy. Statewide incentives have encountered resistance and variability, such as a proposed 0.244 dollars per kilowatt-hour tariff deemed too expensive by the Public Utility Commission of Rhode Island. The absence of a stable incentive structure has discouraged companies from making the long-term investment in offshore wind energy in the U.S.

Offshore wind turbines in the U.S., such as the Cape Wind project proposed in 2001, have also drawn public opposition. The Cape Wind project has encountered lengthy resistance because of potential scenic obstructions,before gaining federal approval in 2010. Most recently, Native American groups have expressed their opposition on the grounds that Cape Wind would obscure their view of the sun during religious ceremonies despite simulation results that predict that the Cape Wind turbines would protrude from the horizon no more than 0.5 in when viewed from the nearest beach in Cape Cod.

The problems of implementing offshore wind energy in the U.S. stand in contrast to the sharp increase in U.S. onshore wind energy.



HyWind being towed from Åmøyfjorden to Karmøy; a floating windmill at sea in deep water.

Photo courtesy of www.siemens.com

The U.S. had an instrumental role in the development of wind turbines, with American Charles F. Busch among the pioneers of the technology. In 2010, the U.S. generated more onshore wind energy than any other country at 36,300 megawatts, with China coming in close second at 33,800 megawatts. Advocates of onshore wind energy praise its zero emissions and widespread applications from business to personal use. With a maximum theoretical efficiency of 59.3 percent and typical capacity factors of 30-40 percent, wind energy surpasses the capacity of other types of sustainable energy, such as solar panels, which have a commercial efficiency of only around 24.5 percent. Most of these desirable traits also apply to offshore wind energy.

In addition to these positive characteristics, offshore wind energy may also address some of the shortcomings of its onshore equivalent. Wind turbines require a certain range of wind speeds for effective operation, and many parts of the U.S., such as Wisconsin, lack a favorable meteorological climate that consistently generates winds with sufficient velocity. For this reason, wind energy tends to be concentrated in states such as Texas and California, whose annual outputs of 9403 and 2798 megawatts in 2009, respectively, dwarfed the 449 megawatts produced by Wisconsin over the same period. However, wind speed tends to increase with elevation due to the atmosphere and with distance from the shore due to the decreased surface roughness of water, presenting an attractive alternative to states with bleak prospects for onshore wind energy. In addition to generating more power from higher wind speeds and taller turbines, offshore relocation often alleviates the aesthetic and noise complaints associated with onshore wind turbines. To address similar concerns in Wisconsin, Governor Scott Walker has recently proposed a law that would increase minimum distance of wind turbines from property lines from 450 ft to 1800 ft. The nearly four-fold increase would effectively dismantle all new onshore wind energy projects in Wisconsin, which would relocate to more welcoming environments in other states according to industry experts. Offshore wind energy may represent one way for Wisconsin to catch up to neighboring Midwestern states such as Minnesota and Illinois, who have higher outputs of 1810 and 1547 megawatts respectively.

Before the widespread adoption of offshore wind energy in the U.S., further research is needed. Compared to Europe, some potential sites on the U.S. western coast reside in deeper waters, which require more expensive technology. While shallow waters use a steel structure called a monopile to attach the wind turbine to the seabed, deeper waters require an alternative support system because the steel structure becomes exorbitantly expensive, complicated, and unstable. Deepwater components, especially those for floating offshore wind turbines, remain at a relatively early stage of development. Though benefitting from the generally more shallow waters compared to the western coast, offshore wind turbines on the eastern coast of the U.S. must contend with an annual hurricane season and various shipping channels. The Great Lakes also present a distinct set of problems: freshwater ice has a crushing strength three times greater than saltwater ice, and most of the shallow water except for Lake Eerie resides within 15 miles of shore where the sight of offshore wind turbines may irritate local residents. The answers to these problems and others will determine the future of offshore wind energy in the U.S. WE

Article by: Melissa Dettmann
Design by: Akhilesh Dakinedi
Photography by: Mark Trader

Anatomy of an offshore wind turbine

The Nacelle
The nacelle is the portion of the wind turbine where the rotation of the blades, caused by the wind's energy, is converted into electricity. The nacelle houses several components that work in tandem to produce electricity. First, a gearbox transfers the relatively slow rotation of the blades into high-speed rotation required for the generator. The generator transforms the rotational energy from the gearbox into electricity. The nacelle also houses sensors and drive motors required to orient the wind turbine so that the blades face the oncoming wind.

The Blades
The blades are the parts of the wind turbine that transfer the wind's momentum to mechanical rotation. Modern offshore wind turbines have three blades that measure between 30 and 40 meters long. As wind passes over the blades, they crate lift like airplane wings. Unlike planes however, in wind turbines, this lift is directed to cause the blades to rotate. The three blades together constitute the rotor.

The Tower
The tower is little more than a large tube that supports the nacelle and rotor. Typical offshore wind turbines have tower heights between 60 and 80 meters. The tower also acts as a conduit for cables that carry the electricity from the generator. Last, the tower allows maintenance workers to access the nacelle and rotor.

The Foundation
A large steel pile driven into the sea bottom supports most offshore wind turbines; this support structure is called a monopole. The monopole is driven between 10 and 20 meters into the seabed, depending on the depth of the water and the geologic nature of the seabed.

Citations:
http://ocsenergy.anl.gov/guide/wind/index.cfm
http://offshorewind.net/Other_Pages/Turbine-Diagram.html#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Highlights from UW Union history

June 5th, 1904
Former University of Wisconsin President, Charles Van Hise, gives his inaugural address where he calls for the development of a Union building.

1925, Armistice Day
It wasn't until 1925 on Armistice Day that the first shovel of dirt was dug where Memorial Union now stands.

October 5th, 1928
Memorial Union opens however, women are excluded from socializing in the Rathskeller.

1933
Memorial Union becomes the first public university union to sell 3.2% alcohol beer after being granted approval by the Board of Regents.

1942
In 1937 women are allowed in the Rathskeller from 2pm on, however, it wasn't until 1942 that women are granted full access, at any time to the Rathskeller.

1971
"Fewer Walls, More Bridges" is the theme of Union South's opening celebration.

2006
University of Wisconsin students vote to renovate Memorial Union and rebuild Union South.

April 15th, 2011
The grand opening of the newly rebuilt Union South.

1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010

John Murphy:

From researching to teaching; nuclear reactor operation to basic engineering

When asked his favorite part of working at the University of Wisconsin - Madison, John Murphy of the nuclear engineering and engineering physics department took less than one second to respond, "the students."

Initially graduating with a degree in mathematics, Murphy later went on to receive his master's in mechanical engineering and then in nuclear engineering. John is originally from Fond du Lac, Wisconsin, and achieved all of his degrees as a Badger here at UW–Madison.

After receiving his masters in mechanical engineering, John spent a few years of his life working in industry. Having more than one job offer upon graduation, Murphy chose to work with an aerospace company named Rocketdyne in Los Angeles. "I was 24 and wanted an adventure, so I took the job in Los Angeles," Murphy says.

While in California, Mr. Murphy worked on Strategic Defense Initiative (SDI) experiments involving kinetic kill vehicles. "It sounds very sinister, but it is actually just intercepting an incoming missile with an outgoing missile. It was a very interesting job. I was able to work in advanced programs and perform many different types of calculations involving engineering functions," John says.

"Mechanical engineering is the broadest type of engineering. Any student who is unsure as far as engineering departments, I recommend mechanical. You can do anything with a mechanical engineering degree," Murphy says.

After experiencing the West coast, Murphy decided to move back to Wisconsin. He had a job as an energy management engineer with the Wisconsin Power and Light Company lined up as well as goals of starting a family with his wife. Still happily married, John's son is a now a high school student in the process of looking at colleges, and his daughter is a sophomore civil engineering student here at UW–Madison.

While experiencing the mechanical engineering industry, however, Murphy always had thoughts of nuclear engineering in the back of his mind. He decided to come back to UW–Madison for another master's degree, this time in nuclear engineering. "I love nuclear and I love what we do in our department," Murphy says. "Mechanical engineering students and nuclear engineering students are trained in an extremely similar way. Both backgrounds are very strong."

Soon after receiving his master's in nuclear engineering in 1992, John started working for UW–Madison. He has certainly made many large and important contributions to the University since then.

During the first ten years of his career with UW–Madison, John spent the majority of his time on research projects with professors in the nuclear engineering and engineering physics department. Murphy's main area of study was reactor safety, "trying to minimize accidents," Murphy says. "I was involved in modeled fuel-coolant interactions (FCIs) and the effect of hot molten metallic material falling into water and potentially driving a steam explosion. We want to avoid this in

Prof. John Murphy's Into to Engineering students learn all aspects of the design process, from safety and ethics to fabrication and testing.

case a nuclear reactor has a partial fuel melt."

Now focused primarily on teaching, Murphy's current role on campus has allowed him to interact more closely with his favorite aspect of UW–Madison, the students. John spends most of his time co-coordinating Intro to Engineering 160 with pre-engineering advisor, Eman Zaki. In addition, John is starting to teach power plant technology (NE565), frequently helps with principles and practice of nuclear reactor operations (NE234), and instructs senior design in the nuclear engineering department with Professor Michael Corradini.

> "The students are what drive the University and we have top flight students at UW – Madison."
>
> - John Murphy

Nuclear engineering 234 is a four credit course which essentially teaches students everything one must know in order to operate a nuclear reactor. Murphy helps out with NE 234 by instructing the engineering students how the operating console of the nuclear reactor works. At the end of this course, students decide whether to take the Nuclear Regulatory Commission (NRC) administered licensing exam. Upon passing this exam, the students become licensed reactor operators and can potentially work at UW–Madison's reactor.

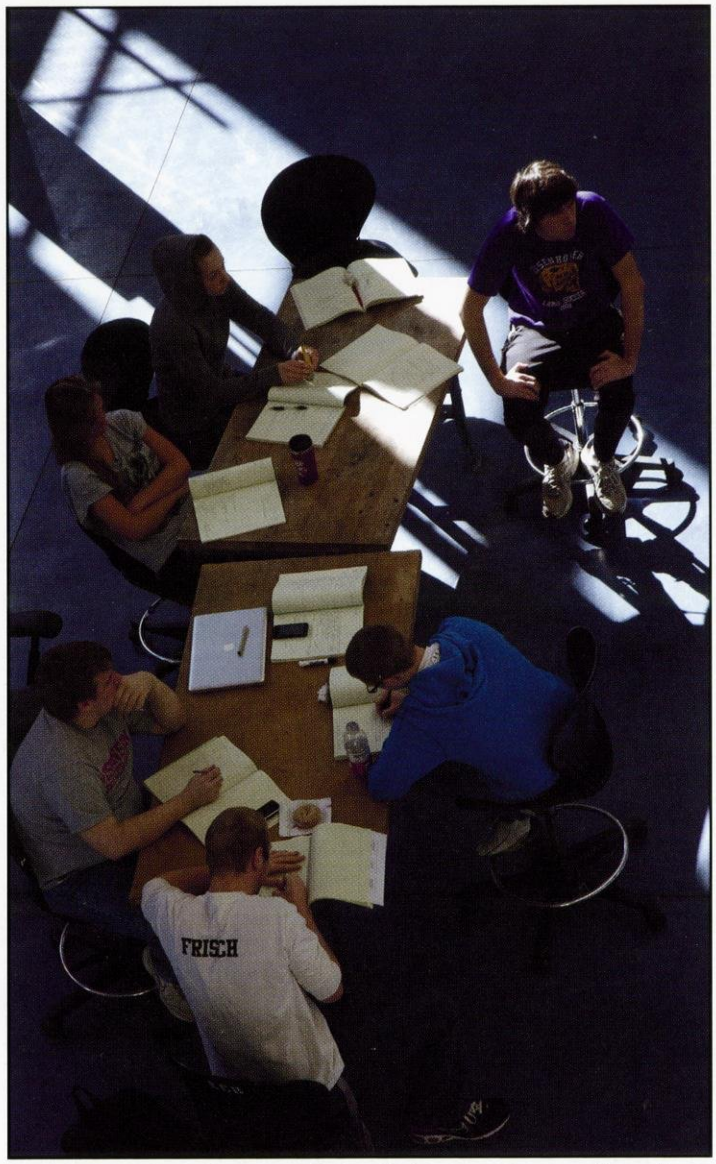
Giving students the chance to operate the reactor is a very beneficial and instructive opportunity. UW–Madison's nuclear reactor is about 1/3,000 the size of the average commercial reactor. Unlike most nuclear reactors it is not used to generate power. Our nuclear reactor's primary purposes include education, research and outreach for the public education.

Despite his love for the nuclear engineering department, John finds himself thoroughly enjoying teaching a class not as closely connected to his department, Intro to Engineering 160. Whether it's designing recycling solutions, a strawberry picker, fire truck rust buster, or a children's walker, some of the newest engineering students on campus are already busy solving complex problems in their introductory engineering courses.

Taken by about 550 freshman engineering students each year, great amounts of planning and organizing are required to make this course functional. Along with Professor Richard Straub of biological systems engineering and Jennifer Binzley of general engineering student support and advising, John spends about half his time working on this design course.

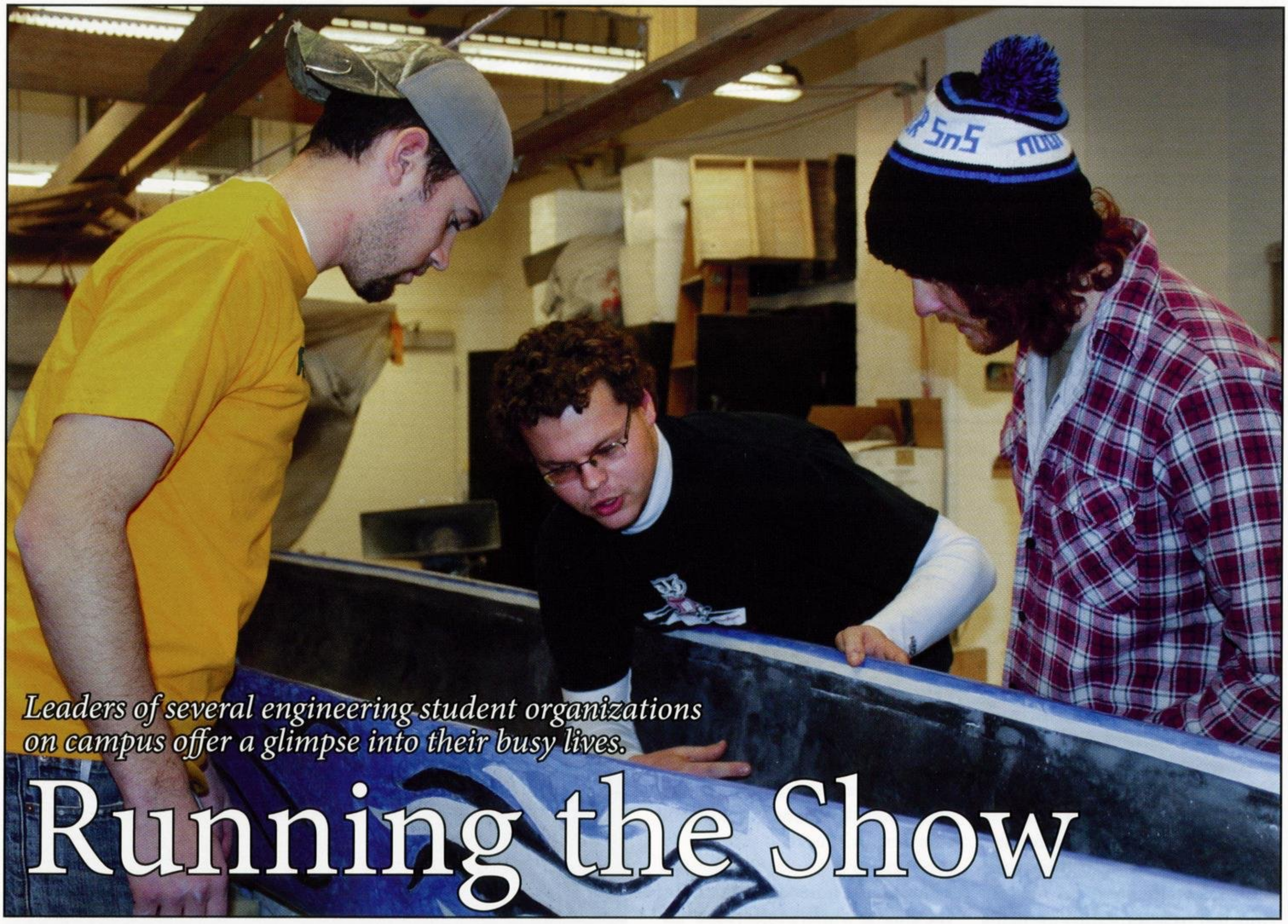
John and the other coordinators of 160 choose which projects the "client-centered" student teams will be working on with the help of an online database of projects. "We like to help non- profits or groups of people who wouldn't normally have access to these types of technical design solutions," Murphy says. Throughout the semester, the freshman students receive great amounts of engineering experience by working in teams, surveying the engineering disciplines and learning to use different computer tools and lab techniques.

The freshman students John instructs never fail to impress him. "UW–Madison students are even better than they were ten years ago. I see the high quality of our students right away in Intro to Engineering 160. The way 90 percent of these freshmen students think about the complex problems they are assigned is amazing, you would think they are 24 years old! I love working with the freshmen," Murphy says. "The students are what drive the University and we have top flight students at UW–Madison."



InterEGR 160 students work in design teams to solve client-centered engineering problems.

Article by: Elly Underwood
Design by: Flora (Jing) Qu
Photography by: Adam Dircz



Running the Show

Great leaders in history have made their mark mostly due to the support they have received from the people they are leading. Whether it was Abraham Lincoln or Michael Jordan, they all gained support from the people around them, and ultimately helped the entire group achieve their goal. Here at UW-Madison there are many great leaders, maybe with not as profound of an impact as Abraham Lincoln, but still enough to shape the people of the groups they are leading and impact the campus. In the College of Engineering, almost all of the student organizations have an appointed leader. The challenge is achieving that position and living up to the expectations. Student organizations such as the Concrete Canoe Team, the American Society of Mechanical Engineers and the Institute of Industrial Engineers have members in leadership that are so enthusiastic about the organization, they can't help but succeed.

However, leadership is a difficult thing to develop in college, and especially in engineering. Most companies expect you to graduate knowing everything about how to be a leader and yet there are very few actual courses that can teach this highly desirable skill. Some will argue that leadership is something a person is simply born with, while others claim that great leaders are developed over time. Either way, it seems that people who are driven and who love the group they're leading can rise to the occasion and become extremely influential and productive leaders.

No group can function without its leaders, and the various student groups and organizations here on campus are no exception. Student organizations are a great way for students to get involved on campus and a great way for people to develop their leadership skills. In fact, there are over fifty student organizations just within the College of Engineering, and all of them have multiple positions of leadership. Being at the top of an organization means that there are very high expectations to keep that student organization performing at the level it has previously performed at. Not to say these positions are impossible, but the students who achieve them are definitely dedicated to the organization and posses the leadership skills necessary to keep their respective organizations running smoothly.

Most of the student organizations have either one president or a few chairs that share the main leadership duties. Nick Edwards, a fifth year senior in mechanical engineering, is the chair of the American Society of Mechanical Engineers (ASME). As chair, he is expected to "keep track of all the other officers and make sure they are doing what they need to do," Edwards says. "My biggest responsibility is knowing what the other positions have to do and staying on top of what should be going on," he says.

Cam Barnes is a graduating senior in materials science and engineering and is one of the three co-chairs for the Concrete Canoe Team. The duties among the co-chairs are divided up based on the chairs strengths or area of study. Barnes is primarily responsible for the concrete mix for the canoe because he is a materials science major, but as one of the chairs he also keeps up with, "fundraising, sending out emails, contacting sponsors, and coordinating smaller meetings with different members of the team," Barnes says. "Making sure everything is going as smoothly as we can get it," is a big focus for Barnes as well as, "trying to motivate the rest of the teammates to help us, that's the most difficult thing," he says.

The president of the Institute of Industrial Engineers (IIE) is Sara Blake, a fifth year senior in industrial engineering. "As president of IIE, I oversee the entire organization," Blake says. "I help the officer board with anything they need and I plan section meetings, kick offs, and officer meetings."

Being in a leadership position is a big commitment, but with careful planning and dedication these leaders have found that it can be fun and rewarding too. "The beginning of each semester is really busy," Edwards says. "I usually put in about 15 to 20 hours per week when it's busy, and about 10 on an average week." The spring semester is busy for the Canoe team because they are preparing for competition and Barnes puts in about "30 to 40 hours a week" in the shop. Blake puts in about 15 hours per week for her position.

Some leaders aspire to be in these positions in advance and are able to anticipate the time commitment a lot better. "I knew I wanted this role early on so I tried to set up my semester with the least amount of worry," Barnes says. "I set up my schedule so I am done with class by 2 every day so I can spend a couple hours in the canoe lab and still have time to work on homework or other things at night."

Whether they have a light class schedule or not, their time is still very limited and most student leaders have to rely on their time management skills as well as their fellow members of the organization if things get a bit too hectic. "I have two planners and a Google calendar with little reminders popping up every five minutes," Blake says laughing. "I've never used a planner before but I started and it's really helpful," Edwards says. "In other positions you have one big project you're in charge of, but the thing about being the chair is that you have a million little things you have to keep track of and being organized really helps with that," he says. Reaching out to other members is an excellent way to develop leadership as well. "I definitely rely on my VP and the entire officer board for everything," Blake says, "when I am overloaded I just reach out to people. I am not afraid to ask for help."

Dedicating a lot of one's time and efforts to the organization is part of being a leader, but is not mean to deter anyone from taking on these positions and it is certainly rewarding when everything is said and done. "I would say if you're interested in being a student org leader, definitely go for it," Edwards says, "it really is kinda cool being able to say you're the leader of this organization. Plus it's a great way to get to know people, the organization itself and other student orgs."

It's definitely apparent that dedication is the word to best describe the relationship between student leaders and their organizations. If it weren't for these people who truly love the groups they are a part of, those organizations would not be as successful as they are. These leaders want to better the organizations as well as their members. They are constantly encouraging others to get involved and run for a leadership position. Moreover, these students genuinely like being leaders. They like helping others, reaching their goals and encouraging their teammates. Whether they were born with it, or just developed it throughout life, these leaders are proving that if you really enjoy something, you will excel at it. "Just have fun and be confident," Blake says, "you can't be a high up leader if you don't enjoy it!" WE

Article by:
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Design by:
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Photography by:
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Not your average pair of genes

The wide field of biotechnology offers many exciting possibilities that just might offer a viable option for creating biofuels.

An exciting field on campus and across the country is on the forefront of developing tomorrow's technologies, from biofuels to new medicines to new computers. This expansive field is biotechnology.

Due to its rather broad nature, there is no strict definition for what biotechnology is, though it can roughly be described as using parts of biological systems and living organisms to develop new products and technology, either organic or synthetic. It is a wide-ranging term that applies to a wide variety of sciences, including synthetic biology, organic chemistry, systems biology and more. The findings of this research have an incredibly wide range of applications from antimalarial medicines to the development of biofuels.

Biotechnology is not in itself a new scientific development. The field began roughly 40 years ago right alongside the birth of genetic engineering. With these advancements in genetics, scientists were able to splice out gene sequences from certain organisms and use its traits for other purposes, such as in medicines.

Since then, the field has exploded, especially in recent years. Synthetic biology companies have sprouted up across the nation and universities have drastically increased their research in the area.

Here at UW-Madison, research in biotechnology is thriving, especially in synthetic biology. As professor of chemical and biological engineering Brian Pfleger says of synthetic biology, "Instead of just tweaking things that already exist in an organism, we're designing novel functions." This entails introducing these genes into a different organism in order to carry out different functions such as fighting a disease, like in medicines, or creating biofuels to replace fossil fuels.

Just a few of the many cyanobacteria cultures being heated in Professor Pfleger's lab

Pfleger's research focuses specifically on creating biodiesel. Such a fuel would be more environmentally friendly than regular diesel.

"We're using microorganisms to produce precursors to diesel fuels – hydrocarbons," Pfleger says. "They wouldn't be any different from the ones that go in your engine today."

The sources for this biodiesel comes from bacteria, sugars and environmental sources. One of the main things limiting the advancement of this research is trying to figure out which genes to use to develop the desired product. Another limitation is that often researchers are not sure if different genes will interact with each other in the desired way.

As for the UW's research as whole it is one of the leaders in the field of biotechnology. As the head of the Great Lakes Bioenergy Center – a nationwide organization coordinating research in sustainability among universities and private laboratories – UW receives millions of dollars each year in funding to research

Students in Dr. Pfleger's chemical engineering lab are researching methods of using cyanobacteria to create sustainable biofuels.

Article by: Andrew Golden
Design by: Chandresh Singh
Photography by: Sara Karraker

Professor Pfleger inspects the cyanobacteria cultures in his research lab

biofuels, bioenergy, biosynthesis and other related topics.

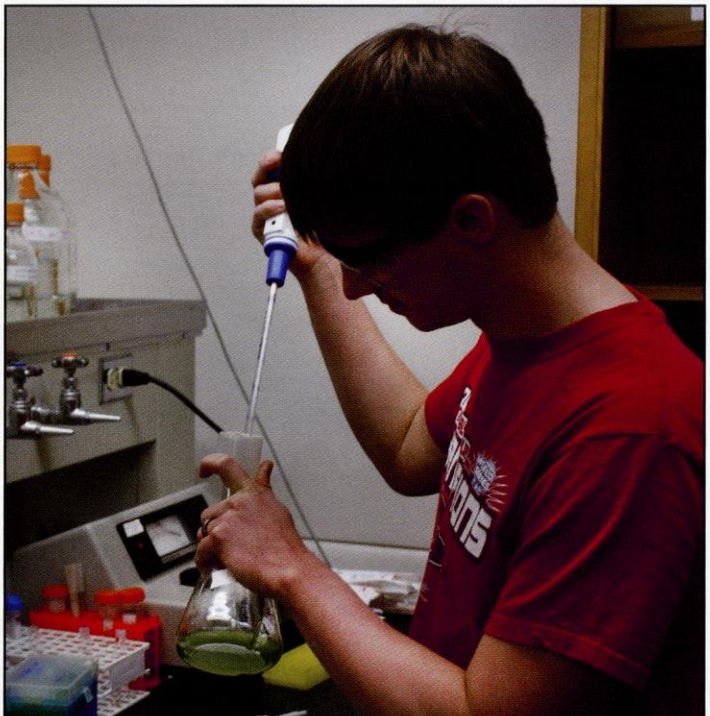
Much of the university's research, as a member of the Great Lakes Bionergy Center, focuses on the question of sustainability – how to wean ourselves from fossil fuels in favor of renewable sources, how to stem pollution, and countless other problems. Biochemists at the university work with a team that comes from a wide range of fields, including geneticists, mathematicians, mechanical engineers and others.

"We're using microorganisms to produce precursors to diesel fuels – hydrocarbons. They wouldn't be any different from the ones that go in your engine today."

- Professor Brian Pfleger

There is also prevalent research in biotechnology among the private sector, according to Pfleger. These biochemical laboratories are centered mainly in two clusters in the country – in California's Silicon Valley and in and around Boston. The companies in these regions, Pfleger says, are the ones doing more "cutting edge" research. Larger companies like DuPont and Monsanto have also shown interest in the area, such as for agricultural purposes, like genetically modified foods.

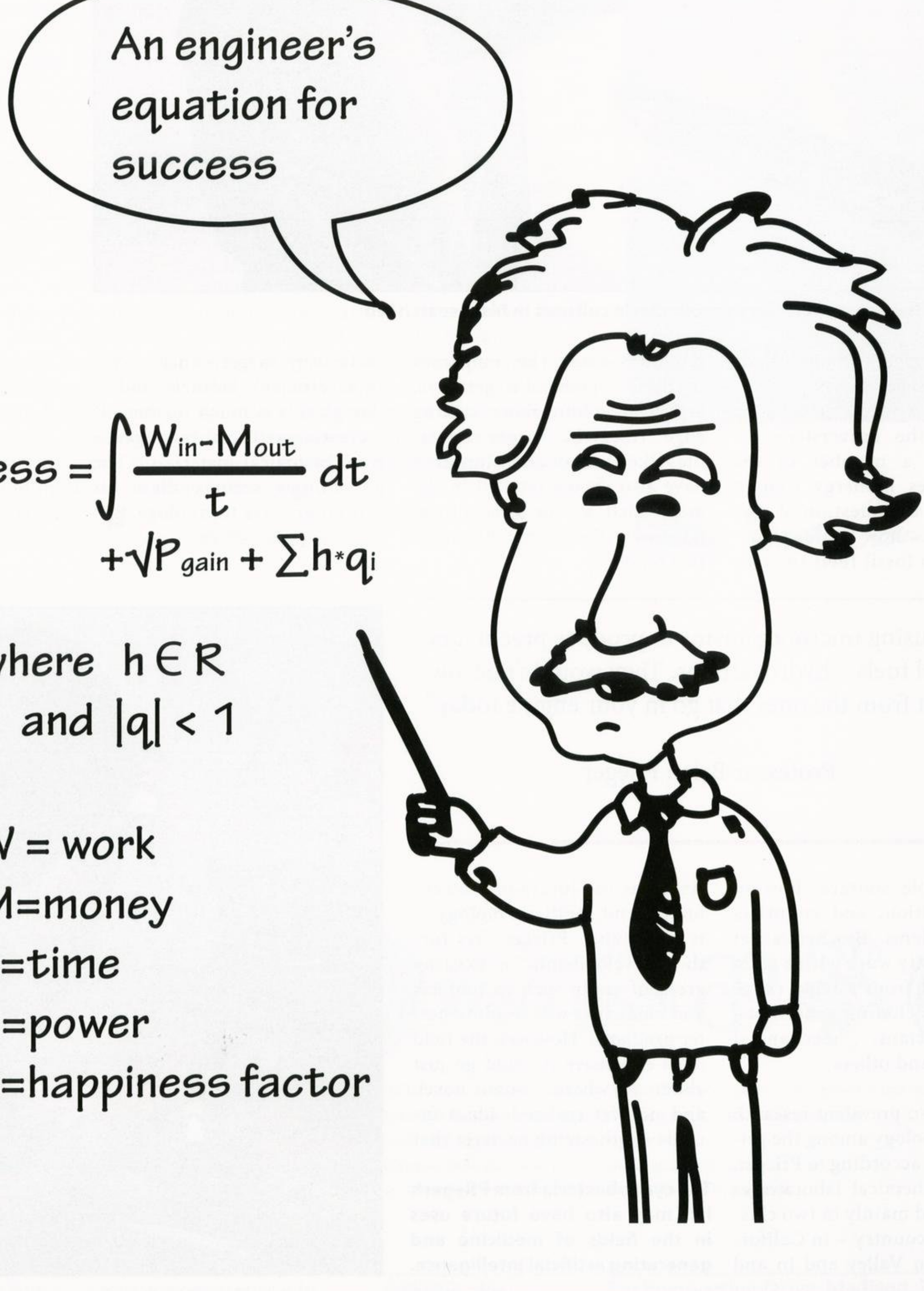
As far as the future of biotechnology and synthetic biology, it is uncertain. Pfleger says further developments in existing areas of study such as biofuels and medicines will result in better products. However, the field is so expansive it could go just about anywhere. Some novel, and not yet realized, ideas include synthesizing bacteria that exclusively target cancer cells, super-efficient biofuels and – though this is much further off – creating artificial intelligence from biological materials. The possibilities seem endless for this progressive technology. WE



The cyanobacteria from Pfleger's lab may also have future uses in the fields of medicine and generating artificial intelligence.

Just one more

The finest in eclectic humor



$$\text{success} = \int \frac{W_{in} - M_{out}}{t}\,dt + \sqrt{P_{gain}} + \sum h * q_i$$

where $h \in R$
and $|q| < 1$

W = work
M=money
t=time
p=power
h=happiness factor

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