FESC
Florida Energy Systems Consortium

# FLORIDA ENERGY CONNECTIONS

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Florida Energy Systems Consortium

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## Inside this Issue



**Upcoming Events:**

**SEC Symposium**—February 10-12, 2013-The Hyatt Regency, Atlanta, GA
Read more

**Solar POWER-GEN**—February 13-15, 2013– San Diego Convention Center, San Diego, CA
Read more

**2nd Annual Natural Gas Vehicle Infrastructure Conference & Exhibition**—February 25-27, 2013– Houston, TX
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**ARPA-E Innovation Summit**—February 25-27, 2013– Houston, TX
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## USF: Focus on Sustainability

An international team of researchers led by the University of South Florida will spend the next five years designing, implementing and teaching about a revolutionary attempt to turn wastewater into usable water, energy, and nutrients.

The project is funded through a $3.9 million grant from the National Science Foundation –USF's largest-ever sustainability grant –and will set new standards for interdisciplinary research in water and energy.

The coalition of nearly three dozen faculty and researchers will include about 100 undergraduate and graduate students from institutions in the United States, the Caribbean and Europe. Also included in the effort are USF's master's degree students who are part of a unique graduate program with the Peace Corps where they are already working and conducting research in developing nations.

USF is joined in the project with the University of Virgin Islands and the University of Belize. European partners are the University of Exeter, the UNESCO-IHE Institute of Water Education in the Netherlands, and the Institute of Chemical Technology in the Czech Republic.

"What makes the USF project unique is that we are working together from the start in the research enterprise, rather than farming out parts of the study to disciplinary specialists along the way," said Christian Wells, co-principal investigator and associate professor of anthropology at USF.

"By bringing together sustainability scientists from all across USF we can begin to

*USF Continued on page 2*

*USF continued from page 1*

address global problems from a more holistic perspective," he said.

The project's overarching research question, said USF professor of civil and environmental engineering James Mihelcic, is: Can effective, geographically-appropriate, and culturally relevant engineered systems be established that utilize wastewater as a resource for recovery of energy, water, and nutrients?

Mihelcic, who leads USF's Master's International Peace Corps program, said the project seeks to find new ways to convert wastewater into a renewable source of water, energy and nutrients and to change the way the world thinks about wastewater to be "not as waste, but a resource."

"This is the most significant sustainability research project that USF has landed," Mihelcic said. "NSF is funding this work because it can be transformational in tackling complex problems currently facing the Tampa Bay region."

The effort is funded as part of the NSF's Partnerships for International Research and Education (PIRE), an agency-wide program supporting international projects in the science and engineering communities. Specifically, the project comes under the NSF's efforts to advance sustainability science, engineering and education as an approach to global challenges associated with population growth and the strain on limited natural resources.

"This project epitomizes the translation of USF goals and strategic initiatives into action -world class research, outstanding student recruitment, global collaborations and connections, and enhancing our interdisciplinary base here at USF," said Linda Whiteford, USF professor of anthropology. "This combination of engineering and the socio-behavioral sciences is truly a cutting-edge framework for the future."

The goal of the program is to catalyze the best new ideas and practices on reusing wastewater as a resource while incorporating educational opportunities that broaden students' participation in science, technology, engineering and math courses related to sustainability, such as seminars and undergraduate research experiences.

"This project is unique in terms of its systems approach. It focuses not only on one stage of a new system, but the entire life of the system (cradle to grave) to avoid problem shifting across the life cycle stages. It looks at not only technological aspects of new systems, but across environmental, economic and social systems and their interactions to avoid unintended consequences. Such systems thinking and analysis are critical for the sustainability of new innovations and the sound training of future engineers," said Qiong (Jane) Zhang, an assistant professor of civil and environmental engineering at USF who will lead the system analysis of the project.

The PIRE will introduce a very exciting partnership with the University of the Virgin Islands (UVI) that allows their undergraduate students to complete dual bachelor's degrees in science and engineering, said USF Associate Professor Maya Trotz, who is co-principal investigator. Known as a 3+2 program, USF established this relationship with Bethune-Cookman University in 2006 where science students complete three years there followed by two years in USF's College of Engineering. Given the student demographic at UVI, we expect this partnership to increase the diversity of the college.

The project looks at social and cultural shifts which need to occur to ensure that the new systems created are understood, used and accepted by communities –including addressing the perceived risks of reusing wastewater. Tampa, a community that has struggled with how it can

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*USF continued from page 2*

effectively reuse treated wastewater, will be one of the study sites.

"This grant will provide great opportunities for graduate students to not only be part of an international team of experts addressing the conversion of wastewater into usable forms but also to learn how to effectively collaborate with researchers across disciplines and boundaries."

Whiteford, Wells and Rebecca Zarger, USF assistant professor of anthropology, recently returned from Belize where they established relationships with partners there.

"We found a wide range of ways in which people are using—or trying to use—local resources to solve global problems," said Wells. "Our work will help these communities navigate some of the challenges associated with managing sanitation systems and accessing clean water while creating new sources of energy in the face of changes to the global economy. A major contribution to emerge from this work will be identifying the broader causes and consequences of human decision-making in the face of environmental change."

The project will attack the challenge of converting wastewater into usable resources through various fronts –not only engineering new systems, but addressing environmental and social challenges associated with a radically new approach to wastewater management. The proposal includes several new systems for cleaning wastewater and managing the waste portion of the product in a safe manner that does not create another environmental or human health challenge.

Mihelcic said students and faculty will be trained to work not only in these interdisciplinary teams, but also understand how to function in global problem solving teams, learning about best practices and solutions that can be transferred across geographical and cultural boundaries.

"The ability to work in teams is absolutely critical for today's graduates and projects such as this greatly help prepare students for future leadership positions. Graduate students have become greatly interested in pursuing careers in sustainability and the experience afforded by this project will bring the involved students closer to their goal of leading sustainability efforts globally," said Karen Liller, dean of the USF Graduate School and associate vice president for Research and Innovation.

The USF team is comprised of James Mihelcic, Maya Trotz, Sarina Ergas, Daniel Yeh, Oiong Zhang, Delcie Durham, Yogi Goswami and Bernard Batson of the College of Engineering; Christian Wells, Rebecca Zarger and Linda Whiteford of the Department of Anthropology; Frank Muller-Karger of the College of Marine Science; and Allan Feldman of the College of Education.

"The research is important because it addresses very complex issues of water scarcity and supply, energy production, wise use of finite natural resources, protection of the environment and mitigation of climate change –all critical issues that will protect the environment while also improving economic and social well-being of residents of Florida, the United States and the world," said Mihelcic.

"The knowledge we create will assist local, regional, and global management of water and energy resources. Our students and faculty will be placed in interdisciplinary teams. Imagine now that engineers who are focused on technological solutions will be able to integrate issues of culture and behavior into the solutions, while also having command for how decisions they make in design and planning impact large environmental systems," he said.

# UCF's New Buildings Increase Space and Energy Efficiency

As construction continues with nearly $64 million in new projects set in motion, it seems UCF really may be under construction forever — or at least for the foreseeable future.

UCF has multiple construction projects underway around campus including Classroom II, student housing, Greek homes and a satellite Recreation and Wellness Center.

Classroom II is an underway project expected to be finished fall 2013 and will be built to adhere to the Leadership in Energy and Environmental Design standards for energy efficiency. This means Classroom II, as well as all other UCF building construction, will have better air quality, water usage and energy efficiency.

According to UCF Sustainability, these new improvements are estimated to save 20 to 40 percent of energy and water consumption compared to baseline buildings.

Ashley Hodas, a senior studying health sciences, said she's glad UCF is keeping energy efficiency in mind with its new construction.

"I'm really excited that UCF is working towards building more energy-efficient buildings," Hodas said. "Being one of the largest schools in the nation, we can set the tone for other schools to follow suit."

Gene Kruckemyer, news editor and writer for UCF News and Information, said in an email that Classroom II will be a three-story building, built to accommodate more students as well as general-purpose classrooms and is located between Classroom I and the Psychology Building. It will have seven lecture halls ranging from 130 to 450 seats, and will be nearly 80,000 square feet, as there is a need for additional classroom instruction space. Up to this point, the current buildings only have about 12 or 13 rooms on campus that hold more than 100 students, said Brian Boyd, the university's registrar.

Kiara Guzman, a senior health sciences major, sees the benefits of the new construction.

"Since I'm a health sciences major, I am always taking classes that are held in big lecture rooms filled with students," Guzman said. "The addition of new classrooms with more seats will definitely be beneficial, especially if a class I want to take is full. Maybe now there will be more likely of a chance that a space will open up for me in the future."

Additionally, within Classroom II there will be more office and support space. The buildings' third floor will house the Air Force ROTC offices, and the second floor will house the Army ROTC offices. There will be a military history library and a "virtual battle lab" for simulations. The construction of this new building is costing the university $23.4 million, Kruckemyer said.

Col. Todd Freece, commander of the Air Force ROTC at UCF, explained the ROTC's excitement for the new building.

*UCF continued on page 5*

*UCF continued from page 4*

“We are very excited for the opportunity to move into a more permanent facility," Freece said. "We have been based in trailers over the last 15 years, and it allows our students to be more centrally located on campus. It also demonstrates a real, concrete level of commitment from the university and the state to supporting the Army and Air Force, and we look forward to it.”

In addition to Classroom II, UCF is building a new residential village, Academic Villages II, which will be next to the original Academic Villages on the southern side of campus. According to UCF Facilities Planning and Construction, this building will consist of three residence halls — for a total of 672 beds — as well as a support building, costing the university about $39 million, Kruckemyer said. The three-building addition is scheduled to be completed by late summer, the same time a new 1,030-space parking garage is expected to open for the Academic Villages.

Douglas Woodrow, a freshman studying computer science, understands the need for more housing.

“When I was accepted to live on campus, I was so excited,” he said. “I know that it is difficult to get on-campus housing because of all of the incoming students, so more housing definitely wouldn’t hurt. More students will now be able to experience dorm life than ever before at UCF. I know that thus far, I definitely would not trade it in for off-campus housing.”

He also expressed his feelings toward the expansion.

“I definitely support classroom expansion for the additional areas of education,” he said.

UCF’s first LEED Gold building is the Physical Sciences building located near Memory Mall.

According to UCF Sustainability, the construction of newer, greener buildings is easier and more cost effective than retrofitting an existing building. All of UCF’s new construction on campus now adheres to the LEED standards for energy efficiency.

UCF’s fraternity and sorority row is growing, too. Two new Greek residence homes as well as a Greek life center are being built near Alafaya Trail and Gemini Boulevard. These buildings will be owned by the university and maintained by the Department of Housing and Residence Life. The new houses will be occupied by Chi Omega and Kappa Kappa Gamma and are scheduled for completion this fall, joining the 11 other Greek houses on campus, Kruckemyer said.

Scheduled to open this semester in Knights Plaza, a new satellite Recreation and Wellness Center is being built and will feature 1,840-square-feet of exercise and fitness space. About $1.2 million saved during the construction of the campus’ larger center is being used to build this smaller venue, Kruckemyer said.

Being built just across McCulloch Road from the UCF campus and Bright House Networks Stadium, NorthView student housing complex will be the UCF area’s newest student apartment community.

Scheduled to open fall 2013, NorthView will allow students to pay rent by semester to their student accounts located in myUCF. Student financial assistance, such as grants, scholarships and loans, can also be used to pay for NorthView, Kruckemyer said.

One expected addition that students won’t be seeing on campus in the near future is the organic grocery store, which was proposed in July 2012, but decided against by UCF in December 2012.

## Zircar Zirconia, Inc. Supplies High Temperature Insulation for Solar Thermochemical Fuel Production Reactor

Zircar Zirconia, Inc., a global leader in high temperature insulation products, received multiple orders in late December,2012 from the University of Florida's(UF) Solar Fuel Team to supply custom machined, high temperature insulation reactor components.

Zircar Zirconia Inc. shipped today 4 custom sets of alumina insulation boards that will manage the solar energy supplied by a high flux solar simulator for high temperature solar thermochemical research. The 50 kWe high flux solar simulator consisting of an array of Xe-arc lamps, each coupled to an ellipsoidal mirror designed for the UF Solar Energy Engineering Laboratory. The UF high flux solar simulator serves as an experimental platform for solar thermal and solar thermochemical research.

Zircar Zirconia alumina fiber boards excel at solving thermal management problems by providing rigid, machinable refractory materials for rapid proto-typing that outperform conventional alumina-silicate fiber boards.

"This project strengthens our global position in the solar energy market," said David Hoskins, sales manager at Zircar Zirconia, Inc.. "It is a typical example of Zircar Zirconia drawing on its leading technical expertise in high temperature insulation to provide customized solutions with a fast turnaround that facilitate our customers technological growth." Zircar has supplied custom machined, high temperature insulation components to both international and domestic university and national lab solar researchers since the 1990's and its experience in supplying customized components with a short lead time was critical in winning this contract.

This project is DOE Advanced Research Projects Agency-Energy (ARPA-E) funded for the production of synthetic fuel that can harvest and store the sun's energy in chemical form via high temperature thermochemical conversion of carbon dioxide (CO2) and water to fuel--allowing solar energy to be easily transported and stored. The University of Florida is developing a windowless high-temperature chemical reactor that converts concentrated solar thermal energy to syngas, which can be used to produce gasoline. The overarching project goal is lowering the cost of the solar thermochemical production of syngas for clean and synthetic hydrocarbon fuels like petroleum. The team will develop processes that rely on water and recycled CO2 as the sole feed-stock, and concentrated solar radiation as the sole energy source, to power the reactor to produce fuel efficiently. Successful large-scale deployment of this solar thermochemical fuel production could substantially improve our national and economic security by replacing imported oil with domestically produced solar fuels.

## FSU: Study Finds Energy Use in Cities has Global Climate Effects

The heat generated by everyday energy consumption in metropolitan areas is significant enough to influence the character of major atmospheric circulation systems, including the jet stream during winter months, and cause continental-scale surface warming in high latitudes, according to a trio of climate researchers that includes Ming Cai, a professor in Florida State University's Department of Earth, Ocean and Atmospheric Science.

Led by Guang Zhang, a research meteorologist at Scripps Institution of Oceanography at the University of California, San Diego, the scientists report in the journal *Nature Climate Change* that waste heat released in major cities in the Northern Hemisphere causes as much as 1 degree C (1.8 degrees F) of continental-scale winter warming in high latitudes of the North America and Eurasian continents. They added that this effect helps to

explain the disparity between actual observed warming in the last half-century and the amount of warming predicted by computer models that only include anthropogenic greenhouse gases and aerosols.

The study, "Energy Consumption and the Unexplained Winter Warming Over Northern Asia and North America," appears in online editions of the journal on Jan. 27. The study was funded in part by the National Oceanic and Atmospheric Administration's Climate Program Office.

Cai, Zhang and Aixue Hu of the National Center for Atmospheric Research in Boulder, Colo., considered the energy consumption — from heating buildings to powering vehicles — that generates waste heat release. The world's total energy consumption in 2006 was 16 terawatts (one terawatt equals 1 trillion watts). Of that, 6.7 terawatts were consumed in the 86 metropolitan areas considered in this study.

"The burning of fossil fuel not only emits greenhouse gases but also directly effects temperatures because of heat that escapes from sources like buildings and cars," Hu said.

The release of waste heat is different from energy that is naturally distributed in the atmosphere, the researchers noted. The largest source of heat, solar energy, warms the Earth's surface. Atmospheric circulations distribute that energy from one region to another. Human energy consumption distributes energy that remained dormant and sequestered for millions of years, mostly in the form of oil or coal. Though the amount of human-generated energy is a small portion of that transported by nature, it is highly concentrated in urban areas.

"The world's most populated metropolitan areas, which also have the highest rates of energy consumption, are along the east and west coasts of the North American and Eurasian continents, underneath the most prominent atmospheric circulation troughs and ridges," Cai said. "The concentrated and intensive release of waste energy in these areas causes a noticeable interruption to normal atmospheric circulation systems, leading to remote surface temperature changes far away from the regions where the waste heat is generated."

The authors report that the influence of urban heat can widen the jet stream at the extratropics, or area outside the tropics. They add that the heating is not uniform. Partially counterbalancing it, the changes in major atmospheric systems cool areas of Europe by as much as 1 degree C, with much of the temperature decrease occurring in the fall.

The study does not address whether the urban heating effect disrupts atmospheric weather patterns or plays a role in accelerating global warming, though Zhang said drawing power from renewable sources such as solar or wind provides a societal benefit in that it does not add net energy into the atmosphere.

Zhang said the climate impact this research studied is distinct from the so-called urban heat island effect, an increase in the warmth of cities compared to unpopulated areas caused by land use changes. Such island effects are mainly a function of the heat collected and re-radiated by pavement, buildings and other urban features.

"What we found is that energy use from multiple urban areas collectively can warm the atmosphere remotely, thousands of miles away from the energy consumption regions," Zhang said. "This is accomplished through atmospheric circulation change."

They also find observational evidence indicates that the waste heat can be the "missing forcing" that would account for the discrepancy between the observed temperature change and that is simulated in computer models forced only by anthropogenic greenhouse gases and aerosols. They suggest that the influence of energy consumption should be considered, in addition to heat-trapping gases and aerosols, as necessary anthropogenic factors in computer models to predict the future climate.

NOAA's mission is to understand and predict changes in the Earth's environment, from the depths of the ocean to the surface of the sun, and to conserve and manage the nation's coastal and marine resources.

# UF Engineering Assistant Professor gets Grant for Solar Cell Work

A UF engineering instructor has received funding to study a compound that could potentially make solar energy more affordable.

Materials science and engineering associate professor Jiangeng Xue will work on the light powered technology project with researchers from two other universities. Their research aims to test barium silicide, a compound of barium and silicon found in Earth's crust.

Little is known about the barium silicide compound, and its application for solar power has not really been studied. The abundance of both barium and silicon could make solar cells cost-effective.

The compound also could be promising in terms of harvesting sunlight, being a semi-conductor and transporting the electric charge carriers.

Xue stressed the necessity for cheap, clean energy to compete with fossil fuels.

"Overall, it is really important to find a low cost resource," Xue said. "The question is further lowering the cost and driving the efficiency up."

The Scialog Collaborative Innovation Award from the Research Corporation for Science Advancement is funding the project. The corporation funds high-risk and potentially high-reward research.

"When [the research] does succeed, the results can trigger major changes in technology and, occasionally, even in our fundamental understanding of nature," said James M. Gentile, president and CEO of the corporation.

Xue and his UF students will be working on the solar cells themselves. Meanwhile, a team from the University of Illinois at Urbana-Champaign will focus on the computer calculation of the compound's properties. A team from the University of Wisconsin-Madison will research the chemical synthesis of the materials.

# Recent Funding Opportunities

FESC office tracks the energy related funding opportunities, shares them with faculty and industry partners, facilitates the submission of multi-faculty, multi-SUS university competitive proposals in response to solicitations for major research programs. The most recent funding opportunities are listed below. For a complete list please visit the funding opportunities page on the FESC website.

- **DE-FOA-000838: SunShot Incubator Program** Letter of Intent due: February 25th, 2013
  More Information
- **DE-FOA-0000807: Nuclear Energy University Programs-Fellowship and Scholarship Support** Application Deadline: Continuously through November 30th, 2015
  More Information
- **DE-FOA-0000792: Solid-State Lighting Manufacturing Research and Development-Round 4** Application Deadline: February 21st, 2013
  More Information
- **Particulate and Multiphase Processes** Full Proposal Window: January 15th, 2013- February 19, 2013
  More Information