

KEY FESC RESEARCH

Enhancing Energy Efficiency and Conservation

Zero Energy Homes

Developing Florida's Biomass Resources

Liquid Fuels from Biomass

Harnessing Florida's Solar Resources

Solar Thermal Power

Rectifying Antenna Solar Power

Clean Water using Advanced Solar Energy Detoxification

Ensuring Nuclear Energy and Carbon Constrained Technologies for Electric Power in Florida

Exploiting Florida's Ocean and Wind Energy Resources

Securing our Energy Storage and Delivery Infrastructure

Power Generation Expansion

Establishing PV Industry in Florida

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Useable By-Products from Bio-Waste

By Vickie Chachere, *USF News*, Nov. 7, 2011

There are some unvarnished facts about life on our planet that need addressing, for USF Assoc. Prof. and FESC Co-PI, Daniel Yeh. First, there are 7 billion people who live on the Earth, all needing clean water to grow food and energy to power their communities, and all of them produce bio-waste. So what if you could take some of the things humans really need - like clean water and energy - and harvest those necessities from the one thing everybody has to do? Even better, what if you could get Bill and Melinda Gates to agree this is a really intriguing idea?

Yeh is one of this year's winners of a Bill and Melinda



FESC co-PI Daniel Yeh harvests clean water, methane and nutrients from sewage.

Gates Foundation Grand Challenges Explorations grant to support his innovative anaerobic membrane bioreac-

tor, a device trademarked as the "NEWgenerator." It recovers nutrients, energy and water from human wastes, leaving very little to be disposed of and producing new products which are in short supply.

"How are we going to make enough food? Where's the energy going to come from? We have to stop having everything being a one-way street. We need to close the loop," said Yeh.

The project is one of 110 in six categories selected for support from the Gates Challenges fund, which is designed specifically for researchers to explore unconventional ideas that could solve persistent global health and development challenges.

Yeh will use the \$100K grant to develop a prototype device that, once linked into a septic system, will convert human waste into water that has been thoroughly cleaned of pathogens and is suitable for crop irrigation or household uses such as in cooling systems or flushing. The process, which uses microbes to break down the waste, also produces methane gas which can be captured and used for

heating and as a clean energy source.

Yeh is not the first to look at waste as a renewable energy source. Cruise ships and "green" buildings are already filtering wastewater to near drinking-water quality and recycling it for cooling systems and to flush toilets.

Yeh has developed a contained refinery system that is relatively inexpensive, doesn't consume much energy itself and doesn't leave much byproduct from the waste processing. The Gates grant will help fund the construction of a larger prototype that will be put into use at the Learning Gate Community School, a Hillsborough County charter school that has built its curriculum around sustainability.

Yeh's machine uses anaerobic microbes to break down the wastes in a process which produces methane gas and separates the water out. A very small amount of sludge is produced, and it is easily returned to the septic system for usual disposal. The methane gas can be captured and piped out of NEWgenerator while the water is processed through a specialized

See "... human bio-waste to power"

FESC Universities



The Florida State University System provides the backbone of renewable energy expertise for the Florida Energy Systems Consortium. Member universities include:

- University of Florida
- Florida State University
- Florida Atlantic University
- University of Central Florida
- University of South Florida
- University of West Florida
- University of North Florida
- New College of Florida
- Florida International University
- Florida Gulf Coast University



Biowaste ...

Exploring

the

conversion

of biowaste

to energy.

This is

a process

that is

renewable

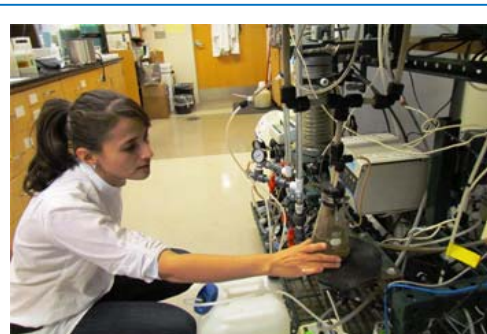
and

environmentally

attractive.

... human bio-waste to power (from pg. 1)

membrane that removes other elements, bacteria & other pathogens that would make using the reclaimed water problematic. What's left behind is H₂O containing 2 nutrients: ammonia & phosphate. Those are exactly the 2 nutrients plants need to grow, making the H₂O especially useful for crop irrigation, he noted. Over 4 years, Yeh has built & perfected a small version of the NEWgenerator. The test "waste" matter isn't what you might think; Yeh uses dry cat food soaked in H₂O which mimics the properties of human waste. "The dirtier the better," Yeh explains of the raw matter going into the machine. "The more polluted it is, the more methane we can recover."



Recently graduated Ph.D. student Ana Prieto, fine-tunes the NEWgenerator.

The system differs from current wastewater treatment plants which use aerobic microbes to breakdown wastes. Those systems require more energy to run and leave considerable sludge byproduct that must be disposed. Yeh's project also is intended for a much smaller scale than large centralized systems which are expensive for communities to construct.

The demonstration project at Learning Gate will be constructed in an area of the large school grounds where access is controlled, although the school will incorporate its design and planned functionality into its lessons on sustainability. The challenges in building a larger-scale device is keeping the cylinder where the anaerobic microbes do their work airtight and continually refining the design to make it rugged and affordable to operate as it would need to be in a developing nation.

The prototype model will return the water and sludge that comes out of the reactor to the septic system, but the eventual goal is to be able to plug the NEWgenerator into a variety of sanitation systems for waste treatment and recovery of water and nutrients.

Faculty and Student Activities

- ◆ FESC co-PI Maya Trotz of Civil and Environmental Engineering organized the 2011 Assoc. of Environmental Engineering and Science Professors conference, held at USF-Tampa Bay. Conference themes included water depletion & degradation; assessing & improving air quality & waste management; infrastructure for an expanding & urbanizing population, vulnerability & adaptation to climate change.
- ◆ A research consortium led by the USF-St. Petersburg College of Marine Science was awarded more than \$11M through BP Oil's "Gulf of Mexico

Research Initiative" to continue assessing the impacts of the 2010 Deep water Horizon oil spill in the Gulf of Mexico's ocean and coastal ecosystems and to build better ways for predicting damage from future spills. FESC Co-PI Robert Weisberg and his colleagues will carry out substantive research in this project.

- ◆ FESC co-PI Chris Ferekides' research team netted \$987K from the US DOE's Sunshot Initiative for their project researching the doping of thin-film, cadmium-telluride PV cells to increase cell open-circuit voltage, leading to higher cell efficiencies.

- ◆ Graduate student Innocent Udom received the NASA-Harriett G. Jenkins Pre-doctoral Fellowship Project (JFPF) award based on a proposal submitted using data from Prof. Sarina Ergas' FESC funded project "Green Aviation Fuels from Microalgae." Udom received \$121,500 from NASA Glenn Research Center.
- ◆ Graduate student Syed Ali Gardezi won first place in the poster competition at the 2011 Florida Energy Systems Consortium Annual Summit, held at the University of Florida, in Gainesville in September. Gardezi's poster was entitled "Fischer-Tropsch Synthesis via Biomass Derived Synthesis Gas" (S.A. Gardezi, B. Joseph, the late J.T. Wolan, and Y. Goswami)

Solar Decathlon

USF Architecture students led Team Florida in the 2011 international Solar Decathlon competition. A two-year project, Team Florida designed and built "Flex House," a net-zero solar energy home. Team Florida's USF faculty advisor Dr. Stan Russell is a co-PI within CERC's FESC.

The U.S. DOE's Solar Decathlon challenges collegiate teams to design, build, and operate solar-powered houses that are cost-effective, energy-efficient, and attractive. The winner of

the competition was the team that best blends affordability, consumer appeal, and design excellence with optimal energy production and maximum efficiency. The houses were intended for different housing markets, including lower-income, disaster relief, retirement and single families. This year's 20 collegiate teams spent almost two years creating houses to compete in the 10 contests of the Solar Decathlon. To win, a team had to produce a house that:

- Is affordable, attractive, and easy to live in;
- Maintains comfortable and healthy indoor environmental conditions;

- Supplies energy to household appliances for cooking, cleaning, and entertainment;
- Provides adequate hot water;
- Produces as much or more energy than it consumes.

The University of Maryland took the overall trophy this year.



USF's Flex House during construction.

FESC Expertise

FESC was charged to perform R+D on innovative energy systems that lead to alternative energy strategies, improve energy efficiencies, and expand economic development for FL. The consortium has considerable energy-related expertise and competitively funded research. FESC's research focuses on those energy areas most relevant to Florida. Specifically, the FESC research agenda addresses energy generation from our two most abundant renewable resources (biomass and solar), carbon-free electric power generation (nuclear power, carbon sequestration), tapping the energy available from the ocean along our long and populated coastline, reducing consumption through energy conservation, and defining more efficient load management and energy storage systems.

FAQs and Links

FESC's outreach effort focuses on increasing Florida's energy use efficiency and to measurably reduce its emissions of greenhouse gases. Educational materials and programs developed by FESC are based on energy and climate research findings and analysis conducted at Florida's state universities as well as national sources.

Outreach programs are designed to deliver practical, applicable information and knowledge to targeted groups including: the general public, professionals, local officials and state policymakers.

A website full of handy FAQs makes energy awareness easy to acquire. http://www.floridaenergy.ufl.edu/?page_id=13

Another site houses an extensive library of links to many RE related sites: http://www.floridaenergy.ufl.edu/?page_id=11



<http://www.floridaenergy.ufl.edu/>

At **USF UNIVERSITY OF SOUTH FLORIDA**

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College of Engineering
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Phone: 813-974-7322 Fax: 813-974-2050



The USF FESC management team is led by CERC's Prof. Yogi Goswami as Director. Ms. Barbara Graham coordinates communications and publications. For more information: <http://cerc.eng.usf.edu>

Yogi Goswami goswami@usf.edu

Barbara Graham grahambj@usf.edu

CERC / FESC Competes Research One

During November the CoE held the 4th Annual Research Day as part of the wider "USF Research One" celebration of activities and events showcasing the work of researchers throughout the USF System. CoE's Research Day features cutting edge research presentations by engineering students and faculty and provides an opportunity for networking with local industry. This year the event was held in the newly renovated multi-purpose classroom in the Engineering II Building. CERC and FESC-supported graduate students presented poster papers at the event.

- "Metal Thin-film Roughness Mitigation through Thermal annealing for Self-Assembled Monolayer Growth" (M. Celestin, S. Koiry, S. Krishnan, and Y. Goswami)
- "Analysis of Supercritical Fluids for Geothermal Power Conversion" (R. Vidhi, S. Kuravi, Y. Goswami, and L. Stefanakos)
- "DFT Studies on the Influence of Platinum Promoter on CO Activation Pathways of Cobalt Catalyst in Fischer Tropsch Synthesis" (N. Balakrishnan, V. Bhethanabotla, and B. Joseph)
- "Fischer Tropsch Synthesis via Biomass Derived Syngas (S.A. Gardezi, B. Joseph, and J.T. Wolan)
- "Towards Efficient Synthetic Hydrocarbon Fuel Production: Role of Cobalt Nanoparticle Size" (B. Mankidy, B. Joseph, J.T. Wolan, Y. Goswami, and V. Gupta)

FESC Researcher Passes

Dr. John T. Wolan, Jr., 53, of Tampa, passed away August 17, 2011. Born in 1957 in Abington, Pennsylvania, he received a bachelor's degree from the University of Central Florida and master's and doctorate degrees from the University of Florida. Dr. Wolan was an associate professor of USF's Chemical and Biomedical Engineering since 2001. Dr. Wolan was also a FESC co-PI, actively investigating the production of liquid fuels to biomass via thermo-chemical conversion processes, which earned an honorable mention at the DOE's sponsored Global Venture challenge in 2010. Dr. Wolan is survived by his daughter, siblings and parents. A celebration of John's life was held August 27 at Tims Memorial Presbyterian Church in Lutz.

Visitors



Michele Bustamante preparing samples in laboratory glove box.

- ◆ CERC hosted Michele Bustamante from Rensselaer Polytechnic Institute in NY state, for 2011 NSF Summer Research Experiences for Undergraduates (REU) program. Michele's work involved preparing carbonate eutectic salts for use as thermal storage in concentrated solar power applications.
- ◆ The US Dept. of State sponsored Internat'l Visitor Leadership Program brought visitors from India as part of the "Climate Change and Clean Energy: A Project for India" program to learn about clean energy research from CERC directors Lee Stefanakos and Yogi Goswami, in April. The program explored technological and regulatory issues involved with promoting clean energy technology in the US. The group was locally sponsored by the Internat'l Council of the Tampa Bay Region.
- ◆ The US Energy Assoc. (a member committee of the World Energy Council) hosted a group of So. Asian energy executives to visit the USF and tour the CERC laboratories, in March. The USEA program, "So. Asia Regional Initiative for Energies" aims at building global networking contacts for energy professionals in both the public and private sectors. Group members working in the public energy utilities, wind power and micro-solar sphere hailed from Sri Lanka, Nepal, and Bangladesh.



(L-R) Raymond Herbert, Dr. Yogi Goswami, Dr. Tom Weller, Lisa Montelione, and Randy Klindworth.

- ◆ In June, Tampa City Councilwoman Lisa Montelione, Raymond Herbert (Tampa Facilities Manager) and Randy Klindworth (Hillsborough County Energy Manager) toured the CERC laboratories and spoke with co-director Yogi Goswami and CoE Associate Dean Tom Weller, in a fact-finding mission to better position Tampa in the rapidly evolving sustainable energy field.