FESC
Florida Energy Systems Consortium

FLORIDA ENERGY CONNECTIONS

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Florida Energy Systems Consortium

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Welcome

Welcome to the first FESC e-newsletter. With this quarterly newsletter, we will introduce you to FESC researchers and educators, as well as industry partners, who are working toward Florida's sustainable energy future.

FESC was created by the Florida State government to promote collaboration among the energy experts at its 11 supported universities to share energy-related expertise. The consortium assists the state in the development and implementation of an environmentally compatible, sustainable, and efficient energy strategic plan. The Consortium was charged to '***perform research and development on innovative energy systems that lead to alternative energy strategies, improved energy efficiencies, and expanded economic development for the state***'. The legislature appropriated funding for research at five of the universities as well as support for education, outreach, and technology commercialization.

The Consortium reports to and supports the Florida Energy and Climate Commission in developing and implementing the State's energy and climate agenda. For more information on FESC institutions, our members and partners, and our research, education, and outreach activities, please see our website. <www.floridaenergy.ufl.edu>

FESC Technical Teams Reap Rewards

Energy researchers in the State University System are continually seeking opportunities to leverage funding and strengthen their research. In 2009, the State University System was awarded over 400 grants totaling almost $100 million. To facilitate collaboration among Florida's universities, FESC has gathered faculty in selected research areas to share their expertise and apply for specific funding opportunities in their research area. Teams formed to date include Energy Efficiency and Conservation, Carbon Capture and Sequestration, Ocean Energy, Energy Storage, Smart Grid, Solar PV, Solar Thermal, Algae, Biomass, and Policy and Systems. The latest funding opportunities can be found at the FESC Website, www.floridaenergy.ufl.edu. Click on "Funding Opportunities." If you would like to join a research team, please contact Canan Balaban at cbalaban@ufl.edu .

2010 FESC Summit to be held September 28—29 at the UCF Student Union

Planning has begun for the second annual FESC Summit, which will be held at the University of Central Florida's Student Union on September 28-29, 2010. The format is expected to follow that of last year's successful first summit, with pre-summit workshops, oral and poster sessions from FESC-funded or associated projects, and nationally known speakers.

More than 160 people attended the first FESC Summit, held September 29-30, 2009 at the University of South Florida's Marshall Student Center. Participants represented a broad cross-section of energy interests, ranging from government and industry to research, development, and education. The Summit will be organized yearly to bring together energy experts in the State University System of Florida to share their energy-related research findings and to promote future collaboration.

A keynote address by Sam Baldwin, Chief Technology Officer and Member of the Board of Directors for the Office of Energy Efficiency and Renewable Energy with the US Department of Energy, opened the Summit. His talk, entitled "Energy Efficiency and Renewable Energy: Challenges and Opportunities," was extremely valuable and is available on the FESC website.

The Summit's first day also featured presentations by James Murley, Chairman of the Florida Energy and Climate Commission, and Mark Futrell of the Florida Public Service Commission, which addressed Florida's energy

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Focus on Industry: Florida Power and Light Co.

By Buck Martinez, Senior Director of Development

With its earliest roots tracing back to Thomas Edison, FPL was formed on December 28, 1925. FPL began its first year of service with 76,000 electric and gas customer accounts serving 58 communities with 230 miles of transmission lines, 1,149 miles of distribution lines, and a generating capacity of 70 megawatts.

Today, FPL is one of the largest and highest-performing electric utilities in the nation, with over 73,000 miles of distribution and transmission lines and a generating capacity of over 22,000 megawatts. In 2008, FPL served 4.5 million customer accounts with clean and reliable energy while keeping customer bills the lowest in the state.

Buck Martinez, FPL's senior director of development, joined FPL in1981. Prior to being named to his present position, he served as director of human resource services, overseeing the corporate safety department, labor relations and the corporate quality program. Martinez's current responsibilities include overseeing the development of renewable energy projects in Florida.

Martinez is one of the founding members of the FESC advisory board. "It is an opportunity to participate in new and innovative concepts in energy, and at the same time, be able to give back to

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Outreach Update

The Program for Resource Efficient Communities (PREC) at the University of Florida will be conducting professional training programs (most are CEU approved for the construction industry, architects, and professional engineers) that promote energy efficiency and weatherization in commercial and residential buildings. In some instances, the training will support Community Energy Retrofit Incentive Programs (Sarasota), Workforce Development programs (Manatee), and professional certifications (Miami-Dade, Broward). Additional training will support cost effective energy saving strategies for homeowners and include homeowner outreach workshop/seminars. Please check the website listed under each training for further updates, registration information, registration fees, and training locations as more information becomes available.

Outreach programs currently scheduled for 2010		
2/11	Manatee	**Homeowner's "Remodel Green Workshop"** Open to the public, no charge For more information and registration go to: http://buildgreen.ufl.edu/cecampus.htm
2/12	Manatee	**Green Advantage /Professional Training** Provides 8 continuing education hours Cost - $75 with scholarship (a limited number) or $175 For more information and registration go to: http://buildgreen.ufl.edu/cecampus.htm
2/18	Broward	**Green Advantage: Commercial/Professional Training** Provides 8 continuing education hours For more information and registration go to: http://www.abceastflorida.com/Management_Education/Environmental_Courses/Green_Advantage.aspx
3/22	Pinellas	**Energy Efficient Building Construction in Florida/Professional Training** Provides 8 continuing education hours Cost - $75 with scholarship (a limited number) or $175 For more information and registration go to: http://buildgreen.ufl.edu/cecampus.htm
4/15	Pinellas	**Train-the-Trainer for Homeowner's " Remodel Green Workshop"** For select County Extension Faculty only
4/15	Miami-Dade	**Green Advantage: Commercial/Professional Training** Provides 8 continuing education hours For more information and registration go to: http://www.abceastflorida.com/Management_Education/Environmental_Courses/Green_Advantage.aspx
4/20	Manatee	**HVAC and IEQ for Contractors** Provides 8 continuing education hours Cost - $75 with scholarship (a limited number) or $175 For more information and registration go to: http://buildgreen.ufl.edu/cecampus.htm

FESC Announces Technology Commercialization Phase I Awards

In Phase 1 of its Technology Commercialization Program, FESC has awarded more than $100,000 to five FESC universities to fund market studies and business plans for 15 energy-related technologies with commercial potential. These funds will provide support for market studies, business plans, and the introduction of energy-related technologies to potential licensees, with the ultimate goal of attracting research and development funding to State University System institutions, and identifying licensees for commercialization of high-potential energy technologies.

FESC's two-phase technology commercialization program is designed to promote industrial collaboration and technology transfer in the energy sector. Candidate technologies include bio-energy, solar energy, energy efficiency and conservation, nuclear energy, ocean energy, carbon capture and sequestration, storage and delivery, and energy management.

Phase 1 provides a platform for FESC to work with technology transfer directors across the State University System to identify technologies with commercial potential for two purposes: 1) development of a statewide database of energy-related technologies that FESC can co-promote with universities to industries in Florida and beyond; and 2) funding the development of business plans, market analyses, and industry/investor presentations of a subset of these technologies. Technologies in this subset of 15 awardees will be coordinated into commercialization packages to attract potential industry partners who might provide development funding and license the technologies.

Modeled on the Florida High Tech Corridor Council Matching Grants Research Program, Phase 2 will provide FESC matching funds for technology development partnerships between industry and State University System institutions. FESC anticipates a highly competitive program, for which we will award 4 grants for matching funds of up to $50,000 each.

FESC anticipates releasing the Phase 2 Request for Proposals in Spring 2010.

FESC Technology Commercialization Phase 1 Awards:

- "Novel Fabrication Method of Nanoscale Fibers and Tubes," Florida International University
- "Synthesis of Hydrides and the Vehicular Use of Hydrogen Producing Reactions," Florida International University
- "Indium Phosphide, Indium-Gallium-Arsenide and Indium-Gallium-Antomionide-Based High Efficiency Multijunction Photovoltaics for Solar Energy Harvesting," Florida State University
- "Multi-Piece Wind Energy Blades," Florida State University
- "Microgrid Controllers and Solar Wind Distributed System Controls," Florida State University
- "High Efficiency Air Conditioning Condenser Fan Blades," University of Central Florida
- "Milling Technology Leads the Way to Cost Effective Ethanol Production," University of Central Florida
- "Hybrid Photovoltaic and Thermoelectric Cell Elements Improve Solar Cell Efficiency," University of Central Florida
- "Wind and Solar Battery Chargers," University of Central Florida
- "Advanced Membrane Reactors for H_2 Production," University of Florida
- "ChromaDynamics," University of Florida
- "A Highly Efficient, Long-Lifetime, All-Weather Compatible Nanomaterials-Based Display Technology," University of Florida
- "High-Power, Fuel Flexible, Cost-Effective Solid Oxide Fuel Cell," University of Florida
- "Enhanced PbS (Lead Sulfide) Quantum Dots for Solar Cells," University of South Florida
- "A Practical Method of CO_2 Sequestration," University of South Florida

FGCU Solar Field Goes Online

In late December, Florida Gulf Coast University's solar energy farm quietly went live. The 2-megawatt system, encompassing of 10,080 panels on 16 acres, is now powering about 200,000 square feet on the FGCU campus, including Lutgert Hall, Holmes Hall, and Academic Building 7. It is the largest working solar field operated by a university in the United States.

A partnership between FGCU and Regenesis Power, construction of the $14 million project appears to be completed on time and under budget. The field should result in energy cost savings of between $700,000 and $800,000 per year.

"This 16-acre energy field will significantly reduce our dependence on non-renewable energy sources, save money, reduce our carbon footprint and serve as a model of environmental and ecological sustainability for our region, the state of Florida and the nation," said FGCU President Wilson G. Bradshaw at the project's initiation.

"In addition to the environmental, sustainable, and cost saving attributes of the solar field, we are looking forward to enhanced research opportunities since a portion of the solar field has been dedicated for research purposes," adds Dr. Tom Roberts, FGCU Associate Vice President for Research and FESC Oversight Board member.

The Florida legislature appropriated $8.5 million to FGCU during the 2008 legislative session to construct a solar energy field. FGCU formed a public-private partnership with Regenesis Power resulting in the construction of a $17 million project. Regenesis Power is a national alternative energy company headquartered in Simi Valley, California with regional offices in Florida.

"Delivering solutions to our client's energy needs today requires a combination of advanced technology, innovative expertise and collaborative partnering, and we are pleased to bring these resources to FGCU's solar energy initiative," said John Polumbo, President and CEO of Regenesis Power. "This PV installation, together with the utilization of solar hot water systems on campus, will significantly advance FGCU's energy goals."

Regenesis Power is a solar energy company with expertise in the design, construction and financing channel management of large scale commercial photovoltaic projects. Regenesis Power also provides fully managed solar water heating programs for electric and water utility companies, enabling them to offer their residential and business customers a clear choice for clean energy on a mass scale. The Regenesis Power team has designed, developed and managed over 30 MW of industrial and commercial solar projects throughout the U.S.

FGCU and the entire community will reap major benefits from the solar energy farm. Paramount among its benefits is cost-savings. The solar energy field is projected to save the institution $22 million over a 30 year period. Its impact will be felt immediately as electrical cost will be reduced from 10.5 cents per kilo-watt hour to two cents per kilo-watt hour.

Environmentally, the benefits are equally dramatic. As a clean energy source, annually the solar energy field will prevent an estimated 9,000 pounds of nitrogen oxide, 14,000 pounds of sulfur dioxide and 5.1 million pounds of carbon dioxide from being introduced into our environment.

Given the rich resource of sunshine in Southwest Florida, the solar energy field is a pilot program designed to encourage and model the use of clean energy. On behalf of the state of Florida, FGCU will use this project to teach and conduct research into renewable energy sources to benefit K-12, the business community and the construction industry as well as the general public.

For additional information on the project visit www.fgcusolar.com; the website will serve as the prime project resource for updated information.

Challenges of Carbon Capturing and Sequestration

By Diane Gow McDilda

The concern over increasing levels of carbon dioxide (CO_2) in the atmosphere has increased the interest in research to reduce emissions. One area of study gaining attention is the ability to capture carbon before it escapes into the atmosphere and store it safely underground. There's no better place to capture carbon than at a fixed source, like a fossil fuel power plant. And with Florida's saline aquifers, the state looks to be candidate for carbon storage.

Mark Stewart, a professor in the Geology Department at the University of South Florida (USF), is the lead investigator on a research project that's investigating the efficacy of capturing carbon at fixed sources and sequestering it in the carbonate rocks that run thousands of feet deep beneath Florida's ground surface.

Stewart emphasizes that the project is truly a team effort, with each member bringing their expertise to the table.

"I may be the lead for the CO_2 sequestration research in Florida for FESC, but it wouldn't work without collaborators," says Stewart.

The project comprises various aspects of the capture and storage process. The removal of carbon from the flue gas is often the most complicated component of the process. For this element, Stewart relies on Yogi Goswami, professor of Chemical Engineering at USF and Co-Director of the Clean Energy Research Center.

Goswami's research involves developing more effective and economic ways to capture CO_2 from flue gas. Technologies include the use of solvents, sorbents, membranes, and cryogenic separation. One method of particular interest utilizes ceramic cloth impregnated with a thin film of calcium or calcium-magnesium. As the flue gas passes through, the carbon is captured by converting the oxide to carbonate. With the carbon secured, flue gas, minus CO_2, escapes. Heating the ceramic converts the carbonate back to the oxide, driving off the CO_2 and making it available for sequestration.

"It's an on-off cycle," explains Stewart. "It's not easy to capture CO_2 and then it requires a lot of energy to separate it. It's possible to use the flue gas to heat the ceramic."

Goswami's research is also focusing on increasing the thermal efficiency of the system and extending the life of the thin oxide film, in hopes of making the solid sorbent technology more cost effective and scalable.

Once the carbon is captured, the next challenge is how to most effectively transfer it to Florida's deep saline aquifers for storage. Both the physical and chemical aspects of injecting carbon into the subsurface must be considered. With Stewart's background in geophysical and mathematical modeling, his role is to evaluate the physical aspects of CO_2 storage.

"We use a model the Department of Energy developed, TOUGH, that has the capability of simulating the behavior of three-phase systems, gas, brine, and supercritical CO_2," says Stewart.

Data were gathered from the Florida Geologic Survey for the study area, the Cedar Key-Lawson formation. The southern half of the Florida Peninsula was selected for study as it's suitable for both geologic sequestration and enhanced oil recovery (EOR). Stewart and the team evaluated possible injection rates into vertical and horizontal injection wells and determined that rates as high as 8 million tons per year (Mt/y) could be obtained for a single vertical injection well, possibly higher for a horizontal well that isn't limited by the thickness of the

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needs and opportunities. Later, FESC Director Tim Anderson led a roundtable discussion that provided input toward how Florida universities can best promote research collaboration among themselves and with industry, and thereby assist the state's economic development.

A poster overview presentation followed, where poster presenters were given two minutes and two slides to describe their posters. This novel approach was very well received, and allowed the audience to target posters of specific interest as the day culminated in a poster session and reception.

The Summit's second day was more technical, with oral presentation sessions organized around the following topics:

- Energy Efficiency & Conservation, Education & Outreach, Policy
- Biomass Resources, Carbon Capture
- Ocean Energy Resources, Solar Resources
- Energy Storage and Delivery, Smart Grid
- Future Drections

Day tw also featured Technical Team Roundtable discussions built around these specific FESC research interests: Energy Efficiency and Conservation, Carbon Capture and Sequestration, Ocean Energy, Energy Storage, Smart Grid, Solar PV, Solar Thermal, Algae, Biomass, and Policy and Systems. Summit participants chose a topic and joined a table with those who shared their expertise or interest to promote future collaboration on grant proposals. Several graduate students served as scribes, and summaries of each discussion have been documented.

The Summit culminated with presentations on specific energy challenges and opportunities, given by Camille Coley, Executive Assistant Vice President of Florida Atlantic University and Director of the Center for Ocean Energy, Mark Jamison, Director of the University of Florida's Public Utilities Research Center, and Jim Fenton, Director of the University of Central Florida's Florida Solar Energy Center.

In addition to the Summit itself, two important Pre-Summit activities took place. The CAPS and PCUE Florida Smart Grid Workshop attracted about 100 representatives of Florida electric utilities, including members of the Florida Reliability Coordinating Council (FRCC), power industry suppliers and technology developers, research and development organizations and other stakeholders. They focused efforts on defining, coordinating and planning for the smart grid in Florida, including perspectives on evolving the smart grid, smart grid infrastructure, including communications, updates on activities at the federal level, and workforce and education needs. Keynote talks and panel sessions identified opportunities and developed strategies and plans for smart grid activities relevant to Florida's unique needs and energy infrastructure.

Additionally, the Florida Energy and Climate Commission held their monthly meeting at the Marshall Student Center on the morning of Tuesday, September 29. FESC Director Tim Anderson was included in the agenda to welcome the Commissioners to the Summit.

The FESC website will be continually updated as plans progress for the 2010 Summit.

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the State," he said. "Working with our best-in-class universities allows the business community to work in unison with research and academia to provide the residents of Florida with the most innovative and cost effective energy solutions. I would also like to acknowledge the leadership that Dr. Tim Anderson brings to FESC. He is a visionary and demonstrates tremendous commitment in his position."

As a member of the advisory board, Martinez's experience and knowledge will allow him deliver expert advice, ideas, and opinions to FESC's researchers and leadership.

An important part of FPL's business strategy focuses on developing, building and operating clean energy plants. FPL is at the forefront of developing renewable solar energy here in the sunshine state.

"At FPL Group, good stewardship of the air we breathe means producing more clean energy and helping customers consume less energy," said Martinez. "Today, we are the number one provider of renewable energy in North America. Our emissions rates of carbon dioxide (CO_2), sulfur dioxide (SO_2) and nitrogen oxides (NO_X) are among the lowest in our industry. We have the number one demand side management program among electric utilities nationwide. And we have called for mandatory legislation that reduces greenhouse gas emissions and puts a price on carbon."

FPL is a leader in Florida's development and implementation of an environmentally sustainable and efficient energy future. "FPL is constructing or has completed 110 megawatts of new solar projects in DeSoto and Martin County, and at the Kennedy Space Center, to make Florida number two in the nation in solar energy," Martinez explained.

President Barack Obama joined FPL Group and Florida Power & Light Company officials in October, 2009, for the commissioning of the DeSoto Next Generation Solar Energy Center, which will be the largest photovoltaic solar facility in the nation. "Together, the DeSoto, Martin County, and Kennedy Space Center sites will prevent the release of nearly 3.5 million tons of greenhouse gases over the life of the projects, which is the equivalent of removing 25,000 cars from the road each year, according to the U.S. Environmental Protection Agency," Martinez adds. FPL is currently working with local officials to secure the necessary approvals to expand the DeSoto facility even further, with a potential future capacity of up to 300 megawatts.

To expand Florida's solar energy future, Florida needs a policy environment that encourages a dramatic expansion of renewable energy. FPL believes that the governor, state Legislature and Public Service Commission have shown strong leadership, and that leadership needs to continue. The renewable energy industry must see bold action and a continued commitment from Florida to attract new investment to the state.

The renewable energy industry in Florida has the possibility to create sustainable job growth and provide a significant economic stimulus to local economies. FPL has several additional shovel-ready solar projects on which it is ready to move forward with legislative and regulatory support. Billions of dollars in construction, operation and maintenance of clean energy facilities in Florida could result in thousands of new jobs. FPL's ultimate goal is to position Florida as a leader in clean-energy generation and as a hub for the development of cutting-edge technology that will rival job corridors in other states.

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geologic formation.

The proximity of a sequestration site to EOR operations cannot be overlooked. And as surprising as it may sound to some, CO_2 is not solely a combustion by-product, but a useful material.

"Gas and oil companies have been injecting CO_2 into wells for over 40 years," explains Stewart. "CO_2 is commercially viable."

Where primary recovery operations generally recover as much as 30-50 percent of the oil and gas originally present, using CO_2 for enhanced recovery can produce an additional 10-20 percent.

"CO_2 under supercritical conditions turns to liquid," Stewart says. "It acts similarly to trichloroethylene, or TCE, a solvent dry cleaners used. Using supercritical CO_2 is like dry cleaning the oil reserves; it strips the oil off the grains."

While revenues from enhanced oil recovery do offset the cost of sequestration, the actual sequestration isn't as effective, as 70-80 percent of the total volume of CO_2 injected is recovered and reused.

While permitting is required for using CO_2 in EOR operations, it's not an insurmountable hurdle. Permitting for CO_2 sequestration; however, is currently in limbo. The US Environmental Protection Agency (EPA) hasn't finalized underground injection permitting requirements, primarily over concern of groundwater contamination. This regulatory uncertainty discourages industries from adopting geologic sequestration.

When injection moves beyond physical into the chemical realm, this is when two more researchers come into play. Jeffrey Cunningham and Maya Trotz, both professors in the Civil & Environmental Engineering at USF, are involved with the chemical reactions that take place in the subsurface as CO_2 is injected. For this the pair relied on TOUGHREACT software to predict the geochemical response to a steady injection of CO_2.

When CO_2 is injected into a brine aquifer it lowers the pH. This in turn dissolves dolomite and calcite, the primary minerals of the limestones of the Florida Peninsula, and precipitates the calcium sulfate mineral gypsum. The concern is that these reactions could decrease the porosity and permeability of the aquifer, possibly clogging the well and limiting its efficiency. Model results from the study indicate that long term effects on well performance would be minimal.

In line with EPA's concern is the release of contaminants. Previous research as shown that treated wastewater injected into aquifers caused the dissolution of arsenic from subsurface soils into groundwater.

"This is Maya's specialty," says Stewart. "She's working with a consultant and a utility on the effect of injecting wastewater from a city and adding highly chlorinated material. Now we're asking, 'what if we pre-dissolve CO_2 or co-inject CO_2?'"

The question of pre-dissolving CO_2 is posed as a matter of storage efficiency. When pre-dissolved, CO_2 stays in solution, allowing a greater volume of carbon to be sequestered, essentially packing more carbon into a unit of storage space.

As utilities in Florida, and across the country, anticipate regulatory constraints on carbon, there's no absolute answer as to which regulatory scenario will play out. Regulations can take the form of cap and trade or a carbon tax. Because utilities tend to be conservative in nature, planning 40 years into the future, this puts them in the position of having to prepare where no roadmap exists. This is more difficult for states and utilities that rely almost entirely on coal for electrical power production.

In Florida, electricity production relies heavily on natural gas, which generates half the amount of CO_2 per kW-hour of electricity when compared to coal. This positions Florida well for the near future with regard to avoiding financial impacts from carbon caps or taxes. However, even with a lower CO_2 output, carbon emissions will have to be addressed by Florida utilities.

This may come about through sequestration projects, like Stewart's, or industry changes, such as implementing more CO_2 efficient combined-cycle combustion systems and relying more on natural gas, nuclear and solar power. Mostly likely it will be a combination of the two.