Florida Energy Systems Consortium
Annual Report
to
Office of the Governor
Office of the President of the Senate
Office of the Speaker of the House of Representatives
Department of Agriculture and Consumer Services
Pursuant to
Florida Statute 1004.648

Reporting Period: October 1, 2010 – September 30, 2011

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EXECUTIVE SUMMARY

Overview:
The Florida Energy Systems Consortium (FESC) had a productive third year of energy research, technology transfer, education, and outreach activities. We are successfully facilitating interactions amongst Florida's energy industry and researchers in the 11 State Universities, Florida's State and Community Colleges, and the Florida Institute of Technology. FESC facilitates the submission of competitive proposals through providing seed funding to develop proposal concepts, access to major instrumentation, test and process facilities, proposal coordination and development. SUS energy faculty submitted 386 proposals requesting $388,519,936 during the twelve-month period October 1, 2010 thru September 30, 2011. The SUS energy faculty received 514 research and education energy-related awards totaling $117,813,842.[1] The awards exceed the number of proposals since most of the awards were based on proposals submitted prior to this period, but the number demonstrates the competitiveness of the SUS faculty in this arena.

As highlights, FESC-funded researchers received 3 ARPA-E grants recently totaling $11.5M. One of the ARPA-E grants is on production of turpentine, a natural liquid biofuel isolated from pine trees. The pine tree developed for this project is designed to increase the turpentine storage capacity of the wood. The fuel produced from these trees would become a sustainable domestic biofuel source able to produce 100 million gallons of fuel per year from less than 25,000 acres of forestland. In addition, the recent collaborative $8M Sunshot award included FESC-funded faculty. The details of the recent FESC faculty awards are given in the New Program Development section of this report. In many instances, funding provided by FESC was instrumental in providing preliminary results to enhance the competitiveness of proposals or access to unique facilities. A summary of the accountability measures is outlined in table 1. The supporting data for the table is given in Appendix B.

FESC university experts in each thrust area worked with the FESC Industrial Advisory Board to prepare a *Strategic Plan for Renewable Energy in Florida*. FESC submitted the final document to the Commissioner Putnam, members of the Energy Office, and Dr. Mary Bane, among others.

PIs of the FESC Phase II Technology Commercialization program projects have made great progress. An executive summary of the awards and their progress are provided in the "FESC Phase II Project Reports" section of this report.

FESC's contribution to energy education and outreach programs is outlined in the Education & Outreach section of the report. The FESC web site is one of the tools for outreach and it continues to be a widely used by energy specialists worldwide (~20,000 visitors from 135 countries).

Over 200 people (faculty, students, government, and industry representatives) attended the third annual FESC Summit, held on September 27-28, 2011 at the University of Florida's Reitz Union. The industry participation was quite significant this year with over 100 attendees enhancing information exchange and networking.

Research Highlights:
Thirty (30) projects have been completed and fifty (50) FESC funded projects are ongoing including the FESC Phase II Technology Commercialization projects. The Principal Investigators of the remaining projects continue to make considerable progress on their research, often leading to added external support.

[1] The proposal and award data were collected through databases at each university, published news releases, and faculty input. The database information was reviewed carefully and proposals and awards only related to energy research were included. The SUS energy faculty were identified by each institution as those with energy related research. The FESC-funded faculty are those that received FESC funding for research investment.

A brief description of each completed and continuing research project is provided in Appendix A of this report. The projects are also posted at the FESC website http://www.floridaenergy.ufl.edu/. Detailed final reports (for completed projects) and progress reports (for continued projects) are compiled in a separate document ("Project Progress Reports") and provided as an attachment to this report.

During this reporting period, FESC distributed and posted 160 announcements of funding opportunities with the goal of generating competitive SUS-based proposals and thus leveraging state funds. Appendix C contains the list of announcements. Some examples of this effort are listed in the "New Program Development" section of this report. Significantly increased email communication from energy companies reflected that they are also benefiting from the funding opportunities posted at the FESC web site. FESC faculty and administration reached out to industry partners for collaborative proposals. Some examples of this are given in the Industrial Collaboration section of this report.

The FESC leadership visited or communicated via teleconference with the State of Florida offices as well as the Department of Energy, National Energy Laboratories, NASA Glenn, and NASA KSC to discuss potential FESC collaboration on their energy programs which led to white paper or proposal development.

Third FESC Summit:

The third annual FESC Summit, held September 27-28, 2011 at the University of Florida's Reitz Union with a record attendance. The industry participation was quite significant this year with 117 attendees.

The Summit is 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. The program featured internationally renowned speakers, as well as presentations and posters highlighting FESC's innovative work leading to alternative energy strategies, improved energy efficiencies and expanded economic development for Florida. The Summit opened with welcoming remarks from Win Phillips, University of Florida's Senior Vice President COO, and Commissioner Adam H. Putnam, Florida Department of Agriculture and Consumer Services. The keynote address, entitled "Linking Science, Innovation, and Policy to Transform the World's Energy Systems: The MIT Initiative," was presented by Robert C. Armstrong, Director of the Massachusetts Institute of Technology Energy Initiative.

In addition to the Summit itself, two Pre-Summit Workshops were held on September 26. The first, *The Florida Clean Energy Workshop* was organized by DOE/EERE and focused on innovation in R&D and manufacturing in Florida's Clean Energy industry. This one day workshop drew 163 participants. The Community College Energy Workshop was organized by the Florida Advanced Technological Education Center (FLATE). Forty three people participated in this workshop. It is also noted that both the FESC Advisory Board and FESC Oversight Board held their meetings during the Summit.

Technology Commercialization and Industrial Collaboration:

In this reporting period, significant progress was made in the commercialization projects funded by the FESC Phase II program.

FESC Phase II program is modeled on the very successful Florida High Tech Corridor Council Matching Grants Research Program. In our program, FESC provides up to $50K in matching funds for each project, which requires an industry match and has so far attracted in excess of $400K of industry support. FESC has awarded six grants. Four industry contracts are already in place, one in contract preparation phase (due to delay in industry match), and one is on hold awaiting the resolution in patent options to another company. The executive summary of the progress made for each project is provided in "FESC Phase II Project Reports" section of this report. One example of FESC Phase II projects is the deployment of "Solar Sausage" concentrating system at the Yulee St. site in Tallahassee in collaboration with FSU and their industry partners. A series of 50-foot long prototype sausages were made and inflated on site. Many issues were identified that needed to be resolved before manufacturing and deploying several hundred solar sausages on site including methods of constructing, mounting, and operating the balloons, distribution of air and electricity, and removal of heat.

50-foot balloon Solar Susage

The Consortium continues to work closely with technology transfer and economic development offices in Florida to attract industry to our state. FESC has been actively pursuing research, infrastructure improvement, and economic development collaborations with multiple companies and other entities to assure that the Consortium's research and education agenda are aligned with industry's needs and to move FESC technologies quickly to serve Florida's industry and economy. Collaborations that FESC is fostering across Florida include Buckeye Technologies, Planet Green Solutions, Algenol, Nutri-Turf, Anheuser Busch and Speedling, Weyerhaeuser, Plum Creek Timber, Research Management Services, Rayonier, Rayonier, CelFor, and ArborGen, Mustang Solar, Petra Solar, Blue Chip Energy, LLC and Advanced Solar Power (Subsidiary of Blue Chip), Progress Energy, SAFT, Bren-Tronics, G4 Synergetics, Encel, Planar Energy Devices, Energy Concepts, Bing Energy, TECO Energy, Greenpoint, LLC, Marpan Recycling. This represents only a small set of examples of the industrial collaborations involving FESC.

The FESC administration office and the University of Central Florida in collaboration with the Technological Research and Development Authority (TRDA), recently received $1M (total project cost : $1.7M) grant from the US Economic Development Administration (EDA) to implement a unique model that links Florida-based universities, incubation networks, investors and industry resources together to create a network of Proof of Concept centers to accelerate the creation and commercialization of innovative clean technology research. The grant is titled as "Igniting Innovation Cleantech Acceleration Network (I^2 CAN)".

The University of Florida announced the opening of the Florida Innovation Hub (the first building located in Innovation Square) recently. The Hub was built with an $8.2M grant from the Economic Development Administration and a $5M matching funds from UF. Programs and activities at the hub will bring together entrepreneurs, investors, students and service providers to incubate new ideas. Nanophotonica, one of the tenants of the Hub, was funded by FESC Phase I program.
Link to the Hub web site: http://innovationsquare.ufl.edu/

Education and Outreach:

Assisting in preparing a qualified workforce is vital for Florida's evolving energy industry. FESC is strategically focused on workforce preparation for the existing and emerging energy industry. Many energy-industry educational opportunities are available throughout the state, while other exciting

opportunities are being developed. FESC is working to coordinate these efforts and ensure that existing distance education facilities at each university will be utilized to make these programs available via on-line courses. The FESC outreach program is using the statewide UF/IFAS Cooperative Extension Service as well as other avenues to provide Florida residents with new approaches to energy efficiency. Thirty-one professional presentations were conducted during the year at the national, state and local levels. New fact sheets were added to the FESC website. Publication addressing the developments in the PACE financing markets titled *Options for Clean Energy Financing Programs: Scalable Solutions for Florida's Local Governments* was updated. The details of the education and outreach activities are given in this report.

The FESC website continues to be an important communication tool for our program. It is updated regularly to remain current and to better serve our users. FESC prepares and distributes electronic newsletters by email. The newsletters are also posted at FESC web site. Based on a Google Analytics report, the FESC web site was viewed by 19,794 Google visitors during the period of September 30, 2010-October 1, 2011. The viewers visited 53,471pages. Viewers were from a total of 135 countries, including those in North and South America, Europe, Asia, Australia, and Africa.

In summary, the Florida Energy Systems Consortium has made significant progress in its research, education, industrial collaboration, and technology commercialization agenda. FESC faculty members statewide are successfully collaborating in research and proposal development. FESC education programs are being readied for Florida's clean energy workforce, and our industry partners are actively participating in technology transfer and commercialization of FESC-developed technologies.

The Florida Energy and Climate Commission was sunsetted in the last legislative session. FESC now reports to the Department of Agriculture and Consumer Services.

ACCOUNTABILITY MEASURES

The accountability measures are summarized in Table 1. The supported data is provided in Appendix C.

Table 1: Accountability Measures

FLORIDA ENERGY SYSTEMS CONSORTIUM October 1, 2010 – September 30, 2011	
Research Effectiveness (FESC and Associated Research)	
Competitive Contracts and Grants Applied (SUS energy faculty)[2]	# of Applications: 386 Requested Funding: $388,519,936
Competitive Contracts and Grants Received (SUS energy faculty)	# of Awards: 514 Award Amount: $117,813,842
Publications in Refereed Journals and Other (FESC funded faculty)	Total: 253
Professional Presentations (FESC funded faculty)	Total: 196
Invention Disclosures Submitted and/or Patents Received (SUS)	63
Energy Agreements/Revenues Received (SUS)	Energy Agreements: More than 15 Revenues Received: $42,980
Collaboration Effectiveness (FESC and Associated Research)	
Collaborations with Other Postsecondary Institutions (FESC funded faculty)	Total: 37
Collaborations with Private Industry (FESC funded faculty)	Total: 63
Students Supported with Consortium Funds (FESC funded faculty)	Total: 286 Undergraduate: 27 Master: 82 PhD: 150 Post-docs: 27
Students Graduated (FESC funded faculty)	Total: 37 Master: 21 PhD: 14 BS: 2
Economic Development Effectiveness (FESC and Associated Research)	
Business Start-Ups in Florida *(During Oct. 1, 2008 to Sep 30, 2011 Period)*	10
Specialized Industry Training and Education (Outreach)	19

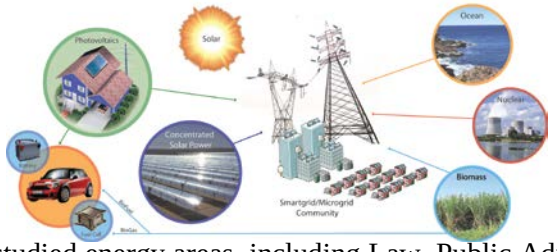
[2] The proposal and award data were collected through databases at each university, published news releases, and faculty input. The database information was reviewed carefully and proposals and awards only related to energy research were included. The SUS energy faculty were identified by each institution as those with energy related research. The FESC-funded faculty are those that received FESC funding for research investment.

RESEARCH THRUST AREAS

The FESC research program is focused on seven strategic research thrusts, including the overarching Energy Systems thrust. These thrusts were defined on the basis of Florida resources and also the perceived needs of the State of Florida.

A brief description of each thrust and tasks under the thrust areas are given below.

1. Overarching Strategic Research Thrust: Understanding Florida's Energy Systems



An inherent advantage of the consortium is that it collects the research expertise across the entire SUS and thus can conduct energy research more broadly. FESC's key strategy is to inject a systems approach to energy research. This thrust provides a platform for each of the other thrusts and allows direct connection to Florida's energy economy. This thrust unites existing strengths in energy science and engineering with recognized expertise in non-traditionally studied energy areas, including Law, Public Administration and Policy, Economics, Environmental Studies, Geography, Urban and Regional Planning, Information Systems, Social Sciences, and Media Arts. Experts from these areas will assist Florida's governing bodies in the development and implementation of a comprehensive, long-term, environmentally compatible, sustainable, and efficient energy strategic plan by performing select and recurring analyses to provide objective and quantitative policy assessments. It will help evaluate and identify critical energy infrastructure, such as sighting, de-risking, capitalization, licensing, permitting, and governing. We have twelve (12) FESC funded projects under this thrust. One of them has been completed.

2- Enhancing Energy Efficiency and Conservation

In the U. S., buildings account for 39% of our primary energy use and 72% of our electrical use. Thus, the reduction in energy usage in buildings is one of the highest priorities of the country's energy challenges. Advances in building and energy efficiency technologies will provide substantial value to Florida, not only for energy use and Green House Gas emissions reduction but also for economic development and job creation. Additional building energy research and development is needed to achieve the efficiency requirements cost effectively. Human behavior is also an important factor in the implementation of energy efficiency and conservation.

The Consortium's focus is to improve residential and commercial building efficiency, integrate energy systems in sustainable community developments, support industry energy auditing, develop integrated energy-water management systems, study human behavior to implement energy efficiency effectively, and provide outreach and education. Developing innovative energy-efficient building technologies that minimize the use of natural resources and utilize renewable and sustainable materials will result in sustainable and economically viable communities. There are eleven (11) FESC funded projects under this thrust. Four projects have been completed.

3- Developing Florida's Biomass Resources

The State of Florida produces more biomass than any other state in the U.S. (~7% of total). Given the state's dependence on imported oil for transportation fuels and the value of transportation to our tourism industry, developing methods to convert this resource to fuels is important. The Consortium is pursuing microbial

and gasification routes to produce this carbon-neutral fuel. In addition, algae production systems promise a direct route to fuel, along with its use for bioremediation of agricultural waste water and production of products from the residual biomass.

There are 13 FESC funded projects under this thrust in the areas of algae, energy crops, biochemical conversion (cellulosic ethanol, plastics from biomass, etc.), and thermochemical conversion (biofuels, waste to energy, new catalyst development), and bio gasification. There are thirteen (13) projects under this thrust: 3 projects in algae (2 projects were completed), 2 projects in energy crops, 3 projects in biochemical conversion (1 project was completed), 1 project in bio gasification, and 4 projects in thermochemical conversion.

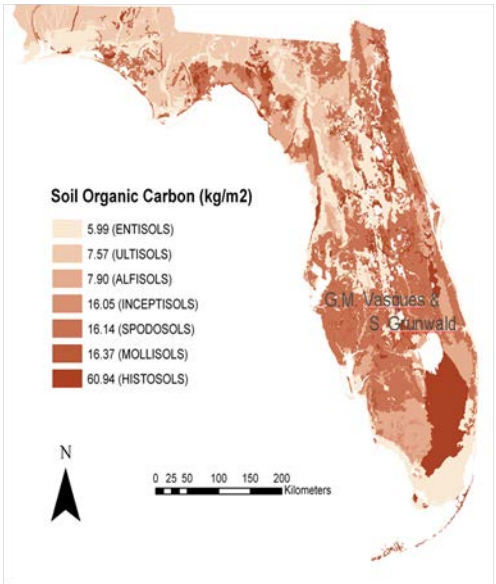
4- Harnessing Florida's Solar Resources

The Sunshine State has more solar insolation than any state east of the Mississippi River and the conversion of sunlight to electric power or fuel promises to be an important contribution to the State's renewable energy portfolio. Photovoltaics (PV) directly converts light to electricity and can be deployed in a distributed manner. Both thin film and organic PV technologies as well as systems integration are being pursued by Consortium faculty. Concentrated solar thermal energy is also being explored for conversion to electricity, production fuels and feed stocks as well as water desalination. The faculty research expertise in solar thermal and PV across the Consortium is well recognized for its excellence.

There are 23 FESC funded projects under this thrust: 1 project in solar testing facility (completed), 7 projects in solar thermal, 2 projects in clean drinking water by using solar technologies, 5 projects in low cost PV manufacturing, 3 projects in advanced PV device program, and 5 projects in PV integration. USF is about to complete their new PV pilot line.

5- Ensuring Nuclear Energy & Carbon Constrained Technologies for Electric Power in Florida

Nuclear energy is a major contributor to meeting Florida's energy needs today and will continue to be so in the future. Nuclear energy is a stable source of large-scale base load electric power with virtually no carbon emissions from operations. It's projected that a significant portion of the nuclear workforce at Florida's five existing nuclear facilities will retire over the next 10 years. This comes at a time when aggressive expansion of Florida's nuclear portfolio is being pursued, driving an even greater need for a trained workforce.



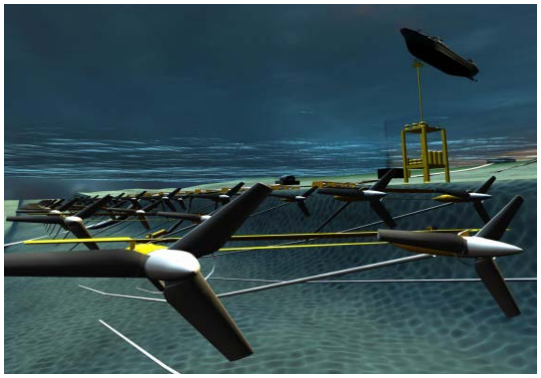
The State University System of Florida will soon have the only digitally controlled training reactor in the country. This system will provide training in critical areas such as design, construction, operation, fuel reprocessing, and waste remediation.

Carbon Capture and Sequestration for Carbon-Constrained Technologies

With the prevalence of fossil fuels in base load power generation, development of clean coal and natural gas power

generation with carbon capture and sequestration is critical to the future of the state and nation. Increasing national and international concern over rising levels of greenhouse gases, particularly carbon dioxide, are increasing the probability of regulatory or economic incentives for large, fixed carbon sources to restrict carbon emissions. In addition, major financial institutions are seeing increasing risk in providing capital investments for large fossil-fuel power plants without a plan for carbon capture and sequestration. To remain competitive in a carbon-constrained economy and to continue to provide abundant and affordable energy, Florida's electric power utilities need access to technologies that can effectively and economically constrain carbon emissions. Such technologies include systems in development at FESC universities to capture carbon dioxide directly from power plant exhaust, to use carbon dioxide from power plants to grow algae for biofuels, and to enhance the ability of Florida's soils and forests to capture and sequester carbon dioxide. FESC researchers are also developing state-of-art chemical and numerical models to predict the physical and chemical effects of carbon dioxide sequestration in the deep, saline carbonate aquifers of Florida. There are five (5) projects under this thrust area. Two projects were completed.

6- Exploring Florida's Marine Energy Resources



Marine energy is an emerging technology that uses the power of ocean currents, waves, tides, thermal gradient, and salinity gradient to create renewable energy. Tapping ocean energy resources will reduce our reliance on fossil fuels. Unique to Florida, the Gulf Stream comes closest to the US coastline off the shores of South Florida, which is a major population center and home to one of the leading ocean energy research centers in the nation. Research areas of focus include ocean current and thermal differential systems, cold, deep ocean water-based air-conditioning, underwater hydrogen generation and storage, and environmental impact and mitigation.

On August 03, 2010, the U.S. Department of Energy (DOE) announced that Florida Atlantic University (FAU) has been designated a national center for ocean energy research and development. This new Southeast National Marine Renewable Energy Center (SNMREC) joins centers in the Pacific Northwest and in Hawaii that also work to advance the operational readiness of ocean energy technologies. In addition to the $1 million in funding appropriated to FAU last year, with this designation DOE has awarded the Center $250,000 to undertake research and development of technologies capable of generating renewable power from ocean currents and ocean thermal energy. FAU is ideally located to oversee development of equipment that can generate sustainable, cost-competitive electricity from ocean energy resources in the Florida Straits and the Gulf Stream.

SNMREC's primary focus is to determine the potential of Florida's ocean-current resource and on ocean thermal energy conversion in waters offshore. SNMREC's role is to bridge the gap between concept and commercial deployment of ocean energy technologies by providing at-sea testing facilities for both ocean current and thermal energy research and for technology development. Research cuts across environmental, ecological, resource, and technology areas. Over the past several years, the regulatory environment associated with MRE development on the continental shelf has evolved considerably, and the Center's initial strategy has expanded as well to accommodate the regulatory requirements. In particular, the Center has continued to move forward in strategic research, in pursuing key technology, and in defining standards criteria; it has also become more and more deeply engaged in regulatory process formation, which will influence the development of MRE in Florida, while continuing to educate and engage the public.

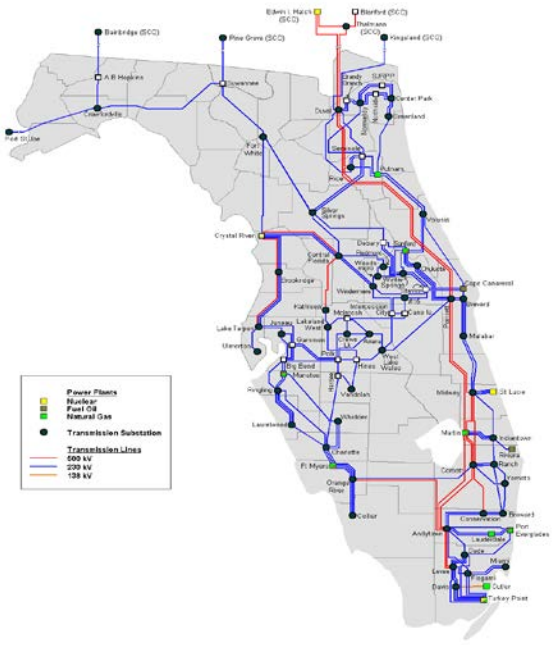
Research and development for an ocean energy industry is being addressed with a system-level, phased approach. Joint research is ongoing at FAU, with FESC partners, and other industrial, government, and academic partners. Initial research in areas such as ocean resource analysis and modeling, prognostics and

health monitoring systems, materials and anti-fouling, mooring and anchor systems, and environmental/benthic baseline assessment have been funded.

SNMREC's technology and industry support efforts are underway in three distinct but inter-related tracks. First, the Center is actively engaged in sensor and instrument acquisition, deployment, and analysis to more fully characterize offshore energy resources, as well as the benthic and pelagic environment. Second, in support of ongoing research and to further an operational and technical understanding of offshore energy systems and challenges, the Center has designed, partially fabricated, and will begin testing a small-scale hydrokinetic turbine system. Testing will be completed for components, sub-systems, and major systems of the turbine, eventually evolving to full system testing in a phased, risk-reduction process. Finally, the Center is working to begin early development of system-level test operations and data collection infrastructure. This effort is intended to support and promote a phased approach for early-stage testing to minimize risk and further scaled development for the growing industry, as well as to help establish standards criteria and practice for the future sector.

7- Securing our Energy Storage and Delivery Infrastructure

Energy generation, consumption, transmission, distribution, and storage together comprise a dynamic and interconnected system. This complexity will grow very significantly as the transportation sector connects with the electricity sector through plug-in hybrid electric vehicles. At the same time, renewable energy sources such as wind, solar, and biomass are becoming increasingly important parts of the energy system; however renewable energy sources are intermittent. Smart grid technologies offer new capabilities for monitoring and control of the electric energy system while simultaneously exposing new avenues for adversarial attacks.



This thrust addresses the need in the areas of smart grids, energy storage, and energy security.

Smart Grid

The aim is to address the challenges of the reliable movement of electrical energy throughout the state as the power system is transformed to include far more renewable and alternative sources, increased use of distributed energy resources (including storage and electric vehicles), emergence of microgrids, possible expansion of new very-large centralized base load (nuclear), and incorporation of new power conversion, transmission, measurement, communication and control technologies (smart grid).

Electric Storage

In the electric storage area, the Consortium faculty is working towards improving battery and capacitor based storage. To reduce system-wide power outages and for more stable and reliable power delivery, the Consortium is pursuing research in micro grids and smart grids. Micro grids provide islanding capabilities allowing grids to separate from each other. This streamlines integration of both stationary and non-stationary energy storage devices. Smart grids allow control strategies and two way communications via Smart Meter system, provide intelligent energy management and improve energy efficiency.

Florida being a relatively flat sandy peninsula cannot effectively use pumped hydroelectric storage (PHES) technology or compressed air energy storage (CAES) and other than its Northern border Florida cannot

easily purchase electricity across state lines. With these constraints electrochemical energy storage using batteries is Florida's best option. This is also coupled with the opportunities led by various Utilities in Florida putting large scale PV installations throughout the state which could benefit from battery storage to satisfy peaking demand. The addition of 10-KW PV powered with lead acid battery emergency power systems to 90 emergency shelters throughout the state presents opportunities for demonstrations between Florida Universities and the local Utility. In some cases Utilities may want to pursue demonstrations of battery load-leveling with their PV installations that are coming on line.

There is a great deal of interest in, and enthusiasm for, utilizing renewable energy sources effectively in order to reduce utilization of fossil fuels, which in turn reduces CO_2 emissions significantly, and to move toward a more sustainable energy system. On utility scale, energy storage is critical to utilize renewable energy because of the intermittent nature of renewable energy sources such as photovoltaic and wind turbine. The technology will allow utilities to use the distribution network more efficiently, as power plants can be operated at a higher percentage of capacity while ensuring electrical supply at all times, thereby reducing the demand for peaking power plants that have the lowest efficiency with highest operating cost. Electrochemical energy storage using batteries is considered to be one of the most promising technologies satisfying gigawatt power and gigawatt-hours energy density requirements for large scale storage applications.

Research areas in battery technology includes new materials development (electrodes, separators, electrolytes and other components), new chemistry & concepts development for ultra-low cost, high efficiency and long lasting energy storage systems.

Energy Security

Concern over global warming, geopolitics of oil production, and natural and man-made threats make it imperative that we have a solid understanding of the security of our energy systems.

It is clear that changes in one part of this interconnected grid system have a significant impact on the other parts. For example, capacity constraints in transmission limit choices on generation and consumption of energy. Consequently, we must take a "total systems" view of the challenges posed by the energy issues. It should be kept in mind that a system view is applicable at various levels of granularity: global, national, state, regional, city, military base, city, island, enterprise, etc. Indeed, this "systems theme" is central to the vision of the Florida Energy Systems Consortium.

This research direction provides for a substantial mix of near term and longer term/next generation economy jobs across the spectrum of energy programs (i.e., biomass, solar, ocean, water, smart grid/microgrid) as each facility will be customized to make best use of the renewable energy natural resources of the region. It will lead to jobs for highly skilled engineers and scientists (e.g., development of next generation renewable energy systems and components for testing and deployment across multiple facilities).

Additionally, there are opportunities in private sector facilities such as international company campuses and critical facilities that can benefit from a secure energy systems approach as outlined above. Also, local communities may also have a strong interest in the security of their energy supply.

There are twelve (12) under this thrust. Eight of them are funded by FESC. Five of the projects have been completed.

8- Policy and Other

In addition to the above mentioned projects, there are five projects (4 of them completed) in policy area, 4 projects in other energy areas (3 projects completed), 6 projects in education and outreach (3 projects completed), and 4 FESC Phase II tech commercialization projects.

RESEARCH PROGRAM

The FESC research program includes 80 FESC funded projects within the seven strategic thrusts. Thirty (30) projects have been finalized and we now have fifty (50) continuing FESC funded projects including the FESC Phase II technology Commercialization projects. In addition, we have 1 FAMU, 1 UWF, and 5 FIU projects that are not funded by FESC. The Florida State University completed all their projects. The Principal Investigators of the remaining projects continue to make considerable progress on their research, often leading to added external support. Brief description of each finalized and continuing research project is given in Appendix A of this report. The projects are also posted at the FESC website http://www.floridaenergy.ufl.edu/. Detailed final reports (for completed projects) and progress reports (for continued projects) are compiled in a separate document ("Project Progress Reports") and provided as an attachment to this report.

Table 1 below gives the list of the projects under each thrust area. Some of the projects are collaborative multi-university projects; however since funding was appropriated to each institution, only the lead university information is given in the table.

Table 1 – FESC Research Thrust and Project Summary
(Only lead university information is given)

Projects	Title/PI/Lead Institution
THRUST 1: Overarching	
	Power Generation Expansion Portfolio Planning to Satisfy Florida's Growing Electricity Demands PI: Tapas Das, Co-PI: Ralph Fehr - USF
	Joint Optimization of Urban Energy-Water Systems in Florida (Thrust 2: Efficiency) PI: James P. Heaney - UF
	Combined Cooling, Heat, Power, and Biofuel from Biomass and Solid Waste (Thrust 3: Biomass) PI: William Lear, Co-PI: Jacob Chung - UF
	Design, Construction, and Operation of CSP Solar Thermal Power Plants in Florida (Thrust 4: Solar) PI : Yogi Goswami, Co-PIs: E. Stefanakos, M. Rahman, S. Aydin, R. Reddy - USF
	Development of High Throughput CIGS Manufacturing Process (Thrust 4: Solar) PI: Neelkanth Dhere – UCF/FSEC
	Solar Photovoltaic Manufacturing Facility to Enable a Significant Manufacturing Enterprise within the State and Provide Clean Renewable Energy (Thrust 4: Solar) PI: Don Morel, Co-PIs: Chris Ferekides, Lee Stefanakos
	Research to Improve Photovoltaic Cell Efficiency by Hybrid Combination of PV and Thermoelectric Cell Elements (Thrust 4: Solar) PIs: Nicoleta Sorloaica-Hickman, Robert Reedy – UCF/FSEC
	An Integrated Sustainable Transportation System (Thrust 4: Solar) PI: David Norton (Formerly Eric Wachsman (PI) and Shirley Meng (Co-PI); They have left UF) ***This project has been completed***
	PV Energy Conversion and System Integration (Thrust 4: Solar) PI: I. Bataraseh, Co-PIs: J. Shen, Z. Qu, X. Wu, W. Mikhael, L. Chow - UCF
	Integrated PV/Storage and PV/Storage/Lighting Systems (Thrust 4: Solar) PI: Franky So, Co-PI: Jiangeng Xue, Shirley Meng - UF
	The Future Florida Grid: Ensuring a Reliable and Resilient Electrical Energy Transmission and Delivery

	System in a Changing Environment (Thrust 7: Storage & Delivery) PI: Steinar Dale, Co-PIs: T. Baldwin, O. Faruque, J. Langston, P. McLaren, R. Meeker, K. Schoder, M. Steurer – FSU ***This project has been completed***
	Secure Energy Systems (Thrust 7: Storage & Delivery) PI: Pramod Khargonekar
THRUST 2: Enhancing Energy Efficiency and Conservation	
	Innovative Proton Conducting Membranes for Fuel Cell Applications PI: Ongi Englander, Co-PIs: Anant Paravastu, Subramanian Ramakrishnian – FSU ***This project has been completed***
	Sustainably Integrated Advanced Building Subsystems (OGZEB) PI: A. "Yulu" Krothapalli, Co-PI: Justin Kramer – FSU ***This project has been completed***
	Insight into Membrane Degradation Mechanisms Through Verification of Chemical and Mechanical Degradation Test Capabilities, **PI:** Darlene Slattery, **Co-PI's**: Len Bonville, Marianne Rodgers – UCF/FSEC ***This project has been completed***
	Energy Efficient Building Technologies and Zero Energy Homes PI: R. Vieira, Co-PIs: P. Fairey, J. Sonne – UCF/FSEC
	Joint Optimization of Urban Energy-Water Systems in Florida, PI: James P. Heaney - UF
	Planning Grant: High Performance and Low Cost Fuel Cells for Future Vehicles PI: Jim Zheng, Co-PIs: Richard Liang, Chuck Zhang, Ben Wang – FSU ***This project has been completed***
	NIRT: C-MEMS/CNEMS for Miniature Biofuel Cells PI: Marc Madou, Co-PIs : Chunlei Wang, Sylvia Daunert and Leonidas Bachas –FIU *(not funded by FESC)*
	Fabrication of Nano Fractal Electrodes for On-Chip Supercapacitors PI: Chunlei Wang – FIU *(not funded by FESC)*
	Energy Efficient Technologies and The Zero Energy Home Learning Center PI: Stanley Russell, Co-PIs: Yogi Goswami - USF
	Unifying Home Asset & Operations Ratings: Adaptive Management via Open Data & Participation PI: Mark Hostetler, Co-PI Hal Knowles - UF
	Meteorological Factors Affecting Solar Energy Efficiency in the Tropics PI: Paul Ruscher, Co-PIs: (formerly Yaw Owusu, Hans Chapman) - FSU ***This project has been completed***
THRUST 3: Developing Florida's Biomass Resources	
Algae	
	Establishment of the Center for Marine Bioenergy Research: Systems Approach to BioEnergy Research (SABER) PI: J. Kostka (has left FSU), Co-PIs: William Cooper, Ivonne Audirac, Amy Chan-Hilton, Ellen Granger - FSU ***This project has been completed***
	Constructual Optimization of Solar Photo-Bioreactors for Algae Growth

	PI: Juan Ordonez – FSU ***This project has been completed***
	Optimization of Algae Species for Biofuels Production using Genetic Altration PI: Ed Phlips, UF
High Energy Crops	
	Energy Intensive Crop Development PI: Gary Peter, Matias Kirst, Don Rockwood - UF
	Water-Use Efficiency and Feedstock Composition of Candidate Bioenergy Grasses in Florida PI: Lynn E. Sollenberger, Co-PIs: John Erickson, Joao Vendramini, Robert Gilbert - UF
Biochemical Conversion	
	Development of Biofuel Production Processes From Synthetic and Biomass Wastes PI: Pratap Pullammanappallil - UF
	Engineering Biocatalysts for Hemicelluloses Hydrolysis and Fermentation PI: James F. Preston - UF
	Thermophilic Biocatalysts for the Conversion of Cellulosic Substrates to Fuels and Chemicals PI: K.T. Shanmugam – UF ***This project has been completed***
Biogasification	
	Combined Cooling, Heat, Power, and Biofuel from Biomass and Solid Waste PI: William Lear, Co-PI: Jacob Chung - UF
Thermo-Chemical Conversion	
	Production of Liquid Fuels Biomass via Thermo-Chemical Conversion Processes PI: Babu Joseph, Co-PIs: Yogi Goswami, Venkat Bhethanabotla, John Wolan, Vinay Gupta - USF
	Feasibility, Sustainability and Economic Analysis of Solar Assisted Biomass Conversion PI: Babu Joseph, Co-PI: Q. Zhang - USF
	Integrated Florida Bio-Energy Industry PI: Ali T-Raissi, Co-PIs: Nazim Muradov, David Block - UCF
	Biofuels Through Thermochemical Processes: Approach to Produce Bio-jet Fuel PI: Anjaneyulu Krothapalli - FSU
THRUST 4: Harnessing Florida's Solar Resources	
Solar Testing Facility	
	Solar Systems Testing Facility PI: James Roland, David Block – UCF/FSEC ***This project has been completed***
Solar Thermal	
	Concentrating Solar Power Program PI: Charles Cromer, R. Reedy – UCF/FSEC ***This project has been completed***
	Development of Novel Water Splitting Catalysts for the Production of Renewable Hydrogen PI: Helena Hagelin-Weaver - UF
	Enhanced and Expanded Solar Thermal Test Capabilities PI: John DelMar, Robert Reedy - UCF/FSEC (PI use to be J. Walters)
	Solar Fuels for Thermochemical Cycles at Low Pressures PI: Jörg Petrasch – UF

	Solar Thermal Power for Bulk Power and Distributed Generation PI: David Hahn, Co-PIs: James Klausner, Renwei Mei, Helena Weaver - UF
	Design, Construction and Operation of CSP Solar Thermal Power Plants in Florida PI : Yogi Goswami Co-PIs: E. Stefanakos, M. Rahman, S. Aydin, R. Reddy – USF
	Multi-Generation Capable Solar Thermal Technologies PI: A. Krothapalli - FSU ***This project has been completed***
Clean Drinking Water Using Solar Technologies	
	Low Cost Solar Driven Desalination PI: James Klausner - UF
	Clean Drinking Water using Advanced Solar Energy Technologies PI: Lee Stefanakos, Co-PIs: Yogi Goswami, Matthias Batzill, Maya Trotz, Sesha Srinivasan - USF
Low Cost PV Manufacturing	
	Enhanced and Expanded PV Systems Testing Capabilities at FSEC PI: S. Barkaszi Co-PI: R. Reedy – UCF/FSEC
	Development of High Throughput CIGS Manufacturing Process PI: Neelkanth Dhere – UCF/FSEC
	Florida Opportunities for PV Manufacturing and Applications PIs: D. Block, J Fenton, P. Fairey, W. Schoenfelds, R. Reedy - UCF/FSEC
	Development of Low Cost CIGS Thin Film Hot Carrier Solar Cells PI: Gijs Bosman, Co-PI: Tim Anderson – UF
	Solar Photovoltaic Manufacturing Facility to Enable a Significant Manufacturing Enterprise within the State and Provide Clean Renewable Energy PI: Don Morel, Co-PIs: Chris Ferekides, Lee Stefanakos – USF
Advanced PV Device Program	
	Research to Improve Photovoltaic (PV) Cell Efficiency by Hybrid Combination of PV and Thermoelectric Cell Elements. PIs: Nicoleta Sorloaica-Hickman, Robert Reedy – UCF/FSEC
	PV Devices Research and Development Laboratory PI: Robert Reedy, Co-PIs: Nicoleta Sorloaica-Hickman, Neelkanth Dhere – UCF/FSEC
	Beyond Photovoltaics: Nanoscale Rectenna for Conversion of Solar and Thermal Energy to Electricity PI: Shekhar Bhansali, Co-PIs: Lee Stefanakos, Yogi Goswami, Subramanian Krishnan - USF
PV Integration	
	PV Energy Conversion and System Integration PI: I. Batarseh, Co-PIs: J. Shen, Z. Qu, X. Wu, W. Mikhael, L. Chow - UCF (PI use to be N. Kutkut)
	Non-Contact Energy Delivery for PV System and Wireless Charging Applications PI: Jenshan Lin - UF
	An Integrated Sustainable Transportation System PI: David Norton (Formerly Eric Wachsman (PI) and Shirley Meng (Co-PI); They have left UF) ***This project has been completed***
	PV Power Generation Using Plug-in Hybrid Vehicles as Energy Storage PI: J. Shen, Co-PIs: I. Batarseh - UCF

	Integrated PV/Storage and PV/Storage/Lighting Systems PI: Franky So, Co-PI: Jiangeng Xue, Shirley Meng - UF
THRUST 5: Ensuring Nuclear Energy & Carbon Constrained Technologies for Electric Power in Florida	
	Reducing Residential Carbon Emission in Florida: Optional Scenarios Based on Energy Consumption, Transportation, and Land Use PI: Tingting Zhao, Co-PI: Mark Horner – FSU ***This project has been completed***
	Planning Grant: Enhanced Thermal Performance and Microstructure Simulation of Nuclear Fuels PI: Justin Schwartz – FSU ***This project has been completed***
	Biocatalytic Lignin Modification for Carbon Sequestration PI: Jon Stewart - UF
	Database Infrastructure for Integrative Carbon Science Research PI: Sabine Grunwald, Co-PI: Tim Martin - UF
	Creation of Carbon Sequestration Data, Technologies and Professional Cohorts for Florida PI: Mark Stewart, Co-PIs: Jeffrey Cunningham, Maya Trotz - USF
THRUST 6: Exploring Florida's Ocean Energy Resources	
	Southeast National Marine Renewable Energy Center PI: Susan H. Skemp, Co-PI: Howard P. Hanson, James VanZwieten - FAU
	Buoy Array for Ocean Wave Power Generation PI: Z. Qu, Co-PI: K. Lin – UCF ***This project has been completed***
THRUST 7: Securing our Energy Storage and Delivery Infrastructure	
	The Future Florida Grid: Ensuring a Reliable and Resilient Electrical Energy Transmission and Delivery System in a Changing Environment PI: Steinar Dale, Co-PIs: T. Baldwin, O. Faruque, J. Langston, P. McLaren, R. Meeker, K. Schoder, M. Steurer – FSU ***This project has been completed***
	Microgrids for a Sustainable Energy Future PI: Chris S. Edrington, Co-PIs: H. Li, J. Ordonez, J. Zheng, M. Steurer – FSU ***This project has been completed***
	Real-Time Power Quality Study For Sustainable Energy Systems PI: U. Meyer-Baese, Co-PIs: Helen LI, Simon Foo, Anke Meyer-Baese, Juan Ordonez – FSU ***This project has been completed***
	Planning Grant: Advancing Knowledge of Network Theory for Analysis and Design of Smart Power Grids PI: Svetlana V. Poroseva, Co-PIs: Yousuff Hussaini, Per Arne Rikvold – FSU ***This project has been completed***
	Investigating the Effect of Appliance Interface Design on Energy-Use Behavior PI: Paul Ward, Co-PIs: Ian Douglas, David Eccles – FSU ***This project has been completed***
	Energy Delivery Infrastructures PI: Lee Stefanakos, Co-PIs: Zhixin Miao (Formerly Alex Domijan (PI). He has left USF)
	Micro Battery Defense Development PI: Chunlei Wang – FIU *(not funded by FESC)*

	Electrostatic Spray Deposition of Nanostructured Porous Metal Oxide Composite PI: Chunlei Wang – FIU *(not funded by FESC)*
	Fabrication and Investigation of Porous Tin Oxide Anodes for Li-Ion Micro Batteries PI: Chunlei Wang – FIU *(not funded by FESC)*
	Very High Energy-Density Ultracapacitors PI: E. Bakhoum – UWF *(not funded by FESC)*
	Secure Energy Systems PI: Pramod Khargonekar - UF
	Optimization, Robustness and Equilibrium Modeling for the Florida Smart Grid PI: Panos Pardalos - UF
Policy	
	Economic Impacts of Renewable Energy and Energy Efficiency Policies PI: Theodore Kury – UF
	Environmental Impacts of Energy Production Systems: Analysis, Evaluation, Training, and Outreach PI: Amy B. Chan-Hilton Co-PIs: G. Chen, W. Huang, M. Watts, M. Ye, P. Lee - FSU ***This project has been completed***
	Promoting Energy and Land Use Through Land Use, Transportation and Green Infrastructure Polices PI: Tim Chapin, Co-PIs: Ivonne Audirac, Chris Coutts, Greg Thompson, Mark Horner – FSU ***This project has been completed***
	Political and Economic Institutions Regarding Siting of Energy Facilities PI: R. Mark Isaac, Co-PIs: Douglas Norton, Svetlana Pevnitskaya – FSU ***This project has been completed***
	Experimental Investigation of Economic Incentives of Policies, Institutions and R&D in Environmental Conservation PI: Svetlana Pevnitskaya, Co-PI: Dmitry Ryvkin – FSU ***This project has been completed***
Other	
	Fusion Energy Spheromak Turbulent Plasma Experiment-STPX PI: Charles A. Weatherford, Co-PIs: Kyron Williams, Ephrem Mezolin – FAMU *(not funded by FESC)*
	Marketing Strategies to Incentives Entrepreneurship and Innovation in the Development of Sustainable Energy PI: Joe Cronin – FSU ***This project has been completed***
	Energy Sustainable Florida Communities PI: Richard Fieock, Co-PIs: Ivonne Audirac, Keith Ihlanfeldt – FSU ***This project has been completed***
	Development of a Renewable Energy Research Web Portal PI: Charles R. McClure, Co-PIs: Ian Douglas, Chris Hinnant – FSU ***This project has been completed***
	Planning Grant: Hydrogen Storage Using Carbon-Based Adsorbent Materials PI: Efstratios Manousakis – FSU ***This project has been completed***

Education and Outreach	
	Florida Advanced Technological Education Center (FLATE) PI: Marilyn Barger – Hillsborough Community College
	Outreach Activities for FESC PI: Pierce Jones, Kathleen C. Ruppert, Hal S. Knowles III, Nicholas Taylor, Barbra Larson, Craig Miller - UF
	UFTR Digital Control System Upgrade for Education and Training of Engineers and Operators PI: Gabriel Ghita – UF (PI use to be Alireza Haghighat; he has left UF)
	Energy and Efficiency Video Public Service Announcements PI: Andy Opel, Co-PIs: Phil Steinberg, Leslie France-Patterson, Laura Arpan, Ian Weir – FSU ***This project has been completed***
	Planning Grant: Climate Modeling and Outreach Activities PI: Shawn R. Smith, Co-PIs: Steve Cocke, David Zierden, James O'Brien, Julie Harrington – FSU ***This project has been completed***
	Visiting Law Professor PI: JB Ruhl, Jim Rossi, Co-PIs: Uma Outka – FSU ***This project has been completed***
FESC Phase 2 Technology Commercialization	
	Development of a Low Cost Concentrating Solar Energy System Using Solar Sausages PI: David Van Winkle, Sean Barton - FSU
	Stress Evolution in Solid-State Li-Ion Battery Materials PI: Kevin S. Jones – UF
	SWNT Based Air Cathodes for Fuel Cells & Metal Air Batteries PI: Andrew G. Rinzler - UF
	Uni-Directional Impulse Turbine for the Powering of Offshore Monitoring Systems PI: Zhihua Qu Co-PI: Kuo-chi Lin - UCF

NEW PROGRAM DEVELOPMENT

The new program development effort aims to facilitate the submission of multi-faculty, multi-SUS university competitive proposals in response to solicitations for major research programs. By collecting the best research expertise in the SUS, competitive funding requests to federal agencies, national and global foundations, and industry can be made. 160 funding opportunities were distributed to the FESC faculty during this period. The list of funding opportunities is given in Appendix C. The funding opportunities are also posted at the FESC web site: http://www.floridaenergy.ufl.edu/?page_id=912. Faculty teams were formed to respond to the funding opportunities based on the responses received from the faculty. The FESC office facilitates proposal development in a variety of ways beyond solicitation awareness, including identifying leaders, communicating with external partners in industry, national labs and other non-SUS universities, providing professional technical writing help, arranging telecons, and assisting with cost share development, budgets and boiler plates. Having the FESC wide MOU in place has been very helpful. One example is the proposal participation request from the Savannah River National Laboratory. The request was very close to the proposal submission deadline. Since we had the FESC wide MOU, FESC faculty members from 4 FESC university were able to participate.

FESC expertise documents have been prepared in the areas of algae technology, solar PV, solar fuels, smart grid and storage, and building efficiency. The documents provide the list of faculty and their expertise, facilities, and industry collaboration. They are posted at FESC web site to better communicate to potential partners the capabilities of the SUS research enterprise.

Some of the funding opportunities sent to faculty are given below as an example:

Competitive Funding Opportunities				
#	**Title**	**Call #**	**Agency**	**Funding**
1	Solar Agile Delivery of Electrical Power Technology (Solar ADEPT)	DE-FOA-0000474	DOE	$5M
2	High Energy Advanced Thermal Storage (HEATS)	DE-FOA-0000471	DOE	$10M
3	Plants Engineered to Replace Oil (PETRO)	DE-FOA-0000470	DOE	$15M
4	Atmospheric System Research	DE-FOA-0000556	DOE	$3M
5	SunShot Initiative: Rooftop Solar Challenge to Induce Market Transformation	DE-FOA-0000549	DOE	$12.5M Phase 1; $25-30M Phase 2
6	Green Electricity Network Integration (GENI)	DE-FOA-0000473	DOE - ARPA E	$250K - $10M
7	Emerging Frontiers in Research and Innovation 2012	NSF 11-571	NSF	$31M
8	Engineering Research Centers (ERC)	11-537	NSF	$9.75M

Some of the recent awards to the FESC funded faculty are:

ARPA-E grant awards

- **University of Florida $6,367,276**
  Commercial Production of Terpene Biofuels in Pine. The University of Florida project will increase the production of turpentine, a natural liquid biofuel isolated from pine trees. The pine tree developed for this project is designed to increase the turpentine storage capacity of the wood. Existing pine trees have

a terpene content of 3 percent to 5 percent. The researchers will work towards increasing this to more than 20 percent. The fuel produced from these trees would become a sustainable domestic biofuel source able to produce 100 million gallons of fuel per year from less than 25,000 acres of forestland.

- **University of Florida $2,975,920**
  Thermal Fuel: Solar Thermochemical Fuel Production via a Novel Low Pressure, Magnetically Stabilized, Non-volatile Iron Oxide Looping Process. The University of Florida will develop a new dual cavity, high temperature chemical reactor that converts concentrated solar thermal energy to Syngas, which can be used to process 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 use water and recycled CO_2 as the sole feed-stock and concentrated solar radiation as the sole energy source. Successful large scale deployment of this solar thermochemical fuel production will be the key in accomplishing the mission to enhance the nation's economic and energy security by replacing imported oil with domestically produced solar fuels.

- **University of South Florida (SunBorne Energy), $2,439,450**
  Concentrating Solar Power/Nuclear: Development of a Low Cost Thermal Energy Storage System Using Phase Change Materials with Enhanced Radiation Heat Transfer. The University of South Florida team will develop low cost industrially scalable high temperature phase change materials (PCMs) for thermal energy storage (TES) system. An innovative electroless encapsulation technique will be used to enhance the heat transfer to overcome the low thermal conductivity of common PCMs. The proposed research will result in the development of an innovative high temperature and smaller footprint TES system at a low cost representing almost a 75% reduction in the cost of TES.

Sunshot Awards

- **University of South Florida, $987,717**
  Project will research the doping of thin-film, cadmium-telluride PV cells to increase cell open-circuit voltage, leading to higher cell efficiencies.

- **National Renewable Energy Laboratory (lead) including University of Florida, $6,240,942 Total program**
  Project will research high-efficiency PV cells based on CIGS (copper indium gallium diselenide) in

  order to reduce related cost barriers. Areas of focus are to benchmark the project partners' PV devices, address the buffer and transparent conducting oxide layers, and broaden the approach to processing CIGS cells.

- **University of Delaware (lead) and University of Florida, $1,200,000 Total program**
  Project will advance processing technologies in CIGS PV. These advances will create improvements in manufacturing and increase solar cell efficiency.

Economic Development Administration i6 Green Challenge

University of Central Florida, Technological Research and Development Authority, University of Florida, $1,000,000 (EDA) + $613,155 (Applicant) + $299,746 (DOE) = $1,912,901 Total program

The Igniting Innovation Cleantech Acceleration Network (**I2** CAN) is a unique distributed proof-of-concept model that consists of a network of Florida-based universities, incubation networks, investors and industry resources that are coming together to accelerate the commercialization of innovative clean technology research into new technology companies or to license into existing firms. The **I2** CAN will provide commercialization resources to entrepreneurs, scientists and established companies that are interested in commercializing clean technology research conducted within Florida's research institutions. A particular

emphasis will be given to research areas in which Florida excels - solar energy, biofuels, green building technologies, and smart grid (energy storage and software/sensors).

Examples of Proposal Support

DE-FOA-0000479 : Solar Energy Grid Integration Systems – USF and FSU proposal teams
DE-FOA-0000492 : Foundational Program to Advance Cell Efficiency (F-PACE) – FESC faculty and Blue Chip Energy collaboration
DE-FOA-0000493 : Extreme Balance of System Hardware Cost Reductions (BOS-X) - FESC faculty and Blue Chip Energy collaboration
DE-FOA-0000471 : High Energy Advanced Thermal Storage (HEATS) – USF proposal team
FL Municipal Electric Association (FMEA) – FSU faculty and American Capital Resources Company Collaboration
DE-FOA-0000239: FY 2011 Vehicle Technologies Program Wide (NETL) – UF Faculty and Planar collaboration
DE-FOA-0000337: Integrated Process Improvements for Biochemical Conversion of Biomass Sugars: From Pretreatment to Substitutes for Petroleum-based Feedstocks, Products and Fuels – FESC faculty and Savannah River National Laboratory collaboration
DE-FOA-0000452 : SciDAC: Earth System Model Development – FSU and UF proposal team
DE-FOA-0000490 - Industrial Assessment Centers – UF proposal team
DE-FOA-0000505: Scientific Discovery through Advanced Computing Institutes – FAMU proposal team
DE-FOA-0000510: Biomass Research And Development Initiative – UCF-FSEC proposal team
DE-FOA-0000520 : Reducing Market Barriers and Non-Hardware Balance of System Costs – CEFA (FSU), PURC and Blue Chip Energy collaboration
US EDA- i-6 Challenge – UF, UCF, TRDA collaboration
DE-FOA-0000506 - U.S.-India Joint Clean Energy Research and Development Center – UF and USF proposal teams
DE-FOA-0000560 - Innovative Manufacturing Initiative – Several proposals in collaboration with Verdicorp, Blue Chip Energy, and Ferrite Tech.
NSF Science Tech Centers – UF team
NSF Smart Grid – UF and UC Berkley collaboration
NSF – ERC: UF team

INDUSTRIAL COLLABORATION AND TECHNOLOGY COMMERCIALIZATION

FESC's industrial program promotes collaboration between the partner universities and industrial partners from small, medium, and large companies, as well as other organizations such as incubators, research parks, investors, entrepreneurs, and government laboratories.

FESC has an Industrial Partnership and Innovation Strategy that assures active collaboration with the private sector and other partners that support and guide FESC's vision, collaborate with FESC in our research, education, innovation, and outreach programs.

The progress for this period is given below.

Strategic Plan By FESC- Renewable Energy in Florida

The "Strategic Plan" for renewable energy in Florida focusing on economic development and job creation has been prepared with input from experts in each thrust area and feedback from the advisory board members. The final document has been sent to the Commissioner Putnam, the energy office, and Dr. Mary Bane.

FESC Industrial Database

FESC has identified a need in Florida's energy related programs in that no single database exists cataloging the breadth of renewable energy companies and associations across Florida. While capturing and maintaining a 100% complete dataset of industrial contacts may not be feasible, FESC has initiated an effort to create a database of important industry players in order to quickly identify synergies between FESC's research, education, and technology commercialization programs and Florida industry. Sources of information for this database include Florida energy related trade associations, researcher and university contacts, Florida energy program grantees, and other sources. To date, FESC has compiled and is maintaining a relational database of over 350 companies and other entities in Florida that have a key stake in Florida's energy strategies. FESC has collaborated with Enterprise Florida to combine their database with FESC industrial database. The combined database has over 500 entries. Each company has been checked to insure that information is current. The database will be constantly updated and will provide an avenue for program information dissemination, industrial needs assessments, and potential collaborations.

Recent Funding from US EDA

FESC administration office and the University of Central Florida in collaboration with the Technological Research and Development Authority (TRDA), received $1M (Total project cost : $1.7M) grant from the US Economic Development Administration (EDA) to implement a unique model that links Florida-based universities, incubation networks, investors and industry resources together to create a network of Proof of Concept centers to accelerate the creation and commercialization of innovative clean technology research. The grant is titled as "Igniting Innovation Cleantech Acceleration Network (I^2 CAN)".

The I^2 CAN will provide commercialization resources to entrepreneurs, scientists and established companies that are interested in commercializing clean technology research conducted within Florida's research institutions. A particular emphasis will be given to research areas in which Florida excels - solar energy, biofuels, green building technologies, and smart grid (energy storage and software/sensors).

Industrial Collaboration Project Examples

FESC has been actively pursuing research, infrastructure improvement, and economic development collaborations with multiple companies and other entities to assure that the Consortium's research and education agenda are aligned with industry's needs and to move FESC technologies quickly to serve Florida's industry and economy. Outlined below is a sampling of specific collaborations that FESC is fostering across Florida:

- **Buckeye Technologies:** UF is building a $20M fully integrated biofuels pilot plant (State of Florida award) adjacent to a leading specialty cellulose producer, Buckeye Technologies Inc. in Perry, Florida, to demonstrate the production of cellulosic ethanol. UF is collaborating with Buckeye in this effort. The plant is expected to open in 2012 and will process 3 tons of sugarcane bagasse or 5 tons of wood products per day.
- **Lykes Brothers:** Research partnership with UF.

- **Planet Green Solutions:** UF developed joint research facility for biomass gasification to energy.
- **Algenol**: collaboration with FGCU faculty. UF faculty also visited Algenol facility and discussed potential interactions.
- **Midwest Research Institute (MRI):** Developed collaborative proposals in algae technology.

Nutri-Turf, Anheuser Busch and Speedling: UF is collaborating on the development of energy crops (miscanthus plants).

- **Weyerhaeuser, Plum Creek Timber, Research Management Services, Rayonier, Rayonier, CelFor, and ArborGen:** UF collaboration on energy intensive crop development (Eucalyptus, poplar wood, perennial grass, and southern pine).
- **NASA KSC and Glenn:** FESC faculty and the NASA Glenn Research Center "Green Lab" team members have worked together and wrote a white paper for the potential of a "National Biofuel Biomass Test-bed" (NBBT) in Florida. We are now working with NASA KSC to define a location.

- **Mustang Solar:** The USF Solar Cell Lab formed a joint venture for the development of a roll-to-roll process for thin film $CuIn_xGa_{1-x}Se_2$ solar modules. Processing equipment and processing procedures developed by the venture will be sold and licensed to solar module manufacturers.
- **Petra Solar:** UCF is collaborating with Petra Solar on grid stability with distributed generations and micro-invertors for solar panels.
- **Blue Chip Energy, LLC and Advanced Solar Power (Subsidiary of Blue Chip):** FESC faculty collaborated with Blue Chip Energy on several multimillion dollar proposal efforts.
- **Progress Energy:** USF has a collaborative demonstration project combining renewable energy generation with an advanced battery system to supply renewable energy to meet peak demand. In addition, UF is collaborating on the PoWER system demonstration.

- **Energy Storage Programs:** **SAFT** received $95M grant from the U.S. Department of Energy with $95M cost share to build a 235,000-square-foot plant in Jacksonville. FESC is collaborating with SAFT to establish an energy education center.

on
  - **Bren-Tronics:** UF collaboration on Li-Ion rechargeable batteries
  - **G4 Synergetics and Encel**: UF collaboration bipolar cells.
  - **Planar Energy Devices:** UF collaboration on solid state Li-based batteries.
  - **Energy Concepts:** UF collaboration on integrated absorption refrigeration development.
  - **Bing Energy:** FSU spin off company in fuel cells.
- **TECO Energy and ECT:** USF has completed modeling of subsurface injection of super-critical carbon dioxide at the Polk Power Station and provided technical consultation on evaluation methods for injection well system at Polk Power Station.
- **Greenpointe, LLC:** FSU collaboration on waste to energy project.
- **Marpan Recycling:** FSU collaboration on construction and demolition waste.

This represents only a small set of examples of the industrial collaborations involving FESC.

Innovation HUB at the University of Florida and Thin Film Pilot Line at USF

The University of Florida announced the opening of the Florida Innovation Hub (the first building located in Innovation Square) recently. The Hub was built with an $8.2M grant from the Economic Development Administration and a $5M matching funds from UF. The 48,000 ft^2- facility located in downdown Gainesville serves as an incubator for technology-based start-up companies. The Hub provides office space, modern laboratories, conference rooms, and other resources to the tenants. Programs and activities at the hub will bring together entrepreneurs, investors, students and service providers to incubate new ideas. The Hub houses the UF's Office of Technology Licensing and UF Tech Connect. Nanophotonica, one of the tenants of the Hub, was funded by FESC Phase I program. Link to the "Florida Innovation Hub at UF" web site: www.floridainnovationhub.ufl.edu\

A new 2,500 square foot Thin Film Pilot Line at the University of South Florida (USF - Tampa) is a $2M facility (including $1.6M FESC funding) that will be operational within 6 months. It is adjacent to the USF Incubator Building which will foster university/industry partnerships. It will be used to manufacture solar cells at pilot scale.

FESC Technology Commercialization Program

This program was reported in our previous reporting period. It is given again for completeness including recent progress.

FESC has devised a multi-tiered approach to investing its limited technology commercialization resources. In devising this strategy, FESC is focused on 1) fully complimenting the existing resources across the SUS and state of Florida's economic development community, 2) providing the maximum potential return / economic impact to Florida's economy on our investment, 3) maximum leveraging of FESC resources with industrial support, and 4) a focus on driving later stage energy technologies in the FESC university research

portfolio toward commercialization. This has led to development of a two-tiered program as outlined below:

- *Phase I: Early Stage Market Research / Business Plans* – Recognizing that a number of FESC funded technologies may have unknown, or at least undocumented, commercial potential and also recognizing that university licensing offices and technology licensees (entrepreneurs, SMEs, large corporations) alike are looking for a greater depth of understanding of potential applications of some of FESC's later stage technologies in order to optimize technology licensing and the path to market, FESC initiated a funding program of business plans and market research studies for select FESC technologies. This program was completed and program details were reported in the previous reporting period. The funded projects are given in the table below:

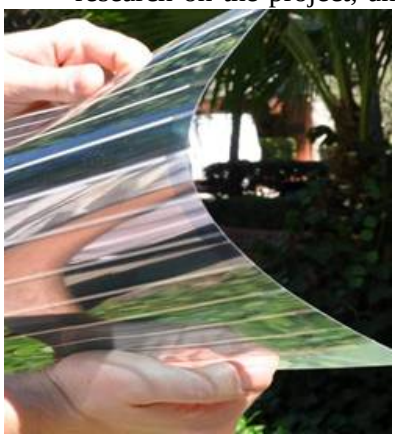
University	Project	Energy Field
FIU	Novel Fabrication Method of Nanoscale Fibers and Tubes	Energy Storage and Distribution
FIU	Synthesis of Hydrides and the Vehicular Use of Hydrogen Producing Reactions	Renewable Fuels
FSU	High Efficiency Multijunction PVs for Solar Energy Harvesting	Solar Energy
FSU	Multi-Piece Wind Energy Blades	Wind Energy
FSU	Microgrid Controllers & Solar Wind Distributed System Controls	Energy Storage and Distribution
UCF	High Efficiency Air Conditioning Condenser Fan Blades	Energy Efficiency
UCF	Milling Technology Leads the Way to Cost Effective Ethanol Production	Bio-energy
UCF	Hybrid PV and Thermoelectric Cell Elements Improve Solar Cell Efficiency	Solar Energy
UCF	Wind and Solar Battery Chargers	Energy Storage and Distribution
UF	Advanced Membrane Reactors for H_2 Production	Renewable Fuels
UF	ChromaDynamics	Energy Efficiency
UF	Highly Efficient, Long-Life, Weather Compatible Nanomaterials-Based Display	High Performance Display Tech.
UF	High Power, Fuel Flexible, Cost-Effective Solid Oxide Fuel Cell	Energy Storage and Distribution
USF	Enhanced Lead Sulfide Quantum Dots for Solar Cells	Solar Energy
USF	A Practical Method of CO_2 Sequestration	Carbon Capture and Sequestration

FESC funded 15 business plans and market research studies at $7.5K each for FESC funded later stage technologies. The Office of Technology Licensing at each university is promoting these technologies.

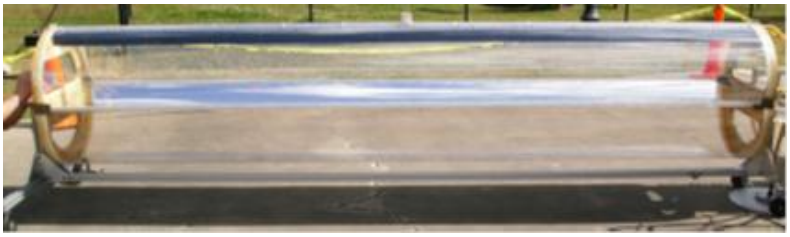
Phase II: Matching Funds R&D Program – The second tier of the FESC technology commercialization funding program is modeled on the very successful Florida High Tech Corridor Council (FHTCC) Matching Grants Research Program which has been ongoing at USF and UCF since 1996 and at UF since 2005. This 2nd tier also builds off of the results of the first tier as the business plans and market research studies in tier 1 above will provide for more complete information in attracting industrial partners and selecting appropriate projects for funding in tier 2. In this program, FESC core universities proposed energy related projects for FESC funding that is matched on a 2:1 basis by industry funds. This model serves a number of purposes: 1) industry partners are by definition highly engaged in the development process in the university as they are co-funding the R&D package, 2) this provides at least a 2X leveraging of

Wave Energy – Prototype Turbine (UCF)

FESC funds on each project, 3) a natural pipeline of the technology deployment to the private sector partner is established as they are typically working on development aspects in parallel with the university research on the project, and 4) the FHTCC program has proven time and again that this model spawns new and long lasting R&D collaborative relationships between companies and SUS university researchers. FESC provided up to $50K per project attracting around $400K of industry support to these FESC funded projects. Four industry contracts are already in place. One is in progress (delayed due to lack of industry match funds) and one is on hold waiting resolution in patent options with another company. The table below gives the list of the FESC Phase II projects.



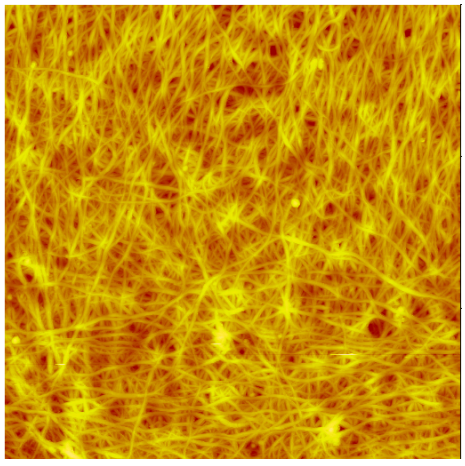
Organic Solar Cells (UF)



Solar Sausage (FSU)

The Phase II projects are listed in the table below.

University	Title	PI	Company
FSU	Deployment of a Low Cost Concentrating Solar Energy Systems Using Solar Sausages	David Van Winkle	Hunter Harp Holdings, LLC
UCF	UCF and Harris Corp Joint Wave Energy Projects	Zhihua Qu	Harris Corp.
UF	SWNT Based Air Cathodes for FC and Metal Air Batteries	Andrew Rinzler	nRadiance LLC, portfolio company of Nanoholdings LLC
UF	Stress Evolution in Solid-State Li-ion Battery Materials	Kevin Jones	Planar Energy Devices Corp.
UF	Development of High Efficiency Polymer Solar Cells (Contract in progress)	Franky So/John Reynolds	Sestar Technologies, LLC.
UF	*Cleaner, More Efficient Turbine Energy Production Using Robust, Miniature Solid-State Gas Sensors (On Hold)*	*Oscar D. Crisalle*	*Siemens*



Fuel Cell - Carbon Nano Fibers (UF)

Micro-turbine Test System (UF)

The executive summary of each report is given below. The detailed reports are given in the "Project Progress Reports" document that is attached to this report.

Uni-Directional Impulse Turbine for the Powering of Offshore Monitoring Systems

PI: Dr. Zhihua Qu, UCF and Co-PI's: Dr. Kuo-chi Lin, Electrical Engineering and Computer Science, UCF
Industry Partner: Harris Corporation

The University of Central Florida and Harris Corporation have joined efforts to design, build and analyze a wave powered abandoned oil well monitoring system for use in the Gulf of Mexico. This system proposes a fully automated oil leak detection system which is self-powered by the local ocean energy which is converted to electricity, conditioned and sent from the surface buoy to the ocean floor to supply power for an abandoned oil well monitoring system.
This project was split into four different components which were completed by four UCF senior design teams; three of the teams were chosen from last year's Mechanical Materials and Aerospace Department (MMAE) senior design class and the fourth team was chosen from the electrical engineering senior design class. The project was split into two major components, the first one being the design, construction and testing of a fully automated and battery powered oil well monitoring system. The second component focuses on the conversion of wave motion into electrical energy which is used to power the sensor battery system. Each of these two major components has been undertaken by two teams.

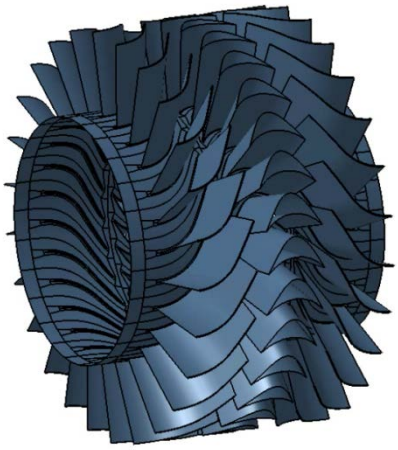


Figure 1. Turbine Schematic

In order to provide a monitoring system for abandoned oil wells a mechanical senior design team designed, tested, and built a fully powered and automated oil detection system for end users such as the EPA. The system acts like a cap to be installed on the top of all abandoned oil wells. The cap is shaped like a nozzle which forces any leaking oil from the well to flow out through the nozzle and through a channel were a series of sensors detect for the presence of oil.

Since ocean waves provide an intermittent and inconsistent source of energy a smart energy converter was needed to convert, condition, and supply consistent power to the sensor system. For this purpose an electrical engineering team created a black box electrical unit which was made in four parts: Input Circuit, DC-DC Converter, Battery Charge Controller, and Microcontroller.

In order to provide electrical energy for the monitoring system a unique uni-directional impulse turbine was designed, built and tested. The team made the design schematics which were built by the HARRIS corp. through the use of their rapid prototyping machine. The experimental testing resulted in 44% turbine efficiency for the optimal flow coefficient.

In order to house the turbine and generator system a mechanical engineering senior design team designed, built and tested a floating buoy which was acted as the link between the ocean wave motion and the impulse of air flow through the turbine section. A quarter scaled buoy was constructed and was hydro-dynamically stable in all of the field tests.

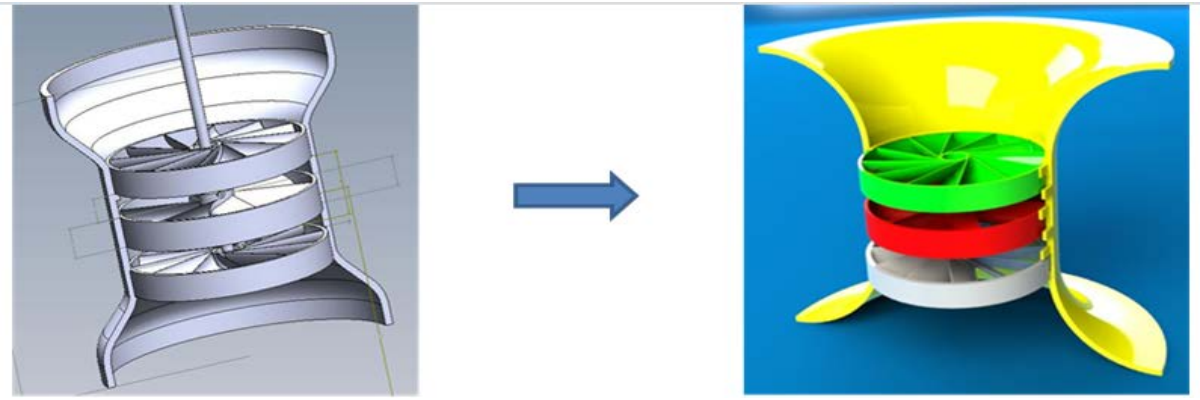


Fig 2. Illustration of two prototypes of the bi-directional turbine and nozzle design

Fig 3. Illustration of buoy components and buoy experimental prototype

SWNT Based Air Cathodes for Fuel Cells & Metal Air Batteries

PI: Dr. Andrew G. Rinzler, Department of Physics, UF
Industry Partner: nRadiance LLC

The goal of this project is to develop and use novel gas diffusion oxygen reducing electrode (air cathode) based on single wall carbon nanotube (SWNT) films in zinc-air batteries and fuel cells. Metal-air batteries, utilizing surrounding air as an inexhaustible cathode material have the highest specific and volumetric energy density of any primary battery system available. Gas diffusion oxygen electrodes, where molecular oxygen is electrocatalytically reduced, are vital to battery and fuel cell performance. The air cathode should be permeable to air or another source of oxygen, but must be substantially hydrophobic so that electrolyte will not leak though it, and have an electrically conductive element connected to external circuitry. Generally, conventional air cathode is a thick multilayer film comprising carbonaceous powder mixed with nanoscale metal catalyst to promote oxygen reduction and hydrophobic polymer additive pressed onto electrically conductive layer. While noble metals such as platinum that are commonly used as catalysts in conventional air cathodes offer the advantages of intrinsic catalytic activity, their deficiency in resource, high costs, and susceptibility to catalyst poisoning, have become a serious concern for commercial applications. An optimized SWNT based air cathode catalyst that would constitute a significant improvement in existing technologies is being developed. This new system avoids precious metals, is not poisoned, is thin, light-weight, and resists electrolyte flooding.

Findings to date indicate that the catalyst being developed is competitive with platinum in terms of its oxygen reduction activity in alkaline and neutral pH environments. This makes it suitable for a broad range of power generating devices including alkaline fuel cells, enzyme based biofuel cells, microbial fuel cells, micro-fuel cells, small direct methanol fuel cells and advanced metal-air batteries.

Our findings will contribute to making fuel cells economically viable and permit broader implementation of long lived sources of portable power. Platinum is costly because of its actual scarcity on Earth versus its importance and utility in many chemical processes. It has been estimated that if the worlds fleet of 500 million internal combustion vehicles were converted to fuel cell power plants using platinum catalysts (what is used in today's fuel cells) the world's supply of platinum would be exhausted in only 15 years (even with recycling). This is perhaps the biggest roadblock to a viable hydrogen economy.

Our work involves single wall carbon nanotubes which are themselves costly in today's market. The difference compared to platinum however is that this is not due to any scarcity of carbon from which nanotubes are made but rather because the motivation for their bulk manufacture (and attendant economy of scale) has been lacking. Our finding may change that equation.

Since patent is pending on this work, detailed report will not be provided.

Examples of applications: Metal-air batteries and fuel cells generate clean, reliable energy for transportation, stationary and portable applications such as:

Low/zero-emission vehicles, spacecraft etc.

Portable electronics

Residential/business back-up power generators

Development of a Low Cost Concentrating Solar Energy System Using Solar Sausages

PI: Dr. David Van Winkle, and Sean Barton, Department of Physics, Florida State Univers*ity*
Industry Partner: Hunter and Harp Holdings (HHH)

Beginning in late 2010, weekly meetings have been held at HHH offices in Tallahassee that include representatives of the several entities involved in deploying the "Solar Sausage" concentrating system at the Yulee St. site in Tallahassee. The entities include Pro Solar Inc., Barkley Consulting Engineers Inc., Winton Engineering PA, and Applied Research and Design Inc. A series of 50-foot long prototype sausages were made and inflated on site. Many issues were identified that needed to be resolved before manufacturing and deploying several hundred solar sausages on site including methods of constructing, mounting, and operating the balloons, distribution of air and electricity, and removal of heat.

Specific accomplishments:

- We have identified the correct adhesives for bonding the PET polyester films to each other and the correct bond geometry for minimizing the pealing stresses on the adhesive.
- We have designed and partially built the actuation system for rotating the balloons to track the sun.
- We have streamlined the process of producing the balloons such that a team of 16 workers can produce about 1 balloon per hour. Currently 150 of 336 balloons have been produced. While our current manual process produces balloons of 50-foot length, HHH is investing in machinery that will produce balloons of continuous length, to be cut to the length desired. This will reduce the number of "balloon ends" in the final application. Balloon ends are undesirable from the standpoint of electrical distribution, air distribution, solar-tracking actuation, and optical end effects.
- We have designed and are generating the software required to control absolute pressure in the balloons, to control differential pressure between the compartments of the balloon to maintain the optic, and to make astronomical predictions and control the rotation of the balloons. (Specifically, an FSU led portion of the project – resulting in an in-kind cash match from HHH to FSU to purchase instrumentation from National Instruments for this part.)
- We have developed procedures for mitigation of damage during high-wind and catastrophic-wind events which include increasing the pressure in the balloons, securing the photovoltaic modules with a tensioned retainer cable, and (if time allows) removing the photovoltaic modules.
- We have identified the need for photovoltaic material with greater concentration ratios.
- We have identified a variety of alternative methods by which the balloons could be rotated to track the sun.
- We have identified several of these scenarios that eliminate the need for counterweights.
- In the future, with higher concentration PV material and longer balloons, costs may be scientifically reduced using the centralized-elevated-receiver concept.

As can be seen in the accompanying photographs, the project is well along in terms of deployment of the technology on the Yulee St. site.

The project has involved full and part-time employment of approximately 100 individuals over the last 8 months doing construction, site development, and manufacturing.

View of the Yulee St. site from the north east corner

First full-sized inflatable mirror

Plant Street facility for production of the balloons

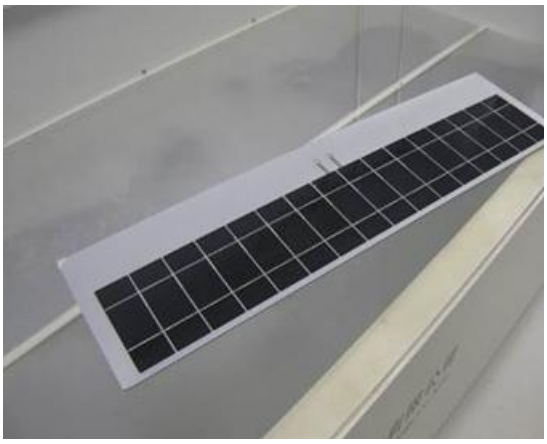
Glue machine applying glue to reflective membrane

Reheating the glue to bond the membranes together

The Solar Sausage Forming and Glue Machine

Load-adhesion testing of a 50-foot balloon

A 50-foot balloon



Encapsulated photovoltaic cells

Street View of the Yulee St. Site from the East

EDUCATION

The Education program has three focus areas, community college programming at the Associate of Science and certificate level, nuclear energy education, and a Master's degree in sustainable energy.

The Community Colleges offer an opportunity to develop a trained energy workforce through programming for both technician level 2 year students, as well as students planning on completing a Bachelor's degree.

FESC works closely with the Florida Community College system as well as with the Florida Advanced Technological Education Center (FLATE), which coordinates the design of industry specific training programs for technicians at the community colleges in Florida. FESC disseminates energy curricula in cooperation with FLATE.

On the Collegiate Level, programming includes curriculum directed at the workforce for the nuclear industry needed by five nuclear power plants in Florida.

Progress

UF has developed an online "Energy Certificate Program" for engineers and scientists to continue their education through graduate certification. The Energy Certificate has four tracks: Solar Energy, Wind Turbines, Gas Turbines, and Energy Management; and is delivered completely online; so it could serve as a means for energy education throughout FL and the nation. The certificate will be received from the Department of Mechanical &Aerospace Engineering. The link to the UF EDGE Energy Certificate and Sustainable Engineering Certificate program is: http://www.ufedge.ufl.edu/programs/certificates.php

Dr. Jay Kapat, UCF, has developed Professional Science Master (PSM) program on Energy. The initial track on "Turbo-Power Generation (turbo-machinery based power generation that currently provides more than 98% of all electricity)" is being proposed, with significant support from related local industry. The future tracks on "Generation and Smart Grids", "Photo-Voltaics", and/or "Smart Buildings" are being discussed. This is a multidisciplinary and system focused program to address key systems in energy and power industry. It will have a highly challenging – 8 STEM courses and 5 Professional courses in 3 semesters. The industry partners will provide summer-long internship, 1:1 industrial mentor, co-instruction of key courses.

FSU added 3 classes:

- The Economics of Sustainable Energy taught by Doug Norton (FSU, Spring, 2010)
- Sustainable Development Law taught by Uma Outka (FSU, Spring, 2010)
- Governing Sustainable Communities, Richard C. Feiock (FSU, Spring, 2010)

In addition, Southeast National Marine Renewable Energy Center (SNMREC) has developed an Educational Curriculum to enhance interest in science, mathematics, engineering, and technology and to support improvements in education for students from K-12 with original curricula and teacher workshops. Energy from Ocean Currents: the New Renewable is an ocean-energy curriculum developed for 11th and 12th grade students with funding from an award by the US Department of Energy's Office of Energy Efficiency and Renewable Energy. The curriculum is based on the "5 E's", an innovative instructional-based model used for teaching that fosters inquiry-based thinking by engagement, exploration, explanation, elaboration, an thinking by engagement, exploration, explanation, elaboration, and evaluation.

There are six comprehensive lessons built around the scientific basis of SNMREC research, each aligned with the Florida Sunshine State Standards benchmarks, with hands on activities reinforcing each lesson. One such activity is building an electric generator from a soda can to demonstrate an induction coil alternating current generator. The lessons also include "Meet the Scientist" segments that feature a SNMREC engineer or scientist.

The curriculum was introduced to 40 teachers from three counties in South Florida in three workshops. Teachers who participated in the pilot workshop implemented the curriculum with their classes and gave valuable feedback. They also participated in the second and third workshops as facilitators, and they received in-service credits from their school districts. Pre- and post-lesson tests at the workshop and an online survey after utilizing the lessons in their classrooms provided the teachers with the opportunity for assessing the program, and the feedback was very positive. The second year of the program will reach additional teachers and incorporate enhancements to the original curriculum.

University of Florida Nuclear Training Reactor (UFTR) Digital Control System Upgrade for Education and Training of Engineers and Operators, Dr. Gabriel Ghita

In order to make the UFTR capable of offering training to engineers and operators, it is necessary to receive approval from NRC on reactor relicensing application and on the Licensing Amendment Request (LAR) for the digital control upgrade. Then install and test the new digital system. Thus far, we have been working on:

i) Licensing applications (submitted to NRC)
    a. UFTR Relicensing Application
    b. LAR for digital protection system
ii) Basic Design Documentation (submitted/to be submitted to AREVA)
iii) Application Software Development

i - a. UFTR Relicensing Application

The work has been completed in 2010. In August, 2011 a NRC team performed an Audit. The first part of the audit, August 1-3, was dedicated to UFTR license renewal. The discussion comprised the current version of the proposed UFTR technical specifications and the draft request for additional information in order to complete the review for the UFTR relicensing. A new set of RAI is expected from the NRC.

i - b. LAR for the digital protection system

A modified Final Safety Analysis Report (FSAR) was submitted based on NUREG 1537 "Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors," and referenced various documents related to licensing of a digital protection system. Figure 1 below depicts this process.

On August 3 -5, 2011, the NRC has conducted an audit of the UFTR application for a license amendment to install a Digital Control System Upgrade. The intent of the audit was to gain understanding of the project progress and current facility status. In addition, it identified information required to be docketed in order to support the basis of the licensing decision. The regulatory audit will allow the NRC staff to more efficiently gain insights on the UFTRs software development programs and processes. An Audit Summery is expected from NRC with recommendation of the approach for completion of the LAR Application.

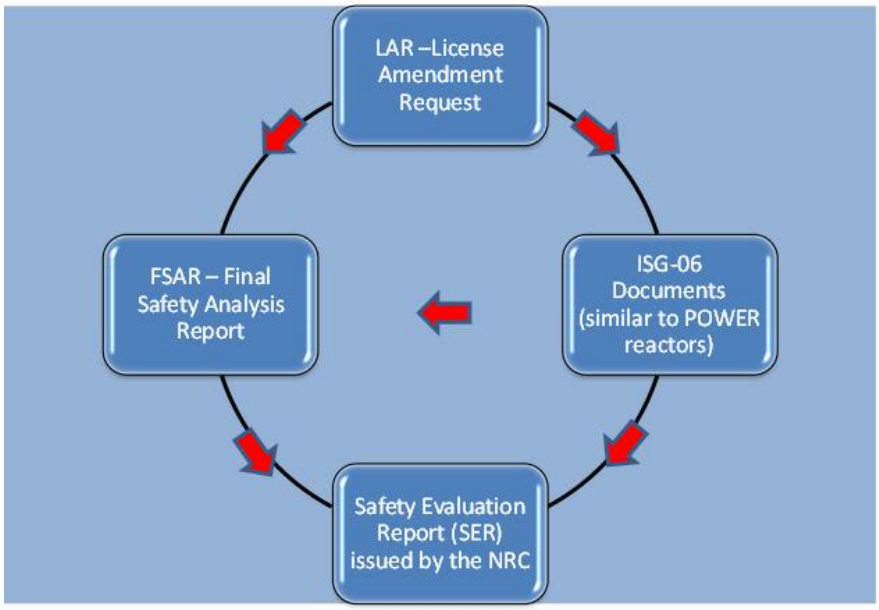


Fig. 1 - New licensing process for the UFTR Digital Control upgrade

Up to now, we have prepared the modified FSAR and completed 20 documents from which 17 documents have been submitted to the NRC (Table I).

Table I - List of Documents for the UFTR LAR on Digital Upgrade

#	Document ID	Document Title	Status/Due Date
1	UFTR-QAP	UFTR QA Program	Done
2	UFTR-QAP-01-P	Conduct of Quality Assurance	Done
3	UFTR-QA1-QAPP	Quality Assurance Project Plan (QAPP)	Done
4	UFTR-QA1-01	Software Quality Assurance Plan (SQAP)	Submitted
5	UFTR-QA1-02	Software Configuration Management Plan (SCMP)	Submitted
6	UFTR-QA1-03	Software Verification and Validation Plan (SVVP)	Submitted
7	UFTR-QA1-05	Software Safety Plan (SSP)	Submitted
8	UFTR-QA1-06.1	Software Test Plan – SIVAT Plant	Submitted
9	UFTR-QA1-06.2	Factory Acceptance Test (FAT) Plan	Submitted
10	UFTR-QA1-07	Software Installation Plan	Work in progress
11	UFTR-QA1-08	Software Integration Plan	*
12	UFTR-QA1-09	Software Operations and Maintenance Plan	Submitted
13	UFTR-QA1-10	Software Training Plan	Submitted
14	UFTR-QA1-11	Software Reviews and Audit	Submitted
15	UFTR-QA1-12	System Description	Submitted
16	UFTR-QA1-14	Safety System Design Basis	Submitted
17	UFTR-QA1-100	Functional Requirements Specification (FRS)	Submitted
18	UFTR-QA1-101.1	List of I/O (with the FRS)	Submitted
19	UFTR-QA1-102.1	Software Requirements Specifications (SRS)	AREVA review
20	UFTR-QA1-102.3	ID Coding	Submitted
21	UFTR-QA1-103	Diversity and Defense-in-Depth (D3) Analysis	Submitted
22	UFTR-QA1-105	Teleperm XS Cyber Security	Submitted
23	UFTR-QA1-109	Software Library and Control	Submitted
24	UFTR-QA1-110	Software Generation and Download	Work in progress
25	UFTR-QA1-111	Interface Specification	Work in progress

26	UFTR-QA1-112	HW Requirement Spec (HRS)**	**
27	UFTR-QA1-113	System Architecture.	AREVA review
28	UFTR-QA1-114	QDS Software Requirement Specification (QDS SRS)	Work in progress
29	UFTR-QA1-115	HW Design Solution (HDS)	Work in progress
30	UFTR-QA1-116	Component Arrangement Specification	Work in progress
31	UFTR-QA1-117	Hardware Parameters Listing	Work in progress
32	UFTR-QA1-118	Periodic Test Concept and Operation and Maintenance	Work in progress

*Postponed to the later phase ****** Not needed

A paper titled as "Digital Upgrade of the UFTR Protection and Control Systems." was presented in Nov 2010, at the ANS winter meeting in Las Vegas, NV. A paper entitled "Implementation of Digital Upgrades to the UFTR Protection and Control Systems" was submitted and accepted for presentation at the ANS Meeting in Washington DC, November 2011.

ii) Basic Design Documentation (submitted/to be submitted to AREVA)
We have prepared the documents in support of TXS protection system manufacturing in Germany, as part of the Basic Design Documentation and submitted to AREVA for review.

iii) Application Software Development
We have been working on the *FunBase* and *SPACE* software tools. The former tool was used in support of document preparation, particularly the Software Requirements Specifications, and latter tool is used to prepare network diagrams, and eventually the necessary *object* file for operating the TXS system.
We are currently training ourselves and trying to determine the limitations and capabilities of the two tools.

Florida Advanced Technological Education Center (FLATE), Dr. Marilyn Barger

The development of the process for the Florida State College System to respond to FESC's long term strategy to bring energy related technologies out of the Florida University System is well underway. Activities this year included identifying the current status of credit and non-credit energy related courses within the State College System. In addition, online curriculum related to Alternative Energy Systems has been developed. FLATE has the college contacts and process in place to respond to any FESC and/or regional economic development authority request to provide assistance to a designated State College because of a technician workforce development need as identified or triggered by a new or expanding energy related company's operations in the State.

Since October 1, 2010 FLATE achieved several milestones. It completed the online curriculum of an introductory (overview) course in Alternative Energy Systems. Eighteen modules in the form of presentation slides are now available to the state colleges (and others) online at www.flate.pbwiki.com at the energy link. The modules have been reviewed by subject matter experts before posting for level and content. The detailed list includes energy storage, biofuels and bioenergy, wind energy, solar energy, geothermal, energy policy and regulations, etc.
In December 2010, FLATE surveyed the 28 state and community colleges to determine their offerings in three categories: (1) non credit courses and training programs; (2) academic programs; and (3) individual courses that had as a major component any type of energy science, technology or applications. 50% of the State and community colleges responded to all 3 parts of the survey. This survey information and links were used to update information about energy program offerings in the state on the FESC website. The data revealed that all of the 14 colleges that responded offered some energy curriculum and that offerings varied across the state depending on local industry needs. Several are offering non-credit curriculum developed by the Banner Center for Clean Energy. This survey will be revised and administered again in early 2012.

FLATE and its partners made several presentations during the past 12 months. Project Manager, Jorge Monreal, presented a poster entitled "Building the Technician Workforce for Florida's Energy Future" at the Green Energy Summit in Milwaukee, WI, where he also gathered information about community college

programs focused on industrial energy efficiency. Dr. Marilyn Barger gave a 30 minute presentation "Developing an Alternative Energy Credit Certificate for Florida" at the IREC 2011 Clean Energy Workforce Education Conference in Saratoga Springs, NY (March 2011).

Additionally, FLATE presented a poster at the annual FESC Summit, September 27-28, 2011 at the University of Florida, Gainesville. Finally, FLATE regularly updates / presents information about energy curriculum and training issues at the statewide Florida Engineering Technology Forum that meets twice per year at various colleges across the state. Many of these schools are looking to add "energy" curriculum and/or programs and are requesting guidance on what industry is asking for across the state and what and how other colleges are implementing credit programs. The goal of these activities is to keep colleges working together and sharing curriculum rather than develop independent programs not properly aligned to statewide frameworks. The ET Forum group and FLATE also undertook efforts to work with the state common course numbering system to identify a prefix for energy technology courses. The new prefix will be effective in the 2012 academic year and will be called ETP (Engineering Technology – Power).

On Monday Sept 26, 2011 FLATE and FESC sponsored an energy workshop for high school and college educators at the Center for Innovation and Economic Development at Santa Fe College in Gainesville, FL. Over 45 participants heard presentations from the new Department of Economic Opportunity (DEO) about newly released Green Job Report; heard updates from the Florida Department of Education (FLDOE) state supervisor of the Energy Cluster; learned about the new high school energy programs from the Florida Energy workforce Consortium (FEWC); and shared new information from FLATE and the Banner Centers for Energy, Clean Energy and Construction as well as the colleges. A hands-on workshop in the afternoon demonstrating hand held tools for defining energy losses in buildings completed the day. 13 of the educator attendees took advantage of the support offered by FLATE to attend the Florida Energy System Consortium (FESC) Third Annual Summit at the University of Florida on the following 2 days (September 27028, 2011). Reviews of the event are still being tabulated, but the very positive verbal responses from the participants made it clear that there was a need and desire to have future events for this industry sector. Additionally, the participants were addressed by special guest, Henry Kelly, Acting Assistant Secretary & Principal Deputy Assistant Secretary, Office of Energy Efficiency & Renewable Energy who gave an overview of the newest resource for education and training: Department of Energy's National Training and Education Resource (NTER). All materials from the Workshop are now posted on the FLATE FESC page (www.fl-ate.org/projects/fesc).

Activities for the 2010-2011 year are listed below.

- Participated as Advisory Council Member for the Banner Center for Energy's Focus Group meeting to assess future educational needs from industry within the Indian River State College area. (Orlando, FL)
- Attended presentation from the Sustainability Education & Economic Development (SEED) on application of Nanotechnology to Solar Cells. (Brandon, FL)
- Reviewed proposed course curriculum and frameworks in the Florida Energy Workforce Consortium (FEWC) quarterly meeting. (Orlando, FL)
- Jointly with Brevard CC, Tallahassee CC, FSCJ and University of Florida's Industrial Assessment Center discussed possibilities of establishing new educational programs at the three colleges that would prepare a new workforce in commercial building and residential energy efficiency. (Gainesville, FL)
- Focus group participant for the Second Annual Gathering of Tampa Bay Sustainability Educators for idea generation and implementation plans to improve sustainability efforts in the Tampa Bay area. (Tampa, FL)
- Initiated discussions with Hillsborough CC on partnership arrangements with other Florida colleges for participation in an exchange course with Denmark for Sustainability Studies where see towns that utilize distributed power generation facilities such as CHP plant with trash as fuel source. Obtained partnership with SCF in Sarasota. (Tampa, FL)
- Completed and distributed a survey to all State/Community colleges throughout Florida to assess the state's current educational offerings in alternative/sustainable energy.

- Worked with HCC's Sustainability Council towards its goal of reducing greenhouse gas (GHG) emissions on a yearly basis. Energy audits are to be conducted by TRANE across all campus locations as well as implementation of GHG emission mitigation projects.
- Began planning phase on a professional development summer energy workshop for middle school/high school teachers.
- Discussed with a local development company, HCC leadership, and District's House Representative, Rachel Burgin, future development of a CHP site in the Valrico, FL area and the possibility of using a portion of the site as a training facility for hands-on alternative energy education.
- Presented a poster entitled "Building the Technician Workforce for Florida's Energy Future" at the Green Energy Summit in Milwaukee, WI.
- Presented "Developing an Alternative Energy Credit Certificate for Florida" at the IREC 2011 Clean Energy Workforce Education Conference in Saratoga Springs, NY.
- Compiled data from 14 State/Community colleges that replied to the survey of alternative/renewable energy courses offered in Florida. Following up with non-respondents.
- Completed upload onto FLATE's Wiki of course curriculum EST1830 Introduction to Alternative and Renewable Energy made up of 16 individual instructional "modules". Course content is made freely available to self-learners, students and educators. Material is available here: http://flate.pbworks.com/w/page/35326400/EST1830-Introduction-to-Alternative-Energy-Course-Content
- Attended FSEC Teacher Energy workshop to network with K-12 teachers and FSEC.
- Offered summer program for middle school students on energy for underrepresented students in conjunction with the EST2 grant partners (BCC, TCC and FSCJ). A total of 50 students participated across the state in 3 4-day events.
- Began collaborations with UF's Industrial Assessment Center (IAC) for refining the college curriculum. Dr. Tim Middlekoop has become an active participant in the work to write competencies required and possibly offering "field experience" on his various site visits, or helping to define what these could look like in an educational environment.
- Developed several flyers and brochures for FLATE - FESC
- Developed a model to crosswalk the Department of Labor's occupation codes with the military occupation codes to help returning veterans find jobs in related energy fields. A prototype aligning DOL's Electronics Engineering Technician has be cross walked with several MOS codes. Final review is being conducted. Next steps will be defined when this prototype is completed in Dec 2011.

Funds leveraged/new partnerships created: FLATE has leveraged its NSF and FESC resources to help Brevard Community College to apply for and be awarded a very competitive NSF grant, $ 500,000, implement two energy related specialization within the A.S. Engineering Technology Degree. In addition, FLATE was able to secure a $ 100,000 award from NSF to develop a faculty/student interchange that will allow Florida to benefit from the well advanced energy related technology educations practices at technology colleges in Spain.

FLATE External Collaborators: Brevard Community College; Tallahassee Community College; Daytona State College; Central Florida Community College; Polk State College; Florida State College at Jacksonville; Valencia Community College; School District Hillsborough County; Florida Department of Education – Division of Adult and Career Education; West Side Technical School; WFI Banner Center for Energy; Advanced Technology for Energy and Environment Center (ATEEC); University of West Florida, Dept. of Construction Technology; WFI Banner Center for Construction; WFI Banner Center for Clean Energy; USF College of Engineering; Madison Area Technical College ATE project for Alternative Energy certifications; Milwaukee Area Technical College Energy Conservation and Advanced Manufacturing Center (ECAM); Florida Energy Workforce Consortium (FEWC); TECO; Progress Energy; ISTEC (Ibero Science and Technology Education Consortium), Center for Energy workforce Consortium (CEWD); UF Industrial Assessment Center, CREATE NSF Center for Alternative Energy; EST2 NSF ATE Grant project;

DOE's Office of Energy Efficiency & Renewable Energy; Gulf Coast State College; Palm Beach State College; University of South Florida's College of Engineering.

Southeast Solar Provider of Instructor Training Network by Florida Solar Energy Center of the University of Central Florida (US DOE funded program)

This project creates a southeastern region solar training network for the purpose of addressing critical needs for high-quality, local, and accessible training in solar system design, installation, sales and inspection. The southeastern region training network is a five-year effort intended to create a geographic network that will offer training programs in solar installations across the southeastern region of the U. S. The project objectives are to accelerate market adoption of solar technologies by ensuring that high-quality installations are standard and to create sustainable jobs within the solar installation industry.
The Florida Solar Energy Center (FSEC) is the operator of the Southeast Solar Provider of Instructor Training Network (SSPITN) and provides the train-the-trainer programs for the nine-member state and territory region. The training network provides the capacity to train educational instructors in photovoltaics (PV) and solar water heating and cooling (SWHC) from institutions designated by the energy offices in the nine partner states and territories. The trained faculty then conducts training in PV and SWHC at their educational institutions.

The SSPITN first established partnerships with the energy offices in the seven states and two territories. From these state and territory partnerships, faculty members from educational institutions were recommended for training. These faculty members then had their credentials reviewed by FSEC before final acceptance into the training program. The selected individuals were then trained in photovoltaics and/or solar water heating and cooling using train-the-trainer programs offered at FSEC. After training, the instructors returned to their educational institutions for the purpose of offering similar courses or programs. To track the trained faculty, a post training survey was developed and conducted.
The SSPITN also developed curriculum, needed laboratory equipment, a SSPITN web site, a newsletter and coordinated its program efforts with its educational and state partners, the solar industry, associations, workforce boards, other regional training providers, the program national administrator and DOE.
The SSPITN program has developed an instructional model for its training network that focuses on both content and delivery. By employing nationally recognized experts in solar technologies and instructional methods, the SSPITN has prepared instructors from throughout its region to deliver high quality training in their respective states and territories. The training received by the faculty/instructors involves classroom time as well as demonstration and hands-on learning. The primary training objective was to have the trained faculty/instructors offer PV and solar programs to their students, thus, creating a workforce pool for local solar contractors.

During the first phase, the SSPITN "Train the Trainer" (TTT) program has educated 108 individual faculty members from 49 different southeastern institutions in PV and SWHC technologies. Twenty-five of the institutions have committed to offering PV and SWHC training in the near term, while the remainder is in the process of developing courses. Using data collected from the trained individuals, the 25 institutions are estimated to offer PV and SWHC training to over 2100 students within the next year. With 25 institutions offering a program in the near term, the lasting impact of TTT programs appears to be excellent.
With regard to the training programs, the instructors that have taken the TTT courses are prepared to teach anything from a general education course for post-secondary and adult education, to a college course in engineering. The instructional materials are varied and cover technical topics as well as institutional and policy issues. What course is ultimately offered by the trainer will be monitored by the SSPITN during its assessment activities. As for the installer training component of the SSPITN, the curriculum for both the PV and SWHC courses have been aligned with the NABCEP task analyses. The instructional material given to each of the trainers will allow them to begin offering a similar program in one to three months at their respective institutions.

OUTREACH

FESC outreach program leverage the existing network of UF extension offices to reach out to each of our communities. The Florida Cooperative Extension Service has experience developing and delivering educational programs and products related to energy and resource-efficient community development with emphasis on housing. These programs and products include targeted continuing education courses for licensed builders, architects, engineers, landscape architects, interior designers, and others. Also, the UF Program for Resource Efficient Communities is an interdisciplinary group that promotes the adoption of best design, construction, and management practices in new residential master planned developments.

The goal of the program is to develop educational outreach programs and materials designed to deliver practical, applicable information and knowledge on energy-related topics to the general public as well as targeted to specific audiences such as builders, planners, engineers, architects, small businesses, local governments, and utilities through the Cooperative Extension Service and others. By focusing educational programming on climate and efficient use of energy and water, the program aims to provide the knowledge needed by building and energy professionals, local governments, and the general public, to significantly reduce greenhouse gas emissions in Florida.

Outreach Team Members:

- *Dr. Pierce Jones, Director, Program for Resource Efficient Communities (PREC)*
- *Dr. Kathleen C. Ruppert*
- *Hal S. Knowles III*
- *Nicholas Taylor*
- *Dr. Barbra Larson*
- *Craig Miller*

Detailed report in this area can be found in the "Project Progress Reports" which is provided as an attachment to this report. A summary of the progress made is given below:

Energy/Climate Awareness Fact Sheets:

Completed twelve fact sheets for the FESC website with four more currently in various stages of development. Additional topics have been determined. Updated the publication to address developments in the PACE financing markets with new version published in October 2010 titled *Options for Clean Energy Financing Programs: Scalable Solutions for Florida's Local Governments*.

Energy Extension Service:

Thirty-one professional presentations were conducted during the year at the national, state and local levels.

UF/PREC continued to be involved with the Climate Variability and Change Focus Team, specifically with the Local Government Working Action Group, providing participating Extension Agents with information on FESC-related activities. Also participating on the Sustainable Housing and Home Environment Focus Team along with actively working with the new UF Housing Specialist, who recently assisted us in updating two energy-related factsheets intended for homeowners.

The book *Energy Efficient Building Construction in Florida* continues to be sold to contractors studying for the Construction Industry Licensing Board's certification exam. Over 4,600 books have been sold in the past two years. With the change in the exam to meet the state's updated building code scheduled to go into effect with the April 2012 exam, the book is currently under revision.

PREC partnered on a services agreement with Alachua County Environmental Protection Department to develop a draft *Low Impact Development Design Manual* for use in the county's land development review process. The target audience for the draft manual is developers and design engineers, and the county intends to expand content to include a guidance manual for builders and homeowners. A workshop to engage local stakeholders, the Florida Department of Environmental Protection, St. Johns River Water Management District, and Suwannee River Water Management District was held on June 23, 2011. The final draft manual (Produced a manual: *Low Impact Development (LID) Design Manual for Alachua County, Florida*) and feedback report were provided to Alachua County on September 30, 2011.

Energy and Carbon Costs of Water Supply: A Tampa Bay Water Case Study**.** This research and outreach project investigates the energy, monetary, and carbon (i.e., greenhouse gas) costs associated with water supply from Tampa Bay Water's system by evaluating facilities-level data from Tampa Bay Water, merging those data with power plant emissions data from U.S. EPA's eGRID and measuring costs associated with groundwater, surface water, and desalinated supply. Data from water years 2006-2009 have been analyzed, and since February 2010, results have been presented at 20 events. Through outreach activities, results have been shared with over 300 professionals, many of whom deal directly with natural resource (water, energy and land use) management issues in Florida and nationally.

Also a result of this FESC-funded project, Jennison was invited to participate as a representative of the University of Florida in a national workshop to develop a joint Blueprint for Energy and Water Efficiency. This workshop was sponsored by the Turner Foundation and convened by the Alliance for Water Efficiency and American Council for an Energy Efficient Economy in December 2010. The results of this workshop were published in May 2011 in a report titled "Addressing the Energy-Water Nexus: A Blueprint for Action and Policy Agenda", accessible at http://www.aceee.org/white-paper/addressing-the-energy-water-nexus.

Organized and delivered two Emerging Energy Issues and Topics In-Service Trainings. The first, conducted in May of 2011, emphasized energy consumption and energy production in residential settings. The second, held in September 2011, emphasized social and technological issues related to energy efficiency based on current research. Combined, these trainings reached County Extension faculty in 18 Florida counties and included both classroom and hands-on instruction that can be utilized back in their home counties.

Worked with Florida 4-H on the *S.A.V.E.: Steps in Achieving Viable Energy* youth education outreach program and materials intended for middle-school aged youth. Florida 4-H previewed the curriculum at the FESC 2010 Summit in Orlando. The curriculum is designed for students in middle school and high school and also for 11-13 year-olds in afterschool programs or clubs. The program focuses on 4 areas of energy awareness: forms, sources, users and impacts. The afterschool and club program consists of 30 activities and can be used over a 3 year period.

A website is also a part of the project to support the materials (http://florida4h.org/projects/SAVE.shtml) The Pasco County School System is contemplating adopting the curriculum for 5th graders as the materials closely align with the new Florida Next Generation Education Standards.

Co-developed the *Sustainable Floridians* pilot course with Kathryn Ziewitz and Wes MacLeon, UF Department of Family, Youth, and Community Sciences and Extension faculty in Leon, Manatee, Marion, Osceola, Pinellas, Sarasota, and Wakulla counties.

The course consists of the following elements: Information to provide a foundation in understanding key sustainability issues, with a geographic concentration on Florida. This information will be shared through multi-media informational presentations delivered by course leaders and readings and other supplemental materials that provide informative and stimulating material.

- **Group discussions** in which participants talk about the readings and share experiences in implementing sustainability actions.
- **Activities** designed to help the participants take practical steps toward greater personal sustainability, including reducing energy and water consumption, and personal miles of travel. Participants will receive a data log to record and track their monthly usage of energy and water and the number of miles driven. During this course and after, they will be contacted at several intervals to collect data.

The course was piloted in Leon (twice), Marion (twice), and Pinellas (twice) counties to date with additional county participation planned in Osceola and Sarasota counties.

The Energy Efficient Home Series – (3 hours) – equips homeowners with the knowledge of building energy and water uses and efficiency strategies that can be applied to their homes. A series of factsheets (18) addressing topical residential energy efficiency issues as well as a complete homeowner handbook (~100 pages) is provided. Osceola County Extension offers a 3-hour *Saving Money on Your Electric Bill* class where participants learn no cost, low cost and some cost actions to save money every month on their electric bill at home. The also learn about the Osceola Energy Initiative (OEI) www.osceola.org/go/energy and other incentives to lower costs of energy saving options.

Continued collaboration with Extension's Home Energy Community of Practice following Barbra Larson's assisting with developing/editing materials for the website at Montana State University's Weatherization Training Center in July. This group brings together Cooperative Extension, research, and other professionals to develop, enhance, and maintain a national online presence on energy, sustainability, and housing. As a follow-up she will be attending the Housing Education and Research Association's Annual Conference in Baton Rouge, LA, in October of 2011.

Demand Side Management: In addition to other activities, with the assistance of a ~$450,000 grant, working with all of Florida's utilities and weatherization retrofit providers to evaluate the performance of weatherized homes pre- and post-retrofit.

Continuing Education: Offered and taught: Greenhouse Gas Reduction and Energy Conservation I: Comprehensive Planning Under Florida's HB 697; Energy Efficient Building Construction in Florida; Remodel Green & Profit; Residential Green Advantage®; and via webinar, Community Planning: Challenges and Opportunities for Local Government in Florida CEU classes.

Workforce Development: Collaborated with the Employ Banner Center for Construction and the Florida Solar Energy Center, using a grant from the U.S. Department of Energy, to develop curriculum and establish statewide access to weatherization training. In addition, offered the following:
Residential Green Advantage® – (8 hours) Provides an overview of key building features that effect building performance. An overview of appropriate provisions found in the *Florida Building Code* is

included. The course addresses the Building as a System and examines building failures due to outdoor and indoor environments through both building design and building construction techniques. An overview of green building certification programs is included, but not limited to, USGBC - LEED for Homes, NAHBA Green Building Standards, DOE/EPA Energy Star and FGBC - Green Homes Standard.

Description of training curricula and the method of delivery for the following courses currently under development:
General WAP Procedure and Building Science Fundamentals; Green Remodeling Certification; and Remodeling Health and Safety Certification
The *General WAP Procedure and Building Science Fundamentals* training will reinforce the DOE Standardized weatherization training curricula: Introduction to Weatherization, Communication Skills, Building Science, and Mobile Home and Multi-Family Basics. A review of the State of Florida Weatherization Assistance Program Procedures and Guidelines will be included. Selected FSEC and UF/PREC building science training materials that address hot-humid building practice will be introduced.

The *Green Remodeling Certification* will be built around the DOE Standardized weatherization training curricula: Blower Door Basics, Pressure and Thermal Boundaries, Materials, Tools & Equipment and Typical Weatherization Measures. The training will review the Florida Weatherization Handbook: Materials, Installation and Workmanship Standards and the Southeastern Field Guide. Energy and Water efficiency will be reinforced using existing UF/PREC and FSEC training materials. The training will combine classroom lecture, hands-on exercises, demonstrations and case studies. The Green Remodeling Certification will be achieved by completing the General WAP Procedure and Building Science Fundamentals training and successfully completing (passing) a Green Remodeling core competency exam.

Remodeling Health and Safety Certification will be built around the Combustion and Worker Safety DOE Standardized curricula topical areas. The certification will reinforce EPA Lead Safe work practices and relevant OSHA Safety Guidelines. The interaction of the building systems and Indoor Environmental Quality will also be included utilizing existing NIOSH, EPA and UF/PREC teaching materials. The training will combine classroom lecture and hands-on demonstrations, inspections and case studies. Remodeling Health and Safety Certification will be achieved by completing the General WAP Procedure and Building Science Fundamentals training and successfully completing (passing) a Remodeling Health and Safety core competency exam.

Each module will be developed using a combination of UF/PREC, the Banner Center for Construction and FSEC content specialists and each module will include a PowerPoint presentation; participant guide and facilitator training guide at a minimum. Information will be provided in the participant guide to directly supplement materials presented in the PowerPoint presentation. In addition, links to more detailed information will be provided. All programs will include a core competency exam that participants must pass to receive a certificate.

UF/PREC is also partnering with the University of Nebraska (Lincoln) to develop a training curriculum for electrical contractors. The Advanced Building Analyst Training Program for Electrical Contractors will focus on commercial building efficiencies from retrofitting lighting and plug loads. Once developed, the training will be delivered in a 3-day format and will consist of approximately 20 contact hours, which may, in whole or in part, be credited toward continuing education units (CEUs) required for licensure in Nebraska and Florida. UF/PREC is currently developing the curriculum materials, including an Instructor's Manual of presentation materials (e.g. PowerPoint slides) and a comprehensive student workbook/resource guide for each module. Modules will include a list of objectives, skills, requirements (e.g. instructional spaces, equipment, PPE, etc.) and a table of contents. Each module will consist of 'hands-on' demonstrations, exercises and/or activities, delivered through a series of case studies.

Alternatively Fueled Vehicles: Working with Progress Energy to evaluate performance of PHEV using converted Toyota Prius equipped with GPS tracking system and software to monitor performance. A FESC publication on AFVs is planned.

Collaboration on New Initiatives: Copyright applied for and received for "Quantifying Household Energy Performance Using Annual Community Baselines Annual Community Baselines" (2011).

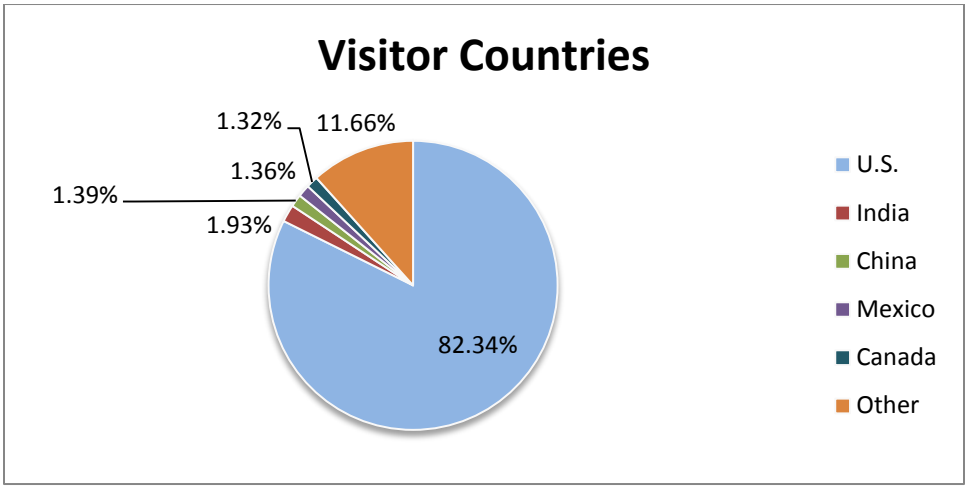
External Collaborators:
Tampa Bay Water, UF/IFAS County Extension Offices, American Water Works Association, River Network, Alliance for Water Efficiency, Florida Section of the American Water Works Association, American Council for an Energy Efficient Economy (ACEEE), St. Johns River Water Management District, Southwest Regional Planning Council, Florida International University, Florida State University, University of South Florida, University of Central Florida, Florida A&M University, Florida Atlantic University, Gainesville Regional Utilities, Clay Electric, Progress Energy, Canin Associates, Inc., Orlando Utilities Commission, City of Tallahassee, etc.

FESC Web Site (www.FloridaEnergy.ufl.edu)
The FESC website continues to be an important communication tool for our program. It is updated regularly to remain current and to better serve our users. Based on a Google Analytics report, the FESC web site was viewed by 19,794 Google visitors during the period of September 30, 2010-October 1, 2011. The viewers visited 53,471pages. Viewers were from a total of 135 countries, including those in North and South America, Europe, Asia, Australia, and Africa. The data compiled from Google Analytics are given below:

Activity overview of the FESC's website from September 30, 2010-October 1, 2011.

Activity	9/30/2010-10/1/2011
Total Visitors	19,794
Unique Visitors	13,830
New Visitors	13,435
Returning Visitors	6,359
Page Views	53,471
Average Page Per Visit	2.70

The chart below illustrates the countries from which the website visitors are from.



The final chart displays the website traffic sources.