Florida Energy Systems Consortium
Annual Report
To the
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
Florida Office of Energy
Pursuant to
Florida Statute 1004.648

Reporting Period: October 1, 2011 – September 30, 2012

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EXECUTIVE SUMMARY

Overview: The Florida Energy Systems Consortium continues to leverage State funding in energy research, technology transfer, education, and outreach activities. The FESC office facilitates submission of competitive proposals in a variety of ways beyond solicitation awareness, including identifying leaders and building teams, communicating with industry partners, national labs and other non-SUS universities, providing professional technical writing help, and assisting with cost share development, budgets, and boiler plates. The SUS energy faculty submitted 259 proposals requesting $334,176,368 during the twelve-month period October 1, 2011 thru September 30, 2012. The SUS energy faculty received 274 research and education energy-related awards totaling $64,473,021.[1] Significant examples include:

- A UF-led team received an award to form a Joint Clean Energy Research and Development Center (JCERDC) in biomass energy. This 5 year $125M project is aimed at reducing energy consumption, cutting dependence on petroleum products and increasing use of renewable fuels. (http://news.ifas.ufl.edu/2012/04/20/uf-led-research-team-selected-for-125-million-joint-u-s-india-energy-project/)
- The U.S. Department of Energy (DOE) has funded the nation's only university-based Photovoltaic (PV) Regional Test Center (RTC) at the University of Central Florida, which received FESC funding for test equipment.
- The NSF funded a Sustainable Energy Pathways (SEP) proposal to perform fundamental research on earth abundant thin materials. A $1.9M award for 4 years was made for the UF led program.
- South Florida State College received a NSF grant in bioenergy education.

FESC technology transfer program includes business plan/market research development (Phase I) and industry matched funding of early stage development (Phase II). During this reporting period, **twenty-five (25) technologies were licensed to industry** and $81,913 licensing revenue was collected. **Twenty (20) companies have been formed over the last three years** based on university developed technologies. The company list with the area of technology is given at the "Business Start-Ups" section of this report (Appendix B). FESC is one of the partners of the FL CAN grant funded by the Economic Development Administration ($1.3M for 2 years). FL CAN 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 research into new technology companies or to license into existing firms.

FESC university experts in each thrust area worked to update the *Strategic Plan for Renewable Energy in Florida*. The updated document will be submitted to the Commissioner Putnam, members of the Energy Office, and Dr. Mary Bane, among others when it is completed

FESC continues to contribute to energy education and outreach programs. Notably, the FESC summit was combined with the Florida Energy Summit this year. The Consortium has generated **over 50 Fact sheets aimed to help the citizens of Florida** better understand how they might better conserve and increase their energy efficiency. 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 17,713 Google visitors** (75% new visitors) during the

[1] The proposal and award data were collected through databases at each university, published news releases, and faculty input. Note a specific proposal may be submitted in one FESC caledar year and funded in a later year. 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.

period of September 30, 2011-October 1, 2012. The viewers visited 45,739 pages. Viewers were from a total of 134 countries, including those in North and South America, Europe, Asia, Australia, and Africa.

Research Highlights: The majority of the initial FESC funding was dedicated to seeding energy research at five of the FESC universities. Most of the FESC research funds were spent and ~80% of the projects have been completed. Detailed final reports for all completed projects and progress reports for continuing projects are compiled in a separate document ("Project Progress Reports") and provided as an attachment to this report. 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/.

During this reporting period, FESC distributed and posted over 100 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. Several examples are listed in the "New Program Development" section of this report. Importantly the **FESC office as well as its faculty has reached out to more than 150 industry partners for collaborative proposals.** Some examples of this are given in the Industrial Collaboration section of this report (p. 25).

A key team formation effort occurred in response to the DOE Energy Storage Innovation HUB call for $120M funding. FESC formed a core planning team in 2010 in anticipation of this funding opportunity. The core team members communicated with potential partners during this pre-proposal time and the team was finalized formed prior to the call for proposals issued in May 2012. The participating institutions include the FESC Universities, Cal Tech, Case Western Reserve, Illinois Inst. Tech., Northeastern U., Notre Dame, Missouri U. of Sci. and Tech., UC Santa Barbara, University of Kansas, University of South Carolina, Univ. Southern California, Vanderbilt, Washington Univ., NREL and SEMATECH. The proposal team was invited to Washington DC for reverse site visit and waiting US DOE's decision. It is noteworthy that **FESC has led and submitted a proposal for all four HUB proposal solicitations**, representing a major effort.

Technology Commercialization and Industrial Collaboration: The results of FESC funded research generated both additional external funded research as well as innovations leading to commercialization. FESC technology transfer program includes business plan/market research development (Phase I) and industry matched funding of early stage development (Phase II). Progress and accomplishments are given in the "Industrial Collaboration and Technology Commercialization" section of this report (p. 23). To date FESC has funded 5 Phase II projects of which three are complete. The completed projects are the UCF-Harris Corp. joint wave energy project, UF-nRadiance LLC joint fuel cell project, and FSU-Hunter Hunter Harp Holdings joint solar concentrator project. The two active Phase II projects are Li-Ion battery (Dr. Kevin Jones, UF) in partnership with Planar Energy Devices, and Polymer Solar Cells (Dr. Franky So, UF) with Sestar Technologies. The project reports are provided in the "FESC Phase II Project Reports" section of this report.


50-foot balloon Solar Concentrator

As an example, the FESC Phase I Project entitled as "Milling Technology Leads the Way to Cost Effective Ethanol Production" (PI: Dr. Blair at UCF) was licensed by Thor Energy. This technology embodies a novel milling technology for cellulosic ethanol production. In addition, 24 technologies were licensed to industry and the $81,913 licensing revenue was collected during this reporting period. New companies are being formed by using the university developed technologies. **Twenty (20) companies have been formed over the last three years**. The company list along with the technology area is provided at the "Business Start-Ups" section of this report (Appendix B).

FESC is one of the partners of the FL CAN grant funded by the Economic Development Administration ($1.3M for 2 years). FL CAN 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 into new technology companies or to license into existing firms. FESC is uniquely positioned to identify clean technology research with high commercial potential and to facilitate relationships between Florida universities, entrepreneurs and licensees. FESC administration office cataloged all energy and clean technology-related intellectual property developed at Florida universities and NASA Kennedy Space center. The IP catalog lists over 370 IP opportunities in the energy and cleantech areas (Appendix D). FESC works with the Technology Transfer directors at each University, FL CAN Market Research team, and the mentor networks to assist with technology commercialization. To facilitate the accessibility of a network of university laboratories that are dedicated to energy and clean technology development, FESC administration office developed a catalog of user and lab facilities within the Florida University System, FIT, and NASA Kennedy Space Center. The Lab Catalog provides 52 FESC university user facilities and it is given in Appendix E. Entrepreneurs, students, scientists and established companies interested in developing commercial products based on Florida-based research have access to these user facilities.

Perhaps equally important, the Consortium has established close connections with Florida's energy industry. In particular, we facilitate interactions between our industry and the FESC faculty and their resources. This often results in the submission of proposals for research interactions. FESC is currently in communication with over 150 companies to provide technical assistance. We also work closely with technology transfer and economic development offices in Florida to attract industry to our state.

PV Regional Test Center: As a result of FESC funding for PV testing and facilities, the US DOE has funded the nation's only university-based Photovoltaic (PV) Regional Test Center (RTC) at the UCF Florida Solar Energy Center (FSEC). The UCF RTC will provide validation testing for large-scale photovoltaic systems and will help banks, insurance companies, and other stakeholders establish the confidence that new PV technologies perform reliably in the field. The UCF site was selected as the Hot-Humid Climate regional test center and will accommodate up to four megawatts of power production. The DOE will award approximately $2.3M for construction of the RTC and the purchase of test equipment. The detailed information is given under the "New Program Development" section of this report.

Florida PV Manufacturing Consortium (PVMC): The U.S. Photovoltaic Manufacturing Consortium is an industry-led consortium for cooperative R&D among industry, university, and government partners to accelerate the development, commercialization, and manufacturing of solar photovoltaic (PV) systems in the U.S. The PVMC's main mission is to accelerate the transition of new technologies into mainstream manufacturing. Consortium activities include collaborative research projects, standards development, technology road mapping, and fostering increased connectivity amongst U.S. manufacturers. The PVMC is based at FSEC to develop c-Si technology. Detailed description is given in the "Industrial Collaboration" section of this report. Additional information can also be found at www.uspvmc.org.

Exploring Florida's Ocean Energy Resource: A 2007 Request for Information published announced that the U.S. Department of Interior's Bureau of Ocean Energy Management (BOEM) would issue limited leases authorizing renewable energy resource assessment, data collection, and technology testing activities on the Outer Continental Shelf (OCS), and that it was accepting nominations for limited leases to conduct these activities. Florida Atlantic University submitted a notice of intent for limited lease blocks off the coast of Florida, east of its SeaTech facility at Dania Beach. In July 2010, the US DOE designated FAU as the Southeast National Marine Renewable Energy Center (SNMREC) as one of three such centers in the nation. In December 2010, SNMREC submitted a lease application to BOEM for three lease blocks under the Interim Policy. BOEM is conducting the Environmental Assessment (EA) which is a

precursor to granting a lease. A draft EA was released for public comment, and BOEM is currently engaged in finalizing the EA, with an anticipated completion date of December 2012. It is anticipated that based on a final assessment by BOEM and the State of Florida that a lease will be granted to FAU and SNMREC in early 2013.

To date the SNMREC has leveraged state funding in the amount of $4,083,635 for federal and industry funding, and has submitted a scope of work for up to $1.25M additional FY2012 federal funding under the current DOE contract. The SNMREC will provide a centralized, standardized testing capability for ocean current energy conversion prototypes; initially, scaled versions and eventually full-scale devices will be tested. Testing is ongoing for the experimental prototype turbine components and subsystems. Discussions are ongoing with over forty companies to determine testing/validation requirements for open-ocean testing of their proposed experimental devices at the SNMREC's test facility. Further, critical environmental measurements will be obtained from the observational platform. Additional test berths will need to be installed as commercial devices progress through development gates (including grid-connection and moored stand-alone systems in the 1:4 and 1:1 scale). Technology R&D, specifically in areas related to intelligent monitoring and environmental assessment will continue as Marine Hydrokinetic (MHK) commercial devices are developed to ensure safety and reduce risk. A future permanent ocean observing system co-located with offshore test facilities will provide real-time environmental measurements, resource characterization, and device performance data. The environmental measurements and assessments, in conjunction with device deployments, will allow for the investigation of interaction with installed MHK systems after baseline ecological activity information is gathered. Education and outreach programs will continue to be fostered in all levels of curricula to populate the growing economic sector, and a publicly available and useful data clearinghouse will provide related and integrated data specifically for MHK and Ocean Thermal Energy Conversion development.

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. To date 209 professional presentations were conducted during the year at the national, state and local levels. Over 50 Fact Sheets have been developed for the extension service officers to use as they interface with the public and posted at FESC web site at http://www.floridaenergy.ufl.edu/?page_id=273. FESC outreach team members accepted State Coordinator role for the Sustainable Floridians^{SM} program (Dean for Extension and UF's Office of Sustainability contributing ~$70,000 to the effort) with the responsibility to assist county faculty in their training and inspiring of consumers and/or volunteers regarding the significance of sustainability; the value of lifestyle choices and their impact on the environment; and the challenge to share the responsibility for protecting Earth's limited resources. Other areas that show promise for the future include the metered energy consumption data analysis contracts with utilities; the Osceola Energy Initiative (OEI) retrofit loan program; and resource efficient communities work with Plum Creek and the Gilchrist Club. FESC's contribution to energy education and outreach programs is outlined in the Education & Outreach section of the report.

FESC Website: 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 17,713 Google visitors (75% new visitors) during the period of September 30, 2011-October 1, 2012. The viewers visited 45,739 pages. Viewers were

from a total of 134 countries, including those in North and South America, Europe, Asia, Australia, and Africa.

Florida Advanced Technological Education (FLATE): 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. FLATE has the college contacts and processes in place to respond to any FESC and/or regional economic development authority request to provide assistance to a designated State College. These requests can be focused on the technician workforce development need as identified or triggered by industrial partners, FESC university partners or from expanding energy-related companies' operations in the State.

Since October 1, 2011 FLATE has achieved several milestones. Together with the National Science Foundation-funded Energy Systems Technology Technicians (EST^2) project team, FLATE has been developing a new Industrial Energy Efficiency specialization for the Engineering Technology (ET) Degree and associated College Credit Certificate. Experts from industry, government, and academia have been instrumental in ensuring that the new specialization is directly aligned with current industry needs. The specialization's first draft is now complete and the framework will be submitted to the Florida Department of Education in the late 2012 so colleges can implement it in the 2013-2014 academic year.

In March, a short survey was administered to gather data to ensure the new framework is comprehensive and covers all areas necessary to produce the skilled workforce needed in this area. In addition, it provided an opportunity to identify individuals interested in collaborating to work on the new curriculum framework. Occupations respondents intend to train students for, included Energy Technicians, Environmental Technicians, Sustainability Planners, Smart Grid Technicians, Energy Auditors and any generally all individuals involved in developing and implementing Energy Management Programs for their company. The vast majority of respondents were very interested in collaborating to craft the new curriculum framework.

The Industrial Energy Efficiency specialization track comes at a time when interest in reducing operating costs through energy efficiency maximization is growing significantly both in Florida and throughout the nation. The new specialization is designed to provide the training necessary to teach manufacturing, industrial, and other appropriate technicians, such as HVAC technicians or electricians, to save energy costs on the plant floor. Upon completion of the program students will be armed with the knowledge and skills necessary to implement energy efficiency strategies in industrial processes/systems, and as a result impact the bottom line.

In September 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. Following the success of last year's event, FLATE will be coordinating a second workshop held at the Florida Solar Energy Center in Cocoa in February or March of 2013. Finally, FLATE regularly updates and presents information about energy curricula and training issues at the statewide Florida Engineering Technology Forum that meets twice per year at various colleges across the state.

FESC 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. Our responses to Energy Storage Innovation HUB and the Joint Clean Energy Research and Development Center (JCERDC) in biomass grants are some of the examples of major multi-university, industry partnerships. One of our FESC-funded UF faculty was the PI for the JCERDC grant application and received US DOE award to form a joint US-India consortia. In addition, 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.

Florida Energy Summit: This year, the FESC summit was combined with the Florida Energy Summit that was held at the Rosen Shingle Creek in Orlando, FL on August 15-17, 2012. FESC faculty members presented the latest emerging technologies, which will have an impact on future energy production. In addition, FESC faculty and students presented 40 posters. More information can be found on the Florida Energy Summit website at the link: *http://www.floridaenergy.ufl.edu/?page_id=11053*. FESC universities shared a booth and presented new technologies developed at FESC universities.

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.

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, 2011 – September 30, 2012	
Research Effectiveness (FESC and Associated Research)	
Competitive Contracts and Grants Submitted (SUS energy faculty)[2]	# of Applications: 259 Requested Funding: $334,176,368
Competitive Contracts and Grants Received (SUS energy faculty)	# of Awards: 274 Award Amount: $64,473,021
Publications in Refereed Journals and Other (FESC funded faculty)	Total: 242
Professional Presentations (FESC funded faculty)	Total: 202
Invention Disclosures Submitted and/or Patents Received (SUS)	59
Technologies Licensed and Revenues Received	Energy Agreements: Over 25 Revenues Received: $81,913
Collaboration Effectiveness (FESC and Associated Research)	
Collaborations with Other Postsecondary Institutions (FESC funded faculty)	Total: 35
Collaborations (or Potential Collaborations) with Private Industry (FESC funded faculty)	Total: 120
Students Supported with Consortium Funds (FESC funded faculty)	Total: 336 Undergraduate: 35 Master: 104 PhD: 163 JD Law: 2 Post-docs: 32
Students Graduated (FESC funded faculty)	Total: 39 Undergraduate: 5 Master: 17 PhD: 17
Economic Development Effectiveness (FESC and Associated Research)	
Business Start-Ups in Florida *(During Oct. 1, 2008 to Sep 30, 2012 Period)*	20
Specialized Energy Education Training and Outreach	14

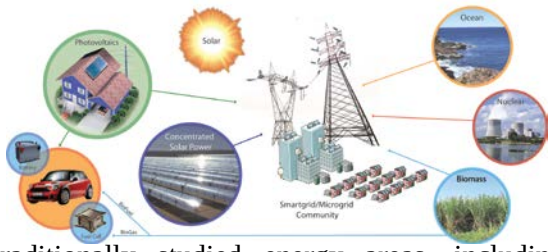
[2] The proposal and award data were collected through databases at each university, published news releases, and faculty input. The database information was reviewed carefully and proposals and awards only related to energy research were included. The SUS energy faculty were identified by each institution 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 area is 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.

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 result in sustainable and economically viable communities.

3- Developing Florida's Biomass Resources

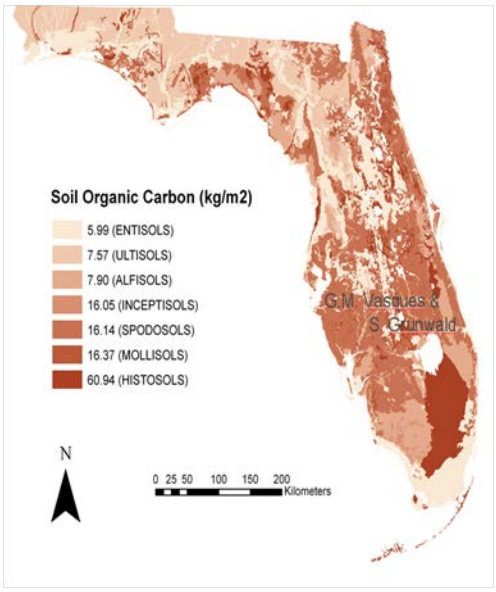
The State of Florida produces more biomass than any other state in the U.S. (~7% of total). Given the state's dependence on imported oil for transportation fuels and the value of transportation to our tourism industry, developing methods to convert this resource to fuels is important. The Consortium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

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.

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.

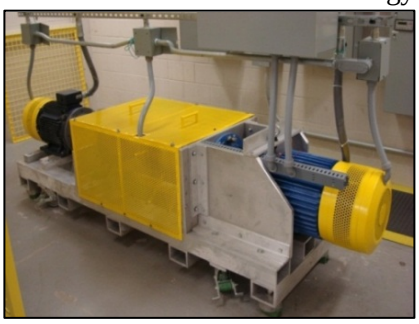


Carbon Capture and Sequestration for Carbon-Constrained Technologies: With the prevalence of fossil fuels in base load power generation, development of clean coal and natural gas power generation with carbon capture and sequestration is critical to the future of the state and nation. Increasing national 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.

6- Exploring Florida's Marine Energy Resources

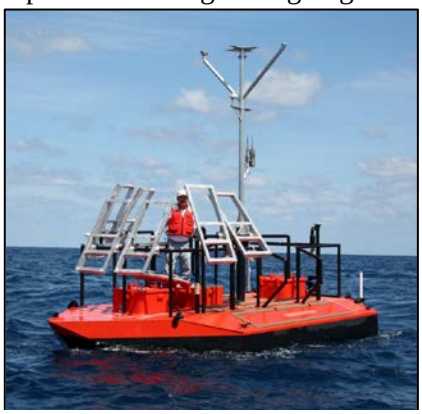
Marine renewable energy (MRE) resources fall into two broad categories: *marine hydrokinetic* (MHK) energy and thermal potential energy that can be tapped using the *ocean thermal energy conversion* (OTEC) process. Off the coast of Florida, the potential of ocean currents is greater than anywhere in the U.S.

Further, recent studies have shown that there is potential for OTEC in Florida as well. The Southeast National Marine Renewable Energy Center (SNMREC) at Florida Atlantic University is focusing on these two areas in investigating the challenge of harnessing the power of the Gulf Stream for the generation of base load electricity. The Center is developing a centralized, standardized testing capability which will provide for testing current energy conversion prototypes; initially, scaled versions and eventually full-scale devices. An MHK lease application on the outer continental shelf (OCS) was submitted to the US Department of Interior, Bureau of Ocean Energy Management (BOEM) in Dec. 2011. This is the first national application submitted which will influence the model for future lease applications. BOEM is funding an Environmental Assessment, a precursor to approving the lease. The Center developed a curriculum for upper-division high-school students to introduce the topic within secondary education.



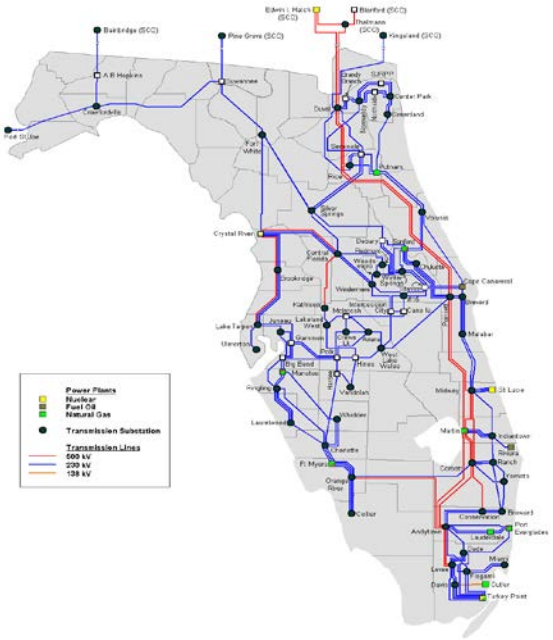
20kW dynamometer for generator testing

The SNMREC is actively engaged in sensor and instrument acquisition, deployment, and analysis to more fully characterize offshore energy resources, and the benthic and pelagic environment. Second, fabrication of a small-scale hydrokinetic turbine system is in the final stages of completion. Testing is ongoing for components, sub-systems, and major systems of the turbine. Discussions are ongoing with over 40 companies to determine testing/validation requirements for open-ocean testing of their proposed experimental devices at the SNMREC's test facility. In addition, critical environmental measurements will be obtained from the observational platform.



Mooring and Telemetry Buoy Sea-trial

Two sea trials were successfully conducted of a mooring and telemetry buoy to ready it for at-sea deployment. In-lab technology testing is underway with a scaled generator dynamometer which provides a platform to test offshore electrical systems before use and simulate offshore grids. Aerial surveys are being conducted to determine offshore turtle and marine mammal distribution and activity prior to install/test of MHK devices. Sub-sea surveys of installation sites are helping to identify deep water coral distribution and determine appropriate anchor areas. Over fifty upper-division graduates and Principle Investigators have been engaged in research in marine renewable energy (MRE) to date.



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.

RESEARCH PROGRAM

The FESC research program included 82 FESC funded projects within the seven strategic thrusts. The project descriptions for all are given in Appendix A. Eight projects from FIU (not funded by FESC) and 1 project from UWF (not funded by FESC) are also included. 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. The majority of these projects have been completed. Table 1 below gives the list of the active ~50 FESC projects as of May 1, 2012. Since then some the projects have been completed. Final report was provided on all the completed projects (separate report) and also posted at FESC web site: http://www.floridaenergy.ufl.edu/?page_id=24

2011 Florida Statutes 377.703 "Additional functions of the Department of Agriculture and Consumer Services" states that the department shall serve as the state clearinghouse for indexing and gathering all information related to energy programs in state universities, in private universities, in federal, state, and local government agencies, and in private industry and shall prepare and distribute such information in any manner necessary to inform and advise the citizens of the state of such programs and activities. This shall include developing and maintaining a current index and profile of all research activities, which shall be identified by energy area and may include a summary of the project, the amount and sources of funding, anticipated completion dates, or, in case of completed research, conclusions, recommendations, and applicability to state government and private sector functions. Per energy office's request, the list of energy related projects within FESC universities were gathered, complied, sorted by energy topic, and posted at the FESC web site under "FL University Research": http://www.floridaenergy.ufl.edu/?page_id=9144.

Table 1: Active FESC Projects as of May 1, 2012
(Only lead university information is given)

Projects	Summary
THRUST 1: Overarching	
	Title: *Power Generation Expansion Portfolio Planning to Satisfy Florida's Growing Electricity Demands* **PI:** Tapas Das, **Co-PI**: Ralph Fehr - USF **Budget:** $71,906 **External Collaborator:** Argonne National Lab
THRUST 2: Enhancing Energy Efficiency and Conservation	
	Title: Energy Efficient Building Technologies and Zero Energy Homes **PI:** R. Vieira, **Co-PIs:** P. Fairey, J. Sonne - UCF/FSEC **Budget:** $1,224,000
	Title: Joint Optimization of Urban Energy-Water Systems in Florida **PI:** James P. Heaney - UF **Budget: $72,000**
	Title: Energy Efficient Technologies and The Zero Energy Home Learning Center **PI:** Stanley Russell, **Co-PIs:** Yogi Goswami **Graduate Assistant**: Mario Rodriguez - USF **Budget:** $344,600 **External Collaborators:** FSU Engineering: Justin Kramer, Brenton Greska; UF Department of Interior Design: Maruja Torres, Nam-Kyu Park; UF Rinker School of Building Construction: Robert Ries; UCF FSEC: Stephanie Thomas Ries; Beck Construction; Hees and Associates Structural Engineers.
	Title: Unifying Home Asset & Operations Ratings: Adaptive Management via Open Data & Participation **PI**: Mark Hostetler, **Co-PI:** Hal S. Knowles, III - UF **Budget**: $24,000 **External Collaborators:** Nick Taylor (Ph.D. Student, UF School of Natural Resources & Environment), Jennison Kipp (Assistant In, UF Program for Resource Efficient Communities)
THRUST 3: Developing Florida's Biomass Resources	
Algae	

	Title: Optimization of Algae Species for Biofuels Production Using Genetic Altration **PI:** Ed Phlips- UF **Budget:** $15,000
High Energy Crops	
	Title: Energy Intensive Crop Development **PI:** Gary Peter , Matias Kirst, Don Rockwood - UF **Budget:** $432,000
	Title: Water-Use Efficiency and Feedstock Composition of Candidate Bioenergy Grasses in Florida **PI:** Lynn E. Sollenberger, **Co-PI's:** John Erickson, Joao Vendramini, Robert Gilbert - UF **Budget:** $191,981 **External Collaborators: :** Speedling, Inc., Nutri-Turf, Inc., British Petroleum (BP), and Southeast Renewable Fuels (SERF)
Biochemical Conversion	
	Title: Development of Biofuel Production Processes From Synthetic and Biomass Wastes **PI:** Pratap Pullammanappallil - UF **Budget:** $192,000 **External Collaborators:** University of Central Florida
	Title: Engineering Biocatalysts for Hemicelluloses Hydrolysis and Fermentation **PI:** James F. Preston - UF **Budget:** $192,000 **External Collaborators**: Collaborations are in various units within the University of Florida: L.O. Ingram and K.T. Shanmugam, Microbiology and Cell Science; F. Altpeter, Agronomy; G. Peter, Forest Resources and Conservation.
Bio gasification	
	Title: Combined Cooling, Heat, Power, and Biofuel from Biomass and Solid Waste **PI:** William Lear, **Co-PI:** J.N. Chung - UF **Budget:** $576,000 **External Collaborators:** Siemens Power Generation, Florida Turbine Technologies, Energy Concepts Co., Nu-Power Technologies LLC, PlanetGreenSolutions Inc., LPP Combustion, LLC.
Thermo-Chemical Conversion	
	Title: Production of Liquid Fuels Biomass via Thermo-Chemical Conversion Processes **PI:** Babu Joseph, **Co-PIs:** Yogi Goswami, Venkat Bhethanabotla, John Wolan, Vinay Gupta - USF **Budget:** $554,447 **External Collaborators:** Prado & Associates
	Title: Feasibility, Sustainability and Economic Analysis of Solar Assisted Biomass Conversion **PI:** Babu Joseph, **Co-PI:** Q. Zhang - USF **Budget:** $45,238
	Title: Integrated Florida Bio-Energy Industry **PI:** Ali T-Raissi **Co-PIs:** N.Z. Muradov, D.L. Block - UCF/FSEC **Budget:** $648,000
THRUST 4: Harnessing Florida's Solar Resources	
Solar Testing Facility	
Solar Thermal	
	Title: Development of Novel Water Splitting Catalysts for the Production of Renewable Hydrogen **PI:** Helena Hagelin-Weaver - UF **Budget:** $ 100,000
	Title: Enhanced and Expanded Solar Thermal Test Capabilities **PI:** J. Del Mar**,** R. Reedy - UCF/FSEC (PI use to be J. Walters) **Budget:** $809,295 **External Collaborators:** Solar thermal manufacturers
	Title: Solar Fuels for Thermochemical Cycles at Low Pressures

	PI: David Hahn (used to be Jörg Petrasch) - UF **Budget:** $ 100,000 **External Collaborators:** Wojciech Lipinski, University of Minnesota
	Title: Solar Thermal Power for Bulk Power and Distributed Generation **PI:** David Hahn, **Co-PIs:** James Klausner, Renwei Mei, Helena Weaver - UF **Budget:** $446,400
	Title: Design, Construction and Operation of CSP Solar Thermal Power Plants in Florida **PI :** Yogi Goswami, **Co-PIs:** Lee Stefanakos, Muhammad Rahman, Sunol Aydin, Robert Reddy - USF **Budget:** $882,000 **External Collaborators:** Sopogy Inc. and Gulf Coast Green Energy.
Clean Drinking Water	
	Title: Low Cost Solar Driven Desalination **PI:** James Klausner - UF **Student:** Fadi Alnaimat/ Ph.D **Budget:** $252,000 **University:** UF
	Title: Clean Drinking Water using Advanced Solar Energy Technologies **PI:** Lee Stefanakos **Co-PI's:** Yogi Goswami, Matthias Batzill, Maya Trotz, Sesha Srinivasan - USF **Budget:** $326,756 **External Collaborators:** NA
Low Cost PV Manufacturing	
	Title: Enhanced and Expanded PV Systems Testing Capabilities at FSEC **PI:** S. Barkaszi, **Co-PI:** R. Reedy - UCF/FSEC **Budget:** $196,018
	Title: Development of High Throughput CIGS Manufacturing Process **PI:** Neelkanth Dhere **-** UCF/FSEC **Budget:** $141,620
	Title: Florida Opportunities for PV Manufacturing and Applications **PIs:** D. Block, J Fenton, P. Fairey, W. Schoenfelds, R. Reedy - UCF/FSEC **Budget:** $81,120
	Title: Development of Low Cost CIGS Thin Film Hot Carrier Solar Cells **PIs:** Gijs Bosman, **Co-PI:** Tim Anderson - UF **Budget:** $450,000
	Title: Solar Photovoltaic Manufacturing Facility to Enable a Significant Manufacturing Enterprise within the State and Provide Clean Renewable Energy **PI:** Don Morel – USF, **Co-PIs:** Chris Ferekides, Lee Stefanakos - USF **Budget:** $1.6M **External Collaborators:** Mustang Solar, a Division of Mustang Vacuum Systems
Advanced PV Device Program	
	Title: Research to Improve Photovoltaic (PV) Cell Efficiency by Hybrid Combination of PV and Thermoelectric Cell Elements. **PIs:** Nicoleta Sorloaica-Hickman**,** Robert Reedy - UCF/FSEC **Budget:** $167,820
	Title: PV Devices Research and Development Laboratory **PI:** Robert Reedy **Co-PI's:** Nicoleta Sorloaica-Hickman, Neelkanth Dhere - UCF/FSEC **Budget:** $450,250
	Title: Beyond Photovoltaics: Nanoscale Rectenna for Conversion of Solar and Thermal Energy to Electricity **PI:** Shekhar Bhansali (now with FIU), **Co-PIs:** Elias Stefanakos, Yogi Goswami, Subramanian Krishnan - USF **Budget:** $598,500

	External Collaborators: Bhabha Atomic Research Center, India
PV Integration	
	Title: PV Energy Conversion and System Integration **PI:** I. Bataraseh, **Co-PI's:** J. Shen, Z. Qu, X. Wu, W. Mikhael, L. Chow – UCF (PI use to be N. Kutkut) **Budget: $1,267,000**
	Title: Non-Contact Energy Delivery for PV System and Wireless Charging Applications **PI:** Jenshan Lin - UF **Budget: $**252,000
	Title: PV Power Generation Using Plug-in Hybrid Vehicles as Energy Storage **PI:** J. Shen, **Co-PI:** I. Batarseh - UCF **Budget:** $380,816 **External Collaborators:** City of Tavares, FL
	Title: Integrated PV/Storage and PV/Storage/Lighting Systems **PI:** Franky So, **Co-PI:** Jiangeng Xue - UF **Budget:** $576,000
THRUST 5: Carbon Constrained Technologies for Electric Power in Florida	
	Title: Biocatalytic Lignin Modification for Carbon Sequestration **PI:** Jon Stewart - UF **Budget:** $200,000
	Title: Database Infrastructure for Integrative Carbon Science Research **PI:** Sabine Grunwald. **Co-PI:** Tim Martin - UF **Budget:** $199,440
	Title: Creation of Carbon Sequestration Data, Technologies and Professional Cohorts for Florida **PI:** Mark Stewart, **Co-PIs:** Jeffrey Cunningham, Maya Trotz - USF **Budget:** $479,640 **External Collaborators:** Tampa Electric Company (TECO); Florida Power and Light (FPL); Environmental Consulting and Technology (ECT), Inc.; Los Alamos National Laboratory.
THRUST 6: Exploiting Florida's Ocean Energy Resources	
	Title: Southeast National Marine Renewable Energy Center **PI:** Susan H. Skemp**, Co-PIs:** Howard P. Hanson, James VanZwieten - FAU **Budget: $8,750,000** **Universities:** UCF, FSU, ERAU, University of Miami, Oregon State University, University of Washington, Pennsylvania State University, University of New Hampshire, University of Hawaii, University of Edinburgh, Heriot-Watt University, Nova Southeastern University, Virginia Polytechnical Institute, Florida Institute of Technology, Embry-Riddle Aeronautical University **External Collaborators:** Numerous industry and State and federal government as well as FFRDCs, such as National Renewable Energy Laboratory, Woods Hole Oceanographic Institution, U.S. Department of Energy, U.S. Department of Interior (Bureau of Ocean Energy Management and Regulation and Enforcement), U.S. Department of Commerce (National Oceanic and Atmospheric Administration), and Florida Department of Environmental, Protection, to name a few.
THRUST 7: Energy Storage and Delivery Infrastructure	
	Title: Energy Delivery Infrastructures **PI:** Lee Stefanakos **Co-PIs:** Zhixin Miao - USF (Formerly Alex Domijan (PI) and Arif Islam (Co-PI). Left USF). **Budget:** $485,184
	Title: Secure Energy Systems **PI**: Pramod Khargonekar - UF **Budget**: $220,000
	Title: Optimization, Robustness and Equilibrium Modeling for the Florida Smart Grid **PI:** Panos Pardalos - UF **Budget**: $30,000

Policy	
	Title*:* Economic Impacts of Renewable Energy and Energy Efficiency Policies **PI:** Theodore Kury – UF (PI use to be Mark Jamison) **Budget:** $150,000
Education and Outreach	
	Title: Florida Advanced Technological Education Center (FLATE) **PI:** Marilyn Barger - UF **Budget:** $300,000 **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 Alternative 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).
	Title: Outreach Activities for FESC **PI:** Pierce Jones, Kathleen C. Ruppert, Hal S. Knowles III, Nicholas Taylor, Barbra Larson, Craig Miller- UF **Budget:** $497,670 **External Collaborators:** Primarily DCA, FSU, UCF (FSEC), USF, and DEP with many others as well.
	Title: 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) **Budget:** $308,000 **External Collaborators:** Several engineers from AREVA NP Inc & Siemens Corporation
FESC Phase 2 Technology Commercialization	
	Title: Development of a Low Cost Concentrating Solar Energy System Using Solar Sausages **PIs:** David VanWinkle, Sean Barton – UF **Industry Partner:** Hunter and Harp Holdings (HHH)
	Title: Stress Evolution in Solid-State Li-Ion Battery Materials **PI:** Kevin S. Jones – UF **Industry Partner:** Planar Energy
	Title: SWNT Based Air Cathodes for Fuel Cells & Metal Air Batteries **PI:** Andrew G. Rinzler – UF **Industry Partner:** nRadiance LL
	Title: Development of high efficiency polymer solar cells **PI:** Frank So – UF **Industry Partner:** SestarTechnologies, LLC

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. Over 100 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.

The notable proposals facilitated by FESC during the reporting period include:

- DE-FOA-0000559, Energy Innovation Hub - Batteries and Energy Storage (Multi-university team with 15 universities, Sematech and NREL)
- DE-FOA-0000506, U.S.-India Joint Clean Energy Research and Development Center: One multi university team was formed. The UF led team received an award to form the Joint Clean Energy Research and Development Center (JCERDC) in biomass. The project is aimed at reducing energy consumption, cutting dependence on petroleum products and increasing use of renewable fuels. (http://news.ifas.ufl.edu/2012/04/20/uf-led-research-team-selected-for-125-million-joint-u-s-india-energy-project/).
- DE-FOA-0000651 - Sunshot Incubator program (One industry led team)
- DE-FOA-0000652 - Technologies to Ensure Permanent Geologic Carbon Storage (One university led team).
- DE-FOA-0000670, ARPA-E (Six faculty led teams)
- DE-FOA-0000675, Advanced Management and Protection of Energy-Storage Devices (One university led team).
- DE-FOA-0000677, Solid State Energy Conversion Alliance (SECA) Core (One university led team).
- BP - RFP-II, Gulf of Mexico Research Initiative (One university led team).
- SN-12-15-PKM, Advanced Drop-In Biofuels Production Project (Two industry led teams).
- NIST: 2012-BCTEP-01, Building Construction Technology Extension Program (BCTEP) Pilot Projects (One university led team).
- The Rural Jobs and Innovation Accelerator Challenge, A Coordinated Initiative to Advance Regional Competiveness (One university led team).
- NSF GOALI (One university led team).
- NSF 12-548, SBIR Program Phase I Solicitation FY-2013 (One industry led team).
- Sandia Energy Storage RFP# 1145 (One industry led team).

In addition to team formation, the team members were introduced to industry, and industry support letters were collected from the industry partners.

FESC expertise documents in the areas of algae technology, biomass, solar PV, solar fuels, smart grid/energy storage, and building efficiency have been updated and posted at the FESC web site (http://www.floridaenergy.ufl.edu/?page_id=1687). The documents provide the list of faculty and their expertise, facilities, and industry collaboration.

FESC funding was leveraged to establish new programs. Some of the examples are:

- US - India Joint Clean Energy Research and Development Center at UF: (http://news.ifas.ufl.edu/2012/04/20/uf-led-research-team-selected-for-125-million-joint-u-s-india-energy-project/).
- Florida PV Manufacturing Consortium (Given in the "Industrial Collaboration" section of this report).
- UCF Test Center for Photovoltaic (Solar to Electric) Systems Performance Validation (summarized below)
- UCF Test Center for Photovoltaic (Solar to Electric) Systems Performance Validation (details are given below)

As a result of FESC funding for PV testing and facilities, the US Department of Energy has funded the nation's only university-based Photovoltaic (PV) Regional Test Center (RTC) at the University of Central Florida. The UCF RTC will provide validation testing for large-scale photovoltaic systems and will help banks, insurance companies, and other stakeholders establish the confidence that new PV technologies perform reliably in the field. The UCF site was selected as the Hot-Humid Climate regional test center and will accommodate up to four megawatts of power production.

Figure 1. UCF Campus and RTC Site

The Department of Energy (DOE) will award approximately $2.3 million to UCF's Florida Solar Energy Center for construction of the RTC and the purchase of test equipment. A multi-year contract will fund the center, with first-year funding of approximately $500,000. Industry, in cooperation with DOE and UCF, will supply and install the PV systems. The UCF RTC will begin at two megawatts and, as demand grows, may expand by another two megawatts.

Energy will be produced by the facility during the day at peak demand periods. The estimated value of energy, based on current utility rates, is almost $300,000 annually for the initial two megawatts.

The proposed project site is located in the southeast corner of campus at the end of Neptune Drive. The undeveloped 20-acre parcel is bounded by a residential development including a 200-foot vegetative buffer zone to the east, a 20-acre wetland to the south, a commercial area and large retention pond to the west, and undeveloped university property to the north.

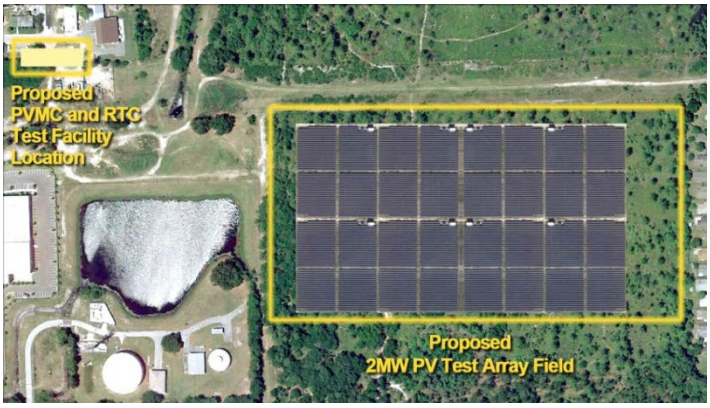


Figure 2. PV Array Field Concept and General Location

The RTC--together with an existing DOE program for PV testing and reliability ($500,000 per year) and a DOE SEMATECH subcontract ($1million per year for five years) for crystalline silicon photovoltaic manufacturing research--positions Florida as the nation's leader in PV applications and manufacturing research. Researchers will conduct reliability and performance studies on PV systems, and they will provide manufacturing research and education.

The RTC and the Photovoltaic Manufacturing Consortium will serve Florida as a magnet for related industries. Initially, they will attract visits by PV

experts who will spur interest in relocating and starting PV-related manufacturing and service businesses in Florida.

A total of 107 funding opportunities were distributed to FESC faculty members. Some of the funding opportunities sent to faculty are given below as an example (see Appendix C for complete listing):

Title	Call #	Agency	Funding
Energy Innovation Hub - Batteries and Energy Storage	DE-FOA-0000559	US DOE	$120M
A Pilot Institute for the National Network for Manufacturing Innovation (NNMI)	BAA-12-17-PKM	AFRL	$60M
Advanced Drop-in Bio fuels Production Project	FOA-12-15-PK	Air Force	$420M
Safety of Oil and Gas Operations in the US Outer Continental	E12PS00004	Department of Interior	$5M
Research and Education Program for Historically Black Colleges and Universities and Minority-Serving Institutions (HBCU/MI)	W911NF-12-R-0009:	DOD	$25M
Rapid Innovation Fund Broad Agency Announcement	HQ0034-12-BAA-RIF-0001:	DOD	$3M
Basic Research to Enable Agriculture Development	NSF 11-579	NSF	$12M
Sustainable Energy Pathways (SEP)	NSF-11-590	NSF	$34M
Solar Energy Evolution And Diffusion Studies (SEEDS)	DE-FOA-0000740	US DOE	$9M
Innovative Pilot and Demonstration Scale Production of Advanced Biofuels	DE-FOA-0000739	US DOE	$20M
U.S.-India Joint Clean Energy Research and Development Center	DE-FOA-0000506	US DOE	$125M
Plug and Play Photovoltaics	DE-FOA-0000653	US DOE	$25M
ARPA-E	DE-FOA-0000670	US DOE	$150M
Biomass Research and Development Initiative	DE-FOA-0000657	USDA and US DOE	USDA-NIFA: $25M; US DOE: $10M