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, 2013 – September 30, 2014

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EXECUTIVE SUMMARY

Overview: The Florida Energy Systems Consortium administration office worked very closely with the Office of Energy, the FESC Oversight Board, the FESC Steering Committee, and the FESC Industrial Advisory Board to request new recurring research funding from the state. The FESC administration office had several meetings with the Office of Energy during this reporting period to present the budget request and elucidate its positive impacts on the future of our state in the energy area. The Office of Energy approved bridge funding for the FESC administration office, education, and outreach funds. FESC recurring research funding request will go through the legislative session per our telecon conversation with Commissioner Putnam. All 12 University VPRs are in support of this funding request.

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 - by disseminating solicitations, identifying research leaders and building teams to compete in these solicitations, communicating with industry partners, national labs and other non-SUS universities, and assisting with cost share development, budgets, and boiler plate proposal text. The Accountability Measures on page 10 of this report summarize the accomplishments for the year.

The SUS energy faculty submitted **381 proposals requesting $97,728,262** during the twelve-month period October 1, 2013 thru September 30, 2014. The SUS energy faculty received **375 research and education awards totaling $58,766,712**[1]. Significant examples include:

- US DOE grant on "Unobtrusive Multi-static Serial LiDAR Imager (UMSLI) for Wide-area Surveillance and Identification of Marine Life" by FAU (funding: $500,000)
- US DOE funding on "Consortium for Materials and Energy Studies (CMAES)" by FAMU (funding: $1,055,528)
- US DOE funding on "Experimental Hadronic Nuclear Physics" by FSU (funding: $942,000)
- US DOE funding on "Foundations for Engineering Education for Distributed Energy Resources (FEEDER)" by UCF, (funding: $408,516)
- US DOE funding on "Building America Partnership for Improved Residential Construction (BA-PIRC)" by UCF/FSEC (funding: $985,834)
- US DOE funding on "Electric Vehicle Transportation Center (EVTC)" by UCF/FSEC (funding: $1,689,780)
- US DOE funding on "Solar Thermochemical Fuel Production Via A Novel Low Pressure, Magnetically Stabilized, Non-Volatile Iron Oxide", by UF (funding: $591,025)
- US DOE funding on "Commercial Production of Terpene Biofuels in Pine" by UF (funding: $550,000)
- US DOE funding on "Research in High Energy Experimental Physics" by UF (funding: $1,306,000)
- US DOE ARPA-E funding on "Development of a Low Cost Thermal Energy Storage System Using Phase Change Materials with Enhanced Radiation Heat Transfer", by USF (funding: $2,596,682)

With the inclusion of Polytechnic University, FESC now has 12 state universities and 1 guest member. The guest member is Florida Institute of Technology (FIT). We are working with the University of Miami (UM) faculty as well.

[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 calendar 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.

The 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, **twelve (12) technologies were licensed to industry. Eighty three (83) invention disclosures/patents were submitted/received. Twenty eight (28) companies have been formed since 2008** 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 was one of the partners of the Florida Clean Energy Acceleration Network (FL CAN) grant funded by the Economic Development Administration ($1.3M for 2 years). The FL CAN grant was completed on March 31, 2014. The last quarterly report was submitted to the program manager. The IP catalog information was moved to a new web site: http://www.innovationconcourse.com/Seekers. The FESC office will continue to collaborate with the team members to provide FESC user facility support to the Florida energy industry.

FESC continues to produce results in energy research, technology transfer, education, and outreach activities. The FESC administrative office is successfully facilitating interactions among Florida's energy industry and researchers at the 12 state universities, Florida's State and Community Colleges, and the Florida Institute of Technology. The FESC office has developed over 1000 faculty/industry contacts. This comprehensive network enables and facilitates the transfer of FESC technologies quickly for maximum benefit to Florida's economy. FESC coordinates research teams to develop and submit a significant number of joint proposals. FESC continues to contribute to energy education and outreach programs. Seven new energy education projects were funded recently. Their descriptions and brief progress reports are given in the "education" section of this report on page 26. The Consortium's outreach team initiated Sustainable Floridian^{SM} Program with ARRA funding. The program has been offered in Leon, Marion, Pinellas Osceola, and Sarasota Counties. The program was funded recently through Office of Energy bridge funds to continue with the development of the program.

FESC Office established the "***Energy Crop Certification***" faculty workgroup in collaboration with Treasure Coast Research Park to develop a roadmap for a statewide implementation of Advanced Biofuel Feedstock Certification Program. The primary goal of this program is to make alternate crops available for the farmers that have unusable land due to citrus greening issue.

FESC organized an Energy Workshop in collaboration with Office of Energy and the FESC Steering Committee members. The workshop was held on May 12-13, 2014 at the Hilton Conference Center, Gainesville, Florida. The Link to the workshop presentations can be viewed here:
http://www.floridaenergy.ufl.edu/?page_id=20288

Buck Martinez, Sr. Director Office of Clean Energy, FPL, is now Chair of the FESC Industrial Advisory Board. FESC organized a stakeholders meeting hosted by Buck Martinez at Juno Beach, FL on Aug 20, 2014. The meeting participants were FESC industrial advisory board members, FESC Steering Committee members, and invited industry members. Five new industrial advisory board members joined the FESC board. The new members are: Ben Amaba, IBM; Gary Freeman, Duke Energy; Jennifer Grove, Gulf Power; Charles Vinick, Aquantis Inc.; Dan Holladay, UCF; Richard Paul-Hus, Hypower, Inc. The new members either replaced the retired board members or filled the needed expertise.

The FESC website continues to be an important communication tool for the FESC program. FESC office hired a part time employee with web design expertise. FESC web site has been updated to make it more user friendly. The updates will continue. FESC prepares and distributes bi-monthly electronic newsletters by email to over 1000 subscribers. The e-newsletters are published at FESC website: http://www.floridaenergy.ufl.edu/?page_id=1999

FESC administration attended 13 conferences and workshops to expand the FESC network by developing new partnerships. The list of the conferences and workshops attended during the reporting period is given on page 21 of this report.

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.

Research Highlights

The initial FESC research funds were dedicated to seeding energy research at five of the FESC universities with over 80 projects. 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/?page_id=6 . The majority of the projects have been completed. There are 14 FESC funded projects during this reporting period (listed on page 18 of this report). Two of the projects are now complete. Their final reports are given in Appendix D. Seven out of fourteen projects are in energy education.

FESC Office established an "***Energy Crop Certification***" faculty workgroup in collaboration with Treasure Coast Research Park to develop a roadmap for a statewide implementation of Advanced Biofuel Feedstock Certification Program. The primary goal of this program is to make alternate crops available for the farmers that have unusable land due to citrus greening issue. The development of new hybrids, new cultivation methods and processing technologies of Advanced BioFuel (ABF) and Advanced BioChem (ABC) crops hold tremendous promise but face substantial regulatory, technological and cultural barriers that prevent supply chain adoption. Energy Crop Certifications are handled by EPA; however due to demand, getting an approval takes a very long time. Roadmap development is needed in our state to streamline the EPA requirements to speed up the energy crop certification process. The faculty working group, in collaboration with Treasure Coast Research Park and State Office of Energy, will develop a "Workflow Process and Implementation Plan" for a statewide Advanced Biofuel Feedstock Certification Program.

CSP Plant at USF

Dr. Yogi Goswami has completed his FESC funded project to build a concentrating solar power (CSP) plant on the USF/Tampa campus. This concentrating solar thermal pilot power plant can produce 50 kW of electricity. The collected solar energy is translated into thermal heat which is stored in phase change materials, which are also under development at USF. The CSP plant will be used for continued research and student hands-on education. His final report with photos are given on page 163 of this report.

During this reporting period, FESC distributed and posted over **137 announcements of funding opportunities** with the goal of generating competitive SUS-based proposals and thus leveraging state funds. Several examples are listed in the "New Program Development" section of this report. Appendix C contains the list of announcements.

The Southeast National Marine Renewable Energy Center (SNMREC), continues to strategically select and foster scientific and technical research in conjunction with industry and agency R&D needs. Economic assessments are being conducted to determine financial efficacy and hurdles to install commercial MHK devices. Critical environmental measurements will be continuously acquired from an offshore observational platform and subsea instrumentation. While pursuing regulatory permission for offshore testing and measurement activities, the SNMREC has paved the road for regulatory framework development and data availability used for policymaking. An MHK lease application submitted to the US Department of Interior's Bureau of Ocean Energy Management (BOEM) in 2010 is becoming the model for future commercial leases.

As this is *the first U.S. application for MHK projects on the outer continental shelf*, an Environmental Assessment (EA) of the Center's activities by BOEM is helping prepare the agency for future commercial lease applications. The EA was publicly released in August 2013 with a Finding of No Significant Impact (FONSI). As a result of the extensive efforts, on June 1, 2014 the SNMREC was granted the first national lease by the U.S. Department of Interior's Bureau of Energy Ocean Management to conduct renewable energy activities in support of MHK. *These projects represent the first and only such capability globally for ocean current energy*.

Technology Commercialization and Industrial Collaboration

The consortium connects Florida's energy industry to statewide faculty members in order to meet the energy industry's technical needs and facilitates the commercialization of university energy-related technology. FESC is currently in communication with over 200 companies to provide technical assistance, to write collaborative proposals, or to assist Florida industry with university user facilities and patent catalogs. FESC office also works closely with technology transfer and economic development offices in Florida to attract industry to the state of Florida.

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). To date, FESC funded 5 Phase II projects. There are no new projects in this area, because these funds are depleted.

Twelve technologies were licensed to industry during this reporting period. **Twenty eight (28) companies have been formed since 2008**. The company list along with the technology area is provided at the "Business Start-Ups" section of this report (Appendix B). The technology of these companies is university-developed in areas that include solar fuels, concentrated solar, energy efficient optoelectronic devices, fuel cells, coating for battery/fuel cell, efficient light emitters, energy efficiency, bioenergy, and chemicals from biomass, nanoparticle thin film PV, waste to energy, and H_2 sensor.

FESC is continuing to promote and forge collaborations among energy experts across Florida's universities, Florida industry, and other Florida state entities to expand the comprehensive FESC network.

Education

FESC education program has three focus areas: 1- Community College program at the Associate of Science and certificate level run by FLATE; 2- Nuclear energy education; 3- Undergraduate/Master program. Progress highlights are given below.

Florida Advanced Technological Education (FLATE): Together with the National Science Foundation-funded Energy Systems Technology Technicians (EST^2) project team, FLATE has developed a new Industrial Energy Efficiency (IEET) specialization for the Engineering Technology (ET) Degree and associated College Credit Certificate, in addition to the existing Alternative Energy Specialization. The IEET program framework has been approved by the FL Department of Education and colleges will be able to implement it in the 2014-2015 academic year. FLATE's Third Annual Summer Energy Camp was a huge success with the highest attendance ever and feedback from both teachers and students overwhelmingly positive! Thirty 7th and 8th grade students were treated to four days of exciting, hands-on activities centered on capturing and keeping their interest in STEM (Science, Technology, Engineering and Math) subjects – specifically renewable energy. In addition, 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 developing independent programs not properly aligned to statewide frameworks.

University of Florida Nuclear Training Reactor (UFTR) Digital Control System Upgrade: The UFTR is implementing the first ever fully digital control and safety system at a nuclear reactor in the United States. The refurbishment project was launched based on the conversion of the reactor core from high-enriched uranium to low enriched fuel as part of a nationwide effort after 9/11. As part of this program, many major upgrades have been completed over the FESC project period, including an NNSA-funded security system ($460k), a renovated HVAC system ($250k), a new stack exhaust monitor and high plume exhaust system funded by DOE ($212k), and a new nuclear instrumentation system ($300k). FESC funding has been leveraged to augment these efforts, including the design of a new control blade drive systems for the UFTR and purchase of field instrumentation sensors to integrate with the new control design. The UFTR will restart operations at the end of 2014, with most upgrades fully implemented. The digital control interface design is complete and manufacturing and install are on hold pending both identification of a new manufacturing partner and regulatory approval.

Undergraduate/Master and Certificate program: FESC awarded seven new projects to develop undergraduate/master-level courses. These courses will also be available on-line.

Outreach

FESC Outreach Team: The outreach team was provided new funding to continue with the Sustainable Floridian^{SM} Program. The mission of the Sustainable Floridian^{SM} program is to guide Floridians on how to take individual responsibility for protecting Earth's limited resources. Through a discussion-to-action format, the program educates participants about making wise use of resources, making households and communities more resilient and financially sound, and understanding the impact of individual lifestyle choices.The Sustainable Floridian^{SM} program report is given on p. 41 of this report.

FESC Website and e-Newsletter: The FESC website continues to be an important communication tool for our program. It is updated regularly to make it user friendly, remain current and to better serve our users. Based on a Google Analytics report, the FESC web site was viewed by 15,832 Google visitors (12,338 or 77.9% new visitors) during the period of September 30, 2013-October 1, 2014. The viewers visited 38,612 pages. Viewers were from over 131 countries, including those in North and South America, Europe, Asia, Australia, and Africa. FESC prepares and distributes bi-monthly electronic newsletters by email to over 1000 subscribers. Printed version of recent e-newsletters is given on page 46 of this report.

FESC May 2014 Workshop: FESC workshop was held on May 12-13, 2014 at the Hilton University of Florida Conference Center in Gainesville, FL. The workshop was organized to bring together energy experts in the State University System of Florida and industry 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 workshop was opened with welcoming remarks from Dr. David Norton, University of Florida's Vice President of Research, and Patrick Sheehan, Director, State Office of Energy. Over 200 people attended the workshop. The details are given on page 47 of this report.

FESC will be hosting a 1.5-day instructional workshop on "Integration of Renewable Energy into the Grid". This instructional workshop is designed for industrial personnel, students and faculty who want to learn the state of the art and future directions in enabling renewable energy integration. Experts in this area will present the workshop lectures

Other

- University of South Florida research team led by Dr. Daniel Yeh won a $50K Cade Museum Prize grand prize. The prize winners, BioReNEW, have developed a machine called the NEWgenerator that uses

filtering systems and safe bacteria that digest waste to turn waste material into usable nutrients, clean water and energy off of the typical sewage and utility grid.

- Florida Agricultural and Mechanical University Launche**d** the FAMU Sustainability Institute (FAMU-SI)**.** The institute will directly engage students with the goal of training future sustainability practitioners, entrepreneurs, leaders in science, technology, research, engineering, agriculture, and mathematics (STREAM) and other related disciplines.

- The University of Central Florida partnered in partnership with Osceola County and the Florida High Tech Corridor Council established the International Consortium for Advanced Manufacturing Research (ICAMR). ICAMR serves as a one-stop shop for development and integration of advanced devices and materials (processes, tools, prototyping, EDA), providing access to materials (like GaN, InGas, and other III-V materials). The center will break ground in March 2015, and its first phase will be completed within two years. It is expected to create an estimated 20,000 direct jobs and up to 80,000 indirect jobs over the course of 10 years. http://www.icamr.net/.

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 B.

Table 1: Accountability Measures

FLORIDA ENERGY SYSTEMS CONSORTIUM October 1, 2013 – September 30, 2014	
Research Effectiveness (FESC and Associated Research)	
Competitive Contracts and Grants Submitted (SUS energy faculty)[2]	# of Applications: 381 Requested Funding: $97,728,262
Competitive Contracts and Grants Received (SUS energy faculty)[2]	# of Awards: 366 Award Amount: $58,174,283
Publications in Refereed Journals and Other (FESC funded faculty)	Total: > 60
Professional Presentations (FESC funded faculty)	Total: > 30
Invention Disclosures Submitted and/or Patents Received (SUS)	83
Technologies Licensed and Revenues Received	Technologies Licensed: 12 Revenues Received: $2,000
Collaboration Effectiveness (FESC and Associated Research)	
Collaborations with Other Postsecondary Institutions (FESC funded faculty)	Total: >3
Collaborations (or Potential Collaborations) with Private Industry (FESC funded faculty)	Total: >13
Students Supported with FESC funded faculty	Total: 55 Undergraduate: 1 Master: 13 PhD: 38 Post-docs: 3
Students Graduated (FESC faculty)	Total: 29 Undergraduate: 1 Master: 7 PhD: 21
Economic Development Effectiveness (FESC and Associated Research)	
Business Start-Ups in Florida ***(During Oct. 1, 2008 to Sep 30, 2014 Period)***	28 8 of these companies did not survive

[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

Per Commissioner Putnam's request and feedback from the Office of Energy, FESC steering Committee members worked with FESC faculty and redefined the FESC research program goals with five focus areas. The details of the program are given below.

Five Focus Areas towards Florida's Energy Leadership

Five focus areas for the Florida Energy Systems Consortium (FESC) are summarized below. In each of these areas, Florida's state universities will partner with industry to provide technical expertise to meet pressing industry needs and to bring emerging energy technologies to market. These novel technologies harness Florida's natural resources and reduce energy dependency on outside sources. In addition, these focus areas will be represented in the consortium's workforce development programs which serve Florida's utilities and in the consortium's education programs which serve the public by reducing their energy bills through conservation.

Supporting Utilities in Smart Grid and Energy Storage

Support Investor Owned Utilities (IOU), Cooperative Electric Utilities, and Municipal Utilities to develop smart grids with intermittent power sources such as PV and wind, distributed electric generation, state-of-the-art power electronics, and grid level energy storage.

Enhancing Energy Efficiency and Conservation

Develop new technologies for high efficiency HVAC building retrofits using advanced sensing and control; conduct field evaluations to document the cost/benefits of building energy efficiency programs; develop solutions to help absorb intermittency of renewable energy sources by using fast-responding management of building loads such as HVAC; and recruit advanced Florida builders and early adopter homeowners to collaborate on zero energy building design and retrofit projects.

Converting Florida's Biomass to Renewable Fuels

Develop energy-rich crops to supplement agricultural residues as sources of cellulosic biomass; develop scalable and cost-effective processes to produce fuels, chemicals, and power from biomass and algae; develop cost-effective integrated anaerobic digestion systems to support Florida's farmers in producing bioenergy (methane) and bio fertilizer from Florida feed stocks.

Harnessing Florida's Solar Energy

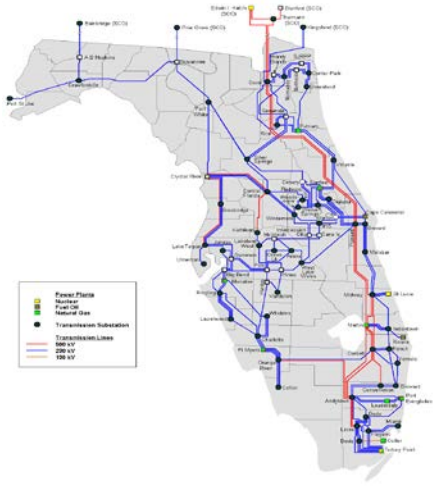
Improve solar PV panel efficiency; work towards automatic permitting, automatic utility interconnection, and autonomous operation of PV systems; develop high-temperature, thermal energy storage for concentrated solar power technology; develop transportation fuels with solar energy by converting water and CO_2 to syngas then liquid fuels; develop solar desalination technology.

Power Generation by Using Marine Hydrokinetic (MHK) Resources

Develop technologies to harness ocean current energy, ocean wave energy, and ocean thermal energy to produce electricity; determine whether offshore wind is a viable renewable energy resource for Florida and whether it is capable of supporting a new industry and the jobs and revenue that could come with it; assist a growing ocean current energy sector to identify and reduce various barriers to commercial implementation.

Detailed Descriptions of the Focus Areas

Supporting Utilities in Smart Grid and Energy Storage



According to a reliable 2008 study by the Political Economy Research Institute, an investment of $8 Billion in Florida's electric infrastructure would result in 123,756 persistent Florida jobs. In 2011, Florida consumed over 230 terawatt-hours of electricity, or the equivalent of about $25 billion in retail sales. It was second in the nation in electric energy consumption behind Texas. These recommended investments and this staggering level of load are a unique Florida opportunity, an opportunity that is often referred to as smart grid investments or grid modernization. The investments will provide better jobs, reliability, flexibility, information and automation - all of which are essential to growing Florida's economy.

Florida Power and Light's (FPL's) smart grid expansion is costing over $800 million. FPL has achieved real economic, safety, and reliability benefits from a fully wired and operational smart grid. FPL has shown that when done correctly, a smart grid is able to automatically sense and gather important data about both consumer and supplier habits, allowing operators and computers to better tweak systems before any major problems arise. FPL installed 4.5 million smart meters alongside more than 10,000 sensors all over the grid. To date, over four hundred malfunctioning transformers have been sensed before they caused a power outage, probably saving Florida small and large business tens of millions, if not over a hundred million dollars in lost revenue. Duke Energy, Gulf Power, TECO, JEA and a host of municipal and cooperative utilities are just as engaged.

FESC universities actively collaborate with Florida utilities in high profile projects. The Gateway to Power Consortium (G2P), led by FPL and Smart Energy Grid Associates, seeks to deliver workforce training for electrical power sector personnel in areas most relevant to the next-generation electric power workforce. The $3.6M US DOE funded SUNGRIN initiative is looking at the implications of a high penetration of solar energy on the Florida Grid. The FESC initiated Network of Energy Sustainable Communities (NESC) provides information and venues to train the local government units on energy opportunities, increasing their efficiency in capturing federal energy block grants. Florida's $126 Million US DOE funded SunSmart program has worked to increase the deployment of solar energy and energy storage systems in schools, business and electric vehicles. The following are some of the areas to focus:

1. **Floridian Economics, Policy Uncertainty and Consumer Behavior:** We must know, in order of magnitude, the energy economy investments that yield the greatest benefit to utilities, consumers, energy security and energy independence.
2. **Science and Technology to Support Florida's Generation Capacity Growth, Transmission Grid Expansion, Efficiency and Modernization:** FESC must determine the right priority of investments that need to be made in electric generation (in particular the mix of new nuclear, clean coal technologies that pass new US EPA standards, natural gas, and alternative sources), as well as identify the transmission upgrades that will lead to higher distribution availability (new and self-healing lines) and efficiency.
3. **Science and Technology to Support Florida's Distribution Grids, Distributed Generation Resources, Demand Side Management, and Premise Appliance integration in Efficiency Programs:** We must first educate a changed and enlightened consumer (conservation). Additionally, automating efficiency and load management functions will allow Florida to do more with less electricity, provide grid stabilizing ancillary service and lessen the need for expensive and dirty fast ramping electric generation.

4. **Resilient Grids by Using Science and Technologies of Cyber-Physical Systems**: Advanced metering implementation has meant unprecedented access to data through distributed sensors. To obtain access to all of this data requires communication infrastructure, and to make use of this data requires a combination of automated centralized and decentralized decision making (e.g. fault detection and response). Advanced monitoring, detection, protection and controls must be developed and implemented that reliably meet the needs of the grid. These technologies must be robust to hardware failures and resilient to malicious attacks.
5. **Electric Vehicles (EV) as a Solution to Florida's Significant Energy Storage Problem:** Much of the promise of Smart Grid is based on a perception that it will lead to an increased penetration of renewable energy. Unfortunately, this may never come to pass in Florida if man-made energy storage options do not become available. Florida has almost no opportunities for natural energy storage at grid-scale. Because EV are a significant leveraging factor, Florida may be the best state in the country to first achieve a true economic electric vehicle based transportation economy.

Enhancing Energy Efficiency and Conservation

Energy efficiency and conservation offer the greatest potential to reduce Florida's energy consumption. Buildings use more energy than any other sector of the economy, including transportation and industry. Therefore, the focus of this thrust area is on improving resource efficiency in the built environment: including existing and newly constructed residential and commercial buildings both at the scale of individual structures and communities. Because of Florida's hot/humid climate, much of the building sciences research conducted nationally doesn't apply well in our state. Building performance research is needed to evaluate and support implementation of specific efficiency practices in Florida. Key research opportunities include development of novel energy efficiency retrofit technologies and analysis of end-use energy consumption data in collaboration with utilities. The following are some of the areas to focus:

1. Energy Efficient Building Technologies for Residential and Commercial Buildings: Buildings account for ~84% of total electric power use in the state. A 35% reduction in building energy use can be achieved by improved efficiency, saving Florida millions of kWhr/yr. Further reduction can be achieved by creating "zero energy homes" using only on-site PV power, a stated goal of the U.S. DOE. This offers the opportunity to develop marketable products that meet Florida's energy and environmental goals. New and emerging building energy efficiency systems require study with respect to Florida's unique hot/humid climate. Cost/benefit analysis of efficient buildings, building energy efficiency expertise in our education system and our marketplace along with creative financial instruments and business models are needed. Conservation can also benefit from the use of more renewable energy sources. New technologies are needed to handle the intermittent nature of renewables. Buildings are expected to play a key role since they form the largest electric demand. To address this need, FESC will develop new technologies for high efficiency HVAC retrofits in both commercial and residential buildings using advanced sensing and control, conduct field evaluations to document the cost/benefits of "beyond code" building energy efficiency programs; conduct testing of building efficiency options; create building energy course work; construct and monitor zero energy buildings; develop solutions to help absorb intermittency of renewable energy sources by using fast-responding management of building loads such as HVAC, including benefit/cost analysis and their effect on the electric grid; and recruit advanced Florida builders and early adopter homeowners to collaborate on zero energy building design and retrofit projects. As part of the Consortium, well-instrumented testing structures and buildings will be established to evaluate the effectiveness of integrated emerging technologies.

2. Analysis of Metered Energy Consumption Data to Increase Effectiveness of Florida Utilities' Demand Side Management (DSM) Programs: Florida utilities have made substantial investments in energy conservation and efficiency programs. Expectations of savings, or deemed savings, are typically used to

estimate program cost effectiveness and make decisions about DSM portfolios, types of programs, and specific energy conservation measures. Although metered consumption data are readily available, utilities seldom conduct follow-up evaluations of savings. Systematic measurement and verification (M&V) is needed to accurately determine whether utility DSM programs are actually achieving their energy and demand savings goals. FESC proposes to evaluate end-use energy consumption data from Florida municipal utilities merged with property appraiser and DSM program data for the following research and analysis tasks: measure energy savings of high-efficiency HVAC DSM participants; establish marginal energy savings values across equipment efficiency levels (SEER-14 to SEER-18 vs. SEER-13); compare measured to modeled/deemed savings estimates; calculate the individual and average cost effectiveness of high-efficiency HVAC retrofits; identify poor performers among installed HVAC systems from data, and flag for maintenance and/or re-commissioning; and provide results to partnering municipal utilities for targeting of future DSM programs to the customers likely to achieve the greatest savings.

Converting Florida's Biomass to Renewable Fuels

FESC member universities are internationally recognized leaders in biomass energy research. Florida ranks first in the country in annual generation of cellulosic biomass with almost 10% of the US total. In Florida several biomass species are produced in large volumes, primarily sugar cane bagasse in South Florida, citrus peel in Central Florida, and woody biomass in North Florida. Moreover, the State has all the key assets for algae technologies: year-round warm weather and sunlight, long shore line, under-utilized land (decommissioned phosphate mines and aquaculture operations), CO_2 from Florida industries (utility, cement, mining, landfills), and wastewater from industrial and municipal treatment facilities. Harnessing cellulosic biomass and algae for conversion to liquid transportation fuels (and other value-added products) is a huge economic opportunity, as over 135 billion gallons of gasoline (worth over $400 billion) and 60 billion gallons of aviation, military, and diesel fuels (worth over $200 billion) are consumed annually just in the United States. Florida's location and resources position it to be a leader in the development and commercialization of biomass-to-fuel technologies in partnership with the private sector. Such a leadership will bring investment, jobs, and tax revenue to the State and will diversify Florida's economy, while making it more sustainable. We propose four (4) key focus areas:

1. **Feedstock Development and Deployment:** With our expertise in genetics and management, we will develop energy-rich crops to supplement agricultural residues as sources of cellulosic biomass. Using breeding and molecular genetics we will develop high energy-yielding cultivars with improved biosafety and by employing management science we will devise growing systems for Florida annual and perennial grasses, oil- and sugar-rich plants, and woody and aquatic energy crops. In parallel, we will develop economic models to estimate costs and identify opportunities for farmers and investors.
2. **Cellulosic Biomass Technologies:** Using our expertise in applied biomass research we will develop scalable and cost-effective processes to produce fuels, chemicals, and power from cellulosic biomass. In the biochemical approach we will study pretreatment and enzymatic hydrolysis to convert biomass to sugars for microbial fermentation to biofuels and hydrocarbons. In the thermochemical approach gasification and catalytic conversion or pyrolysis will convert biomass to drop-in liquid hydrocarbons, power, and co-products such as fertilizers. The technical data will be fed to economic models to calculate capital and operating costs and required key resources (energy, water, raw materials, and land).
3. **Algae Technologies:** Based on our expertise in algae research we will develop modular and cost-effective algae cultivation systems. Algal biomass production will be based on the use of industrial flue-gas CO_2 and wastewater, followed by cell harvesting and lipid or polysaccharide extraction for conversion to bio crude oil or alcohols, respectively. These will be upgraded to jet and military fuels at existing US oil refineries. At the same time we will optimize co-product generation, such as fish food, animal feed, and

methane from algal biomass to improve process economics.

4. **Anaerobic Digestion Technologies:** Based on our expertise in anaerobic digestion research, we will develop cost-effective integrated anaerobic digestion systems to produce bioenergy (methane) and bio fertilizer from organic Florida feedstocks, including purpose-grown energy crops, algal press cake, crop residues, food waste, and other organic materials. In partnership with Florida farmers, food processors, and grocers we will optimize the anaerobic digestion of these materials for production of methane-rich biogas that is readily converted to electricity or used in natural gas systems.

Harnessing Florida's Solar Energy

Solar energy is a ubiquitous clean energy resource, and great progress has been made in recent years to develop advanced technologies to harness its potential to enable power production for the grid, domestic power production and heating, thermal desalination, clean fuel production, industrial process heat, and solar cooling, among others. The State of Florida has substantial solar energy resources and a strong incentive to take on the national grand challenge economical solar energy conversion through sustained research and development of the next generation solar energy technologies so that a robust solar energy industry is grown from within. Because solar energy is an intermittent energy source it is essential that solar energy collection be coupled with energy storage technologies to be economically impactful. Numerous storage solutions are being pursued, including thermal, thermochemical, and electrochemical. FESC is prepared to lead a rigorous and transformational research effort to develop the next generation solar energy technologies that will reach levelized cost parity with fossil energy power production. The following are some of the areas to focus:

1. **Photovoltaics: A.** Florida researchers have been the global leaders in the development of thin film photovoltaic cells including CdTe and CIGS. However, some of the materials are rare. Replacement of these materials with earth abundant materials and development of large area cells would help establish new PV manufacturing industry in the State and increase job growth. **B.** Developing highly integrated and smart power electronics to convert solar energy and connect to the grid is very important to developing highly reliable grid-tie PV system. **C.** In addition smart electronic approaches and new materials and processing can be used to improve the performance of the PV panels by controlling their temperature and keeping the surface dust free. **D**. Transformative concepts in the development of efficient and cost effective super capacitors for smart grid operation of PV.
2. **Automatic Permitting, Automatic Utility Interconnection and Autonomous Operation of PV Systems:** Residential rooftops offer the largest real estate for installing PVs. Widespread adoption of residential PV must address various potential costs, including permitting and auditing of PV systems, the cost of connection/disconnection to the grid, and the cost of volatility of solar radiation. Applied research of system integration and operation is needed in the areas of permitting automation, interconnectivity, communications, voltage control and stability, energy and data management, and advanced control of demand response.
3. **Concentrated Solar Power (CSP):** In order for CSP to reach grid parity the thermal power conversion efficiencies must increase and the costs must decrease and high temperature thermal storage technologies should be employed to increase the power plant utilization factor, especially to enable the sale of power to the grid during peak hours. The research needed includes: a) Development of novel thermodynamic cycles for power production which might include but are not limited to supercritical steam, supercritical CO2, Ericsson, or Brayton combined cycles; b) High temperature thermal energy storage; high efficiency mechanical storage, and combined thermal/photovoltaic power production.
4. **Solar Fuels:** Gaseous and liquid fuels can be produced using solar energy by converting water and CO_2 to syngas which can be used directly or converted to liquid fuels such as jet fuel using Fischer Tropsch synthesis. Various approaches to liquid fuel production are available, including PV-Electrolysis,

Thermochemical, and Photosynthesis. There is great interest to develop some of these technologies with the potential to start a new type of industry in Florida and lead to job growth.

5. **Heating, Cooling and Clean Water:** a) Another transformative application for solar energy within the State of Florida includes thermally driven refrigeration and cooling. Highly absorbing and desiccant materials such as zeolites and metal hydrides may pave the way for innovative new thermal refrigeration and cooling systems that can operate using solar energy. Other desiccant materials such as Lithium Chloride give us an opportunity to design Desiccant/vapor compression hybrid cooling systems with high potential COP. b) Solar Desalination can play a very important role in providing abundant clean drinking water for Florida. Technologies may include but are not limited to humidification/dehumidification, thermodynamic cogeneration of power and water, and reverse osmosis operated by solar power. c) Solar photocatalytic technologies for clean water have improved a lot and can become commercial. However, additional research to extend the wavelength range to utilize the visible light would increase the effective use of sunlight and reduce costs. d) Solar heating, cooling and desalination technologies should include thermal energy storage to allow their utilization when sunlight is not available.

Power Generation by Using Marine Hydrokinetic (MHK) Resources

Covering more than 70% of Earth's surface, the oceans collect and store the sun's vast energy quite effectively, which is available 24/7 in various forms (tides, waves, ocean currents, gradients, etc.). Surrounded by the ocean on three sides, and with the second longest coastline of all U.S. states, Florida is uniquely positioned to harness marine renewable energy resources. Several forms of marine renewable energy that could soon be cost-competitive with fossil fuel sources for utility-scale power generation have emerged in Florida – ocean current energy, ocean thermal energy, and offshore wind. Each still requires investment in technology development, environmental research, and policy issues, but realization of commercial power generation from these sources will yield energy security, sustainability, and a more diverse renewables portfolio for the state.

1. **Ocean Current Energy:** Ocean currents flow in complex patterns governed by the wind, by the water's salinity and temperature, by the shapes and highly variable depths of the ocean basins, and by Earth's rotation. Most ocean currents are driven by wind and by solar heating of surface waters near the equator, while some currents result from density and salinity variations within the water column. Converting these currents into usable electrical power requires equipment to transform flowing water into mechanical energy and then to electricity (i.e., rotating turbines or linear "kites"). In particular, an ocean current resource is primarily found offshore Southeast Florida, in the channel between Florida and the Bahamas—the Florida Current portion of the Gulf Stream. The Southeast National Marine Renewable Energy Center (SNMREC), designated by the U.S. Department of Energy, has been assisting a growing ocean current energy sector to identify and reduce various barriers to commercial implementation. Although still an emerging market, the ocean current energy sector promises not only to be a unique opportunity for Florida to establish an international expertise and capability, but a significant base-load power source for its residents and businesses in the coming decades.
2. **Ocean Wave Energy:** Electric generation from ocean wave energy could provide plentiful clean and sustainable energy to Florida. Through collaboration with Harris Corporation, innovative concepts including a wave buoy (for an array deployment in the sea) and an oscillating wave column (with a uni-directional impulse turbine for coastal deployment) have been developed, and laboratory prototypes have been tested. The development of large-scale generation systems that can be robust to extreme weather conditions is critical in the state of Florida.
3. **Ocean Thermal Energy:** The SNMREC is also investigating ocean thermal energy conversion (OTEC) potential, the process by which the temperature difference between the ocean's warm surface and cold

deep water is used to generate power. Long pipes pump abundant cold water to the sea surface which, in conjunction with warm water, turn turbines that generate electricity, albeit with low efficiency. Although typically only found in areas of the tropical oceans with greater than 1000 meter depth (like the southern portions of the Gulf of Mexico), portions of the Southeast Florida coast exhibit unique characteristics where required temperature differences are found in less than 300 meters depth. This technology was demonstrated in Hawaii and other places around the world late in the 20th century, but further developments are needed to achieve cost-competitive generation, especially further offshore from coastlines. While large OEMs such as Lockheed Martin Corp. are proceeding with floating OTEC technology development in other parts of the world, utility-scale power generated from this marine renewable resource is most viable for the continental U.S. in Florida, but unique challenges (like high current conditions) must be tackled before full implementation.

4. **Offshore Wind:** Wind power is the fastest growing source of renewable energy, with worldwide production doubling every three years. Wind is converted to electricity using 50 to 100 tower-mounted wind turbines, arranged as a wind farm. Offshore wind, considered to be a marine renewable energy resource, is not affected by the roughness of the land surface (topography, vegetation, buildings) and so presents an attractive potential. Large-scale offshore wind resource maps reveal potential for wind power in Florida's coastal waters. Offshore wind farms are usually built in relatively shallow water, and Florida's wide continental shelves present ample opportunities for their placement outside of coastal view sheds. FESC scientists have found that the northwestern Gulf of Mexico has the potential to generate several thousand megawatts of power for Floridians. The study will ultimately help determine whether wind is a viable renewable energy resource for Florida and whether it is capable of supporting a new industry and the jobs and revenue that could come with it.

RESEARCH PROGRAM

The FESC research program included 84 FESC funded projects within the seven strategic thrusts. The project descriptions are all 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, only the lead university information is listed in the table. The majority of these projects have been completed. Table 1 below presents the list of the 14 active/completed FESC projects during the reporting period. Seven of them are the recently funded energy education projects. The energy education project progress reports are given on page 26 of this report. Final reports and other progress reports are given in Appendix D of this report.

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. Per Office of Energy'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. The projects are also given in this file:

2013 FL University Energy Projects.docx

Table 1: Active and Completed FESC Projects During This Reporting Period

Projects	Summary
THRUST 2: Enhancing Energy Efficiency and Conservation	
1	**Title:** Unifying Home Asset & Operations Ratings: Adaptive Management via Open Data & Participation **PI**: Mark Hostetler, **Co-PI:** Hal S. Knowles, III - UF **External Collaborators:** Nick Taylor (Ph.D. Student, UF School of Natural Resources & Environment), Jennison Kipp (Assistant In, UF Program for Resource Efficient Communities) **Status: Active**
THRUST 3: Developing Florida's Biomass Resources	
2	**Title:** Simulation and Measurement of Biomass Suspension Rheology **PI:** Jennifer Sinclair Curtis – UF Project Period: 8/2014-7/2016 **Status: Active**
THRUST 4: Harnessing Florida's Solar Resources	
Solar Thermal	
3	**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 **External Collaborators:** Sopogy Inc. and Gulf Coast Green Energy. **Status: This project was completed**
THRUST 6: Exploiting Florida's Ocean Energy Resources	
4	**Title:** Southeast National Marine Renewable Energy Center **PI:** Susan H. Skemp**, Co-PIs:** Howard P. Hanson, James VanZwieten - FAU **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. **Status: Active**
Education and Outreach	
5	**Title:** Florida Advanced Technological Education Center (FLATE) **PI:** Marilyn Barger - UF **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). **Status: Active**
6	**Title:** UFTR Digital Control System Upgrade for Education and Training of Engineers and Operators **PI:** Kelly Jordan – UF (PI used to be Alireza Haghighat; he has left UF) **External Collaborators:** Several engineers from AREVA NP Inc. & Siemens Corporation **Status: This project was completed**
7	**Title:** Energy Sustainability Course **PI:** Mark Jamison - UF **Status: Active**
8	**Title:** Buildings and Energy: Design and Operation Vs. Sustainability"- An Energy Engineering Course for Florida-specific Building Design & Operation **PI:** Prabir Barooah - UF **External Collaborators:** Dr. Timothy Middelkoop, University of Missouri **Status: Active**
9	**Title:** Renewable Energy Education Program at USF's Patel College of Global Sustainability **PI:** George Philippidis - USF **Status: Active**
10	**Title:** Introducing Specialization in "Sustainable Energy Systems" for Under-Graduate Students in Engineering at the University of West Florida **PI:** Bhuvana Ramachandran and Co-PI: Muhammad Rashid, UWF **Status: Active**
11	**Title:** A Certificate Program to Enhance Sustainable Behavior Change Competencies for Energy---Focused Educational Outreach Professionals **PI:** Laura A. Sanagorski Warner - UF **Status: (Recent award)**
12	**Title:** Solar Energy Technologies: Fundamentals and Applications in Buildings **PI:** Cheng-Xian (Charlie) Lin - FIU **External Collaborators:** NA **Status: Active (Recent award)**
13	**Title:** Renewable Energies and Sustainability Education **PI:** Ryan Integlia and Sesha Srinivasan - Polytech **Status: Active (Recent award)**
14	**Title:** Outreach Activities for FESC **PI:** Pierce Jones, Kathleen C. Ruppert, Hal S. Knowles III, Nicholas Taylor, Barbra Larson, Craig Miller-UF; **Status: Active**

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. **137 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, arranging telecons, providing support letters, and finding ways to meet the cost share requirements.

Proposal Development Facilitation

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

- RHD-4-23073 for "Regional Wind Deployment Resource Centers": FESC collaborated with SE Coastal Wind Coalition for a proposal development to respond to US DOE's call on Regional Wind Deployment Resource Centers. FESC faculty in this area was introduced to the proposal team. This is a wining proposal and FESC office/faculty will continue to work with the SE Coastal Wind Coalition.
- DE-FOA-0001042 - National Incubator Initiative for Clean Energy: Led by the **UCF** Office of Technology Licensing Office.
- DE-FOA-0001052 - Solid Oxide Fuel Core Technology Program: **UF Lead**.
- DE-FOA-0001060 - Systems Biology of Bioenergy-Relevant Microbes to Enable Production of Next-Generation Biofuels: **FAMU Lead**. Submitted a pre-proposal then invited for a full proposal. Collaborative effort of FAMU, UF, USF, and Pacific Northwest National Lab.
- DE-FOA-0001098 - Marine and Hydrokinetic (MHK) Research and Development (R&D) University Consortium: **FAU Lead**
- DE-FOA-0001027, Building Energy Efficiency Frontiers & Incubator Technologies (BENEFIT) – 2014: 3 concept papers from UF.
- DE-FOA-0001071 - Solar Market Pathways: **UCF/FSEC Lead**
- DE-FOA-0000974: Bioenergy Technologies Incubator: **UF Lead** in collaboration with FreeStan USA and **USF Lead**
- DE-FOA-0000997 - Microgrid Research, Development, and System Design: **USF Lead** in collaboration with UF and FIU faculty.
- NSF 14-534 - Sustainability Research Networks Competition (SRN): Three **UF Led** proposals submitted.
- NSF "Sustainable Energy Pathways": **UF Lead.**
- NSF PD 13-7607 - Energy, Power, Control and Networks (EPCN): **UF and USF** collaborative proposal
- DE-FOA-0001002 (ARPA-E): Innovative Development in Energy-Related Applied Science (IDEAS), **UF Lead**
- Office of Energy RFP, "Landlord Tenant Energy Efficiency"): **UF and UCF/FSEC** collaborative proposal
- SBIR/REET – Energy glass: **UF and industry** collaborative proposal

Energy Crop Certification Workgroup

The primary goal of this program is to make alternate crops available for the farmers to make lost citrus land productive again. The development of new hybrids, new cultivation methods and processing technologies of Advanced BioFuel (ABF) and Advanced BioChem (ABC) crops hold tremendous promise but face substantial regulatory, technological and cultural barriers that prevent supply chain adoption. Energy Crop

Certifications are handled by EPA; however due to demand, getting an approval takes a very long time. Businesses requiring certifications use service providers. The service providers work with National Labs to meet the requirements of the certification process. Life cycle analysis and greenhouse gas (GHG) emission reports are part of the requirements. A road map development in our state is needed to streamline the EPA requirements to speed up the energy crop certification process.

FESC Office established a FESC faculty workgroup in collaboration with Treasure Coast Research Park to provide a "Workflow Process and Implementation Plan" to FDACS/Office of Energy to implement a statewide Advanced Biofuel (ABF) Feedstock Certification Program.

The key deliverables of the workgroup are:

- Outline what FESC can do to speed the ABF Feedstock Certification Process for Florida ABF crops.
- Develop a primary and secondary list of Florida target crops for potential ABF certification.
- Identify EPA, USDA and industry stakeholders, their certification needs, and baseline data requirements for completion of a typical ABF crop Feedstock certification report.
- Recommend ABF crop Feedstock certification program targets (number of certifications per year), credential requirements, certification report content, and format to FDACS/Office of Energy.
- Provide guidance for funding the ABF crop certification program. Identify respective clients, their certification service needs, and explore current market pricing on similar services.
- Identify Florida research resources and service providers to process ABF crop certification.

Conferences Attended

FESC administration attends conferences and workshops to expand the FESC network by developing new partnerships. The list of the conferences and workshops attended during the reporting period is given below:

1. 7th Annual Algae Biomass Summit, Sep 30 - October 3, 2013, Orlando FL. Organized by Algae Biomass Organization.
2. Orlando, FL, 32819. 800-992-2694October 14-15, 2013 : Florida Energy Summit, Orlando FL: http://www.floridaenergysummit.com/agenda.html
3. November 6, 2013, Tallahassee, FL: NG Symposium and showcase http://www.cngshowcase.com/agenda/
4. February 10-11, 2014: The International Brassica Carinata Workshop. Quincy, FL. Visited ARA and Carinata fields during this workshop. Met faculty involved in this research, farmers, and seeds growers (Agrisoma, Wise Seed).
5. February 19-20, 2014: 41st Annual PURC Conference - Politics & Policy: What is Next for Utilities? Gainesville FL. http://warrington.ufl.edu/centers/purc/training/conference.asp;
6. March 6-7, 2014: iiSBE Net Zero Built Environment 2014. Gainesville, FL. The agenda is posted at: http://www.cce.ufl.edu/iisbe-net-zero/agenda/ . The symposium brought together design professionals, researchers, industry, and government to exchange information on research, case studies, and emerging best practices centered on the net zero built environment concept strategy.
7. March 24-26, 2014: International Biomass Conference & Expo. Orlando FL. The agenda is posted at: http://biomassconference.com/ema/DisplayPage.aspx?pageId=Agenda1;
8. March 28-29, 2014, 2nd Interdisciplinary Workshop on Smart Grid Design & Implementation, Gainesville FL; http://ccc.centers.ufl.edu/?q=SG2014
9. June 5-6, 2014: C. Balaban attended the "International Energy Investments" conference that was held in Istanbul Turkey. This was an international conference with ~200 attendees. She gave a FESC overview presentation to introduce FESC. In addition, she was the chair during the 1st day of the conference. Dr.

Mark Jamison from UF PURC also gave a presentation at this conference. Link to the conference site: http://www.internationalenergyinvestments.com/iei-turkey-energy-summit/#

10. 2014 EIA Energy Conference, Wash DC, July 14-15, 2014; http://www.fbcinc.com/e/eia/
11. NIST Wash DC office visit, July 15, 2014. C. Balaban gave a FESC overview presentation to NIST energy people. http://www.fbcinc.com/e/eia/
12. FESC Advisory Board meeting (open to industry partners), 8/20/2014; Juno Beach, FL. Hosted by FPL. FESC funding request and FESC Wind Energy initiatives were presented. Presentations are posted at http://www.floridaenergy.ufl.edu/?page_id=21108
13. Sep 18, 2014, UF IFAS meeting organized by Florida Earth Foundation, Gainesville FL. http://www.floridaearth.org/agmodule2014

INDUSTRIAL COLLABORATION AND TECHNOLOGY COMMERCIALIZATION

FESC's industrial collaboration program promotes exchange between the 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.

FESC Technology Commercialization Program Description

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 previous reporting period.

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 Matching Grants Research Program which has been ongoing at USF and UCF since 1996 and at UF since 2005. This second 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 will propose 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 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 envisions providing up to $50K in matching funds for each project and with industry match (summarized in table below) on each project, attracting in excess of $500K of industry support to these FESC funded projects.

Progress Made During the Reporting Period

Both Phase I and II projects were completed. New projects will be funded when new funding is received. FESC office continues to work with faculty and industry to create new collaborative projects.

The Florida Cleantech Acceleration Network (FL CAN)

FESC was one of the partners of the FL CAN grant funded by the Economic Development Administration ($1.3M for 2 years). The FL CAN grant was completed on March 31, 2014. The last quarterly report was submitted to the program manager. The potential technology seekers such as strategic investors, customers or end users that are looking for innovative technology companies to invest in, and products to commercialize will be provided with this link: http://www.innovationconcourse.com/Seekers. The seeker, then can review the small business in this area and review the available IP. The FESC office will continue to collaborate with the team members to provide FESC IP information and user facility support to the Florida energy industry.

Companies Contacted and/or Assisted

The companies we are in communication with are listed at FESC web site based on area of expertise (under different sub menus): http://www.floridaenergy.ufl.edu/?page_id=11727

Companies/organizations contacted and/or assisted during the reporting period include Lockheed Martin, TerViva Inc., Sicarga, Citizen Energy, The Balmoral Group, Duke Energy, Siemens, Gulf Coast Energy network, Dayaway, EcoUrbana, CAAFI, Southeastern Coastal Wind Coalition, OUC, UN- Pakistan, G4 Synergetics, Encel, Saft, Power Tree, 25x'25 Alliance, NiteBloom, Bing Energy, Battery Innovation Center, INEOS, ASERTTI (http://www.asertti.org/), Eco-smart Inc., IBM, Aquantis Inc. Chemergy, Hydromatic Technologies (Dryers), Treasure Coast Research Park, EIW Corp., Pi-Innovation Inc., International Institute for Sustainable Laboratories (I2SL), World Housing solutions, Saf Glass, TIRC Energy Engineering International (representative for Saf Glass), Mainstream Engineering, NIST, USDA, ARA, Canadian Consulate, BioFuelNet - Canada, Agrisoma, Harvest Power, Viesel Fuel LLC, Algenol, Manny Garcia - Pool company, and Urjanet.

Some examples of collaborations:

Bing Energy: Working with Bing Energy and TECO representatives for Fuels Cell - CHP demonstration.

Viesel Fuel LLC – Located in Stuart, Florida. They have a 7.5 million gallon/year biodiesel facility that is pioneering the use of enzymes and resins to access lower-quality feedstocks in the production of ASTM D6751 certified biodiesel. The enzymatic and resin technologies employed by Viesel require less energy than traditional biodiesel production, thereby reducing greenhouse gas emissions, and can be constructed for a lower capital cost than traditional biodiesel plants. Visited the company to better understand their process and assist. Introduced the owner to a UF faculty performing field tests with Carinata (oil crop). The UF Faculty will send Carinata oil samples to Viesel for a test run.

Commercial Aviation Alternative Fuels Initiative (CAAFI) – Rich Altman, Executive Director Emeritus, is one of the members of the Energy Crop Certification work group. We are having meetings and telecons to develop a roadmap for the certification process.

Applied Research Associates, Inc. (ARA) – Visited their facility in Panama City FL for a facility tour. Toured their labs and bio jet fuel pilot plant. Shared FESC faculty expertise for potential collaboration.

TerViva Inc.: TerViva develops new crops for underproductive agriculture land. In Florida, they are focused on an oilseed tree crop that can make lost citrus land productive again. The downstream products from this crop target the deep-demand markets for fuel, feed, fertilizer, and biochemicals. Organized a meeting with UF IFAS Faculty and Terviva representatives for collaborative work. Faculty members are in communication with the company representatives.

SAF-GLAS, LLC – Located in Riviera Beach, FL. In addition to disaster resistant and security glass products, the company is developing Energy Glass which is an optically clear Vertical Building Photovoltaic Window System that produces continuous energy from sunlight, diffused, ambient light and ground reflectance. Visited the company with FESC faculty members. Collaborative proposal are being written.

Hydromatic Technologies (Kissimmee, FL) – An energy efficient device company specializing in energy efficient heating technologies for clothes dryers and other appliances. Connected the company president to UF faculty for collaborative US DOE proposal development.

EDUCATION

The Education program has three focus areas, community college programming at the Associate of Science and certificate level, nuclear energy education, and Undergraduate/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 and development of classes for undergradure/master and energy certification program.

Progress Made During the Reporting Period

Seven new grants were awarded to develop new energy education programs. Progress reports on existing and new programs are given below.

Florida Advanced Technological Education Center (FLATE)

PI: Dr. Marilyn Barger, Hillsborough Community College

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; Palm Beach State College; School District Hillsborough County; Florida Department of Education – Division of Adult and Career Education; West Side Technical School; 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), Usurbil GLBHI (Spain); TKNIKA - Innovation Institute for Vocational Training (Spain); 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; University of Miami; University of Alabama; Rutgers University; Energy Reduction Solution, SMC Corporation of America, Energy Conservation Group; Florida Solar Energy Consortium; Tampa Bay Regional Business Plan Energy Efficiency and Conservation Sub-Committee.

Summary

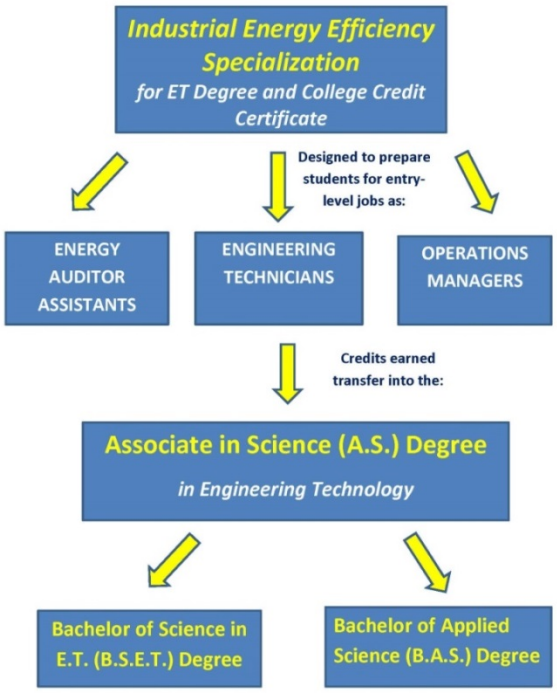
FESC partnered with Florida Advanced Technological Education Center (FLATE) to develop statewide curriculum frameworks for technical A.S./A.A.S. degree programs supporting existing and new energy business sectors.

FLATE develops and processes through the FLDOE the industry-validated student competencies of the frameworks. FLATE also develops new courses required for each new program of study. Additionally FLATE helps state and community colleges implement the new frameworks in their institutions. To support the new curriculum, FLATE works closely with the FESC Public Outreach and Industry Partnership programs to provide professional development opportunities for teachers and faculty to upgrade and update their knowledge base.

Project Activities, Results and Accomplishments

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 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.

Together with the National Science Foundation-funded Energy Systems Technology Technicians (EST^2) project team, FLATE has developed a new Industrial Energy Efficiency specialization for the Engineering Technology (ET) Degree and associated College Credit Certificate, in addition to the existing Alternative Energy Specialization. Experts from industry, government and academia have been involved in this collaborative effort and instrumental in ensuring that the new specialization is directly aligned with current industry needs. It will help students prepare to become a **SEP - Superior Energy Performance Certified Systems Practitioners** and **CEM Certified Energy Managers**.



In addition, the program will train workers who will assist a company in achieving the ISO 50001 standards related to energy management, as well as ISO 14001:2004 to assure a company's stakeholders that measures are being taken to improve their environmental impact. Credits earned in this certificate will transfer into the Associate in Science (A.S.) degree in Engineering Technology. The IEET program framework has been approved by the FL Department of Education, curriculum content modules to support the newly defined courses are complete, and are able to implement it in the current academic year.

Industrial Energy Efficiency Course List

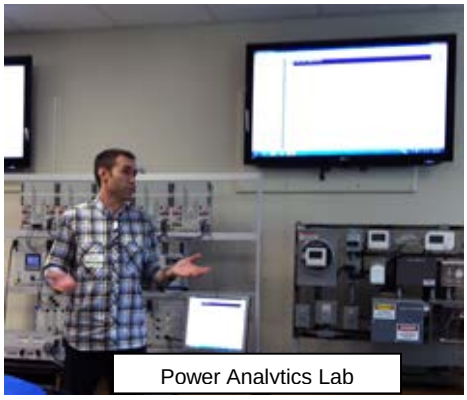
1. Fundamentals of Industrial Energy Efficiency (3 CH)
2. Industrial Systems (3 CH) *pre or co-requisite of Fundamentals of Industrial Energy Efficiency*
3. Energy benchmarking and performance analysis (3 CH) *pre or co-requisite of Fundamentals of Industrial Energy Efficiency*
4. Industrial Energy Analytics and Troubleshooting (3 CH) *pre or co-requisite of Fundamentals of Industrial Energy Efficiency and Industrial Systems*
5. Energy Efficiency Instrumentation and Measurement (3 CH) *prereq of Fundamentals of Industrial Energy Efficiency and Industrial Systems*
6. Industrial Controls and System Integration (3CH) *prereq of Fundamentals of Industrial Energy Efficiency and Industrial Systems*

7. Industrial Energy Efficiency Capstone (3CH or variable)

Engineering Technology Energy-Related Programs as of January 2014

COLLEGE CREDIT CERTIFICATES	COLLEGES OFFERING
Alternative Energy Systems Specialist (CCC) **Career Cluster:** Manufacturing CIP #: 0615000003 **Program Length:** 18 (Primary) or 15 (Secondary)Credits	Eastern Florida State College/BCC, Daytona State College (pending), State College of Florida, Gulf Coast State College, Broward College (pending), Palm Beach State College
Industrial Energy Efficiency Specialist (CCC) **Career Cluster:** Manufacturing CIP #: 061500000x **Program Length:** 21 (Primary) or 24 (Secondary) Credits	Florida State College at Jacksonville – pending with content being included in current courses
A.S. DEGREE SPECIALIZATIONS (60 credit hours)	**COLLEGE OFFERING**
A.S. Eng Tech Alternative Energy Technology	Eastern Florida State College/BCC, State College of Florida, and Gulf Coast State College
A.S. Eng Tech Industrial Energy Efficiency	Florida State College at Jacksonville - pending

Frameworks are posted on the FLDOE website:
http://www.fldoe.org/workforce/dwdframe/mfg_cluster_frame12.asp



Power Analytics Lab

Attendees examine Electric Vehicles

FLATE coordinated a third highly successful energy workshop/forum (the previous workshops were held in Gainesville and Cocoa), for high school and college educators, as well as industry partners, hosted by the Institute for Energy and Environmental Sustainability at Palm Beach State College on January 31, 2014. Forty attendees attended a wide variety of presentations, were treated and participated in a Power Analytics Development activity.

The morning session included presentations about electric vehicles, algal biofuel and marine renewable energy, as well as a Florida Department of Education update from Kathryn Frederick Wheeler, Supervisor of Energy and Architecture and Construction Career Clusters.

Florida Power and Light Company brought a selection of electric cars/truck for participants to explore up-close, during the lunch hour. The afternoon session included a panel discussion on turbines and advanced fuels followed by a power analytics professional development activity held in IEES' state-of-the art power analytics lab. For the first time, thanks to Palm Beach State College's Media Technology and Instructional Services, the meeting was also broadcast live via the Internet, so that folks that wanted to attend, but couldn't travel could participate "remotely".

FLATE's Fourth **Annual Summer Energy Camp** was held July 7 – 10, 2014 at Hillsborough Community College's SouthShore campus which is LEED (Leadership in Energy and Environmental Design) silver-certified by the USGBC (U.S. Green Building Council), and boasts an earth-friendly, energy-conscious functionality incorporating a number of sustainable features. The camp was a huge success with over ¾ of the campers being Hispanic females. Feedback from both teachers and students overwhelmingly positive! Twenty two 7th and 8th grade students were treated to four days of exciting, hands-on activities centered on capturing and keeping their interest in STEM (Science, Technology, Engineering and Math) subjects – specifically renewable energy. Camp participants were all part of Hillsborough County School District's AVID (Advancement Via Individual Determination) Excel Program, consisting of first generation college-bound, English language learners. The possibility of adding a high school energy camp in 2015 is being discussed.

Cumulative Camp Data

	Total	Male	%	Female	%	White	%	Hispanic	%	Black	%
2011	12	8	67%	4	33%			11	92%	1	8%
2012	13	9	69%	4	31%			13	100%		
2013	25	15	60%	10	40%			23	92%		
2014	22	6	27%	16	73%	0	0	22	100%	0	0

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. At the April 3 – 4 ET Forum in Bartow, FL at Polk Community College, the new Industrial Energy Efficiency Specialization and College Credit Certificate courses were presented.

Activities for the 2013-2014 year are listed below.

- Attended the Manufacturers Association of Florida Summit in St. Petersburg, FL, December 3 – 5, 2013
- Coordinated a third Community College Energy workshop for 40 attendees at the Institute for Energy and Environmental Sustainability at Palm Beach State College on January 31, 2014.
- Presented "Integrating Environmental Sustainability Concepts and Practices into Florida's Engineering Technology Education System" at the American Society for Engineering Education's Conference for Industry and Education Collaboration in February, 2014 in Savannah, GA.
- Attended the 2014 Beyond Sustainability 38th Annual Conference at Hillsborough Community College, Ybor City, February 28 – March 1.
- FLATE hosted the Engineering Technology (ET) Forum in Tampa in October, 2013 and in Bartow, April 3-4, 2014 where the Energy Efficiency Specialization courses and content were presented.
- FESC Workshop May 12-13, Gainesville. Presenting a poster, "Matching Training to Industry Needs: Industrial Energy Efficiency Education".
- Attended the Florida Energy Teachers' Network Fourth Annual Workshop in Gainesville. June 11-12.
- Fourth Summer Energy Camp for under-represented middle school students was held July 7-10 at HCC's SouthShore Campus in Ruskin, FL in conjunction with the EST2 grant partners (BCC, TCC and FSCJ).

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.

University of Florida Nuclear Training Reactor (UFTR) Digital Control System Upgrade for Education and Training of Engineers and Operators

PI: Dr. Kelly Jordan (Project was initiated by Dr. Aliriza Haghighat)

Executive Summary

As nuclear power plants age, analog safety instrumentation obsolesces and becomes difficult to maintain. Adoption of advanced digital instrumentation and control (I&C) technologies in the nuclear sector has significantly lagged that of other industries. Utilities have been slow to implement these systems due to regulatory licensing uncertainty and a lack of internal expertise with new systems. As the previous generation of the nuclear workforce retires, the pool of available expertise in analog technology declines. The experience at Japan's Fukushima Power Station shows the need to continually modernize and augment reactor safety and operational systems.

In Operation since 1959, the UFTR has undertaken an ambitious project to renovate replace all aspects of the facility, with a center point on upgrade of the 50-year old analog I&C systems with new, modern digital systems. Once modified, the facility will provide training and education for the future workforce as well as a demonstration platform in the area of advanced digital I&C for nuclear reactors. This effort ushers in a new focus on advanced digital I&C research, development, and testing, and greatly augments the existing Nuclear Engineering Program at UF. Further, the UFTR facility will offer training courses for other educational institutions in the state, such as Florida International University and Indian River State College, who provide the majority of nuclear technician education in Florida, as well as training for personnel from nuclear utilities and government agencies, including the Nuclear Regulatory Commission.

The refurbishment project was launched based on the conversion of the reactor core from high-enriched uranium to low enriched fuel as part of a nationwide effort after 9/11. As part of this program, many major upgrades have been completed over the FESC project period, including an NNSA-funded security system ($460k), a renovated HVAC system ($250k), a new stack exhaust monitor and high plume exhaust system funded by DOE ($212k), and a new nuclear instrumentation system ($300k). FESC funding has been leveraged to augment these efforts, including the design of a new control blade drive systems for the UFTR and purchase of field instrumentation sensors to integrate with the new control design.

The completion of the full digital control system portion of the upgrade has been adversely affected by two external factors. First, the UFTR had established a contract with Siemens Energy for the design and manufacture of the control system interface which has been dissolved. A business restructuring driven by Siemens Global resulted in the disbanding of the Siemens Energy Nuclear I&C division responsible for this project. After this, the UFTR decided to pursue another vendor partner for this system. Secondly, the Nuclear Regulatory Commission has de-prioritized licensing actions for existing research reactors resulting in multi-year delays in the approval of upgrades. Congress has declared the shortage of medical isotopes a national security concern. Several new nuclear reactor-based medical isotope production projects have begun and are in the process of submitting licenses to the Nuclear Regulatory Commission, which has prioritized these projects over licensing of existing research reactors.

Despite these adverse project impacts, the UFTR will restart operations at the end of 2014, with most upgrades fully implemented. The digital control interface design is complete and manufacturing and install are on hold pending both identification of a new manufacturing partner and regulatory approval. FESC funding has been instrumental in maintaining progress of refurbishment and ensuring the success of existing efforts despite these adverse impacts.

The final report is given on page 157 of this report.

Buildings and Energy: Design and Operation Vs. Sustainability

PIs: Dr. Prabir Barooah, Dr. Duzgun Agdas, and Dr. Ravi S. Srinivasan

Project start date: May 16, 2014
Project end date: May 15, 2015

Summary

To achieve higher standards in building design and operation, a solid foundation of energy engineering and sustainability principles is essential. At UF engineering, there are no courses offered to students and industry professionals in energy topics particularly related to buildings, specifically for the design and operation in Florida climate conditions. This project fills this void through the development of an energy engineering course.

Goals and Objectives

1. To develop and offer an online undergraduate/graduate energy engineering course for Florida-specific building design and operation.

Project Activities, Results and Accomplishments

Progress made (as of 10.09.2014):

- The undergraduate / graduate course officially commenced in Fall 2014. The corresponding UF official course numbers are: EML 6934 / EML 4930.
- This course is also available via UF Edge (online course). Video recordings of all lectures are available in UF Edge for access by students taking the online version of this course.
- Currently, there are 13 students (8 graduate students and 5 undergraduate students) enrolled in its first term. More students and industry professionals are expected to join in the coming years as the course is advertised via UF Edge.
- For the benefit of the State of Florida, the building energy modeling project specifically focuses on a retrofit of an existing building in UF campus, i.e., Rinker Hall. The selection of this retrofit project was crucial as students will learn the issues related to Florida-specific climate and the nuances of modeling, calibration, and improving building energy efficiency.
- Besides the primary course faculty (PIs), guest lecturers participated in this course.

Concluding Remarks

This engineering course is a game-changer in respect to buildings and energy. As the course delivery is completed by end of Fall term, the PIs have planned to focus on advertising this course to industry professionals in the State of Florida with a view to greater enrollment and impact in subsequent offerings.

Renewable Energy Education Program at USF's Patel College of Global Sustainability

PI: George Philippidis, Ph.D., University of South Florida (USF)

Project Description

The goal of this project is to establish an education program in renewable energy at USF's Patel College of Global Sustainability (PCGS) by developing two graduate-level courses: (1) *"Renewable Transportation Fuels"* and (2) *"Renewable Power Portfolio"*. The courses will be developed for both in-class and on-line delivery and will constitute the concentration in Renewable Energy for the College's existing M.A. in Global Sustainability.

Technical Report

(1) Course: *Renewable Transportation Fuels*

During the 3rd calendar quarter of 2014 the content of this course was completed and the course was successfully launched for Fall Semester 2014 on Aug. 26, 2014. It is taught by Dr. Philippidis on Tuesdays at 6:00-8:45 pm at USF's Patel Center and through the Canvas System Online. The first class consists of 13 graduate students in class and 5 graduate students on line (including a student attending on line from Taiwan).

The course is delivered in the form of weekly modules, each one consisting of a PowerPoint presentation, assigned readings from the selected textbook and the literature, and in-depth discussion, both in class and on line. The instructor has created a discussion board on Canvas, where students are required to respond to the instructor's questions on a weekly basis and to comments made by their classmates.

The 11 modules of the course are:

1. Energy for a green economy
2. Corn ethanol and biodiesel
3. Sugarcane ethanol
4. Biomass as a biofuels resource
5. Advanced biofuels
6. Biochemical conversion of biomass
7. Thermochemical conversion of biomass
8. Algae technologies
9. Economics and finance of advanced biofuels
10. Sustainability and environmental aspects of biofuels
11. Establishing a biofuels industry (integrative case study)

Two exams are planned, a mid-term and a comprehensive final. For the research project the students have already selected their individual topic of interest from the list of modules. Students will share their findings with their classmates during a professional presentation and will produce an individual written report at the end of the semester.

Moreover, 3 professionals from the biofuels industry have accepted invitations to appear in class as guest speakers. Their presentations will be recorded professionally and posted on canvas for access by the on-line students.

(2) Course: *Renewable Power Portfolio*

Development of the content of this course has started and is in progress. The course will focus on the various forms of renewable power: solar water heating, photovoltaics, concentrating solar power, wind, geothermal, bioenergy, and ocean energy. Technology, economics, financing, policy, market penetration and prospects, regulatory, and sustainability aspects will be presented for each of these forms of renewable energy.

A textbook has been selected ("Introduction to Renewable Energy" by V. Nelson, CRC Press, 2011). The modular structure of this course will be similar to that of the first course, including a research project in one of the areas listed above and participation by guest speakers from utilities and other renewable energy companies. The course will be launched in Spring 2015.

Financial Report
Submitted separately (in the form of an invoice) by our Grant Financial Administrator Sharon Corlett.

Energy Sustainability Course (Undergraduate level)

PI Name: Mark Jamison, Public Utility Research Center, University of Florida

Institution: Public Utility Research Center, University of Florida
Project Time Period: Fall 2014 and Spring 2015
Date: October 3, 2014

Summary
A general business class for upper level undergraduates, "The Economics of Sustainable Energy" is being offered in Fall 2014 and Spring 2015.

Goals and Objectives
The class provides students with fact-based and analytically rigorous discussions of the economic realities of sustainable energy. Key topics include energy markets and regulation, analytical techniques, environmental policies, economics of fuels, energy efficiency, and case analysis.

Project Activities, Results and Accomplishments (This is the main body of report and may use other headings such as Research Description, Results, etc. – author's choice. Items that should be included are accomplishments, benefits to the state and how funds were leveraged.

- Lectures are currently being taught in-class for UF undergraduate students.
- The course will be recorded and made available to non-students. This will allow Florida citizens to better understand utilities and topics relating to sustainability from an economics perspective.
- Students will participate in a forum in which they will discuss issues related to sustainability in Florida.

Introducing Specialization in "Sustainable Energy Systems" for Under-Graduate Students in Engineering at the University of West Florida

PI: Dr. Bhuvaneswari Ramachandran, Assistant Professor, Department of Electrical and Computer Engineering, University of West Florida

Co-PI: Dr. Muhammad H Rashid, Professor, Department of Electrical and Computer Engineering University of West Florida

Project Time Period: Aug 2014 to July 2016

Summary
The objective of this proposal is to introduce a specialization in "Sustainable Energy Systems" for Undergraduate Engineering students at the University of West Florida that could also be used to educate industry professionals towards workforce development. The courses have been designed from the perspective of energy system planning, a subject that has always been complex and evolving rapidly during the past 10-15 years to accommodate dramatic changes in the industry. These changes include the ongoing transformation of the nation's generation portfolio from being heavily dependent on fossil fuels to one that is heavily dependent on renewables (especially wind and solar) and the need for operating competitive electricity markets.

The courses designed under this specialization will assist professionals in understanding the limits of our present energy systems and lead us to a future in which we can continue to provide reliable and secure energy resources for improved human quality of life. The proposed specialization program focuses on electrical engineering sources and systems that are non-polluting, conserving of energy and natural resources, economically viable and safe for workers, communities and consumers. Coursework takes a systems level and interdisciplinary approach to solving seemingly intractable sustainable energy problems, as opposed to single disciplinary and locally optimized approaches destined to yield marginal positive impacts. Students will be able to create study programs suited to their interests and aspirations through their choice of electives and design projects. The course is electrical engineering-based but also covers a wider range of topics including economics, sustainability and environmental studies.

Discussions to offer this course as a certificate course are going on between faculty and Continuing Education department of the University. According to the designed curriculum, students were to take 4 courses from within the Specialization Core (12 credits) and one elective on Environmental Law with the schedule given below.

As the first step, a website was created for the specialization so that students can refer to it for information about faculty and contents of courses. The URL for website is
http://uwf.edu/cas/cas-departments/electrical-and-computer-engineering/specialization-options/sustainable-energy-systems/

The course on Renewable Energy Systems taught by Dr.Muhammad Rashid, Professor of Electrical and Computer Engineering, has been offered this fall 2014 and 34 students have enrolled for this course. Online material was developed and uploaded on to the University's electronic learning and communicating site called 'eLearning'. Study material and lectures for 'Future Energy Systems' course is under preparation by Dr. Bhuvaneswari Ramachandran with assistance from a student assistant. They will be uploaded on to 'eLearning' by March 2015 in preparation for course offering during summer 2015. The progress made is on track with the schedule that was proposed initially.

Goals and Objectives

The objective of this project is to_introduce a specialization in "Sustainable Energy Systems" for Undergraduate Engineering students at the University of West Florida that could also be used to educate industry professionals towards workforce development. Energy sustainability is about finding the correct balance between a growing economy, the need for environmental protection and social responsibilities in order to provide an improved quality of life for current and future generations. In short, it is meeting the needs of the present without compromising the needs of the future. Sustainable-energy education can inspire technical innovation with an environmentally conscious mindset. The proposed curriculum in "Sustainable Energy Systems" allows a student in any four-year undergraduate School or College to complete a coherent suite of classes that reveals the interdisciplinary nature of energy studies. The curriculum includes the essential elements of energy from the business, economics, and engineering perspectives, as taught by faculty in those areas. This program can be easily divided into modules to fit into a certificate course for professionals working in the industry and hence can aid them towards workforce development.

Project Activities, Results and Accomplishments

As the first step, a website was created for the specialization so that students can refer to it for information about faculty and contents of courses. The URL for website is

http://uwf.edu/cas/cas-departments/electrical-and-computer-engineering/specialization-options/sustainable-energy-systems/

The timeline for offering courses under this specialization is

Year-1	Fall 2014	Renewable Energy Systems
	Summer 2015	Future Energy Systems
Year-2	Fall 2015	Power Electronics and Drives
	Summer 2015	Sustainable Power Systems: Planning, Operation, and Markets
Elective	Fall/Spring	Environmental Law

The course on Renewable Energy Systems taught by Dr.Muhammad Rashid, Professor of Electrical and Computer Engineering, has been offered this fall 2014 and 34 students have enrolled for this course. Online material was developed and uploaded on to the University's electronic learning and communicating site called 'eLearning'. Study material and lectures for 'Future Energy Systems' course is under preparation by Dr. Bhuvaneswari Ramachandran with assistance from a student assistant. They will be uploaded on to 'eLearning' by March 2015 in preparation for course offering during summer 2015. The progress made is on track with the schedule that was proposed initially.

Concluding Remarks

The School of Science and Engineering (SSE) in specific and the University of West Florida as a whole are very supportive of this plan to introduce an undergraduate specialization in "Sustainable Energy Systems". Every effort is being made by the faculty and administration to make this specialization sustain in the University for a very long time to come.

Solar Energy Technologies: Fundamentals and Applications in Buildings

PI: Cheng-Xian (Charlie) Lin, Ph.D., Associate Professor, Department of Mechanical and Materials Engineering, Florida International University

Summary
In this project, the PI at Florida International University will develop a new online course in solar energy technologies, with emphasis on solar applications in buildings, taking account the unique solar resource and infrastructure in the state of Florida.

During this report period, the PI has received the new award notice from FESC. The research offices at FIU and University of Florida (UF) are currently working on getting the subcontract in place.

Goals and Objectives
In this project, the PI from FIU will develop a new online solar energy course, with emphasis on the solar system applications in different buildings for electrical power generation as well as for heating and cooling systems, by taking into account Florida's solar resource and infrastructure.

The course will be offered completely online through the Blackboard Learn system. The course targets senior undergraduate students and entry level graduate students who study in FIU as well as other universities in the state of Florida. The course will be offered at least once a year. Students will earn 3 credit hours by taking the course in the Spring, Fall, and/or Summer semesters.

Project Activities, Results and Accomplishments
FESC decided to fund this project in August 4, 2014. The official subcontract agreement has been received by the PI on October 8, 2014.

Currently, the research offices at FIU and UF are working on the necessary paperwork to get this contract in place.

This project was recently approved. The progress report will be provided in May 2015 report.

Renewable Energies and Sustainability Education

CO-PI's: Dr. Ryan Integlia, Electrical and Computer Engineering, Florida Polytechnic University and Dr. Sesha Srinivasan, Physics/Innovation and Technology, Florida Polytechnic University

Team Participants:
Mr. Gary Albarelli, Florida Industrial and Phosphate Research
Dr. Brian Birky, Florida Industrial and Phosphate Research
Dr. Jorge Vargas, Electrical and Computer Engineering
Dr. Jaspreet Dhau, Chemistry and Business

Summary: This education proposal is aimed at developing a stand-alone course content accessibility, conducting competitions and workshop that can be offered to undergraduate and graduate students at the Florida Polytechnic University. The related content would be available through online education delivery platforms and as a byproduct, would be accessible by the general public and may provide added awareness and public outreach. This work will be aligned with the renewable energy and sustainable infrastructure initiative at the University. This course will create awareness and engagement of various renewable energy systems, technologies promoting sustainable, and economic development concepts supporting entrepreneurship among students and industry (Mosaic and others) that impacts the workforce and the economy of Florida.

This project was recently approved. The progress report will be provided in May 2015 report.

A Certificate Program to Enhance Sustainable Behavior Change Competencies for Educational Outreach Professionals

PI: Laura A. Sanagorski Warner, Ed.D. , Assistant Professor, Department of Agricultural Education and Communication, Center for Landscape Conservation and Ecology, University of Florida/IFAS

Summary
This project describes a certificate program targeting Extension and other educational outreach professionals. The intention of this educational offering is to improve the process of program delivery focused on sustainable behavior change. Ultimately, improved delivery strategies will increase the adoption of behavior change related to energy and other limited resource use. Behavior change is an important component of sustainability. When sharing information about environmental concerns, "simple education that invokes this information is often insufficient to move people to action" (Shaw, 2010, p. 109). Recognizing that most environmental challenges are caused by human behavior, it is critical to focus on encouraging changes in behavior over increasing knowledge alone (Bickman, 1972; Shaw, 2010). However, many approaches to behavior change require specialized skills that may not be immediately available to the educational practitioner.

The goal of this project is to provide training on social marketing, a promising approach to behavior change (Rogers, 2003; Shaw, 2010). This educational program will be offered to environmental educators who work for a variety of institutions throughout Florida, including outreach professionals who work in Florida museums and Extension educators who encourage the sustainable use of energy, water, and other limited resources. The resulting product will be a certificate program for outreach professionals designed to enhance competencies to encourage behavior change among their audiences.

Social marketing can be applied to many areas of environmental sustainability, including energy, water, climate change, and many other areas. Additionally, it can be used by many different entities that include Extension educators, museum outreach professionals, individuals, utility companies, energy companies, county governments, state government.
It is anticipated that 50 educational outreach professionals throughout Florida will engage in this program during the project time frame. However, the impact will reach the thousands of individuals who are taught by these participants. The online nature of this project will allow us to expand our reach nationwide in subsequent years.

This project was recently approved. The progress report will be provided in May 2015 report.

OUTREACH

FESC outreach program leverages 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*
- *Ms. M. Jennison Kipp Searcy*

FESC provided new funding to the outreach group to continue with their Sustainable Floridian[SM] Program.

Sustainable Floridians[SM] Program, By Kathleen C. Ruppert (kr@ufl.edu)

Rationale for the Program

There is a compelling need to improve environmental, economic, and social sustainability at individual, community, and regional scales1,2. Energy directly impacts sustainability on all of these scales. Recognizing the importance of taking a leadership role in addressing sustainability issues for Florida communities, UF/IFAS Extension adopted statewide Initiatives 3 and 6, Enhancing and conserving Florida's natural resources and environmental quality and Strengthening urban and rural community resources and economic development, respectively, as part of the UF/IFAS Extension Roadmap 2013-2023, indicating the importance of this topic.

The mission of the national Cooperative Extension System is to improve the lives, and meet the ever-changing needs, of American citizens through the consumer-scale application of the academic research knowledge emerging from land grant universities. Through the Sustainable Floridians[SM] program participants learn that energy is a part of everything we do in our lives.

Many consumer-oriented programs advertise solutions to address various challenging consumer needs. Yet, solutions are often only relevant to a specific and temporary point in space. Additionally, true differentiation between a problem and a solution requires reflection and intention. In other words, overcoming constraints and realizing new opportunities necessitates that citizens contemplatively look back and consciously move forward toward goal achievement within their community. In terms of offering "solutions," the Sustainable Floridians[SM] program develops and iteratively refines its curriculum to provide "enablers" and produce "change agents."

Energy Challenges for Florida Communities include:

- Environmental challenges: conserving resources for the future
  - Maintain land and water resources for future humans and wildlife
  - Reduce dependency upon outside resources (fossil fuels, non-local water)
  - Climate change in Florida: effects on coastal cities, agriculture, wildlife
- Economic challenges: doing more with less
  - Stressed families, communities, governments, businesses, and community organizations
  - Uneven distribution of economic, social, and environmental assets across and within communities
- Urban challenges:
  - Maintaining healthy urban/suburban cores
  - Positioning for smarter vs. sprawling future growth
  - Balancing compactness and green infrastructure
- Rural challenges:
  - Maintaining and diversifying agriculture
  - Providing essential social services in economically distressed communities
- Urban-Rural challenges:
  - Building regional strength through increased urban-rural food connections
  - Strengthening regional sense of place.
  - Disaster preparedness challenges including adaptation, mitigation and resilience.

The Extension Approach to Energy and Climate-related Education

The scope of energy related issues outlined above is extensive. How can this Extension program contribute? The UF/IFAS Extension service already delivers diverse programs that educate citizens about sustainable practices and how to incorporate them into their lives. This program is designed to take advantage of the Extension Service's institutional strengths to deliver holistic sustainable living programming with a social component. This program builds upon strengths in delivering sound, reliable information in a network of existing communication channels throughout the state of Florida and in a setting that creates a civic, nonpartisan "third space." Exercises that go along with the curriculum add an experiential learning element. Providing reliable, research-based information is the first step. There has been a call for education in both formal and non-formal venues to address sustainability issues including "climate literacy".[3, pg. 575-84] Other issues are equally important: literacy about environmental concerns such as water supply and quality, energy sources and alternatives, etc.

The goal is to provide up-to-date, reliable information with a geographic focus on Florida. This educational component of the program is especially necessary in order to reach the population of newcomers to the state who are unfamiliar with the state's ecology, economy and geography. In so doing, incorporating a 'sense of place' to all who live and/or work in Florida.

Social Learning

A growing field of research is highlighting the importance of social dynamics in bridging the gap between knowledge and action about sustainability. Information alone, or even financial incentives, is not always enough to induce behavioral change that results in more sustainable outcomes for individuals and communities. According to environmental psychologist Doug McKenzie-Mohr, "The cornerstone of sustainability is delivering programs that are effective in changing people's behavior. If we are to make the transition to a sustainable future, we must concern ourselves with what leads individuals to engage in behavior that collectively is sustainable, and design our programs accordingly".[4, pg.14]

Peer interaction is shown to affect decision making and commitment to change[5]. For this reason, the program is structured to include peer discussions that allow participants to discuss obstacles that stand in the way of adopting sustainable behaviors, as well as solutions to overcoming these obstacles. The peer interaction portion brings in local knowledge, creates group cohesion, and improves chances of lasting behavioral change by taking into account the effect of social processes upon behavioral change. In addition, participants will be working on a personal sustainability plan throughout the course, which they can discuss along the way with their classmates or share with other group members at the final course meeting.
Another hands-on component is record keeping, which will enable participants to become aware of their baseline levels of water and electricity consumption and personal vehicular miles traveled. Participants will be asked to continue to keep records and report their data after the course is completed to gauge the effectiveness of the program. While achieving behavioral changes is difficult, the potential for strengthening communities through cumulative sets of individual actions is real.

Course graduates are strongly encouraged to continue working with their county Extension office upon completion of the course on sustainability-related projects and activities that improve their community. The eventual goal is to develop a group that can assist themselves as well as other households and the community at large in becoming more resilient.

The class has multiple components, from which the leaders adapt as needed to show local needs and situations. Nevertheless, three themes permeate the class: 1) ***footprints:*** learning about our ecological impacts and how to reduce them; 2) ***handprints***: becoming inspired to create positive changes in our communities with synergistic aid of the class and the backing of research-based material, and 3) ***connections***: re-thinking the connections among our community, environment, and economy.
Whether the class is a group of varied citizens, members of a government "green team," or a gathering of sustainability-minded local leaders, we believe this program is beneficial in providing the audience with practical information for incorporating sustainable practices into their lives while also increasing their knowledge base about sustainability issues in Florida, which are all related to energy.

Program Mission and Goals

The mission of the Sustainable Floridians[SM] program is to guide Floridians on how to take individual responsibility for protecting Earth's limited resources. Through a discussion-to-action format, the program educates participants about making wise use of resources, making households and communities more resilient and financially sound, and understanding the impact of individual lifestyle choices.

Goals

- Improve environmental and financial resilience for participants and communities.
- Provide information that identifies Florida-appropriate targeted actions for conserving resources, including energy and water.
- Motivate participants to implement conservation and efficiency actions that save resources and money.
- Provide a forum that promotes sustainability leadership within the community.

Desired Outcomes

- Creation of participants' individual sustainability action plans that fit their situations, based upon an increase in knowledge about sustainability issues in Florida.
- Reduction in the direct energy and water usage among participants.
- Establishment of a statewide database for energy and water usage and vehicle miles traveled.
- The identification of future community-level actions that can be taken to increase community resilience and sustainability.

Works Cited

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4. Diamond, J. 2005. *Collapse: How Societies Choose to Fail or Succeed*. New York: Penguin.
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Activities, with regard to the Sustainable Floridians^{SM} Program, include:

- Organized and participated in an in-service training in Gainesville, representing 13 Florida counties, at the annual state-wide Family Youth and Community Sciences Extension Summit (May 7th) to introduce county faculty to the program as well as share experiences from county faculty who had piloted the program to date.
- Spoke to the consumer horticulture agents at their 2014 Master Gardener Program Coordinator in-service training, representing approximately 15 counties, in Gainesville on May 22nd to encourage them to participate with their fellow county faculty members in offering the program in their county.
- Worked with county faculty from five counties to organize and offer a 3-hour in-service training titled "Helping Youth and Adults Address Climate Change through Experiential Learning" for 26 county and state faculty during the 2014 Extension Professionals (EPAF) statewide Extension Professionals Associations of Florida annual conference in Panama City Beach on August 28th.
- Participated in a training session at the 2014 Extension Professionals Associations of Florida (EPAF) annual conference in Panama City providing an overview of FESC and the Sustainable Floridians^{SM} program.
- Added an additional module, "Climate Change and Sea Level Rise," to the Sustainable Floridians^{SM} course materials.

- Brevard County began the program in August. Monroe County is planning to offer the program in the Fall of 2014.
- Participated in national webinars that are aiming to increase energy literacy for all citizens…provided materials to their national clearinghouse and hope to incorporate the materials they are developing into the program next year.
- Maintained a SharePoint site, making all of the materials (PowerPoints, pdfs, evaluation, instructor guides, etc.) accessible by County Extension Faculty once they request more information and/or involvement.
- Began working with the Fall 2014 Design, Construction, and Planning students in DCP4941 – Practicum in Sustainability and the Built Environment, in the development of additional course modules.
- Working with the Fall 2013 class of DCP 4941 – Practicum in Sustainability and the Built Environment students and UF's Office of Sustainability, created the "Action Plan for Promoting Sustainability in Extension Offices" document that was then reviewed and made available to IFAS administration and all of the county extension offices in the state as well as being made available to members of the National Network for Sustainable Living Education (NNSLE).
- Initiated meetings with UF's Office of Sustainability to work toward shared activities and trainings that can benefit the Sustainable Floridians^{SM} program as well as Extension faculty, thereby encouraging sustainable practices and improving the economic, environmental, and social conditions of communities throughout the state. As such the Office of Sustainability, working with the Florida Association of Natural Resources Extension Professionals (FANREP) has agreed to sponsor two awards for county extension offices that show they are practicing sustainability. FANREP anticipates having the criteria in place by the end of December, 2014.
- Began updating/editing some of the existing fact sheets.
- Maintained an active advisory committee consisting of the state leader and county faculty members from Flagler, Leon, Monroe, Palm Beach, and Pinellas counties, which "meets" via periodic conference calls.
- Presented a poster and provided a presentation titled "Sustainable Floridians^{SM} Program – Strengthening Your Sense of Place" as part of the FESC Workshop held in Gainesville on May 12th and 13th.
- Formed and updated an email list of county faculty interested in learning more about the program and FESC, in general.
- Worked with the County Agent in Pinellas County, UF's Office of Counsel, and the SF Advisory Committee to develop the criteria and form, "The University of Florida Institute of Food and Agricultural Sciences (IFAS) Use of the Sustainable Floridians^{SM} Mark," that can be used by other educational institutions to apply to use the Sustainable Floridians^{SM} title in their programmatic efforts. Approved the first such use to St. Petersburg High School.
- Initiated discussion between a Brevard County Agent and a Water Resource Specialist, here on the main campus, to begin a pilot program with some of the SF graduates in research involving monitoring homeowner water use.
- Submitted a request, and received approval, to offer a two day in-service training in 2015 titled "How to Get Someone to Change Their Behavior and Think it is Their Idea."
- Worked with IFAS Extension Initiatives 3 and 6, Enhancing and conserving Florida's natural resources and environmental quality and Strengthening urban and rural community resources and

economic development, respectively, begun in 2013 as part of the UF/IFAS Extension Roadmap 2013-2023, to show the continuing importance of this topic.

- Kathleen Ruppert received the Champions for Change Award from UF's Office of Sustainability in the Academics category on April 11th.
- The program was selected as 3rd Place Southern Region Winner in the Environmental Education category and 3rd Place National Winner by the National Extension Association of Family and Consumer Sciences (NEAFCS) organization.

Other Outreach Activities

FESC Web Site and e-Newsletter (www.FloridaEnergy.ufl.edu)

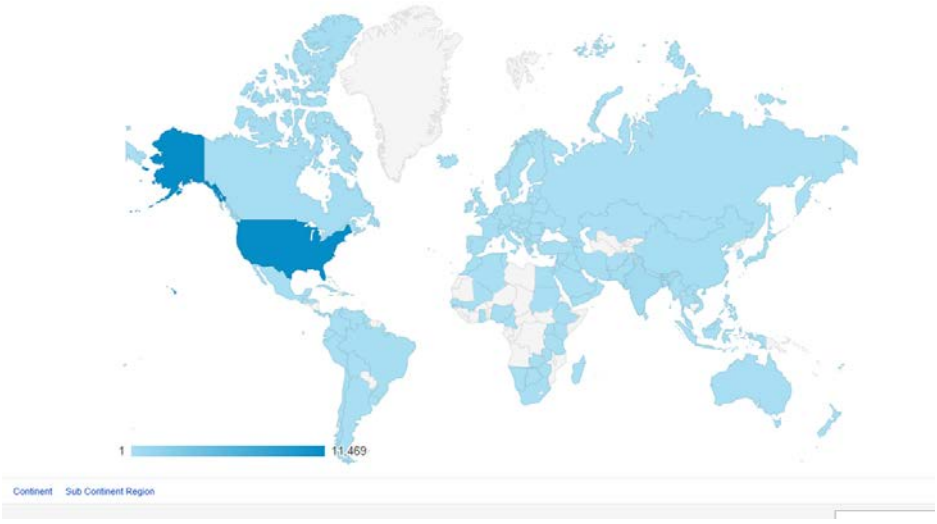
FESC Website: FESC Website and e-Newsletter: The FESC website continues to be an important communication tool for our program. It is updated regularly to remain current and to better serve our users. Based on a Google Analytics report, the FESC web site was viewed by 15,832 Google visitors (12,338 or 77.9% new visitors) during the period of September 30, 2013-October 1, 2014. The viewers visited 38,612 pages. Viewers were from over 131 countries, including those in North and South America, Europe, Asia, Australia, the Middle East and Africa. FESC prepares and distributes bi-monthly electronic newsletters by email to over 1000 subscribers.

The data compiled from Google Analytics are given below:

Activity overview of the FESC's website from September 30, 2013-October 1, 2014.

Activity	9/30/2013-10/1/2014
Total Visitors	15,832
New Visitors	12,338
Page Views	38,612

FESC WebsiteVisits by Country



FESC e-Newsletter: FESC prepares and distributes electronic newsletters every other month to over 900 FESC industry/faculty contacts. The e-newsletter provides the current events and funding opportunities. It highlights the accomplishments of FESC faculty and Florida industry. It also covers global energy related news. The newsletters are posted at FESC web site: http://www.floridaenergy.ufl.edu/?page_id=1999. The most recent newsletters are given below as an example.

FESC Newsletter April2014.pdf | FESC Newsletter June 2014.pdf | FESC Newsletter July 2014.pdf | FESC Newsletter September 2014.pdf

FESC May 2014 Workshop

FESC workshop was held on May 12-13, 2014 at the Hilton University of Florida Conference Center in Gainesville, FL. The workshop was organized to bring together energy experts in the State University System of Florida and industry 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 workshop was opened with welcoming remarks from Dr. David Norton, University of Florida's Vice President of Research, and Patrick Sheehan, Director, State Office of Energy. Over 200 people attended the workshop.

The workshop agenda is posted at http://www.floridaenergy.ufl.edu/wp-content/uploads/Preliminary-Agenda-March-12_2014.pdf

The invited speakers and the title of their presentations are given below:

- Biomass: Paul Bryan, Professor at UC Berkeley and former Program Manager for US-DOE Efficiency and Renewable Energy's Biomass Program
- Smart Grid: Electric Energy Systems of the Future - Visions, Challenges, and Opportunities - Pramod P. Khargonekar, Head of Engineering Directorate, National Science Foundation
- Solar Energy: Solar Energy: What's Next? - Dr. Ryne Raffaelle, Vice President for Research and Associate Provost, Rochester Institute of Technology
- Energy Efficiency: DOE Building Technologies Office: Energy Efficiency R&D - Patrick Phelan, Supervisor, Building Technologies Program, US-DOE, Energy Efficiency and Renewable Energy
- Natural Gas: Natural Gas: Serving Florida's Energy Needs Today and in the Future - John R. Mclelland, Director Gas Supply and Wholesale Origination, TECO Peoples Gas
- Marine Energy: Camille Coley, Assistant Vice President for Research, Associate Director for the Southeast National Marine Renewable Energy Center, Florida Atlantic University

The workshop presentations are given at http://www.floridaenergy.ufl.edu/?page_id=20288

The poster session abstracts are given at http://www.floridaenergy.ufl.edu/?page_id=20236 and http://www.floridaenergy.ufl.edu/?page_id=20624

FESC Feb 2-3, 2015 Workshop, Orlando FL

FESC will be hosting a 1.5-day instructional workshop on "Integration of Renewable Energy into the Grid". This instructional workshop is designed for industrial personnel, students and faculty who want to learn the state of the art and future directions in enabling renewable energy integration. Experts in this area will present the workshop lectures.

2nd Interdisciplinary Workshop on Smart Grid Design & Implementation: The workshop was organized by Dr. Sean Meyn, Director of Florida Institute for Sustainable Energy (FISE), Department of Electrical & Computer Engineering, in collaboration with the Warrington College of Business Administration. It was held at the University of Florida on March 28 - 29, 2014. Link to the event: http://ccc.centers.ufl.edu/?q=SG2014. Lectures slides and video can be downloaded here http://ccc.centers.ufl.edu/?q=SG2014_Schedule

The goal of the workshop was to examine how best to maximize the contribution of renewable energy and a "smart grid" to realize a sustainable energy future. Engineers, economists, policymakers and industry members from utilities participated in the workshop. Industry members included Xavier Brossat - EDF Paris, Patrick Gannon - S-G Interoperability, Buck Martinez - FP&L, John D. McDonald - GE Energy Management, Tariq Samad – Honeywell, Raiford Smith - Duke Energy, and Jakob Stoustrup - PNNL.

APPENDIX A – DESCRIPTION OF RESEARCH PROJECTS

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 **Description**: The objectives of the proposed research include: 1) developing a comprehensive generation technology based portfolio optimization methodology, 2) developing carbon revenue redistribution strategies to achieve goals of emissions control policies (cap-and-trade), and 3) develop educational resources to enhance training of scientific workforce for the state of Florida. The research will directly address three major challenges: fulfillment of the growing power demand, meeting the emissions control targets, and supply of technology workforce. The potential economic impact of the proposed research on the State of Florida is expected to be very high, since an energy-secure environment is a basic necessity to support the current trend of explosive growth both in industry and human resources. **Budget:** $71,906 **External Collaborator:** Argonne National Lab
	Title: Joint Optimization of Urban Energy-Water Systems in Florida (Thrust 2: Efficiency)
	Title: Combined Cooling, Heat, Power, and Biofuel from Biomass and Solid Waste (Thrust 3: Biomass)
	Title: Design, Construction, and Operation of CSP Solar Thermal Power Plants in Florida (Thrust 4: Solar)
	Title: Development of High Throughput CIGS Manufacturing Process (Thrust 4: Solar)
	Title: Solar Photovoltaic Manufacturing Facility (Thrust 4: Solar)
	Title: Research to Improve Photovoltaic Cell Efficiency (Thrust 4: Solar)
	Title: An Integrated Sustainable Transportation System (Thrust 4: Solar)
	Title: PV Energy Conversion and System Integration (Thrust 4: Solar)
	Title: Integrated PV/Storage and PV/Storage/Lighting Systems (Thrust 4: Solar)
	Title: Reliable and Resilient Electrical Energy Transmission and Delivery Systems (Thrust 7: Storage & Delivery)
	Title: Secure Energy Systems – Vision and Architecture for Analysis and Design (Thrust 7: Storage & Delivery)
THRUST 2: Enhancing Energy Efficiency and Conservation	
	Title: Innovative Proton Conducting Membranes for Fuel Cell Applications **PI:** Ongi Englander, **Co-PIs:** Anant Paravastu, Subramanian Ramakrishnian - FSU **Description:** This project was initiated in January 2009 as an interdisciplinary effort among Englander (Mechanical Engineering), Paravastu (Chemical and Biomedical Engineering) and Ramakrishnan (Chemical and Biomedical Engineering). The work was divided into two main tasks: (1) the fabrication and characterization of silica and latex-supported membranes, and (2) the incorporation of protein nanomaterials inside the silica membranes. Three female students have participated and contributed to the project (see below). Two of the students (Holley and Kissoon) have received/will receive MS degrees in Materials Science. Two of the students (Kissoon and Witherspoon) belong to underrepresented groups. **Budget:** $30,000 ***This project has been completed***
	Title: Sustainably Integrated Advanced Building Subsystems (OGZEB) **PI:** A. "Yulu" Krothapalli, **Co-PI:** Justin Kramer - FSU **Description:** This project focused on the development of building subsystems that minimize the use of natural resources and carbon-based energy in Florida while also using materials that are renewable and sustainable. A key component of this project was the Off-Grid Zero Emissions Building, which allowed for the testing of these subsystems. This team forms the engineering team participating in the Team Florida's Solar Decathlon Competition. Lessons learned from the Off-Grid Zero Emission Building are incorporated into Team Florida's design. This project is complete.

	Budget: $503,168 ***This project has been completed***
	Title: Insight into Membrane Degradation Mechanisms Through Verification of Chemical and Mechanical Degradation Test Capabilities **PI:** Darlene Slattery, **Co-PIs**: Len Bonville, Marianne Rodgers - UCF/FSEC **Description:** The objectives of the program were to gain insight into fuel cell membrane degradation mechanisms including both chemical and mechanical degradations. In order to achieve this objective, the Membrane Electrode Assembly Durability Test System, MEADS, was verified, after which chemical degradation tests were conducted. By performing post mechanical testing and analyzing the data, the impact of accelerated degradation tests on the cell performance decay, chemical decomposition and mechanical weakening of the membranes were evaluated. This project is complete. **Budget:** $351,518 ***This project has been completed***
	Title: Energy Efficient Building Technologies and Zero Energy Homes **PI:** R. Vieira, **Co-PIs:** P. Fairey, J. Sonne - UCF/FSEC **Description:** The project consists of two elements: 1) the construction of two flexible research homes at FSEC to conduct research on advanced building energy efficiency technologies under controlled conditions; and 2) a staged, field retrofit study in a small number of unoccupied homes to measure and document the effectiveness of a series of retrofit measures that can be deployed using current technology. The project will also conduct an annual meeting where other FESC participants, other university members and utility, industry, the U.S. Department of Energy and other stake holders who will be briefed on plans and progress. Inputs from meeting participants will be sought. **Budget:** $1,224,000
	Title: Joint Optimization of Urban Energy-Water Systems in Florida **PI:** James P. Heaney - UF **Description:** Urban water infrastructure systems for providing water supply, collecting and treating wastewater, collecting and managing stormwater, and reusing wastewater and stormwater require major energy inputs. End users of the water require even more energy to heat this water for showers and baths, clothes washing, cooking and other uses. Increasingly, cities will rely on alternative water supplies such as desalination that require much more energy per gallon of water produced. Conservation is the ideal way to save energy and water by managing the demand for these precious commodities. Major strides have been made in reducing indoor water use from about 75 gallons per person per day to as low as 40 gallons per person per day. However, these gains are being offset by concurrent increases in outdoor water use for irrigation that range from 30 to 300 gallons per person per day depending on irrigation practices and the size of the landscape. From a water use perspective, perhaps the greatest challenge will be the expected growing competition for water if certain energy options are implemented in order to reduce our current dependence on foreign oil. Several recent national studies warn of this impending energy-water crisis. This project will build on our extensive experience in evaluating urban water conservation options to include the implications for energy use and to develop integrated energy-water management systems that are compatible. **Budget: $72,000** Back to Thrust 1: Overarching
	Title: Planning Grant: High Performance and Low Cost Fuel Cells for Future Vehicles **PI:** Jim Zheng, **Co-PIs:** Richard Liang, Chuck Zhang, Ben Wang - FSU **Description:** The objective of this project is to provide an innovative approach to revolution of current energy storage and conversion technology and greatly leverage FSU position in the strategic important area for sustainable energy. The project was performed by Drs. Jim Zheng and Richard Liang at the Department of Electrical and Computer Engineering and Department of Industrial Engineering, respectively. First to demonstrate preliminary results in high performance of energy storage and conversion materials and devices in order to seek outside funding consistent with the vision of IESES. The deliverables were conference proceedings and journal papers and proposal submissions for additional funding. This project is complete. **Budget:** $15,000

	Research Integration (collaboration): NCSU and NHMFL on advantage batteries; Industrial Engineering on fuel cells; Maxwell Technologies, Inc. and Ionova Technologies, Inc. on supercapacitors; CAPS on microgrids; MARTECH on thermoelectric; Shanghai Institute of Technical Physics on photovoltaic; N. Dai, F.Y. Huang, S.L. Wang, X.N. Li, J.P. Zheng (co-PI), and D. Wei, "An International Collaboration Group on Solar Cell Technologies Development", Sponsor: Chinese Academy of Sciences, Budget: $877,193 (￥6,000,000 RMB), Project Dates: 4/09-4/14. ***This project has been completed***
	Title: NIRT: C-MEMS/CNEMS for Miniature Biofuel Cells **PI:** Marc Madou, Co-PIs : Chunlei Wang, Sylvia Daunert and Leonidas Bachas - FIU **Description:** In recent years, the quest for alternative sources that can autonomously power bioMEMS devices, especially those geared for in vivo applications, such as monitoring and drug delivery, has been the focus of research by scientists and engineers as new power sources will prove critical for the advancement of the field. Current batteries are still less than optimal and often present drawbacks related to safety, reliability and scalability. An ideal power source for implantable devices should take advantage of natural compounds present in the body of an individual and use them as fuel to produce power in a continuous and reproducible manner, as long as the patient's physiological functions remain steady. Biofuel cells, which are capable of converting biochemical energy into electrical energy, have been deemed as a potential solution to the drawbacks presented by conventional batteries, but the power density and operational lifetime requirements for implanted devices have not been met yet. To that end, we are integrating genetically engineered catalytic proteins and carbon-based 3 dimensional (3D) MEMS/NEMS structures to create new biofuel cells. The biofuel cell electrode surfaces, especially fractal electrode array, presents significantly increased surface area as compared to traditional architecture, increasing the biocatalyst loading capacity considerably for high power throughput. The genetically engineered enzymes inherently increase enzyme stability, consequently increasing biofeul cell lifetime. The scaled fractal electrode surface plays a role in wiring the enzymes to the biofuel cell anode, which increases the electron transfer efficiency from the enzyme to the electrode for an increase in the overall performance of the biofuel cells. Furthermore, C-MEMS/C-NEMS architectures will enable the reproducible fabrication of low cost carbon-based electrode structures. **Budget:** $171,432 (PI portion) (total amount: $1,000,000) - *Not Funded by FESC.*
	Title: Fabrication of Nano Fractal Electrodes for On-Chip Supercapacitors **PI:** Chunlei Wang - FIU **Description:** Nature has always strived for the highest efficiency in all organisms. Just as nature has benefited from fractal structures in almost all of its organisms, biomimetic fractal designs in electrochemical devices such as power conversion & storage devices and sensors can also lead to benefits in scaling. Our proposed concept is geared to take advantage of the scaling relationship between interface area and overall volume. Fractal electrode design is believed as a promising solution to optimize surface area while minimizing the internal resistance. We will fabricate and characterize carbon-based microelectrodes pyrolyzed from photolithographically patterned photoresist, which exhibits nano fractal geometry by design. In contrast with the current research trend of, first fabricating carbon nanostructures (CNTs, CNFs, etc), and then lithographically defining an electrode at the convenient location on the substrate, our novel methods will integrate the fabrication of the micro and the nano- structures using simple process thus bridging the gap that separates these two scales. Since the fabrication methods are all based on IC manufacturing methods, it will be easy to integrate into microchips. **Budget:** $150,000 - *Not Funded by FESC.*
	Title: Energy Efficient Technologies and The Zero Energy Home Learning Center **PI:** Stanley Russell, **Co-PIs:** Yogi Goswami **Graduate Assistant**: Mario Rodriguez - USF **Description:** The project is to create and evaluate an affordable residential scale Zero Energy building that will function as an exhibition of energy efficiency and Zero Energy Home [ZEH] technology on or near the University of South Florida campus. The project will feature the most cost-effective combination of renewable solar energy with high levels of building energy efficiency. The building will incorporate a carefully chosen package of the latest energy-.efficiency technologies and renewable energy systems to achieve the most successful and reliable results.

	The building will utilize Photovoltaic solar electricity and solar domestic hot water heating systems using the grid as an energy storage system, producing more energy than needed during the day and relying on the grid at night. Plug-in hybrid automobile technology offers a promising means of providing distributed energy storage for such homes but has not been sufficiently tested. Using a systems approach to couple zero energy home technology with PHEVs we will explore opportunities to develop marketable products that meet Florida's energy and environmental goals. **Budget:** $344,600 **External Collaborators:** FSU College of Engineering- Justin Kramer, Brenton Greska; UF- Department of Interior Design- Maruja Torres, Nam-Kyu Park; UF Rinker School of Building Construction- Robert Ries; UCF Florida Solar Energy Center- 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 **Description**: Recent environmental, social, and economic challenges are fostering a wave of interest in maximizing energy efficiency and conservation (EE+C) in existing U.S. homes. Long standing programs, ratings, and metrics are being reapplied into new stimulus initiatives such as the *Recovery through Retrofit*[3] program. Simultaneously, electric and gas utilities are expanding their demand side management (DSM) programs from weatherization and conventional technology replacement incentives to include conservation behavior campaigns with "recommendation algorithms" designed to assist in homeowner energy retrofit decision making. Furthermore, loan programs are emerging to address the financial barriers that commonly limit initiation of the necessary retrofits. Collectively, these approaches most often project future home energy performance based on engineering models of the physical characteristics of homes (i.e., "asset ratings"). Yet to date, the marketplace is inadequately integrating historical household energy consumption patterns (i.e., "operational ratings") into the decision tree to optimize retrofit program efficacy and consumer benefits. Moving toward the unification of asset and operational ratings is crucial for successful program management, proper monitoring/measurement/verification (MMV), loan risk assessment, and for the persistence of reduced home energy use over time. However, unification will not be easy. This research project combines qualitative and quantitative research methods in social science and building science using Florida case studies to evaluate the opportunities and constraints of asset and operational rating unification and the steps necessary to get there. Relationships between our project and the collaborative, transparent, and participatory nature of "open government" initiatives are also being explored. **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)
	Title: Meteorological Factors Affecting Solar Energy Efficiency **PI:** Paul Ruscher **Co-PIs:** (formerly Yaw Owusu, Hans Chapman - FSU **Description:** There are numerous meteorological factors that limit the efficiency of solar energy systems in the tropics. Depletion of available solar energy at the surface by increased water vapor, cloudiness, temperature of the solar panel system, pollution, are sometimes overlooked, because engineering specifications for design are often based upon midlatitude continental air masses. The typical tropical atmospheric reduction factors were reviewed using a state of- the-art solar energy model for this project. In addition, meteorological variability can be quite extreme in the tropics and many engineering studies on feasibility of renewable energy sources in general are often based upon "typical" year criteria, rather than longer term climatologies. It is suggested that climatological data be utilized to more accurately portray the variability of output to be expected at a typical installation. Many of these variables are already widely available from a combination of surface and upper air meteorological stations, as well as remote sensing data from satellites. We demonstrated the sources for these data as well as strategies for teaching about solar energy efficiency using routine observations from school-based weather stations. This project is complete.

	Budget: $15,000 ***This project has been completed***
THRUST 3: Developing Florida's Biomass Resources	
Algae	
	Title: Establishment of the Center for Marine Bioenergy Research: Systems Approach to BioEnergy Research (SABER) **PI:** J. Kostka (he has left FSU), **Co-PIs**: William Cooper, Ivonne Audirac, Amy Chan-Hilton,Ellen Granger – FSU **Description:** IESES' Systems Approach to Bio-Energy Research (SABER) is particularly focused on coupling algal cultivation to wastewater nutrient remediation. SABER has partnered with the City of Tallahassee's T. P. Smith Waste Water Treatment Plant in order to study the growth of local fresh water algae in waste water for use as biofuel. The two main objectives of this project are to: 1) perform both laboratory and field experiments to test for species-specific growth potentials, as well as for the effects of different environmental parameters, including light, carbon dioxide, and nutrient availability on microalgal growth rates and lipid production, and 2) determine the extent to which microbes (i.e. bacteria), which are exceptionally abundant in waste water, act as either competitors (for nutrients, carbon) or symbiotically with algae. To do this we are examining the bacterial community present in the waste water and detecting community shifts that occur during algae cultivation. We are also examining the nutrient uptake dynamics between bacteria and algae by monitoring the usage and production of nitrogen, phosphorous, and carbon-containing compounds. Finally, a number of advanced analytical chemistry techniques are being used to characterize wastewater before and after algae cultivation. With a better understanding of the microbial and biogeochemical processes occurring in waste water during algae cultivation, engineering approaches may be proposed in order to further optimize algal growth in waste water. **Budget:** $494,135 **External Collaborators:** City of Tallahassee ***This project has been completed***
	Title: Constructual Optimization of Solar Photo-Bioreactors for Algae Growth **PI:** Juan Ordonez - FSU **Description**: This was a planning grant (15K, only). The work was targeted towards placing us in a more competitive position in future submissions in the area of bio-fuels. By the end of this one-year effort we now have a complete design of a small-scale photo-bioreactor for algae growth, obtained additional funds that will allow us to build a large-scale photo-bioreactor and conduct the necessary research for its optimal design and operation. This project is complete. **Budget:** $15,000 **External Collaborators:** Federal University of Parana, Brazil ***This project has been completed***
	Title: Optimization of Algae Species for Biofuels Production Using Genetic Altration **PI:** Ed Phlips- UF **Description:** This study will begin in June, 2011, and will focus on genetically altering selected species of algae to optimize their performance in biomass production systems aimed at biofuels. Two approaches to genetic alteration will be explored: mutagenesis and transformation. **Budget:** $15,000
High Energy Crops	
	Title: Energy Intensive Crop Development **PI:** Gary Peter , Matias Kirst, Don Rockwood - UF **Description:** To build a commercially viable, industrial scale system to produce transportation fuels and electricity from biomass requires both efficient conversion technologies and environmentally sustainable, cost effective supplies of biomass. In the US, Florida ranks first in its annual growth of plant biomass, because of its large cultivable land area and its subtropical climate, even though substantial land areas that can be planted are not currently in agricultural or forest production. The development of high yielding production systems for dedicated energy crops is considered essential for a sustainable, biomass to energy

	industry to be established, because the long-term availability of sufficient amounts of reasonably priced biomass is one of the most important factors in the site selection for new biofuel and bioenergy facilities. Dedicated energy crops are ones that 1) have high yields with minimum energy inputs in terms of agronomic practices, water and nutrient applications, 2) can be harvested, transported and processed efficiently into fuel or power, and 3) can be grown sustainably for generations without adverse environmental affects, or significantly impacting the food supply. We will evaluate likely energy crop species, *Eucalyptus* and southern pine to provide important yield and best management practices for growing these species for bioenergy conversion. We will also provide important chemical composition information that will impact the conversion efficiency of this biomass to ethanol, and identify and characterize important genes that regulate wood chemical composition **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 **Description:** Florida ranks first in the USA in annual growth of plant biomass because of a large cultivatable land area, high rainfall, and long growing season. In order to capitalize on these advantages, the agricultural production sector and biomass conversion industries require information regarding which crops are adapted to particular Florida regions and local environments, how much biomass can be produced during what times of the year, which crops produce the most biomass per unit of water used, and which crops have the desired yield and composition for particular bioenergy applications. Research conducted to date has quantified the seasonal biomass supply provided by the most likely crops for use in Florida, identified crops and management practices that result in most efficient water use, and described the chemical composition of these plants to allow estimates of potential energy production per unit of biomass. Florida growers and industry representatives have gained access to this information through on-line resources, presentations by several of the project investigators at the Florida Farm to Fuel Conference, and by attending the Bioenergy Crop Field Day at the University of Florida Plant Science Research and Education Unit. Seven graduate students are being trained through this project and undergraduate students are gaining invaluable research experience via internships mentored by project investigators. Faculty involved in the FESC project have formed collaborations regarding agronomic and breeding projects with Speedling, Inc., SERF, and BP. Both SERF and BP plan to construct ethanol facilities in Florida that would create an estimated 400 temporary construction jobs and 140 permanent jobs each. **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 **Description:** With the ever-increasing price of petroleum and its finite supply, it is of high priority to develop domestic sources of transportation fuel, as well as other chemicals. Ethanol is an attractive alternate fuel that is being produced from corn starch. It is necessary to target other feedstocks for biofuel production and develop processes that have a minimal environmental impact. There is considerable ongoing research on developing processes and catalysts for conversion of biomass to biofuels like ethanol (called cellulosic ethanol process). But this project addresses other feedstocks with the following objectives: 1) development of biocatalysts for the conversion of waste biodegradable poly lactic acid based plastics to ethanol and 2) development of processes that processes for the production of additional fuels like biogas, bio-oil and biochar from the waste and byproducts of a cellulosic ethanol plant for the cleanup and reuse of these waste streams **Budget:** $192,000 **External Collaborators:** University of Central Florida
	Title: Engineering Biocatalysts for Hemicelluloses Hydrolysis and Fermentation **PI:** James F. Preston - UF **Description:** Our goal is to develop biocatalysts for the cost-effective production of fuel alcohols and chemical feedstocks from underutilized sources of renewable biomass and evolving energy crops. To reach

	this goal protocols for efficient saccharification of hemicellulose fractions from these resources will be developed. Objectives are to: 1. Develop improved enzyme-mediated saccharification protocols of hemicelluloses with existing bacterial biocatalysts for production of biofuels and chemical feedstocks. 2. Develop Gram positive biocatalysts for direct conversion of hemicelluloses to biobased products. 3. Develop systems with bacterial biocatalysts for efficient bioconversion of the hemicellulose fractions of perennial energy crops (poplar, eucalyptus, switchgrass, energy cane) to targeted products. **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.
	Title: Thermophilic Biocatalysts for the Conversion of Cellulosic Substrates to Fuels and Chemicals **PI:** K.T. Shanmugam - UF **Description:** Biomass is an attractive source of sugars for a state like Florida that produces very limited amount of corn for fermentation to produce ethanol as transportation fuel or other products such as lactic acid that can be converted to bioplastics. Florida currently generates about 8.7 million tons of dry cellulosic biomass per year (US-DOE) that can be converted to about 0.7 billion gallons of ethanol. With specific energy crops and short rotation trees cultivated for energy production using the abundant sunshine and water resources, the ethanol produced from biomass can be significantly increased to meet the demand for transportation fuel in the State of Florida. Before biomass-based fuels and chemicals become an economic reality, several key steps in the depolymerization of biomass to constituent sugars need to be addressed. One is depolymerization of cellulose to glucose by fungal cellulases before fermentation to ethanol by microbes. The current estimated cost of fungal cellulases is $0.32 per gallon ethanol produced and this cost is targeted for reduction to $0.10 or less by year 2012 (DOE). We have demonstrated that by increasing the temperature of Simultaneous Saccharification and Fermentation (SSF) of cellulose from 30-35 ºC to 50-55 ºC, the amount (and associated cost) of cellulases can be reduced by the required 3-fold with the current commercial enzyme preparations. A microbial biocatalyst that produces ethanol or other chemicals as the main fermentation product and can also function at this higher temperature and pH 5.0 in conjunction with the fungal cellulases in the SSF process is a critical component of this process. We have identified a thermophilic facultative anaerobe, *Bacillus coagulans*, with versatile metabolic capability as the microbial platform for the SSF of biomass to products and engineering this L(+)-lactic acid producing bacterium to produce ethanol. *The primary objective of this proposed study is to construct a B. coagulans derivative that produces ethanol as primary product of fermentation and to enhance the ethanol productivity of the engineered derivative.* **Budget:** $192,000 ***This project has been completed***
Bio gasification	
	Title: Combined Cooling, Heat, Power, and Biofuel from Biomass and Solid Waste **PI:** William Lear, **Co-PI:** J.N. Chung - UF **Description:** The goal of this project is to provide the underlying research and demonstration of a novel technology which would enable the economic utilization of dispersed biomass and solid waste resources to produce electric power, cooling, heat, and transportation fuels. This integrated gasification and power generation system combines University of Florida advances in high-temperature gasification, hydrogen generation and separation, and advanced gas turbine systems. Their integration is expected to result in significant improvements in the cost, emissions, feedstock flexibility, and water requirements, all in a relatively compact, modular plant system. This in turn will enable much greater utilization of renewable energy supplies, helping the development of a sustainable energy supply infrastructure. **Budget:** $576,000 **External Collaborators:** Siemens Power Generation, Florida Turbine Technologies, Energy Concepts Co., Nu-Power Technologies LLC, PlanetGreenSolutions Inc., LPP Combustion, LLC. Back to Thrust 1: Overarching

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 **Description:** The objective of this project is to develop technology for the economical thermo-chemical conversion of lingocellulosic biomass (non-food grade biomass such as agricultural waste, bagasse from sugar mills, citrus peels, switch grass, municipal green waste, etc.) to clean burning liquid fuels. Five of the major advantages of this process over a biochemical route to production of ethanol are: (i) it does not utilize food-grade feed stocks and therefore complements and does not compete with the agricultural food production in the state, (ii) the fuel produced is similar to those derived from petroleum unlike ethanol derived fuels which have at least a 25% lower energy content, (iii) the conversion is accomplished in using fast chemical reactions unlike the slow biological reactions for fermenting alcohol, (iv) the process does not require large amounts of water and associated energy costs of separating the water from the fuel as in bioethanol processes, (v) it can utilize a wide variety of biomass sources unlike the biochemical route which cannot work with high lignin containing biomass. **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 Description: The main deterrent for commercialization of biomass conversion processes is the cost of conversion; particularly the need to sacrifice as much as 30% of the energy content in the biomass for the thermo chemical conversion step. We want to research and develop the concept to use solar thermal energy from concentrating units to provide energy for the biomass gasification step. We also propose to evaluate the sustainability of such a process. Overall Objective: The overall objective is to conduct a theoretical analysis of solar assisted thermo chemical conversion of biomass from the point of view of energy efficiency, economic feasibility, environmental impact, and long term sustainability of renewable energy production. **Budget:** $45,238
	Title: Integrated Florida Bio-Energy Industry **PI:** Ali T-Raissi **Co-PIs:** N.Z. Muradov, D.L. Block - UCF/FSEC **Description:** The aim of this project continues to be production of liquid hydrocarbon fuels derived from lignocellulosic and aquatic biomass employing a two-step thermocatalytic process. In the first step, pre-treated biomass is gasified with oxygen (or air) and steam yielding synthesis gas (syngas) containing hydrogen and carbon monoxide. In the second step, syngas generated by the gasifier enters a Fischer Tropsch (FT) synthesis unit where it reacts to form a range of liquid hydrocarbon fuels – including diesel. **Budget:** $648,000
	Title: Biofuels Through Thermochemical Processes: Approach to Produce Bio-Jet Fuel **PI**: Anjaneyulu Krothapalli - FSU **Description:** The objective of this project was to develop technologies to produce biojet and biodiesel fuels from sustainable sources such as bio-oils and hydrogen produced from biomass generated synthetic gas. Novel processing concepts, reactor design and catalyst systems are employed in this integrated approach to convert any cellulosic biomass and any nonedible bio-oils into bio-jet fuel (Figure 1). Feedstock flexibility offers significant cost and logistic advantages to this approach. Unlike other processes which use only the oil derived from a plant, the entire plant can be used as feedstock source and the proposed approach can also convert the more challenging lignocellulosic component. This project is complete. **Budget:** $229,572 ***This project has been completed***
Biomass Suspension Rheology	
	Title: Simulation and Measurement of Biomass Suspension Rheology **PI:** Jennifer Sinclair Curtis – UF Project Period: 8/2014-7/2016

	Description: Biomass is a promising source of renewable energy. Although this form of energy production holds much potential to reduce energy dependence on petroleum-based fuel consumption, one key challenge in the large-scale commercialization of these systems is the physical handling of biomass suspensions. These suspensions span a wide spectrum of solids concentrations and particle size during the various biomass processing steps. A combined program of simulation and experimentation is utilized to investigate the dynamics and rheology of fibrous suspensions of biomass. In order to reliably design and optimally operate biomass processes, the rheological behavior of these complex fluids over a range of solids concentrations and particle size must be understood. On the simulation side, the discrete element method, capable of calculating stresses and effective viscosity of biomass over a wide span of moisture content (using a liquid bridging model) and particle sizes, is developed. The rheology of well-characterized fibrous suspensions (wheat straw and corn stover) will be fully evaluated and compared with the simulation results. The shear rheology will be measured using a vaned geometry. Successful completion of the proposed work will provide insights into the rheological behavior of fiber-filled suspensions that will aid the design and optimal operation of processes in renewable energy. **Budget:** $100,000
THRUST 4: Harnessing Florida's Solar Resources	
Solar Testing Facility	
	Title: Solar Systems Testing Facility **PI:** James Roland, David Block - UCF/FSEC **Description:** Over the past four years, the Florida Solar Energy Center (FSEC) has received a significan increase in demand for solar and PV systems testing and certification. This occurrence has resulted in requirin the Center to correspondingly amplify its capabilities to respond to the increased demand. Thus, the objectiv of this task was to construct a solar and PV systems testing facility by adding walls, windows, doors and A/C to an existing Florida Solar Energy Center roof only facility. The enclosing of this existing space was done fo the purpose of increasing laboratory space and to allow for laboratory testing of solar water heating system and PV modules and inverters. The action was taken following a study which determined this project was th most cost effective means of adding valuable indoor laboratory space. **Budget:** $600,609 ***This project has been completed***
Solar Thermal	
	Title: Concentrating Solar Power Program **PI:** Charles Cromer, R. Reedy - UCF/FSEC **Description:** The objective of this effort is to produce a detailed Florida map of the solar direct beam and global resource available for use in Florida whereby a potential user of solar energy can enter their location latitude and longitude and receive a table of solar energy monthly averages for that specific site as derived from the past eleven years of data. The concept is to use NOAA satellite photos and utilize the brightness of the cloud cover as a clearness factor predictor of the solar energy that gets through to the ground below. **Budget:** $52,000 **External Collaborators:** FPL ***This project has been completed***
	Title: Development of Novel Water Splitting Catalysts for the Production of Renewable Hydrogen **PI:** Helena Hagelin-Weaver - UF **Description:** This project focuses on the development of iron-based catalysts for the thermochemical splitting of water into hydrogen and oxygen. The thermochemical process of splitting water is particularly well-suited for the utilization of solar energy to provide the heat for the reaction and is a way to produce a renewable hydrogen fuel. As hydrogen is difficult to transport and store, producing hydrogen on site for power plants using proton exchange membrane (PEM) fuel cells or internal combustion engines to generate electricity or for the production of chemicals, such as liquid hydrocarbon fuels, is a very attractive approach. The project uses a two-step process in which water is passed over a reduced iron oxide to generate hydrogen while the oxygen is taken up by the oxygen-deficient iron oxide (Step 1: FeOx-1 + H2O □FeOx + H2). In the second step the resulting iron oxide is heated to desorb oxygen and regenerate the

	oxygen-deficient iron oxide to close the catalytic cycle (Step 2: FeOx □FeOx-1 + ½O2). The main objectives of the project are to develop mixed metal oxide catalysts that 1) will release oxygen at temperatures lower than 1500°C (Step 2), while still maintaining water-splitting activity (Step 1) and 2) are stable up to the temperature necessary for the oxygen desorption step. **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) **Description:** The Florida Solar Energy Center (FSEC) serves the State of Florida by providing independent, third-party testing and certification of solar equipment for the main purposes of providing product value in the marketplace, especially for products that are not widely "proven" with consumers such as solar water heating systems and solar electrical (photovoltaic) systems. Even more important, third-party certification provides protection to reputable manufacturers, ensuring that lower quality products, often from foreign markets, do not compete head-to-head with Florida and U.S. products unless they meet the same standards. **Budget:** $809,295 **External Collaborators:** Solar thermal manufacturers
	Title: Solar Fuels for Thermochemical Cycles at Low Pressures **PI:** Jörg Petrasch - UF **Description:** The project focuses on the production of solar fuels from solar thermochemical cycles employing metal/metal oxide redox pairs. These thermochemical cycles consist of a high temperature endothermic solar driven reduction step and a low temperature, slightly exothermic water or CO2 splitting step. The high temperature step typically proceeds at temperatures above 2000 K. Hence, it poses a range of material and design challenges. According to Le Chatelier's principle, the temperature for the solar dissociation reaction decreases as the pressure inside the reactor is reduced. The central hypothesis of the project is that operating the high temperature step of metal/metal oxide solar thermochemical cycles at reduced pressures will lead to significantly relaxed temperature requirements, while the work necessary to produce the pressure difference will not significantly reduce the overall efficiency of the process. The main goal of the project is to demonstrate the feasibility of carrying out high temperature thermal reduction of metal oxides in rarefied conditions using high intensity solar radiation from UF's solar simulator. **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 **Description:** While there are many different approaches to hydrogen generation, the most attractive means is to split water molecules using solar energy. The current approach is to develop highly reactive metal oxide materials to produce intermediary reactions that result in the splitting of water to produce hydrogen at moderate temperatures (<1000 K). It is envisioned that the metal oxide reactors will ultimately be mounted within a solar concentrating reactor, and irradiated via heliostats. This Task is structured toward the overall goals of solar-driven, thermochemical hydrogen production, with associated efforts toward the enabling surface science, catalysis, particle science, material synthesis, nano-structures, multiscale-multiphase physics modeling, and process simulation that will enable the realization of solar hydrogen-based fuels to power the transportation economy. Successful efforts as targeted in this project are a critical step toward increased renewable-resource based fuels and energy, reduction of GHG emissions, and establishment of a new power industry in Florida. **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 Florida utilities are mandated to achieve 20% renewable energy contribution to their generation mix by 2020. While technologically feasible with solar energy, the capital costs are high – presently, capital costs range from $6,000-$7,000/kW for PV and $3,500-$4,000/kW for concentrating solar thermal power. This project targets the development of solar thermal power technology for bulk power and distributed generation, which will diversify energy resources in Florida and reduce greenhouse emissions by utilizing renewable sources.

	Also, there will be economic impacts with the establishment of new power industry in Florida, which will help the electrical utilities of the state to meet the renewable portfolio standards. The project has three main tasks; the first one is to develop design methodologies and standards for the proven solar thermal power technologies in combination with bio or fossil fuels based on Florida conditions and resources. Secondly, the project aims to set up demonstration and test facilities for these technologies for optimization for Florida conditions, and the final task is to develop and commercialize innovative technologies based on new thermodynamic cycles. **Budget:** $882,000 **External Collaborators:** Sopogy Inc. and Gulf Coast Green Energy. Back to Thrust 1: Overarching
	Title: Multi-Generation Capable Solar Thermal Technologies **PI:** A. Krothapalli, **Co-PI:** Brenton Greska - FSU **Description:** The objective of the research was to develop and demonstrate small-scale solar thermal technologies that can be used separately, in conjunction with one another, or with existing waste heat producers, thus improving the overall system efficiency. This project is complete. **Budget:** $544,226 ***This project has been completed***
Clean Drinking Water	
	Title: Low Cost Solar Driven Desalination **PI:** James Klausner - UF **Student:** Fadi Alnaimat/ Ph.D **Description**: This work concerns the development of a cost effective, low power consumption, and low maintenance desalination process that is powered by solar energy. The solar diffusion driven desalination (DDD) process is most suitable for decentralized applications. While theoretical models have been developed to analyze the evaporation and condensation processes of the solar DDD under transient operating conditions (Alnaimat et al., 2011), experimental investigations have been conducted to validate the theoretical models. In this reporting period, the overall distillation performance of the solar DDD has been investigated under different design and operating conditions. The best operating modes have been proposed to improve the water production and reduce the specific energy consumption. **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 **Description:** Availability of fresh water is one of the biggest problems facing the world and Florida is one of the most vulnerable to fresh water shortages. Moreover, Florida ground water is contaminated in many locations from leaky underground tanks, agricultural pesticides, and other chemicals. Although it is possible to desalinate abundant seawater, conventional systems are too energy intensive. Solar energy can provide the needed energy, and innovative new solar vacuum (USF) and humidification/dehumidification (UF) desalination systems can provide adequate fresh water for the state's needs. Systems are being developed for both bulk water desalination and small community needs/disaster response. We will also develop photocatalytic disinfection to remove contaminants and integrate these technologies with solar PV for complete water supply systems. Photocatalysis is a promising water treatment technology capable of utilizing solar light. However, the construction of an effective photocatalytic disinfection system for water purification is currently limited by the lack of reliable models to aid in the design and testing of these systems. Simplified models have been proposed, but most are inadequate because they rely on traditional disinfection theories which are not applicable to photocatalysis. Therefore, the major goal of this research is to develop a model for photocatalytic disinfection based on fundamental processes which may then be used to design water treatment systems in the state of Florida. **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 **Description:** An important FSEC function is consumer protection from poorly designed and manufactured PV modules and systems. FSEC's test capabilities were established over 10 years ago and were adequate at the time to test PV modules for certification. However, PV costs have fallen and competing electric utility rates have risen. In the last two years, these curves have crossed under some economic scenarios and incentive programs, and the demand for PV module testing and system certification has jumped. Thus, this task will provide for enhanced and expanded PV testing and certification capabilities. The task will also be done in close coordination with FSEC's work with the U.S. Department of Energy's PV program. **Budget:** $196,018
	Title: Development of High Throughput CIGS Manufacturing Process **PI:** Neelkanth Dhere - UCF/FSEC **Description:** A reduction in the cost of CIGS and other thin film PV modules is required for broad PV applications. The objective is to develop a high-rate deposition process for synthesis of CIGS absorbers and other layers by employing in-line and batch deposition techniques. The goal is finally to attract a PV manufacturing company to Florida by developing a high-rate manufacturing process for $CuIn_xGa_{1-x}Se_2$ (CIGS) solar cells. **Budget:** $141,620 Back to Thrust 1: Overarching
	Title: Florida Opportunities for PV Manufacturing and Applications **PIs:** D. Block, J Fenton, P. Fairey, W. Schoenfelds, R. Reedy - UCF/FSEC **Description:** The overall goal of this project is to assist in the development of a photovoltaic (PV) manufacturing industry in Florida. The project objective is to conduct a review of the state, national and international PV manufacturing data for the purposes of establishing industry practices and an industry data base. The data base will then be available to assist Florida in establishing PV manufacturing firm(s). **Budget:** $81,120
	Title: Development of Low Cost CIGS Thin Film Hot Carrier Solar Cells **PIs:** Gijs Bosman, **Co-PI:** Tim Anderson - UF **Description:** Our study is focused on hot carrier solar cells for cell conversion efficiency improvement in a low cost, high throughput CIGS system. The rapid thermalization loss of hot photoexited carriers interacting with the lattice can potentially be reduced through phonon engineering in the absorber layer; the subsequent extraction of the hot carriers may be realized through device engineering of energy selective contacts. **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 **Description:** The primary goal of this project is to enable the establishment and success of local solar photovoltaic manufacturing companies to produce clean energy products for use within the state and beyond and to generate jobs and the skilled workforce needed for them. Thin film technologies have shown record efficiencies of 20%, and present tremendous opportunities for new Florida start-up companies. USF, UCF, and UF are collaborating to develop a pilot line facility for thin film solar technologies, which will serve as a test bed for making ongoing improvements in productivity and performance of solar modules, develop advanced manufacturing protocols, and help train a skilled workforce to ensure the success of new companies. **Budget:** $1.6M **External Collaborators:** Mustang Solar, a Division of Mustang Vacuum Systems Back to Thrust 1: Overarching
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

	Description: Photovoltaic/thermoelectric (PV/TE) cell integration is a promising technology to improved performance and increase the cell life of PV cells. The TE element can be used to cool and heat the PV element, which increases the PV efficiency for applications in real-world conditions. Conversely, the TE materials can be optimized to convert heat dissipated by the PV element into useful electric energy, particularly in locations where the PV cell experiences large temperature gradients, i.e. use the thermoelectric module for cooling, heating and energy generation depending on the ambient weather conditions. Thus, the goal of this research effort is to research and develop nanoscale design of efficient thermoelectric material through a fundamental understanding of the materials properties and to design and build a photovoltaic thermoelectric (PV/TE) hybrid system. **Budget:** $167,820 Back to Thrust 1: Overarching
	Title: PV Devices Research and Development Laboratory **PI:** Robert Reedy **Co-PI's:** Nicoleta Sorloaica-Hickman, Neelkanth Dhere - UCF/FSEC **Description:** The primary challenge facing the PV industry is to dramatically reduce the cost/watt of delivered solar electricity by approximately a factor of 2 to 3, to increase the manufacturing volume by a factor of 10 and to improve the cell efficiencies by a factor of 2 to 3. This task will conduct R&D on basic science of PV cells and develop a world class PV cell laboratory for future cell research. The R&D will focus on developing new and improved PV cells such as organic PV, nano-architectures, multiple excitation generation, plasmonics, and tandem/multi-junction cells. **Budget:** $450,250
	Title: Beyond Photovoltaics: Nanoscale Rectenna for Conversion of Solar and Thermal Energy to Electricity **PI:** Shekhar Bhansali, **Co-PIs:** Elias Stefanakos, Yogi Goswami, Subramanian Krishnan - USF **Description:** The main objective of the proposal is to commercialize and scale up a new technology, rectenna to convert waste heat energy to electricity. Although the prediction of highly efficient (~85%) solar rectennas was published almost 30 years ago, serious technological challenges have prevented such devices from becoming a reality. Since the ultimate goal of a direct optical frequency rectenna photovoltaic power converter is still likely a decade away, we plan to convert optical solar radiation to thermal radiation (~30 THz regime) using an innovative blackbody source. Leveraging the research efforts of the world-class team members, we plan to further develop the rectenna technology that is within reach of efficient radiation conversion at 30 THz. A fully integrated, blackbody converter and 30 THz rectenna system will be capable of converting at least 50% of solar and thermal energy into usable electrical power, clearly demonstrating a truly transformational new technology in the renewable energy technology sector. **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) Description: The objective of this project is to develop a system-driven Plug'N'Gen solar power system demonstrating architecture of decentralized, low-cost, mass-produced, PV panel-mounted micro-inverters. This system will be able to compete with today's centralized multi-kW PV inverters that require cost prohibitive professional installation. The project tasks are: 1) novel inverter topology and control concepts; 2) advanced digital control algorithms; 3) SmartTie interface with the utility grid; and 4) low cost and ultra-compact PV inverter in package. **Budget: $1,267,000** Back to Thrust 1: Overarching
	Title: Non-Contact Energy Delivery for PV System and Wireless Charging Applications **PI:** Jenshan Lin - UF **Description**: Innovative non-contact energy delivery method will be used in photovoltaic energy generation system to accelerate the system deployment. Instead of delivering electric power using cables penetrating through building structures, magnetic field coupling allows power to be transferred wirelessly through

	building walls and roofs. In the meantime, the DC electric energy from photovoltaic cells is converted to AC energy. This enables the photovoltaic system to be quickly set up or relocated, and the collected solar energy from outdoor system can be conveniently delivered to indoor appliances. Techniques to achieve high efficiency at high power delivery through different building structures will be studied for this plug-and-play architecture. In addition, the technique and the system can also be used for non-contact charging of electric vehicles. The transmitter/charger can be placed as a mat on garage floor or parking space. The receiver inside vehicle will pick up the energy delivery through magnetic coupling. This eliminates the need of connecting charging wires to vehicles and exposed metal contacts, which is a safer method of charging electric vehicles **Budget: $**252,000
	Title: An Integrated Sustainable Transportation System **PI:** David Norton, Keith Duncan – UF (Formerly Eric Wachsman (PI) and Shirley Meng (Co-PI);left UF) **Description:** The proposed vehicle, operating on biofuel while in transit and charged by the sun while parked, is the ultimate sustainable transportation system operating completely on renewable American energy resources. Moreover, the use of solid oxide fuel cells (SOFCs) rather than an IC engine in this hybrid vehicle results in a dramatic improvement in efficiency and reduction in emissions. SOFCs are the most efficient technology for converting energy from hydrocarbon fuels to electricity on a "well to wheels" basis. In contrast, the more conventional fuel cells require hydrocarbon fuels to first be converted to H_2, with resultant efficiency losses, followed by losses due to H_2 transport and storage. Therefore, on a system-basis SOFCs hold the potential for producing the least CO_2/kWh from conventional fuels, and if designed to operate on biofuel would in effect be carbon neutral and operating on a renewable resource. *If developed this vehicle would be a transformational change in transportation technology.* **Budget:** $594,000 **External Collaborators:** Solid-State Energy Technology, Inc., Lynntech, Inc., Planar Energy Devices, Inc., CFX Battery, Inc. Back to Thrust 1: Overarching ***This project has been completed***
	Title: PV Power Generation Using Plug-in Hybrid Vehicles as Energy Storage **PI:** J. Shen, **Co-PI:** I. Batarseh - UCF **Description:** The objective of this project is to develop and demonstrate an alternative PV power generation architecture that uses plug-in hybrid vehicle as the energy storage and transfer element with a total system cost target of $3.50/W. The tasks include developing efficient, reliable, and inexpensive maximum power tracking DC/DC battery chargers and 3-phase converters. A 10kW demonstration solar carport charging station will be built on UCF campus. A plug-in hybrid vehicle with a 25kWh battery bank (battery-only driving range of 50-100 miles) and onboard bidirectional AC charging system will be demonstrated **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 **Description:** The goal is to increase the efficiency and reduce the cost of solar power through the integration of PV, Li-battery, and LED lighting technologies. Since all components are in the form of thin films, the PV/battery/LED system can be integrated as a single module. Since half of the materials cost of each device is the substrate, integrated module will also reduce materials costs and processing steps. Importantly, their integration further eliminates the need for inverters since they are all low-voltage devices. Such an integrated device can be used to store energy during the day and power the LED panel for lighting in the evening. In addition, we will explore the possibility of fabricating a semi-transparent module. The success of this Task will lead to a novel solar-power lighting panel that can be used as a sky light during the day and a lighting panel during the night without using grid-power. We not only will develop the technologies, but also integrate devices and perform technology-economic evaluation, including life-cycle costs. **Budget:** $576,000 Back to Thrust 1: Overarching
THRUST 5: Ensuring Nuclear Energy & Carbon Constrained Technologies for Electric Power in Florida	

	Title: Reducing Residential Carbon Emission in Florida: Optional Scenarios Based on Energy Consumption, Transportation, and Land Use **PI:** Tingting Zhao**, Co-PI:** Mark Horner - FSU **Description:** In 2007 the Governor of Florida established targets for greenhouse gas (GHG) emissions, which mandate that the State of Florida aims to reduce emissions to 2000 levels by 2017 and to 1990 levels by 2025. To fulfill these goals, not only is the development of renewable sources of energy and fuel needed, but it is also necessary to achieve more sustainable energy and fuel consumption patterns. This project is dedicated to the latter objective, i.e., exploring the effectiveness of optional scenarios for households' consumption of energy and transportation fuels with respect to carbon dioxide mitigation. Human land use is another major concentration of this research, as changes in the built environment and vegetation cover may create sources or sinks of carbon dioxide and hence affect the intensity and origins of carbon emissions. The proposal of this project consisted of three major steps: 1) calculating the Florida baseline carbon dioxide emissions from residential energy and fuel consumption as well as human land uses; 2) developing models of household behavior regarding various energy/fuel conservation and incentive options based on a residential survey; and 3) forecasting energy/fuel demand and CO_2 emission levels in 2017 and 2025 throughout the state of Florida based on the scenarios created in step two. This project was planned to be completed within two years. The PIs concentrated mainly on 1) journal publications on carbon inventory analysis at the state level; 2) finalizing the household energy consumption survey (including sampling design), which is composed of over 30 questions dedicated to household energy practice and responses to energy-saving incentives; and 3) preparation for the external grant application to the NSF Geography and Spatial Sciences (GSS) program. Data collection from the survey is complete and data analysis is underway. **Budget:** $60,844 ***This project has been completed***
	Title: Planning Grant: Enhanced Thermal Performance and Microstructure Simulation of Nuclear Fuels **PI:** Justin Schwartz - FSU **Description:**The objective of this proposal was to perform preliminary investigations to determine the viability of improved oxide nuclear fuels through high thermal conductivity coatings such as "BeO." To meet Florida's sustainable energy demands, they pursued the option of enhanced oxide nuclear fuel performance by considering the potential for improved thermal behavior through high thermal conductivity oxide coatings. This work will included a literature search of past investigations of the impact of enhanced thermal conductivity on nuclear fuel and reactor performance, the temperature and irradiation dependence of the thermal conductivity of BeO and other high thermal conductivity oxides, the chemical and thermal compatibility of BeO and nuclear fuels (UO2, PuO2, ThO2 and MOX), and initial studies into BeO coatings on HfO2 particles, where HfO2 serves as a benign surrogate for nuclear fuel oxides. This project is complete. **Budget:** $15,000 ***This project has been completed***
	Title: Biocatalytic Lignin Modification for Carbon Sequestration **PI:** Jon Stewart - UF **Description:** After cellulose, lignin is the second most abundant forma of carbon in plants. Lignin's complex structure makes it difficult to use this material in value-added products, and ahte vast majority of lignin is currently burned to provide energy for factory operations. While burning plant derived lignin does not add to global greenhouse gas levels, having options to remove lignin from the global carbon cycle would lead to diminished atmospheric CO2 levels. This could be accomplished by chemically altering lignin's structure to facilitate long-term terrestrial sequestration or using it in value-added products that would not be discarded immediately. We will use Nature's catalysts (enzymes) to tailor the chemical structure of lignin for both deep-well injection (by using lignin derivatives as drilling "muds") and for materials that can be used in building, packaging, and other manufactured products.) **Budget:** $200,000
	Title: Database Infrastructure for Integrative Carbon Science Research

	PI: Sabine Grunwald. **Co-PI:** Tim Martin - UF **Description:** Rising CO_2 concentrations in the atmosphere and effects on global climate change have been well documented, and future impacts are uncertain but potentially devastating. Florida's natural and agro-forest ecosystems have much potential to sequester carbon in biomass and soils due to unique climatic and landscape conditions. However, research gaps exist to accurately assess carbon pools and fluxes at coarse scales, ranging from county to the region and larger. The overarching objective of this project is to address these obstacles by creating a terrestrial carbon information system (called "TerraC") for the carbon science community, focused on ecosystems in Florida. The information system will be administered through the UF Carbon Resources Science Center (http://carboncenter.ifas.ufl.edu), a multi-disciplinary Center dedicated to research in support of enhanced agricultural and natural resource carbon management. **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 **Description:** Rising concerns over increasing levels of greenhouse gases, especially carbon dioxide, have led to suggestions to capture carbon dioxide at fixed sources, such as fossil fuel power plants, and sequester the carbon for millennia by injecting it underground. Florida overlies many thousands of feet of carbonate rocks which may be suitable for geologic sequestration of carbon dioxide. This project will investigate the potential for geologic sequestration of carbon dioxide in Florida, the physical and chemical changes that may occur as a result of injection, assess the potential for escape of injected carbon dioxide, determine the risk, if any, to aquifer systems used for water supplies, develop methodologies for Florida utilities to predict the performance and risks of proposed sequestration projects, and educate a cohort of geologic sequestration professionals to create a carbon sequestration industry in Florida. **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: Florida's Ocean Energy Resources	
	Title: Southeast National Marine Renewable Energy Center **PI:** Susan H. Skemp**, Co-PIs:** Howard P. Hanson, James VanZwieten - FAU **Description**: The research and development program being conducted by the Southeast National Marine Renewable Energy Center (SNMREC) is structured to be the catalyst that will enable the ocean energy industry in Florida toward determining solutions to answer the state's energy challenge. This project focuses on determining the potential of harnessing the ocean current resource and ocean thermal energy conversion (OTEC). The regulatory process both at State and Federal levels continues to evolve as the roles and interdependencies of the individual agencies are more clearly articulated. In addition, knowledge to make these decisions is being defined and targeted on a micro level necessary to assess individual devices. SNMREC's mission 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. **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.

	Title: Buoy Array for Ocean Wave Power Generation **PI:** Z. Qu, **Co-PI**: K. Lin - UCF **Description:** The objective of this project is to develop a novel design that can extract ocean wave energy for commercial consumption. The design detailed herein is unique in that it is a wave point energy harvester that is small in size and contains all of the mechanical components directly within the buoy. The project focuses mainly on the mechanical system within the buoy as well as methods to control the electrical load on the system. Different mechanical systems have been developed and tested on a motion platform to simulate a vertical wave motion—these systems have been analyzed and compared in order to provide an ever-increasingly effective design. The Harris Corp. have acted as new collaborators with the project since October 1st 2010, funding four UCF senior design teams in the development of a buoy for wave power generation. **Budget:** $150,000 ***This project has been completed***
THRUST 7: Securing our Energy Storage and Delivery Infrastructure	
	Title: 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 **Description:** The project research goal 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 baseload (nuclear), and incorporation of new power conversion, transmission, measurement, communication and control technologies (smart grid). This project has also supported ongoing participation and contributions in national, state, and local power and energy stakeholder groups, including the Gridwise Alliance, the North American Synchrophasor Initiative (NASPI), the American Society of Mechanical Engineers' (ASME) National Energy Committee, the Institute of Electrical and Electronics Engineers (IEEE) Power Engineering Society (PES), Florida's Great Northwest Alternative Energy Advisory Council, and the Tallahassee-Leon Economic Development Council (EDC) Energy and Environment Roundtable. **Budget:** $431,982 Back to Thrust 1: Overarching ***This project has been completed***
	Title: Microgrids for a Sustainable Energy Future **PI:** Chris S. Edrington, **Co-PIs:** Helen Li, Juan Ordonez, Jim Zheng, Mischa Steurer - FSU **Description:** The primary aim of the project was to address research and development in the area of microgrids. Specifically the focus was in the area of PV and Plug in Hybrid Electric Vehicles integration, microgrid modeling and control, grid-tying inverters/converters, energy storage, tri-generation, and standards development for smart grids. **Budget:** $719,333 ***This project has been completed***
	Title: 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 **Description:** The main objective of this project is the collection of preliminary data for IESES proposals that can be used to seek local, national and international sources of external funding from private and government sponsors. The overall project has been split up in several independent subprojects to allow a timely completion of the tasks. All tasks have been completed successfully. **Budget:** $15,000 ***This project has been completed***
	Title: 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 **Description:** With power grids evolving towards increasing size, complexity, and integration, it has become more difficult to describe and predict their behavior, even under normal operational conditions. With

	technological development, climate change, and activities in the political arena, adverse circumstances (natural disasters, intelligent adversary, software design errors, human errors, etc.) have become more probable and costly events. The Project seeks to provide industry and government with advanced analytical and computational tools necessary for the automated evaluation of the structural resilience and reliability of power grids. The potential applications of the Project's results go beyond power grids. Any infrastructure essential to our society and economy (e.g., computer, communication, transportation) can benefit from the Project's results. This project is complete. **Budget:** $15,000 ***This project has been completed***
	Title: Investigating the Effect of Appliance Interface Design on Energy-use Behavior **PI:** Paul Ward**, Co-PIs:** Ian Douglas, David Eccles - FSU **Description:** The primary objective of this research project was to identify the behavioral factors that contribute to energy in/efficiency in the home. In particular, this project was designed to (a) examine current state-of the science on behavioral factors that affect energy efficiency, (b) report on the efficiency of typical energy consuming technology used in the home as well as existing programs designed to improve efficiency, and (b) investigate the types of human-technology interactions and other behavioral factors that lead to in/efficient energy use. To achieve these objectives this project proposed to use laboratory-based experimental and field-based methods to (i) identify interface-design factors that constrain individuals to behave in locally optimal but globally sub-optimal ways, and (ii) survey how cognitive, technological, and motivational behavioral issues affect use in the home environment. **Budget:** $247,720 ***This project has been completed***
	Title: Energy Delivery Infrastructures **PI:** Lee Stefanakos **Co-PIs:** Zhixin Miao - USF (Formerly Alex Domijan (PI) and Arif Islam (Co-PI). Left USF). **Description:** The proposed project is to simulate the effects of a renewable energy generation system in a microgrid context to the distribution grid system. The proposed project is to simulate the combination of renewable distributed generation and a battery system to assess the effects during critical conditions such as power system peak. A research opportunity is to investigate how existing tools can be applied to properly representing dynamic and transient behaviors of microgrids. Therefore, in this project we propose using simulation tools to model a microgrid and investigate how well we can reproduce its measured behavior in the field **Budget:** $485,184
	Title: Micro Battery Defense Development **PI:** Chunlei Wang - FIU **Description:** The microbattery market for new miniature portable electronic devices such as cardiac pacemakers, hearing aids, smart cards, personal gas monitors, micro electromechanical system (MEMS) devices, embedded monitors, and remote sensors with RF capability is increasing rapidly. Thin-film lithium batteries are among the most advanced battery systems that can scale down to the dimensions that match the MEMS devices. However, these two-dimensional (2D) batteries are necessarily thin in order to maintain effective transport of Li ions. In order to power MEMS devices with limited device area (areal "footprints"), batteries must somehow make good use of their thickness. Three-dimensional (3D) configurations offer a means to keep transport distances short and yet provide enough material such that the batteries can power MEMS devices for extended periods of time. In this project, we focus on developing functional 3D microbatteries based on our carbon microelectromechanical systems (C-MEMS) technique. These microbatteries could offer order of magnitude increases in electrode surface area and charging capability than thin film batteries at the same size scale. **Budget:** , $192,418.30 – *Not Funded by FESC*
	Title: Electrostatic Spray Deposition of Nanostructured Porous Metal Oxide Composite **PI:** Chunlei Wang - FIU

	Description: Recently, conversion reactions of interstitial-free 3d metal oxide structures (such as CoO, CuO, and NiO) with structures unsuitable for intercalation chemistry have nevertheless been shown to exhibit large, rechargeable capacities in cells with lithium. The specific capacities of these materials, which are potential candidates for the negative electrode, can be as high as 1,000 mAhg-1 (about three times of commonly used graphitic carbons). However, practical implementation using these metal oxides is hampered by the large capacity loss of the first cycle and poor material cyclability. These problems are partially attributed to the significant volume changes that occur during lithium uptake and removal (molar volume change of ~100%), which causes mechanical failure and the loss of electrical contact at the anode. They are also due to aggregation of metal nanoparticles that appears during the process of discharging the metal oxide anodes. In order to overcome these two challenges and develop excellent rate capabilities and high power densities of Li-ion batteries, metal oxide composite electrodes with hierarchical mixed conducting network structures will be synthesized. We propose the preparation and testing of multi-component metal oxide anode films with a variety of morphologies using a simple and versatile method based on the electrostatic spray deposition (ESD) technique. The ESD technique enables us to reproducibly fabricate thin film ceramic materials with simple, low-cost and controllable designed morphologies. ESD-derived ceramic thin films we obtained including 3-D reticular, spongy-like, hollow sphere, dense, etc morphologies. The structures of these films can be easily tailored by changing the precursor solution component(s) and adjusting the substrate temperature. In this project, we plan to fabricate porous metal oxide materials, MxOy (M=Fe, Co). Material characterization methods (such as: SEM, TEM, AFM, BET, etc) will be used to study the correlation between ESD parameters and surface morphologies. **Budget:** $88,378.711 - *Not Funded by FESC*
	Title: Fabrication and Investigation of Porous Tin Oxide Anodes for Li-Ion Micro Batteries **PI:** Chunlei Wang - FIU **Description:** The requirement of higher energy capacity microbatteries demands the exploitation of new substitute materials with higher energy capacity than traditional graphite. SnO2 has been considered as one of the most promising substitutes for the carbon anode in Li-ion batteries due to its high Li+ storage capacity. However, the practical application of SnO2 as anode is restricted by poor cyclability and rate capability due to large volume change during cycling, which can cause disintegration and electrical disconnection from current collector. In this project, we propose the preparation and testing of tin oxide anode films with a variety of porous morphologies using Electrostatic Spray Deposition (ESD) technique. Our research focus will be developing an ESD processing to fabricate tin oxide electrode with different pore sizes ranging from macropores to mesopores and down to micropores; constructing hierarchical porous tin oxide electrode by controlling process parameters and introducing a surfactant or polymer additives, and material characterization and electrochemical analysis in order to investigate the correlation between morphology and electrochemical performance and understand the underlying mechanism. The proposed research will significantly enhance our understanding of fundamental issues regarding intrinsic properties of porous SnO2 films as anode for Li-ion batteries. **Budget:** $100,000 - *Not Funded by FESC*
	Title: Very High Energy-Density Ultracapacitors **PI:** E. Bakhoum, UWF **Description:** A new type of ultracapacitor that offers a capacitance density on the order of 500 Farads per cubic centimeter or higher has been created. The principle behind the new ultracapacitor structure is the insertion of a 100 nm-thick layer of barium strontium titanate as an interface between the activated carbon electrode and the electrolyte. The new ultracapacitors are highly needed in hybrid vehicle applications; as any significant increase in the energy storage capability of the ultracapacitors leads to substantial improvement in the fuel efficiency of hybrid vehicles. Two manuscripts about this new development were published in 2009. Additional research is ongoing. - *Not Funded by FESC*
	Title: Secure Energy Systems **PI**: Pramod Khargonekar - UF **Description**: The goal of this project is to investigate the concept of secure energy systems and formulate a concrete vision of a broad-based, comprehensive research program. An additional project goal is to develop architecture for modeling, analysis, and design of secure energy systems. An energy system consists of a

	collection of interconnected subsystems representing energy generation devices, energy consumption devices, transmission, distribution, and storage devices, and communications and computing devices. Such systems are dynamic and its operation is influenced by external perturbations. Definition of the system and it environment depends on the problem of interest. This project is motivated by strong interest among key decision makers in understanding and assuring security of energy systems in the face of various natural and man-made threats. Increasing penetration of renewable energy sources and capabilities offered by smart grid have the potential to enhance or degrade security of energy systems. Thus, these new developments present additional motivation for understanding of secure energy systems. Whereas there is an intuitive understanding of security and assurance, much work remains to be done in formulating precise definitions that cover problems of interest and devising an overall architecture that may facilitate a system level analysis and design of such secure energy systems. Taking into account rapid changes in the energy issues in a wide variety of private and public sectors, this project is a proactive effort to develop a vision and architecture for analysis and design of secure energy systems. It is expected that the results of this project will lead to future development and integration of specific analysis and design algorithms and software that will assist system designers in assessing and ensuring an appropriate level of system security. **Budget**: $220,000 Back to Thrust 1: Overarching
	Title: Optimization, Robustness and Equilibrium Modeling for the Florida Smart Grid **PI:** Panos Pardalos - UF Description: This project began in January 2011. It aims to develop algorithms for optimal design and functioning of Florida's next generation of power transmission and distribution systems that will incorporate the new realities of the grid. The goal is to create innovative real time capabilities for 1) optimal location of renewable energy source; 2) detection and prevention of instabilities and outages; and 3) operating models including generalized Nash equilibrium problems in the electricity market. **Budget**: $30,000
Policy	
	Title*:* Economic Impacts of Renewable Energy and Energy Efficiency Policies **PI:** Theodore Kury – UF (PI use to be Mark Jamison) **Description**: To serve its mission and contribute to FESC's fulfillment of its mission, PURC is conducting the three projects described below. These projects will be completed in two years and will deliver policy relevant reports and academic quality papers. The projects are: 1) Economic and Job Impacts of State Renewable Energy and Energy Efficiency Policies This project will provide empirical estimates of state renewable energy and energy efficiency policies on economic development and jobs. 2) Electric Grid Impacts of State Renewable Energy and Energy Efficiency Policies This project will provide an estimate of the impacts of renewable energy policies on the electric grid. It will fill a gap in the literature for Florida, which as to date focused on the impacts on electricity generation. 3) Effects of Energy Commodity Profit Margins on Effectiveness of Energy Efficiency Programs This project will test an assumption that is built into many state energy policies and that is held by many policy makers at the national level, namely that utilities would improve consumer energy efficiency practices if utility prices were decoupled from utility profits. **Budget:** $150,000
	Title: Environmental Impacts of Energy Production Systems: Analysis, Evaluation, Training, and Outreach **PI:** Amy B. Chan-Hilton, **Co-PIs:** Gang Chen, Wenrui Huang, Michael Watts, Ming Ye, Paul Lee - FSU **Description:** The goal of this project is to develop tools and conduct research to objectively assess environmental and water resources needs and constraints while developing prudent energy strategies and policies. The focus of this research will be on fuel cycle and energy production systems. The objectives of this project were to analyze the environmental and water resources demands and potential impacts, specific to Florida's unique geographical challenges, of fuel cycle systems and develop an objective environmental

	impact screening and evaluation tool or decision support system for energy planning and policy making by Florida's industry, utilities, and government. As Florida develops its long-term energy strategy, multiple efforts are ongoing to develop and apply a wide range of energy technologies that are sustainable and carbon-neutral. But pragmatic issues related to environmental impact and sustainability need to be addressed before these technologies may be implemented. This project directly addressed the FESC's Thrust 6 on "Energy systems and their environmental and economic impacts." This project also directly addresses IESES's Objective 4 on unique geographical challenges and Objective 5 on sustainable energy engineering, science and the sustainable energy economy. **Budget:** $118,470 **External Collaborators:** Florida Department of Environmental Protection ***This project has been completed***
	Title: 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 **Description:** In response to the many issues related to energy provision, energy sustainability, and GHGs, in 2007 Governor Crist created an Action Team on Energy and Climate Change. This group was tasked with investigating and recommending strategies for reducing GHG emissions, creating more sustainable energy systems in Florida, and for establishing Florida as an international leader in innovative energy provision. Related to this, the 2008 session saw the Florida Legislature pass HB 697 which, among many things, requires every local government in the state to address energy systems and GHG emissions explicitly within their comprehensive plans. Currently, the linkages between energy planning, environmental and economic sustainability, land use and transportation planning, and GHG reductions have never been stronger in Florida. This project is aimed at continuing the momentum in Florida for developing broad-based solutions to these problems by helping to develop a knowledge base for informing state policy in the areas of energy, sustainability, and land use and transportation planning. **Budget:** $168,185 ***This project has been completed***
	Title: Political and Economic Institutions Regarding Siting of Energy Facilities **PI**: R. Mark Isaac, **Co-PIs:** Douglas Norton, Svetlana Pevnitskaya - FSU **Description:** The "Hold-Out" project evaluates the "hold-out" concept, which is discussed repeatedly in the context of public policies regarding land acquisition and facilities siting, but a clear definition is elusive. To economists, the most likely definition is that a profitable amalgamation of land parcels by one buyer from competing sellers does not occur because of the failure of the private bargaining process. However, sometimes the term seems to be used more for delay instead of failure in bargaining, or even the very different concept of creation of any bilateral bargaining situation of the buyer and the "last" or "holding-out" seller, which may be inconvenient to the buyer but is immaterial in terms of economic efficiency unless efficient trades actually fail. The experimental design is complete, the programming is complete, Institutional Review Board approval has been obtained, and we have conducted two complete experimental treatments. This research was presented at one of the Presidential Sessions at the 2009 Meetings of the Southern Economics Association in November in San Antonio. **Budget:** $79,621 ***This project has been completed***
	Title: Experimental Investigation of Economic Incentives of Policies, Institutions and R&D in Environmental Conservation **PI:** Svetlana Pevnitskaya, **Co-PI:** Dmitry Ryvkin - FSU **Description:** Policies and institutions aiming at reducing pollution and battling climate change often do not reach desirable results because actual decisions of governments and economic agents deviate from those predicted by theory. We employed methods of experimental economics to find and explore such deviations and their causes, and used the findings to modify theory and design better policies and institutions. In this project, we constructed a theoretical model of decisions in a dynamic environment with costs of pollution and climate change, while testing the theory in laboratory experiments with human subjects. We studied actual behavior and explore responses to changes in the environment, production technologies, investment in clean technology and institutions. This project is complete.

	Budget: $43,217 ***This project has been completed***
	Other
	Title: Fusion Energy Spheromak Turbulent Plasma Experiment-STPX **PI:** Charles A. Weatherford, **Co-PIs:** Kyron Williams, Ephrem Mezolin - FAMU **Description:** The Florida A&M University's Center for Plasma Science and Technology (CePaST) has nearly completed the construction of a spheromak fusion reactor. A spheromak is one of a general class of experiments used to investigate key plasma physics principles relevant for the development of magnetically confined, controlled thermonuclear fusion as a source of electrical power. This project involves collaboration between Florida A&M University CePaST, West Virginia University, and Auburn University. The spheromak turbulent plasma physics experiment (STPX) is being constructed at FAMU in a facility especially built for the STPX experiment. Fusion research is a key element in the nation's long term energy supply strategy, The spheromak concept may be a possible alternative to the tokamak concept (deployed at ITER) which affords access to fundamental fusion science issues supportive of fusion while allowing us to maintain and nurture an American fusion scientific workforce. This project will determine, using a fast duty cycle between theory, experiment, and simulation, the essential elements required for full kinetic modeling of an entire spheromak plasma using ab initio MHD with direct modifications from new turbulence physics. The project will focus on the management of fluctuations and transport in a spheromak plasma using new turbulence physics models and comprehensive helicity control. We will employ high time- and spatial-resolution measurements of electron temperatures, ion temperatures, and magnetic field fluctuations to investigate, understand, and eventually control reconnection driven heating as a means of increasing the plasma temperature of spheromak plasmas. We will use divertor diagnostics of radiation and particle transport along with edge biasing for electric field control to explore the effects of driven flows on confinement and heating in spheromak plasmas with microparticles and will investigate the effects of MW pulses coupled to protons on the plasma current and confinement. **Budget:** $950,000 – *Not Funded by FESC* **Universities and External Collaborators:** Dr. Earl Scime, West Virginia University Dr. Ed Thomas, Auburn University Dr. Simon Woodruff, Woodruff Scientific, Inc
	Title: Marketing Strategies to Incentives Entrepreneurship and Innovation in the Development of Sustainable Energy **PI:** Joe Cronin - FSU **Description:** The objective of this project was to investigate the role of market pull strategies in advancing sustainability goals. Specifically, the intent is to identify what "drives" consumers' attitudes and behaviors relative to sustainable products. This includes consumers' personal attitudes, opinions, and beliefs, their perceptions of their own and organizations' abilities to affect or change the environment in which they live, and their personal characteristics (e.g., demographics). In addition, in collaboration with the College of Communications, the strengths and weaknesses of the various communication modalities that can be used to deliver sustainability knowledge to consumers (e.g., advertisements, testimonials, expert word-of-mouth communications, public relations, publicity, etc) were assessed. Specifically, the research attempts to identify the optimal market pull modality; that is, the means by which to deliver to consumers the knowledge that drives the purchase of sustainable goods and services. The overall objective of the research is to provide much needed market pull information for organizations embarking on "green" marketing strategies; that is, firms in the process of developing or expanding their mix of environmentally friendly goods and services. **Budget:** $191,555 ***This project has been completed***
	Title: Energy Sustainable Florida Communities **PI:** Richard Feiock, **Co-PIs:** Ivonne Audirac, Keith Ihlanfeldt - FSU

	Description: The objective of NESC is to stimulate innovation and energy investments that will accelerate energy savings by local governments by sharing best practices and organizing and managing large scale collaboration and bulk buying projects. Florida State University has been working with U.S. DOE contributing surveys, research and outreach assistance to assist in efforts to promote investment, collaboration, and bulk purchasing by local governments that will achieve significant cost savings. This includes organizing NESC conference calls co-hosted by hosted by FSU and DOE, conducting several surveys, and hosting a meeting of Florida local government EECBG sub-awardees. These initial research efforts and conference calls have been successful in identifying broad interest in collaboration and bulk buying. They also revealed significant barriers to collaboration that need to be addressed including issues related to coordination within governments, among governments and with other organizations. We are now undertaking activities to address these barriers to collaboration at three levels: First we are conducting focused regional workshops throughout the state. By bringing interested governments in each region together with experts in collaboration, governance, finance, and purchasing we will identify specific projects and design the mechanisms to put the projects in place. Second, are expanding our statewide dialogue on a more systematic basis and share the insights and successes of our regional workshops. Third, we are working with universities and other partners throughout the U.S. to share strategies and insights and help replicate our successes in other states. By expanding our efforts and formalizing the network we will make large scale energy savings a reality. **Budget:** $125,424 ***This project has been completed***
	Title: Development of a Renewable Energy Research Web Portal **PI:** Charles R. McClure, **Co-PIs**: Ian Douglas, Chris Hinnant - FSU **Description:** This project identified, organized, and made available via a web portal, research generated as part of the FESC effort as well as other selected related information resources and tools as identified by FESC participants. The goal of this project was to provide IESES, FESC, researchers, and others in the state of Florida with the research information they need to accomplish statewide energy goals. An initial product from this project was an operational web portal that identifies, organizes, and provides access to a range of FESC and other research related to renewable and alternative energy information. A second product was research results on extending technologies that allow users to share information and grow/sustain the web portal through a range of social networking techniques. This research attempts to position FSU to seek additional external funding related to interactive databases and web portals. The ultimate expected outcomes resulting from the project include increased IESES and FESC researcher productivity; increased leverage and collaboration of FESC resources and funding; and improved policy- and decision-making regarding the future uses and development of renewable and alternative energy in Florida. **Budget:** $194,542 ***This project has been completed***
	Title: Planning Grant: Hydrogen Storage Using Carbon-Based Adsorbent Materials **PI:** Efstratios Manousakis - FSU **Description:** This project was a theoretical investigation of a variety of carbon based nano-porous materials, such as activated carbon or single-wall or multi-wall carbon nanotubes, which can be used to store and transport hydrogen. We find that by doping with metallic elements, the micro-surfaces of these carbon-based porous materials provide increased van der Waals forces to the adsorbed hydrogen molecules; this effect significantly enhances the volumetric energy density for hydrogen storage and we caried out a full theoretical investigation to find the optimum conditions. This project is complete. **Budget: $15,000** ***This project has been completed***

Education and Outreach	
	Title: Florida Advanced Technological Education Center (FLATE) **PI:** Marilyn Barger - UF **Description:** FLATE (Florida Advanced Technological Education Center) is FESC's partner to develop statewide curriculum frameworks for technical A.S./A.A.S. degree programs supporting existing and new energy business sectors. FLATE develops the frameworks and facilitates their progress through the multiple sequential industry-validation, student competencies based, FLDOE procedure. FLATE also develops new courses and provides faculty professional development as required for each new program of study. Additionally FLATE helps colleges in the State College System implement the new frameworks in their institutions. To support the new curriculum, FLATE will work closely with the FESC Public Outreach and Industry Partnership programs to provide additional professional development opportunities for teachers and faculty to upgrade and update their STEM knowledge base. **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 **Description:** Developing 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. **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) **Current PI:** Kelly Jourdan **Description:** The goal of this project is to contribute to a major initiative on design, licensing and construction of a fully digital control system for the University of Florida Training Reactor (UFTR). This makes the UFTR the first operating nuclear power plant in the United States that uses a fully digital control system. This facility will provide for the training and education of the necessary workforce in the area of digital control and instrumentation for nuclear reactors. With this effort, a new focus/certificate on digital control and instrumentation will be developed at the Nuclear and Radiological Engineering (NRE) Department. Further, the UFTR facility will offer training courses for community colleges (Central Florida, Indian River, and Jacksonville) in the State of Florida, personnel from nuclear utilities and government agencies including the Nuclear Regulatory Commission (NRC). The project has already received significant funding from industry and government in form of grants, contracts, equipment/systems, and engineers' time. **Budget:** $308,000 **Curent Budget:** $45,000 **External Collaborators:** Several engineers from AREVA NP Inc & Siemens Corporation

	Title: Energy and Efficiency Video Public Service Announcements **PI:** Andy Opel, **Co-PIs:** Phil Steinberg, Leslie France-Patterson, Laura Arpan, Ian Weir - FSU **Description:** This interdisciplinary team produced 6-8 short (30-second/one-minute) video public service announcements (PSAs) that address issues of energy and efficiency and one 12-15 minute informational documentary targeted to Florida legislators and the Governor's office. These videos will be tailored to reinforce existing IESES efforts. **Budget:** $200,720 ***This project has been completed***
	Title: Planning Grant: Climate modeling and Outreach Activities **PI:** Shawn R. Smith, **Co-PIs**: Steve Cocke, David Zierden, James O'Brien, Julie Harrington - FSU The objective of the planning grant is to develop at least one external funding proposal that focuses on areas of climate modeling and/or climate outreach that support the activities of the IESES. The focus of our activities has centered on evaluating the potential offshore wind resource in the northeastern Gulf of Mexico and elsewhere in Florida's waters. Preliminary research has been completed using observations from instrumented Air Force towers and buoys in the waters around Florida. The existence of wind power capacity has been identified at the assessed locations. Due to the sparseness of in-situ wind data in the region, a numerical modeling approach will need to be pursued to develop a wind climatology with sufficient spatial and temporal scales to further define the offshore wind power capacity. A vast portion of the work conducted focused on outreach and education. When we began our project, the idea of offshore wind power in Florida was not even on the radar of the Florida Legislature or the renewable energy sector at large. We worked to raise the visibility of offshore wind as an energy resource for Florida by attending meetings, connecting with the wind power industry in Florida, and briefing two members of the Florida Legislature and presenting to the Florida Energy and Climate Commission. As a result of these connections, we submitted a preliminary proposal to Siemens Wind Power and have developed a network of colleagues both within FSU and the private sector that are interested in further developing Florida's offshore wind resource. **Budget:** $15,000 ***This project has been completed***
	Title: Visiting Law Professor **Principal Investigator:** JB Ruhl, Jim Rossi **Co-PI:** Uma Outka - FSU **Description:** Two-year Visiting Scholar, Uma Outka, at the College of Law researched the interface between land use law and innovative energy solutions and delivering academic symposia and graduate student seminars on the research scope, comprising Sustainable Energy Research Project (SERP) within Environmental and Land Use Law Program. This project is complete. **Budget:** $214,603 ***This project has been completed***
	Title: Energy Sustainability Course **Principal Investigator:** Mark Jamison - UF **Description:** This project creates the course GEB 4930 Energy Sustainability as a general business class. It examines issues in energy sustainability that confront policy-makers and managers around the world. It also covers energy utility markets and regulation, challenges in addressing environmental externalities, methods for encouraging environmentally friendly energy solutions, and the hard realities of the economics and science of energy. The capstone is a research paper that examines alternative energy futures for the State of Florida. Top papers will have the opportunity to participate in a moderated forum sponsored by the Bob Graham Center for Public Service focused on Energy Sustainability in Florida. The course will be videotaped and made available to non-UF students in 2015. **External Collaborators:** NA **Status: Active**

	Title: Buildings and Energy: Design and Operation Vs. Sustainability"- An Energy Engineering Course for Florida-specific Building Design & Operation **Principal Investigator:** Prabir Barooah - UF **Description:** To achieve higher standards in building design and operation, a solid foundation of energy engineering and sustainability principles is essential. At UF engineering, there are no courses offered to students and industry professionals in energy topics particularly related to buildings, specifically for the design and operation in Florida climate conditions. This project fills this void through the development of an energy engineering course. **External Collaborators:** Dr. Timothy Middelkoop, University of Missouri **Status: Active**
	Title: Renewable Energy Education Program at USF's Patel College of Global Sustainability **Principal Investigator:** George Philippidis - USF **Description:** The goal of this project is to establish an education program in renewable energy at USF's Patel College of Global Sustainability (PCGS) by developing two graduate-level courses: (1) "Renewable Transportation Fuels" and (2) "Renewable Power Portfolio". The courses will be developed for both in-class and on-line delivery and will constitute the concentration in Renewable Energy for the College's existing M.A. in Global Sustainability. **External Collaborators:** NA **Status: Active**
	Title: Introducing Specialization in "Sustainable Energy Systems" for Under-Graduate Students in Engineering at the University of West Florida **Principal Investigator:** Bhuvana Ramachandran and Co-PI: Muhammad Rashid, UWF **Description:** The specialization in "Sustainable Energy Systems" initiated at the University of West Florida is a collaborative effort among faculty in the Department of Electrical and Computer Engineering and Department of Ethics, Law and Policy at the University of West Florida. The objective is to facilitate an understanding of the technology, processes, economics and policy that underpin energy systems within the context of the sustainability of energy supply and demand. **External Collaborators:** NA **Status: Active**
	Title: A Certificate Program to Enhance Sustainable Behavior Change Competencies for Energy---Focused Educational Outreach Professionals **Principal Investigator:** Laura A. Sanagorski Warner - UF **Description:** The aim of this educational offering is to improve the process of program delivery focused on sustainable behavior change within the context of energy usage. **External Collaborators:** NA **Status: (Recent award)**
	Title: Solar Energy Technologies: Fundamentals and Applications in Buildings **Principal Investigator:** Cheng-Xian (Charlie) Lin - FIU **Description:** In this project, the PI at Florida International University will develop a new online course in solar energy technologies, with emphasis on solar applications in buildings, taking account the unique solar resource and infrastructure in the state of Florida. **External Collaborators:** NA **Status: Active (Recent award)**
	Title: Renewable Energies and Sustainability Education **Principal Investigator:** Ryan Integlia and Sesha Srinivasan - Polytech **Description:** This education proposal is aimed at developing a stand-alone course content accessibility, conducting competitions and workshop that can be offered to undergraduate and graduate students at the Florida Polytechnic University. **External Collaborators:** NA **Status: Active (Recent award)**

FESC Phase 2 Technology Commercialization	
	Title: Development of a Low Cost Concentrating Solar Energy System Using Solar Sausages **PIs:** David VanWinkle, Sean Barton – UF **Description:** 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. **Industry Partner:** Hunter and Harp Holdings (HHH)
	Title: Stress Evolution in Solid-State Li-Ion Battery Materials **PI:** Kevin S. Jones – UF **Description:** Li-ion battery (LIB) technology is promising for use in electric drive vehicle (EDV) and stationary energy storage applications. However, challenges with materials safety, performance, cost, and manufacturing scalability have largely prohibited LIB implementation in these situations. Challenges in stress evolution during the fabrication and processing of the elements of the cells remain and are not well understood. In this study the roles of component fabrication and processing conditions on the resulting stresses in the materials are being evaluated. Thin film battery components will be deposited on stainless substrates using a novel fabrication method invented and patented by Planar Energy and the components will be subjected to different annealing treatments. A novel curvature measurement system will be used to characterize the stress in the component layers both after deposition and annealing and structural analysis techniques will be used to correlate the resultant component material microstructure and crystallographic phase(s) with the measured stresses. **Industry Partner:** Planar Energy
	Title: SWNT Based Air Cathodes for Fuel Cells & Metal Air Batteries **PI:** Andrew G. Rinzler – UF **Description:** 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. **Industry Partner:** nRadiance LL

	Title: Uni-Directional Impulse Turbine for the Powering of Offshore Monitoring Systems **PI:** Zhihua Qu, **Co-PI:** Kuo-chi Lin – UCF **Description:** Numerical modeling and experimental testing of turbine for wave energy conversion. 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. **Industry Partner:** Harris Corporation

APPENDIX B – ACCOUNTABILITY MEASURES – DATA

1. Competitive Grants Applied by all SUS faculty in Energy Area

During Oct. 1, 2013 to Sep 30, 2014 Period (Back to top)

SUS energy faculty submitted **381 funding proposals amounting to $97,728,262** during the twelve-month period of Oct 1, 2013 through Sep 30, 2014. The information was collected through the databases at each university, published news releases, and faculty input. The database information was reviewed carefully and listings that are not energy related were deleted.

Due to confidential nature of this information, the listing of the proposals submitted is not given in this report; however the break down by university is provided below:

University	# of Proposals Submitted	Funding Requested
FAU	6	$6,264,494
FSU	76	$15M+ (*Estimated amount*)
UCF/FSEC	127	$31,865,374
UF	140	$39,522,425
UNF	4	$626,938
USF	27	$25,712,233
UWF	1	$1,292
TOTALS	**381**	**$97,728,262**

2. *Competitive Grants Received by All SUS Faculty in Energy Area*

During Oct. 1, 2013 to Sep 30, 2014 Period (Back to top)

All SUS energy faculty information is listed below to show the scope of the SUS research program. This information might be helpful in forming collaborative teams, informing the outside world (e.g., industry) of FESC's research interests. The information was collected through the databases at each university, published news releases, and faculty input. The database information was reviewed carefully and listings that are not energy related to energy were deleted.

The SUS faculty received **366 research and education awards totaling $58,174,283** during the twelve-month period of Oct 1, 2013 through Sep 30, 2014. Note many 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.

#	Faculty	University	Source/Agency	Project Title	Start Date	End Date	Amount
1	Lewis Johnson FAMU CePaST (Center for Plasma Science & Technology)	FAMU	Pacific Northwest National Laboratory	Consortium for Advanced Chemometrics and in-situ analysis using Laser Ablation Multi Collector Inductively Coupled Mass Spectroscopy (LAMC- ICMS) and/or Laser Induced Breakdown Spectroscopy (LIBS)	8/6/2014		$61,736
2	Ephrem-Denis Mezonlin FAMU CePaST (Center for Plasma Science &Technology)	FAMU	US DOE	Turbulent Transport Diagnostics for Plasmas	8/18/2014		$156,000
3	Andrew Jones Jr. , Department of Mathematics	FAMU	U.S. Nuclear Regulatory Commission	Preparation for Future Nuclear Scientists and Engineers	8/29/2014		$240,000
4	Charles Weatherford, CePaST (Center for Plasma Science and Technology)	FAMU	Tuskegee University/National Nuclear Security Agency	Experimental & Computational Studies on High Temperature Plasmas	9/8/2014		$90,105
5	Charles Weatherford, CePaST (Center for Plasma Science and Technology)	FAMU	US DOE	Consortium for Materials and Energy Studies (CMAES)	9/30/2014		$1,055,528
6	Lewis Johnson, CePaST (Center for Plasma Science and Technology)	FAMU	US DOE	Consotium for Research on the Science & Engineering of Signatures (ROSES) .	9/30/2014		$678,870
7	S. H. Skemp	FAU	Univ. of NC	CSI Ocean Energy Gulf Stream Field Observations	4/15/14	6/15/14	$15,000
8	S.H. Skemp & F. Dahlgleish	FAU	DOE	Unobtrusive Multi-static Serial LiDAR Imager (UMSLI) for Wide-area Surveillance and Identification of Marine Life	9/30/14	9/39/16	$500,000

9	S.H. Skemp	FAU	DOE	Southeast National Marine Renewable Energy Center - Advanced Water Power Projects: Modification FY2013 Funding	9/30/13	8/31/15	$250,000
10	Adams T	FSU	Fermi National Accelerator Lab	Activities Related To Forward Calorimetry R&D			$68,000
11	Albrecht-Schmitt T	FSU	U. S. Department of Energy	Differentiating between Lanthanides and Actinides			$200,000
12	Albrecht-Schmitt T	FSU	University of Notre Dame	TAS Recovery Act: Material Science of Actinides- EFRC			$69,373
13	Alvi F	FSU	Air Force Office of Scientific Research	A Comprehensive Study of 3-D Shock/Turbulent Boundary La			$161,998
14	Alvi F	FSU	Florida A&M University	Research & Education Program for HBCUs			$9,296
15	Alvi F	FSU	University of Florida	PIRE: Collaborations with Japan and France on Complex an			$79,229
16	Askew A	FSU	Universities Research Associat	Search for Supersymmetry in Events with Photons			$14,000
17	Balicas L	FSU	U. S. Department of Energy	SISGR - High Magnetic Fields as a Probe to Unveil the Ph			$162,000
18	Cattafesta L	FSU	National Aeronautics & Space A	Aeroacoustic Measurements of a Leading Edge-Slat			$25,491
19	Cattafesta L	FSU	National Science Foundation	I/UCRC Planning Grant: Applications in Flow Control			$4,818
20	Cattafesta L	FSU	Office of Naval Research	A Novel Method to Predict Circulation Noise Control			$33,000
21	Cattafesta L	FSU	University of Florida	ONR Vortex 87790 - An Experimental Investigation Of Wing			$4,500
22	Chanton J	FSU	University of Arizona	Pathways to Carbon Liberation: A Systems Approach to Und			$351,230
23	Cooper W	FSU	Georgia Institute of Technolog	Soil C Storage and Turnover in A Northern Peatland Fores			$123,524
24	Edrington C	FSU	North Carolina State Universit	NSF Engineering Research Center for Future Renewable Ele			$557,001
25	Edrington C	FSU	University of Texas at Arlington	Organic Distributed Decision-Making for Heterogeneous En			$24,500
26	Ellington W	FSU	UT-Battelle LLC	UT-Battelle Core Universities Partnership			$29,000
27	Eugenio P	FSU	U. S. Department of Energy	Experimental Hadronic Nuclear Physics			$942,000
28	Faruque M.O.	FSU	University of Central Florida	Foundations for Engineering Education for Distributed En			$60,000
29	Feiock R	FSU	University of North Texas	RCN-SEES: Predictive Modeling Network for Sustainable Hu			$62,500
30	Gunzburger M	FSU	U. S. Department of Energy	DIAMOND: An Integrated Multifaceted Approach To Mathema			$200,000

31	Gunzburger M	FSU	U. S. Department of Energy	EQUINOX: Environment for Quantifying Uncertainty: Inte			$150,000
32	Gunzburger M	FSU	U. S. Department of Energy	Predicting Ice Sheet and Climate Evolution at Extreme Sc			$40,134
33	Jung S	FSU	University of Florida	Full Scale Wind Load Testing of Aluminum Screen Enclosur			$6,846
34	Kumar R	FSU	M4 Engineering	Evaluation of Unsteady Loading on Store Trajectories			$12,000
35	Kumar R	FSU	M4 Engineering	Wind Tunnel Balance Correction for Structural Motion Eff			$9,011
36	Kumar R	FSU	Northrop Grumman Corporation	Flowfield Characteristics of Axisymmetric and Non-Axixym			$42,000
37	Larbalestier D	FSU	U. S. Department of Energy	NB3SN Superconductors for the LHC and for Accelerators B			$1,260,000
38	Larbalestier D	FSU	U. S. Department of Energy	The Underlying Science of High Critical Current Density			$1,500,000
39	Lee P	FSU	Supramagnetics, Inc	A New Nb3Sn Process with a Novel Artificial Pinning Cent			$150,000
40	Lee P	FSU	U. S. Department of Energy	The Cost of Grain Boundaries on the Performance of Supec			$400,000
41	McGinnis R	FSU	Naval Sea Systems Command	Research and Development of Next Generation Naval Integr			$780,686
42	McGinnis R	FSU	Office of Naval Research	ESRDC FY-14-FY16			$1,987,499
43	McGinnis R	FSU	Office of Naval Research	ESRDC Swampworks FY2013			$411,511
44	Meeker R	FSU	U. S. Department of Energy	The Sunshine State Solar Grid Initiative			$754,986
45	Milligan J	FSU	RTI International	Science, Technology, Research and Innovation Development			$60,080
46	Morey S	FSU	Fugro Global Environmental and Ocean Sci	Hi-Res Environmental Data for Enhanced UDW Operations Sa			$211,149
47	Oates W	FSU	Air Force Office of Scientific Research	Modeling and Experimental Characterization of Novel Phot			$21,323
48	Oates W	FSU	Florida A&M University	Simulation of Fluid-Structure Interaction for High-Reyno			$5,590
49	Oates W	FSU	University of Florida	A01 3 High-Temperature Sapphire Pressure Sensors for Har			$619,686
50	Pamidi S	FSU	Tai Yang Research Corp	hSTTR: Fabrication of Higher Temperature Semiconductor+			$222,821
51	Piekarewicz J	FSU	U. S. Department of Energy	From Quarks to the Cosmos			$129,000
52	Plewa T	FSU	U. S. Department of Energy	Diverging Supernova Explosion Experiments on NIF			$556,352

53	Prosper H	FSU	U. S. Department of Energy	High Energy Research At Florida State University			$667,000
54	Prosper H	FSU	Universities Research Associat	Electrons in Jets and Searching Beyond the Lamppost			$14,000
55	Roberts W	FSU	U. S. Department of Energy	Research in Hadron Physics			$103,000
56	Schlottmann P	FSU	U. S. Department of Energy	Strongly Correlated Electron Systems			$180,000
57	Shatruk M	FSU	UT-Battelle LLC	Computational/Combinatorial Discovery of New Intermetall			$120,000
58	Shatruk M	FSU	UT-Battelle LLC	GO! Graduate Opportunities Program - Xiaoyan Tan: Magnet			$3,000
59	Shih C	FSU	Air Force Research Laboratory	Mechanical Engineering Educational Programs, Senior Caps			$24,854
60	Shih C	FSU	Florida A&M University	High Temperature Supersonic Jet Noise Fundamental Studie			$17,552
61	Shih C	FSU	National Park Service	Cone and Friction Cone Penetrometer Applications to Arch			$70,880
62	Shih C	FSU	U. S. Department of Education	U.S.-Brazil Partnership In Sustainable Energy and Aerona			$58,110
63	Shih C	FSU	University of Central Florida	Direct Drive Solar-Powered Arcjet Thruster			$500
64	Shih C	FSU	University of Michigan Ann Arbor	Noise and Thermal Mitigation of Naval Systems			$75,000
65	Siegrist T	FSU	U. S. Department of Energy	Discovery and Crystal Growth of New Oxide Phases from Me			$200,000
66	Siegrist T	FSU	UT-Battelle LLC	Go Program: Jifeng Sun - Computation of Electronic Band			$89,424
67	Smirnov D	FSU	U. S. Department of Energy	Infrared Optical Study of Graphene in High Magnetic Fiel			$155,352
68	Steurer M	FSU	Alliance for Sustainable Energy, LLC	NREL PHIL Anti-Islanding Testing and Demonstration			$75,006
69	Stiegman A	FSU	University of California (Sant	Hierarchical Design of Supported Organometallic Catalyst			$420,000
70	Taira K	FSU	Air Force Office of Scientific Research	Understanding the Fundamental Roles of Momentum and Vort			$35,831
71	Taira K	FSU	U. S. Army Research Office	Network-Theoretic Modeling of Fluid Flow			$14,986
72	Taira K	FSU	U. S. Army Research Office	Turbulent Flow Modification with Thermoacoustic			$34,638
73	Taira K	FSU	University of Florida	Three Dimensional Control of High Speed Cavity Flows			$32,083
74	Telotte J	FSU	National Science Foundation	Collaborative Project: Energy Sustainability Remote Labo			$127,264

75	Tozer D	FSU	U. S. Department of Energy	Electron Interactions in Actidnides and Related Systems			$1,074,000
76	Uzun A	FSU	National Institute of Aerospace	Direct Numerical Simulation of Three-Dimensional Boundar			$23,449
77	Van Sciver S	FSU	U. S. Department of Energy	Liquid Helium Fluid Dynamics Studies			$250,000
78	Volya A	FSU	U. S. Department of Energy	Atomic Nucleus: A Finite Open Quantum Many-Body System			$354,000
79	Wahl H	FSU	University of Notre Dame	Quarknet			$7,000
80	Walsh R	FSU	UT-Battelle LLC	One Piece Tie Plate Specimen Testing			$18,091
81	Weinberg M	FSU	Fermi National Accelerator Lab	2014 LPC Fellowship			$36,908
82	Wiedenhoever I.L.	FSU	U. S. Department of Energy	Spectroscopy of Resonances in the Astrophysical rp-Proce			$139,000
83	Yang W	FSU	Oak Ridge Associated Universit	Computational Study of Cellulose Synthase Via Enhanced S			$25,000
84	Ye M	FSU	U. S. Department of Energy	Computational Bayesian Framework for Quantification and			$151,905
85	Yeboah Y	FSU	FSU Foundation	University Eminent Scholar Chair Fund			$18,000
86	Zheng J	FSU	Battelle Memorial Institute	Investigation of Pre-Lithiated Anodes for Li-Ion Batteri			$150,000
87	Zheng J	FSU	FSU Foundation	Development of High Energy Li Capacitors			$46,996
88	Zheng J	FSU	General Capacitor	Development and Characterization of Li-ion Capacitor Ele			$227,144
89	Zheng J	FSU	General Technical Services	Investigation on the Effects of Porosity and Catalyst to			$375,000
90	PI: Jones, Dr. W	UCF	National Aeronautics and Space Administration	Aquarius Investigation to Quantify Effects of Rainfall on Near-Surface Ocean Salinity Profiles	2/18/2014	5/18/2017	$117,417
91	PI: Georgiopoulos, Dr. Michael	UCF	National Science Foundation	CAMP - YES (Career Advancement Mentoring Program for Young Entrepreneur and Scholars)	8/1/2014	7/31/2019	$126,900
92	PI: Rahnavard, Dr. Nazanin	UCF	National Science Foundation	CAREER: A Generalized Compressive Sensing Approach to Data Acquisition and Ad-Hoc Sensor Networking	1/1/2014	1/31/2016	$334,832
93	PI: Wang, Dr. Jun	UCF	National Science Foundation	CAREER: Data-Intensive HPC Analytics: A systems approach through extended interfaces, data restructuring and data-centric scheduling	3/15/2010	2/28/2015	$115,021
94	CoPI: Georgiopoulos, Dr. Michael	UCF	3XLOGIC Florida LLC	Central Florida - STEM Training Consortium (CF-STEM) Internship Funding - 3XLOGIC Florida, LLC	5/1/2014	4/1/2016	$3,750
95	CoPI: Georgiopoulos, Dr. Michael	UCF	AgileSrc, LLC.	Central Florida - STEM Training Consortium (CF-STEM) Internship Funding - Agilesrc, LLC	7/7/2013	4/1/2016	$3,750

96	CoPI: Georgiopoulos, Dr. Michael	UCF	BBA Aviaton USA Inc.	Central Florida - STEM Training Consortium (CF-STEM) Internship Funding - BBA Aviation, Inc.	7/10/2013	4/1/2016	$3,750
97	CoPI: Georgiopoulos, Dr. Michael	UCF	Cubic Simulation Systems, Inc.	Central Florida - STEM Training Consortium (CF-STEM) Internship Funding - Cubic Simulation Systems, Inc.	5/12/2014	4/1/2016	$7,500
98	CoPI: Georgiopoulos, Dr. Michael	UCF	Datanautix, Inc.	Central Florida - STEM Training Consortium (CF-STEM) Internship Funding - DATANAUTIX, INC.	4/2/2012	4/1/2016	$3,750
99	CoPI: Georgiopoulos, Dr. Michael	UCF	GeoCove, Inc.	Central Florida - STEM Training Consortium (CF-STEM) Internship Funding - GeoCove, Inc.	7/26/2013	4/1/2016	$3,750
100	CoPI: Georgiopoulos, Dr. Michael	UCF	Lockheed Martin Missiles and Fire Control	Central Florida - STEM Training Consortium (CF-STEM) Internship Funding - Lockheed Martin	8/9/2013	4/1/2016	$75,005
101	CoPI: Georgiopoulos, Dr. Michael	UCF	Nexgen Global Technologies	Central Florida - STEM Training Consortium (CF-STEM) Internship Funding - Nexgen Global Technologies	6/27/2013	4/1/2016	$7,500
102	CoPI: Georgiopoulos, Dr. Michael	UCF	Orlando Utilities Commission	Central Florida - STEM Training Consortium (CF-STEM) Internship Funding - Orlando Utilities Commission (OUC)	7/31/2013	4/1/2016	$3,750
103	CoPI: Georgiopoulos, Dr. Michael	UCF	US Army PEO STRI	Central Florida - STEM Training Consortium (CF-STEM) Internship Funding - PEO STRI	10/28/2013	4/1/2016	$18,750
104	CoPI: Georgiopoulos, Dr. Michael	UCF	Aptas Technologies LLC	Central Florida - STEM Training Consortium (CF-STEM) Internship Funding- Aptas Technologies LLC	5/19/2014	4/1/2016	$6,250
105	CoPI: Georgiopoulos, Dr. Michael	UCF	Innovative Medical Device Solutions	Central Florida - STEM Training Consortium (CF-STEM) Internship Funding -Innovative Medical Device Solutions	5/14/2014	4/1/2016	$7,500
106	CoPI: Georgiopoulos, Dr. Michael	UCF	Program Works, Inc.	Central Florida - STEM Training Consortium (CF-STEM) Internship Funding -Program Works, Inc.	7/12/2013	4/1/2016	$11,250
107	CoPI: Georgiopoulos, Dr. Michael	UCF	Stirling Dynamics	Central Florida - STEM Training Consortium (CF-STEM) Internship Funding -Stirling Dynamics	5/9/2014	4/1/2016	$3,750
108	CoPI: Georgiopoulos, Dr. Michael	UCF	SightPlan Inc.	Central Florida - STEM Training Consortium (CF-STEM) Internship Funding-SightPlan, Inc.	6/1/2014	4/1/2016	$5,400
109	PI: Behal, Dr. Aman	UCF	National Science Foundation	CHS: Medium: Collaborative Research: Social Learning in Mixed Human-Robot Groups for People with Disabilities	9/1/2014	8/31/2017	$144,924
110	PI: Rahnavard, Dr. Nazanin	UCF	National Science Foundation	CIF: Small: Collaborative Research: Cooperative Sensing and Communications for Cognitive Radio Networks	1/1/2014	12/31/2014	$44,581
111	PI: Gong, Dr. Xun	UCF	Defense Advanced Research Projects Agency	Customizable Antenna Array Using Pixelated and Reconfigurable Slot-Ring Antennas	2/25/2014	10/25/2014	$87,501
112	PI: Liou, Dr. Juin	UCF	Allegro MicroSystems, LLC	Design, Characterization, and Optimization of Electrostatic Discharge (ESD) Power Clamps for Automotive Electronics	6/1/2014	5/31/2017	$45,000
113	PI: Wu, Dr. Xinzhang (Thomas)	UCF	ANSYS, Inc.	Development of Electric Machine Advanced Modeling Techniques	4/1/2013	3/31/2015	$20,000

114	PI: Abdolvand, Dr. Reza	UCF	National Science Foundation	EAGER: Investigation and Optimization of Thermoelectric Properties of Highly-Doped Polysilicon Nanowires	1/1/2014	3/31/2015	$144,145
115	PI: Qu, Dr. Zhihua	UCF	Leidos	Electric Power Markets, Case Studies, and Energy Management System	3/3/2014	3/2/2015	$20,000
116	CoPI: Qu, Dr. Zhihua	UCF	US Department of Transportation	Electric Vehicle Transportation Center (EVTC)	9/30/2013	9/30/2017	$422,445
117	CoPI: Atia, Dr. George	UCF	University of Rochester	Exploiting Multidimensional Classical Optical Entanglement for Enhanced Spatial Scene Recognition	6/1/2014	5/31/2015	$55,523
118	PI: Liou, Dr. Juin	UCF	Analog Devices	Failure Criteria Metric under ESD Stress Conditions	5/1/2007	8/31/2019	$600,000
119	PI: Qu, Dr. Zhihua, CoPI: Vosoughi, Dr. Azadeh, CoPI: Simaan, Dr. Marwan, CoPI: Seyedi-Esfahani, Dr. Alireza, CoPI: Lotfifard, Dr. Saeed	UCF	US Department of Energy	Foundations for Engineering Education for Distributed Energy Resources (FEEDER)	9/30/2013	9/30/2014	$408,516
120	PI: Abdolvand, Dr. Reza	UCF	National Science Foundation	GOALI: Lateral-Mode MEMS Filter Arrays on Ultrananocrystalline Diamond for Multi-Band Communication	1/1/2014	4/30/2015	$130,190
121	CoPI: Jones, Dr. W	UCF	NASA Shared Services Center	GOLD SALMON project	10/14/2011	9/30/2020	$251,092
122	PI: Yuan, Dr. Jiann-Shiun, CoPI: Lin, Dr. Mingjie, CoPI: Gong, Dr. Xun, CoPI: DeMara, Dr. Ronald, CoPI: Atia, Dr. George, CoPI: Abdolvand, Dr. Reza	UCF	National Science Foundation	I/UCRC Multi-functional Integrated System Technology (MIST)	9/1/2014	8/31/2019	$36,400
123	CoPI: Georgiopoulos, Dr. Michael	UCF	National Science Foundation	I3: The UCF Community Embraces the Knowledge-Based Economy	5/1/2010	4/30/2015	$42,058
124	PI: Jones, Dr. W	UCF	NASA Shared Services Center	Improved Active/Passive Ocean Vector Wind Retrievals	7/22/2010	7/21/2015	$45,000
125	PI: Seyedi-Esfahani, Dr. Alireza	UCF	Griffiss Institute, Inc.	Inference in Complex Networks of Dynamical Systems	9/1/2014	12/31/2014	$10,000
126	PI: Wu, Dr. Xinzhang (Thomas)	UCF	Applied Power Electronics Corp	Integrated Inductor Design for High-Efficiency, High-Density Soft-Switching Multi-Port Photovoltaic Power Manager for SBIR OSD Phase I Project O133-EP2-2210	3/11/2014	10/31/2014	$9,965
127	PI: Qu, Dr. Zhihua	UCF	Coleman Aerospace	Novel Guidance and Control Algorithms for Missile Defense Systems	8/7/2013	10/30/2015	$80,000
128	PI: Jones, Dr. W	UCF	NASA Marshall Space Flight Center	Observations of Ocean Surface Wind Speed and Rain Rate with the Hurricane Imaging Radiometer (HIRAD)	2/4/2011	2/3/2016	$29,246

129	PI: Qu, Dr. Zhihua, PI: Qu, Dr. Zhihua	UCF	Harris Corporation	Ocean Energy Exploration, Extraction and Monitoring Systems	9/1/2010	8/7/2014	$2,860
130	PI: Jones, Dr. W	UCF	NASA Shared Services Center	On Orbit Inter-Satellite Radiometric Calibration	3/15/2013	3/14/2016	$154,087
131	PI: Malocha, Dr. Donald	UCF	Albido Corporation	Passive Wireless Sensor System for Structural Health Monitoring	6/20/2014	12/19/2014	$34,800
132	PI: Malocha, Dr. Donald	UCF	NASA Langley Research Center	RF - TT Commercialization "Saw Temperature Sensor System"	9/27/2013	5/9/2014	$11,947
133	PI: Malocha, Dr. Donald, PI: Malocha, Dr. Donald	UCF	NASA Langley Research Center	RF: TT NASA Langley Wafer Fabrication 6 Designs	6/5/2014	9/30/2014	$25,000
134	CoPI: Wu, Dr. Xinzhang (Thomas)	UCF	Rini Technologies, Inc.	Thermal Management of Electrical Actuation via Enhanced Air Circulation	9/27/2013	9/26/2015	$90,000
135	PI: Wu, Dr. Xinzhang (Thomas)	UCF	Calnetix, Incorporated	Three Dimensional FEA Modeling and Permanenet Magnet Motor	8/1/2014	10/31/2014	$3,000
136	PI: Malocha, Dr. Donald, PI: Malocha, Dr. Donald	UCF	QinetiQ North America	TTO: Malocha Auxiliary Balance Account	2/11/2014	4/15/2017	$18,325
137	CoPI: Georgiopoulos, Dr. Michael	UCF	National Science Foundation	UCF COMPASS: Convincing Outstanding-Math-Potential Admits to Succeed in STEM	7/1/2012	9/30/2017	$11,500
138	PI: Malocha, Dr. Donald	UCF	MNEMONICS, Inc.	Wireless SAW Strain Gauge and Integrated Interrogator Design	3/7/2013	5/21/2014	$93,288
139	PI: Sonne, Mr. Jeffrey, CoPI: Withers, Mr. Charles	UCF	Florida Department of Business and Professional Regulation	A Review of Home Airtightness and Ventilation Approaches for Florida Building Commission Research	2/24/2014	6/30/2014	$27,800
140	PI: Kettles, Colleen	UCF	US Department of Energy	Advancing Alternative Fuel Markets in Florida	1/31/2013	1/30/2015	$234,775
141	PI: Withers, Mr. Charles	UCF	Florida Department of Business and Professional Regulation	An Assessment of Energy Efficient Methods of Indoor Humidity Control in Florida Housing for Florida Building Commission Research	2/24/2014	6/30/2014	$44,491
142	PI: Muradov, Dr. Nazim	UCF	Office of Naval Research	An Energy-Dense Al-NaBH4-PEMFC Based Power Generator for Unmanned Undersea Vehicles	1/28/2013	12/31/2015	$145,755
143	PI: Schoenfeld, Dr. Winston	UCF	HybridaSol, LLC	Applied Research in Thermoelectric Materials Processing and Hybrid Thermoelectric-Photovoltaic Devices	1/1/2014	11/30/2014	$45,000
144	PI: Martin, Mr. Eric, CoPI: Withers, Mr. Charles, CoPI: Vieira, Mr. Robin, CoPI: Parker, Mr. Danny, CoPI: McIlvaine, Mrs. Janet, CoPI: Fairey, Mr. Philip, CoPI: Chasar, Mr. David	UCF	National Renewable Energy Laboratory	Building America Partnership for Improved Residential Construction (BA-PIRC) Task Order 5	3/31/2014	1/10/2015	$985,834

145	PI: Click, Mr. David, CoPI: Moaveni, Mr. Houtan, CoPI: Kettles, Colleen	UCF	City of Orlando	City of Orlando: 2MW PV Project at Wastewater Facility	11/1/2013	12/31/2015	$10,213
146	PI: Dhere, Dr. Neelkanth	UCF	National Renewable Energy Laboratory	Comparison the modes and mechanisms of degradation of experimental c-Si PV modules with various encapsulants	2/11/2014	2/10/2015	$11,870
147	PI: Gu, Dr. Lixing, CoPI: Raustad, Mr. Richard	UCF	National Renewable Energy Laboratory	Continuity and Innovation in the Development and support of Energy Plus	6/20/2011	10/31/2014	$873,600
148	PI: Swami, Dr. Muthusamy, CoPI: Vieira, Mr. Robin	UCF	Florida Department of Business and Professional Regulation	Development of the Compliance Software Tool Assistance Manual for the 2014 Florida Building Energy Code	2/24/2014	6/30/2014	$70,000
149	PI: Click, Mr. David, CoPI: Schleith, Mrs. Susan	UCF	Duke Energy Florida, Inc.	Duke Energy SunSense Schools - 2014	8/7/2014	12/31/2014	$30,000
150	PI: Kettles, Colleen	UCF	Brevard Workforce Development Board Inc.	Education and Training for Clean Energy Cluster Workers	2/24/2014	9/30/2015	$29,949
151	PI: Block, Dr. David, PI: Block, Dr. David, PI: Block, Dr. David	UCF	US Department of Transportation	Electric Vehicle Transportation Center (EVTC)	9/30/2013	9/30/2017	$1,689,780
152	PI: Gu, Dr. Lixing	UCF	Oak Ridge National Laboratory	EnergyPlus Enhancements	5/20/2014	8/31/2014	$10,000
153	CoPI: Reedy, Mr. Robert, CoPI: Click, Mr. David	UCF	US Department of Energy	Foundations for Engineering Education for Distributed Energy Resources (FEEDER)	9/30/2013	9/30/2014	$272,344
154	PI: Barkaszi, Mr. Stephen	UCF	Sandia National Laboratories	FSEC FY13 RTC Partner Support	10/24/2012	12/31/2014	$134,000
155	PI: Kettles, Colleen, CoPI: Click, Mr. David, CoPI: Barkaszi, Mr. Stephen	UCF	Broward County	Go SOLAR Florida: SunShot Challenge II	7/22/2014	3/31/2016	$75,000
156	PI: Barkaszi, Mr. Stephen	UCF	National Renewable Energy Laboratory	High Voltage Test Bed for PV Modules	9/8/2014	9/7/2015	$16,129
157	PI: Raustad, Mr. Richard	UCF	Ranger Energy Saving Technologies, LLC	Initial and Possible Future Testing of a Unitary HVAC System Advanced Control Module	5/1/2014	7/31/2014	$14,995
158	PI: McIlvaine, Mrs. Janet	UCF	Florida Department of Business and Professional Regulation	Investigation of Potential Benefits of Revising Exception 1 under Florida Building Code, Energy Conservation	2/24/2014	6/30/2014	$12,237
159	PI: Block, Dr. David, CoPI:	UCF	US Department of Energy	Phase 2 of the Southern Region Resource and Training Program as Part	10/1/2011	12/30/2014	$389,884

	Harrison, Mr. John			of the Southern Alternative Energy Training Network			
160	PI: Martin, Mr. Eric, CoPI: Sutherland, Karen, CoPI: Parker, Mr. Danny	UCF	Florida Power & Light Company	Phased Deep Retrofits, Phase II	5/2/2014	12/31/2015	$170,000
161	PI: Schleith, Mrs. Susan	UCF	Florida Power & Light Company	RF: FPL SunSmart Schools DAS program	5/1/2009	7/31/2014	$13,952
162	PI: Shields, Ms. Sherri	UCF	Sherwood Associates, Inc.	Solar ABCs Website Maintenance	1/24/2014	1/23/2015	$2,500
163	PI: Dhere, Dr. Neelkanth	UCF	Colorado School of Mines	Solar Energy Research Institute for India and the United States (SERIIUS)/ Study of PV module Reliability and Durability in the Hot and Humid Climate	1/21/2013	7/22/2018	$73,955
164	PI: Muradov, Dr. Nazim	UCF	Texas A&M Engineering Experiment Station	Solar Hybrid Hydrogen Production Cycle with In-situ Thermal Energy Storage	2/16/2014	2/16/2017	$123,304
165	PI: Click, Mr. David, CoPI: Moaveni, Mr. Houtan	UCF	Florida Department of Transportation	Solar Power at the Turkey Lake Service Plaza: A Best Practices Guide for Governmental Agencies Interested in Solar Power Projects	4/22/2013	12/31/2014	$6,767
166	PI: Click, Mr. David, CoPI: Reedy, Mr. Robert	UCF	Orlando Utilities Commission	Solar Technical Services	10/1/2013	10/1/2016	$90,000
167	PI: Kettles, Colleen	UCF	Leonardo Technologies, Inc	Space Coast Clean Cities Coalition Support 2012	11/16/2009	11/15/2014	$30,000
168	PI: Click, Mr. David, CoPI: Reedy, Mr. Robert, CoPI: Moaveni, Mr. Houtan	UCF	Florida State University	SUNGRIN Simulation-Assisted Understanding of the High-Penetration PV Effects and Requirements	5/1/2012	8/31/2015	$50,000
169	PI: Click, Mr. David, CoPI: Schleith, Mrs. Susan, CoPI: Moaveni, Mr. Houtan, CoPI: Kettles, Colleen	UCF	Duke Energy Florida, Inc.	SunSmart Schools E-Shelter Plus-Up (Utility Program) AKA SunSense Plus UP	10/14/2013	8/29/2014	$1,214,756
170	PI: Chasar, Mr. David, CoPI: Click, Mr. David	UCF	Atlantic Housing Partners	Task 1: Energy Analysis and Performance Testing of Multifamily Dwellings	8/10/2007	12/31/2014	$7,919
171	PI: Chasar, Mr. David, CoPI: Click, Mr. David	UCF	Atlantic Housing Partners	Task 3: Energy Analysis and Performance Testing of Multifamily Dwellings	8/10/2007	12/31/2014	$17,081
172	PI: Colon, Mr. Carlos	UCF	US Department of Interior/National Park Service	Technical Assistance for the Electric Load Survey and Battery Energy Storage Recommendation at the Dry Tortugas Garden Key National Park	8/1/2014	12/30/2015	$30,543
173	PI: Parker, Mr. Danny	UCF	University of California/Lawrence Berkeley	Technical Assistance to Lawrence Berkeley National Laboratory with the Home Energy Saver Software	1/16/2013	11/30/2014	$50,000

			National Laboratory				
174	PI: Fairey, Mr. Philip, CoPI: Sen Sharma, Mr. Raju	UCF	Residential Energy Service Network, Inc	Technical Support for Residential Energy Services Network	9/1/2012	12/31/2014	$12,800
175	PI: Moaveni, Mr. Houtan, CoPI: Click, Mr. David	UCF	Tampa Electric Company	TECO Energy	8/1/2013	7/31/2015	$47,617
176	ALTPETER F	UF	UNIV OF ILLINOIS /US DOE	ENGINEERING HYDROCARBON BIOSYNTHESIS AND STORAGE TOGETHER WITH INCREASED PHOTOSYNTHETIC EFFICENCY INTO SACCHARINAE	11/14/2013	2/14/2015	$377,000
177	ANDERSON T J	UF	MIDWEST RESEARCH INST /US DOE	ENABLING THE CIGS THIN-FILM PV TECHNOLOGY TO MEET THE DOE GOAL OF $0.50/W MODULE PRICE	5/30/2014	10/11/2015	$276,644
178	BACIAK J E	UF	BATTELLE PACIFIC NW LAB	2014 RADIATION DETECTION FOR NUCLEAR SECURITY SUMMER SCHOOL SUPPORT	5/29/2014	8/15/2014	$9,465
179	BACIAK J E	UF	US DEPT OF ENERGY	BII3 GAMMA-RAY SPECTROMETERS FOR RELIABLE ROOM-TEMPERATURE NUCLEAR MATERIALS SAFEGUARDING	2/17/2014	1/14/2017	$65,713
180	BACIAK J E	UF	US DEPT OF ENERGY	UNIVERSITY OF FLORIDA NUCLEAR SCIENCE AND ENGINEERING FELLOWSHIP AND SCHOLARSHIP - CHRISTOPHER GREULICH	8/14/2014	6/30/2017	$5,000
181	BACIAK J E	UF	US DEPT OF ENERGY	UNIVERSITY OF FLORIDA NUCLEAR SCIENCE AND ENGINEERING FELLOWSHIP AND SCHOLARSHIP - KYLE VAUGHN	8/14/2014	6/30/2017	$5,000
182	BALACHANDAR S	UF	LOS ALAMOS NATIONAL SECURITY	COUPLING OF THE PARTICLE TRANSPORT MODEL TO THE TURBULENCE MODEL	9/22/2014	8/30/2015	$37,500
183	BALACHANDAR S	UF	US DEPT OF ENERGY	PSAAP: CENTER FOR COMPRESSIBLE MULTIPHASE TURBULENCE (CCMT)	2/25/2014	1/26/2015	$239,528
184	BALACHANDAR S	UF	US DEPT OF ENERGY	PSAAP: CENTER FOR COMPRESSIBLE MULTIPHASE TURBULENCE (CCMT)	6/30/2014	1/26/2015	$533,341
185	BAROOAH P	UF	NATL SCIENCE FOU	REU SUPPLEMENT: CAREER: DISTRIBUTED ESTIMATION AND CONTROL FOR ENERGY EFFICIENT BUILDINGS	7/9/2014	1/31/2015	$16,000
186	BOLCH W E	UF	BATTELLE PACIFIC NW LAB	DISOMETRY SUPPORT FOR TECHA RIVER POPULATIONS - HYBRID PHANTOM BASED INTERNAL AND EXTERNAL DOSE COEFFICIENTS	3/20/2014	9/30/2015	$40,000
187	BOLCH W E	UF	BATTELLE PACIFIC NW LAB	DISOMETRY SUPPORT FOR TECHA RIVER POPULATIONS - HYBRID PHANTOM BASED INTERNAL AND EXTERNAL DOSE COEFFICIENTS	11/1/2013	9/30/2014	$49,913
188	BOLCH W E	UF	UT-BATTELLE	DOSE COEFFICIENTS FOR RADIONUCLIDE EXPOSURE OF THE PREGNANT ADULT, EMBRYO AND FETUS	4/3/2014	3/18/2015	$45,001

189	BOLCH W E	UF	UT-BATTELLE	DOSE COEFFICIENTS FOR RADIONUCLIDE EXPOSURE OF THE PREGNANT ADULT, EMBRYO AND FETUS	8/26/2014	3/18/2015	$52,400
190	BOMAN B J	UF	FL DEPT OF AG AND CONSUMER SER	ADVANCING E TUBER - A SUSTAINABLE FEEDSTOCK FOR BIOFUELS AND BIOGAS ON FALLOW FLORIDA CITRUS LANDS	2/10/2014	11/30/2015	$549,975
191	BORKHATARIA R R	UF	UF FOU	DORIS DUKE CONSERVATION SCHOLARS PROGRAM: PARTNERSHIP THROUGH THE UNIVERSITY OF FLORIDA	1/23/2014	9/30/2017	$33,494
192	BORKHATARIA R R	UF	UF FOU	DORIS DUKE CONSERVATION SCHOLARS PROGRAM: PARTNERSHIP THROUGH THE UNIVERSITY OF FLORIDA	10/22/2013	9/30/2017	$254,408
193	CARTHY R R	UF	UF FOU	DORIS DUKE CONSERVATION SCHOLARS PROGRAM PARTNERSHIP THROUGH THE UNIVERSITY OF FLORIDA	10/23/2013	9/30/2017	$194,107
194	CHEN Y	UF	US DEPT OF ENERGY	PREDICTION OF THERMAL TRANSPORT PROPERTIES OF MATERIALS WITH MICROSTRUCTURAL COMPLEXITY	10/1/2013	7/14/2014	$150,000
195	CHEN Y	UF	US DEPT OF ENERGY	PREDICTION OF THERMAL TRANSPORT PROPERTIES OF MATERIALS WITH MICROSTRUCTURAL COMPLEXITY	5/29/2014	7/14/2015	$150,000
196	CHENG H P	UF	US DEPT OF ENERGY	A COMPUTATIONAL APPROACH TO COMPLEX JUNCTIONS AND INTERFACES	12/2/2013	11/30/2014	$180,000
197	CHENG H P	UF	US DEPT OF ENERGY	PARTIAL FINANCIAL SUPPORT OF THE 54TH SANIBEL SYMPOSIUM: 360 DEGREE VIEW OF QUANTUM THEORY & AB INITIO SIMULATION....	2/19/2014	1/14/2015	$15,000
198	CHENG H P	UF	NATL SCIENCE FOU	UNDERSTANDING AND REDUCING THERMAL NOISE VIA ATOMISTIC SIMULATIONS	7/11/2014	8/31/2017	$105,000
199	CHERNATYNSKIY A	UF	BATTELLE	MICRO/NANO SCALE AFM-BASED THERMAL CONDUCTIVITY MEASUREMENT AND ATOMISTIC MODELING FOR OXIDE FUEL	1/7/2014	9/30/2014	$23,001
200	CHILD B	UF	NATURE CONSERVANCY	UF-TNC PARTNERSHIP TO DEVELOP TRANSIDSICIPLINARY RESEARCH INTHE NATURE CONSERVANCY'S AFRICAN CONSERVATION PROGRAMS	12/9/2013	11/15/2014	$50,000
201	CHUNG J N	UF	UF FOU	HINES/PROGRESS ENERGY EMINENT SCHOLAR CHAIR	10/16/2013	8/31/2017	$16,046
202	CHUNG J N	UF	UF FOU	HINES/PROGRESS ENERGY EMINENT SCHOLAR CHAIR	1/31/2014	8/31/2017	$16,162
203	CHUNG J N	UF	UF FOU	HINES/PROGRESS ENERGY EMINENT SCHOLAR CHAIR	4/10/2014	8/31/2017	$16,817
204	CHUNG J N	UF	UF FOU	HINES/PROGRESS ENERGY EMINENT SCHOLAR CHAIR	7/22/2014	8/31/2017	$16,951
205	DILORENZO N	UF	FL DEPT OF AG AND	INTEGRATED FEEDSTOCK DEVELOPMENT AND MANAGEMENT OF OILSEED	11/22/2013	6/30/2016	$44,020

			CONSUMER SER	CROPS FOR DROP-IN BIOFUELS IN FLORIDA			
206	DUFAULT N S	UF	FL DEPT OF AG AND CONSUMER SER	INTEGRATED FEEDSTOCK DEVELOPMENT AND MANAGEMENT OF OILSEED CROPS FOR DROP-IN BIOFUELS IN FLORIDA	11/22/2013	6/30/2016	$44,210
207	DUFFY R	UF	UF FOU	DORIS DUKE CONSERVATION SCHOLARS PROGRAM: PARTNERSHIP THROUGH THE UNIVERSITY OF FLORIDA	10/23/2013	9/30/2017	$45,022
208	EHSANI R	UF	CITRUS RESEARCH & DEVEL FDTN	IN FIELD SOLAR HEAT TREATMENT OF HLB-INFECTED ORANGE TREES FOR INOCULUM REDUCTION	10/4/2013	6/30/2014	$229,618
209	EVANS E A	UF	FL DEPT OF AG AND CONSUMER SER	ADVANCING E TUBER - A SUSTAINABLE FEEDSTOCK FOR BIOFUELS AND BIOGAS ON FALLOW FLORIDA CITRUS LANDS	2/10/2014	11/30/2015	$71,420
210	FIELD R D	UF	US DEPT OF ENERGY	COLLIDER PHYSICS AT THE UNIVERSITY OF FLORIDA	5/15/2014	3/31/2015	$46,099
211	FIELD R D	UF	US DEPT OF ENERGY	COLLIDER PHYSICS AT THE UNIVERSITY OF FLORIDA	5/15/2014	3/31/2015	$66,900
212	FISHER P	UF	US DEPT OF AG	NUTRIENT, WATER, AND LABOR EFFICIENCY IN FLORICULTURE PRODUCTION	8/1/2014	7/31/2018	$24,319
213	FLETCHER P J	UF	WILDLIFE CONSERVATION SOCIETY	COORDINATING MARINE-RELATED RESEARCH, CONSERVATION AND EXTENSION IN NICARAGUA AND THE WIDER CARIBBEAN	5/1/2014	4/30/2016	$90,000
214	FURIC I K	UF	FERMILAB	CMS PHASE 2 UPGRADE R&D SUBSYSTEM-GEM DETECTOR R&D/MUON TRIGGER R&D	9/29/2014	12/31/2014	$21,500
215	FURIC I K	UF	FERMILAB	CMS PHASE 2 UPGRADE R&D SUBSYSTEM-GEM DETECTOR R&D/MUON TRIGGER R&D	9/29/2014	12/31/2014	$45,060
216	GEORGE A D	UF	US DEPT OF ENERGY	PSAAP: CENTER FOR COMPRESSIBLE MULTIPHASE TURBULENCE (CCMT)	2/25/2014	1/26/2015	$127,505
217	GEORGE A D	UF	US DEPT OF ENERGY	PSAAP: CENTER FOR COMPRESSIBLE MULTIPHASE TURBULENCE (CCMT)	6/30/2014	1/26/2015	$303,340
218	GOLUOGLU S	UF	UT-BATTELLE	ELEMENTS OF NUCLEAR SAFEGUARDS, NON-PROLIFERATION, AND SECURITY	5/5/2014	12/30/2014	$137,511
219	GOLUOGLU S	UF	US NUCLEAR REGULATORY COM	UF NRC-10 FACULTY DEVELOPMENT	5/22/2014	4/30/2014	$698
220	GONZALEZ A H	UF	CA INST OF TECHNOLOGY /NASA	CONSTRAINING DARK ENERGY AND MODIFIED GRAVITY WITH EUCLID	12/3/2013	9/30/2014	$5,000
221	GUAN Y	UF	SANDIA NATL LABORATORIES	COMPUTATIONAL STUDIES FOR THE UNIT COMMITMENT PROBLEM UNDER UNCERTAINTY IN THE CURRENT DEREGULATED ENERGY MARKET ENVIRON	1/2/2014	1/15/2015	$78,000
222	GUAN Y	UF	UNIV OF CHICAGO /US DOE	INTEGRATING FTR WITH POWER SYSTEM OPERATIONS	9/29/2014	9/14/2015	$50,000

223	GUAN Y	UF	NATL SCIENCE FOU	PLUG-IN HYBRID ELECTRIC VEHICLES AND ELECTRICITY MARKETS	7/1/2014	7/31/2017	$236,254
224	GUAN Z	UF	MICHIGAN STATE UNIV/US AG	GENOMICS-BASED APPROACHES FOR IMPROVING PETUNIA PRODUCTION EFFICIENCY AND PERFORMANCE	5/22/2014	8/31/2015	$13,812
225	GUGEL K S	UF	VERIFONE	IPPD 2013-2014: DISTRIBUTED MULTIMEDIA INFRASTRUCTURE FOR FUEL DISPENSING OPERATIONS	1/24/2014	8/15/2014	$16,500
226	HAFTKA R T	UF	US DEPT OF ENERGY	PSAAP: CENTER FOR COMPRESSIBLE MULTIPHASE TURBULENCE (CCMT)	2/25/2014	1/26/2015	$31,612
227	HAFTKA R T	UF	US DEPT OF ENERGY	PSAAP: CENTER FOR COMPRESSIBLE MULTIPHASE TURBULENCE (CCMT)	6/30/2014	1/26/2015	$94,837
228	HAHN D W	UF	US DEPT OF ENERGY	CARBON DIOXIDE SHUTTLING THERMOCHEMICAL STORAGE USING STRONTIUM CARBONATE	6/19/2014	4/30/2016	$84,202
229	HAHN D W	UF	US DEPT OF ENERGY	SOLAR THERMOCHEMICAL FUEL PRODUCTION VIA A NOVEL LOW PRESSURE, MAGNETICALLY STABILIZED, NON-VOLATILE IRON OXIDE LOOPING	9/11/2014	12/18/2014	$7,325
230	HAHN D W	UF	US DEPT OF ENERGY	SOLAR THERMOCHEMICAL FUEL PRODUCTION VIA A NOVEL LOW PRESSURE, MAGNETICALLY STABILIZED, NON-VOLATILE IRON OXIDE LOOPING	9/11/2014	12/18/2014	$92,572
231	HAHN D W	UF	US DEPT OF ENERGY	SOLAR THERMOCHEMICAL FUEL PRODUCTION VIA A NOVEL LOW PRESSURE, MAGNETICALLY STABILIZED, NON-VOLATILE IRON OXIDE LOOPING	1/21/2014	12/18/2014	$224,628
232	HAHN D W	UF	US DEPT OF ENERGY	SOLAR THERMOCHEMICAL FUEL PRODUCTION VIA A NOVEL LOW PRESSURE, MAGNETICALLY STABILIZED, NON-VOLATILE IRON OXIDE LOOPING	1/22/2014	12/18/2014	$303,198
233	HAHN D W	UF	US DEPT OF ENERGY	SOLAR THERMOCHEMICAL FUEL PRODUCTION VIA A NOVEL LOW PRESSURE, MAGNETICALLY STABILIZED, NON-VOLATILE IRON OXIDE...	1/21/2014	12/18/2014	$591,025
234	HAHN D W	UF	US DEPT OF ENERGY	SOLAR THERMOCHEMICAL FUEL PRODUCTION VIA A NOVEL LOW PRESSURE, MAGNETICALLY STABILIZED, NON-VOLATILE IRON OXIDE...	9/11/2014	12/18/2014	$140,759
235	HALL C D	UF	US NAVY	NOVEL ENERGY-RICH LINEAR TRIAZENES, NITROGEN YLIDS AND HETEROCYCLIC N-OXIDES	3/27/2014	6/30/2017	$50,000
236	HAYES J P	UF	UF FOU	DORIS DUKE CONSERVATION SCHOLARS PROGRAM: PARTNERSHIP THROUGH THE UNIVERSITY OF FLORIDA	10/15/2013	9/30/2017	$175,605
237	HAYES J P	UF	UF FOU	DORIS DUKE CONSERVATION SCHOLARS PROGRAM: PARTNERSHIP THROUGH THE UNIVERSITY OF FLORIDA	10/23/2013	9/30/2017	$793,358

238	HE Z	UF	ST LUCIE CNTY	EVALUATE THE IMPACTS OF SEDIMENT STORAGE ON PLANT GROWTH IN THE DETENTION AREA	5/7/2014	1/5/2015	$12,188
239	HIRSCHFELD P J	UF	US DEPT OF ENERGY	THEORY OF NOVEL SUPERCONDUCTORS	9/3/2014	8/31/2015	$105,000
240	HODGES A W	UF	FL DEPT OF AG AND CONSUMER SER	COMMERCIAL PRODUCTION OF TERPENE BIOFUELS FROM EXISTING SLASH PINE PLANTATIONS	1/24/2014	11/30/2015	$33,154
241	HOLMES D B	UF	MARION CNTY	EXTENSION AGENT - MARION COUNTY COMMUNITY RESOURCE EFFICIENCY AGENT	4/24/2014	9/30/2017	$10,607
242	JONES J L	UF	NATL SCIENCE FOU	PARTICIPANT SUPPORT: IRES: AUSTRALIAN INTERNATIONAL RESEARCHEXPERIENCE FOR STUDENTS: MATERIALS FOR ENERGY TECHNOLOGIES	2/5/2014	9/30/2014	$8,694
243	JONES P H	UF	FL HOUSING FINANCE CORP /US DOE	UTILITY ENERGY DATA SERVICES FOR MULTIFAMILY ENERGY RETROFITPROGRAM	1/29/2014	1/21/2017	$60,000
244	JORDAN K A	UF	US DEPT OF ENERGY	BII3 GAMMA-RAY SPECTROMETERS FOR RELIABLE ROOM TEMPERATURE NUCLEAR MATERIALS SAFEGUARDING	2/17/2014	1/14/2017	$65,322
245	JORDAN K A	UF	US DEPT OF ENERGY	UNIVERSITY OF FLORIDA NUCLEAR SCIENCE AND ENGINEERING FELLOWSHIP AND SCHOLARSHIP - LUCAS ROLISON	8/14/2014	6/30/2017	$155,000
246	KATRITZKY A R	UF	US NAVY	NOVEL ENERGY-RICH LINEAR TRIAZENES, NITROGEN YLIDS AND HETEROCYCLIC N-OXIDES	11/13/2013	6/30/2017	$25,000
247	KATRITZKY A R	UF	US NAVY	NOVEL ENERGY-RICH LINEAR TRIAZENES, NITROGEN YLIDS AND HETEROCYCLIC N-OXIDES	2/4/2014	6/30/2017	$25,000
248	KIM N H	UF	US DEPT OF ENERGY	PSAAP: CENTER FOR COMPRESSIBLE MULTIPHASE TURBULENCE (CCMT)	2/25/2014	1/26/2015	$27,182
249	KIM N H	UF	US DEPT OF ENERGY	PSAAP: CENTER FOR COMPRESSIBLE MULTIPHASE TURBULENCE (CCMT)	6/30/2014	1/26/2015	$81,546
250	KIRST M	UF	US DEPT OF ENERGY	A SYSTEMS BIOLOGY, WHOLE-GENOME ASSOCIATION ANALYSIS OF THE MOLECULAR REGULATION OF BIOMASS	5/22/2014	4/14/2015	$36,767
251	KLAUSNER J F	UF	US DEPT OF ENERGY	DOE ARPA-E IPA FOR DR. JAMES KLAUSNER	10/14/2013	9/23/2014	$21,172
252	KLAUSNER J F	UF	US DEPT OF ENERGY	DOE ARPA-E IPA FOR DR. JAMES KLAUSNER	9/16/2014	9/10/2016	$386,663
253	KOBZIAR L N	UF	US DEPT OF INTERIOR	FOOD, FUEL, AND FIRE: ASSESSING THE EFFECTS OF FUEL TREATMENTS ON WILDLIFE HABITAT QUALITY IN LONGLEAF PINE . .	9/15/2014	8/31/2016	$11,980
254	KOBZIAR L N	UF	US DEPT OF INTERIOR	FOOD, FUEL, AND FIRE: ASSESSING THE EFFECTS OF FUEL TREATMENTS ON WILDLIFE	9/15/2014	8/31/2016	$12,942

				HABITAT QUALITY IN LONGLEAF PINE . .			
255	LADD A J	UF	US DEPT OF ENERGY	REACTION-INFILTRATION INSTABILITIES IN FRACTURED AND POROUS	2/27/2014	2/28/2015	$156,135
256	LAMM A J	UF	US DEPT OF AG	SMART PHONE APPS: SCIENTIFIC VALIDATION QUANTIFICATION OF WATER CONSERVATION	10/7/2013	8/31/2016	$31,536
257	LEE W S	UF	BARD (US ISRAEL AG R&D FUND)	INNOVATIVE YIELD MAPPING SYSTEM USING HYPERSPECTRAL AND THERMAL IMAGING FOR PRECISION TREE CROP MANAGEMENT	7/18/2014	11/30/2017	$55,000
258	LELE T	UF	NATL SCIENCE FOU	COLLABORATIVE RESEARCH: MECHANICS OF THE NUCLEAR LIPID BILAYERS	9/4/2014	8/31/2017	$155,294
259	LELE T	UF	NATL INST OF HLTH	SUBSTRATE RIGIDITY AND GENE EXPRESSION:ROLE OF NUCLEAR TENSION	7/25/2014	7/31/2016	$409,915
260	LEON R	UF	FL DEPT OF AG AND CONSUMER SER	INTEGRATED FEEDSTOCK DEVELOPMENT AND MANAGEMENT OF OILSEED CROPS FOR DROP-IN BIOFUELS IN FLORIDA	11/22/2013	6/30/2016	$44,210
261	LI T	UF	NATL SCIENCE FOU	CSR:SMALL LEVERAGING DISTRIBUTED GENERATION AND ADAPTIVE ENERGY STORAGE MANAGEMENT FOR EFFICIENT AND SCALE-OUT RENEWA	9/5/2014	7/31/2017	$450,000
262	MANUEL M V	UF	BATTELLE MEMORIAL INST	CENTER FOR MATERIALS SCIENCE AND NUCLEAR FUEL	6/30/2014	12/31/2014	$12,000
263	MANUEL M V	UF	BATTELLE MEMORIAL INST	CENTER FOR MATERIALS SCIENCE OF NUCLEAR FUEL	12/3/2013	12/31/2014	$90,960
264	MANUEL M V	UF	SANDIA NATL LABORATORIES	EFFECTS OF ALLOYING ADDITIONS TO THE STRUCTURE AND PROPERTIES OF MAGNESIUM THIN FILMS - FELLOWSHIP FOR RYAN HOOPER	8/6/2014	8/14/2015	$25,000
265	MASTERS F J	UF	FLORIDA INTERNATIONAL UNIV / FL DIVISION OF EMERGENCY MGMT	CONTINUATION OF RESEARCH ON THE WIND RESISTANCE OF DISCONTINOUS ROOFING SYSTEMS	3/14/2014	6/15/2014	$40,000
266	MASTERS F J	UF	DEPT OF BUSINESS & PROF REGUL	FULL SCALE WIND LOAD TESTING OF ALUMINUM SCREEN ENCLOSURES	3/13/2014	6/30/2014	$81,390
267	MATCHEV K T	UF	US DEPT OF ENERGY	TASK T: ELEMENTARY PARTICLE THEORY AND PHENOMENOLOGY AT THE UNIVERSITY OF FLORIDA	4/24/2014	3/31/2015	$100,784
268	MATCHEV K T	UF	US DEPT OF ENERGY	TASK T: ELEMENTARY PARTICLE THEORY AND PHENOMENOLOGY AT THE UNIVERSITY OF FLORIDA	4/24/2014	3/31/2015	$178,024
269	MATCHEV K T	UF	US DEPT OF ENERGY	TASK T: ELEMENTARY PARTICLE THEORY AND PHENOMENOLOGY AT THE UNIVERSITY OF FLORIDA	4/24/2014	3/31/2015	$188,191
270	MAUPIN J A	UF	US DEPT OF ENERGY	MULTIFUNCTIONAL UBIQUITIN-FOLD PROTEINS OF ARCHAEA	8/11/2014	7/14/2015	$150,000

271	MEI R	UF	US DEPT OF ENERGY	CARBON DIOXIDE SHUTTLING THERMOCHEMICAL STORAGE USING STRONTIUM CARBONATE	6/19/2014	4/30/2016	$78,906
272	MEI R	UF	US DEPT OF ENERGY	CARBON DIOXIDE SHUTTLING THERMOCHEMICAL STORAGE USING STRONTIUM CARBONATE	6/18/2014	4/30/2016	$257,573
273	MEI R	UF	US DEPT OF ENERGY	SOLAR THERMOCHEMICAL FUEL PRODUCTION VIA A NOVEL LOW PRESSURE, MAGNETICALLY STABILIZED, NON-VOLATILE IRON OXIDE LOOPING	9/11/2014	12/18/2014	$40,862
274	MEI R	UF	US DEPT OF ENERGY	SOLAR THERMOCHEMICAL FUEL PRODUCTION VIA A NOVEL LOW PRESSURE, MAGNETICALLY STABILIZED, NON-VOLATILE IRON OXIDE LOOPING	1/22/2014	12/18/2014	$63,198
275	MEYN S	UF	UNIV OF CENTRAL FLORIDA /US DOE	FEEDER:FOUNDATIONS FOR ENGINEERING EDUCATION FOR DISTRIBUTEDENERGY RESOURCES	1/24/2014	9/30/2014	$10,000
276	MIGLIACCIO K W	UF	US DEPT OF AG	SMART PHONE APPS: SCIENTIFIC VALIDATION QUANTIFICATION OF WATER CONSERVATION	10/7/2013	8/31/2016	$31,711
277	MITSELMAKHER G	UF	FERMILAB	LPC FELLOWSHIPS IN PHYSICS FOR SOUVIK DAS	1/21/2014	12/31/2014	$34,924
278	MITSELMAKHER G	UF	US DEPT OF ENERGY	TASK P: RESEARCH IN HIGH ENERGY EXPERIMENTAL PHYSICS USING THE CMS DETECTOR AT THE LARGE HADRON COLLIDER, CERN, GENEVA	9/16/2014	3/31/2015	$15,000
279	MITSELMAKHER G	UF	US DEPT OF ENERGY	TASK P: RESEARCH IN HIGH ENERGY EXPERIMENTAL PHYSICS USING THE CMS DETECTOR AT THE LARGE HADRON COLLIDER, CERN, GENEVA	4/1/2014	3/31/2014	$18,900
280	MITSELMAKHER G	UF	US DEPT OF ENERGY	TASK P: RESEARCH IN HIGH ENERGY EXPERIMENTAL PHYSICS USING THE CMS DETECTOR AT THE LARGE HADRON COLLIDER, CERN, GENEVA	5/8/2014	3/31/2015	$54,000
281	MITSELMAKHER G	UF	US DEPT OF ENERGY	TASK P: RESEARCH IN HIGH ENERGY EXPERIMENTAL PHYSICS USING THE CMS DETECTOR AT THE LARGE HADRON COLLIDER, CERN, GENEVA	5/8/2014	3/31/2015	$1,306,000
282	MORGAN K T	UF	US DEPT OF AG	SMART PHONE APPS: SCIENTIFIC VALIDATION QUANTIFICATION OF WATER CONSERVATION	12/19/2013	8/31/2016	$119,297
283	MORGAN K T	UF	US DEPT OF AG	SMART PHONE APPS: SCIENTIFIC VALIDATION QUANTIFICATION OF WATER CONSERVATION	10/7/2013	8/31/2016	$192,854
284	MUNOZ P R	UF	US DEPT OF AG	IMPROVING BREEDING EFFICIENCY IN AUTOTETRAPLOIDS WITH GENOME-WIDE PREDICTION	9/22/2014	8/31/2017	$500,000
285	NEWMAN M A	UF	SM STOLLER CORPORATION	BAFFLED MULTI-LEVEL SAMPLERS (BMLS)	6/19/2014	9/30/2014	$2,104

286	NINO J C	UF	US DEPT OF ENERGY	BII3 GAMMA-RAY SPECTROMETERS FOR RELIABLE ROOM TEMPERATURE NUCLEAR MATERIALS SAFEGUARDING	2/17/2014	1/14/2017	$89,467
287	NINO J C	UF	US DEPT OF ENERGY	UNIVERSITY OF FLORIDA NUCLEAR SCIENCE AND ENGINEERING FELLOWSHIP AND SCHOLARSHIP - PAUL JOHNS	8/14/2014	6/30/2017	$155,000
288	PEARTON S J	UF	AGNITRON TECHNOLOGY	MANUFACTURING IMPROVEMENTS OF AIN FOR WIDE BANDGAP SEMICONDUCTOR POWER DEVICES - PHASE I	7/11/2014	3/8/2015	$9,430
289	PETER G F	UF	US DEPT OF ENERGY	COMMERCIAL PRODUCTION OF TERPENE BIOFUELS IN PINE	2/20/2014	1/10/2016	$550,000
290	PHILLPOT S R	UF	US NUCLEAR REGULATORY COM	2014 UNIVERSITY OF FLORIDA NRC NUCLEAR ENGINEERING GRADUATE FELLOWSHIP PROGRAM	8/29/2014	7/31/2018	$343,213
291	PHILLPOT S R	UF	BATTELLE MEMORIAL INST	CENTER FOR MATERIALS SCIENCE OF NUCLEAR FUEL	5/7/2014	12/31/2014	$20,000
292	PHILLPOT S R	UF	BATTELLE MEMORIAL INST	CENTER FOR MATERIALS SCIENCE OF NUCLEAR FUEL	11/25/2013	12/31/2014	$109,040
293	PHILLPOT S R	UF	LOS ALAMOS NATIONAL SECURITY	EFFECT OF STRAIN ON DEFECT MIGRATION IN FLUORITE STRUCTURED OXIDES	9/10/2014	7/31/2015	$40,000
294	PHILLPOT S R	UF	UNIV OF ILLINOIS/ BATTELLE MEMORIAL INST	ENGINEERED ZIRCALOY CLADDING AND FUEL PELLET MODIFICATIONS FOR IMPROVED ACCIDENT TOLERANCE OF LWR NUCLEAR FUEL	1/22/2014	1/30/2016	$78,504
295	PHILLPOT S R	UF	US DEPT OF ENERGY	INNOVATIVE COATING OF NANOSTRUCTURED VANADIUM CARBIDE ON THE F/M CLADDING TUBE INNER SURF MITIGATING THE FUEL...	2/25/2014	1/14/2017	$83,183
296	PREVATT D O	UF	US DEPT OF COMMERCE	DEVELOP A TECHNOLOGY TO REPAIR FAILED ASPHALT SHINGLE TAB SEALS TO MITIGATE HURRICANE WIND DAMAGE TO RESIDENTIAL...	2/3/2014	9/30/2015	$160,000
297	PREVATT D O	UF	METAL CONSTRUCTION ASSOC	EVALUATION OF WIND UPLIFT PRESSURES ON AIR PERMEABLE DISCONTINOUS METAL ROOFING SYSTEMS	7/30/2014	8/14/2017	$293,000
298	RANKA S	UF	US DEPT OF ENERGY	PSAAP: CENTER FOR COMPRESSIBLE MULTIPHASE TURBULENCE (CCMT)	2/25/2014	1/26/2015	$54,173
299	RANKA S	UF	US DEPT OF ENERGY	PSAAP: CENTER FOR COMPRESSIBLE MULTIPHASE TURBULENCE (CCMT)	6/30/2014	1/26/2015	$128,882
300	RAY A L	UF	MACARTHUR FOU, JOHN D & CATH	MULTIFAMILY ENERGY EFFICIENT CONSUMPTION, TENANT STABILITY &RETROFIT EFFECTIVENESS	1/13/2014	12/31/2016	$370,000
301	RAY H	UF	US DEPT OF ENERGY	NEURINO CROSS SECTIONS: FOUNDATIONS OF THE FUTURE	2/17/2014	3/31/2016	$33,306
302	RAY H	UF	US DEPT OF ENERGY	NEURINO CROSS SECTIONS: FOUNDATIONS OF THE FUTURE	5/7/2014	3/31/2016	$105,000

303	RAY H	UF	US DEPT OF ENERGY	NEURINO CROSS SECTIONS: FOUNDATIONS OF THE FUTURE	2/17/2014	3/31/2016	$127,694
304	REN F	UF	AGNITRON TECHNOLOGY/ US DOE	MANUFACTURING IMPROVEMENTS OF AIN FOR WIDE BANDGAP SEMICONDUCTOR POWER DEVICES - PHASE I	7/11/2014	3/8/2015	$25,570
305	ROWLAND D L	UF	US DEPT OF AG	SMART PHONE APPS: SCIENTIFIC VALIDATION QUANTIFICATION OF WATER CONSERVATION	12/20/2013	8/31/2016	$4,876
306	ROWLAND D L	UF	US DEPT OF AG	SMART PHONE APPS: SCIENTIFIC VALIDATION QUANTIFICATION OF WATER CONSERVATION	10/7/2013	8/31/2016	$31,726
307	ROY S	UF	UNIV OF CENTRAL FLORIDA	FHTCC MATCHING FUNDS: PLASMA ACTUATED OPEN REFRIGERATION DISPLAY CASES: A BASIC STUDY FOR BETTER ENERGY EFFICIENCY	7/16/2014	12/31/2014	$18,864
308	ROY S	UF	UNIV OF CENTRAL FLORIDA	FHTCC MATCHING FUNDS: PLASMA ACTUATED OPEN REFRIGERATION DISPLAY CASES: A BASIC STUDY FOR BETTER ENERGY EFFICIENCY	10/29/2013	9/15/2014	$60,000
309	ROY S	UF	COOL FLOW DYNAMICS	FHTCC: PLASMA ACTUATED OPEN REFRIGERATION DISPLAY CASES: A BASIC CASE STUDY FOR BETTER ENERGY	7/16/2014	12/31/2014	$38,300
310	ROY S	UF	COOL FLOW DYNAMICS	FHTCC: PLASMA ACTUATED OPEN REFRIGERATION DISPLAY CASES: A BASIC CASE STUDY FOR BETTER ENERGY	10/29/2013	9/15/2014	$60,000
311	SANTOS J E	UF	ALLTECH BIOTECHNOLOGY CTR	EFFECT OF HIGH DHA ALGAE SUPPLEMENTATION ON FERTILITY OF DAIRY COWS WITH AN ALGAE PRODUCT RICH IN DHA.	1/15/2014	6/30/2015	$133,848
312	SCHANZE K S	UF	BOE TECHNOLOGY GROUP CO	HIGH EFFICIENCY OLED MATERIALS AND DEVICE ENGINEERING	5/9/2014	5/3/2017	$422,319
313	SCHERT J D	UF	FL DEPT OF TRANSPORTATION	DEVELOPMENT OF STANDARD OPERATING PROCEDURE FOR ANALYSIS OF AMMONIA CONCENTRATIONS IN COAL FLY ASH	12/16/2013	3/31/2015	$625
314	SCHERT J D	UF	FL DEPT OF TRANSPORTATION	DEVELOPMENT OF STANDARD OPERATING PROCEDURE FOR ANALYSIS OF AMMONIA CONCENTRATIONS IN COAL FLY ASH	12/16/2013	3/31/2015	$24,314
315	SCHUUR T	UF	UNIV OF OKLAHOMA / US DOE	FROM STRUCTURE TO FUNCTIONS: METAGENOMICS-ENABLED PREDICTIVEUNDERSTANDING OF SOIL MICROBIAL FEEDBACKS TO CLIMATE CHANGE	8/4/2014	8/31/2015	$134,375
316	SCHUUR T	UF	UNIV OF OKLAHOMA / US DOE	FROM STRUCTURE TO FUNCTIONS: METAGENOMICS-ENABLED PREDICTIVEUNDERSTANDING OF SOIL MICROBIAL FEEDBACKS TO CLIMATE CHANGE	12/2/2013	8/31/2014	$142,561

317	SHEPLAK M	UF	US DEPT OF ENERGY	HIGH-TEMPERATURE SAPPHIRE PRESSURE SENSORS FOR HARSH ENVIRONMENTS	2/21/2014	12/31/2016	$850,571
318	SHEPLAK M	UF	CA INST OF TECHNOLOGY / US AIRFORCE	WALL TURBULENCE WITH DESIGNER PROPERTIES IDENTIFICATION, CHARACTERIZATION & MANIPULATION OF ENERGY PATHWAYS	4/15/2014	11/14/2014	$126,716
319	SINGH R K	UF	SINMAT	FHTCC: NOVEL POLISHING TO FABRICATE ULTRA LOW THICKNESS VARIATION DIAMOND SUBSTRATES FOR NEXT GENERATION BEAM....	1/22/2014	8/7/2015	$50,000
320	SO F	UF	US NAVY	AMBIENT PROCESSING OF POLYMER SOLAR CELLS	5/12/2014	3/31/2017	$112,000
321	SO F	UF	BOE TECHNOLOGY GROUP CO	HIGH EFFICIENCY OLED MATERIALS AND DEVICE ENGINEERING	5/9/2014	5/3/2017	$435,482
322	SO F	UF	NANOHOLDINGS	INFRARED SENSORS AND BROADBAND ABSORBING SOLAR CELLS	7/16/2014	9/30/2014	$65,577
323	SO F	UF	NANOHOLDINGS	INFRARED SENSORS AND BROADBAND ABSORBING SOLAR CELLS	8/28/2014	9/30/2014	$65,577
324	SO F	UF	NANOHOLDINGS	INFRARED SENSORS AND BROADBAND ABSORBING SOLAR CELLS	4/14/2014	6/30/2014	$113,286
325	SOLTIS D E	UF	US DEPT OF COMMERCE	PD-14-02 CONSERVATION GENETICS OF RED MANGROVES IN FLORIDA	12/12/2013	6/30/2014	$1,923
326	STANTON C J	UF	WASHINGTON UNIV /NSF	DEVELOPMENT OF LASER-ENHANCED NMR FOR SPECTROSCOPY OF PHOTOVOLTAIC MATERIALS	6/30/2014	7/31/2015	$23,801
327	STEWART G R	UF	US DEPT OF ENERGY	UNDERSTANDING IRON SUPERCONDUCTORS/FOCUS ON NODAL BEHAVIOR	1/9/2014	11/30/2014	$150,000
328	SUBHASH G	UF	AREVA FEDERAL SERVICES /US DOE	HOLISTIC APPRACH TO AN ENHANCED ACCIDENT TOLERNT FUEL SYSTEM	7/16/2014	12/31/2014	$121,051
329	TANNER D B	UF	US DEPT OF ENERGY	SEARCH FOR AXIONIC DARK MATTER	5/2/2014	3/31/2015	$47,055
330	TANNER D B	UF	US DEPT OF ENERGY	SEARCH FOR AXIONIC DARK MATTER	5/2/2014	3/31/2015	$62,945
331	TANNER D B	UF	US DEPT OF ENERGY	THE GENERATION 2 AXION DARK-MATTER EXPERIMENT (GEN 2 ADMX)	4/9/2014	6/30/2014	$0
332	TANNER D B	UF	US DEPT OF ENERGY	THE GENERATION 2 AXION DARK-MATTER EXPERIMENT (GEN 2 ADMX)	9/10/2014	6/30/2015	$153,340
333	TANNER D B	UF	US DEPT OF ENERGY	THE GENERATION 2 AXION DARK-MATTER EXPERIMENT (GEN 2 ADMX) (OFF CAMPUS)	4/9/2014	6/30/2014	$0
334	TANNER D B	UF	US DEPT OF ENERGY	THE GENERATION 2 AXION DARK-MATTER EXPERIMENT (GEN 2 ADMX) (OFF CAMPUS)	9/10/2014	6/30/2015	$56,660
335	TOWNSEND T G	UF	FL DEPT OF TRANSPORTATION	DEVELOPMENT OF STANDARD OPERATING PROCEDURE FOR ANALYSIS OF AMMONIA	12/16/2013	3/31/2015	$1,250

				CONCENTRATIONS IN COAL FLY ASH			
336	TOWNSEND T G	UF	FL DEPT OF TRANSPORTATION	DEVELOPMENT OF STANDARD OPERATING PROCEDURE FOR ANALYSIS OF AMMONIA CONCENTRATIONS IN COAL FLY ASH	12/16/2013	3/31/2015	$73,448
337	TRICKEY S B	UF	US DEPT OF ENERGY	ORBITAL-FREE QUANTUM SIMULATION METHODS FOR APPLICATION TO WARM DENSE MATTER	6/26/2014	8/31/2015	$255,000
338	TULENKO J S	UF	BATTELLE MEMORIAL INST	DEVELOPMENT OF INNOVATIVE ACCIDENT TOLERANT HIGH THERMAL CONDUCTIVITY UO2-DIAMOND COMPOSITE FUEL PELLETS	1/22/2014	8/15/2015	$8,724
339	TULENKO J S	UF	AREVA FEDERAL SERVICES/US DOE	HOLISTIC APPRACH TO AN ENHANCED ACCIDENT TOLERNT FUEL SYSTEM	7/16/2014	12/31/2014	$81,774
340	VERMERRIS W	UF	US DEPT OF AG	NEXT-GENERATION SWEET SORGHUMS - SUSTAINABLE PRODUCTION OF FEEDSTOCKS FOR FUELS, CHEMICALS AND VALUE-ADDED PRODUCTS	12/18/2013	4/30/2015	$50,000
341	WALTERS B S	UF	US DEPT OF ENERGY	SOLAR LIVING HOUSE	4/22/2014	4/15/2016	$14,590
342	WASHBURN S S	UF	US DEPT OF TRANSPORTATION	ON-BOARD DIAGNOSTICS INNTEGRATION INTO TRAFFICE MICROSIMULATION FOR VEHICLE-SPECIFIC FUEL USE AND EMISSIONS	11/6/2013	12/31/2014	$67,500
343	WATLING J I	UF	US DEPT OF INTERIOR	SETTING CONSERVATION TARGETS FOR THE PENINSULAR FLORIDA LANDSCAPE CONSERVATION COOPERATIVE	9/2/2014	8/31/2016	$48,167
344	WEAVER J F	UF	US DEPT OF ENERGY	GROWTH AND REACTIVITY OF OXIDE PHASES ON CRYSTALINE PD AND PT SURFACES	8/15/2014	8/31/2015	$200,000
345	WEI W	UF	NATL SCIENCE FOU	CAREER: THE RATIONAL DESIGN OF PLASMONIC PHOTOCATALYSTS FOR EFFICIENT SOLAR ENERGY CONVERSION	3/5/2014	6/30/2019	$140,000
346	WILKIE A C	UF	FL DEPT OF AG AND CONSUMER SER	ADVANCING E TUBER - A SUSTAINABLE FEEDSTOCK FOR BIOFUELS AND BIOGAS ON FALLOW FLORIDA CITRUS LANDS	2/10/2014	11/30/2015	$100,871
347	WRIGHT D L	UF	FL DEPT OF AG AND CONSUMER SER	INTEGRATED FEEDSTOCK DEVELOPMENT AND MANAGEMENT OF OILSEED CROPS FOR DROP-IN BIOFUELS IN FLORIDA	11/21/2013	6/30/2016	$885,100
348	WU C	UF	KOOGLER & ASSOCIATES	ANALYZING ELEMENTAL COMPOSITION OF FILTER SAMPLES FROM BIOMASS BOILER	5/21/2014	6/30/2014	$1,430
349	YANG Y	UF	UNIV OF ILLINOIS / BATTELLE MEMORIAL INST	ENGINEERED ZIRCALOY CLADDING AND FUEL PELLET MODIFICATIONS FOR IMPROVED ACCIDENT TOLERANCE OF LWR NUCLEAR FUEL	1/21/2014	1/30/2016	$81,985

350	YANG Y	UF	UNIV OF CHICAGO / US DOE	IN SITU HIGH-ENERGY X-RAY CHARACTERIZATION FO MICROSTRUCTURE, DEFORMATION AND DAMAGE EVOLUTION IN NUCLEAR REACTOR...	1/27/2014	9/30/2016	$224,974
351	YANG Y	UF	US DEPT OF ENERGY	INNOVATIVE COATING OF NANOSTRUCTURED VANADIUM CARBIDE ON THE F/M CLADDING TUBE INNER SURF MITIGATING THE FUEL...	2/25/2014	1/14/2017	$166,462
352	YANG Y	UF	BATTELLE	MICRO/NANO SCALE AFM-BASED THERMAL CONDUCTIVITY MEASUREMENT AND ATOMISTIC MODELING FOR OXIDE FUEL	1/7/2014	9/30/2014	$52,436
353	YANG Y	UF	UNIV OF CHICAGO /US DOE	MICROSTRUCTURAL ANALYSIS OF STAINLESS STEELS AND NICKEL ALLOYS FOR LWR APPLICATIONS	10/2/2013	3/31/2015	$10,000
354	Nuszkowski, John	UNF	Life Cycle Engineering, Inc	Small Scale Engine Performance Screening for Alternative Navy Fuels	7/23/2013		$6,000
355	Lampropoulos, Christos	UNF	Research Corporation for Science Advancement	Target Synthesis of Hybrid Nanomaterials From Single-Molecule Magnets	3/6/2014		$45,000
356	Jeffrey Cunningham (PI) and Maya Trotz (co-PI)	USF	United States Geological Survey (USGS)	Development and Application of New Modeling Capabilities in the Geochemist's Workbench®: Subsurface Sequestration of Supercritical Carbon Dioxide (CO2) in Deep Saline Aquifers.	Jan 2015	31 Dec 2015	$49,899
357	Goswami Stefanakos	USF	US DOE – ARPA-E	Development of a Low Cost Thermal Energy Storage System Using Phase Change Materials with Enhanced Radiation Heat Transfer	Dec. 5, 2011	Dec. 14, 2014	$2,596,682
358	B. Joseph	USF	NCIIA- E-Team Grant	Conversion of Landfill Gases to Liquid fuels	Jun 2104	June 15	$20,000
359	Kuhn & Joseph	USF	NCIIA (now Venture Well)	NCIIA Trash 2 Cash-Energy Phase II Proposal	3/14	3/15	$20,000
360	Stefanakos, Goswami	USF	AGDF	Field Testing of Gas Heat Pump	August 1, 2013	April 15, 2015	$184,499
361	Stefanakos Goswami	USF	Colorado School of Mines	Sustainable Phovoltaics and Subcontract Coordination (SERIIUS) CSM	Jan. 21, 2013	July 22, 2018	$200,000
362	Stefanakos, Goswami	USF	FPL	Performance Evaluation Energy Saving Potential of VaporGenics Organic Rankine Cycle Ai-Conditioning Unit	Dec. 1, 2013	Dec. 31, 204	$113,515
363	Stefanakos Goswami	USF	NSF	EAGER: Development of a Rectenna for Energy Harvesting and Detection Applications	Aug. 15, 2014	July 31, 2016	$259,819
364	Stefanakos, Goswami	USF	Keilir Energy Center / Univ. of Iceland	PCM Thermal Energy Storage and Transport System (TEST) For the Utilization of Geothermal Heat and other Heat Source	Feb. 1, 2014	Dec. 31, 2015	$141,088
365	Stefanakos	USF	NSRC	Microencapsulated Phase Change Materials	Feb. 2, 2013	Jan. 31, 2015	$38,000
366	Bhuvane Ramachandran	UWF	FL Space Grant Consortium	Team ARGONAUCKET: NASA Training Grant Hybrid Rocket Competition	10/01/2013		$1,292
				$58,174,283		**TOTAL**	$58,174,283

3. *Publications by FESC Faculty*

During Oct. 1, 2013 to Sep 30, 2014 Period (Back to top)

Total # of Publications: Over 60

The majority of FESC funded projects were completed. The publication information was received from faculty who have active projects and faculty who sent publication information.

#	University	Publications
	FAU	1. J.H. VanZwieten, M.G. Seibert, and K. von Ellenrieder, (2014) "Anchor selection study for ocean current turbines" Journal of Marine Engineering and Technology, 13 (1), 59-73. 2. J. VanZwieten, W. McAnally, J. Ahmad, T. Davis, J. Martin, M. Bevelhimer, A. Cribbs, R. Lippert, T. Hudon, and M. Trudeau (2014) "In-Stream Hydrokinetic Power – A Review and Appraisal" ASCE Journal of Energy Engineering, available online, no. 04014024. 3. J.H. VanZwieten Jr., I Meyer, and G.M. Alsenas (2014) "Evaluation of HYCOM as a tool for ocean current energy assessment" in Proceedings of the 2nd Marine Energy Technology Symposium (METS14) hosted by the 7th annual Global Marine Renewable Energy Conference, April 15-18, Seattle, Washington, Available: http://vtechworks.lib.vt.edu/handle/10919/49220. 4. W.E. Laing Jr. and J.H. VanZwieten (2014) "Development of a driving electric dynamometer rotor emulator for MHK in stream turbines" in Proceedings of the 2nd Marine Energy Technology Symposium (METS14) hosted by the 7th annual Global Marine Renewable Energy Conference, April 15-18, Seattle, Washington, Available: http://vtechworks.lib.vt.edu/handle/10919/49218 5. J.D. Ramirez, J.H. VanZwieten, and L.L. Gloria (2014) "Adaptive torque control of in-stream hydrokinetic turbines" in Proceedings of the IEEE Oceans Conference, St. John's, Newfoundland, Canada, September 14-19, no. 140418-081
	UF	1. K.A. Jordan, D. Springfels, D. Schubring, ``Modern Design and Safety Analysis of the University of Florida Training Reactor" Nuclear Engineering and Design *Submitted*. 2. C.R. Hughes, O. Pelaez, D. Schubring, and K.A. Jordan ``One-row Scwr Design Analysis Using Coupled RP/TH Analysis" Nuclear Technology *Submitted*. 3. J.M. Lewis, R.P. Kelley, D. Murer, and K.A. Jordan ``Fission Signal Detection using Helium-4 Gas Fast Neutron Scintillation Detectors" Applied Physics Letters. 105 (1), 014102. 4. J.M. Lewis, D. Raetz, D. Murer, and K.A. Jordan, ``In-situ Fission Rate Measurements using Helium-4 Scintillation Detectors" IEEE Transactions on Nuclear Science. 64.4, (2014) 2217-2221. 5. C.R. Hughes, O. Pelaez, D. Schubring, and K.A. Jordan ``One-Row SCWR Design Analysis using Coupled RP/TH Analysis" TH'14 International Embedded Topical Meeting on Advances in Thermal Hydraulics 2014, June 15-19, 2014, Reno, NV. 6. K.A. Jordan, K. Goluoglu, B. Shea ``Status of the Major Refurbishment and Digital Conversion of the University of Florida Training Reactor" Trans. American Nuclear Society Winter Meeting, Nov 2013 *Invited*. 7. K.A. Jordan, D. Schubring, G. Girardin, A. Pautz ``Validation of Reactor Physics-Thermalhydraulics Coupled Calculations in Water-Cooled Research Reactors with Laminar Flow Regimes" Joint IGORR (International Group on Research Reactors)/IAEA 2013 Conference, Oct. 13-18, 2013 Daejeon, Korea. 8. K.A. Jordan, D. Seifman, S. Kowalczyk, D. Cronin ``A Fully-reconstituted Safety Basis at the University of Florida Training Reactor" Joint IGORR (International Group on Research Reactors)/IAEA 2013 Conference, Oct. 13-18, 2013 Daejeon, Korea.

		9. K.A. Jordan, B. Shea, M. Berglund ``Preparing a Research Reactor for the next 50 years: The UFTR Facility Renovation" Joint IGORR (International Group on Research Reactors)/IAEA 2013 Conference, Oct. 13-18, 2013 Daejeon, Korea. 10. Y. Guo, C. Wassgren, B. Hancock, W. Ketterhagen, and J. Curtis,, "Computational study of granular shear flows of dry, flexible fibers using the discrete element method", Submitted to Journal of Fluid Mechanics, 2014
1	USF	**BOOK** 1. Sherif, S.A. Goswami, D.Y., and Stefanakos, E.K. (Co-Editors), (2014) Handbook of Hydrogen Energy, CRC Press/Taylor and Francis Publishers, Boca Raton, FL.
8	USF	**BOOK CHAPTERS** 1. Abutayeh, M., Li, C., Goswami, D.Y., and Stefanakos, E. (2014) "Solar Desalination," Chapter 13 in Desalination: Water from Water (Ed. Jane Kucera), Scrivener/John Wiley Publishing, MA. 2. Goswami, D.Y. (2013) "Solar Energy," Chapter 8 in *2013 Survey of Energy Resources*, (Ed.) J. Trinnaman, World Energy Council, London. 3. Mahishi, M., Goswami, D.Y., Ibrahim, G., and Elnashaie, S.S.E.H. (2014) "Hydrogen Production from Biomass and Fossil Fuels", Ch. 5, in Handbook of Hydrogen Energy, CRC Press/Taylor and Francis Publishers, Boca Raton, FL. 4. Srinivasan, S.S., Sharma, P.C., Stefanakos, E.K., and Goswami, D.Y. (2014) "Metal Hydrides" Ch. 20, in Handbook of Hydrogen Energy, CRC Press/Taylor and Francis Publishers, Boca Raton, FL. 5. Srinivasan, S.S., Sharma, P.C., Stefanakos, E.K., and Goswami, D.Y. (2014) "Complex Hydrides" Ch. 21, in Handbook of Hydrogen Energy, CRC Press/Taylor and Francis Publishers, Boca Raton, FL. 6. Srinivasan, S.S., Sharma, P.C., Stefanakos, E.K., and Goswami, D.Y. (2014) "Nanomaterials for Hydrogen Storage Hydrides" Ch. 22, in Handbook of Hydrogen Energy, CRC Press/Taylor and Francis Publishers, Boca Raton, FL. 7. Srinivasan, S.S., Sharma, P.C., Stefanakos, E.K., and Goswami, D.Y. (2014) "Chemical Hydrogen Storage" Ch. 23, in Handbook of Hydrogen Energy, CRC Press/Taylor and Francis Publishers, Boca Raton, FL. 8. Vijayaraghavan, S., Goswami, D.Y. (April 2013) "Solar Thermal Energy, Industrial Heat Applications." In: Cleveland, C.J., (Ed.), Encyclopedia of Energy, Elsevier, Inc., pp. 661-667
37	USF	**JOURNAL ARTICLES** 1. Abutayeh, M., Goswami, D.Y., and Stefanakos, E.K. (2013) "Solar thermal power plant simulation," *Environmental Progress and Sustainable Energy*, 32 (2), pp. 417-424, doi: 10.1002/ep.11636 2. Abutayeh, M., Goswami, D.Y., and Stefanakos, E.K. (2013) "Theoretical and experimental simulation of passive vacuum solar flash desalination," ASME *Journal of Solar Energy Engineering*, May, 135, pp. 021014-1-021014-13. 3. Bellan, S., Gonzalez-Aquilar, Romero, M., Rahman, M.M., Goswami, D.Y., Stefanakos, E.K., and Couling, D. (2014) "Numerical analysis of charging and discharging performance of a thermal energy storage system with encapsulated phase change material," *Applied Thermal Engineering*, doi: 10.1016/j.applthermaleng.2014.07.009. 4. Besarati, S.M., and Goswami, D.Y. (2013) "Analysis of advanced supercritical carbon dioxide power cycles with a bottoming cycle for concentrating solar power applications," Journal of Solar Energy Engineering (Transactions of the ASME) Vol. 136, No. 1. Doi: 10.1115/1.4025700 5. Besarati, S.M., and Goswami, D.Y. (2014) "A computationally efficient method for the design of the heliostat field for solar power tower plant," *Renewable Energy*, 69, 226232.

6. Besarati, S.M., and Goswami, D.Y. (2014) "Analysis of advanced supercritical carbon dioxide power cycles with a bottoming cycle for concentrating solar power applications," *Journal of Solar energy Engineering*, February, Vol. 136, pp 010904-1-7.
7. Besarati, S.M., Goswami, D.Y., and Stefanakos, E.K. (2014) "Optimal heliostat aiming strategy for uniform distribution of heat flux on the receiver of a solar power tower plant," *Energy Conversion and Management*, 84, pp. 234-243.
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10. Daza, Y.A., Kent, R.A., Yung, M.M., and Kuhn, J.N., "Carbon dioxide conversion by reverse water gas shift chemical looping on perovskite-type oxides" Industrial & Engineering Chemistry Research 53 (2014) 5828-5837. (DOI: 10.1021/ie5002185)
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13. Demirocak, D.E., Srinivasan, S.S., Ram, M.K., Goswami, D.Y., and Stefanakos, E.K. (2013) "Volumetric hydrogen sorption measurements: Uncertainty error analysis and the importance of thermal equilibration time," *International Journal of Hydrogen Energy*, 38, pp. 1469-1477.
14. Demirocak, D.E., Srinivasan, S.S., Ram, M.K., Kuhn, J.N., Muralidharan, R., Li, X., Goswami, D.Y., and Stefanakos, E.K. (2013) "Reversible hydrogen storage in the Li-Mg-N-H system: The effects of Ru doped single walled carbon nanotubes on NH_3 emission and kinetics," *International Journal of Hydrogen Energy* (available online http://dx.doi.org/10.1016/j.ijhydene.2013.05.176)
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23. Li, C., Besarati, S., Goswami, Y., Stefanakos, E., and Chen, H. (2013). "Reverse osmosis desalination driven by low temperature supercritical organic rankine cycle," *Applied Energy*, 102, pp. 1071-1080.
24. Li, C., Goswami, Y., and Stefanakos, E. (2013) "Solar assisted sea water desalination: A review," *Renewable and Sustainable Energy Reviews,"* 19, 136-163.
25. Li, C., Kosmadakis, G., Manolakos, D., Stefanakos, E., Papadakis, G., and Goswami, D.Y. (2013) "Performance investigation of concentrating solar collectors coupled with a transcritical organic Rankine cycle for power and seawater desalination co-generation," *Desalination*, vol. 318, no. 3, pp. 107-117.
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4. *Presentations by FESC Faculty*

During Oct. 1, 2013 to Sep 30, 2014 Period (Back to top)

Total # of Presentations: Over 30
The majority of FESC funded projects were completed. The publication information was received from faculty who have active projects or collaborating with faculty who has active projects.

#	Presenter	University	Title/Event	Date
1	J.H. VanZwieten	FAU	"Marine Renewable Energy – Ocean Current and Ocean Thermal" Invited presentation given to FAU's "Renewable Energy" Class offered by the EE department, Boca Raton, Florida, April 21.	April 21, 2014
2	J.H. VanZwieten Jr., I Meyer, and G.M. Alsenas	FAU	"Evaluation of HYCOM as a tool for ocean current energy assessment" Presented at the 2nd Marine Energy Technology Symposium (METS14) hosted by the 7th annual Global Marine Renewable Energy Conference, Seattle, WA	April 15-18, 2014
3	G.M. Alsenas	FAU	"Standards, Protocols, and Conformity Assessment in Testing" Presented at Energy Oceans 2014, Atlantic City, New Jersey.	June 3-5, 2014
4	W.E. Laing Jr. and J.H. VanZwieten	FAU	Development of a driving electric dynamometer rotor emulator for MHK in stream turbines" Presented at the 2nd Marine Energy Technology Symposium (METS14) hosted by the 7th annual Global Marine Renewable Energy Conference, Seattle, Washington.	April 15-18, 2014
5	S.H. Skemp	FAU	"SNMREC Program Experience with All Things Environmental" Invited Panelist for HydroVision 2014, Nashville, TN.	July 22-24, 2014
6	S.H. Skemp	FAU	"Blue Energy – SNMREC" Invited Speaker to Florida Energy Systems Consortium – Advisory Board Meeting, Juno Beach, Florida	August 20, 2014
7	S.H. Skemp	FAU	"SNMREC Program Update – Successes and Challenges" Presented at the 7th annual Global Marine Renewable Energy Conference, Seattle, WA	April 15-18, 2014
8	S. H. Skemp	FAU	"Blue Energy" Invited Panelist to HydroVision, Nashville, TN	July 22-24, 2014
9	S. H. Skemp	FAU	"Powered by the Ocean – Blue Energy", Invited Speaker – TEDx Presenters, Boca Raton, FL	May 9, 2014
10	S. H. Skemp	FAU	"Ocean Current Energy", Invited Panelist – IBM Consumer Conference, Orlando FL	June 3, 2014
11	C. E. Coley	FAU	"Ocean Renewable Energy: Offshore Wind and Marine Hydrokinetic Power" Invited Speaker to Florida Energy Summit, Orlando, FL	Oct. 14, 2013

12	Jennifer Curtis	FESC	Welcome and FESC overview, FESC workshop, Gainesville Fl.	May 2014
13	Jennifer Curtis	FESC	FESC overview; Visiting PSC, Tallahasse, FL	Feb 18, 2014
14	Canan Balaban	FESC	International Energy Investments conference in Istanbul Turkey, FESC Overview presentation	June 5 2014
15	Canan Balaban	FESC	NIST visit, Washington DC, FESC Overview presentation	July 2014
16	Mark Jamison	UF	International Energy Investments conference in Istanbul Turkey; Regulation on energy markets, lessons from US	June 5, 2014
17	Yogi Goswami	USF	Alam, T., Dhau, J., Goswami, D.Y., Rahman, M., and Stefanakos, E.K. (2014) "Experimental investigation of a packed-bed latent heat thermal storage system with encapsulated phase change material." In the Proceedings of the ASME 2014 International Mechanical Engineering Congress and Exposition (IMEC-E), Montreal, Canada, November. (IMECE2014-38307)	2014
18	Yogi Goswami	USF	Ayou, D.S., Bruno, J.C., Goswami, D.Y., and Coronas, A. (2014) "Integration of scroll-expanders into combined absorption cycles for power and refrigeration applications," "Proceedings of the International Sorption Heat Pump Conference (ISHPC 2014), Washington, D.C., March.	2014
19	Yogi Goswami	USF	Myers, Jr., P.D., Goswami, D.Y., and Stefanakos, E.K. (2014) "Molten salt spectroscopy for quantification of radiative absorption in novel maetal chloride-enhanced thermal storage media. In the Proceedings of the ASME 2014 International Mechanical Engineering Congress and Exposition (IMEC-E), Montreal, Canada, November. (IMECE2014-20157)	2014
20	Yogi Goswami	USF	Ramos-Archibold, A., Goswami, D.Y., Rahman, M., Stefanakos, E.K., and Bhardwaj, A. (2014) "Thermal assessment of a latent heat energy storage module using a high temperature phase change material with enhanced radiative properties. In the Proceedings of the ASME 2014 International Mechanical Engineering Congress and Exposition (IMEC-E), Montreal, Canada, November. (IMECE2014-38390)	2014
21	John Kuhn	USF	Kuhn, J. Keynote speaker at Florida AVS meeting, Surface Science, Orlando FL March 2014. "Surface properties via model catalytic reactions over supported metal nanoparticles"	March 2014
22	Ramos-Archibold	USF	Ramos-Archibold, A., Rahman, M.M., Goswami, D.Y., Stefanakos, E.K. (2013),"Numerical solution of heat transfer during solidification of an encapsulated phase change material," Proceedings of the ASME 2013 International Mechanical Engineering Congress and Exposition (IMECE 2013), San Diego, CA., November.	Nov 2013

23	Sridharan, P., Archibold	USF	Sridharan, P., Archibold, A.R., Rahman, M.M., Goswami, D.Y., and Stefanakos, E.K. (2013) "Melting in vertical cylinders during thermal energy storage," Proceedings of the ASME 2013 International Mechanical Engineering Congress and Exposition (IMECE 2013), San Diego, CA., November.	Nov 2013
24	M H Rashid	UWF	Invited Lecture on Power Electronics – Trends and Challenges. IIT, Delhi, India	January 10, 2014
25	M H Rashid	UWF	Invited Lecture on Power Electronics Applications in Renewable Energy, International conference on **Renewable Energy Utilization (ICREU-2014.** Coimbatore Institute of Technology, Coimbatore, India	January 9, 2014
26	M H Rashid	UWF	Invited Lecture on Power Electronics – Trends and Challenges at USG College of Engineering, Coimbatore, India	January 8, 2014
27	M H Rashid	UWF	Invited Lecture on Outcome Based Education at Coimbatore Institute of Technology, Coimbatore, India	January 8, 2014
28	M H Rashid	UWF	Invited Lecture on Power Electronics – Trends and Challenges at Coimbatore Institute of Technology, Coimbatore	January 9, 2014
29	M H Rashid	UWF	Invited Lecture on The Process of Outcome-Based Education. The 2nd International Conference on Advances in Electrical Engineering (ICAEE 2013), Independent University Bangladesh	Dec 18, 2013
30	M H Rashid	UWF	Invited Lecture on Power Electronics Applications in Renewable Energy, The 2nd International Conference on Advances in Electrical Engineering (ICAEE 2013), Independent University Bangladesh	Dec 19, 2013
31	M H Rashid	UWF	Professional Ethics. IEEE Student Section, Independent University Bangladesh	Dec 21, 2013
32	Dr. Bhuvaneswari Ramachandran	UWF	2014 Florida Energy Systems Consortium Workshop, Hilton University of Florida Conference Center, Gainesville, FL	May 12-13, 2014

5. *Invention Disclosures & Patents By SUS Faculty*

During Oct. 1, 2013 to Sep 30, 2014 Period (Back to top)

Total: 83

#	Faculty	University	Disclosure / Patent #	Title
1	Virginia Tech: -William Nathan Alexander (faculty) -William J. Devenport (faculty) -Ian Clark (graduate student) FAU: -Stewart Glegg (faculty) University of Cambridge: -Nigel Peake (faculty) -Conor Daly (graduate student) Lehigh University: -Justin Jaworski (faculty)	FAU	Joint technology, FAU and Virginia Tech. Virginia Tech invention disclosure signed/dated 4/15/14. FAU disclosure signed/received 6/26/14. Virginia Tech to lead, filed two provisional patents. U.S. Provisional Patent Applications: 1. 61/985,507 filed 4/29/14 62/020,654 filed 07/03/14	Noise Reducing Surface Treatment for Airfoil
2		FSU	None	
3	Arindam Gan Chowdhury and Andres Tremante	FIU	Disclosed 12/9/2013; US Provisional Patent Application filed 5/29/2014	Active Aerodynamics Mitigation and Power Production System for Building Envelope Components
4	Dr. Winston Schoenfeld, David Click, Kristopher Davis, Robert Reedy	UCF	PCT Application filed 11/19/2013	Method and Apparatus for Photovoltaic Cell Degradation Monitoring via Current-Voltage Measurements
5	Dr. Ali Raissi, Gary Bokerman, Dr. Nahid Mohajeri, Dr. Nazim Muradov	UCF	Patent issued 11/26/2013	Gas Permeable Chemochromic Composition for Hydrogen Sensing
6	Jeffrey Sonne, Robin Vieira	UCF	Patent issued 12/17/2013	Solar Gutter and Soffit Facia Systems
7	Dr. Nazim Muradov	UCF	Patent issued 01/07/2014	Methods of Forming Visual Hydrogen Detector with Variable Reversibility
8	Dr. Huang Cunping, Dr. Clovis Linkous, Dr. Nazim Muradov, Dr. Ali Raissi, Karthikeyan Ramasamy, Franklyn Smith	UCF	Patent issued 02/11/2014	Method and System for Hydrogen Sulfide Removal

9	Robert Reedy, Dr. Nicoleta Hickman	UCF	U.S. Non- Provisional Patent Application filed 03/12/2014	Photovoltaic Modules Incorporating Lateral Heat Removal
10	Robert Reedy, Dr. Nicoleta Hickman	UCF	Disclosed 03/20/2014; US Provisional Patent Application filed 08/08/2014	LED Chip With Integrated Thermoelectic Cell
11	Dr. Huang Cunping, Dr. Nazim Muradov, Dr. Ali Raissi	UCF	Patent issued 04/08/2014	Solar metal sulfate-ammonia based thermochemical water splitting cycle for hydrogen production.
12	Jeffery Sonne, Eric Martin, Robin Vieira	UCF	Disclosed 09/09/2014	Heat-Reflecting Umbrella or Suspended Canopy
13	Robin Vieira, Eric Martin	UCF	Disclosed 09/09/2014	Comfort Canopy
14	Robin Vieira, Eric Martin, Dr. Muthusamy Swami	UCF	Disclosed 09/24/2014	Cool Seat
15	Yongpei Guan Ph.D.; Lei Fan	UF	none	Edge Based Modeling and Design for Combined Cycle UnitsT
16	Kevin S. Jones; Shadi al khateeb; Nicholas G. Rudawski	UF	none	Ultrasonic Spray Pyrolysis of FeS2 Cathodes for LI Ion Batteries (EC)
17	Kevin S. Jones; Shadi al khateeb; Nicholas G. Rudawski	UF	none	Ultrasonic Spray Pyrolysis of FeS2 Cathodes for LIBs (WAS RESUBMITTED as 15334)
18	John Hardy; Jennifer S. Ansdrew; Christine E. Schmidt; Emilie Juile Flore Secret; Justin D. Starr	UF	none	Wireless Energy Transfer to Electroactive Materials using Magnetoelectric Nanoparticles
19	Kirk Jeremy Ziegler; Jacob N. Chung; Hong Hu; Cheng Xu; Yang Shao	UF	U.S. Provisional Appl. 62/028,355	An Aluminum Substrate with an Anodized Aluminum Oxide Nanoporous Surface Layer for Significant Boiling and Quenching Heat Transfer Enhancement
20	Subrata Roy; Nicholas S. Campbell	UF	U.S. Provisional Appl. 62/056,778	Bi-Directional Electro-Fluid Dynamic Transducer
21	David P. Arnold; Alexandra Garraud; Nicolas Garraud	UF	U.S. Provisional Appl. 62/025,578	Electrodynamic Wireless Power Transmission Using Rotating Receivers
22	Andrew Gabriel Rinzler; Xiao Chen; Max G. Lemaitre; Bo Liu; Mitchell Austin McCarthy	UF	U.S. Provisional Appl. 61/983,779	Tunable-Source-Gated Transistors for High Power Applications
23	Peng Jiang; Khalid A. Askar; Yin Fang	UF	none	Smart Light-Regulating Coatings and Methods of Making

24	Fan Ren; Ya-His Hwang; Mark E. Law; Stephen J. Pearton	UF	none	Backside Source Field Plate through A via Hole Fabricated Under the Active Area of a Field Effect Transistor
25	Yong Kyu Yoon; Cheolbok Kim; Hyup Jong Kim; David E. Senior	UF	U.S. Provisional Appl. 62/003,181	Glass Interposer Integrated High Quality Electronic Components and Systems
26	William E. Lear Jr.	UF	none	Ultra-High Efficiency Hybrid Power and Storage System
27	Franky Fat Kei So; Ying Chen; Jong Hyun Kim; Rui Liu	UF	none	Dye-Doped Hole Transport Layer for Organic Light Emitting Diodes
28	Subrata Roy	UF	PCT Appl. PCT/US2014/049411	Energy Efficient Open Refrigeration System
29	Yong Kyu Yoon; Dongsu Kim; Kyoun Tae Kim	UF	none	Hydrothermally Grown BaTiO3 on TiO2 Nanotube Layers for Ultra High Charge Density Capacitors
30	Franky Fat Kei So; Ying Chen; Shuyi Liu; Chaoyu Xiang	UF	U.S. Provisional Appl. 61/993,001	Doping Epoxy Matrix as the Functional Layers and Its Application on Multi-Layer Solution-Processed Optoelectronic Devices
31	Jiangeng Xue; Wei David	UF	none	Sunlight Harvesting Transparent Windows
32	Wolfgang M. Sigmund; Shu-Hau Hsu; Ravi Kumar Vasudevan	UF	U.S. Provisional Appl. 62/029,158	Transparent Superhydrophobic Alumina Coatings (combined with 14946)
33	Blayne Michael Phillips; Khalid Askar; Peng Jiang; Yin Fang	UF	U.S. Provisional Appl. 61/897,848	Pressure Sensitive Macroporous Photonic Crystals for Tunable Diffractive Optical Devices, Iridescent Finger Printing Films, and Anti-glaring Coatings and Method for Producing
34	PitFee Jao; Yong-Kyu Yoon	UF	U.S. Provisional Appl. 61/975,451	Photolithographic Fabrication of Nanofibrous 3-D Microstructures
35	Omar Abdelaziz; Dazhi Yu; Devesh Chugh; Mehdi Mortazavi; Saeed Moghaddam; Rasool Nasr Isfahani; Seyyed Abdolreza	UF	U.S. Provisional Appl. 61/925,435	Open Absorption Cycle for Combined Dehumidification, Water Heating, and Evaporative Cooling
36	Devesh Chugh; Saeed Moghaddam	UF	U.S. Provisional Appl. 62/008,084	Novel Architecture for Absorption Based Heaters.

37	Jason M. Lewis; Kelly A. Jordan	UF	U.S. Provisional Appl. 61/928,249	Online Active Detection of Fissile Materials Using Neutron Energy Discrimination
38	Prabir Barooah; Sean Peter Meyn	UF	U.S. Provisional Appl. 61/894,312	System and Method for Providing Low-Frequency Power-Grid Ancillary Service From Commercial Building HVAC Systems
39	Prabir Barooah; Rahul Subramany	UF	U.S. Provisional Appl. 61/915,285	Wireless Sensors and Network for Indoor Climate Monitoring and Control
40	Ryan Durscher; Subrata Roy	UF	U.S. Utility Appl. 14/129,239	Solid State Frequency Modulated Plasma Heating Source
41	Abby Queale; Gary W. Scheiffele; James S. Tulenko; John Daniel Malone; Kevin W. Powers; ronald Howard Baney	UF	U.S. Continuation Appl. 14/226,356	A Heat Transfer Fluid Consisting of Colloidal Diamond for a Nuclear Reactor
42	Charles R. Cook	UF	U.S. Provisional Appl. 61/942,998	Combined Cryogenic Power Generation to Greatly Improve Vehicle Fuel Efficiency.
43	Saeed Moghaddam; Seyyed Abdolreza Fazeli	UF	U.S. Provisional Appl. 61/917,177	Hierarchical Hydrophilic/Hydrophobic Micro/Nanostructures for Pushing the Limits of Critical Heat Flux
44	Do Young Kim; Franky So; Jae woong Lee	UF	PCT Appl. PCT/US2014/012722	A Novel IR Focal Plane Array Using a Solution Processed Pbs Photodetector
45	Aubrey Dyer; John R. Reynolds	UF	U.S. Utility Appl. 14/127,702	Infrared-modulating Electroactive Devices with Visible Region Transparancy (All Other Except SWNT)
46	Jing Zhao; Xiang-Yang Li; Dapeng Wu; Qiuyuan Huang; Xin Li	UF	U.S. Provisional Appl. 61/955,498	Social Networking Reduces Peak Power Consumption in Smart Grid
47	Jiangeng Xue	UF	PCT Appl. PCT/US2014/023330	Quantum-Dot Based Hybrid LED Lighting Devices
48	Shuo Cheng; Yuan Rao	UF	U.S. Continuation Appl. 14/293,727	High Efficiency AC/DC Converter for Ultra Low Voltage Application
49	Prabir Barooah; Sean Meyn	UF	U.S. Utility Appl.	Method to Provide Ancillary Service to the Power Grid by Building HVAC Systems

50	Ben Anger; Clifford R. Bowers	UF	U.S. Provisional Appl. 61/981,459	Hydrocarbon Gas Permeation and Uptake Analysis of Shales and Other Rocks Utilizing Parahydrogen Enhanced NMR
51	David P. Arnold; Jennifer S. Andrew	UF	PCT Appl. PCT/US2014/048142	Advanced Manufacturing of Magnetic Components using Nanoscale Magnetic Powders
52	Ayyoub Mehdizadeh Momen; Benjamin Greek; David W. Hahn; James. F. Klausner; Jorg Petrasch; Nicholas AuYeung; Rishi Mishra; Jinchao Lu; Nihhil Sehgal; Renwei Mei	UF	PCT Appl. PCT/US14/41660	Windowless, Indirectly-Irradiated Solar Thermochemical Reactor with Low-Pressure Capabilities
53	David E. Senior; Cheolbok Kim; Hyupjong Kim; Yong-Kyu Yoon	UF	U.S. Provisional Appl. 62/003,181	Glass Interposer Integrated High Quality Electronic Components and Systems
54	Jenshan Lin; Karl Zawoy; Raul Andres Chinga; Subrata Roy	UF	U.S. Utility Appl. 14/368,217	Portable Power Supply Unit for Plasma Sterilization
55	Rui Qing; Wolfgang M. Sigmund	UF	PCT Appl. PCT/US14/46998	Linixfe1-Xpo4 Solid Solution as Cathode Material for Lithium Ion Batteries
56	James F. Klausner; Jorg Petrasch	UF	U.S. Utility Appl. 14/367,495; EPO Foreign Patent Appl. 12859196.3	Windowless Low-pressure Magnetically Stabilized Solar Thermochemical Reactor
57	Alexandra Garraud; David P. Arnold; Nicolas Garraud	UF	U.S. Provisional Appl. 62/025,578	12859196.3
58	David Kivilcim Hale	UF	U.S. Utility Appl. 14/446,783	Flexible and Practical Automated Calibration of Traffic Simulation
59	Jiangeng Xue; ronald Keith Castellano	UF	CIP Appl. 14/454,353	A Modular Supramolecular Approach to Organic Photovoltaic Devices
60	Bhabendra Pradhan; Do Young Kim; Franky So	UF	U.S. Utility Appl. 14/009,945	Solar Panel Using All Solar Spectrum by Integrating an IR Solar Cell on a Conventional Thin Film
61	Bhabendra Pradhan; Do Young Kim; Franky So	UF	U.S. Utility Appl. 14/009,994	Novel Window with A transparent One Side Emitting OLED Lighting and an IR Sensitive Photovoltaic Panel

62	Bhabendra Pradhan; Do Young Kim; Franky So	UF	U.S. Utility Appl. 14/009,979	Solid State Lighting Window by Transparent One Side Emitting OLED
63	Bhabendra Pradhan; Do Young Kim; Franky So	UF	U.S Utility Appl. 14/124,158	The Transparent Infrared-To-Visible Up-Conversion Device
64	Bhabendra Pradhan; Do Young Kim; Franky So	UF	U.S. Utility Appl. 14/124,136	Novel IR Imaging Sensor by Integrating IR Upconversion Device on CMOS Image Sensor
65	Andrew Rinzler; Aubrey Dyer; John R. Reynolds; Ryan Michael Walczak; Svetlana Vasilyueva	UF	U.S. Utility Appl. 14/127,816	Multiply Controlled Electrochromic Device
66	Hung Ta Wang; Byoung-Sam Kang; Fan Ren; Stephen J. Pearton; Tammay P. Lele	UF	Divisional Appl. 14/099,618	Sensors Using High Electron Mobility Transistors
67	Ayyoub Mehdizadeh Momen; James. F. Klausner; Fotouh A. Al-Raqom	UF	PCT Appl. PCT/US2013/76037	Fuel Production from Solar Heat Utilizing Novel Thermo-Mechanical Stabilized Ferrite Materials
68	Chao Li; Tao Li	UF	PCT Appl. PCT/US2014/018115	Method and Apparatus for Data Center Power Management using On-site Distributed Generation
69	Dhau Stefanakos **Goswami** Jotshi	USF	PCT/US13/75971 Filed: 12/18/2013	Encapsulation of Thermal Energy Storage Media
70	**Goswami** Stefanakos Zhang	USF	14/511,970 Filed: 10/10/2014	Enhancement of Photcatalytic Effect with Surface Roughness in Photocatalytic Reactors
71	B. Joseph	USF	Patent Application Pending	Systems and Methods for Producing Liquid Hydrocarbon Fuels from Natural Gas
72	Krakow, Stefanakos, **Goswami**	USF	13/756,098 Filed: 1/31/2013	Thermal Energy Storage Systems and Methods
73	Kuhn, Bhethanabotla	USF	Patent pending (revised application being submitted)	Systems and Methods For Converting Carbon Dioxide Into Carbon Monoxide
74	Kuhn, Joseph	USF	Patent pending (full patent filed in 1/14)	“Systems And Methods For Producing Liquid Hydrocarbon Fuels”.
75	Li, **Goswami,** Stefanakos	USF	Application Number: PCT/US13/55325 Filed: 8/16/2013	Systems and Methods for Desalinization and Power Generation
76	Ram, **Goswami,** Stefanakos	USF	PCT/US13/68998 Filed: 11/7/2013	Low-Cost Chromatic Devices
77	Ram, Jotshi, Stefanakos, **Goswami**	USF	14/159,874 Filed: 1/21/2014	Method of Encapsulating a Phase Change Material with a Metal Oxide

78	Stefanakos,Jotshi, Dhau, **Goswami**	USF	62/012,633 Filed: 6/16/2014	Encapsulation of Thermal Energy Storage Media
79	John Wolan (deceased) and Syed Ali Gardezi	USF	8,716,170	Eggshell Catalyst and Method of Its Preparation
83	Not available	USF	Not available	4 invention disclosure –kept confidential

6. Technologies Licensed and Revenues Received By SUS Faculty

During Oct. 1, 2013 to Sep 30, 2014 Period (Back to top)

Total: 12

#	University	Faculty	Title	Revenues Received
1	UCF	D. Parker	ERxIQ-(not registered as yet)	Option
2	UCF	N. Dhere	ERxIQ-(not registered as yet)	Option
3	UF	Mary Jennison Kipp; Nicholas Wade Taylor; Pierce H. Jones	Quantifying Household Energy Performance Using Annual Community Baselines	NA
4	UF	Eric David Wachsman; Heesung Yoon; Jianlin Li; Takkeum Oh;	Proton Conducting Membranes for Hydrogen Production and Separation	NA
5	UF	Subrata Roy	Multibarrier Plasma Actuators for High Performance Flow Control	NA
6	UF	Subrata Roy	Plasma Induced Fluid Mixing	NA
7	UF	Subrata Roy	DBD Wind Tunnel for Improved Flow Characterization	NA
8	UF	Subrata Roy	Method and Apparatus for Improving the Efficiency of Open Refrigeratoin Units Using Synthetic Jet Actuators	NA
9	UF	Michael Mastro; Olga Kryliouk; Timothy J. Anderson	Group III-Nitride Direct H-MOVPE Growth On Si(111) Substrate With Oxynitride Interlayer	NA
10	UF	Chin-Cheng (James) Wang; Subrata Roy	System, Method and Apparatus for Microscale Plasma Actuation	NA
11	UF	Subrata Roy	Method and Apparatus for Providing High Control Authority Atmospheric Plasma	NA
12	USF	John Kuhn, Joseph Babu	Systems and Methods for Producing Liquid Fuels	$2,000

7. *Collaborations with Other Postsecondary Institutions - FESC Faculty*

During Oct. 1, 2013 to Sep 30, 2014 Period (Back to top)

Total # of Collaborations: Over 3

SUS related faculty reported 3 collaborations with industry in this reporting period. The actual collaboration is a lot higher than this. But since the majority of the FESC funded projects were completed, full response was not received.

#	Faculty	University	Description of Collaboration	Name of Industry
1	M H Rashid	UWF	External examiner for advising on program quality and accreditation.	The faculty of electrical engineering for undergraduate program at the University of Technology Malaysia MARA (http://www.UiTM.edu.my)
2	M H Rashid	UWF	Ph.D. Thesis on Development of a Novel Charge Pump for High Voltage Applications by RASH MOHAMMADI TOUDESHKI GS27411	Prepared an extensive report as a Ph.D. External Examiner for the University of Malaysia Putra (UPM), May 2013
3	M H Rashid	UWF	EXTERNAL ASSESSOR' REPORT for Promotion to Full Professor	University of Malaysia Science, May 4, 2014

8. *Collaborations with Private Industry - FESC Faculty*

During Oct. 1, 2013 to Sep 30, 2014 Period (Back to top)

Total # of Collaborations: Over 13

SUS related faculty reported 13 collaborations with industry in this reporting period. The actual collaboration is a lot higher than this. But since the majority of the FESC funded projects were completed, full response was not received.

#	Faculty	University	Description of Collaboration	Name of Industry/Organization
1	Lewis Johnson and Charles Weatherford	FAMU	Hazardous Materials Detection	Defense Contract Work
2	Canan Balaban	FESC	Energy Crop Certification Program	TCRDA
3	Zhua Qu	UCF	FEEDER Consortium (Smart Grid)	Duke

4	Zhua Qu	UCF	FEEDER Consortium (Smart Grid)	FPL
5	Gary Peter	UF	Energy Crop Certification Program	TCRDA
6	John Ercikson	UF	Energy Crop Certification Program	TCRDA
7	Canan Balaban/David Wright	UF/FESC	Testing Carinata oil in biodiesel facility	Viesel Fuel LLC
8	Jennifer Curtis	UF/FESC	Biomass rheology/modeling	Shell Oil
9	Yogi Goswami	USF	Manufacturing of ceramic PCM capsules	Kyocera Industrial Ceramic Corporation
10	Yogi Goswami	USF	Thermal energy storage for high temperature solar power plant	SunBorne, Inc.
11	Babu Joseph	USF	Design of processes for converting landfill gases to liquid fuels	Prado Associates, LLC
12	Kuhn Joseph	USF	Startup company of faculty	Trash2Cash-Energy LLC
13	Elias Stefanakos	USF	Testing of photocatalytic air cleaning devices	ATT+L

9. *Students and Post-docs Supported By FESC Faculty*

During Oct. 1, 20013 to Sep 30, 2014 Period **(Back to top)**

Total # of Students and Post docs supported during the reporting period: 55
(Undergraduate: 1, Master: 13, PhD: 38, Post-docs: 3)

#	Faculty	University	Student Name	MS/PhD/Post - Doc
1	J. VanZwieten	FAU	Basil Hacker	M.S.
2	J. VanZwieten	FAU	Andrew Krupski	M.S.
3	J. VanZwieten	FAU	Parakram Pyakurel	Ph.D.
4	J. VanZwieten/ H. Mahfuz	FAU	Marco Canino	M.S.
5	J. VanZwieten/ H. Mahfuz	FAU	Chris Gapstur	Ph.D.
6	Jeanette Wyneken	FAU	Caitlin Bovary	M.S.
7	J. VanZwieten	FAU	Matthew Egeland	M.S.
8	J. VanZwieten	FAU	Anthony Marcus	Ph.D.
	Jennifer Curtis	UF	Nha Thai-Quang	Post Doc.
9	Kelly Jordan	UF	Geoffrey Bickford	MS

10	Franky So	UF	Fred Steffy	Ph.D.
11	Franky So	UF	Jeg Subbiah	Post Doc.
12	Helena Weaver	UF	Justin Dodson	Ph.D.
13	Mark Hostetler	UF	Hal Knowles	Ph.D.
14	Tim Anderson	UF	Vaibhav Chaudhari	Ph.D.
15	Tim Anderson	UF	Rangarajan Krishnan	Ph.D.
16	Tim Anderson	UF	Albert B. Hicks	Ph.D.
17	Tim Anderson	UF	Christopher Muzzillo	Ph.D.
18	Tim Anderson	UF	David Wood	Ph.D.
19	Tim Anderson	UF	Michael Hague	Ph.D.
20	Tim Anderson	UF	Seo Young Kim	Ph.D.
21	Tim Anderson	UF	Joseph C. Revelli	Ph.D.
22	Babu Joseph	USF	Chita Yang	Ph.D.
23	Babu Joseph	USF	Kassie Ngo	Ph.D.
24	Babu Joseph	USF	Ryan Kent	M.S
25	Kuhn & Joseph	USF	Ryan Kent	MS
26	Kuhn & Joseph	USF	Nada Elsayed	PhD
27	Kuhn	USF	Yolanda Daza	PhD
28	Kuhn & Sunol	USF	Ummuhan Cimenlar	PhD
29	Kuhn & Bhethanbotla	USF	Debtanu Maiti	PhD
30	Kuhn & Bhethanbotla	USF	Anne Carraccio	PhD
31	Kuhn & Bhethanbotla	USF	Divya Suresh	MS
32	Kuhn & Bhethanbotla	USF	Jon Pickering	MS
33	Tapas K. Das		Felipe Feijoo	Ph.D.
34	Tapas K. Das		Alireza Ghalebani	Ph.D.
35	Yogi Goswami	USF	Alam, Tanvir	Ph.D.
36	Yogi Goswami	USF	Besarati, Saeb	Ph.D.
37	Yogi Goswami	USF	Bhardwajh, Abhinav	Ph.D.
38	Yogi Goswami	USF	Kamal, Rajeev	Ph.D.
39	Yogi Goswami	USF	Myers, Phil	Ph.D.
40	Yogi Goswami	USF	Osterman-Burgess, Barry	Ph.D.
41	Yogi Goswami	USF	Ramos, Antonio Archibold	Ph.D.
42	Yogi Goswami	USF	Trahan, Jamie	Ph.D.
43	Yogi Goswami	USF	Vidhi, Rachana	Ph.D.
44	Yogi Goswami	USF	Wichramaratne, Chatura	Ph.D.
45	Yogi Goswami	USF	Zeyghami, Medhi	Ph.D.
46	Yogi Goswami	USF	Zhang, Yangyang	Post Doc.
47	Elias Stefanakos	USF	Khawaja, Mohamad	Ph.D.
48	Elias Stefanakos	USF	Amba, Harsha Vardham	M.S.
49	Elias Stefanakos	USF	Azad, Ibrahim	Ph.D.
50	Elias Stefanakos	USF	Gadhiraju, Aaditya	M.S.
51	Elias Stefanakos	USF	Marathe, Amol	MS
52	Elias Stefanakos	USF	Saffold, Gabriel	Ph.D.
53	Elias Stefanakos	USF	Sharma, Saumya	Ph.D.
54	Bhuvaneswari Ramachandran	UWF	Ms. Thenmozli Elayaperunal	B.S. (Electrical & Computer Eng.

10. Students Graduated – FESC Faculty

During Oct. 1, 2013 to Sep 30, 2014 Period (Back to top)

Total # of Students Graduated: 29
(Undergraduate: 1, Master: 7 PhD: 21)

#	Faculty	University	Student Name	MS/PhD/Post -Doc
1	J. VanZwieten	FAU	Basil Hacker	M.S.
2	J. VanZwieten	FAU	Andrew Krupski	M.S.
3	J. VanZwieten	FAU	Matthew Egeland	M.S.
4	Jeanette Wyneken	FAU	Caitlin Bovary	M.S.
5	J. VanZwieten	FAU	Anthony Marcus	Ph.D.
6	Tingting Zhao	FSU	John Sulik	Ph.D.
7	Subramanian Ramakrishnan	FSU	G. Brodeur	Ph.D.
8	Kelly Jordan	UF	Geoffrey Bickford	MS
9	Babu Joseph	USF	Ali Gardezi	Ph.D.
10	Babu Joseph	USF	Matthew Wetherington	BS
11	Manoj Ram	USF	Priyanka Bollisetty	M.S.
12	Elias Stefanakos	USF	Punya Basnakaya	Ph.D.
13	Elias Stefanakos	USF	Emre D. Demirocak,	Ph.D,
14	Elias Stefanakos	USF	Zhang, Yangyang	Ph.D.
15	Elias Stefanakos	USF	Prashantha Sridheran	M.S
16	Elias Stefanakos	USF	Rudraskandan Ratnadurai	Ph.D.
17	Elias Stefanakos	USF	Sam Wiejewardane	PH.D
18	Kuhn	USF	Sandy Pettit	PhD
19	Sarina Ergas	USF	Trina Halfhide	Ph.D.
20	Yogi Goswami	USF	Punya Basnakaya	Ph.D.
21	Yogi Goswami	USF	Emre D Demirocak,	Ph.D.
22	Yogi Goswami	USF	Zhang, Yangyang	Ph.D.
23	Yogi Goswami	USF	Prashantha Sridheran	Ph.D.
24	Yogi Goswami	USF	Rudraskandan Ratnadurai	Ph.D.
25	Yogi Goswami	USF	Rachana Vidhi	Ph.D.
26	Yogi Goswami	USF	Sam Wiejewardane	Ph.D.
27	Yogi Goswami	USF	Antonio Archibold Ramos	Ph.D.
28	Yogi Goswami	USF	Saeb Mostigham Besarati	Ph.D.
29	Yogi Goswami, Sarina Ergas	USF	Innocent Udom	Ph.D,

11. Business Start-Ups in Florida for All SUS Faculty

During Oct. 1, 2008 to Sep 30, 2014 Period (Back to top)

FLORIDA UNIVERSITY SPIN-OFF COMPANIES

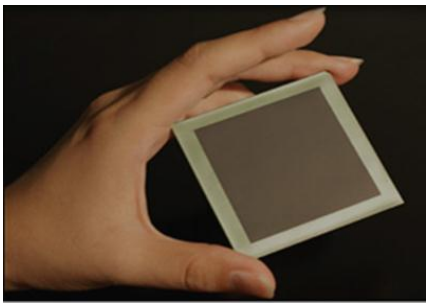
#	University	Name of Business	Location	Start-Up Date	Specialty	# of Employees
1	FSU	Bing Energy International	Tallahassee, FL	2010	Fuel Cells	10 in US and 30 in China
2	FSU	General Capacitor	Tallahassee, FL	2012	Super Capacitors	1
3	FSU	High Performance Magnetics	Tallahassee, FL	2008	Cable-in-Conduit (CIC) magnet components	10-20
4	FSU	SunnyLand Solar, LLC	Tallahassee, FL	2011	Solar Collectors	2
5	UCF	Garmor, Inc.	Orlando, FL	2012	Edge-Functionalized Graphene Oxide	8
6	UCF	HybridaSol	Orlando, FL	2012	PV-TE Hybrid	4
7	UCF	HySense Technology, LLC	Rockledge, FL	2012	H_2 Sensing Tape	3
8	UCF	TALAWAH Technologies	Orlando, FL	2012	H_2 Sensors	3
9	UCF	Helicon Chemical Company	Orlando, FL	2012	Self-cleaning coating chemicals and oxidative fuel additive	5
10	UF	Energy Efficiency Company*	Greenville, SC	2009	Energy Efficiency – Turbines	5 to 10
11	UF	Florida FGT, LLC	Gainesville, FL	2010	Energy Crops	1
12	UF	Florida Sustainables	Gainesville, FL	2010	Chemicals from Biomass	2
13	UF	US Bioplastics	Gainesville, FL		Water-degradable Plastics from Feedstock Waste	5
14	UF	NanoPhotonica, Inc.	Longwood, FL	2010	Next Generation Optoelectronic Devices	5

15	UF	Compressor Company*	Houston, TX	2010	Air and NG Compressors	5 to 10
16	UF	Fuel Cell Company*	Fulton, MD	2010	Solid Oxide Fuel Cells	5 to 10
17	UF	Solar Fuel Company*	Gainesville, FL	2012	Chemicals to H_2	1
18	UF	Solar Powder	Gainesville, FL	2011	Nanoparticle Thin Film Photovoltaics	1
19	USF	MudPower	Lutz, FL	2013	Fuel-Cells Modular Power Sources	2
20	USF	Trash 2 Cash-Energy, LLC	Tampa, FL	2011	Landfill Gas to Liquid Fuel	2
21	USF	New Energy Technologies Inc.**	Columbia MD	2009	SolarWindow™ Technology	**
	Companies Formed but not Survived					
22	UCF	*Almos Battery Corp.*	*Orlando, FL*	*2011*	*Grid Scale Battery (Low Temp Molten Salt)*	*0*
23	UCF	*Mesdi Systems, Inc.*	*Orlando, FL*	*2011*	*Electrospray (for Batteries, FC, etc.)*	*0*
24	UCF	*CeramiPower*	*Orlando, FL*	*2011*	*CHP*	*0*
25	UCF	*PV Integrated*	*Cocoa Beach, FL*	*2011*	*Thin Film PV*	*0*
26	UCF	ERxIQ-(not registered as yet)	Orlando, FL	05, 2014	Clean tech and renewable energy	Unknown at this time
27	UF	*UB-WiSystems, Inc.*	*Gainesville, FL*	*2012*	*Low Power Wireless Transmission*	*0*
28	UNF	Omnii Sense, LLC	*Jacksonville, FL*	*2011*	*Intelligent Sensor Network for Street Light Efficiency*	*0*
29	USF	*Energy Management Professionals*	*Lutz, FL*	*2008*	*HVACR*	*0*

** Company name kept confidential due to university licensing*

*** New Energy Technologies Inc. is not a university spin-off. They licensed USF technology*

Bing



Fuel Cell Company

SunnyLand Solar, LLC, Solar

Description of Florida University Spin-Off Companies

Bing Energy International (Tallahassee, FL – FSU Technology)
http://bingenergyinc.com/ - By utilizing a revolutionary carbon nanotube based solution, Bing Energy International (BEI) has developed a product and process that maximizes the effectiveness of the platinum catalyst required for PEM fuel cells. PEM fuel cells are relatively low temperature devices that can be used in a wide variety of applications ranging from backup power, to automotive power, to stationary power generation. The result is equal or better electrical output, from only 30% of the platinum and with increased durability. This technology has been independently verified to meet nearly all of the Department of Energy's hydrogen fuel cell goals for the year of 2015.

General Capacitor (Tallahassee, FL – FSU Technology)
http://www.news.fsu.edu/More-FSU-News/Florida-State-inks-deal-to-license-new-supercapacitor-invention
General Capacitor LLC is a privately held company and was founded in 2012 to manufacture advanced Li-Ion capacitors.

High Performance Magnetics (Tallahassee, FL – FSU Technology)
http://ciceft.com/ - High Performance Magnetics designs, fabricates and tests advanced cable-in-conduit (CIC) magnet components. CICs are typically used in large-bore, fast-ramping superconducting magnets for high-tech applications such as Magnetically Confined Fusion Energy, High-Field Magnet Laboratories, Spallation Neutron Sources, and Superconducting Magnetic Energy Storage devices.

SunnyLand Solar, LLC (Tallahassee, FL – FSU Technology)
http://www.research.fsu.edu/techtransfer/solarsausage.html - SunnyLand Solar is developing a new solar technology licensed from Florida State University called the "Solar Sausage". This technology has the potential of dramatically reducing the cost of concentrated-solar applications. Material cost, ease of manufacturability, optical quality, and speed of deployment are just some of its benefits. It is an inflatable made of durable Mylar and has been shown to tolerate UV radiation and routine high winds. SunnyLand, as sole licensee, has already deployed over 2,300 these units in North Florida and with determination continues to work on improvements to this burgeoning technology.

Garmor Inc., (Orlando FL – UCF Technology)
http://garmortech.com/ - Garmor has developed a simple yet effective method of producing edge-functionalized graphene oxide. Whereas traditional methods have relied upon powerful oxidizing

agents and acids to produce graphene, Garmor relies upon new advances in milling technology to produce graphene oxide yielding only water as a by-product. These proprietary achievements eliminate hazardous waste disposal costs and deliver a product suitable for large scale production at commodity-type prices.

Graphene/graphene oxide has already been shown to have wide applications as an adsorbent, lubricant, corrosion inhibition, electrodes, transistors, and as an additive used to strengthen composite materials. Garmor's manufacturing technology has been designed to tailor the oxidation level so that it can be uniquely matched to a given application. For example, Garmor's moderately oxidized, edge-functionalized graphene oxide is fully dispersible in water and can be deposited in thin films. This offers the potential for improved electronic displays, solar cells, water-based lubricants, and various hydrophilic polymer composites. Garmor's graphene can also be readily functionalized to accommodate non-polar environments.

HybridaSol, (Orlando FL – UCF Technology)

http://futureenergy.ultralightstartups.com/campaign/detail/809 - Reduced PV degradation and increased PV output are achieved with a ThermoElectric (TE) cell printed on the substrate of the PV cell, then operating the TE cell as a Peltier cooler powered by the PV cell itself. Though diversion of any PV output seems self-defeating, favorable gains in net energy production are achieved by exploiting the large differences in the PV temperature-degradation curve (%Voc/oC) and the heat transport curve (Energyelectric/Energyheat) of the TE cell. Note the very short distances this heat must be transferred, from the PV wafer to the backplane (< 1 mm), and it becomes apparent very little parasitic energy is required from the PV cell. The economics then become attractive, provided the TE materials and process for manufacture of the PV-TE Hybrid are low cost. HybridaSol won a NSF Phase 1 SBIR award and secured new management to run the company and production development. They now have 4 employees.

HySense Technology, LLC, (Rockledge FL – UCF Technology)

http://megawattventures.com/2013finalists/hysensetech/ - Manufactures chemochromic (color-changing) pigments for flammable gas leak detection applications. HySense Technology, LLC believes that in the current and future national energy portfolio, hydrogen and natural gas are two of the most important energy resources. However, keeping such flammable gases contained to establish a safe environment for producers and end utilizers is of utmost importance. Presently, the large majority of gas leak detection systems have been focused on the development of electronic sensors. Electronic sensors have several drawbacks including loss of sensitivity in the field due to the environmental effects, costs, and problems associated with power required on-site. Thus, a visually easy to detect leak detector can greatly enhance the market acceptance and expansion of these valuable energy sources. HySense won CAT5 Awards recently and received $100K funding from the program. They have also received a R&D 100 Award, and has sales with large customers – major utilities, GE, etc.

TALAWAH Technologies (Orlando FL – UCF Technology)

http://www.talawahtechnologies.com/ - TALAWAH Technologies develop wireless hydrogen sensors and a proven communication system that all consume little battery power for detecting physical characteristics in complex environments. TALAWAH Technologies is founded on joint research conducted at the University of Central Florida and the National Aeronautic and Space Administration at Kennedy Space Center. TALAWAH Technologies has commercialized the coherence multiplexed transceiver (CMT) for communication with surface acoustic wave (SAW) sensors. This partnership lead to the invention of the coherence multiplexed SAW sensor system in 2012 and demonstrated a working matrix of SAW sensors that were able to read temperature and range data at distances over 20 meters. Talawah is a pivoting company and have picked up a strong sensor expert mentor recently to identify new opportunities.

Helicon Chemical Company (Orlando FL – UCF Technology)
http://www.heliconchemical.com - This Orlando, Florida Company is transforming recent advances in nanotechnology into commercial products. Their first products are a set of nanoparticle ingredients for high-energy fuels and propellants for the aviation and aerospace industries. Helicon's products promise to increase safety, efficiency, and performance, and reduce environmental impact compared to the conventional jet and rocket fuels and propellants. The technology and founders are from the University of Central Florida. Helicon won 2 Phase 1 SBIRs (from Navy and AirForce), and have a contract with Aerojet Rocketdyne. They now have 5 employees.

Energy Efficiency Company (Anderson, SC – UF Technology)
http://www.emerald-endeavors.com/ - Company's second generation SMART gas sensors are thin-film based gas sensor for combustion applications. Transduction of the analyte composition and concentration is realized through impedance based measurements of an oxide electrode in a solid electrolyte electrochemical cell.

Florida FGT. LLC (Gainesville FL – UF)
http://www.floridafgt.com/ - Florida FGT provides professional advice to forest and agricultural landowners on various aspects of the use of fast-growing Eucalyptus, Corymbia, Populus, Taxodium, and Pinus species.

Florida Sustainables (Gainesville, FL – UF Technology)
http://www.chem.ufl.edu/~miller/floridasustainables/ - Florida Sustainables innovates and markets sustainable materials, especially biorenewable and degradable polymers designed to replace petroleum-based plastics. The company synthesizes polymers called polyesteracetals, providing the strength of petroleum-based plastics lacking in other "green" plastics made from PLAs — or polylactic acid. Their plastics stand up to heat better than current "green" plastics and are not brittle and noisy such as the bag of SunChips abandoned due to consumer complaints. They also degrade within five to 10 years of their usable life compared to 1,000 years for petroleum plastics, and they do not require the composting conditions of PLAs to break down.

US Bioplastics (Orlando FL – UF Technology)
US Bioplastics, an Orlando-based company that takes feedstock waste, paper production by-products, or other plant waste to practical use and then returns it to the environment without damaging the ecology. US Bioplastics' flagship product Gatoresin™, based on technology licensed from the University of Florida, is a bio-renewable, water-degradable plastic designed for use in highly disposable applications. Gatoresin eliminates the possibility of environmental contamination by replacing non-degradable petroleum-based plastics with materials derived from agricultural and other waste products.

Compressor Company (Houston TX – UF Technology)
http://www.oscomp-systems.com/ - They deliver turnkey solutions that enable customers to transition to natural gas as an energy source, even if they do not have access to a pipeline. They successfully delivered commercial quantities of gas to a disconnected user. They are developing game-changing compression technology capable of efficiently compressing wet gas and multiphase streams to compression ratios that are an order of magnitude higher than existing technology.

NanoPhotonica, Inc. (Gainesville, FL – UF Technology)
http://www.nanophotonica.com/ - NanoPhotonica is developing breakthrough nanomaterials, production techniques and associated products that will enable market-altering improvements to optoelectronic products. The company is developing a number of innovations that will transform both the flat panel display and solar panel/green energy sectors. For example, smartphones and camera displays will be able to operate with 50% less power than traditional LCDs. In addition, the production costs are anticipated to be 75% lower than display competitors, while still providing more vivid colors and greater ease of viewing. For display applications, the company's patented, all-solution-processable quantum dot light-emitting diodes technique (S-QLED®) allows fabrication of displays using ink-jet printing methods.

Fuel Cell Company (Fulton, MD – UF Technology)
http://www.redoxpowersystems.com/ - The company was formed in 2012 by a group of scientists and engineers with extensive research, technical and managerial experience. They are pioneering major breakthrough Solid Oxide Fuel Cell technology. It is their solution for Distributed Power Generation and Transportation.

Solar Fuel Company (Gainesville, FL – UF Technology)
http://www.linkedin.com/pub/kevin-bowles/3/b76/b9 - This is a high growth, solar, biofuels (non-biomass) company that uses a proprietary low pressure/high temperature thermochemical process and proprietary reactor to convert solar energy, water and CO_2 into fuel (hydrogen or syngas). Solar Fuel: 1) has a flexible, mobile footprint accommodating varying locations, 2) zero carbon footprint and 3) produces cost competitive, (non-subsidized) fuel. Solar Fuel has raised (late 2011) $3MM from the DOE, $35K from the University of Florida and completed a bench prototype. Solar Fuel is currently scaling the product and is in discussions with potential strategic partners including oil and gas, defense, utility, states and neighboring nations.

Solar Powder (Gainesville, FL, UF Technology)
http://www.research.ufl.edu/otl/pdf/startup/Solar_Powder_COS.pdf - Solar Powder is a solar-energy company that has developed an innovative technology that will set a new low cost point for solar energy. The technology behind Solar Powder uses CIGS, a semiconductor absorber layer composed of copper, indium, gallium and selenium. CIGS was chosen because of its high cell efficiency, high energy yield, and now with Solar Powder, its low cost of manufacturing when compared to other semiconductor material, such as crystalline. Solar Powder has developed a process for the synthesis of the CIGS absorber layer that addresses the major manufacturing cost factors challenged by other CIGS methods. This includes a proprietary nano-powder that is mixed with a secret Solar Powder solvent to allow for liquid application. Solar Powder solar panels can be produced at scale and high yield.

Omnii Sense, LLC (Jacksonville, FL, UNF Technology)
http://istart.org/startup-idea/business/omnii-sense-llc/9030 - Omnii Sense LLC is a developer of intelligent wireless sensor networks that gather, record, and report real time data for multiple industries including energy, health, environmental, and security. The Omnii Sense "smart" sensor technology requires no human interaction once activated and no retrofitting to existing infrastructure. The sensors automatically establish a viable communication path, identify nearest neighbors, perform self-healing in the event of disruption, and can be used to detect everything from energy consumption, to microbes and chemical warfare agents.

Mud Power, Inc. (Saint Petersburg, FL – USF Technology)
https://gust.com/c/mud_power_inc - Mud Power has developed modular long-term power solutions that harness energy generated in a natural process by microorganisms found in marine sediments. Customers will be able to significantly increase the length and data resolution of their deployments located near the seafloor.

Trash 2 Cash-Energy LLC (Tampa, FL – USF Technology)
http://www.trash2cashenergy.com/ - Trash 2 Cash converts landfill gas to customer specific liquid fuel. The proprietary gas to liquid process converts naturally produced landfill gas (LFG), composed mainly of methane and carbon dioxide to hydrocarbon fuels specific to the customer needs such as diesel fuel. Trash 2 Cash couples a patent pending Fischer Tropsch (FT) eggshell catalyst to an innovative process design, incorporating a novel tri-reforming reaction to reduce the troublesome impurities found in crude bio-derived gases and produce desired syngas for the FT reaction. This alleviates many problems associated with accumulating municipal solid waste (MSW) in landfills and provides a domestic, sustainable, green fuel.

USF Technology transfer to New Energy Technologies Inc.* (Columbia MD, USF Technology)
http://www.newenergytechnologiesinc.com/technology/solarwindow
New Energy Technologies is not a university spin off; however they licensed USF SolarWindow™ technology, which enables see-through windows to generate electricity by 'spraying' their glass surfaces with New Energy's electricity-generating coatings – the subject of eleven patent filings.

Companies Formed But Did Not Survive:

Almos Battery Corporation (Orlando, FL – UCF Technology)
The company is engaged in developing a new battery technology which is safe & low cost for electric power grid applications. The proposed product is a prototype battery which is scalable to megawatts power and megawatts-hr energy. The prototype battery is being built. The battery allows the operation to be on an unattended basis for extended period of time. Integration of battery system into utility transmission and distribution is a mature and well defined process.

Mesdi Systems Inc. (Orlando FL – UCF Technology)
http://megawattventures.com/2012/05/29/mesdi-systems-wins-100000-in-acc-clean-energy-challenge/
Mesdi Systems supplies next-generation spray equipment for manufacturing advanced coatings and chemical powders where high quality and product uniformity are vital. Applications requiring these high precision powders and coatings include lithium-ion batteries, solar cells, LED lighting, semiconductors, pharmaceuticals, and medical implants.

CeramiPower, Inc. (Orlando FL – UCF Technology)
CeramiPower, Inc. was founded to develop ceramic based combustion products and combined heat and power unit (CHP) for both military and civilian applications.

Energy Management Professionals (Lutz, FL – USF Technology)
Energy Management Professionals (EMP) was formed to develop and commercialize new technologies that improve the energy efficiency of existing products and processes. The Company's

particular focus was on energy generation utilizing thermodynamics, heat transfer and heat exchange, which are important to the heating, ventilation, air conditioning, and refrigeration ("HVACR") industries and to the current invention. EMP held the rights to two (2) patent-pending applications: ECOGEN Co- Generation System and ReadyPower Portable Power Storage Unit.

P.V. Integrated (Orlando FL – UCF Technology)

P.V. Integrated was formed to develop a novel process for low cost, high throughput manufacturing of CIGS Thin-Film solar cells.

UB-WiSystems, Inc. (Gainesville, FL – UF Technology)

http://megawattventures.com/teams/ubwisystems/

UB-WiSystems, Inc. was founded in May 2012 to provide ultra-low power transceiver solutions for Wi-Fi enabled consumer electronics.

APPENDIX C – FUNDING OPPORTUNITIES SENT TO FESC FACULTY

138 funding opportunities were sent to the faculty during the reporting period of **Oct. 1, 2013 to Sep 30, 2014.** The details are given in the table below.

#	Title	Call #	Agency	Funding
1	CENTER OF EXCELLENCE: Electromagnetic Interference for Extreme	BAA-AFOSR-2014-0002	Air Force Office of Scientific Research	$4.5M
2	Alternative Energy Funding	BAA-RQKM-2014-0005	Air Force Research Laboratory	$37M
3	Cade Museum Prize	N/A	Cade Museum	$50k
4	Fellowships at the Center for International Security and Cooperation	N/A	Center for Inter.Security & Cooperation (CISAC)	Not specified
5	2015 Competition Bioenergy and Biomass Conversion From Plant-Based Research to Prototype Bio-Materials	N/A	CPBR	$185K/year
6	First in the World" grant program (FIPSE)	N/A	Department of Education	$75M
7	Small Business Innovation Research (SBIR) Program	541712	Department of Transportation	Ph 1: $150K, Ph 2: $1M
8	Domestic Nuclear Detection Office Academic Research Initiative Program	DHS-14-DN-077-ARI-001	DHS	$3M
9	Compact High-Density Tactical Energy Storage	14-SN-0012	DOD	3.75M
10	Environmental Security Technology Certification Program (ESTCP) - Installation Energy Technology Demonstrations	BAA-14-0004	DOD	Open
11	Environmental Technologies Solicitation	N/A	DoD	Open
12	The U.S. Army Engineer R&D Center 2014 BAA	W912HZ-14-BAA-01	DOD	Not specified
13	FY 2014 Regional Innovation Grants	EDA-HDQ-OIE-2014-2004219	EDA and U.S. Dep. of Commerce	$8M
14	Clean Energy Activities- Addendum under APS No.: APS-OAA-13-00003	APS-596-14-000001	El Salvador USAID-San Salvador	$18 M

15	11th Annual P3 Awards: A National Student Design Competition for Sustainability Focusing on People, Prosperity and the Planet	EPA-G2014-P3-Q1	EPA	$1M
16	Air, Climate And Energy (ACE) Centers: Science Supporting Solutions	EPA-G2014-STAR-J1	EPA	$30M
17	12th Annual P3 Awards: A National Student Design Competition for Sustainability Focusing on People, Prosperity and the Planet	EPA	EPA	$975k
18	FDSTF Grant	N/A	FL Defense Support Task Force	2.5M
19	Defense Infrastructure Grant	N/A	Florida Defense Support Task Force	200K
20	Defense Reinvestment Grant	N/A	Florida Defense Support Task Force	850K
21	Gulf of Mexico Research Initiative Request for Proposals for 2015-2017 GoMRI Research Consortia	RFP-IV	GoMRI	$35M
22	Hydro Research Foundation Research Awards Program	N/A	Hydro Research Foundation	$18K living stipend + tuition
23	Hydrogen Student Design Contest	N/A	Hydrogen Education Foundation	Not specified
24	Link Foundation Fellowships and Grants In The Energy Field	N/A	Link Foundation	56K
25	Max Tech and Beyond Design Competition for Ultra-Low-Energy-Use Appliances and Equipment	EES - LBNL	Max Tech	$25K
26	Lemelson MIT Prize	N/A	MIT	500K
27	2014 INTERNATIONAL WORKSHOP ON ENVIRONMENT AND ALTERNATIVE ENERGY “Increasing Space Mission Resiliency through Sustainability”	N/A	NASA	Not specified
28	Community Resilience Center of Excellence Program	2014-NIST-CR-COE-01	NIST	4M
29	NIST's AdvancedManufacturing Technology Consortia (AMTech) Program	2014-NIST-AMTECH-01	NIST	5.6M
30	Catalyzing New International Collaborations (CNIC)	NSF 13-605	NSF	$2 M / year
31	US-China Collaborative Research in Environmental Sustainability	NSF 14-102	NSF	Open
32	Critical Techniques and Technologies for Advancing Big Data Science & Engineering (BIGDATA)	NSF 14-453	NSF	$23M

33	Sustainability Research Networks Competition (SRN)	NSF 14-534	NSF	$12M
34	Graduate Research Fellowship Program (GRFP)	NSF 14-590	NSF	33.3M
35	Partnerships for Innovation: Building Innovation Capacity (PFI: BIC)	NSF 14-610	NSF	$10,000
36	Energy, Power, Control and Networks (EPCN)	NSF PD 13-7607	NSF	Not specified
37	Catalysis and BioCatalysis	PD 14-1401	NSF	Not specified
38	EAGERs to Energize Innovative Research and Development on Dynamic Data Systems	NSF 14-108	NSF with Air Force Office of Scientific Research	Not specified
39	NSF/DOE Partnership on Advanced Frontiers in Renewable Hydrogen Fuel Production Via Solar Water Splitting Technologies	NSF 14-511	NSF/DOE	$6M to 18M
40	Travel Grants	N/A	Oak Ridge Associated Universities (ORAU)	$800
41	High-Impact Nanoscience Research	N/A	Oak Ridge National Laboratory	Not specified
42	Travel Grants - Oak Ridge Associated Universities (ORAU) ; Internal LOI due to the Office of Research (Required)	N/A	Oak Ridge NL	$800
43	Operational Energy Plans and Programs - Fuel Hedge Research	HQ0034-OEPP-14-BAA-0001	Other Defense Agency	Open
44	Gilbert F. White Postdoctoral Fellowship Program	N/A	Resources for the Future (RFF)	Annual Stipend
45	ACRP 02-56 - Developing an Airport Business Case for Renewable Energy	ACRP 02-56	Transportation Research Board (TRB)	$300k
46	Tyler Prize for Environmental Achievement	N/A	University of Southern California	$200K
47	Energy Efficiency in Chile	OES-OTE-14-004	US Department of State	$198K
48	Global Nuclear Security Effectiveness Study	S-ISNCT-14-RFP-004	US Department of State	$370K
49	Advanced Research In Dry-cooling (ARID)	RFI-0000010	US DOE	Not specified

50	Integrated Enhanced Geothermal Systems (EGS) Research and Development	DE-FOA-0000842	US DOE	$10M
51	Support of Advanced Coal Research at United States (U.S.) Colleges and Universities	DE-FOA-00001032	US DOE	$2.1M, max 400,000 per
52	Hydrogen Delivery Technologies	DE-FOA-0000821	US DOE	$4M
53	Hydrogen Production Research And Development	DE-FOA-0000826	US DOE	$4M
54	Sunshot Incubator Program	DE-FOA-0000923	US DOE	$10M
55	SOLAR DECATHLON 2015	DE-FOA-0000959	US DOE	$1M
56	Environmental Stewardship for Renewable Energy Te chnologies: MHK Environmental and Resource Chara cterization Instrumentation	DE-FOA-0000971	US DOE	$3.5M
57	Bioenergy Technologies Incubator	DE-FOA-0000974	US DOE	$10M
58	Clean Energy Manufacturing Innovation Institute for Composite Materials and Structure	DE-FOA-0000977	US DOE	$70M
59	Administration of the Wave Energy Converter Prize	DE-FOA-0000979	US DOE	$6.5M
60	U.S. Wind Manufacturing: Taller Hub Heights To Access Higher Wind Resources And Lower Cost Of Energy	DE-FOA-0000982	US DOE	$2M
61	Vehicles Technologies Incubator	DE-FOA-0000988	US DOE	$10M
62	NEXT GENERATION PHOTOVOLTAIC TECHNOLOGIES III	DE-FOA-0000990	US DOE	$9M
63	Vehicles Technologies Program Wide	DE-FOA-0000991	US DOE	51.4M
64	Microgrid Research, Development, and System Design	DE-FOA-0000997	US DOE	$7M
65	FY2014 Scientific Infrastructure Support for Consolidated Innovative Nuclear Research Grant	DE-FOA-0000999	US DOE	$3M, 3.5M
66	CERTIFICATION AND RATING OF ATTACHMENTS FOR FENESTRATION TECHNOLOGIES (CRAFT)	DE-FOA-0001000	US DOE	$1.6M
67	Low Temperature Geothermal Mineral Recovery Program	DE-FOA-0001016	US DOE	$3M
68	Solar Manufacturing Technology 2 (SolarMat2)	DE-FOA-0001018	US DOE	$25M
69	Fossil Energy Research and Developments	DE-FOA-0001023	US DOE	$80M
70	Plant Feedstock Genomics for Bioenergy: A Joint Research Funding Opportunity Announcement USDA, DOE	DE-FOA-0001034	US DOE	$5M

71	Climate and Earth System Modeling: SciDAC and Climate Variability and Change	DE-FOA-0001036	US DOE	$8M
72	Research for Safe and Permanent Geologic Storage of CO2	DE-FOA-0001037	US DOE	$6M
73	Notice of Intent to Issue DE-FOA-0001027, Building Energy Efficiency Frontiers & Incubator Technologies (BENEFIT) - 2014	DE-FOA-0001039	US DOE	Not specified
74	NATIONAL INCUBATOR INITIATIVE FOR CLEAN ENERGY	DE-FOA-0001042	US DOE	$3M
75	Scientific Data Management, Analysis and Visualization at Extreme Scale 2	DE-FOA-0001043	US DOE	$100 to $500K
76	Advanced Gasification and Novel Transformational Coal Conversion Technologies	DE-FOA-0001051	US DOE	$10M
77	Solid Oxide Fuel Cell Core Technology Program	DE-FOA-0001052	US DOE	$6.4M
78	Improved Reliability of Solid Oxide Fuel Cell Systems	DE-FOA-0001058	US DOE	$15M
79	Systems Biology of Bioenergy-Relevant Microbes to Enable Production of Next-Generation Biofuels	DE-FOA-0001060	US DOE	$8M
80	Notice of Intent to Issue Funding Opportunity Announcement No. DE-FOA-0001016 "Low Temperature Mineral Recovery Program"	DE-FOA-0001069	US DOE	NA
81	Research and Development for Next Generation Nuclear Physics Accelerator Facilities	DE-FOA-0001082	US DOE	$1.87M
82	Commerical Building Technology Demonstrations	DE-FOA-0001084	US DOE	$10M
83	High Impact Commercial Building Technology Deployment	DE-FOA-0001086	US DOE	Not specified
84	Analytical Modeling for Extreme-Scale Computing Environments	DE-FOA-0001088	US DOE	$4.5M
85	Scientific Discovery through Ultrafast Materials and Chemical Sciences	DE-FOA-0001089	US DOE	$4M
86	Notice of Intent: Fuel Cell Technologies Incubator: Innovations in Fuel Cell and Hydrogen Fuels Technologies	DE-FOA-0001094	US DOE	Not specified
87	Research, Development and Training in Isotope Production	DE-FOA-0001099	US DOE	2.6M
88	Mickey Leland 2014 Internship Program	N/A	US DOE	Not specified
89	The Innovative and Novel Computational Impact on Theory and Experiment (INCITE)	2015 INCITE	US DOE	Not specified
90	Geothermal Play Fairway Analysis	DE-FOA-0000841	US DOE	$3-5M per phase

91	Clean Energy Supply Chain and Manufacturing Competitiveness Analysis for Hydrogen and Fuel Cell Technologies	DE-FOA-0000854	US DOE	$2M
92	Frontier Observatory for Research in Geothermal Energy (FORGE)	DE-FOA-0000890	US DOE	Phase 1: 2M; Phase 2A: 2M; Phase 2B: 17M; Phase 2C: 10M
93	Alternative Fuel Vehicle Deployment Initiatives	DE-FOA-0000951	US DOE	4.5M
94	Strategies to Increase Residential Energy Code Compliance Rates and Measure Results	DE-FOA-0000953	US DOE	$6M
95	Wind Forecasting Improvement Project in Complex Terrain	DE-FOA-0000984	US DOE	$2.5M
96	Vehicles Technologies Program Wide	DE-FOA-0000991	US DOE	$51.4M
97	FY 2014 Continuation of Solicitation for the Office of Science Financial Assistance Program	DE-FOA-0000995	US DOE	$400M
98	Renewable Carbon Fibers	DE-FOA-0000996	US DOE	12M
99	Open Innovative Development in Energy Related Applied Science (Open Ideas)	DE-FOA-0001002	US DOE	$10 M
100	Exploratory Research for Extreme-Scale Science	DE-FOA-0001003	US DOE	$2M
101	Reliable Electricity Based on Electrochemical Systems (REBELS)	DE-FOA-0001026	US DOE	$30 M
102	Stewardship Science Academic Alliances	DE-FOA-0001067	US DOE	27M
103	Solar Market Pathways	DE-FOA-0001071	US DOE	15M
104	Environmentally-Prudent Unconventional Resource Development	DE-FOA-0001076	US DOE	25-35 M
105	NOTICE OF INTENT (NOI): To Issue a Restricted Eligibility Funding Opportunity Announcement for Collaborative Grid Testing, Research and Valuation and Testing of Advanced Energy Storage Systems	DE-FOA-0001078	US DOE	Not specified
106	Biological and Chemical Upgrading for Advanced Biofuels and Products	DE-FOA-0001085	US DOE	10M
107	Novel Crosscutting Research and Development to Support Advanced Energy Systems	DE-FOA-0001095	US DOE	15M
108	Marine and Hydrokinetic (MHK) Research and Development University Consortium	DE-FOA-0001098	US DOE	4M
109	Research, Development and Training in Isotope Production	DE-FOA-0001099	US DOE	2.6M

110	Advanced Turbine Components for Combined Cycle and Supercritical CO2 Based Power Cycle Applications	DE-FOA-0001107	US DOE	7M
111	Opportunities, Knowledge Advancements, and Technology Improvements for Increased Carbon Dioxide (CO2) Storage in Enhanced Oil Recovery (EOR) Operations	DE-FOA-0001110	US DOE	$8M
112	Promoting Domestic And International Consensus on Fossil Energy Technologies	DE-FOA-0001111	US DOE	$9M
113	Delivery Efficient Local Thermal Amenities (DELTA)	DE-FOA-0001127	US DOE	$30 M
114	METHANE OBSERVATION NETWORKS WITH INNOVATIVE TECHNOLOGY TO OBTAIN REDUCTIONS (MONITOR)	DE-FOA-0001128	US DOE	$30 M
115	Atmospheric System Research: New Site Science Opportunities in the Eastern North Atlantic and North Slope of Alaska	DE-FOA-0001139	US DOE	$1 M
116	RFI Acceleration of Distributed Generation from Wind Energy Systems	DE-FOA-0001155	US DOE	Not specified
117	Collaborative Research in Magnetic Fusion Energy Sciences on Long-Pulse International Stellarator Facilities	DE-FOA-0001156	US DOE	500K
118	Request for Information (RFI): Specific Clean Energy Manufacturing Focus Areas Suitable for a Manufacturing Innovation Institute	DE-FOA-0001158	US DOE	Not specified
119	Advanced Reactor Research and Development	DE-FOA-0001163	US DOE	12M
120	SBIR Small Business Technology Transfer FY 2015 Phase I Release 1	DE-FOA-0001164	US DOE	27M
121	Notice of Intent to Issue FOA: DE-FOA-0001162, entitled "Targeted Algal Biofuels and Bioproducts (TABB)"	DE-FOA-0001177	US DOE	Not specified
122	NOI Building Energy Efficiency Frontiers and Innovations (BENEFIT) 2015	DE-FOA-0001180	US DOE	Not specified
123	Notice of Intent to Issue Funding Opportunity Announcement DE-FOA-0001167 Buildings University Innovators and Leaders Development (BUILD) - 2015	DE-FOA-0001191	US DOE	Not specified
124	Novel In Situ Imaging And Measurement Technologies For Biological Systems Science	DE-FOA-0001192	US DOE	5 M

125	Mickey Leland 2014 Internship Program	N/A	US DOE	Not specified
126	Science Undergraduate Laboratory Internships (SULI)	N/A	US DOE	Not specified
127	Announcement of Teaming Partner List for Upcoming Funding Opportunity Announcement: Reliable Electricity Based on Electrochemical Systems (REBELS)	RFI-0000006	US DOE	Not specified
128	Announcement of Teaming Partner List for For Upcoming Funding Opportunity Announcement for: Local Thermal Management Systems To Reduce Building Energy Consumption	RFI-0000007	US DOE	Not specified
129	Announcement of Teaming Partner List for Upcoming Funding Opportunity Announcement: Methane Observation Networks with Innovative Technology to Obtain Reductions (MONITOR)	RFI-0000008	US DOE	Not specified
130	Funding for Faculty-led Student Teams at U.S. Universities (AY 14/15)	N/A	US DOE and LBNL	$25K
131	Scientific Discovery through Advanced Computing(SciDAC): Multiscale Integrated Modeling for Fusion Energy Science	DE-FOA-0001096	US DOE Office of Science	1.25M
132	U.S. Nuclear Regulatory Commission Funding Opportunity Announcement, Research Conference Grant and Cooperative Agreement Program, Fiscal Year 2014	NRC-HQ-60-14-FOA-0001	US Nuclear Regulatory Commission	Not specified
133	U.S. Nuclear Regulatory Commission Funding Opportunity Announcement, Research Conference Grant and Cooperative Agreement Program, Fiscal Year 2014	NRC-HQ-60-14-FOA-0002	US Nuclear Regulatory Commission	Not specified
134	Agriculture and Food Research Initiative Competitive Grants Program	AFRI 2014 RFA	USDA	$3M
135	Biodiesel Fuel Education Program	USDA/NIFA	USDA	960K
136	Higher Education Challenge Grants Program	USDA-NIFA-CGP-004425	USDA	4.77M
137	Small Business Innovation Research Program - Phase I	USDA-NIFA-SBIR-004553	USDA	$18.3M
138	Obama-Singh 21ST Century Knowledge Initiative (OSI)	N/A	USIEF	$190K

APPENDIX D – PROJECT PROGRESS/FINAL REPORTS

NSF Solar Energy Pathways

PI: Mark Jamison, Public Utility Research Center, University of Florida

Partners: Richard Boampong, Deniz Kazanci, Amanda Phalin, Michelle Phillips
Project Time Period: 2013-2018

Summary
Research regarding economic issues and incentives involved with Solar PV.

Goals and Objectives
The research is addressing three key questions.

1. What is being done to implement thin film solar technologies in developing countries, what problems are being encountered, and how are the problems being overcome?
2. What are the successful applications of thin film solar technologies in developing countries?
3. What are the key product features, economic characteristics, supply chain needs, and support systems for successful implementation of earth abundant kesterite-based, thin film PV materials?

Project Activities, Results and Accomplishments (This is the main body of report and may use other headings such as Research Description, Results, etc. – author's choice. Items that should be included are accomplishments, benefits to the state and how funds were leveraged.

Post-doc Amanda Phalin and graduate student Richard Boampong identified the target countries, namely India, Kenya, and South Africa, but gathered information on other countries as well. The specific research questions include:

- What do thin film solar programs look like in these countries? What is the government implementing? What is the private sector producing and selling?
- What problems have adopters in these countries (e.g., customers, businesses, governments, and utilities) had/overcome in implementing thin film solar technologies/programs (e.g., were there certain products that were not adaptable and why?)?
- What were the keys for the successful products (e.g., price points and price design, physical characteristics of products, distribution channels)?
- How successful are/were thin film products in competing against existing PV, retail electricity, consumer fuels (e.g., kerosene), and the choice of no electricity?
- What is the thin-film technology used for (e.g., electricity generation vs. solar heating for cooking)?
- Do the thin-film products tend to be on- or off-grid?
- What support systems have to be in place (e.g., maintenance and repair, consumer education, and financing)?
- What type of government restrictions or support matter?

Over 100 papers, reports, and articles from academic journals, researchers, NGOs, governments, and inter-governmental organizations have been identified and reviewed. The markets for renewable energy in our target countries look similar and can be divided into two main broad categories:

On-grid renewable energy projects and Off-grid projects. On-grid renewable energy projects allow investors to supply energy to the already existing grid to supplement the under-capacity installed supply of energy and to improve on the unreliability of energy supply. It is normally implemented in urban and peri-urban areas where there is a power infrastructure in place already. Off grid system comprises all the other renewable energy projects using stand-alone generators, residential home system for homes or small renewable energy units such as small solar lanterns and cooking stoves. While in some countries these different categories of off-grid systems can further be categorized into three main segments, there are no clear distinction between these categories in other countries and the same government regulation is used for all off-grid projects. For the purpose of this project, we categorize the different off-grid renewable energy systems as separate and

distinguishable so that the market for renewable energy in our target countries or in developing countries as a whole can be grouped into the following five broad segments:

1. On-grid renewable energy projects: Products for utility-scale and customer-scale applications where the power generated is sold to others, including to the utility.
2. Small Off-grid Systems: Products primarily for residential solar home systems, especially in rural areas, and for small-scale commercial photovoltaic (PV) applications, such as kiosk lighting and mobile phone charging.
3. Large Off-grid Systems: Products providing power for larger institutions, such as schools, health centers, and missions in rural areas and for water pumping. These products are mainly solar PV.
4. Solar Powered Base Stations: Products primarily for powering mobile phone and broadcasting base stations, for and tourism establishments.
5. Small Units: Products that power specific small applications, such as solar lanterns and solar cooking stoves.

Detailed country case studies are being developed for each category.
Junior Economist Michelle Phillips is looking at the regulatory environment in Brazil and institutional features that are relevant for PV adoption.
Benefits to the state include having a better idea of what other cities and countries are doing to incentivize solar PV use, and a better understanding of the complexities of PV adoption/incentives.

Simulation and Measurement of Biomass Suspension Rheology

PI: Jennifer Sinclair Curtis, Chemical Engineering, University of Florida
Project Period: 8/2014-7/2016

Summary: Biomass is a promising source of renewable energy. Although this form of energy production holds much potential to reduce energy dependence on petroleum-based fuel consumption, ***one key challenge in the large-scale commercialization of these systems is the physical handling of biomass suspensions.*** These suspensions span a wide spectrum of solids concentrations and particle size during the various biomass processing steps. ***Fibrous suspensions are also being used increasingly in petroleum exploration applications.*** Fibers have been used since at least the 1960's in petroleum exploration as an additive to well cement to increase its strength. Fibers increasingly are added to drilling muds to alter the rheology in an effort to improve performance of the fluid for the purpose of carrying rock cuttings from the drill bit to the surface. More recently, industry has been using fibrous suspensions to solve critical problems with regard to hydrofracturing.

A combined program of simulation and experimentation is utilized to investigate the dynamics and rheology of fibrous suspensions of biomass. In order to reliably design and optimally operate biomass processes, the rheological behavior of these complex fluids over a range of solids concentrations and particle size must be understood. On the simulation side, the discrete element method, capable of calculating stresses and effective viscosity of biomass over a wide span of moisture content (using a liquid bridging model) and particle sizes, is developed. The rheology of well-characterized fibrous suspensions (wheat straw and corn stover) will be fully evaluated and compared with the simulation results. The shear rheology will be measured using a vaned geometry. Successful completion of the proposed work will provide insights into the rheological behavior of fiber-filled suspensions that will aid the design and optimal operation of processes in renewable energy.

Goals and Objectives: The goal/objective of this project is to predict the flow behavior of biomass over a range of particle aspect ratios and solids concentration.

Project Activities, Results and Accomplishments: Shear flows of dry, flexible fibers were numerically modeled using the Discrete Element Method (DEM) and the effects of fiber properties on the flow behavior and solid-phase stresses were explored. In the DEM simulations, a fiber is formed by connecting a number of spheres in a straight line using deformable and elastic bonds. The forces and moments induced by the bond deformation resist the relative normal, tangential, bending, and torsional movements between two bonded spheres. The bond or deforming stiffness determines the flexibility of the fibers and the bond damping accounts for the energy dissipation in the fibers' vibration. The simulation results show that elastically-bonded fibers have smaller effective coefficients of restitution than rigidly connected fibers. Thus, smaller solid-phase stresses are obtained for flexible fibers, particularly with bond damping, compared to rigid fibers. Frictionless fibers tend to align in the flow direction with minimal deformation as the solid volume fraction increases. However, jamming, with a corresponding sharp stress increase, large fiber deformation, and a dense contact force network, occurs for fibers with friction at high solid volume fractions. It is also found that jamming is more prevalent in dense flows with larger fiber friction coefficient, rougher surface, larger stiffness, and larger aspect ratio.

Concluding Remarks: We have developed a DEM model for flexible fibers and tested in it 3-D periodic shear flow. In the next reporting period, we will validate this model with shear cell experimentation and angle of repose testing on biomass material (wheat straw).

Publications: Y. Guo, C. Wassgren, B. Hancock, W. Ketterhagen, and J. Curtis,, "Computational study of granular shear flows of dry, flexible fibers using the discrete element method", Submitted to *Journal of Fluid Mechanics*, 2014

Unifying Home Asset & Operational Ratings: Adaptive Management via Open Data & Participation

PI: Mark Hostetler (Associate Professor, UF Department of Wildlife Ecology & Conservation)
Co-PI: Hal S. Knowles, III (Change Agent, UF Program for Resource Efficient Communities)

Supported Student(s): Hal S. Knowles, III (Ph.D. Candidate, UF School of Natural Resources & Environment)

External Collaborators: Nick Taylor (Ph.D. Student, UF School of Natural Resources & Environment), Jennison Kipp (Assistant In, UF Program for Resource Efficient Communities)

Description/Abstract: Recent environmental, social, and economic challenges are fostering a wave of interest in maximizing energy efficiency and conservation (EE+C) in existing U.S. homes. Long standing programs, ratings, and metrics are being reapplied into new stimulus initiatives such as the *Recovery through Retrofit*[4] program. Simultaneously, electric and gas utilities are expanding their demand side management (DSM) programs from weatherization and conventional technology replacement incentives to include conservation behavior campaigns with "recommendation algorithms" designed to assist in homeowner energy retrofit decision making. Furthermore, loan programs are emerging to address the financial barriers that commonly limit initiation of the necessary retrofits.

Collectively, these approaches most often project future home energy performance based on engineering models of the physical characteristics of homes (i.e., "asset ratings"). Yet to date, the marketplace is inadequately integrating historical household energy consumption patterns (i.e., "operational ratings") into the decision tree to optimize retrofit program efficacy and consumer benefits. Moving toward the unification of asset and operational ratings is crucial for successful program management, proper monitoring/measurement/verification (MMV), loan risk assessment, and for the persistence of reduced home energy use over time. However, unification will not be easy. This research project combines qualitative and quantitative research methods in social science and building science using Florida case studies to evaluate the opportunities and constraints of asset and operational rating unification and the steps necessary to get there. Relationships between our project and the collaborative, transparent, and participatory nature of "open government" initiatives are also being explored.

The secondary supplemental research will expand on themes and insights gained through the first phase of this existing FESC project. Specifically, these insights suggest that even when adding operational data to building asset data, the reductionist approach to evaluating home energy performance by controlling for known variables may continue to offer an incomplete picture of the complexities of performance trends and the influence of unknown and/or misunderstood variables. Furthermore, the home improvement industry may need to consider the possibility that the magnitude of total energy consumption, while a worthwhile metric and with its net reduction a worthwhile goal, is also an incomplete indicator of home energy performance optimization.

Summary of Progress Since April 2014

Phase one exploratory analysis of utility electricity consumption data at 15-minute intervals has begun for three years (FY2012, FY2013, FY2014) from a random sample of 450 residential customers within the JEA service territory. Evaluation of multiple methods was undertaken. Three probability distribution functions (HistPDF, MultiPDF, and RankCDF) suggested that these time series display power law scaling and may benefit from further nonlinear analysis (Figures 1-3). Rescaled range (R/S) analysis suggested that these time

[4] See, http://www.whitehouse.gov/assets/documents/Recovery_Through_Retrofit_Final_Report.pdf

series display a complex pattern with a Hurst exponent ≥ 0.5 and ≤ 1.0 and may benefit form more in-depth fractal analysis (Figure 4).

Based on preliminary outputs from two variations of a detrended fluctuation analysis run within MATLAB, both residential electricity consumption time series and temperature time series appear to follow a multifractal pattern with the dynamics of variables changing at discrete time scales. At the 1-day to 16-day scales (MFDFA1), the multifractal patterns of the original time series are evidenced by multifractal spectra (Figures 5, 7, and 9) with widths and modes larger than those of pure white noise common to the randomly ordered time series (Figures 6, 8, and 10). At the 4-hour to 24-hour scales (MFDFA2), similar multifractal spectra characteristics in widths and modes appear in both the original (Figures 11 and 13) and the randomly ordered (Figures 12 and 14) time series.

While multiple analytical inputs have been tested (i.e., various minimum and maximum scale thresholds and various polynomial trend order "m" values), further exploratory analysis is necessary to find the optimal balance of time series smoothing without introducing problematic artifacts from overfitting. For example, in the temperature time series, a polynomial trend order of m=6 (Figures 7 and 8) provides a cleaner, smoother, and potentially more meaningful, multifractal spectrum than an m=2 (Figures 9 and 10). Literature in this field of analysis suggests polynomial trend orders of 1, 2, or 3 are most common. However, the minimum scale (i.e., the smallest number of time series readings) analyzed is often considerably smaller (e.g., 16 readings) than the minimum scale in our MFDFA1 analysis (e.g., 96 readings). We believe our larger minimum scale may allow for a higher order polynomial trend fitting.

These initial findings suggest that the actual trend of utility electricity smart meter readings over time provides valuable feedback about the performance of each home as a system beyond mere cumulative energy consumed. Once the optimal multifractal detrended fluctuation analysis inputs and methods are identified, we will generate a methodology manuscript describing the various approaches evaluated and summarizing the distribution of multifractal spectra as correlated to cumulative energy consumed. A second manuscript will evaluate correlations between residential electricity consumption patterns, building asset characteristics (e.g., size, year built, number of beds, number of baths) and key weather patterns.

HistPDF, MultiPDF, and RankCDF

Fractal Analysis in the Social Sciences by Clifford T. Brown and Larry S. Liebovitch
http://www.ccs.fau.edu/~liebovitch/matlab.html

Figure 1. Example Signal (JEA FY2012/13) – HistPDF (Exponential Trend)

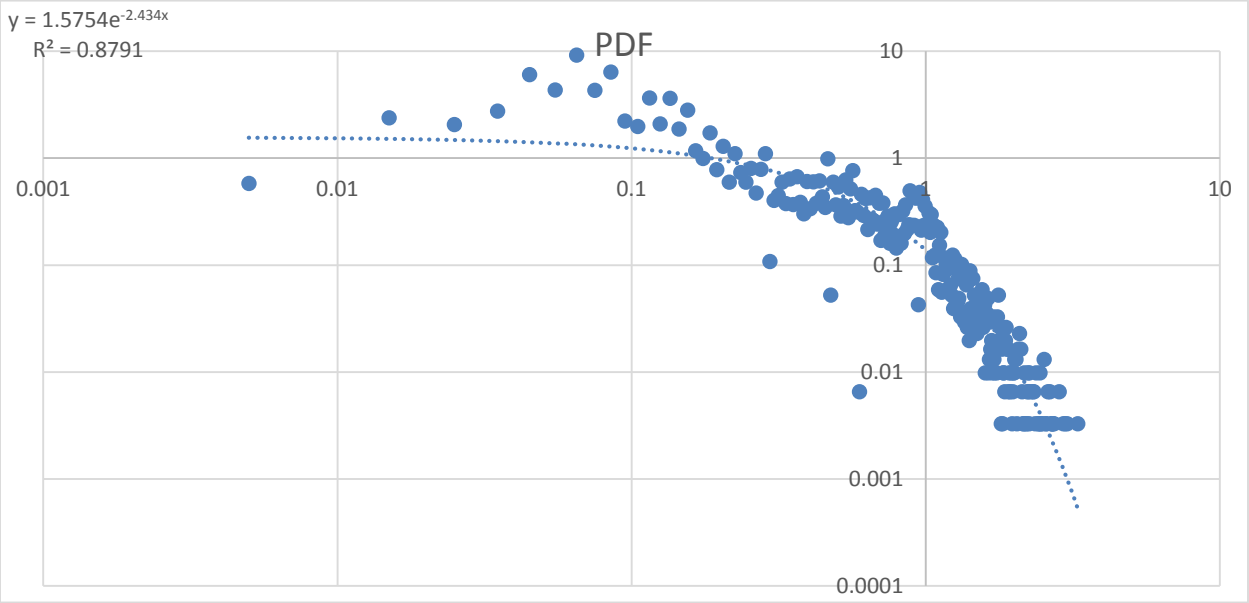


Figure 2. Example Signal (JEA FY2012/13) – MultiPDF (Exponential Trend)

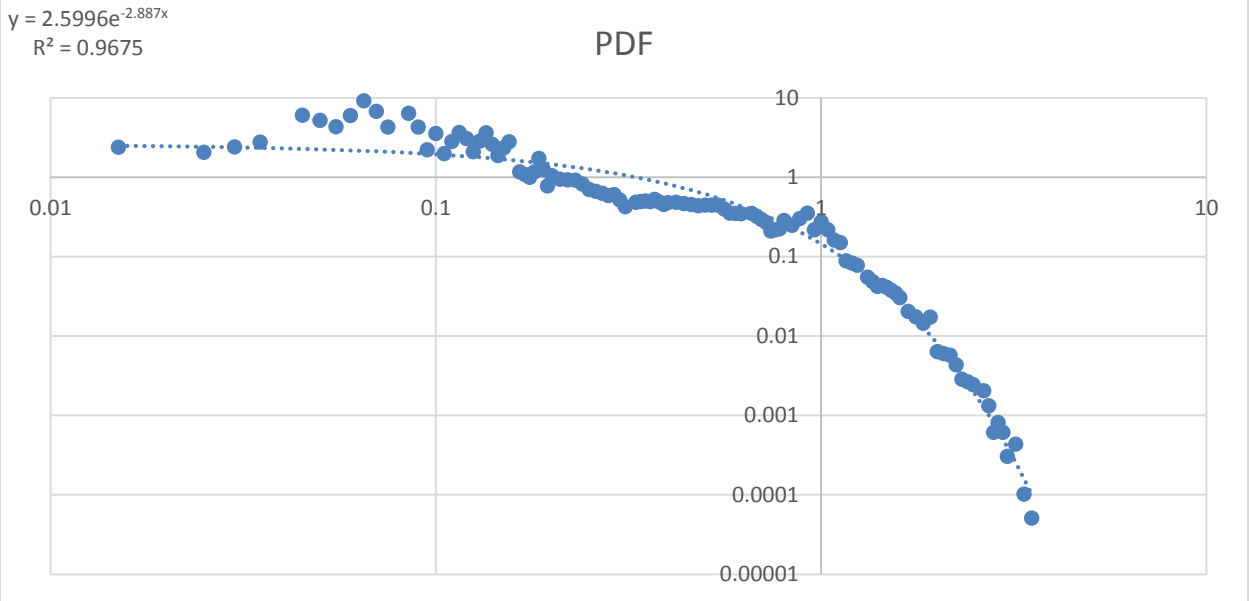
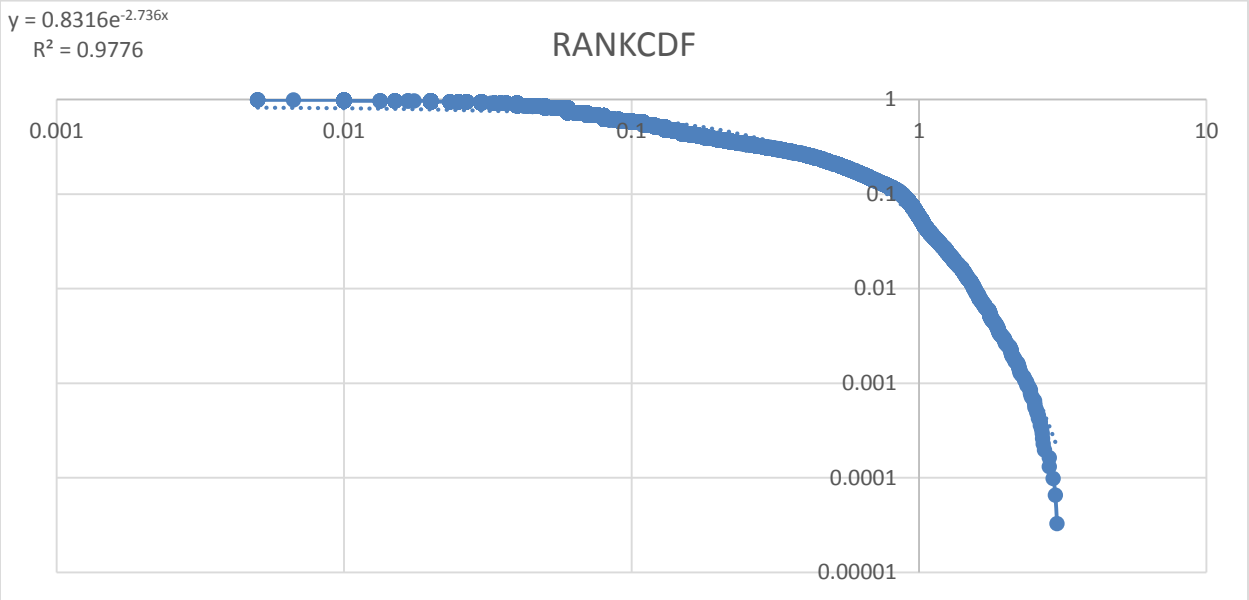


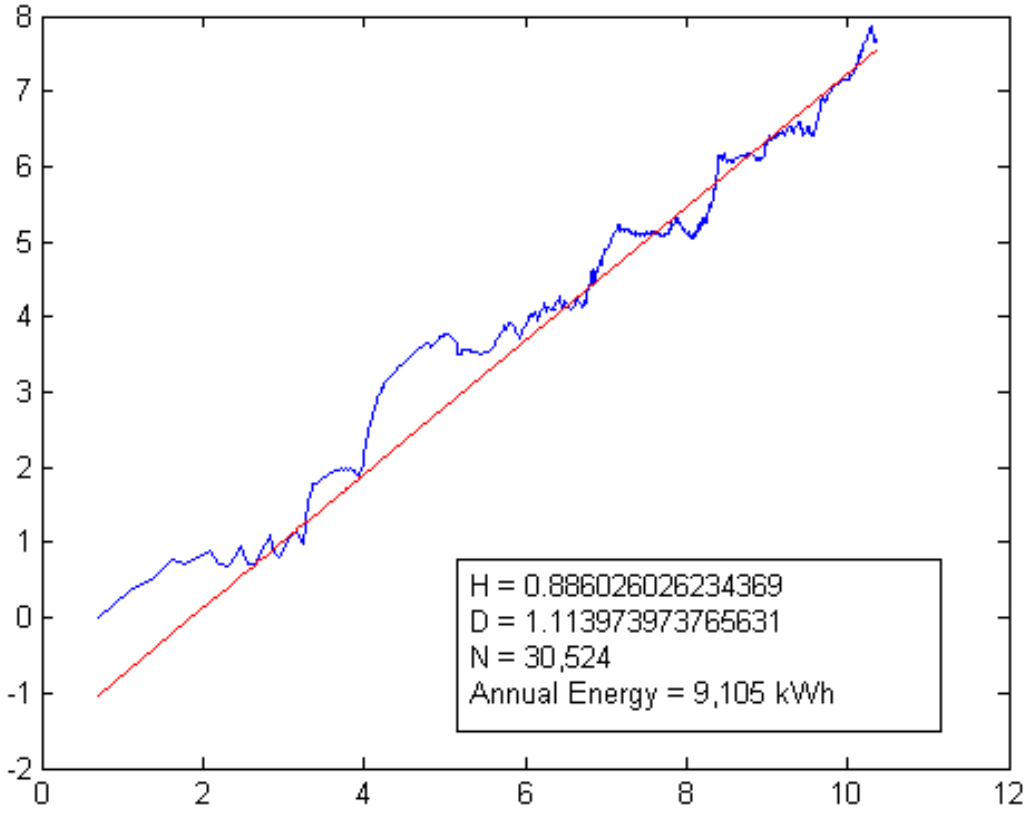
Figure 3. Example Signal (JEA FY2012/13) – RankCDF (Exponential Trend)



Rescaled Range (R/S) Analysis to Estimate Hurst Exponent

Hurst Exponent Estimation
by Vilen Abramov
http://www.mathworks.com/matlabcentral/fileexchange/39069-hurst-exponent-estimation

Figure 4. Example Signal (JEA FY2012/13) – Hurst Exponent (H) and Fractal Dimension (D)



Multifractal detrended fluctuation analysis

Introduction to multifractal detrended fluctuation analysis in Matlab
By Espne Ihlen
http://journal.frontiersin.org/Journal/10.3389/fphys.2012.00141/abstract
http://www.mathworks.com/matlabcentral/fileexchange/38262-multifractal-detrended-fluctuation-analyses

MFDFA1 (for scales from 1 day to 16 days)

Figure 5. Example Signal (JEA FY2012/13) – Original Time Series Order (m=2)

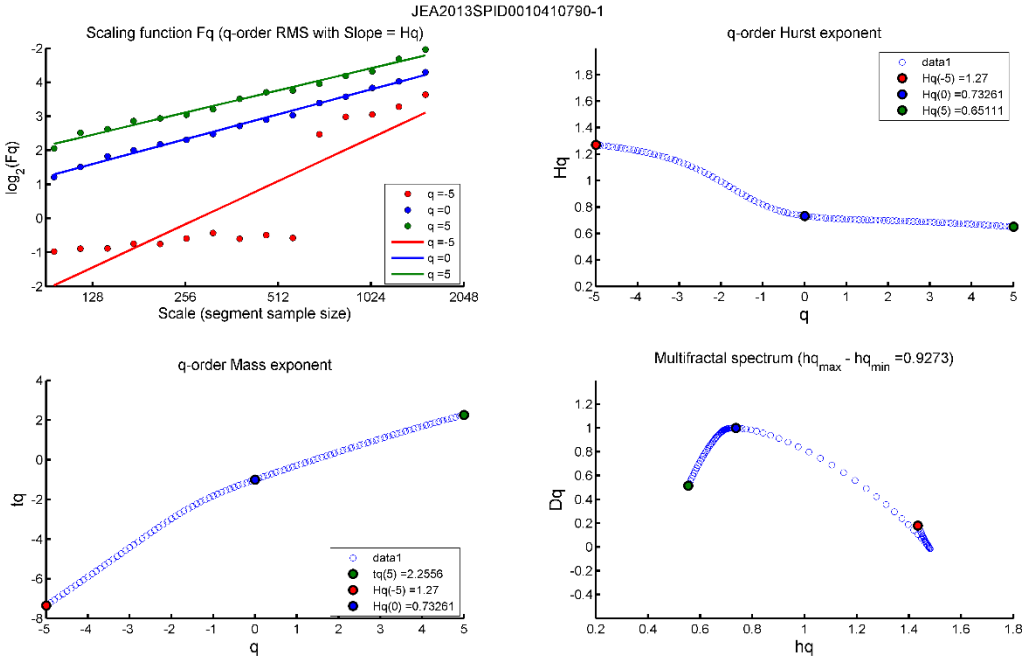


Figure 6. Example Signal (JEA FY2012/13) – Randomized Time Series Order (m=2)

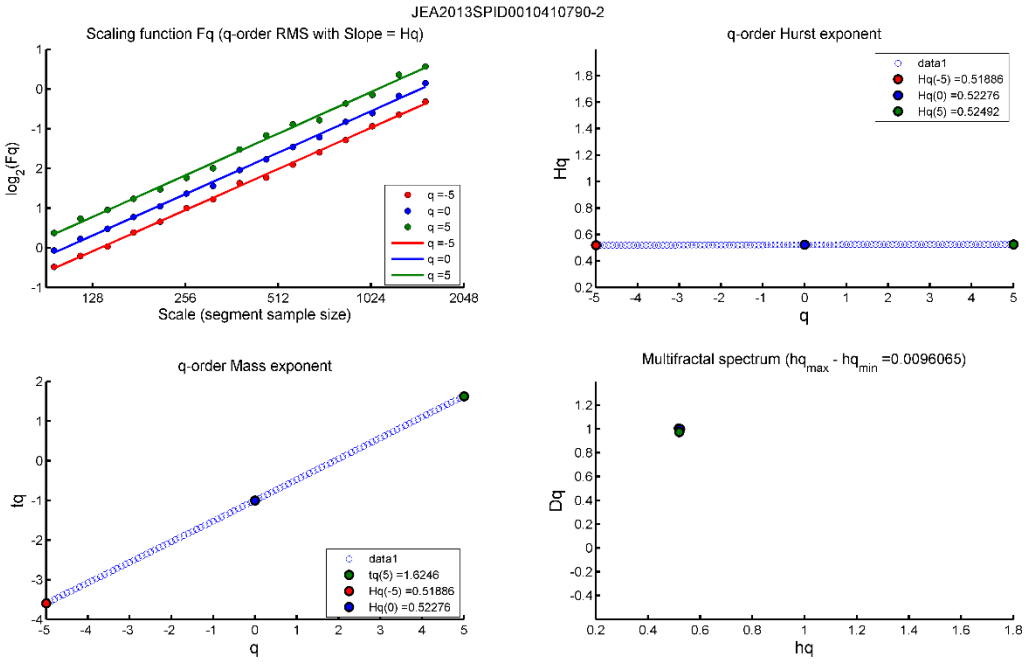


Figure 7. Temperature Signal (FAWN Station 180 CY2012) – Original Time Series Order (m=2)

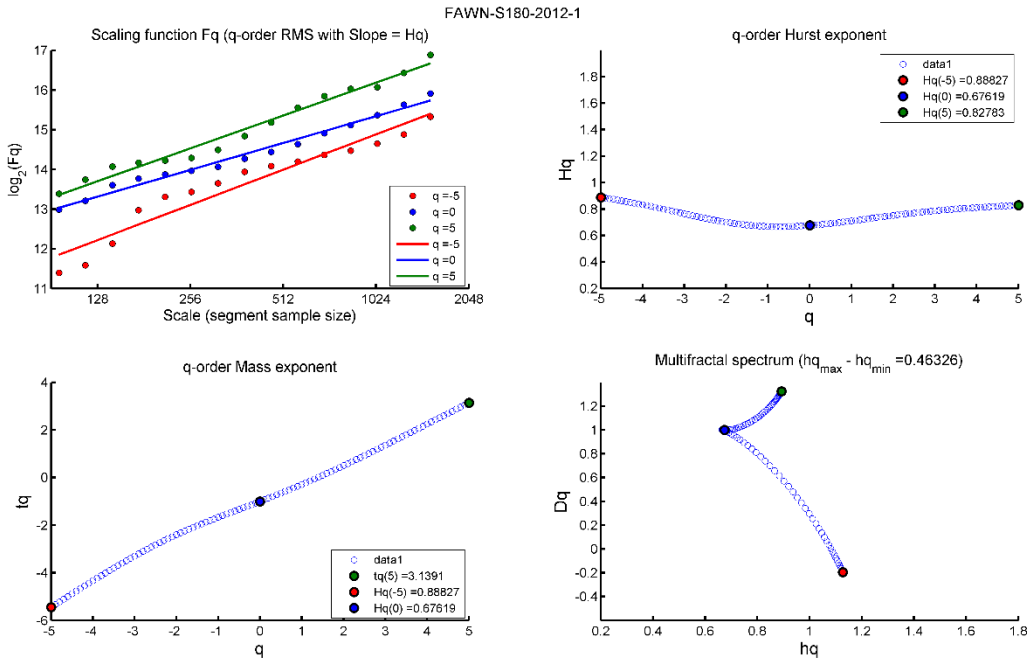


Figure 8. Temperature Signal (FAWN Station 180 CY2012) – Randomized Time Series Order (m=2)

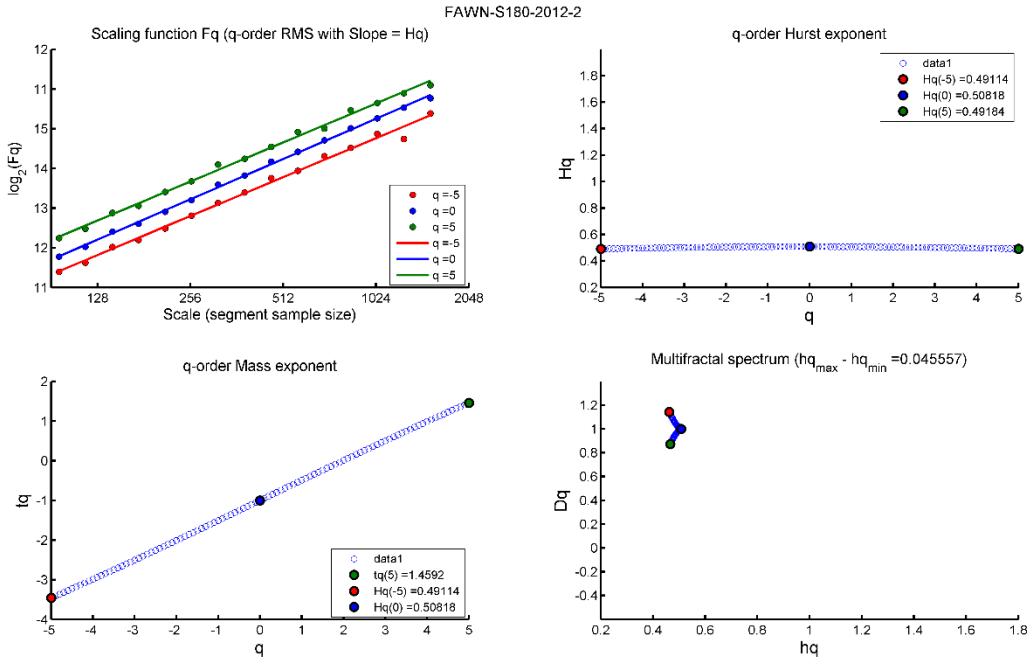


Figure 9. Temperature Signal (FAWN Station 180 CY2012) – Original Time Series Order (m=6)

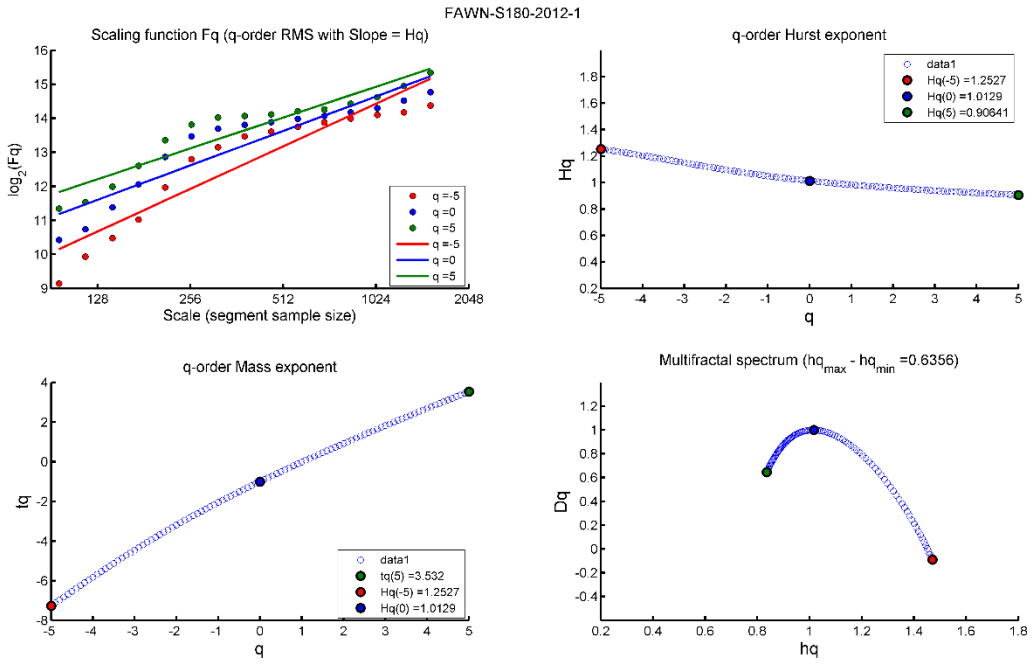
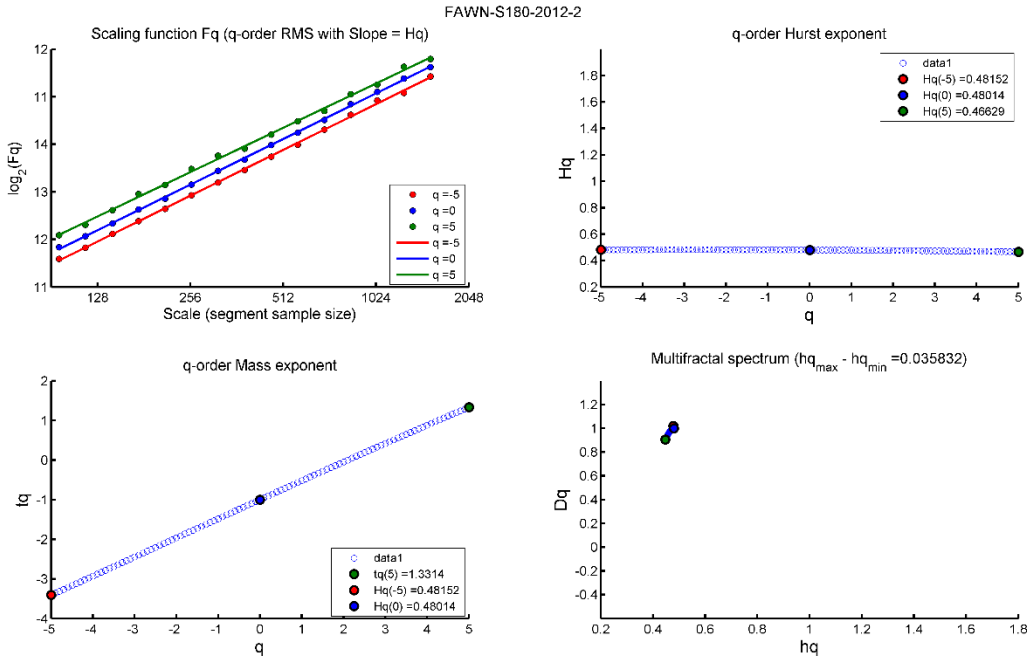


Figure 10. Temperature Signal (FAWN Station 180 CY2012) – Randomized Time Series Order (m=6)



MFDFA2 (for scales from 4 hours to 24 hours)

Figure 11. Example Signal (JEA FY2012/13) – Original Time Series Order (m=2)

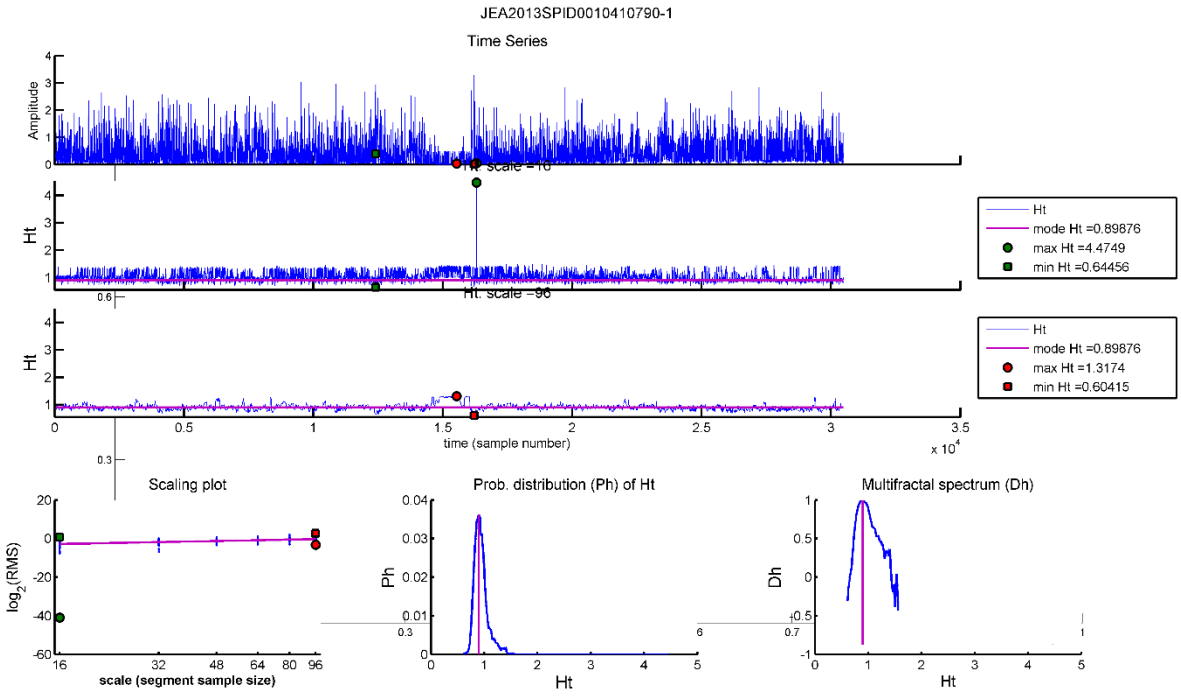


Figure 12. Example Signal (JEA FY2012/13) – Randomized Time Series Order (m=2)

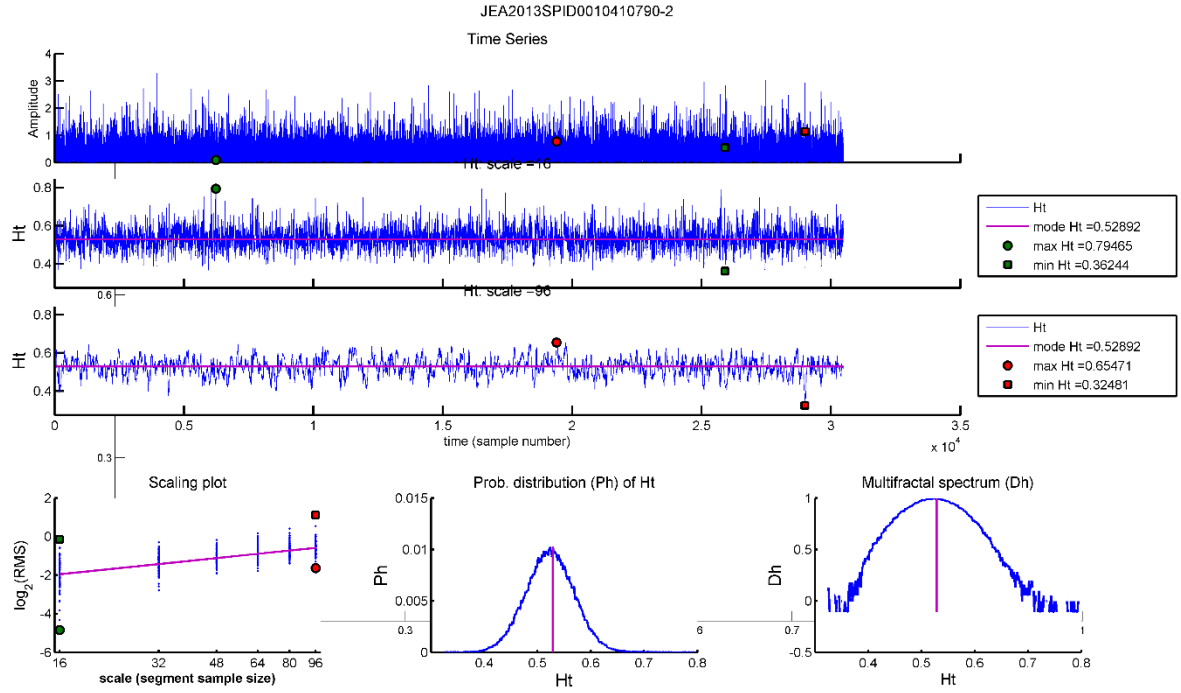


Figure 13. Weather Signal (FAWN Station 180 CY2012) – Original Time Series Order (m=2)

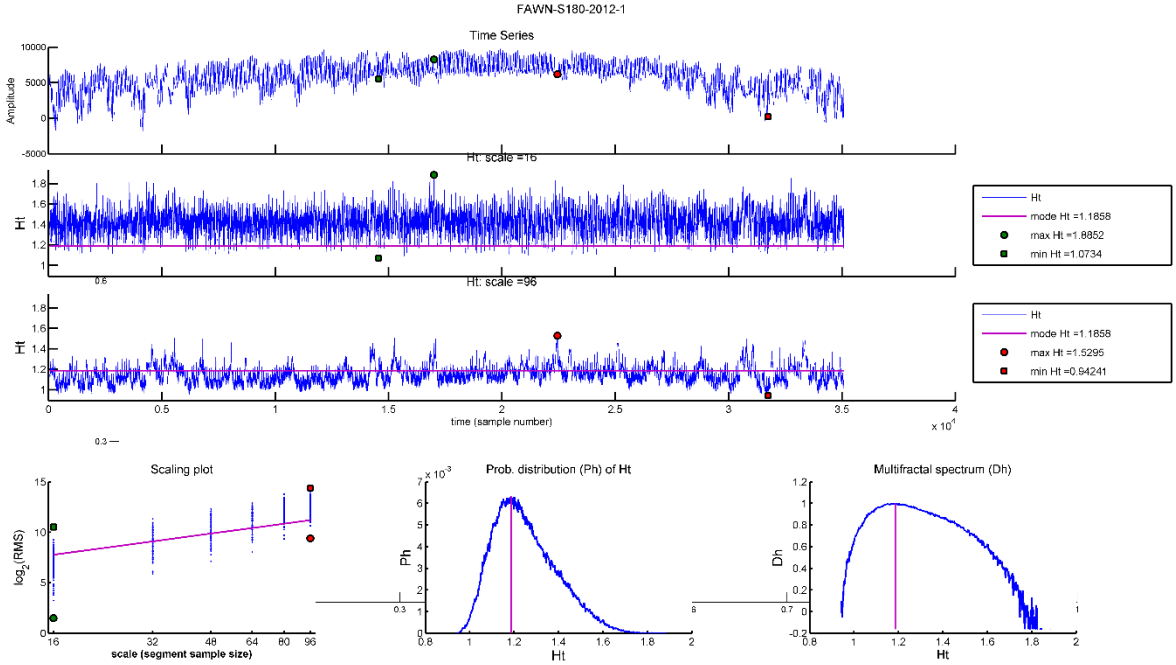
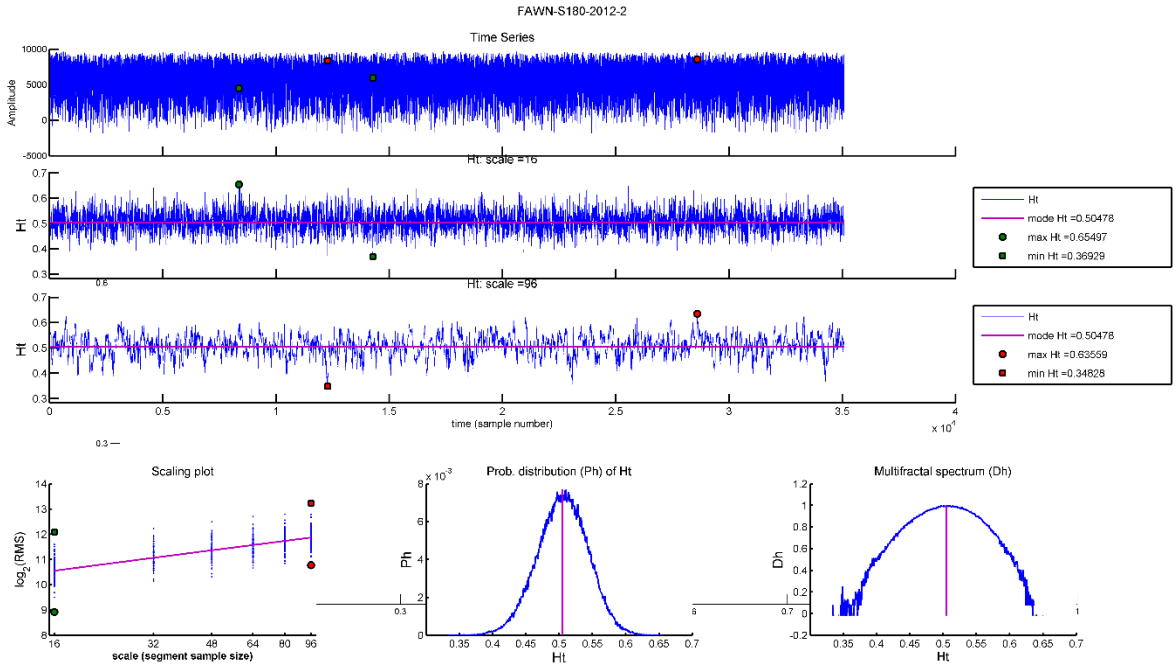


Figure 14. Weather Signal (FAWN Station 180 CY2012) – Randomized Time Series Order (m=2)



Southeast National Marine Renewable Energy Center (SNMREC)

Florida Atlantic University

PI: Susan H. Skemp, **Co-PIs:** Howard P. Hanson, Taghi Khoshgoftaar, Pierre-Phillippe Beaujean, Len Berry, Megan Davis, Jeanette Wyneken, Manhar Dhanak, Eric Chassignet, John Reed, Charles Messing, James VanZwieten, Karl vonEllenrieder, Julie Lambert, Hassan Mahfuz, Stewart Glegg, George Frisk, Bassem Alhalabi, Hari Kalva, Steve Kajura, Madasamy Arockiasamy, Francisco Presuel-Moreno, Isaac Elishakoff, Fraser Dahlgleish, Anni Dahlgleish, Bing Ouyang, Jose Principe

Note: Student listing is appended

Budget: $8,750,000; Funding **Leveraged:** U.S. Department of Energy, National Science Foundation and Industry - $6,281M

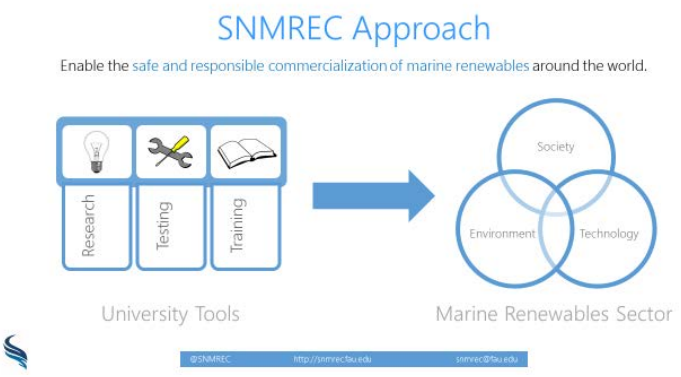
Universities: Florida Atlantic University, collaborating with the University of Central Florida, Florida State University, University of South Florida, Embry-Riddle Aeronautical University, University of Miami, Oregon State University, University of Washington, Pennsylvania State University, University of New Hampshire, University of Hawaii, University of Edinburgh, Heriot-Watt University, Nova Southeastern University, Virginia Polytechnic Institute and State University, and Florida Institute of Technology, North Carolina Coastal Studies Institute, Clemson University, Georgia Institute of Technology, University of the Azores, and Stellenbosch University.

External Collaborators: Numerous industry partners, state and federal government agencies, FFRDCs such as the National Renewable Energy Laboratory, Oak Ridge National Laboratory, Woods Hole Oceanographic Institution, U.S. Department of Energy (Office of Energy Efficiency and Renewable Energy), U.S. Department of Interior (Bureau of Ocean Energy Management, Regulation, and Enforcement), U.S. Department of Commerce (National Oceanic and Atmospheric Administration), the Florida Fish and Wildlife Conservation Commission, and Florida Departments of Agriculture and Consumer Services, and Environmental Protection.

Marine Renewable Energy (MRE) is the availability of energy in ocean currents, waves, tides, and thermal gradients. Tapping MRE resources will reduce our reliance on fossil fuels and help Florida along the road to energy self-sufficiency, energy security, and prosperity. Research areas of focus include improving understanding of ocean current and thermal-gradient resources, implementing testing capabilities to expedite commercial development of these resources, and understanding potential environmental impacts and how to mitigate them.

Summary:

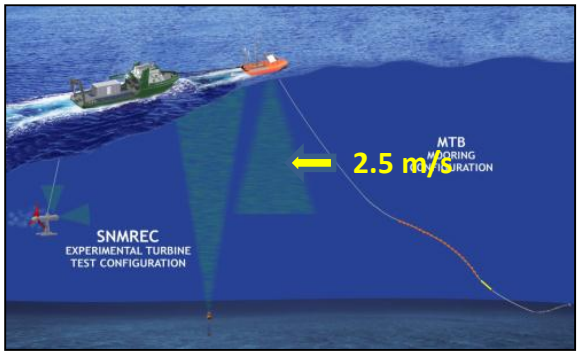
The Southeast National Marine Renewable Energy Center (SNMREC) at Florida Atlantic University (FAU) was designated as such through an award from the U.S. Department of Energy (DOE) in 2010 as an extension of FAU's Center for Ocean Energy Technology, which was originally founded in 2007 by the 2006 Florida State University System Center of Excellence Program. The SNMREC is investigating harnessing power from ocean currents, such as the Gulf Stream, as well as ocean thermal energy conversion to generate base-load



electricity. This baseload, sustainable resource will make a unique contribution to a broadly diversified portfolio of renewable energy for the nation's future. Key drivers for investigation are determined by the regulatory process at State and Federal levels and by market and technology gaps needed to commercialize MRE. The SNMREC's role is to bridge the gap between concept and commercial deployment of ocean energy technologies by providing at-sea testing facilities and technology development for both ocean current and thermal energy systems. Research areas span environmental, resource, economic, educational, and technology topics.

Goals and Objectives:

The Southeast National Marine Renewable Energy Center is developing a small-scale open-ocean energy laboratory and test capability to advance research on marine and hydrokinetic (MHK) ocean current energy and thermal potential energy. The SNMREC is moving forward with strategically selected research, developing and testing key technology, infrastructure and systems as well as standards criteria to meet this need. The collective objective of this project is to provide industry with tools and solutions in areas that have been identified as initial market accelerators.



Small-scale open-ocean test berth

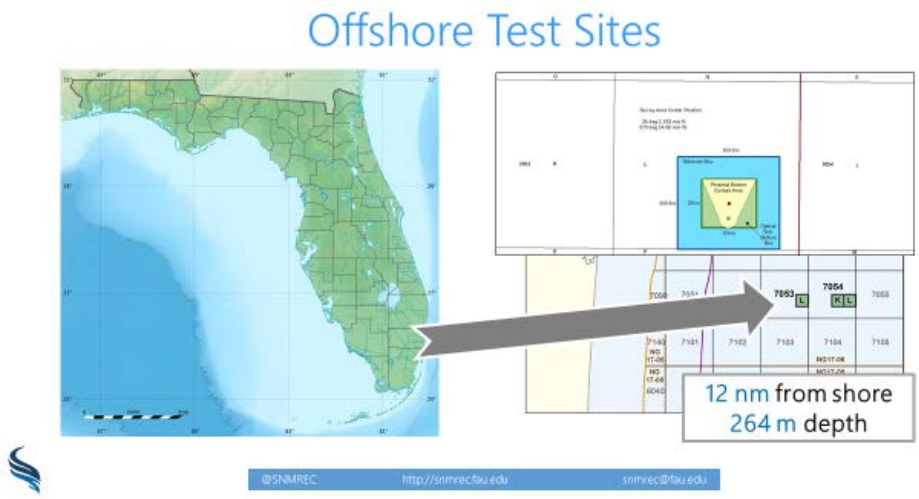
These areas are being addressed according to the U.S. Department of Energy's (DOE) Technology Readiness Level (TRL) scale, specifically, levels 3 (Analytical or experimental critical function proof of concept) through 5 (Laboratory scale validation in relevant environment). The expected outcomes include investigations and solutions for technical gaps in intelligent sensor systems, reliability and prognostics systems, rotor instrumentation and modeling, and composite materials applications for energy extraction devices and components. The first step towards achieving this goal is to install a non-grid connected TRL5/6 offshore test berth and demonstrate its readiness with an accompanying small-scale research and development ocean current turbine unit.

Project Activities, Results and Accomplishments:

The successful implementation of an in-water testing infrastructure for MHK off the coastline of Florida will be the first and only such capability globally. Already, companies from both the U.S. and internationally have expressed a desire to work with the SNMREC in defining not only their test requirements based on their design, but also are exploring both short term occupancy in Florida and potentially longer term manufacturing and grid connection in developing arrays for commercial enterprises.

An MHK lease application on the outer continental shelf (OCS) was submitted to the U.S. Department of Interior, Bureau of Ocean Energy Management (BOEM). This is the first national application which will form the model for future lease applications. BOEM released the Final Environmental Assessment (EA) with a Finding of No Significant Impact (FONSI) on 12 August 2013. The EA and FONSI can be found on the Department of Interior's website at http://www.boem.gov/Florida-Revised-EA-FONSI-August2013/. The Department of Environmental Protection, as the State of Florida's lead Coastal Zone Management Act agency, conducted a consistency determination review of the BOEM EA and FONSI. They notified the BOEM on 25 September 2013 that the issuance of a lease to SNMREC for hydrokinetic technology testing is consistent to the maximum extent practicable with the provisions of the Florida Coastal Management Program. In addition, the DOE NEPA office reviewed the EA and issued a FONSI on 13 November 2013.

Effective 1 June 2014, Florida Atlantic University was granted a 5-year Interim Policy (IP) Lease by the U.S. Department of Interior's Bureau of Ocean Energy Management (BOEM). This lease is the first lease in the U.S. for Marine Hydrokinetic (MHK) Energy activities on the Outer Continental Shelf (OCS), laying the groundwork for industry and other institutions seeking leases in the future. The lease area, that comprises approximately 1,068 acres, lies within Official Protraction Diagram Bahamas NG17 06, covers Block 7053, Aliquot L, and Block 7054, Aliquots K and L (See Figure inserted above). The initial annual lease payment of $3,204 was provided on 7 July 2014.



Under the BOEM lease, an offshore scaled device test berth (approximately 12 nm offshore of Ft. Lauderdale, FL) will be installed to accommodate up to 100kW max instantaneous power production and/or 7m rotor diameter turbine testing. This initial group of industrial devices will provide insight into individual device extraction methods, dynamics, and basic system operability. This project will address the immediate needs of the still immature ocean current energy conversion industry while building a foundation for a future large-scale and grid-connected offshore testing capacity.

Stipulations of the BOEM IP Lease address (I) Payments and (II) Environmental which falls into the following categories: 1) General Environmental, 2) Protection of Archaeological Resources, 3) Protection of Avian and Bat Resources, 4) Protection of Benthic Resources, and 5) Protected Marine Mammal, Sea Turtle and Fish Species. To address categories 2 – 5, Archeological Identification and Benthic Habitat Surveys will be conducted. It was determined that the survey results were required to be integrated into the Project Plan. Therefore, per the BOEM Lease, a Survey Plan was submitted to BOEM on September 9th and is in process of review by their Subject Matter Experts (SME). At the culmination of 30 calendar days, a meeting will be scheduled by BOEM with SNMREC to review their findings and provide their concurrence with the plan. In addition, the lease stipulates a Project Plan (PP) rather than a Construction Operations Plan (COP) is required. The initial draft has been outlined to describe project objectives and proposed activities based on input from the Department of the Interior. However, further work for this document is on hold pending results from surveys yet to be conducted.

A centralized, standardized testing capability will be provided for testing current energy conversion prototypes; initially, scaled versions and eventually full-scale devices. In addition, critical environmental measurements will be obtained on a continuous basis from the observational platform and submerged instrumentation. The test procedure/plan is laid out to incorporate monitoring and failure prediction systems, to gain experience in at-sea operations of this nature, and to support standards and protocol development. Companies from both the U.S. and internationally are working with the SNMREC in defining test requirements based on their design, as well as both short term occupancy in Florida and potentially longer term manufacturing and grid connection options in developing arrays for commercial enterprises.
SNMREC's research ocean current turbine (OCT) was tested at sea to evaluate its design stability and tow characteristics. This 3-meter rotor diameter, 20kW generically designed experimental research turbine (Figure 2) will provide a non-proprietary platform for component development at small scales. A "mock" tow

test (MTT) was conducted on December 11, 2013 offshore Fort Pierce, Florida, near FAU's Harbor Branch Oceanographic Institute (HBOI) campus. The OCT was equipped with a steel ballast weight to simulate the weight of the electrical generator, rather than putting at-risk electric and power equipment. Several monitoring systems were also evaluated, including three underwater video cameras to observe the rotor and attachment point, two acoustic current meters, and an inertial measurement unit (IMU) to measure turbine motion in six degrees of freedom. The SNMREC is also engaged in sensor and instrument acquisition, deployment, and analysis to more fully characterize offshore energy resources, and the benthic and pelagic environment.

During Mobilization at HBOI

At Sea After Successful Deployment

With the DOC van, line handling winches, and other auxiliary equipment, the OCT was towed by a chartered work vessel at various speeds, approximately 50 ft. below the sea surface, in two groups of tests. First, the rotor was fixed so that it would not spin. The purpose of this series of tests was to determine the stability of the turbine without a predominant lateral drag force induced by a rotor producing torque. Although the crew was prepared to affix a drogue chute to provide stability, the OCT behaved well and did not require intervention with a "bow" line attached to the "nose" of the OCT.

Because of the success of the first series of tests, a second was performed which allowed the rotor to spin freely (only affected by friction from seals and bearings, not motor resistances since one was not installed). At approximately 5.5 kts. (speed over water), seals were "bedded-in" and the rotor began to spin. The vessel and turbine tow speeds were then reduced in 0.5 kt. Increments to determine the minimum relative speed required to continue to turn the rotor. However, even with engines all-stop and the turbine at the surface, the rotor continued to spin freely. Therefore, the actual motor-less drive train cut-in speed is near zero knots.

Throughout all tests, tow line tension was measured and recorded, along with vessel speed and course, to obtain drag values for use in computer modeling optimization and verification. Overall, the OCT performed as predicted, and no major issues with stability or deck-handling/deployment were observed.

Final sea trials were successfully conducted of a mooring and telemetry buoy to ready it for at-sea deployment. Additional sub-sea surveys of installation sites will be conducted to identify deep water coral distribution and determine appropriate anchor areas.

Finally, as commercial prototypes and subsystems are brought to SNMREC for testing, all aspects of experiment set up, instrument calibration, data handling, and organizational checks/balances are expected to comply with international quality standards (ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*). The SNMREC is preparing its processes and organization to fully comply with this standard and achieve accreditation. The selected approach is recommended by Agilent Technologies (Huber, 2009) and involves the following steps towards accreditation:

1. Investigation Phase (where an organization defines its scope, gaps, tasks required to achieve accreditation, and estimated costs/ROI)
2. Management Decision
3. Implementation Phase (where an accreditation body is selected, documentation developed, training performed, internal audits and corrections performed, and pre-assessment conducted)
4. Accreditation Audit

One of the biggest unknowns in the operation of ocean current turbine (OCT) systems concerns the behavior of the generator sub-system as it experiences both variable loads and the torque differentials associated with changing currents acting on the rotor. In order to provide a capability to test generators and/or associated instrumentation under realistic conditions, the SNMREC has developed a computer-controlled dynamometer system, located at the FAU SeaTech facility in Dania Beach. This basic capability has been further enhanced with simulated oceanographic conditions to emulate rotor behavior on the test stand as it would occur in an actual ocean current. The 20 kW dynamometer has been fitted with the SNMREC's experimental research turbine power quality and health management systems, and has continued generating data for Prognostics and Health Monitoring (PHM) research. Preliminary work has been completed to emulate rotor behavior in wave conditions and from collected offshore measurements. A laboratory capability feasibility study for ocean current turbine testing was completed, and the results are available in an M.S. Thesis format.

In May 2013, four ADCPs were deployed in a modified diamond configuration to measure both latitude and longitudinal effects of variability in the current. Recovery of three ADCPs occurred in July 2014, with the 4th yet to be retrieved. An additional deployment of up to six buoys is planned for early December 2014.

Aerial survey areas offshore Ft. Lauderdale

Twenty-four months of cross-channel aerial surveys and over forty coastal surveys were completed to determine offshore turtle and marine mammal distribution and activity prior to install/test of MHK devices. Because preliminary data suggests significant population activity near shore, these transects will provide higher resolution data to support analysis efforts. The research team is working with the National Oceanic and Atmospheric Administration's, National Marine Fisheries Service to evaluate the SNMREC's enhanced approach as an expansion of currently accepted methods. The survey areas being assessed are depicted in Figure 3.

United States Coast Guard Cadets continue to be engaged in FAU's Harbor Branch Oceanographic Institute (HBOI) summer internship program, spearheaded by SNMREC. The cadets participated in 2014, during their summer rotation. This program will continue to enhance cooperation between the U.S. Coast Guard and the SNMREC while educating future officers about projects which will be installed in coastal areas.

SNMREC staff continue to work with professors and students at FAU's School of Communications and Multimedia Studies' to create an interactive educational display game. A kiosk is being designed for the Ocean Discovery Center at FAU's Harbor Branch Oceanographic Institute. The kiosk will create a hands-on experience which educates the public about future ocean energy projects. This effort will be leveraged to provide similar kiosks to science and discovery museums. The intent is to provide an opportunity to engage all ages in a hands-on, fun and educational experience about ocean renewable energy production. The kiosks

will increase knowledge of real, cutting-edge research in renewable energy from the ocean as well as, incorporating valuable Science Technology Engineering & Math (STEM) content to inform the public.

The Center developed a curriculum for upper-division high-school students to introduce the topic within secondary education. An additional topic on policy and social interaction with renewable energy, with an emphasis on ocean energy, is in the planning stage.

Over fifty upper-division graduates and Principle Investigators have been engaged in research in marine renewable energy (MRE) to date. Over a dozen of these students have secured positions in energy-related companies.

More than 45 Non-Disclosure Agreements (NDA) have been signed with companies across the global marine industry. Language within the NDAs does not allow for the release of information of the details of the collaborations at this time. Industry sponsored funding is at a level of $155,000.

To date, with the State of Florida funding, the SNMREC has successfully leveraged $6,281M of U.S. Department of Energy and National Science Foundation funds.

UFTR Digital Control System Upgrade for Education/Training of Engineers and Operators

FINAL REPORT

PI: Kelly Jordan, University of Florida

Executive Summary

As nuclear power plants age, analog safety instrumentation obsolesces and becomes difficult to maintain. Adoption of advanced digital instrumentation and control (I&C) technologies in the nuclear sector has significantly lagged that of other industries. Utilities have been slow to implement these systems due to regulatory licensing uncertainty and a lack of internal expertise with new systems. As the previous generation of the nuclear workforce retires, the pool of available expertise in analog technology declines. The experience at Japan's Fukushima Power Station shows the need to continually modernize and augment reactor safety and operational systems.

In Operation since 1959, the UFTR has undertaken an ambitious project to renovate replace all aspects of the facility, with a center point on upgrade of the 50-year old analog I&C systems with new, modern digital systems. Once modified, the facility will provide training and education for the future workforce as well as a demonstration platform in the area of advanced digital I&C for nuclear reactors. This effort ushers in a new focus on advanced digital I&C research, development, and testing, and greatly augments the existing Nuclear Engineering Program at UF. Further, the UFTR facility will offer training courses for other educational institutions in the state, such as Florida International University and Indian River State College, who provide the majority of nuclear technician education in Florida, as well as training for personnel from nuclear utilities and government agencies, including the Nuclear Regulatory Commission.

The refurbishment project was launched based on the conversion of the reactor core from high-enriched uranium to low enriched fuel as part of a nationwide effort after 9/11. As part of this program, many major upgrades have been completed over the FESC project period, including an NNSA-funded security system ($460k), a renovated HVAC system ($250k), a new stack exhaust monitor and high plume exhaust system funded by DOE ($212k), and a new nuclear instrumentation system ($300k). FESC funding has been leveraged to augment these efforts, including the design of a new control blade drive systems for the UFTR and purchase of field instrumentation sensors to integrate with the new control design.

The completion of the full digital control system portion of the upgrade has been adversely affected by two external factors. First, the UFTR had established a contract with Siemens Energy for the design and manufacture of the control system interface which has been dissolved. A business restructuring driven by Siemens Global resulted in the disbanding of the Siemens Energy Nuclear I&C division responsible for this project. After this, the UFTR decided to pursue another vendor partner for this system. Secondly, the Nuclear Regulatory Commission has de-prioritized licensing actions for existing research reactors resulting in multi-year delays in the approval of upgrades. Congress has declared the shortage of medical isotopes a national security concern. Several new nuclear reactor-based medical isotope production projects have begun and are in the process of submitting licenses to the Nuclear Regulatory Commission, which has prioritized these projects over licensing of existing research reactors.

Despite these adverse project impacts, the UFTR will restart operations at the end of 2014, with most upgrades fully implemented. The digital control interface design is complete and manufacturing and install are on hold pending both identification of a new manufacturing partner and regulatory approval. FESC funding has been

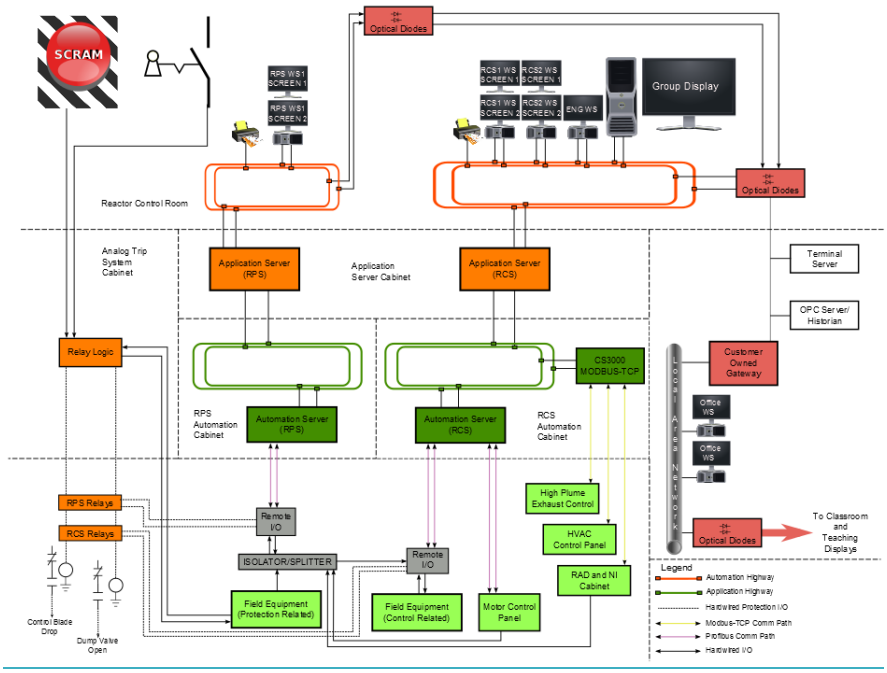
instrumental in maintaining progress of refurbishment and ensuring the success of existing efforts despite these adverse impacts.

Project Activities, Results and Accomplishments

Digital Controls System

University of Florida Training Reactor has completed the detailed design work for the digital controls system and produced a final Functional Requirements Specification document from which a system can be built. The UFTR will commission operations at the end of 2014. After manufacture, the digital system will be integrated into operations for an extensive testing and monitoring phase designed to satisfy requirements of the Nuclear Regulatory Commission.

The final system concept design, showing the system breakdown into a separate shutdown and control sections is shown below:



Expenditure of FESC Funds

FESC funds were spent in as follows:

- $35,000 to Siemens for digital control hardware
- $3,921 to contractors for the UFTR high plume exhaust control system
- $1,441 for electronics for the temperature monitoring system.
- $4,600 for control system components

The high plume exhaust system was funded by a Department of Energy grant in 2012. FESC funds were used for hardware and contracting work to integrate the exhaust system with the digital control system. Funds for the temperature monitoring system was used similarly.

Nuclear Instrumentation: The new nuclear instrumentation is the link between the operating reactor and the new digital control system. Several of the functions of the old control system will be moved into the NI system, including calculation of reactor power and period. The equipment was delivered at the end of 2012, and installation will occur throughout 2013 and 2014, concurrent with the control system. This was funded by from a mix of sources, including a Department of Energy Grant ($118,000), a contribution from Progress Energy ($125,000), and UFTR funds ($60,000).

Body scanner: Canberra donated a Gem 5 whole-body radiation monitor. This device is for exit monitoring of personnel leaving the reactor cell. Measurement ensures that workers are not contaminated by radioactive material. This unit replaces the existing obsolete exit monitor.

Wallplate networking upgrade: The digital control systems communicate using networking protocols. $22,000 was spent upgrading the UFTR building infrastructure to the wall plate networking system.

Waste disposal: The UFTR had accumulated more than six cubic meters of radioactive waste material. We contracted with a transport and disposal firm to send the waste for disposal in Tennessee. This improved facility safety and cleared out sections of the reactor cell that were previously blocked off.

HVAC: Control equipment and instrumentation have strict humidity and temperature requirements, and the existing air handling unit is unable to continue meeting those requirements. A new air handler, filter unit, and ductwork has been installed to replace the existing unit.

Physical Infrastructure Upgrades: There are ongoing efforts with procuring field equipment and interface equipment in support of the Digital Control Project, along with modifications to both control rooms. Machine shop cleanup and abatement of lead and cadmium contamination has been completed.

Security: The National Nuclear Security Administration (NNSA) has provided the UFTR with $462,000 to add new security features and completely renovate its existing security systems. This work has been completed during the project period.

New Partnerships Developed

Three new partnerships have been formed in this reporting period: an industrial training partnership, an in-state medical physics effort, and an international research collaboration on reactor safety.

UFTR – IRSN – FPL Workforce Development Partnership

A new partnership has been formed for nuclear training with FIU and IRSN as primary educational partners. The UFTR has linked up with the $3M-funded Regional Center for Nuclear Education and Training hosted at IRSN and Florida Power and Light / NextEra to develop an enhanced program for training of non-nuclear engineers in the nuclear industry.

To ensure growth and sustainability of Florida's nuclear energy industry, there is a need to enhance Florida's nuclear careers. Training next generation nuclear workforce will provide the skillset needed to expand industry in the state of Florida, engagement at all levels of education (including the graduation of new engineers, technicians and outreach to K-12). Collaboration of Florida academic institutions and industrial partners is paramount to success. Both organizations have appointed representatives to the UFTR advisory board and committed funds for acquiring a nuclear plant simulator, should federal funding also become available.

UFTR – UF Health Cancer Center

The UFTR has participated as a partner with the UF Health Cancer Center for several large center grant proposals on the intersection between nuclear engineering and radiation oncology, including proposals to NASA and NIH. The partnership core leverages four facilities for animal and human irradiation as described in Facilities and Resources: NSRL (heavy ions), UFPTI (protons), UF NGF (neutrons), and UF Shands Cancer Center (gamma-rays for reference irradiations). This core further provides both computational modeling to support both the design of proton and neutron animal irradiations, and anatomic models for organ dosimetry.

UFTR – EPFL Research Reactor Safety Collaboration

Finally, the UFTR is partnering with the Swiss Federal Institute of Technology, Lausanne (EPFL) and the CROCUS reactor to develop new methods for characterizing safety performance of research reactors. This collaboration has a financial commitment of $300k from EPFL to acquire new graduate students and postdoctoral scientists to work with UF in this area.

The principal aim of the project is, in collaboration with the University of Florida and the University of Florida Training Reactor (UFTR) facility, to develop and validate a detailed coupled multiphysics models of the zero-power CROCUS reactor at EPFL and the UFTR, for the comprehensive analysis of the reactor behavior under transient (neutronic or thermal-hydraulic induced) conditions.

These two reactors differ significantly in the core design and thermal power output, but share unique heat transfer and flow characteristics (single-phase laminar flow in complex geometries with the possibility of mechanically entrained air bubbles). Validation experiments will be design to expand the validation domain of these existing models and computational codes and techniques. In this process, emphasis will be put to validate the coupled models developed and get confidence in their applicability for safety analysis.

EPFL will be principally responsible for the design and implementation of transient experiments to generate a database of reactor parameters, i.e. flow distribution, power profile and power evolution to be used to validate against code predictions. UF will focus on the generation of the coupled neutron kinetics and thermal-hydraulic models, including implementation of a TRACE/PARCS reactor simulator model, a PARET model, and development of full-field computational fluid dynamics models (using OpenFOAM) for refined thermalhydraulics physics treatments. In this subtask of the project, the aim is to verify by means of CFD the validity of TRACE predictions for atmospheric pressure water flow.

The work in this project serves as a basis to develop two Ph.D.s, one at each University. The scientific understanding of these multiphysics domains will be expanded and the validation base of commonly-used calculation methods will be expanded to cover a new range of research reactor types. From a practical perspective, CROCUS and the UFTR will have fully validated reactor dynamic and transient models for accident analysis. With these validated models, both facilities will have improved capabilities and flexibility for extended operations. CROCUS and the UFTR will be able to make future reactor modifications with reduced regulatory resistance. A feasibility analysis of future power uprates at these facilities will also result.

Patents
None

Publications

11. K.A. Jordan, D. Springfels, D. Schubring, ``Modern Design and Safety Analysis of the University of Florida Training Reactor" Nuclear Engineering and Design *Submitted*.
12. C.R. Hughes, O. Pelaez, D. Schubring, and K.A. Jordan ``One-row Scwr Design Analysis Using Coupled RP/TH Analysis" Nuclear Technology *Submitted*.
13. J.M. Lewis, R.P. Kelley, D. Murer, and K.A. Jordan ``Fission Signal Detection using Helium-4 Gas Fast Neutron Scintillation Detectors" Applied Physics Letters. 105 (1), 014102.
14. J.M. Lewis, D. Raetz, D. Murer, and K.A. Jordan, ``In-situ Fission Rate Measurements using Helium-4 Scintillation Detectors" IEEE Transactions on Nuclear Science. 64.4, (2014) 2217-2221.
15. C.R. Hughes, O. Pelaez, D. Schubring, and K.A. Jordan ``One-Row SCWR Design Analysis using Coupled RP/TH Analysis" TH'14 International Embedded Topical Meeting on Advances in Thermal Hydraulics 2014, June 15-19, 2014, Reno, NV.
16. K.A. Jordan, K. Goluoglu, B. Shea ``Status of the Major Refurbishment and Digital Conversion of the University of Florida Training Reactor" Trans. American Nuclear Society Winter Meeting, Nov 2013 *Invited*.
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18. K.A. Jordan, D. Seifman, S. Kowalczyk, D. Cronin ``A Fully-reconstituted Safety Basis at the University of Florida Training Reactor" Joint IGORR (International Group on Research Reactors)/IAEA 2013 Conference, Oct. 13-18, 2013 Daejeon, Korea.
19. K.A. Jordan, B. Shea, M. Berglund ``Preparing a Research Reactor for the next 50 years: The UFTR Facility Renovation" Joint IGORR (International Group on Research Reactors)/IAEA 2013 Conference, Oct. 13-18, 2013 Daejeon, Korea.
20. C. Hughes, D. Schubring, K.A. Jordan , D. Raetz, ``Coupled Computational Heat Transfer and Reactor Physics for SCWR" Proc. 2013 ASME Summer Heat Transfer Conference, Minneapolis, MN, July 14-19 2013
21. J. Lewis, G. Bickford, and K. A. Jordan ``Licensing Aspects of the Digital Upgrades to the UFTR Protection and Control Systems" Proc. 8th International Topical Meeting on Nuclear Plant Instrumentation, Control and Human Machine Interface Technologies (NPIC&HMIT 2012), San Diego, CA, July 22-26, 2012.
22. G. Bickford, J. Lewis, and K. A. Jordan ``Implementation of Digital Upgrades to the UFTR Protection and Control Systems " Proc. 8th International Topical Meeting on Nuclear Plant Instrumentation, Control and Human Machine Interface Technologies (NPIC&HMIT 2012), San Diego, CA, July 22-26, 2012.

Design, Construction and Operation of CSP Solar Thermal Power Plants in Florida

FINAL REPORT

PI: Dr. D. Yogi Goswami, goswami@usf.edu

Institution: Clean Energy Research Center, University of South Florida, Tampa, FL
Partners: University of Florida (UF) and University of Central Florida (UCF)

Project Period: Nov. 2008- Nov. 2014

Executive Summary

Florida utilities are mandated to achieve 20% renewable energy contribution to their generation mix by 2020. While technologically feasible with solar energy, the capital costs are still high. This project targets the development of solar thermal power technology for bulk power and distributed generation, which will diversify energy resources in Florida and reduce greenhouse emissions by utilizing renewable sources. Also, there will be economic impacts with the establishment of a new power industry in Florida, which will help the electrical utilities of the state to meet the renewable portfolio standards. The project has three main tasks; the first one is to develop design methodologies for the proven solar thermal power technologies based on Florida conditions and resources. Secondly, the project aims to set up demonstration and test facilities for these technologies for optimization for Florida conditions, and the final task is to develop and commercialize innovative technologies of solar thermal power.

The main research objectives are the development of a test facility and a pilot demonstration solar thermal power system based on the parabolic trough technology.

Parabolic Trough Concentrators

The performance of parabolic trough based solar power plants over the last 25 years has proven that this technology is an excellent alternative for the commercial power industry. Compared to conventional power plants, parabolic trough solar power plants produce significantly lower levels of carbon dioxide, although additional research is required to bring the cost of concentrator solar plants to a competitive level. The cost reduction is focused on three areas: thermodynamic efficiency improvements by research and development, scaling up of the unit size, and mass production of the components and equipment. The optimum design, performance simulation and cost analysis of the parabolic trough solar plants are essential for the successful implementation of this technology. A detailed solar power plant simulation and analysis of its components is needed for the design of parabolic trough solar systems which is the subject of this research.

A preliminary analysis was carried out by complex models of the solar field components. These components were then integrated into the system whose performance is simulated to emulate real operating conditions. Sensitivity analysis was conducted to get the optimum conditions and minimum levelized cost of electricity (LCOE). A simplified methodology was then developed based on correlations obtained from the detailed component simulations.

A comprehensive numerical simulation of a parabolic trough solar power plant was developed, focusing primarily on obtaining a preliminary optimum design through the simplified methodology developed in this research. The proposed methodology is used to obtain optimum parameters and conditions such as: solar field size, operating conditions, parasitic losses, initial investment and LCOE. The methodology is also used to evaluate different scenarios and conditions of operation.

The new methodology was implemented for a parabolic trough solar power plant for two cities: Tampa and Daggett. The results obtained for the proposed methodology were compared to another physical model

(System Advisor Model, SAM) and a good agreement was achieved, thus showing that this methodology is suitable for any location.

Power Cycles for Solar Thermal Power

Low-grade heat sources below 300ºC, are abundantly available as industrial waste heat, solar thermal using low cost solar concentrators, and geothermal, to name a few. However, they are under-exploited for conversion to power because of the low efficiency of conversion. The utilization of low-grade heat is advantageous for many reasons. Technologies that allow the efficient conversion of low-grade heat into mechanical or electrical power are very important to develop. Supercritical Rankine cycles were investigated for the conversion of low-grade heat into power. The performance of these cycles was studied using ChemCAD linked with customized excel macros written in Visual Basic and programs written in C++.

The selection of working fluids for a supercritical Rankine cycle is of key importance. A rigorous investigation into the potential working fluids was carried out, and more than 30 substances were screened out from all the available fluid candidates. Zeotropic mixtures were proposed to be used in supercritical Rankine cycles to improve the system efficiency. Supercritical Rankine cycles and organic Rankine cycles with pure working fluids as well as zeotropic mixtures were optimized for efficient conversion of low-grade heat into power. The results show that it is theoretically possible to extract and convert more energy from such heat sources using the cycle developed in this research than the conventional organic Rankine cycles. A theory on the selection of appropriate working fluids for different heat source and heat sink profiles was developed to customize and maximize the thermodynamic cycle performance.

The outcomes of this research will eventually contribute to the utilization of low-grade waste heat more efficiently.

Combined Power/Cooling Cycle

Binary mixtures exhibit variable boiling temperatures during the boiling process, which leads to a good thermal match between the heating fluid and working fluid for efficient heat source utilization. This study presents a theoretical and an experimental analysis of a combined power/cooling cycle, which combines the Rankine power cycle and the absorption refrigeration cycle to produce power and refrigeration in the same cycle, while power is the primary goal. This cycle, also known as the *Goswami Cycle*, can be used as a bottoming cycle to utilize the waste heat from a conventional power cycle or as an independent cycle using low to mid-temperature sources such as geothermal and solar energy. A thermodynamic analysis of power and cooling cogeneration was conducted. The performance of the cycle for a range of boiler pressures, ammonia concentrations, and isentropic turbine efficiencies were studied to find out the sensitivities of network, amount of cooling and effective efficiencies. The thermodynamic analysis covered a broad range of boiler temperatures, from 85 °C to 350 °C. The first law efficiencies of 25-31% are achievable with the boiler temperatures of 250-350 °C. The cycle can operate at an effective exergy efficiency of 60-68% with the boiler temperature range of 200-350 °C. An experimental study was conducted to verify the predicted trends and to test the performance of a scroll type expander. The experimental results of vapor production were verified by the expected trends to some degree, due to heat transfer losses in the separator vessel. The scroll expander isentropic efficiency was between 30-50%, the expander performed better when the vapor was superheated. The small scale of the experimental cycle affected the testing conditions and cycle outputs. This cycle can be designed and scaled from a kilowatt to megawatt systems. Utilization of low temperature sources and heat recovery is definitely an active step in improving the overall energy conversion efficiency and decreasing the capital cost of energy per unit.

Another combined cycle developed in this project can produce both power and desalinated water in the same thermodynamic cycle. This cycle uses a supercritical Rankine cycle from which heat is rejected into the seawater which in turn gets pre-heated before being desalinated in a Reverse Osmosis (RO) system. The power produced in the cycle is used to run the RO system. Preheating the seawater not only makes use of the heat that would normally be wasted, it also reduces the power requirements of the RO system.

Installation and Operation of 50kWe Solar Power Plant

Sopogy Inc. Honolulu, Hawaii was the main contractor for the installation and operation of a 50 kWe Solar Power Plant at USF. Parabolic collectors (Soponova 4.0) were received from Sopogy and were assembled. A power block for generating electricity from GulfCoast Green Energy was also received and installed. The power block is a Green Machine Elite 4000 manufactured by Electratherm. This machine will produce about 50kWh electricity from the thermal energy produced by the solar field that consists of 199 Soponova 4.0 parabolic concentrators from Sopogy, Inc. The installation and commissioning of the solar field and the Electratherm power generating unit is complete.

Table of Contents

1. Summary

The main research objectives for the project are the development of a test facility and pilot demonstration solar thermal power system based on the parabolic trough technology.

This project consists of 4 different tasks.
Task 1: Development of a simulation and design methodology for parabolic trough technology.
Task 2: Development of a test facility and pilot demonstration.
Task 3. Installation and Operation of 50kWe Solar Power Plant.
Task 4: Thermal Energy Storage.

The design and installation of the solar field and the 50 kW power block have been completed. The Soponova 4.0 (Sopogy Inc.) parabolic trough collectors have been used in the solar field designed to provide 430 W/m^2 of thermal energy after losses. The power block that will convert the thermal energy to electricity is based on the Organic Rankine Cycle (ORC). This power block has a nominal capacity of 50 kW_e. The power block uses a dry cooled condenser, which demonstrates the operation of a CSP power plant without the use of water. This is an important development as we try to reduce water consumption in solar thermal power.

A thermal energy storage system has been developed based on encapsulated phase change materials. This system can be used at this solar thermal power plant as well as any other solar thermal power plant. This development has reduced the cost of thermal energy storage from the present estimated \$45/kWh_{th} down to \$15/kWh_{th}.

2. Goals and Objectives

The main research objectives of the project are:

1. Development of a test facility for various components of a parabolic trough based solar thermal power plant, including thermal energy storage, power block and dry cooling.
2. Design and construction of a pilot demonstration solar thermal power plant based on the parabolic trough technology.

3. Project Activities

Task 1: Development of simulation and design methodology for parabolic trough
The objective of task one is to develop a simulation and design methodology for the parabolic trough and parabolic dish based technologies for Florida conditions.

The daily integration (DI) approach was used to obtain the average direct normal solar radiation for the location of the pilot demonstration solar plant (USF, Tampa, FL.). The direct normal solar radiation obtained for Tampa is shown in Fig. 1. The annual average for this location is 4.6 kWh/m^2-day. These solar radiation values and the solar shading analysis for the solar collector rows were used for the solar field calculation.

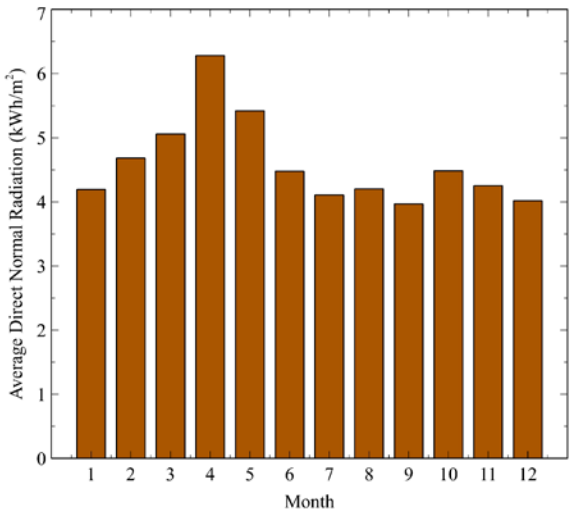

Fig. 1 Direct Normal Radiation for Tampa, FL.

Parabolic trough solar systems are currently one of the most mature and prominent applications of solar energy for the production of electricity. Compared to conventional power plants, parabolic trough solar power plants produce significantly lower levels of emissions and carbon dioxide. Thermal simulations and cost analysis of the system are used to evaluate the economic feasibility. Complex models and components are integrated to emulate real operating conditions, such as: Solar Radiation Model, Solar Thermal Collector, Thermal Energy Storage, Solar Field Piping, Power Block, Cost Analysis, and Integration of all Systems. Fig 2 shows the schematic of a parabolic trough power plant.

An hourly solar radiation model is necessary to calculate the energy input that comes from the sun, since the solar collector performance changes during the whole day. The inputs for the hourly solar radiation model are the long term average values of total horizontal and diffuse radiation, which can be obtained by ground or satellite measurements. Satellite data provide information about solar radiation and meteorological conditions in locations where ground measurement data are not available. Gueymard developed a Daily integration approach model to predict the monthly-average hourly global irradiation by using a large data set of 135 stations with diverse geographic locations (82.58N to 67.68S) and climates. The results showed that the daily integration model is more accurate than other hourly models.

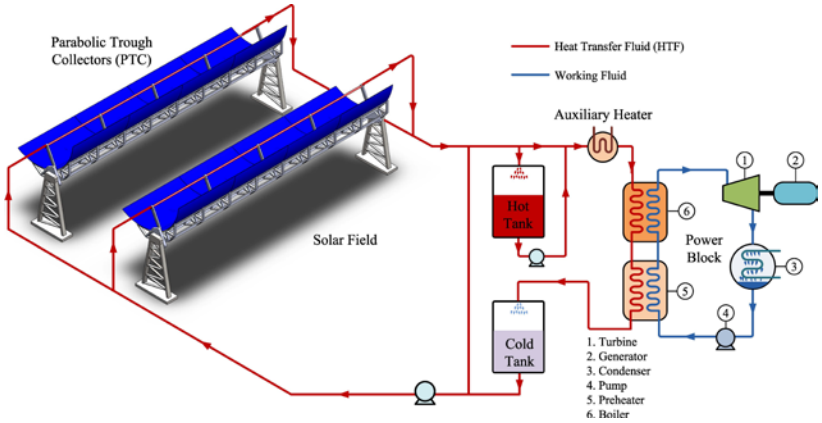

Fig. 2 Parabolic Trough Power Plant

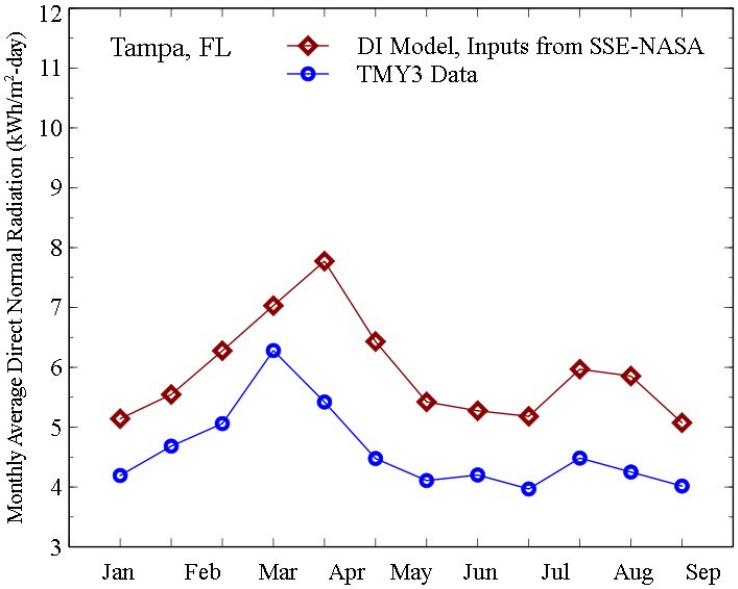

Fig. 3 Comparison of two models

The second part of this task is about the numerical heat transfer model. The receiver consists of an absorber surrounded by a glass envelope. The absorber is typically a stainless steel tube with a selective absorber surface. The glass envelope is an antireflective evacuated glass tube which protects the absorber from degradation and reduces heat losses. The Solar receiver uses conventional glass to metal seals and bellows to achieve the necessary vacuum enclosure and for thermal expansion.

The heat transfer model is based on an energy balance between the heat transfer fluid and the surroundings (atmosphere and sky). A comprehensive radiation exchange model between the absorber and the envelope is included in this study. The results showed that the new model has lower RMSE than the NREL Model (0.985% and 1.382%, respectively). The numerical heat transfer model integrated with the solar radiation model can be used for evaluating the performance of solar collectors for any location.

Task 2: Development of a test facility and pilot demonstration

The second task targets the development of a test facility and pilot demonstration systems based on parabolic trough technologies. The experimental combined power and cooling setup will be used as a preliminary study of the demonstration system that will be developed.

2.1 Performance analysis of a Rankine-Goswami Combined Cycle

Improving the efficiency of thermodynamic cycles plays a fundamental role for the development of solar power plants. These plants work normally with Rankine cycles which present some disadvantages due to the thermodynamic behavior of steam at low pressures. These disadvantages can be reduced by introducing alternatives such as combined cycles which combine the best features of each cycle. In the present study a combined Rankine-Goswami cycle is proposed and a thermodynamic analysis is conducted. The Goswami cycle, used as a bottoming cycle, uses ammonia-water mixture as the working fluid and produces power and refrigeration while power is the primary goal. The experimental Goswami cycle setup is shown in Fig. 4. Figure 5 shows a schematic of the Rankine-Goswami cycle.

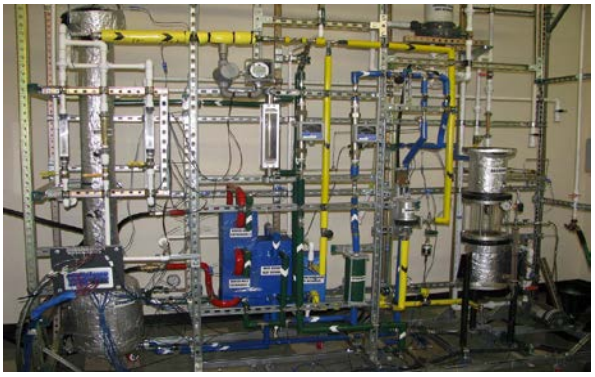

Fig. 4 Experimental Setup of the Goswami Cycle

Parametric studies were conducted for the following cases.

Case	Rectifier	Superheater	Controlled Parameter
R	Yes	No	$x_{recaifier} = 0.995$ $T_{superheater} = T_{recaifier}$
R+S	Yes	Yes	$x_{recaifier} = 0.98$ $T_{superheater} = T_{boiler}$
B (Base)	No	No	Saturated vapor condition at the boiler exit

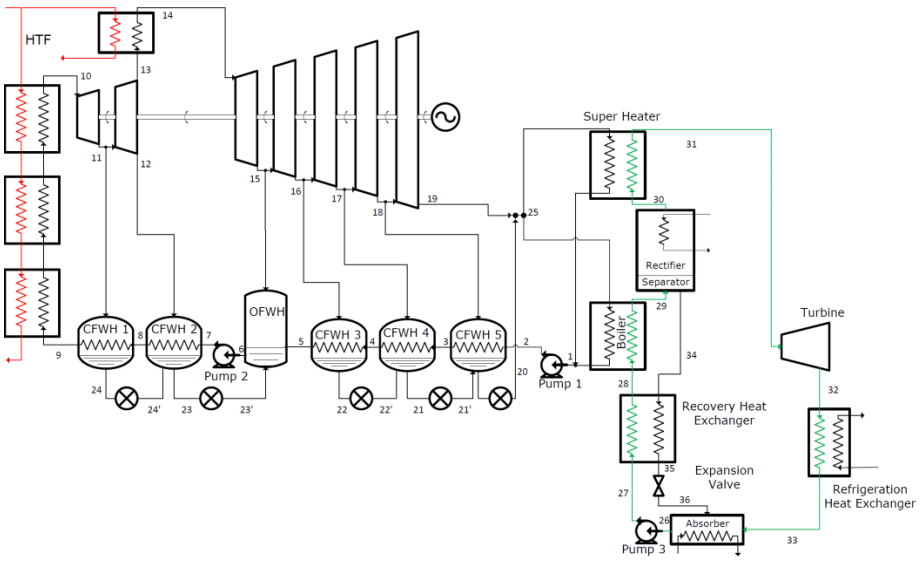

Fig.5 A schematic of a combined Rankine-Goswami thermodynamic cycle

The thermodynamic properties of water and steam were implemented in Python 2.6 by using the international-standard IAPWS-IF97 steam tables. For the Goswami cycle, the properties of ammonia water were obtained from a Gibbs free energy formulation given by Xu and Goswami. In this study the amount of the electric work obtained from the topping cycle was held constant at 50 MWe while for the bottoming cycle the turbine work was considered as an output parameter. Only selected results of the energy efficiency, cooling capacity and the exergy efficiency are given here.

Figure 6 shows the effective First Law efficiency while the cooling capacity of the Goswami bottoming cycle is presented in Figure 7. The effective exergy efficiency in the cycle as a function of the condenser pressure and ammonia mass fraction is also presented in Figure8.

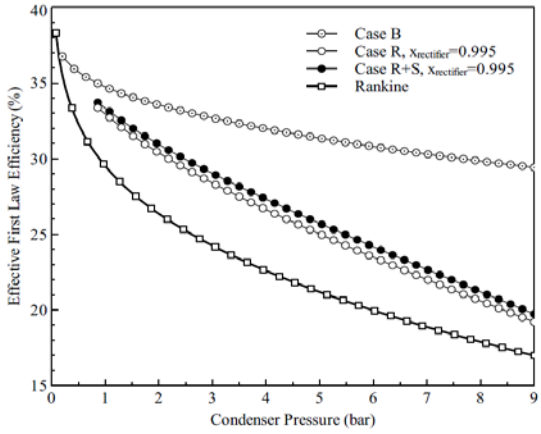

Figure 6 Energy efficiency of the combined cycle

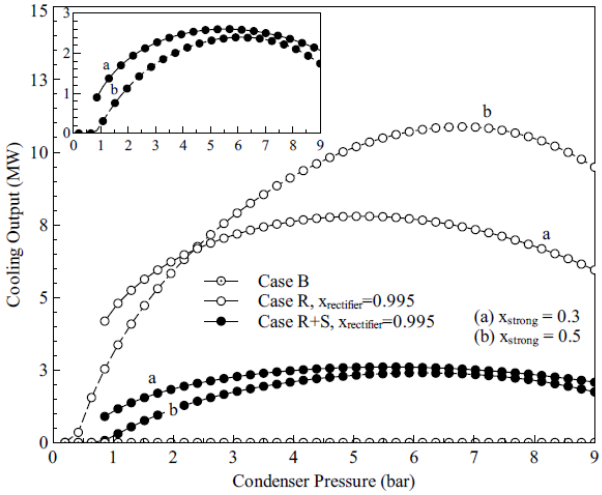

Figure 7 Cooling capacity of the bottoming Goswami cycle

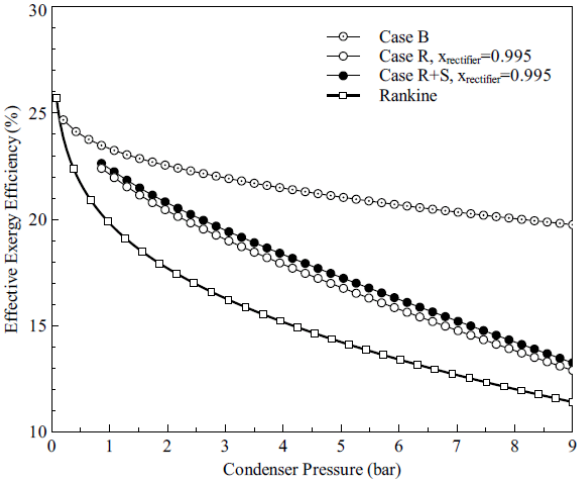

Figure 8 Exergy efficiency of the combined cycle

Task 3. Installation and Operation of 50kWe Solar Power Plant

Sopogy Inc. Honolulu, Hawaii was the main contractor for the installation and operation of the 50kWe Solar Power Plant at USF (Figure 9). Parabolic collectors (Soponova 4.0) were received from Sopogy and were assembled. The power block for generating electricity was receive from and installed by GulfCoast Green Energy. The power block is a Green Machine Elite 4000 manufactured by Electratherm. This machine will produce about 50kWh electricity from the thermal energy produced by the solar field that has 199 Soponova 4.0 parabolic concentrators from Sopogy, Inc. Figures 10 to 14 show various parts of the CSP solar power plant. Figure 10 shows the photo of the Electratherm power generator with the air-cooled condenser. Installation and commissioning of the solar field is complete. Installation and commissioning of the Electratherm power generating unit is also complete.

Figure 9. A view of the parabolic trough solar thermal power plant.

Figure 10 The Power block with the air-cooled condenser.

Figure 11 Solar collectors showing the header connections.

Figure 12 A row of parabolic trough solar collectors.

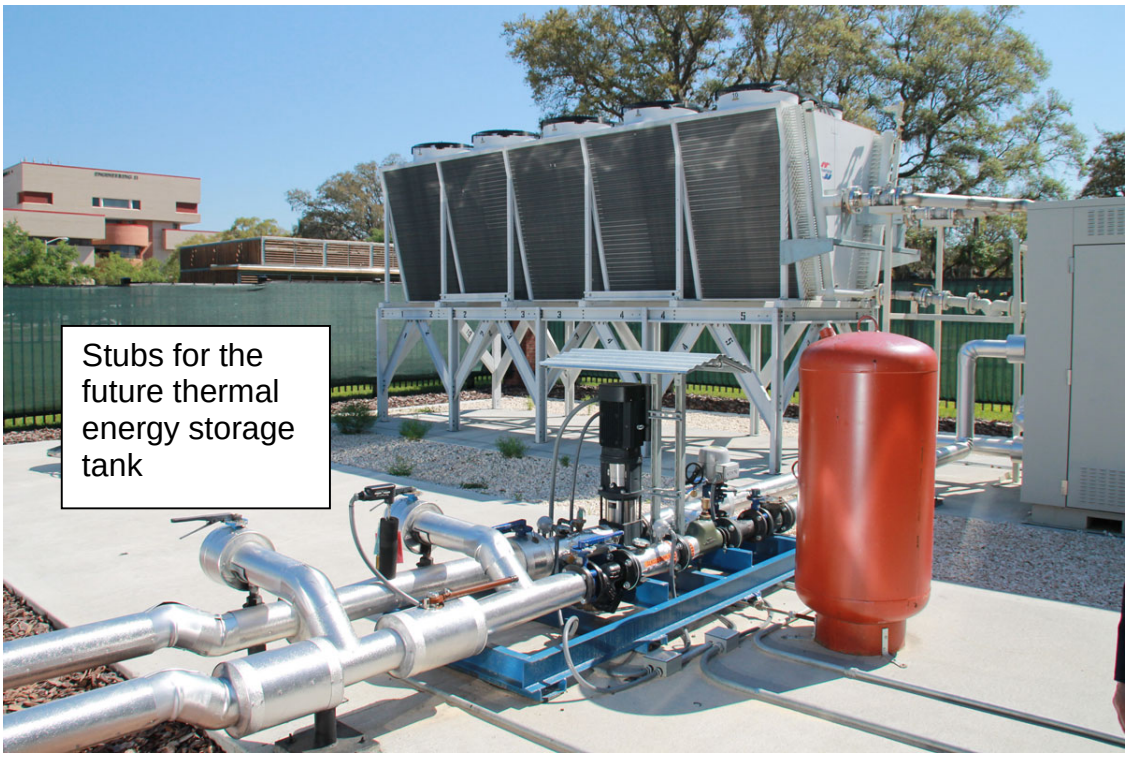

Figure 13 Expansion tank and pump for the heat transfer fluid.

Figure 14 Pump, piping and expansion tank for the heat transfer fluid flow to and from the collector field.

Task 4: Thermal Energy Storage

We have developed a low cost thermal energy storage (TES) system for Concentrating Solar Power (CSP) based on encapsulated phase change materials (PCMs). The system will be able to meet the utility-scale base-load concentrated solar power plant requirements at much lower system costs compared to the existing TES concepts. This project is developing a TES system concept that will allow for an increase of the capacity factor of the present CSP technologies to as much as 75% and reduce the cost to less than $\$15/kWh_{th}$ as compared to the present cost of about $\$45/kWh_{th}$.

We have successfully prepared porous pellets of phase change materials that will allow for the volumetric expansion during PCM melting and hence impose less stress on the encapsulating material. We have also developed the encapsulation techniques and selected the low cost encapsulating materials that will be used to encapsulate the PCM. The following pictures show some of the developed capsules.

Figure 15 Ceramic encapsulated PCM for high temperature thermal energy storage

Figure 16 Metal encapsulated PCM for medium temperature thermal energy storage

4. Results and Accomplishments

This FESC funded research has resulted in the development of a test facility and pilot scale demonstration solar thermal power plant based on parabolic trough technology. The nominal capacity of this facility is $50kW_e$. The electric power from this facility will be supplied to the IDR building or to the TECO grid. This test facility will be used to demonstrate the innovative technologies based on new thermodynamic cycles, thermal energy storage and dry cooling. This project will provide a unique opportunity to students for a hands on experience in the real world application of operating a power generating system with solar heat source. Students will be involved in the daily operation of the system and analysis of the data obtained from the system.

5. Concluding Remarks- This project will have a significant impact on the current research areas of thermal energy storage, thermodynamic cycles and dry cooling. This is a unique facility to provide hands on experience to students interested in real world solar applications.

6. Patents

Title	Application Number	Application Date	Patent Number	Grant Date
Dual-Polarized Feed Antenna Apparatus and Method of Use	11/534,781	9/25/2006	7,362,273	4/22/2008
Dual-Polarized Feed Antenna Apparatus and Method of Use	12/107,122	4/22/2008	7,619,570	11/17/2009
Practical Method of CO2 Sequestration	12/335,049	12/15/2008	7,896,953	3/1/2011
Hydrogen-Storing Hydride Complexes	12/407,116	3/19/2009	8,153,020	4/10/2012
Method of Generating Hydrogen-Storing Hydride Complexes	13/422,600	3/16/2012	8,440,100	5/14/2013
Rectenna Solar Energy Harvester	12/436,601	5/6/2009	8,115,683	2/14/2012
Method and System For Generating Power From Low- and Mid-Temperature Heat Sources	13/591,792	8/22/2012		
Systems and Methods for Thermal Energy Storage	13/665,389	10/31/2012		
Integrated Cascading Cycle Solar Thermal Plants	13/665,270	10/31/2012		
Systems and Methods for Desalinization and Power Generation	PCT/US13/55325	8/16/2013		
Thermal Energy Storage Systems and Methods	13/756,098	1/31/2013		

Method of Encapsulating a Phase Change Material with a Metal Oxide	14/159,874	1/21/2014
Low-Cost Chromatic Devices	PCT/US13/68998	11/7/2013
Encapsulation of Thermal Energy Storage Media	PCT/US13/75971	12/18/2013
Enhancement of Photocatalytic Effect with Surface Roughness in Photocatalytic Reactors	14/511,970	10/10/2014
Encapsulation of Thermal Energy Storage Media	62/012,633	6/16/2014

7. Publications

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3. Besarati, S.M., and Goswami, D.Y. (2014) "Analysis of advanced supercritical carbon dioxide power cycles with a bottoming cycle for concentrating solar power applications," *Journal of Solar energy Engineering*, February, Vol. 136, pp 010904-1-7.

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