



**Florida Energy Systems Consortium
Semi-Annual Report
to
Dr. Win Phillips, Vice President for Research, Chair of the Oversight Board
May 2010**

Reporting Period: Nov 1 2009 – May 1, 2010

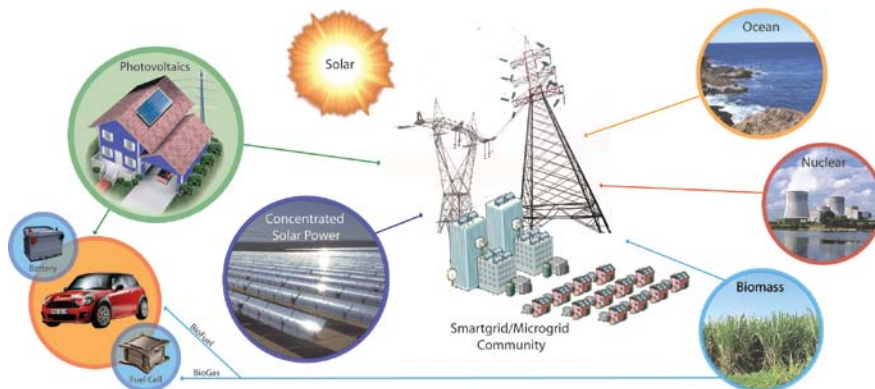


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EXECUTIVE SUMMARY

FESC has made significant progress during this reporting period. In addition to progress on individual FESC-funded research projects, the consortium's accomplishments include participation in three DOE Energy Innovation Hub proposals, the initiation of our Technology Commercialization program, a comprehensive energy strategy report to the Governor's Energy Office, and considerable advancement toward energy education and outreach programs.

The importance of having state universities under one umbrella was especially evident in our response to all three Energy Innovation Hub calls from the US DOE. These calls focused on Fuels from Sunlight, Energy Efficient Building Systems Regional Innovation Cluster Initiative (E-RIC), and Modeling and Simulation for Nuclear Reactors. FESC led the Fuels from Sunlight Hub and the E-RIC, with multiple external partners, and participated in the Nuclear Hub. A Request for Proposals (RFP) is anticipated in the area of energy storage. To respond to this new call, the FESC core planning team has already been formed and the team members are communicating with the potential partners. FESC used a similar strategy to respond to the "PV Manufacturing" call from US DOE. Team members have already been identified and the core team is developing a Concept Paper in response to the first phase of the application.

FESC-funded Principal Investigators continue to work on their research. For this report, each PI submitted a one progress page summary that will be posted at the FESC website. Appendix A contains brief descriptions of each project. Appendix B provides detailed progress summaries.

The House State Universities and Private Colleges Committee requested that FESC give a presentation regarding programs within the SUS and Community Colleges that are preparing the State's energy workforce. Dr. Anderson gave this presentation to the committee on February 3rd, 2010.

At the behest of Florida Energy and Climate Commission, the Governor's Energy Office asked FESC to provide a framework for transition to clean and renewable energy sources, and energy efficiencies, with regard to market driven forces. The report examined three areas: 1) Current Incentive Mix (both State and Federal) in renewable energy and cleantech; 2) Cleantech Barriers to Commercialization and Project Finance; 3) Effects of Regulatory Change – Renewable Portfolio Standard (RPS) Implementation. FESC reviewed existing statutory incentives supporting the deployment of energy efficiency and renewable energy in Florida, then discussed effective mechanisms to overcome barriers to commercialization and project finance. The report culminated with an analysis of a potential state renewable portfolio standard. The study provided baseline recommendations toward the next step in renewable energy and energy efficiency strategic planning and implementation. The study was submitted to the Florida Energy and Climate Commission on February 26th, 2010.

To help facilitate the leveraging of FESC funding and expertise, the FESC administrative office distributed over 80 funding opportunities, summarized in Appendix C, to the FESC faculty during this reporting period. FESC leadership also visited the State of Florida offices as well as to the Department of Energy, National Laboratories, and NASA Glenn to discuss potential FESC collaboration on their energy programs.

The Consortium has worked closely with technology transfer and economic development offices to attract industry to the State. As examples, FESC has worked to attract a Germany-based PV manufacturing and installation company to Florida. We are also working with NASA Glenn and Spaceport Research & Technology Institute for potential algae and halophytes test bed in Florida. NASA scientists introduced us to an Israel based company looking for a power company in US with CO₂ source and available land to

implement their algae technology. We established contact between this company and TECO for potential partnership.

In addition to identifying university researchers and partnering companies and entities for the two FESC-led Hub proposals, FESC also initiated Phase I of our Technology Commercialization Program. FESC worked with technology transfer offices at 5 FESC universities to identify 15 energy related technologies with high commercial potential, and funded each technology at \$7,500 for market studies or business plans. Five of the reports have been received, with the remaining reports expected within the next 30 days. These studies and plans will be shared with industry to accelerate the path of FESC research to commercialization. Phase II 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. In this program, FESC envisions providing up to \$50K in matching funds for each of up to 5 such projects, with an industry match on each project, attracting in excess of \$500K of industry support to these FESC-funded projects. The solicitation was prepared in May and sent to FESC technology transfer offices. The review committee is currently being formed.

A FESC-wide MOU and NDA are now in place and were used for the first time on the two FESC-led Hub proposals. FESC is also developing a MOU with NASA Glenn and Yeungnum University to facilitate collaboration.

The second FESC Summit will be held on September 28-29, 2010 at the University of Central Florida. The summit brings together energy experts in the State University System of Florida to share their energy-related research findings and to promote future collaborations amongst themselves and with industrial partners. A summit committee was established for planning and invitation of speakers. Pre-summit workshops are also being planned.

Education and outreach are vital for Florida's evolving energy industry. FESC is strategically focused on workforce preparation for the existing and emerging energy industry. FESC universities are collaborating on Master's level energy education programs that are integrated across multiple disciplines and will provide advanced technical training and keep students current in energy and sustainability research. Existing distance education facilities at each university will be utilized to make this program available via on-line courses. The programs planned include: Solar Energy (UF), Wind Turbines (UF), Gas Turbines (UF), Sustainable Energy (FSU), Turbo-Power Generation (UCF), Generation and Smart Grids (UCF), Photo-Voltaics (UCF), and/or Smart Buildings (UCF). Additionally, FAU, USF, and FIU submitted a consortium proposal to NSF proposing to develop and deliver a multidisciplinary science Master's degree program in renewable energy and sustainability for fall 2010. UF is now offering an on-line Energy Certificate and a Sustainable Engineering Certificate program. The FESC outreach program is using the statewide Agricultural Extension Service as well as other avenues to provide Florida residents with new approaches to energy efficiency. Progress in education and outreach is given in this report.

The FESC website is continues to be an important part of our program. It is continually being updated to remain current and to better serve our users. FESC distributes electronic newsletters regularly by email and also posts them at the FESC web site. They can be viewed at the link: http://www.floridaenergy.ufl.edu/?page_id=1999. Summaries of FESC expertise in the areas of Algal Biofuels, Small Molecule Chemistry to Energy, and Building Efficiency were developed and posted at the FESC web site. Based on a Google Analytics report, the FESC web site was viewed by 15,519 Google visitors (we are not tracking the users of other web browsers) during the period of May 2009 to May 2010. The viewers visited 51,637 pages. Viewers were from a total of 108 countries, including those in North and South America, Europe, Asia, Australia, and Africa.

FSU launched the [Renewable Energy Research Portal](#). The portal is designed to provide Florida researchers, businesses, investors, decision makers, and citizens with the research information they need to accomplish statewide energy goals. The web portal identifies, organizes, and provides access to a range of renewable and alternative energy information and research. It will use various social networking techniques to sustain and grow as an active information exchange for renewable energy researchers and stakeholders.

The FESC Steering Committee (SC) continues to meet biweekly to discuss strategy. Nicholas C. Gladding is the FECC liaison to the FESC Steering Committee, and he participates regularly in FESC SC telecons and meetings. The Oversight Board consists of the Vice Presidents for Research at each of the 11 universities and will meet on June 3, 2010.

The Florida Energy and Climate Commission (FECC), to which the Consortium reports, has two term vacancies (for Commissioners Nils Diaz and Kathy Baughman McLeod). The other members were confirmed by the Florida Senate.

The Florida Energy Systems Consortium is actively pursuing its research, education, industrial collaboration, and technology commercialization agenda. FESC faculty are collaborating in research and proposal development. FESC-funded research is being conducted to further leverage our research programs, education programs for workforce preparation are being developed, and industry is working closely with FESC experts.

RESEARCH PROGRAM

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

The FESC research program at this point includes 61 funded projects within the 7 strategic thrusts. Table 1 below gives the list of the projects under each thrust area. Project descriptions are given in Appendix A. Seven projects from FIU (not funded by FESC) are also included. FESC funded project progress reports are provided in Appendix B. Some of the projects are collaborative multi-university projects; however since funding was appropriated to each institution, only the lead university information is given in the table.

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

Projects	Title/PI/Lead Institution
THRUST 1: Overarching	
	<i>Power Generation Expansion under a CO₂ Cap-and-Trade Program</i> PI: Tapas Das; Co-PI: Ralph Fehr - USF
	<i>Joint Optimization of Urban Energy-Water Systems in Florida (Thrust 2: Efficiency)</i> PI: James P. Heaney - UF
	<i>Combined Cooling, Heat, Power, and Biofuel from Biomass and Solid Waste (Thrust 3: Biomass)</i> PI: William Lear - UF
	<i>Design, Construction, and Operation of CSP Solar Thermal Power Plants in Florida (Thrust 4: Solar)</i> PI : Yogi Goswami; Co-PI's: Lee Stefanakos, David Hahn, Robert Reddy - USF
	<i>Development of High Throughput CIGS Manufacturing Process (Thrust 4: Solar)</i> PI: N. Dhere – UCF/FSEC
	<i>Solar Photovoltaic Manufacturing Facility to Enable a Significant Manufacturing Enterprise within the State and Provide Clean Renewable Energy (Thrust 4: Solar)</i> PI: Don Morel, USF; Co-PI's: Chris Ferekides, USF, Lee Stefanakos, USF, Tim Anderson, UF, Neelkanth Dhere, UCF/FSEC
	<i>Research to Improve Photovoltaic Cell Efficiency (Thrust 4: Solar)</i> PIs: Nicoleta Sorloaica-Hickman, R. Reedy – UCF/FSEC
	<i>PV Energy Conversion and System Integration (Thrust 4: Solar)</i> PI: N. Kutkut Co-PI's: J. Shen, I. Batarseh, Z. Qu, X. Wu, W. Mikhael, L. Chow – UCF/FSEC
	<i>An Integrated Sustainable Transportation System (Thrust 4: Solar)</i> PI: Eric Wachsman Co-PI: Shirley Meng - UF
	<i>Integrated PV/Storage and PV/Storage/Lighting Systems (Thrust 4: Solar)</i> PI: Franky So, Co-PI: Jiangeng Xue, Shirley Meng - UF
	<i>Reliable and Resilient Electrical Energy Transmission and Delivery Systems (Thrust 7: Storage & Delivery)</i> PI: Steinar Dale - FSU
THRUST 2: Enhancing Energy Efficiency and Conservation	
	<i>Innovative Proton Conducting Membranes for Fuel Cell Applications & Protein Enhanced Proton</i> PI: Ongi Englander, Co-PIs: Anant Paravastu, Subramanian Ramakrishnian - FSU
	<i>Sustainably Integrated Advanced Building Subsystems (OGZEB)</i> PI: A. "Yulu" Krothapalli, Co-PI: Justin Kramer
	<i>Insight into Membrane Degradation Mechanisms Through Verification of Chemical and Mechanical Degradation Test Capabilities</i> PI: Darlene Slattery; Co-PI's: Len Bonville, Xinyu Huang, Marianne Rodgers – UCF/FSEC
	<i>Energy Efficient Building Technologies and Zero Energy Homes</i>

	PI: R. Vieira Co-PI's: P. Fairey, J. Sonne – UCF/FSEC
	<i>Joint Optimization of Urban Energy-Water Systems in Florida</i> PI: James P. Heaney - UF
	<i>Planning Grant: High Performance and Low Cost Fuel Cells for Future Vehicles</i> PI: Jim Zheng, Co-PIs: Richard Liang, Chuck Zhang, Ben Wang - FSU
	<i>NIRT: C-MEMS/CNEMS for Miniature Biofuel Cells</i> PI: Marc Madou, Co-PIs : Chunlei Wang, Sylvia Daunert and Leonidas Bachas -FIU
	<i>Fabrication of Nano Fractal Electrodes for On-Chip Supercapacitors</i> PI: Chunlei Wang - FIU
	<i>Energy Efficient Technologies and The Zero Energy Home Learning Center</i> PI: Stanley Russell Co-PI's: Yogi Goswami - USF
THRUST 3: Developing Florida's Biomass Resources	
High Energy Crops	
	<i>Establishment of the Center for Marine Bioenergy Research: Systems Approach to BioEnergy Research (SABER)</i> PI: Joel E. Kostka; Co-PIs: William Cooper, Ivonne Audirac, Amy Chan-Hilton, Ellen Granger - FSU
	<i>Constructual Optimization of Solar Photo-Bioreactors for Algae Growth</i> PI: Juan Ordonez - FSU
	<i>Seeding Biofuel Entrepreneurship in South Florida</i> PI: George Philippidis – FIU
	<i>Energy Intensive Crop Development</i> PI: Gary Peter , Matias Kirst, Don Rockwood - UF
	<i>Water-Use Efficiency and Feedstock Composition of Candidate Bioenergy Grasses in Florida</i> PI: Lynn E. Sollenberger Co-PI's: John Erickson, Joao Vendramini, Robert Gilbert - UF
Biochemical Conversion	
	<i>Development of Biofuel Production Processes From Synthetic and Biomass Wastes</i> PI: Pratap Pullammanappallil - UF
	Assessment and Development of Pretreatment for Sugarcane Bagasse to Commercialize Cellulosic Ethanol Technology PI: George Philippidis - FIU
	<i>Engineering Biocatalysts for Hemicelluloses Hydrolysis and Fermentation</i> PI: James F. Preston - UF
	<i>Thermophilic Biocatalysts for the Conversion of Cellulosic Substrates to Fuels and Chemicals</i> PI: K.T. Shanmugam - UF
Bio gasification	
	<i>Combined Cooling, Heat, Power, and Biofuel from Biomass and Solid Waste</i> PI: William Lear - UF
Thermo-Chemical Conversion	
	<i>Production of Liquid Fuels Biomass via Thermo-Chemical Conversion Processes</i> PI: Babu Joseph Co-PI's: Yogi Goswami, Venkat Bhethanabotla, John Wolan, Vinay Gupta - USF
	<i>Integrated Florida Bio-Energy Industry</i> PI: Ali T-Raissi Co-PIs: Nazim Muradov, Amit Gujar, Gary Bokerman - USF
	<i>Biofuels Through Thermochemical Processes: a Systems Approach to Produce Bio-jet Fuel</i> PI: Anjaneyulu Krothapalli
THRUST 4: Harnessing Florida's Solar Resources	
Solar Thermal	
	<i>Concentrating Solar Power Program</i> PI: Charles Cromer Co-PI: R. Reedy – UCF/FSEC

	<i>Enhanced and Expanded Solar Thermal Test Capabilities</i> PI: J. Walters Co-PI: R. Reedy – UCF/FSEC
	<i>Solar Fuels for Thermochemical Cycles at low pressures</i> PI: Jörg Petrasch – UCF/FSEC
	<i>Solar Thermal Power for Bulk Power and Distributed Generation</i> PI: David Hahn, James Klausner, Renwei Mei, Joerg Petrasch, and Helena Weaver - UF
	<i>Design, Construction and Operation of CSP Solar Thermal Power Plants in Florida</i> PI : Yogi Goswami Co-PI's: Lee Stefanakos, David Hahn, Robert Reddy - USF
	<i>Solar Water Heating Systems Facility</i> PI: James Roland, David Block – UCF/FSEC
Clean Drinking Water	
	<i>Solar Driven Desalination</i> PI: James Klausner and Skip Ingley
	<i>Clean Drinking Water using Advanced Solar Energy Technologies</i> PI: Lee Stefanakos Co-PI's: Yogi Goswami, Matthias Batzill, Maya Trotz, Sessa Srinivasan - USF
Low Cost PV Manufacturing	
	<i>Enhanced and Expanded PV Systems Testing Capabilities at FSEC</i> PI: S. Barkaszi Co-PI: R. Reedy - USF
	<i>Development of High Throughput CIGS Manufacturing Process</i> PI: N. Dhere – UCF/FSEC
	<i>PV Manufacturing Data Base and Florida Applications</i> PI: R. Reedy Co-PI: D. Block – UCF/FSEC
	<i>Development of Low Cost CIGS Thin Film Hot Carrier Solar Cells</i> PI: Gjs Bosman, Co-PI: Tim Anderson
	<i>Solar Photovoltaic Manufacturing Facility to Enable a Significant Manufacturing Enterprise within the State and Provide Clean Renewable Energy</i> PI: Don Morel, USF; Co-PI's: Chris Ferekides, USF, Lee Stefanakos, USF, Tim Anderson, UF, Neelkanth Dhere, FSEC
Advanced PV Device Program	
	<i>Research to Improve Photovoltaic (PV) Cell Efficiency by Hybrid Combination of PV and Thermoelectric Cell Elements.</i> PIs: Nicoleta Sorloaica-Hickman, R. Reedy – UCF/FSEC
	<i>Research and Develop PV Device Science and Laboratories</i> PI: Nicoleta Sorloaica-Hickman, Robert Reedy – UCF/FSEC
	<i>Beyond Photovoltaics: Productionizing of Rectenna Technology for Conversion of Solar radiation to Electrical Energy</i> PI: Shekhar Bhansali Co-PI's: Lee Stefanakos, Yogi Goswami, Jing Wang - USF
PV Integration	
	<i>PV Energy Conversion and System Integration</i> PI: N. Kutkut Co-PI's: J. Shen, I. Batarseh, Z. Qu, X. Wu, W. Mikhael, L. Chow - UCF
	<i>Non-Contact Energy Delivery for PV System and Wireless Charging Applications</i> PI: Jenshan Lin - UF
	<i>An Integrated Sustainable Transportation System</i> PI: Eric Wachsman Co-PI: Shirley Meng
PV/Storage/Lighting	
	<i>Planning Grant: Hydrogen storage using carbon-based adsorbent materials</i> PI: Efstratios Manousakis - FSU
	<i>PV Power Generation Using Plug-in Hybrid Vehicles as Energy Storage</i> PI: J. Shen Co-PI's: I. Batarseh, N. Kutkut - UCF

	<i>Integrated PV/Storage and PV/Storage/Lighting Systems</i> PI: Franky So, Co-PI: Jiangeng Xue, Shirley Meng - UF
THRUST 5: Ensuring Nuclear Energy & Carbon Constrained Technologies for Electric Power in Florida	
	<i>Reducing Residential Carbon Emission in Florida: Optional Scenarios Based on Energy Consumption, Transportation, and Land Use</i> PI: Tingting Zhao, Co-PI: Mark Horner - FSU
	<i>Planning Grant: Enhanced Thermal Performance and Microstructure Simulation of Nuclear Fuels</i> Justin Schwartz - FSU
	<i>Biocatalytic Lignin Modification for Carbon Sequestration</i> PI: Jon Stewart - UF
	<i>Carbon Capture and Sequestration</i> PI: Sabine Grunwald. Co-PIs: Tim Martin, Howard Beck - UF
	<i>Creation of Carbon Sequestration Data, Technologies and Professional Cohorts for Florida</i> PI: Mark Stewart, Co-PIs: Jeffrey Cunningham, Yogi Goswami, Maya Trotz - USF
THRUST 6: Exploiting Florida's Ocean Energy Resources	
	<i>Center for Ocean Energy Technology</i> PI: Susan H. Skemp, Co-PI's: R. Frederick Driscoll and Howard P. Hanson - FAU
	<i>Buoy Array for Ocean Wave Power Generation</i> PI: P.I. Z. Qu, Co-PI: K. Lin - UCF
THRUST 7: Securing our Energy Storage and Delivery Infrastructure	
	<i>Reliable and Resilient Electrical Energy Transmission and Delivery Systems</i> PI: Steinar Dale - FSU
	<i>Microgrids for a Sustainable Energy Future</i> PI: Chris S. Edrington Co-PIs: Jim Zheng, Mischa Steurer, Dave Cartes - FSU
	<i>Multi-Generation Capable Solar Thermal Technologies</i> PI: A. Krothapalli; Co-PI: Brenton Greska -FSU
	<i>Planning Grant: Real-Time Power Quality Study For Sustainable Energy Systems</i> PI: Dr. U. Meyer-Baese, Co-PIs: Helen LI, Simon Foo, Anke Meyer-Baese, Juan Ordonez - FSU
	<i>Planning Grant: Advancing Knowledge of Network Theory for Analysis and Design of Smart Power Grids</i> PI: Svetlana V. Poroseva Co-PIs: Yousuff Hussaini, Per Arne Rikvold - FSU
	<i>Investigating the Effect of Appliance Interface Design on Energy-use Behavior</i> PI: Paul Ward; Co-PIs: Ian Douglas, David Eccles - FSU
	<i>Energy Delivery Infrastructure Design and Simulation</i> PI: Alex Domijan Co-PI: Arif Islam - USF
	<i>Micro Battery Defense Development</i> PI: Chunlei Wang - FIU
	<i>Electrostatic Spray Deposition of Nanostructured Porous Metal Oxide Composite</i> PI: Chunlei Wang - FIU
	<i>Fabrication and Investigation of Porous Tin Oxide Anodes for Li-Ion Micro Batteries</i> PI: Chunlei Wang - FIU
Policy and Other	
	<i>Environmental Impacts of Energy Production Systems: Analysis, Evaluation, Training, and Outreach</i> PI: Amy B. Chan-Hilton Co-PIs: Gang Chen, Wenrui Huang, Michael Watts, Ming Ye, Paul Lee - FSU
	<i>Promoting Energy and Land Use Through Land Use, Transportation and Green Infrastructure Policies</i> PI: Tim Chapin; Co-PIs: Ivonne Audirac, Chris Coutts, and Greg Thompson, Department of Urban & Regional Planning, and Mark Horner, Department of Geography - FSU
	<i>Marketing Strategies to Incentivize Entrepreneurship and Innovation in the Development of Sustainable and Environmentally Friendly Goods and Services</i>

	PI: Joe Cronin - FSU
	<i>Energy Sustainable Florida Communities</i> PI: Richard Fieock, Co-PIs: Ivonne Audirac, Keith Ihlanfeldt - FSU
	<i>Political and Economic Institutions Regarding Siting of Energy Facilities: “Hold Out” and “NIMBY” problems, with concurrent developments in undergraduate education.</i> PI: R. Mark Isaac, Co-PI's: Douglas Norton, Svetlana Pevnitskaya - FSU
	<i>Development of a Renewable Energy Research Web Portal</i> PI: Charles R. McClure, Co-PIs: Ian Douglas, Chris Hinnant - FSU
	<i>Energy and Efficiency Video Public Service Announcements</i> PI: Andy Opel, Co-PIs: Phil Steinberg, Leslie France-Patterson, Laura Arpan, Ian Weir - FSU
	<i>An Experimental Investigation of Economic Incentives of Policies, Institutions and R&D in Environmental Conservation, Sustainability and Renewable Energy</i> PI: Svetlana Pevnitskaya, Co-PI: Dmitry Ryvkin - FSU
	<i>Planning Grant: Meteorological Factors Affecting Solar Energy Efficiency in the Tropics</i> PI: Paul Ruscher, Co-PIs: Yaw Owusu, Hans Chapman - FSU
	<i>Planning Grant: Climate modeling and outreach activities</i> PI: Shawn R. Smith, Co-PI: Steve Cocke - FSU
	<i>Visiting Scholar in Energy and Land Use Law, Florida State University College of Law</i> PI: JB Ruhl and Jim Rossi, Co-PIs: Uma Outka - FSU
Education and Outreach	
	<i>Florida Advanced Technological Education Center (FLATE)</i> PI: Marilyn Barger – Hillsborough Community College
	<i>Outreach Activities for FESC</i> PI: Pierce Jones, Kathleen C. Ruppert, Hal S. Knowles III, Nicholas Taylor, Barbra Larson, Craig Miller - UF
	<i>UFTR Digital Control System Upgrade for Education and Training of Engineers and Operators</i> PI: Alireza Haghghat - UF

NEW PROGRAM DEVELOPMENT

The goal of the new program development effort is to significantly impact energy-related research, education, and outreach programs within the SUS. The strategies include:

- Provide exploratory research funding
- Facilitate competitive responses to solicitations; in particular larger-scale center proposals
- Serve as a communications hub

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. 85 funding opportunities were distributed to the FESC faculty during this period. The list of funding opportunities is given in Appendix C. The funding opportunities are also posted at the FESC web site: http://www.floridaenergy.ufl.edu/?page_id=912. Faculty teams were formed to respond to the funding opportunities based on the responses received from the faculty. The FESC office facilitates proposal development in a variety of ways beyond solicitation awareness, including identifying leaders, communicating with external partners in industry, national labs and other non-SUS universities, providing professional technical writing help, arranging telecons, and assisting with cost share development, budgets and boiler plates.

Finding partners outside of Florida is critical to respond to nationwide calls such as the Energy Innovation HUBS. A database of FESC expertise information, including faculty biographies, has been prepared in several areas such as Algae, Solar to Fuels, and Energy Efficiency and posted at FESC web site to better communicate to potential partners the capabilities of the SUS research enterprise. FESC responded to all three Hub solicitations (1- Fuels from Sunlight, 2- Simulation for Nuclear Reactors, 3- E-RIC).

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

Competitive Funding Opportunities			
Title	Call #	Agency	Funding
Solar America Cities-Technical Outreach	DE-FOA-0000086	US DOE	\$10.5M (\$500K-\$6M);
Energy Innovation Hub-Fuels from Sunlight	DE-FOA-0000214	US DOE/NETL	\$122M
Energy Innovation Hub-Modeling and Simulation for Nuclear Reactors	DE-FOA-0000170	US DOE/Office of Nuclear Energy	\$122M
Fiscal Year (FY) 2010 Energy Efficient Building Systems Regional Innovation Cluster Initiative	E-RIC	US DOE, DOC, EDA,NIST/MEP, DOL, ED,SBA, NSF	\$129M
Science Master's Program (SMP)	NSF 09-607	NSF	\$14.7M; 21 Awards
NSF ERC: Energy Systems for a Sustainable Future	NSF-09-545	NSF	\$18.5M for 5 yrs
CHE-DMR-DMS Solar Energy Initiative (SOLAR)	NSF 09-604	NSF	\$7M (\$500K per year); 3 to 10 Awards
i6 Challenge	FFO	FFO	\$1M each for a project period of up to two years



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, and provide our students with an unparalleled educational experience to prepare them as R&D and innovation leaders of tomorrow. FESC's industrial collaboration program is designed to be an effective and efficient avenue for industry to guide FESC activities and benefit from the research, education and outreach activities of the

Consortium. The program promotes a meaningful exchange between the partner universities and industrial partners from small, medium, and large companies, as well as other organizations such as incubators, research parks, investors, entrepreneurs, and government laboratories.

The progress for this period is given below:

FECC Funded Study: Energy Efficiency and Renewable Energy in Florida

At the behest of Florida Energy and Climate Commission, the Governor's Energy Office asked FESC to provide a framework for transition to clean and renewable energy sources, and energy efficiencies, with regard to market driven forces. The report examined three areas:

- Current Incentive Mix (both State and Federal)
- Cleantech Barriers to Commercialization and Project Finance
- Effects of Regulatory Change – RPS Implementation

FESC reviewed existing statutory incentives supporting the deployment of energy efficiency and renewable energy in Florida, then discussed effective mechanisms to overcome barriers to commercialization and project finance. The report culminated with an analysis of a potential state renewable portfolio standard. The study provided baseline recommendations toward the next step in renewable energy and energy efficiency strategic planning and implementation. The study was submitted to the Florida Energy and Climate Commission on February 26th, 2010. The executive summary and full report are posted at: http://myfloridaclimate.com/climate_quick_links/florida_energy_climate_commission/policy_and_resources2/florida_energy_systems_consortium_economic_analysis and also at the FESC web site.

The study was performed by: Erik Sander, UF, Ted Kury, UF PURC, Dr. Julie Harrington, FSU CEFA, Jack Sullivan, FRC, and Dr. Aster R. Adams

Industrial Collaboration

Multi-university Proposal Industrial Partnerships

FESC researchers have identified number of partnering companies and entities for broad research projects and proposals as shown below.

Energy Innovation Hub-Fuels from Sunlight : \$122M (5 years)
FESC Universities: USF (Lead), UF, UCF

External Collaborators: Sandia National Laboratories, Savannah River National Laboratory (SRNL), Oak Ridge National Laboratory (ORNL), Scripps Energy Laboratories (FL), Draper Laboratory, University of Virginia, Georgia Institute of Technology (GIT), Emory University, Tuskegee University, North Carolina A&T State University, West Virginia University, University of Georgia, Yale University

Industry Partners: FPL, Eastman Chemical Company, Universal Oil Products, General Catalyst Partners, Rock Port Capital

Energy Efficient Building Systems Regional Innovation Cluster Initiative (E-RIC): \$129.6M (5 years)

FESC Universities: UCF (Lead), USF, UF, FSU, FIU

External Collaborators: FL MEP, FL SBDC, Florida High Tech Corridor Council (FHTCC), University of IL, ACEEE, Brevard (Workforce), Central Florida (Workforce), Daytona State College, Mid Florida Tech, Osceola Tech Education Center, Seminole State College (SSC)

Industry Partners: Lighting Science Group (Melbourne, Florida) and Sunovia (Sarasota), Coastal Caisson, Dais Analytic, ICS of Florida, Kingspan, LSG, PGT, Windoor, GTI

Energy Innovation Hub-Modeling and Simulation for Nuclear Reactors : \$122M (5 years)

FESC Universities: UF

External Collaborators: University of Utah (Lead), Texas A&M University, Penn State University, Ohio State University, University of Missouri, University of Nevada, Wright State University, New Jersey Institute of Technology

Industry Partners: General Electric Hitachi, Energy Solutions, Edison Welding Institute, Oli Systems LLC, ARETE Inc. , Aspen Tech, Battelle

U.S. China Clean Energy Research Center (CERC): \$12.5M (5 years)

FESC Universities: FIU (Lead), UF, USF, UCF

External Collaborators: Univ. of Nevada, Lighting Research Center at the Rensselaer Polytechnic Institute, Xi'an Jiao Tong University (Xi'an), Tsinghua University (Beijing), Tongji University (Shanghai), Southeast University (Nanjing), Chongqing University (Chongqing), Tianjin University, Center for Building Information, Ministry of Housing and Urban and Rural Development (MOURD), China, NREL, and ORNL

Industry Partners: Future House Real Estate Co., China Academy of Building Research (CABR), Ingersoll Rand Company (Trane's current owner), American Lighting Association (ALA), IBM, Academician of China Academy of Sciences, CNLight, South Gas Company

Industrial Collaboration Project Examples

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

- Collaboration with NASA Glenn Research Center

Canan Balaban, Associate Director, Industrial Collaboration & Commercialization, visited NASA Glenn on March 24, 2010 and gave an overview presentation about FESC and the Florida Institute for Sustainable Energy (FISE) at UF. NASA Glenn requested an MOU between NASA Glenn and FESC. We are working on a draft document to finalize the MOU. NASA Glenn is interested in green energy and they have developed a sophisticated "Green Lab" with advanced algae technology and various eco systems including salt resistance algae and halophytes. Their goal is to have a test bed in Florida especially at the Kennedy Space Center. We are collaborating with the Spaceport

Research & Technology Institute to find a suitable place for potential algae and halophytes test bed in Florida. NASA scientists introduced us to an Israel based company looking for a power company in US with CO₂ source and available land to implement their algae technology. We established contact between this company and TECO for potential partnership.

- Collaborations in Energy Storage Programs

SAFT received \$95M grant from the U.S. Department of Energy with \$95M cost share to build a 235,000-square-foot plant in Jacksonville FL. SAFT has 16 wholly owned facilities worldwide and six in the United States, has more than 2 million lithium-ion battery customers around the world. FESC leadership team is communicating with SAFT management. In addition, FESC faculty was introduced to the SAFT key research scientist. SAFT is planning to build up to 1MW PV on the roof of the new manufacturing facility with their grid level storage. FESC is in discussions with SAFT team to use this installation as a hands-on training experience for FESC undergraduate and graduate students combined with internship opportunities at their manufacturing facility.

As part of the team forming effort to respond to the anticipated Energy Storage Hub solicitation, FESC leadership team is in touch with Sandia National Lab and other national labs, universities, and companies.

This represents only a small set of examples of the industrial collaborations that FESC is initiating.

FESC-Wide Blanket Confidentiality Agreement

As FESC increases its service to the SUS universities, faculty and student researchers are exploring greater numbers of industrial collaboration opportunities that include multiple universities working together. One challenge that will arise as this model is scaled up is the need to foster open discussion while protecting valuable confidential information and intellectual property of the SUS universities and the companies with which they work. Technical discussions that involve a private sector collaborator (e.g. company, entrepreneur, and investor) and multiple universities can be impeded by the requirements to execute multiple university confidentiality agreements. To proactively address this issue, FESC initiated negotiation of the SUS's first blanket confidentiality agreement that spans FESC's core universities (FAU, FIU, FSU, UCF, UF, and USF). This blanket confidentiality agreement is a single instrument which a collaborating company can execute to freely discuss opportunities for research and technology collaborations with any of FESC's core universities. The FESC wide NDA was approved and the executed copy was sent to all the FESC core universities. It was used for the Hub proposals for the first time.

Technology Commercialization

FESC has a relatively limited budget dedicated specifically to spurring industrial collaboration and technology commercialization and the leadership team has consulted with partners and stakeholders from academia, the private sector, government-based entities, and economic development organizations across Florida to design our technology commercialization programs.

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. FESC is funding 15 business plans and market research studies at \$7.5K each for FESC funded later stage technologies. FESC distributed a Request for Proposals to all SUS universities to initiate a competitive selection process. In response, the SUS universities submitted 27 proposals of leading energy technologies for market studies and business plans. FESC convened a panel of energy industry leaders, venture capitalists, and energy policy experts to review and down select to 15 projects that were selected for business plans and market research analyses. These deliverables can be used by FESC, the university technology licensing offices, and the Institute for Commercialization of Public Research to attract private sector partner for technology licensing and development or further sponsored research in the host university. The 15 projects selected for business plans and market research studies are:

University	Project	Energy Field
FIU	Novel Fabrication Method of Nanoscale Fibers and Tubes	Energy Storage and Distribution
FIU	Synthesis of Hydrides and the Vehicular Use of Hydrogen Producing Reactions	Renewable Fuels
FSU	High Efficiency Multijunction PVs for Solar Energy Harvesting	Solar Energy
FSU	Multi-Piece Wind Energy Blades	Wind Energy
FSU	Microgrid Controllers & Solar Wind Distributed System Controls	Energy Storage and Distribution
UCF	High Efficiency Air Conditioning Condenser Fan Blades	Energy Efficiency
UCF	Milling Technology Leads the Way to Cost Effective Ethanol Production	Bio-energy
UCF	Hybrid PV and Thermoelectric Cell Elements Improve Solar Cell Efficiency	Solar Energy
UCF	Wind and Solar Battery Chargers	Energy Storage and Distribution
UF	Advanced Membrane Reactors for H ₂ Production	Renewable Fuels
UF	ChromaDynamics	Energy Efficiency
UF	Highly Efficient, Long-Life, Weather Compatible Nanomaterials-Based Display	High Performance Display Technologies
UF	High Power, Fuel Flexible, Cost-Effective Solid Oxide Fuel Cell	Energy Storage and Distribution
USF	Enhanced Lead Sulfide Quantum Dots for Solar Cells	Solar Energy
USF	A Practical Method of CO ₂ Sequestration	Carbon Capture and Sequestration

- 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 of up to 5 such projects and with industry match (summarized in table below) on each project, attracting in excess of \$500K of industry support to these FESC funded projects.

FESC Phase II Company Match

Company Match	2:1 Cash & 2:1 In-Kind for large companies (100+ employees) 1:1 Cash & 1:1 In-kind for small companies (<100 employees)
FESC Award	\$20K - \$50K annual award

The solicitation was prepared and sent to FESC technology transfer offices on May 5, 2010. The proposals are due on June 25, 2010.

The review committee has been formed. The committee members are:

- Tim Anderson, Director, FESC
- Frank Bevc, Director Technology Policy, Siemens Power
- Canan Balaban, Associate Director, FESC
- Tommy Boroughs, Partner, Holland & Knight, LLP
- Rob Caldwell, VP of Efficiency and Innovative Technology, Progress Energy
- Randy C. Parsley, Director, Global Program Dev., Pratt & Whitney
- Erik Sander, Director, Industry Programs, UF

EDUCATION

The Education program has three focus areas, community college programming at the Associate of Science and certificate level, nuclear energy education, and a Masters 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 Bachelors 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, which now operates five nuclear power plants (FPL and PEF).

Efforts in the Area of Masters Degree:

The Department of Mechanical and Aerospace Engineering (MAE) at the University of Florida, is planning to offer an M.S. degree with an emphasis on Energy. Students will need to complete a total of 10 courses. The MAE Department is also developing an Energy Certificate program in which engineering practitioners can complete one of three different tracks. These tracks include I. Solar Energy, II. Wind Turbines, and III. Gas Turbines. Practitioners who complete three courses within a specified track will be awarded an energy certificate within that specified track.

Dr. Alvin Culaba, FSU, has begun work enhancing an existing Sustainable Energy degree program in the Mechanical Engineering department's Master of Science degree at the FAMU/FSU College of Engineering. He is building on the original efforts of Anjaneyulu Krothapalli of the FSU Energy and Sustainability Center. The concept is to create a prototype for a University-wide Professional Science Master's (PSM) with the ultimate goal of the existing program becoming the basis for establishing an entrepreneurship-based program with two degree tracks: (1) Natural & Engineering Science majors and (2) Social Science & Business majors. The existing program is targeted at students who are interested in the science, technology, engineering, and mathematics as well as applications and policy matters of sustainable energy. The new program will provide students with additional skills to address many of the energy and sustainability challenges faced by the nation and the world, specifically business and management.

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

semesters. The industry partners will provide summer-long internship, 1:1 industrial mentor, co-instruction of key courses.

FAU, USF, and FIU submitted a consortium proposal to NSF proposing to develop and deliver a multidisciplinary science master degree program in renewable energy and sustainability for fall 2010.

Efforts in the Area of On-line Education:

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

UF also offers a certificate program on Sustainable Engineering that is designed for engineering and science professionals. The program offers three courses that can be completed within a year. Brochure Link: http://www.ufedge.ufl.edu/pdf/brochure/Sustainable_Certificate_Brochure.pdf

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

The UFTR is being upgraded to a fully digital control system. 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 two major areas:

- i) Design of the new digital system
- ii) Preparation and submission of licensing documentation to the NRC

A design for the AREVA’s TXS protection system has been completed. Figure 1 shows the components of this design. The UFTR-TXS system includes three major components: Acquisition and Processing (AQP), Monitoring Service Interface (MSI), and Main Control Room (MCR). This design will be housed into two cabinets as shown in Figures 2a and 2b. Cabinet 1 includes the AQP and all the signal processing units, and the Cabinet 2 includes the MSI and all the MCR components.

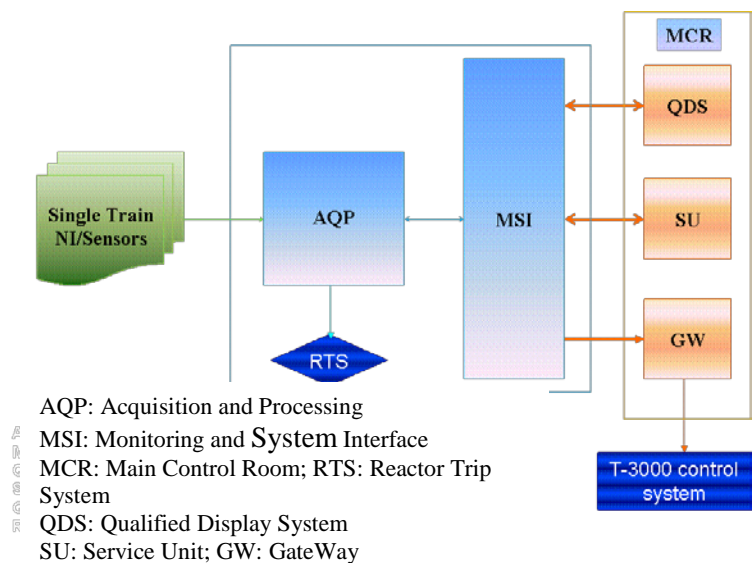


Fig. 1 - Schematic of the UFTR-TXS Protection System

With support from AREVA, several important documents were prepared, and since Jan 2010, seven documents were submitted to the NRC.

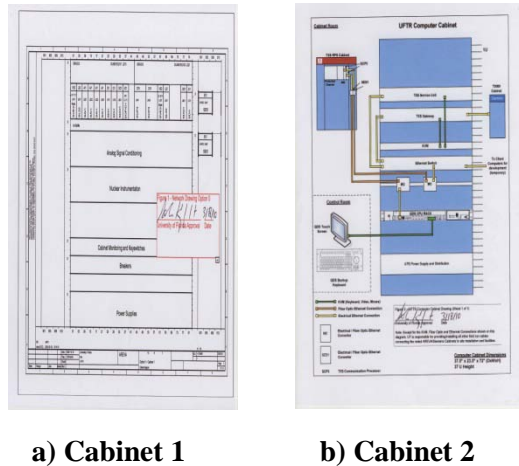


Fig. 2 – Schematic of UFTR-TXS protection system in two cabinets

Florida Advanced Technological Education Center (FLATE)

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 is in the process of developing and processing through the FLDOE the industry-validated student competencies of the frameworks. FLATE will also develop new courses required for each new program of study. Additionally FLATE will help state and community colleges implement the new frameworks in their institutions.

During the current reporting period, FLATE partnered with 10 Florida community colleges and their local industry to define curriculum standards for alternative energy that support industry needs, made several presentations both within and outside of Florida, and is working with Brevard Community College for a fall implementation of the Alternative Energy Systems Certificate. In April, FLATE added Jorge Monreal to the team as Project Manager to help drive implementation of this FESC project.

Specific accomplishments during the period are:

- 11/18/09 Presentation on Energy Curriculum in Florida at Interstate Renewable Energy Council’s (IREC) third “New Ideas in Educating a Workforce in Renewable Energy and Energy Efficiency” Conference. (Albany, NY)
- 2/2/10 Co-presented, with Drs. Tim Anderson and Pierce Jones, to the Florida House Committee for Public Universities and Private Colleges Policy
- 3/10/10 Facilitated the approval by FL DOE of the new curriculum framework for Alternative Energy Technology Specialist (CIP: 0615000003) as a College Credit Certificate program under the Engineering Technology AS/AAS degree program. Brevard Community College (BCC) will adopt in Fall 2010.
- 4/5/10 Added Jorge Monreal as Project Manager- FESC project
- 4/23/10 Presented overview of FESC and its interactions with two year A.S. programs at the spring state wide Engineering Technology Forum held at FSCJ at Jacksonville.

5/7/10

Meeting with Broward College Associate Dean for A.S. programs to discuss alternate energy specialization in the state wide Engineering Technology A.S. degree program

The immediate focus is to help BCC implement the new Alternative Energy Technology Specialist program for the Fall of 2010 by helping to develop curriculum for the introductory course, as well as providing any necessary aid in other courses. Additionally, FLATE is partnering with BCC on an NSF grant to support curriculum development and outreach for college energy programs and degrees.

In the next few months, FLATE in partnership with the FLDOE will conduct a survey to assess what, if any, alternative/renewable energy courses are currently being offered at public state and community colleges, private colleges and high schools. This follow-up to the 2009 Greensforce Florida survey will focus on specific courses currently offered at public and private 2-year degree granting institutions. It will also request enrollment data in courses and programs.

A list of Florida companies with products or services in the Alternative/Renewable energy sector is in the process of being compiled. The goal is to create industry focus groups to assess workforce education needs.

FLATE has partnered with FESC public outreach to develop a professional development workshop to be offered on July 27 at the Hi-TEC conference in Orlando.

OUTREACH

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

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

Outreach Team Members:

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

The progress made is given below:

Energy/Climate Awareness Fact Sheets: Completed four fact sheets for the FESC website with eight more currently in various stages of completion. Additional topics have been determined.

Energy Extension Service: Offered two homeowner classes on energy efficient building construction in Florida. Natural Resources and Florida Yards and Neighborhoods faculty were informed about FESC opportunities and information via articles in their respective state-wide newsletters. Held *Emerging Energy Issues and Topics* in-service training in Gainesville on 3/18 for county faculty representing 16 counties in which the emphasis was updating them on information and activities in support of FESC and to increase their knowledge on specific energy related topics of current and future interest to them and their clientele. This training primarily centered on alternatively fueled vehicles, including viewing of same. The panel discussion on alternatively fueled vehicles was repeated on the same day for the general public. Promoted county activities in three counties hosting green-related activities of local interest. Gave two presentations as part of in-service training program for Family and Community Sciences faculty. A number of other energy and climate related presentations have been conducted around the state. Barbra Larson is a member of the Climate Variability and Change Focus Team that has an in-service training set for June 16-17.

Demand Side Management: Creating protocol to accurately quantify consumption reductions due to various energy efficiency programs. Analyzing energy implications of ENERGY STAR qualified new homes program. Analyzing programmatic effects of DSM programs from various utilities. Working with utilities to streamline DSM programs based on analysis results. Creating documents that will include implications of analysis results for policy makers and the general public. Working with utilities to design and implement a performance based demand side management program that uses smart controllers to reduce potable water

use for irrigation. Worked with Tampa Bay Water to assess the carbon footprint of alternative water supplies. Presented poster on same at Water Institute Symposium on 2/24 as well as a lecture titled *Land Development, Water and Accounting for Greenhouse Gas Emissions in Florida*.

Continuing Education: Offered continuing education classes on *Energy Efficient Building Construction in Florida*, *Low Impact Development*, *HVAC and IEQ*, and *Green Advantage* during this reporting period. Additional classes are being scheduled for this summer—see <http://buildgreen.ufl.edu> as they are scheduled. *Greenhouse Gas Reduction and Energy Conservation: Development Impacts Under Florida's HB 697* is a 110+ page manual published in October 2009 and used as a workbook in the first continuing education class conducted. This for sale manual is under revision and will be used in the next series of CEU classes in May with the goal to present local officials, planners and development professionals with the new requirements of growth management regulations.

Demonstration House: Continued work with Pinellas County Extension on structuring their \$475,000 earmarked grant to build a demonstration facility.

Workforce Development: Working with Osceola County Extension and the Technical Education Center-Osceola on the Osceola Energy Initiative (EECBG) project that received funding through the Florida Energy and Climate Commission. Exploring collaborative opportunities for grant funding for Weatherization Innovation Pilot Program with Sarasota County and the Community Weatherization Coalition.

Alternatively Fueled Vehicles: Held in-service training and panel discussion for the public on PHEV Prius and charging station, potential for PHEV and EVs in Florida, Solar Electric Low Speed Vehicles, Solar Bicycle ASES Photon, Compressed Natural Gas, Liquefied Natural Gas and Liquefied Petroleum Gas, and Bio-diesel 3/18 in Gainesville. Working with Progress Energy to evaluate performance of PHEV using converted Toyota Prius equipped with GPS tracking system and software to monitor performance. FESC publications on AFVs are planned.

Collaboration on New Initiatives: Extending energy analysis techniques to assist utilities across the state. PREC will be working with Florida DCA on analysis of the Federal Weatherization Assistance program. This project will quantify energy savings for up to 19,000 participating households across the State of Florida. Results of this analysis will provide valuable feedback about post consumer impacts of various common demand side management techniques.

The Florida Legislature recently passed enabling legislation allowing local political jurisdictions to establish property assessed clean energy (PACE) financing programs. PREC is developing a manual for Florida to help guide these jurisdictions in the process for energy efficient retrofits of existing housing and applying for a grant from the Doris Duke Charitable Foundation to establish a pilot PACE program with the city of St. Cloud.

FESC Web Site Updates – FESC web site (www.FloridaEnergy.ufl.edu) is being updated periodically to keep it current and to better serve the users. The Public Outreach menu now has the following submenus (http://www.floridaenergy.ufl.edu/?page_id=2183):

- Upcoming Events
- Energy/Climate Awareness Fact Sheets
- Energy Extension Service
- Educational Programs/Workshops
- Demonstrations
- Consulting
- Public Service Announcements

- FESC Research Areas, News and Expertise

An automated Really Simple Syndication (RSS) feeds from over 2,500 academic journals within Science Direct using key word filters for each FESC Thrust Area are listed on “[FESC Research Areas, News and Expertise](#)” page (sub menu). Locating the latest research news from these Science Direct journals, as well as within Scientific American and Discover Magazine, on energy and climate related issues using RSS feeds is a distinct benefit for individuals seeking current research information on specific topics of interest. In addition, FESC faculty with specific expertise can now be easily located through these Thrust Area summaries. The outreach group is also working towards creating a new, shorter web address for use in PSAs that are being produced by FSU.

Based on Google Analytics report, FESC web site was viewed by 15,519 Google visitors (we are not tracking the users of other web browsers) during the period of May 2009 to May 2010. The viewers visited 51,637 pages. The viewers were from North and South America, Europe, Asia, Australia, and Africa (total of 108 countries).

Proposals Submitted by the Outreach Group (11/1/09 - 4/30/10)

- 1- Proposal title: Energy Tracking Software Platform
Submitted: 11/20/09
Agency and Grant Program: U.S. DOE Annual Phase I Small Business Innovation Research (SBIR) Grant, Funding Opportunity Number DE-FOE-0000161
PREC is a subcontractor under this grant submitted by Acceleration and will provide data and analysis support to Acceleration’s project to expand the Gainesville-Green web-based energy data platform
Subcontract Amount: \$19,843
Status: Awarded
- 2- Proposal title: Alachua County Retrofit Ramp-Up Program
Submitted: 12/14/09
Agency and Grant Program: U.S. Department of Energy (USDOE), Energy Efficiency and Conservation Block Grants (EECBG) program (Number DE-FOA-0000148), Topic 1
PREC supported Alachua County on their grant application by providing a letter of leveraged activities
Subcontract Amount: None; PREC provided \$715,977 in leveraged activities
Status: Not Funded
- 3- Proposal title: Osceola Grows Green Initiative
Submitted: 12/14/09
Agency and Grant Program: U.S. Department of Energy (USDOE), Energy Efficiency and Conservation Block Grants (EECBG) program (Number DE-FOA-0000148), Topic 2
PREC supported Osceola County on their grant application by providing a letter of leveraged activities and was included as a proposed subcontractor
Subcontract Amount: \$101,192
Status: Not Funded
- 4- Proposal title: Florida Planning Officials Environmental Education Program Submitted: 12/15/09
Agency and Grant Program: EPA Environmental Education Grant Program
Amount: \$124,966
Status: Pending
- 5- Proposal title: Development of a Municipal Energy Efficiency Program for the City of Charleston
Submitted: 1/14/10
Agency and Grant Program: City of Charleston

PREC was a subcontractor on this grant submitted by EcoAsset Solutions LLC
Subcontract Amount: \$87,474
Status: Not funded

- 6- Proposal title: Florida Weatherization Training Center: Supporting Green Jobs and Safe Weatherization
Submitted: 1/21/10
Agency and Grant Program: DOE Recovery Act - Weatherization Assistance Program Training Centers and Programs
Activities through a Self-Sustaining Statewide Training Network
Amount: \$979,421
Status: Pending
- 7- Proposal title: Reducing Greenhouse Gas Emissions at the Source in New Master Planned Communities
Submitted: 2/4/10
Agency and Grant Program: EPA Source Reduction Assistance Grant Program
Amount: \$ 129,990
Status: Not funded
- 8- Proposal title: Osceola Energy Initiative
Submitted: 2/12/10
Agency and Grant Program: Florida Energy and Climate Commission Energy Efficiency and Conservation Block Grants (EECBG) for Non-Entitled Cities and Counties
Subcontract Amount: \$263,000
Status: Funded
- 9- Proposal title: Weatherization Assistance Program Evaluation
Submitted: 3/9/10
Agency and Grant Program: Florida Department of Community Affairs, DOE American Recovery and Reinvestment Act Weatherization Assistance Program funds
Amount: \$452,769
Status: Awarded, in contract
- 10- Proposal title: Providing the Foundation for Resource Efficient Communities: A Strategy for Reducing Pesticide Risk in Master Planned Residential Development
Submitted: 4/15/10
Agency and Grant Program: EPA Pesticide Registration Improvement Renewal Act (PRIA 2) Partnership Grants
Amount: \$249,884
Status: Pending

FESC SUMMIT

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

The objective of the FESC summit is to facilitate collaboration among the state's multifaceted energy experts, resulting in new, systems-based innovations toward sustainable energy solutions. The program supports FESC's mission to advance energy systems research, education, and outreach programs to serve Florida, the nation, and the world.



More than 160 people attended the first FESC Summit, held September 29-30, 2009 at the University of South Florida's Marshall Student Center. Participants represented a broad cross-section of energy interests, ranging from government and industry to research, development, and education. The Summit location will move to a different Florida academic institution every year so that faculty and students at all Florida colleges and universities can become involved in the vital process of developing a secure and sustainable energy future.

Planning for the 2010 summit is well underway. An internationally renowned keynote speaker is being identified to analyze the national and international energy outlook. Additionally, representatives from our legislative leadership will review Florida's state energy strategy and share their vision for how the state's investment in FESC is changing the lives of our citizens today and in the future. Invitees will include leaders from academia, government and industry. Energy researchers and educators from all 11 State

University System institutions, as well as Florida's community colleges, will have targeted opportunities to come together and build new, cutting-edge energy research and education programs. A poster session will provide participating graduate students an opportunity to present their research and to meet with the industry representatives and faculty from other universities.

Two pre-summit workshops are being considered for September 27, 2010. One will focus on Technology Transfer and Commercialization of new energy innovations. The second would be a collaborative effort between the Program for Resource Efficient Communities <http://buildgreen.ufl.edu/>, and the Southeast Climate Consortium <http://www.seclimate.org/>, which would address climate change and variability as it relates to energy and building efficiency.

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

OTHER ACTIVITIES

FESC program was promoted at the following events/conferences/meetings:

- Clean Energy Webinar, Nov 12, 2009
- The United Nations Conference on Climate Change, Dec 12-19, 2009, Copenhagen
- Federal Laboratories in the Southeast US Region, Jan 21, 2010, Naples, FL
- American Ceramic Society (Electronic Materials and Applications 2010), Jan 22, 2010, Orlando, FL
- Comprehensive Energy and Climate Policy (workshop with IBM), Jan 26, 2010, Washington DC
- Green Renewable Oceanic Technology Transfer, February 22-23, 2010 Orlando, FL
- 2nd UF Water Institute Symposium, February 25, 2010, Gainesville, FL
- Offshore Ocean Energy: A University-Industry-Government Dialog, March 4, 2010, Boca Raton, FL
- 2010 Applied Surface Analysis and FL AVS/FSM Annual Joint Symposium & Exhibition, March 7-10, 2010, Orlando, FL
- NIST Diffusion Workshop March 23-24, 2010, Maryland
- NASA Glenn Research, March 24, 2010, Cleveland, OH
- 2nd Annual Florida Alliance for Renewable Energy Conference, March 26 - 28, 2010, Orlando, FL
- International Conference on Eng. and Meta-Engineering: ICEME 2010, April 8, 2010, Orlando FL
- 2010 International IEEE Microwave symposium, May 23-28, 2010, Anaheim, CA
- U.S. Department of Energy Program Review, May 24-27, 2010, Washington, DC
- Congressional Briefing: Oil and Water in the Gulf - Status of the Spill and How Gulf States University Researchers are Assisting, Assessing and Advising, May 26, 2010, Washington DC

APPENDIX A – DESCRIPTION OF RESEARCH PROJECTS

Projects	Summary
THRUST 1: Overarching	
	<p>Title: Power Generation Expansion under a CO₂ Cap-and-Trade Program PI: Tapas Das Co-PI's: Ralph Fehr Description: The objectives of the proposed research are to 1) develop a comprehensive generation technology based portfolio optimization (GTPO) model and its solution algorithm, and 2) 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 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.</p> <p>Budget: \$71,906 University: USF</p>
	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: PV Energy Conversion and System Integration (Thrust 4: Solar)
	Title: An Integrated Sustainable Transportation System (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)
THRUST 2: Enhancing Energy Efficiency and Conservation	
	<p>Title: Innovative Proton Conducting Membranes for Fuel Cell Applications & Protein Enhanced Proton Conduction Membranes for Advanced Fuel Cells PI: Ongi Englander, Co-PIs: Anant Paravastu, Subramanian Ramakrishnian</p> <p>Description: The objective of this proposal is to establish new research directions in the development of proton conducting materials for fuel cell applications. We will build novel high surface area silica particle based membranes as supports, and infuse in them newly discovered proton conducting protein nanomaterials as well as oxide-based nanocomposites. In order to test electrical transport mechanisms, we will build microfabricated electric testing structures, and subsequently integrate materials with fuel cell test setups.</p> <p>Budget: \$30,000 University: FSU</p>
	<p>Title: Sustainably Integrated Advanced Building Subsystems (OGZEB) PI: A. "Yulu" Krothapalli, Co-PI: Justin Kramer Description: This project focuses 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 is the Off-Grid Zero Emissions Building, which will allow for the testing of these subsystems</p>

	<p>Budget: \$503,168 University: FSU</p>
	<p>Title: Insight into Membrane Degradation Mechanisms Through Verification of Chemical and Mechanical Degradation Test Capabilities PI: Darlene Slattery Co-PI's: Len Bonville, Xinyu Huang, Marianne Rodgers Description: The objectives of the program are 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 will be revealed. .</p> <p>Budget: \$324,000 University: UCF/FSEC</p>
	<p>Title: Energy Efficient Building Technologies and Zero Energy Homes PI: R. Vieira Co-PI's: P. Fairey, J. Sonne 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.</p> <p>Budget: \$1,224,000 University: UCF/FSEC</p>
	<p>Title: Joint Optimization of Urban Energy-Water Systems in Florida PI: James P. Heaney Student: Miguel Morales (M.E.) 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.</p> <p>Budget: \$72,000 University: UF</p>

[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

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 following tasks are proposed to FSU for funding of the planning grant “High Performance and Low Cost Fuel Cells for Future Vehicles”. The proposed tasks will be 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 will be conference proceedings and journal papers and proposal submissions for additional funding.

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.

Title: NIRT: C-MEMS/CNEMS for Miniature Biofuel Cells

PI: Marc Madou, Co-PIs : Chunlei Wang, Sylvia Daunert and Leonidas Bachas

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 propose to integrate 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 biofuel 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)

	University: FIU
	<p>Title: Fabrication of Nano Fractal Electrodes for On-Chip Supercapacitors PI: Chunlei Wang 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.</p> <p>Budget: \$150,000 Universities: FIU</p>
	<p>Title: Energy Efficient Technologies and The Zero Energy Home Learning Center PI: Stanley Russell Co-PI's: Yogi Goswami Graduate Assistant: Mario Rodriguez 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 Zero Energy Home Learning Center [ZEHLC] 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.</p> <p>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</p> <p>Budget: \$344,600 University: USF External Collaborators: FSU, UF, UCF</p>
THRUST 3: Developing Florida's Biomass Resources	
High Energy Crops	
	<p>Title: Establishment of the Center for Marine Bioenergy Research Systems Approach to BioEnergy Research (SABER) PI: Joel E. Kostka Co-PIs: William Cooper, Ivonne Audirac, Amy Chan-Hilton, Ellen Granger Description: This proposed SABER research center will blend fundamental and applied research to:</p> <ol style="list-style-type: none"> 1. Develop sustainable, biologically-based fuel alternatives and renewable energy strategies.

	<p>2. Capture, recycle or clean up environmental pollution (greenhouse gases, excess nutrients) associated with energy production and use. Equally important to our research goals will be partnering with public and private institutions to immediately implement our research for the benefit of society. Biosolutions will be rapidly incorporated into the solid waste treatment and power plant industries. We will partner with the other IESES groups to promote awareness that the near-term realization of clean, cost-effective energy alternatives will occur only through a multidisciplinary systems-based approach from research to planning and implementation. We will assure sustainability by assessing the environmental impacts and promoting the mitigation of those impacts of alternative energy technologies on the geosphere.</p> <p>The centerpiece of the proposed project will be the development of sustainable practices for the production of transportation fuels from algal biomass feed-stocks. Algal cultivation practices will also be incorporated into industrial processes such as CO₂ capture and sequestration from coal-fired power plants and wastewater treatment.</p> <p>Budget: \$494,135 Lead University: FSU</p>
	<p>Title: Constructual Optimization of Solar Photo-Bioreactors for Algae Growth PI: Juan Ordonez Description: This is a planning grant (15K, only). As such, the work proposed, will be 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 expect to: (i) have a complete design of a small-scale photo-bioreactor for algae growth and, (ii) obtain additional funds that will allow us to build a large-scale photo-bioreactor and conduct the necessary research for its optimal design and operation. A technical report will be delivered by the end of the one-year period.</p> <p>Budget: \$15,000 University: FSU External Collaborators: Federal University of Parana, Brazil</p>
	<p>Title: Seeding Biofuel Entrepreneurship in South Florida PI: George Philippidis</p> <p>Description: FIU's Pino Global Entrepreneurship Center has provided seed funding to facilitate the development of algal biofuels technologies in South Florida. The project's goal is to identify fast-growing high-lipid content native algae that will form the basis for lipid conversion to biofuels. A collection of Florida algae will be screened to select the one(s) with promising growth and lipid potential. Growth conditions will be manipulated to understand the effect of key process variables of lipid productivity. Cells will be harvested for lipid extraction and conversion to biodiesel using FIU's pilot-scale transesterification system. In parallel, biofuels will be introduced into the FIU curriculum to seed the development of a workforce educated and skilled in renewables.</p> <p>Budget: \$15,000 University: FIU</p>
	<p>Title: Energy Intensive Crop Development PI: Gary Peter , Matias Kirst, Don Rockwood 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</p>

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
University: UF

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
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 seasons. The development of high yielding production systems for energy crops that can be grown in Florida is considered essential for establishment of a sustainable biomass to energy industry. This is the case because long-term availability of sufficient amounts of reasonably priced biomass will be an important determinant of if and where new biofuel and bioenergy facilities will be built. Because of its size and large number of climatic zones, there will be large regional differences in what energy crops can be used at various locations in Florida and how they will perform. In this project, we are conducting applied research at locations throughout Florida with sweet sorghum, sugarcane, energycane, giant reed, miscanthus, erianthus, and elephantgrass to provide important agronomic practice, yield, water use, and chemical composition information for Florida growers, bioenergy producers, and policy makers. This information will support decision making regarding which crops are adapted to specific environments, which are best suited to particular management practices (e.g., irrigation or none), and which have the desired chemical composition for the intended bioenergy use.

Investigators in the project include Dr. Lynn Sollenberger and Dr. John Erickson (agronomists at University of Florida), Dr. Joao Vendramini (agronomist at the Range Cattle Research and Education Center at Ona, FL), and Dr. Robert Gilbert (agronomist at the Everglades Research and Education Center at Belle Glade, FL). Three graduate students all started their graduate programs in August 2009. External collaborators include Speedling, Inc., which provided planting material of miscanthus.

Budget: \$191,981
University: UF
External Collaborators: Speedling, Inc.

Biochemical Conversion

Title: Development of Biofuel Production Processes From Synthetic and Biomass Wastes
PI: Pratap Pullammanappallil
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

	<p>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</p> <p>Budget: \$192,000 Universities: University of Florida External Collaborators: University of Central Florida</p>
	<p>Title: Assessment and Development of Pretreatment for Sugarcane Bagasse to Commercialize Cellulosic Ethanol Technology PI: George Philippidis Description: The project's objective is to identify a biomass pretreatment process that can cost-effectively convert sugarcane bagasse to an enzymatically digestible and fermentable mix of sugars as a means for determining the commercialization potential of Florida biomass conversion to ethanol fuel. The key objectives are: (1) Assess the lab-scale efficacy of pretreatment processes on sugarcane bagasse; (2) Scale up the most promising bagasse pretreatment process based on the lab scale results; (3) Optimize the pretreatment process to derive design and operation data for commercial-scale bagasse-to-ethanol facilities; and (4) Integrate the critical unit operations to assess the techno-economic feasibility of the bagasse-to-ethanol technology. The FIU-FCC team constitutes a unique public-private partnership with in-depth knowledge of the technology and its shortcomings (19 years of experience by the PI in this field) and experience in commercial agro-energy operations.</p> <p>Budget: \$1,918,306 University: FIU</p>
	<p>Title: Engineering Biocatalysts for Hemicelluloses Hydrolysis and Fermentation PI: James F. Preston 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.</p> <p>Objectives are to:</p> <ol style="list-style-type: none"> 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 <p>Budget: \$192,000 University: UF 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,</p>

	Forest Resources and Conservation
	<p>Title: Thermophilic Biocatalysts for the Conversion of Cellulosic Substrates to Fuels and Chemicals PI: K.T. Shanmugam 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 °C to 50-55 °C, 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, <i>Bacillus coagulans</i>, 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. <i>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.</i></p> <p>Budget: \$192,000 University: UF</p>
Bio gasification	
	<p>Title: Combined Cooling, Heat, Power, and Biofuel from Biomass and Solid Waste PI: William Lear 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.</p> <p>Budget: \$479,813 University: UF External Collaborators: Siemens Power Generation, Florida Turbine Technologies, Energy Concepts Co., Alturdyne, Inc., LPP Combustion, Planet Green Solutions.</p> <p>Back to Thrust 1: Overarching</p>

Thermo-Chemical Conversion

Title: Production of Liquid Fuels Biomass via Thermo-Chemical Conversion Processes

PI: Babu Joseph **Co-PI's:** Yogi Goswami, Venkat Bhethanabotla, John Wolan, Vinay Gupta

Description: The objective of this project is to develop technology for the economical thermo-chemical conversion of lignocellulosic 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

University: USF

External Collaborators: Prado & Associates

Title: Integrated Florida Bio-Energy Industry

PI: Ali T-Raissi **Co-PIs:** Nazim Muradov, Amit Gujar, Gary Bokerman

Description: The aim of this project is to produce liquid hydrocarbon fuels derived from Florida based biomass utilizing a two-step process. In the first step, biomass or biomass-derived pyrolysis oils are gasified with oxygen and steam to synthesis gas (syngas) comprised of mostly hydrogen, carbon monoxide and carbon dioxide gas. For this step, an oxygen source is employed (e.g. oxygen concentrator, electrolytic unit, etc.) for biomass gasification. Use of pure (or nearly pure) oxygen for gasification of biomass allows higher overall process energy conversion efficiency by eliminating nitrogen dilution in the syngas. In the second step, syngas from step 1 is fed into a Fischer Tropsch (FT) synthesis unit and converted to liquid hydrocarbon fuels, e.g., diesel fuel. The process can be employed with any lignocellulosic material including crop residues, forest waste, yard clippings, and energy crops. The technology also provides a means for sequestering carbon in the form of a high-value soil enhancing bio-char (terra preta) by simple modification of the gasification step 1.

Budget: \$648,000

University: UCF/FSEC

Title: Biofuels Through Thermochemical Processes: a Systems Approach to Produce Bio-jet Fuel

PI: Anjaneyulu Krothapalli

Description: The program addresses the emerging needs for aviation industry to have cost effective alternative liquid transportation biofuels. The main objectives are to produce bio-jet and bio-diesel fuels from cellulosic biomass and nonedible bio-oils and demonstrate that they have cost structure and product quality comparable to petroleum based fuels. 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. 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. The proposed approach can also convert the more challenging lignocellulosic component. Through molecular manipulations, the proposed approach allows the production of "designer" biofuels. The technology offers a means to tailor product properties through saturation of double bonds to give better shelf life, cleaving long chain hydrocarbons to maximize the yield of the jet cut, controlling aromatics content of the jet cut for better combustion characteristics, and isomerization to improve ignition

characteristics and for better cold flow properties of the fuel. Successful deployment of research program in biofuels can mean billions of dollars per year in fuel cost savings for aviation industry. It also opens the door for energy independence and distributed fuel generation capability.

An 11 kw Downdraft gasifier is installed and began its operation in April 2010. A prototype steam gasification with external heating module has been designed and built. The hydrodynamic testing of the proof of concept dual fluidized bed steam gasification process has been successfully tested.

Budget: \$229,572

Universities: FSU

External Collaborators: NA

THRUST 4: Harnessing Florida's Solar Resources

Solar Thermal

Title: Concentrating Solar Power Program

PI: Charles Cromer **Co-PI:** R. Reedy

Description: Solar concentrating systems use mirrors to focus sunlight onto receiver pipes at the focal point of the mirrors and are one of the lowest-cost centralized solar power options. After many years of applications, solar concentrating technology has the ability to produce electricity for about \$0.10/kWh in the desert southwest. This technology holds high promise for Florida and could also produce low cost solar electricity assuming it can meet production goals. The objective of this R&D project is to advance concentrating technologies by conducting an analytical study of Florida solar resource in order to predict the performance of the concentrating solar application and then to perform experimental test and evaluation of the predicted results.

Budget: \$52,000

University: UCF/FSEC

External Collaborators: FPL

Title: Enhanced and Expanded Solar Thermal Test Capabilities

PI: J. Walters **Co-PI:** R. Reedy

Description: The project focus was to increase the collector testing reliability, efficiency and capability to meet the market demands for 3rd party independent testing. The project focused on eight (8) projects

- Implement interim testing/certification protocol to streamline quality products to market.
- Design, install and qualify wind systems for collector test platforms
- Convert test platforms to allow all 3 type of collector testing on one platform.
- Automate portions of qualification tests for improved reliability and efficiency
- Increase capability by adding more test stands
- Convert to new control system for improved test reliability and data storage
- Develop automated testing protocol to increase efficiency.
- Design and implement information control system to improve efficiency in record capture, data capture and report generation.

Budget: \$654,295

University: UCF/FSEC

External Collaborators: Solar thermal manufacturers

	<p>Title: Solar Fuels for Thermochemical Cycles at low pressures PI: Jörg Petrasch Description: Using concentrated solar energy to produce hydrogen-rich, carbon-neutral energy carriers via two-step thermochemical cycles is an intriguing concept for tomorrow's energy economy. Concentrated solar energy drives high temperature endothermic metal oxide (MO) reduction reactions. Reaction products are used to produce hydrogen from water or CO from CO₂. In turn, hydrogen and CO may be used to synthesize carbon neutral methanol or methane. At atmospheric pressures, temperatures above 2000 K are necessary for the MO reduction reactions, causing a range of material and design issues. This project aims at lowering the MO reduction temperature by reducing the reaction pressure. M/MO redox reactions at low pressures will be experimentally investigated in a state-of-the art high flux solar simulator. Furthermore, undesired product recombination is less likely under rarefied conditions. Associated efforts will be directed at developing chemical kinetics and multi-phase, multi-scale process models. Process temperature reduction and a better understanding of the underlying physicochemical phenomena will move solar thermochemistry towards commercialization and make it attractive for Florida's high-technology and energy industry.</p> <p>Budget: \$ 100,000 Universities: UF External Collaborators: NA</p>
	<p>Title: Solar Thermal Power for Bulk Power and Distributed Generation PI: David Hahn, James Klausner, Renwei Mei, Joerg Petrasch, and Helena Weaver 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.</p> <p>Budget: \$446,400 University: UF</p>
	<p>Title: Design, Construction and Operation of CSP Solar Thermal Power Plants in Florida PI : Yogi Goswami Co-PI's: Lee Stefanakos, David Hahn, Robert Reddy 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.</p>

	<p>Budget: \$882,000 Universities: USF, UF, UCF External Collaborators: Calnetix Power Solutions Back to Thrust 1: Overarching</p>
	<p>Title: Solar Water Heating Systems Facility PI: James Roland, David Block Description: The objective of the task was to design with air conditioning (A/C), develop construction drawings, obtain permits and then hire a construction firm to add the walls, windows, doors and A/C to an existing FSEC roof facility. The enclosing of this existing space was done for the purpose of increasing laboratory space and to allow for conducting tests on solar water heating systems and PV inverters. The action was taken following a study which determined this project was the most cost effective means of adding valuable laboratory space. Budget: \$600,609 University: UCF/FSEC</p>
Clean Drinking Water	
	<p>Title: Solar Driven Desalination PI: James Klausner and Skip Ingley Student: Fadi Alnaimat/ Ph.D Description: With the advancement of renewable energy utilization for seawater desalination, solar energy is projected to be a promising energy source for seawater distillation. The current approach is to develop a low temperature solar energy driven distillation process that is based on direct evaporation and condensation of water vapor through a packed bed using an air stream. Transient one-dimensional conservation equations have been developed to analyze the heat and mass transfer within direct-contact evaporators and condensers. Closure models have been specified. The conservation equations are solved numerically using a finite difference scheme to predict water, air/vapor mixture and packed bed temperatures in the evaporator and the condenser. The heat and mass transport model accounts for the transient variations within the packed-bed due to changes in the inlet air and water temperature over the course of the experiment. Set of experiments are conducted and used to validate the transient models. The developed model will be used to predict fresh water production at various operating conditions. The transient computer model will be used to design solar driven desalination plants and analyze the economics of construction and operation. Budget: \$252,000 University: UF</p>
	<p>Title: Clean Drinking Water using Advanced Solar Energy Technologies PI: Lee Stefanakos Co-PI's: Yogi Goswami, Matthias Batzill, Maya Trotz, Sessa Srinivasan The availability of fresh water is a big problem facing Florida. In many locations, Florida's water is contaminated from leaky underground tanks and agricultural pesticides. Although salt-water desalination is possible, conventional systems are too energy intensive. Solar energy can supply the power, and innovative vacuum and humidification/dehumidification desalination systems can provide adequate fresh water for the state's needs. This team will develop water desalination for small community needs and also in bulk. Another goal is to develop photocatalytic disinfection to remove contaminants and integrate these technologies with solar PV for complete water supply systems. Projects include: Natural Vacuum Solar Flash Desalination: Creating vacuum conditions above liquids increase their evaporation rates. This phenomenon can be integrated into a practical continuous desalination process by repeatedly flashing</p>

	<p>seawater in vacuumed chambers to produce water vapor that will be condensed producing fresh water. Solar PV Assisted Photocatalysis for Air/Water Disinfection: Improving titanium dioxide photocatalysts for purification and disinfection of water and air contaminated with organic, heavy metal and microbiological species, using solar energy. This can be integrated into a practical continuous desalination process by flashing seawater in vacuum chambers to produce water vapor that will be condensed, producing fresh water.</p> <p>Budget: \$326,756 Universities: USF External Collaborators: NA</p>
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Low Cost PV Manufacturing	
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	<p>Title: Enhanced and Expanded PV Systems Testing Capabilities at FSEC PI: S. Barkaszi Co-PI: R. Reedy 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 and certify 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 PV program.</p> <p>Budget: \$196,018 University: UCF/FSEC</p>
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	<p>Title: Development of High Throughput CIGS Manufacturing Process PI: N. Dhere Description: A reduction in the cost of CIGS and other thin PV film modules is required for large-scale PV applications. The goal of this project is 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. 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.</p> <p>Budget: \$141,620 University: UCF/FSEC Back to Thrust 1: Overarching</p>
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	<p>Title: PV Manufacturing Data Base and Florida Applications PI: R. Reedy Co-PI: D. Block Description: The overall goal of this project is to assist in the stimulation of the development of a photovoltaic (PV) manufacturing industry in Florida. The project objective is to conduct a review of the 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).</p> <p>Budget: \$81,120 University: UCF/FSEC</p>
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	<p>Title: Development of Low Cost CIGS Thin Film Hot Carrier Solar Cells PI: Gjs Bosman, Co-PI: Tim Anderson</p>
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Description: The absorber material α -CuIn_xGa_{1-x}Se₂ CIGS falls into the class of solar cells termed thin film photovoltaics. This technology uses a direct bandgap absorber material (CIGS) with a high absorption coefficient. Thus the absorber layer is very thin, which the use of inexpensive substrates (glass, stainless steel, polymer). Continued decrease in the cost of CIGS PV will likely result by increasing the device efficiency and increasing the processing throughput. One segment of this research 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 photoexcited 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. To address throughput and materials utilization, a novel chemical vapor deposition approach is being developed that promises lower growth temperature and higher deposition rate. The process uses the chlorides of the Cu and group III metals along with elemental Se in a countercurrent configuration.

Budget: \$450,000
University: UF

Title: Solar Photovoltaic Manufacturing Facility to Enable a Significant Manufacturing Enterprise within the State and Provide Clean Renewable Energy
PI: Don Morel, USF; **Co-PI's:** Chris Ferekides, USF, Lee Stefanakos, USF, Tim Anderson, UF, Neelkanth Dhere, FSEC
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
Universities: USF, UF, UCF/FSEC
External Collaborators: NovaRay Solar, Bedford, MA; Brightwats, Inc., Ft. Lauderdale, FL; US Department of Energy, National Renewable Energy Lab

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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, R. Reedy
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

	<p>University: UCF/FSEC</p> <p>Back to Thrust 1: Overarching</p>
	<p>Title: Research and Develop PV Device Science and Laboratories PI: Nicoleta Sorloaica-Hickman, Robert Reedy 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.</p> <p>Budget: \$882,507 University: UCF/FSEC</p>
	<p>Title: Beyond Photovoltaics: Productionizing of Rectenna Technology for Conversion of Solar radiation to Electrical Energy PI: Shekhar Bhansali Co-PI's: Lee Stefanakos, Yogi Goswami, Jing Wang 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.</p> <p>Budget: \$598,500 Universities: USF External Collaborators: Sandia National Laboratory</p>
PV Integration	
	<p>Title: PV Energy Conversion and System Integration PI: N. Kutkut Co-PI's: J. Shen, I. Batarseh, Z. Qu, X. Wu, W. Mikhael, L. Chow 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.</p> <p>Budget: \$1,267,000 University: UCF</p> <p>Back to Thrust 1: Overarching</p>
	<p>Title: Non-Contact Energy Delivery for PV System and Wireless Charging Applications PI: Jenshan Lin</p>

	<p>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.</p> <p>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.</p> <p>Budget: \$252,000 University: UF</p>
	<p>Title: An Integrated Sustainable Transportation System PI: Eric Wachsman Co-PI: Shirley Meng 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 H₂, with resultant efficiency losses, followed by losses due to H₂ transport and storage. Therefore, on a system-basis SOFCs hold the potential for producing the least CO₂/kWh from conventional fuels, and if designed to operate on biofuel would in effect be carbon neutral and operating on a renewable resource. <i>If developed this vehicle would be a transformational change in transportation technology.</i></p> <p>Budget: \$594,000 Universities: UF External Collaborators: Solid-State Energy Technology, Inc., Lynntech, Inc., Planar Energy Devices, Inc., CFX Battery, Inc.</p> <p>Back to Thrust 1: Overarching</p>
PV/Storage/Lighting	
	<p>Title: Planning Grant: Hydrogen storage using carbon-based adsorbent materials PI: Efstratios Manousakis Description: We propose to theoretically investigate 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 propose to carry out a full theoretical investigation to find the optimum conditions.</p> <p>Budget: \$15,000 University: FSU</p>
	<p>Title: PV Power Generation Using Plug-in Hybrid Vehicles as Energy Storage</p>

PI: J. Shen **Co-PI's:** I. Batarseh, N. Kutkut
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
University: UCF
External Collaborators: City of Tavares, FL

Title: Integrated PV/Storage and PV/Storage/Lighting Systems
PI: Franky So, **Co-PI:** Jiangeng Xue, Shirley Meng
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
University: UF

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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
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/fuel consumption patterns. The objective of this project is to explore energy and fuel sustainability as well as CO₂ mitigation in Florida by investigating the household-level energy and transportation fuel consumption and by analyzing changes in land use. The project consists of three major steps: 1) calculating the baseline Florida CO₂ 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 efficiency options based on a residential survey; and 3) forecasting energy/fuel demand and CO₂ emission levels in 2017 and 2025 throughout the state of Florida based on the scenarios created in step two. This project helps identify and determine the efficacy of various proposed practical energy incentives for household energy consumption reduction and carbon mitigation. It provides insights into the possible effectiveness of economic and policy tools for sustainable energy consumption and greenhouse gas reduction.

Budget: \$60,844

	<p>University: FSU</p>
	<p>Title: Planning Grant: Enhanced Thermal Performance and Microstructure Simulation of Nuclear Fuels PI: Justin Schwartz Description: The objective of this proposal is 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, we will pursue 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 include 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. We will conduct an evaluation of possible coating processes and measure their thermal behavior. We will use these findings to pursue external funding.</p> <p>Budget: \$15,000 University: FSU</p>
	<p>Title: Biocatalytic Lignin Modification for Carbon Sequestration PI: Jon Stewart 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.)</p> <p>Budget: \$200,000 University: UF</p>
	<p>Title: Carbon Capture and Sequestration PI: Sabine Grunwald. Co-PIs: Tim Martin, Howard Beck Description: Rising CO₂ 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.</p> <div> </div>

	<p>Budget: \$199,440 University: UF</p>
	<p>Title: Creation of Carbon Sequestration Data, Technologies and Professional Cohorts for Florida PI: Mark Stewart, Co-PIs: Jeffrey Cunningham, Yogi Goswami, Maya Trotz Description: Rising concerns over increasing levels of green house 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.</p> <p>Budget: \$479,640 Universities: USF External Collaborators: TECO; USGS; Environmental Consulting & Technology, Inc.</p>
<p>THRUST 6: Exploiting Florida's Ocean Energy Resources</p>	
	<p>Title: Center for Ocean Energy Technology PI: Susan H. Skemp, Co-PI's: R. Frederick Driscoll and Howard P. Hanson Description: The Center for Ocean Energy Technology's (COET) program is structured to be the catalyst that will enable the ocean energy industry in Florida toward determining solutions to answering the state's energy challenge. This project focuses on determining the potential of harnessing specifically the ocean current resource and ocean thermal energy conversion. The regulatory process at State and federal levels is not clearly defined nor the roles and interdependencies of the individual agencies clearly articulated. In addition, knowledge to make these decisions is more on a macro rather than micro level necessary to assess individual devices. COET'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.</p> <p>Budget: \$8,750,000.00 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 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 (Minerals Management Service), U.S. Department of Commerce (National Oceanic and Atmospheric Administration), and Florida Department of Environmental, Protection, to name a few.</p>
	<p>Title: Buoy Array for Ocean Wave Power Generation PI: P.I. Z. Qu, Co-PI: K. Lin 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. As such, the buoy would simply need to be moored to the ocean floor and have cables to transport power to the</p>

shore, making it ideal for use in a multiple-unit wave farm. 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. Mathematical simulations have been developed to help optimize design parameters for use in subsequent prototype designs that will be able to be implemented in a wave pool or saltwater environment.

Budget: \$150,000

University: UCF

THRUST 7: Securing our Energy Storage and Delivery Infrastructure

Title: Reliable and Resilient Electrical Energy Transmission and Delivery Systems

PI: Steinar Dale

Co-PIs: Mischa Steurer, Kamal Tawfiq, Rick Meeker, Horatio Rodrigo

Description: The project 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 and microgrids, possible expansion of new very-large centralized baseload (nuclear), and incorporation of new power conversion, transmission, measurement, communication and control technologies. In addition, the system must continue to accommodate future demand due to population growth and expanded use of electrical power (including the possibility of more widespread electric transportation), continue to improve ability to survive and recover from extreme events, and deal with increasingly constrained siting options for generation, transmission, and distribution systems.

Budget: \$431,982

University: FSU

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Title: Microgrids for a Sustainable Energy Future

PI: Chris S. Edrington

Co-PIs: Jim Zheng, Mischa Steurer, Dave Cartes

Description: A microgrid strategy can provide a solution for meeting Florida’s sustainable energy needs; this effort focuses on the following:

- Reduce the number of system-wide power outages by providing islanding capabilities allowing grids to separate from each other, providing for a more stable and reliable power delivery infrastructure.
- Provide a framework in which non-traditional, low-carbon footprint, energy sources such as: wind, solar, and fuel cells can be easily integrated into the existing power system.
- Provide for intelligent energy management and increased efficiency via high-penetration levels of power electronics and control strategies.
- Provide for streamlined integration of both stationary and non-stationary energy storage devices as well as future energy conversion resources such as: ocean current and tidal.
- Directly address greenhouse gas targets.

Budget: \$719,333

University: FSU

Title: Multi-Generation Capable Solar Thermal Technologies

PI: A. Krothapalli; **Co-PI:** Brenton Greska

	<p>Description: The objective of the proposed research is 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.</p> <p>The development of an indoor solar simulator capable of providing and sustaining 1 kW/m² over an area of 10 m²</p> <p>The development of a Rankine cycle-based solar concentrating system that is capable of producing at least 2 kW of electricity adaptation and integration of small-scale absorption-based refrigeration systems that can employ the waste heat from the aforementioned Rankine system.</p> <p>Integration of existing membrane distillation technology for waste heat recovery from either, or both, of the above-mentioned technologies. Demonstration of a multi-generation system that combines all of the above-mentioned technologies.</p> <p>Budget: \$544,226 University: FSU</p>
	<p>Title: Planning Grant: Real-Time Power Quality Study For Sustainable Energy Systems PI: Dr. U. Meyer-Baese, Co-PIs: Helen LI, Simon Foo, Anke Meyer-Baese, Juan Ordonez Description: The main objective of this project is the collection of preliminary data for IESSES 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. Four tasks have been completed and one task is still ongoing. The remaining task will be performed by the CO-PIs and their graduate students at Florida State University.</p> <p>Budget: \$15,000 University: FSU</p>
	<p>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 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</p> <p>Budget: \$15,000 University: FSU</p>
	<p>Title: Investigating the Effect of Appliance Interface Design on Energy-use Behavior PI: Paul Ward; Co-PIs: Ian Douglas, David Eccles Description: The primary objective of this research project is 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</p>

	<p>lead to in/efficient energy use. To achieve these objectives this project uses 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.</p> <p>Budget: \$247,720 University: FSU</p>
	<p>Title: Energy Delivery Infrastructure Design and Simulation PI: Alex Domijan Co-PI: Arif Islam Description: The Power Center for Utility Explorations (PCUE) proposes 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 represent dynamic and transient behaviors of microgrids. We use test beds to study integrated systems of revolutionary distributed green generation, improved grid and home efficiency, and automated energy conservation technologies for residential, substation, and distribution scale energy systems Budget: \$485,184 University: USF</p>
	<p>Title: Micro Battery Defense Development PI: Chunlei Wang 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 University: FIU</p>
	<p>Title: Electrostatic Spray Deposition of Nanostructured Porous Metal Oxide Composite PI: Chunlei Wang 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</p>

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
University: FIU

Title: Fabrication and Investigation of Porous Tin Oxide Anodes for Li-Ion Micro Batteries
PI: Chunlei Wang
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
University: FIU

Policy and Other

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
Description: 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 addresses the FESC’s Thrust 6 on “Energy systems and their environmental and economic impacts.” This project also directly addresses the IESES’s Objective 4 on unique geographical challenges and Objective 5 on sustainable energy engineering, science and the sustainable energy economy.

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 are to:

1. Analyze the environmental and water resources demands and potential impacts, specific to Florida’s unique geographical challenges, of fuel cycle systems.

	<ol style="list-style-type: none"> 2. Develop an objective environmental impact screening and evaluation tool (i.e. decision support system) for energy planning and policy making by Florida’s industry, utilities, and government. 3. Provide outreach to industry, utilities, government to allow for discussion and better-informed decisions on energy strategy, regulation, and permitting. 4. Provide training on “Energy and the Environment” to ensure environmental stewardship without sacrificing energy production. <p>Budget: \$118,470 University: FSU External Collaborators: Florida Department of Environmental Protection</p>
	<p>Title: Promoting Energy and Land Use Through Land Use, Transportation and Green Infrastructure Policies</p> <p>PI: Tim Chapin; Co-PIs: Ivonne Audirac, Chris Coutts, and Greg Thompson, Department of Urban & Regional Planning, and Mark Horner, Department of Geography</p> <p>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.</p> <p>We continue to work on generating a report similar to the <i>Tough Choices: Shaping Florida’s Future and Facing Florida’s Revenue Shortfall</i> document prepared by the Collins Institute. This report summarizes the literature on the links between urban development patterns and energy sustainability/ climate change and makes recommendations for state policies and programs to address these issues. The intention is to author a report that is easy-to-read, including graphics, and will highlight the key policies and programs the state should pursue to achieve its energy sustainability and climate change goals.</p> <p>Budget: \$168,185 University: FSU</p>
	<p>Title: Marketing Strategies to Incentivize Entrepreneurship and Innovation in the Development of Sustainable and Environmentally Friendly Goods and Services</p> <p>PI: Joe Cronin</p> <p>Description: The objective of this project is 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 modalities that can be used to deliver sustainability knowledge to consumers (e.g. advertisements, testimonials, expert word-of-mouth communications, public relations, publicity, etc) will be assessed. Specifically, the research will attempt to identify the optimal market pull modality; that is, the means by which to deliver to consumers the</p>

	<p>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.</p> <p>Budget: \$191,555 University: FSU</p>
	<p>Title: Energy Sustainable Florida Communities PI: Richard Fieock, Co-PIs: Ivonne Audirac, Keith Ihlanfeldt Description: The objective of this proposal is to develop an energy sustainability index to measure local governments’ adoption and capacity to implement energy policy innovations in response to the provisions of new energy legislation in Florida. This measure will be applied to investigating factors influencing local government energy policy decisions and be disseminated to research and governmental decision-makers. The following tasks are proposed to FSU for funding: archival data collection; survey of local governments; construction of a Florida Sustainable Communities web site; statistical analysis, hold a workshop on sustainable energy governance in local government; preparation of reports; papers journal manuscripts and grant proposals.</p> <p>Budget: \$125,424 University: FSU</p>
	<p>Title: “Political and Economic Institutions Regarding Siting of Energy Facilities: “Hold Out” and “NIMBY” problems, with concurrent developments in undergraduate education. PI: R. Mark Isaac, Co-PI’s: Douglas Norton, Svetlana Pevnitskaya Description: The “holdout” problem occurs when one economic agent attempts to construct a portfolio of economic assets (often land) from multiple sellers. When a public good has diffuse public benefits but costs concentrated on a few, a “NIMBY” problem (Not In My Back Yard) may exist.</p> <p>Budget: \$79,621 Universities: FSU</p>
	<p>Title: Development of a Renewable Energy Research Web Portal PI: Charles R. McClure, Co-PIs: Ian Douglas, Chris Hinnant Description: This project will identify, organize, and make 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 primary tasks to be completed in this process include:</p> <ul style="list-style-type: none"> • Conduct needs assessment of IESSES and FESC energy researchers and related experts to determine (1) the most important content to be included in the web portal, and (2) preferences to be considered in the design of and applications for the web portal; • Identify and obtain relevant energy research information from IESSES and FESC and other sources as appropriate; • Develop a web portal such that identifies, organizes, and accesses energy research information; • Field test and conduct usability, feasibility, and accessibility testing on web portal; The goal of this project is to provide IESSES, FESC researchers, and others in the state of Florida with the research information they need to accomplish statewide energy goals and to help IESSES meet the thirteen objectives it has undertaken by providing access to research information. <p>Budget: \$194,542</p>

	University: FSU
	<p>Title: Energy and Efficiency Video Public Service Announcements PI: Andy Opel, Co-PIs: Phil Steinberg, Leslie France-Patterson, Laura Arpan, Ian Weir Description: This interdisciplinary team will produce 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.</p> <p>Budget: \$200,720 University: FSU</p>
	<p>Title: An Experimental Investigation of Economic Incentives of Policies, Institutions and R&D in Environmental Conservation, Sustainability and Renewable Energy PI: Svetlana Pevnitskaya, Co-PI: Dmitry Ryvkin 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. The methods of experimental economics allow for finding such deviations and their causes, and use the findings to modify theory and design better policies and institutions. In this project we construct a theoretical model of decisions in a dynamic environment with costs of pollution and climate change and employ laboratory experiments with human subjects to study actual behavior and explore responses to changes in the environment, production technologies, investment in clean technology and institutions.</p> <p>Budget: \$43,217 University: FSU</p>
	<p>Title: Planning Grant: Meteorological Factors Affecting Solar Energy Efficiency in the Tropics PI: Paul Ruscher, Co-PIs: Yaw Owusu, Hans Chapman Description: We wish to document the atmospheric factors that both limit and enhance solar energy utilization in this project, particularly those in the tropics. This will benefit Floridians as well as people in developing nations who wish to deploy solar technologies, to help them understand the benefits and limitations that they can expect to achieve.</p> <p>Budget: \$15,000 University: FSU</p>
	<p>Title: Planning Grant: Climate modeling and outreach activities PI: Shawn R. Smith, Co-PI: Steve Cocke 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 Institute for Energy Systems, Economics, and Sustainability (IESES). The focus of our activities has centered on evaluating the potential offshore wind resource in the northeastern Gulf of Mexico. Preliminary research has been completed using observations from instrumented Air Force towers and confirms the existence of wind power capacity 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. We seek interested collaborators from academia, industry, and government.</p> <p>Budget: \$15,000 University: FSU</p>

	<p>Title: Visiting Scholar in Energy and Land Use Law, Florida State University College of Law Principal Investigator: JB Ruhl and Jim Rossi, Co-PIs: Uma Outka Description: Two-year Visiting Scholar at the College of Law researching 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.</p> <p>Budget: \$214,603 University: FSU</p>
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Education and Outreach

	<p>Title: Florida Advanced Technological Education Center (FLATE) PI: Marilyn Barger Description: FLATE (Florida Advanced Technological Education Center) will partner with FESC to develop statewide curriculum frameworks for technical A.S./A.A.S. degree programs supporting existing and new energy business sectors. FLATE will develop and have processed through the FLDOE the industry-validated student competencies of the frameworks. FLATE will also develop new courses required for each new program of study. Additionally FLATE will help state and community colleges 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 professional development opportunities for teachers and faculty to upgrade and update their knowledge base.</p> <p>Budget: \$300,000 University: 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)</p>
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	<p>Title: Outreach Activities for FESC</p>
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	<p>PI: Pierce Jones, Kathleen C. Ruppert, Hal S. Knowles III, Nicholas Taylor, Barbra Larson, Craig Miller</p> <p>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</p> <p>External Collaborators: Primarily DCA, FSU, UCF (FSEC), USF, and DEP with many others as well</p>
	<p>Title: UFTR Digital Control System Upgrade for Education and Training of Engineers and Operators</p> <p>PI: Alireza Haghighat</p> <p>Faculty Participants: James Baciak, Edward Dugan, Gabriel Ghita, Glenn Sjoden & DuWayne Schubring</p> <p>Staff participants: Brian Shea and Matthew Berglund</p> <p>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.</p> <p>Budget: \$308,000</p> <p>Universities: UF</p> <p>External Collaborators: Several engineers from AREVA NP Inc & Siemens Corporation</p>

APPENDIX B – PROGRESS REPORTS FOR FESC FUNDED PROJECTS

APPENDIX C – FUNDING OPPORTUNITIES SENT TO FESC FACULTY

Competitive Funding Opportunities			
Title	Call #	Agency	Funding
Energy Innovation Hub-Fuels from Sunlight	DE-FOA-0000214	US DOE/NETL	\$122M
Energy Innovation Hub-Modeling and Simulation for Nuclear Reactors	DE-FOA-0000170	US DOE/Office of Nuclear Energy	\$122M
Systems Regional Innovation Cluster Initiative (E-RIC)	NA	US DOE, DOC, EDA,NIST/MEP, DOL, ED,SBA, NSF	\$126M
ARPA-E: Agile Delivery of Electrical Power Technology	DE-FOA-0000288	DOE	\$500K to \$10M; multiple awards
ARPA-E: Building Energy Efficiency Through Innovative Thermodevices	DE-FOA-0000289	DOE	\$500K to \$10M; multiple awards
ARPA-E: Grid-Scale Rampable Intermittent Dispatchable Storage Concept	DE-FOA-0000290	DOE	\$500K to \$10M; multiple awards
Solid State Electrical Distribution Unit	BAA-10-01-PKP	Air Force Research Lab	\$3.6M
Cade Prize for Innovation	NA	Cade Museum	\$50K
Learn and Serve America Higher Education FY2010	CNCS-GRANTS-121809-001	Corp. for National and Community Service	\$7.3M
Power and Energy	DARPA-BAA-09-31	DARPA	Multiple awards are anticipated
Limits of Thermodynamic Storage (LOTS) of Energy	DARPA-BAA-10-15	DARPA	Flexible
Information in a Photon	DARPA-BAA-10-19	DARPA	\$25M
Research and Development Solicitation	N0017810Q3903	Dept. of Navy/Naval Sea Systems Command	Flexible
High Impact Supply Chain R&D for PV Technologies and Systems	DE-FOA-0000234	DOE	\$30-40M
Computational Capabilities to Develop Materials for Advanced Fossil Energy Power Systems	DE-FOA-0000260	DOE	\$0.9 - 1.5 M
Weatherization Innovation Pilot Program	DE-FOA-0000309	DOE	\$30M
Engineering Design of Advanced H ₂ - CO ₂ Membrane Separations.	DE-FOA-0000215	DOE	\$20M
National Administrator of the Solar Instructor Training Network	DE-FOA-0000228	DOE	\$3-4.5M
Photovoltaic (PV) Manufacturing Initiative	DE-FOA-0000237	DOE	\$125M
Co-Production of Power, Fuels, and Chemicals via Coal/Biomass Mixtures	DE-FOA-0000240	DOE	\$4.5M
National Electric Sector Cyber Security Organization.	DE-FOA-0000245	DOE	\$5M in Year 1, \$3M in Year 2, and \$2M in Year 3,
Industrial Technologies Program Superior Energy Performance Program	DE-FOA-0000246	DOE	\$3.7-5M
University Turbine Systems Research	DE-FOA-0000248	DOE	\$2 - \$2.5M; multiple awards
Development of Innovative and Advanced Technologies for Geologic Sequestration.	DE-FOA-0000250	DOE	\$9.6M
SEP Strengthening Building Retrofit Markets and Stimulating Energy Efficiency Action.	DE-FOA-0000251	DOE	\$23 - \$26M for Strengthening Building Retrofit Markets \$2 - \$5M for Stimulating Energy Efficiency Action.
CO ₂ utilization	DE-FOA-0000253	DOE	\$5.6M
Coal Utilization Science	DE-FOA-0000261	DOE	\$4.8 - \$5.6M
Computational Capabilities to Develop Materials for Advanced Fossil	DE-FOA-0000260	DOE	\$0.9 - 1.5 M over 3

Energy Power Systems			years
High-Capacity Optical Networking and Deeply Integrated Middleware Services for Distributed Petascale Science	DE-FOA-0000264	DOE	\$3.5M
Terrestrial Carbon Cycle Research	DE-FOA-0000287	DOE	\$4M
Marine and Hydrokinetic Technology Readiness Advancement Initiative	DE-FOA-0000293	DOE	1.6 M
Nuclear Energy University Programs - Fellowship and Scholarship	DE-FOA-0000304	DOE	\$50K/yr up to 3 years, approx 30 awards
Subsurface Biogeochemical Research	DE-FOA-0000311	DOE	\$5M 15 to 20 awards
Smart Grid Research, Development, and Demonstration	DE-FOA-0000313	DOE	\$30M
Office of Fossil Energy FY2010 Energy and Water Appropriations Act R&D Projects.	DE-FOA-0000317	DOE	\$1,474,000
U.S. China Clean Energy Research Center (CERC).	DE-FOA-0000324	DOE	\$2.5M 1st year \$10M/yr in years FY 2012 - FY 2015
Research and Development for Next Generation Nuclear Physics Accelerator Facilities	DE-FOA-0000339	DOE	\$2M
Enhancing Short Term Wind Energy Forecasting for Improved Utility Operations	DE-FOA-0000280	DOE	
Energy Efficiency Retrofit Policies and Programs	Doris Duke Charitable Foundation:	Doris Duke Charitable Foundation:	range from \$100K to \$350K each
Activities that Advance Methane Recovery and use as a Clean Energy Source	EPA-OAR-CCD-10-02	EPA	\$5M (\$100K-\$750K); 35 agreements
Activities That Advance Methane Recovery And Use As A Clean Energy Source	EPA-OAR-CCD-10-02	EPA	\$5M
Community Action for a Renewed Environment (CARE) Program	EPA-OAR-IO-10-04	EPA	\$2M; level1(1-3 Awards), level 2 (4-6 Awards)
Small Business Innovation Research PHASE I	PR-NC-10-10251	EPA	\$80K
ARRA/Florida Clean Energy Grants (In draft form)	NA	FECC	\$10M (\$100K-\$500K)
ARRA/Compressed Natural Gas Fueling Infrastructure Program	NA	FECC	Ceiling \$50K
i6 Challenge	FFO	FFO	\$1M each for a project period of up to two years
Link Foundation Energy Fellowship	NA	Link Foundation	\$50K (in two installments of \$25K)
Proposed Research on Safety of Renewable Energy Operations in the US Outer Continental Shelf	BAA	MMS	\$500K
Regional Approaches to Sustainable Bioenergy	Program Area Code – A6101	National Institute of Food And Agriculture (NIFA)/ USDA	\$45 M
Software Development for Cyber infrastructure (SDCI)	NSF 10-508	NSF	\$15M; 25-30 Awards
Broadening Participation Research Initiation Grants in Engineering (BRIGE)	NSF 10-509	NSF	\$5M; 27-30 Awards
Proactive Recruitment in Introductory Science and Mathematics (PRISM)	NSF 10-511	NSF	\$3M; 2-4 Awards
Pan-American Advanced Studies Institutes Program (PASI)	NSF 10-517	NSF	\$1.2M; 10-16 Awards
Presidential Awards for Excellence in Science, Mathematics and Engineering Mentoring (PAESMEM)	NSF 10-520	NSF	\$400K; 16 Awards
Environmental Synthesis Center (ESC)	NSF 10-521	NSF	\$30M; 1 Award
Integrative Graduate Education & Research Traineeship Program (IGERT)	NSF 10-523	NSF	\$10.8M; 18 Awards
Advancing Theory in Biology (ATB)	NSF 10-525	NSF	\$5M; 8-10 Awards

Joint Domestic Nuclear Detection Office-NSF:ARI	NSF 10-526	NSF	\$58M(7-8 Awards)
Centers for Ocean Sciences Education Excellence (COSEE)	NSF 10-527	NSF	\$3.71M; 7 Awards
Major Research Instrumentation Program	NSF 10-529	NSF	\$90M; 150 Awards
Climate Change Education (CCE): Climate Change Education Partnership (CCEP) Program, Phase I (CCEP-I)	NSF 10-542	NSF	\$750K and \$1M total for 2 years, 10-15 Awards
NSF/DOE Partnership on Thermoelectric Devices for Vehicle Applications	NSF 10-549	NSF	\$500K per year for up to 3 years
Office of Special Programs	NSF PD 04-7222	NSF	Flexible
Cooperative Activity with DOE Programs for Education and Human Resource Development	NSF PD 07-1594	NSF	Flexible
Power, Controls, and Adaptive Networks (PCAN)	NSF PD 10-1518	NSF	Flexible
Energy for Sustainability	NSF PD 10-7644	NSF	Flexible
U.S. Nuclear Regulatory Commission Funding Opportunity Announcement, Nuclear Education Curricula Development Grant, Fiscal Year 2010	HR-FN-1009-EDU4	Nuclear Regulatory Commission	\$4.7M; 50 Awards
Joseph L. Fisher Dissertation Fellowships	NA	Resources for the Future (RFF)	\$18K for one academic year
Small Producer Program	NA	RPSEA	\$3.2M; 4-8 Awards
Call for Proposals by Lawrence Berkley National Laboratory (LBNL)	NA (Open)	The Molecular Foundry	Flexible
Measuring PM Emissions from Aircraft Auxiliary Power Units, Tires and Brakes	ACRP 02-17	TRB	\$50k
Alternative Fuels as a Means to Reduce PM2.5 Emissions at Airports		TRB	\$50k
Developing Environmental Protocols and Monitoring to Support Ocean Renewable Energy and Stewardship	M10PS00152	U.S. Dept. of the Interior, Minerals Management Service (MMS)	\$6.5M; 1 to 3 awards per topic (8 topics)
BIRD Energy	NA	U.S.-Israel/US DOE	\$1M
Research Interests of the United States Air Force Academy	USAFA-BAA-2009-1	United States Air Force Academy	\$50M
Dwight David Eisenhower Transportation Fellowship Program	DTFH64-10-RA-00001	US Dept. of Transportation	\$900K; 76 Awards
Research in Integrated Assessment Inter-Model Development, Testing, and Diagnostics	DE-FOA-0000219	US DOE	Flexible
Florida Hydrogen Initiative	NA	US DOE/FSEC/UCF	\$1.5M
Advanced Detector Research Program	DE-FOA-0000163	US DOE/High Energy Physics of the Office of Science	\$600K
FY 2010 Continuation of Solicitation for the Office of Science Financial Assistance Program	DE-FOA-0000178	US DOE/NETL	Flexible
FY 2010 Annual Notice: Submission of Renewal and Supplemental Applications for Office of Science Grants and Cooperative Agreements	DE-FOA-0000179	US DOE/NETL	Flexible
Program Year 2010 Weatherization Formula Grants	DE-FOA-0000216	US DOE/NETL	\$210M; 58 Awards
Plant Feedstock Genomics for BioEnergy: A Joint Research Funding Opportunity Announcement	DE-FOA-0000223	US DOE/USDA	\$6M
Energy Cooperatives to Support the National Coal Resources Data System	10HQPA0010	US Geological Survey	\$75K
Rural Energy for America Program (REAP): Rural Energy For America Program Grants/Renewable Energy Systems/Energy Efficiency Improvement Program (REAP/RES/EEI)	REAP/RES/EEI	USDA	\$500K for renewable energy systems and \$250K for energy efficiency improvements.