FESC
Florida Energy Systems Consortium

Florida Energy Systems Consortium
Annual Report

to
Office of the Governor
Office of the President of the Senate
Office of the Speaker of the House of Representatives
Florida Energy and Climate Commission

Pursuant to
Florida Statute 1004.648

November 2009

UF UNIVERSITY of FLORIDA
FLORIDA STATE UNIVERSITY 1851
FAU FLORIDA ATLANTIC UNIVERSITY
UCF
USF UNIVERSITY OF SOUTH FLORIDA
UWF
UNF UNIVERSITY of NORTH FLORIDA
NOVUM COLLEGIUM FLORIDAE MCMLX
FIU FLORIDA INTERNATIONAL UNIVERSITY
FLORIDA GULF COAST UNIVERSITY

Table of Contents

EXECUTIVE SUMMARY

The establishment of the Florida Energy Systems Consortium (FESC) occurred at a time of economic downturn, uncertainty in energy prices and its effect on national security, and concern about climate change. These threats created an opportunity for the State of Florida to rethink its strategies for securing its energy future and to better participate in the changing energy industry, including the emerging renewable energy industry, a revitalized nuclear power industry, and an expanding efficiency-driven renovation market. In creating and investing in FESC the State collected its university research and education potential to contribute to alternative energy strategies, improved energy efficiencies, and expanded economic development for the State.

The SUS has considerable energy-related expertise and competitively funded research, but very little research is being directed at systems integration. The FESC research plan is founded on the observation that many energy-related research and innovation opportunities are at the systems level. The Consortium's research focuses on those energy areas most relevant to Florida. Specifically, the FESC research agenda addresses energy generation from our two most abundant renewable resources (biomass and solar), carbon-free electric power generation (nuclear power, carbon sequestration), tapping the energy available from the ocean along our long and populated coastline, reducing consumption through energy conservation, and defining more efficient load management and energy storage systems.

The Consortium underwent considerable growth during the last 12 months. The Director as well as the Associate Directors completed the transition from their former responsibilities to those of FESC. The fiscal office was established, a fully populated web page released, and an advisory board charter put in place and board members were identified and recruited. The Steering Committee meets bi-weekly to discuss strategy, the Oversight Board consisting of the V.P.'s for Research at each of the 11 universities has met three times, while the Education Committee was established to focus on workforce development.

The Florida Energy and Climate Commission (FECC), to which the Consortium reports, held its inaugural meeting in January and members of FESC are working with the Commission.

The majority of the funding has been directed to research projects across the Consortium in the areas outlined above. It is noted that a 25% reduction of funds was made by the legislature in January, with the exception of the FAU allocation, and that a small amount of funding has been retained for special opportunities (e.g., matching funds, new faculty hiring). A summary of the funded projects is given in this report.

This period began the unveiling of the new presidential administration initiatives in energy and the formulation of a national energy agenda. This included the creation of an unprecedented number of funding opportunities through the American Recovery & Reinvestment Act of 2009 and the fiscal 2009 federal budget. More than 130 funding opportunities, summarized in Appendix B, were distributed to the FESC faculty. In response to these call for proposals, SUS energy faculty submitted 252 funding proposals amounting to $356,706,995 during the eleven-month period November 1, 2008 thru October 1, 2009. The SUS faculty received 419 research and education awards totaling $97,243,762 (Note many of the awards were based on proposals submitted prior to this period, but demonstrates the competitiveness of the SUS faculty in this arena). The details are given in the accountability measures section of the report in Appendix H. In addition, the Consortium responded to funding opportunities and assembled a collection of 36 white papers (listed in Appendix C) to promote to various agencies. Multiple visits to the State of Florida offices as well as to the Department of Energy, the National Science Foundation, Department of Defense, and National Laboratories were made to communicate how FESC could

contribute to their energy programs. As shown in Table 1and summarized in Appendix H, a significant number of proposals were submitted during this last year.

The Consortium has also worked closely with technology transfer and economic development offices to attract industry to the State. The promise of Florida government incentivizing industry as well as investments in energy efficiency has attracted considerable interest by industry to locate new manufacturing facilities in Florida. As examples, FESC has worked to attract a PV manufacturing facility in Florida and relocate a balance of systems manufacturer to Florida. We have also worked with our existing energy industry to assist them in adapting to a changing climate. As examples, Consortium experts are working with FPL and Babcock Ranch to establish the world's largest solar powered city in Southwest Florida, while faculty from 3 universities teamed with Midwest Research Institute to submit a major proposal in the algal fuels area. FESC has compiled and is maintaining a relational database of companies (currently at over 150) and other entities in Florida who have a key stake in Florida's energy strategies. We have also indentified university researchers and 22 partnering companies and entities to define 6 broad research concepts. FESC related faculty reported 103 collaborations with industry in this reporting period. Additionally, FESC worked with the SUS university technology transfer office to identify 27 energy related technologies with high commercial potential and FESC is funding the market studies and business plans for the top 15 inventions from 5 universities. These studies and plans will be exposed to industry to accelerate the path of FESC research to commercialization.

Education and outreach are important for the State to significantly participate in changing energy industry. FESC is strategically focused on workforce preparation for the existing and emerging energy industry. Teaming with Greenforce Florida, the FESC Education Committee convened a summit in February with more than 50 attendees from community colleges, universities, FLATE, and utilities. A database was prepared describing the capabilities and education plans in all the critical areas for our state. FESC collaborated with Workforce Florida Inc., to respond to a US Department of Labor call for workforce development. The outreach program is using the university agriculture extension system as well as other avenues to reach out to the residents of the State to inform them of approaches to decrease their energy consumption. FESC will also develop training centers to work with builders and urban planners to implement energy efficient living and work spaces.

The inaugural FESC Summit was held on September 29-30, 2009 at the University of South Florida. More than 160 people attended and participants represented a broad cross-section of energy interests, ranging from government and industry to research, development, and education. The Summit was preceded by a workshop on Smart Grids with more than 75 people in attendance. The Summit will be organized annually to bring 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. The detailed Summit information and program are provided in this report.

The Florida Energy Systems Consortium is now actively pursuing its research, education, industrial collaboration, and technology commercialization agenda. Faculty from around the State 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.

You are encouraged to visit the FESC web site (www.floridaenergy.ufl.edu) to become more familiar with our Consortium.

ACCOUNTABILITY MEASURES

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

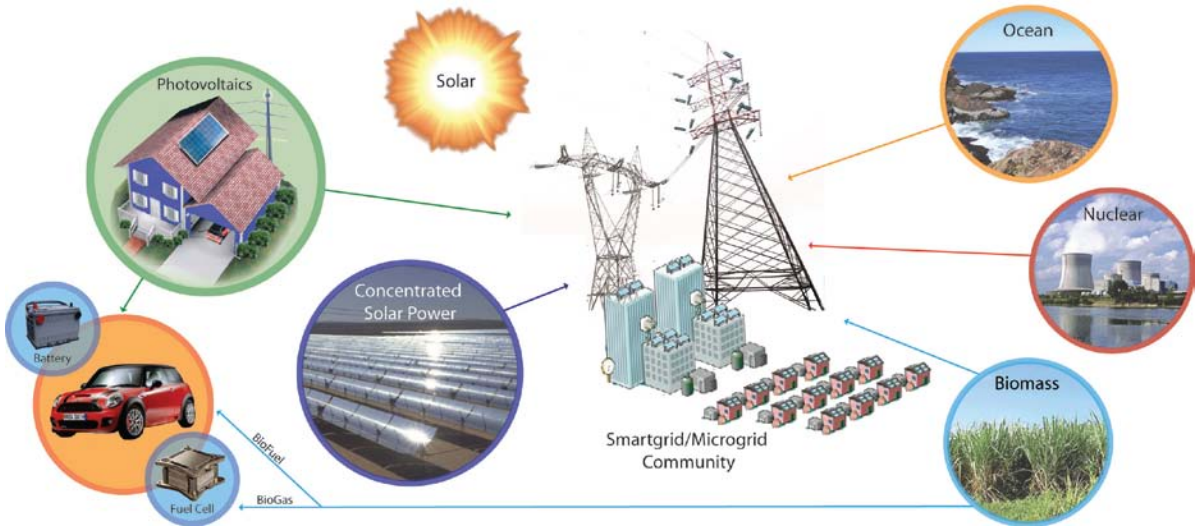
Table 1: Accountability Measures

FLORIDA ENERGY SYSTEMS CONSORTIUM November 1, 2008 – October 1, 2009	
Research Effectiveness (FESC and Associated Research)	
Competitive Contracts and Grants Applied (SUS energy faculty)	# of Applications: 252 Amount: $356,706,995
Competitive Contracts and Grants Received (SUS energy faculty)	# of Awards: 419 Amount: $97,243,762
Total Research Expenditures (FESC funded faculty)	$5,009,289
Publications in Refereed Journals and Other (FESC funded faculty)	Total: 289 Refereed:255 Other: 34
Professional Presentations (FESC funded faculty)	253
Invention Disclosures Submitted and Patents Received	43
Technologies Licensed and Revenues Received	0
Collaboration Effectiveness (FESC and Associated Research)	
Collaborations with Other Postsecondary Institutions	52
Collaborations with Private Industry	103
Students Supported with Consortium Funds (FESC funded faculty)	Total: 176 Undergraduate: 6 Master: 57 PhD: 91 Post-docs: 22
Students Graduated (FESC funded faculty)	Total: 27 Master: 9 PhD: 18
Economic Development Effectiveness (FESC and Associated Research)	
Business Start-Ups in Florida	0
Jobs Created and Jobs Saved in Florida (FESC only)	22
Specialized Industry Training and Education (Outreach)	26

RESEARCH PROGRAM

Strategic Research Thrusts:
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 recognized needs of the State of Florida. A brief description of each thrust and tasks under the thrust areas are given below.

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



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

2- Enhancing Energy Efficiency and Conservation

The 2008 Florida Energy Act calls for new homes to use 50% of 2007 code minimum within 10 years (2019 code cycle). Residences consume more than 40% of Florida's electricity and most commercial buildings have significant energy use from equipment. Advances in building and energy efficiency technologies will provide substantial value to Florida, not only for energy use and Green House Gas emissions reduction but also for economic development and job creation.

Additional building energy research and development is needed to achieve the efficiency requirements cost effectively. Human behavior is also an important factor in the implementation of energy efficiency and conservation.

The Consortium's focus is to improve residential and commercial building efficiency, integrate energy systems in sustainable community developments, support industry energy auditing, develop integrated energy-water management systems, study human behavior to implement energy efficiency effectively, and provide outreach and education. Developing innovative energy-efficient building technologies that minimize the use of natural resources and utilize renewable and sustainable materials will result in sustainable and economically viable communities.

3- Developing Florida's Biomass Resources

The State of Florida produces more biomass than any other state in the U.S. (~7% of total). Given the state's dependence on imported oil for transportation fuels and the value of transportation to our tourism industry, developing methods to convert this resource to fuels is important. The Consortium is pursuing microbial and gasification routes to produce this carbon-neutral fuel. In addition, algae production systems promise a direct route to fuel, along with its use for bioremediation of agricultural waste water and production of products from the residual biomass. A systems approach is being pursued to optimize water and land use, biomass harvesting and transport, and refining processes. The internationally recognized SUS researchers, the biomass production potential, and significant demonstrations projects provide promise to establish a leadership position by the SUS.

4- Harnessing Florida's Solar Resources

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

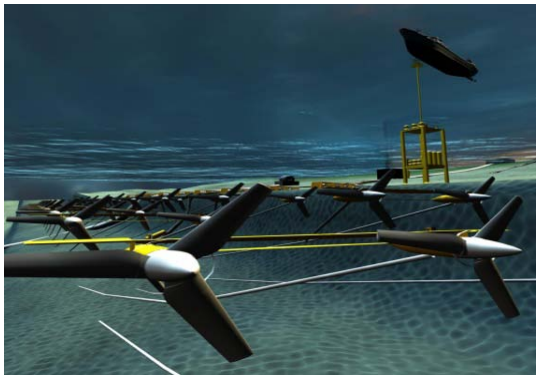
5- Ensuring Nuclear Energy & Carbon Constrained Technologies for Electric Power in Florida

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

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

With the prevalence of fossil fuels in base load power generation, development of clean coal and natural gas power generation with carbon capture and sequestration is criticalto the future of the state and nation. Florida's universities are studying broad advances in energy efficiency, demand response and management techniques, and carbon capture/sequestration technologies ranging from underground carbon sequestration to carbon capture through algal ponds.

6- Exploiting Florida's Ocean Energy Resources



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

7- Securing our Energy Storage and Delivery Infrastructure

Renewable and reliable energy sources are needed to meet the increased electricity demand in Florida; however renewable energy sources such as solar are intermittent requiring storage solutions. Furthermore, load management and efficient operation will benefit from a storage solution.

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

Research Projects:

The FESC research program at this point includes 61 funded projects within the 7 strategic thrusts. Table 2 below outlines the basic information for each project. Project progress report summaries are provided in Appendix A while full progress reports are consolidated and provided as a separate file. Seven projects from FIU (not funded by FESC) are also included in Table 2. 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 2 – FESC Research Thrust and Project Summary
(Only lead university information is given)

Projects	Summary
THRUST 1: Enhancing Energy Efficiency and Conservation	
	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, Anter Al-Azab, Subramanian Ramakrishnian **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. **Budget:** $30,000 **University:** FSU
	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. **Budget:** $503,168 **University:** FSU
	Title: Chemical and Mechanical Degradation of Fuel Cells **PI:** Darlene Slattery **Co-PI's**: Len Bonville, Xinyu Huang, Marianne Rodgers **Students:** B. Pearman (Ph.D), W. Yoon (Ph.D.), W. Rigdon (Ph.D.) **Description:** The objectives of the program are to gain insight into fuel cell membrane degradation mechanisms including both chemical and mechanical degradations. Topics to be researched include a detailed investigation into factors that accelerate degradation, namely OCV and high temperature operation. The chemical and mechanical durability of fuel cell membranes will be evaluated to include varying cell temperature and cell load under static testing conditions. The membrane degradation mechanism will be used to suggest membrane degradation mitigation strategies and the conductivity of more efficient tests to carry out membrane durability studies. **Budget:** $324,000 **University:** UCF/FSEC

	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 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 current technology retrofit measures. **Budget:** $1,224,000 **University:** UCF/FSEC
	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. **Budget:** $72,000 **University:** UF
	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 **University:** FSU

	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 biofeul cell lifetime. The scaled fractal electrode surface plays a role in wiring the enzymes to the biofuel cell anode, which increases the electron transfer efficiency from the enzyme to the electrode for an increase in the overall performance of the biofuel cells. Furthermore, C-MEMS/C-NEMS architectures will enable the reproducible fabrication of low cost carbon-based electrode structures. **Budget:** $171,432 (PI portion) (total amount: $1,000,000) **University**: FIU
	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. **Budget:** $150,000 **Universities:** FIU
	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 project will feature the most cost-effective combination of renewable solar energy with high levels of building energy efficiency. The building will incorporate a carefully chosen package of the latest energy-.efficiency technologies and renewable energy systems to

	achieve the most successful and reliable results. The building will utilize Photovoltaic solar electricity and solar domestic hot water heating systems using the grid as an energy storage system, sending excess power to the grid during the day and taking power back from the grid at night. Plug-in hybrid automobile technology offers a promising means of providing distributed energy storage for such homes but has not been sufficiently tested. Using a systems approach to couple zero energy home technology with PHEVs we will explore opportunities to develop marketable products that meet Florida's energy and environmental goals. **Budget:** $344,600 **University:** USF
THRUST 2: Developing Florida's Biomass Resources	
High Energy Crops	
	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: 1. Develop sustainable, biologically-based fuel alternatives and renewable energy strategies. 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 nearterm 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. The centerpiece of the proposed project will be the development of sustainable practices for the production of transportation fuels from algal biomass feedstocks. Algal cultivation practices will also be incorporated into industrial processes such as CO2 capture and sequestration from coal-fired power plants and wastewater treatment. • The project will create a consortium of scientists from FESC, the Oak Ridge National Laboratory (ORNL), and the Midwest Research Institute of Palm Bay, Florida. State-of-the-art R&D facilities will drive consortium efforts: an off-grid, zero emissions algal cultivation facility at the FSU Coastal and Marine Laboratory (FSUCML), a biomass characterization facility in FSU's Chemistry department, a marine bioprospecting/ biomass conversion facility in FSU's Oceanography department, and a freshwater bioprospecting, algal cultivation and biomethanation facility at UF's Soil and Water Science department. • The proposed program is projected to create 30 undergraduate research fellowships, 15 graduate student assistantships, 8 Ph.D. level positions, 5 technician positions, 10 temporary construction jobs, and 3 highly skilled positions in the biotech work force. Undergraduate and graduate research fellowships will be offered in the natural sciences, engineering, and the social sciences at the host institutions. • Oak Ridge National Laboratory (ORNL) personnel will aid by training students through internships in next generation biotechnology and bioengineering skills, thereby enhancing the skilled workforce to build the energy industry in Florida. • The Midwest Research Institute (MRI) in Palm Bay, Florida, currently supports 6 positions in algae-related research. We expect to double their workforce in this area. MRI will provide optimization and application of harvest and extraction methods to the cultivation facilities and integrated process engineering.

	• The project will stimulate rural development in Franklin County, Florida, where the FSUCML is located. Architects and construction workers will be employed to build the state-of-the-art, algal cultivation facility. Permanent technicians and engineers will be employed to run the facility. Graduate students will be in residence at the FSUCML to complete their research. Federal, private, and international funds will be sought out to continue to support these positions. **Budget:** $494,135 **Lead University:** FSU
	Title: Planning Grant: Constructual Optimization of Solar Photo-Bioreactors for Algae Growth **PI:** Juan Ordonez **Description:** This planning grant money will be used for partial support of a graduate student. We will (1) design a small (lab scale) photo-bioreactor for algae growth and (2) select the type of algae for future experimentation. The main objectives are to place us in a more competitive position in future submissions in the area of biofuels. By the end of this one year effort we expect to have a complete design of a small-scale photo-bioreactor for algae growth and to obtain additional funds that will allow us to build the photo-bioreactor. **Budget:** $15,000 **University:** FSU
	Title: Seeding Biofuel Entrepreneurship in South Florida **PI:** George Philippidis **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. **Budget:** $15,000 **University:** FIU
	Title: Energy Intensive Crop Development **PI:** Gary Peter **Description:** The first step in an integrated Bio-Energy industry is development of energy intensive crops. The proposed research will provide breakthroughs in identification of Florida energy crops and cultivars, development of best agricultural practices for production, and focused improvements using traditional and molecular genetics approaches. Energy crop research will focus on two groups, C-4 plants (e.g., cane and switch grass) and short rotation trees (e.g., pine and poplar). Natural cultivars will be screened for yield, and compositions that enhance digestion into ethanol. Deliberate gene changes will also be investigated to alter plant wall structure for efficient extraction and depolymerization of carbohydrates. The proposed research will: advance our knowledge of how plants partition carbon; identify genes to breed plants that are more readily extractable/digestible to increase conversion efficiency; establish best agricultural practices for production of Florida energy crops; and develop economic models to estimate costs and identify improvement opportunities.

	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 **Students (degree sought):** Arkorn Soikiew (M.S.), Chae-In Na (Ph.D.), Jeff Fedenko (M.S.) **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). Graduate students involved in carrying out project research include Jeff Fedenko, Arkorn Soikiew, and Chae-In Na, all of whom started their graduate programs in August 2009. External collaborators include Speedling, Inc., which has provided planting material of miscanthus. **Budget:** $191,981 **University:** UF
Biochemical Conversion	
	Title: Biochemical Conversion of Florida's Cellulosic Biomass to Liquid Fuels and Chemicals **PI:** Pratap Pullammanappallil **Description:** This project will develop and demonstrate an integrated, multi-product biorefinery at pre-commercial scale to support a full economic and technical feasibility analysis for the use of Florida-grown feedstocks. The goal of this facility is to evaluate, validate, and improve processes, improve efficiency and decrease complexity, and accelerate full commercialization of cellulosic biorefineries in Florida. This facility will represent a complete test bed for new trial crops as well as existing municipal, forestry, and agricultural residues. This facility will complete the renewable cycle by converting solar energy stored in biomass from Florida fields into automotive fuels and chemicals to replace petroleum. Together with energy crop production, this project will provide a comprehensive demonstration of a "Farm to Fuel"/"Fields to Wheels" biorefinery to facilitate commercial development of renewable fuels in Florida. **Budget:** $576,000 **University:** UF
	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. **Budget:** $1,918,306 **University:** FIU
	Title: Engineering Biocatalysts for Hemicelluloses Hydrolysis and Fermentation **PI:** James F. Preston **Students (degree sought):** Changhao Bi (Ph.D. awarded April 2009) **Description:** Our goal is to develop biocatalysts for the cost-effective production of fuel alcohols and chemical feedstocks from underutilized sources of renewable biomass and evolving energy crops. To reach this goal protocols for efficient saccharification of hemicellulose fractions from these resources will be developed. Objectives are to: 1. Develop improved enzyme-mediated saccharification protocols of hemicelluloses with existing bacterial biocatalysts for production of biofuels and chemical feedstocks. 2. Develop Gram positive biocatalysts for direct conversion of hemicelluloses to biobased products. 3. Develop systems with bacterial biocatalysts for efficient bioconversion of the hemicellulose fractions of perennial energy crops (poplar, eucalyptus, switchgrass, energy cane) to targeted products. **Budget:** $192,000 **University:** UF
	Title: Thermophilic Biocatalysts for the Conversion of Cellulosic Substrates to Fuels and Chemicals **PI:** K.T. Shanmugam **Students:** Yue Su (Ph. D.) and Brelan Moritz (Ph. D.) **Description:** Biomass is an attractive source of sugars for a state like Florida that produces very limited amount of corn for fermentation to produce ethanol as transportation fuel or other products such as lactic acid that can be converted to bioplastics. Florida currently generates about 8.7 million tons of dry cellulosic biomass per year (US-DOE) that can be converted to about 0.7 billion gallons of ethanol. With specific energy crops and short rotation trees cultivated for energy production using the abundant sunshine and water resources, the ethanol produced from biomass can be significantly increased to meet the demand for transportation fuel in the State of Florida. Before biomass-based fuels and chemicals become an economic reality, several key steps in the depolymerization of biomass to constituent sugars need to be addressed. One is depolymerization of cellulose to glucose by fungal cellulases before fermentation to ethanol by microbes. The current estimated cost of fungal cellulases is $0.32 per gallon ethanol produced and this cost is targeted for reduction to $0.10 or less by year 2012 (DOE). We have demonstrated that by increasing the temperature of Simultaneous Saccharification and Fermentation (SSF) of cellulose from 30-35 ºC to 50-55 ºC, the amount (and associated cost) of cellulases can be reduced by the required 3-fold with the current

	commercial enzyme preparations. A microbial biocatalyst that produces ethanol or other chemicals as the main fermentation product and can also function at this higher temperature and pH 5.0 in conjunction with the fungal cellulases in the SSF process is a critical component of this process. We have identified a thermophilic facultative anaerobe, *Bacillus coagulans*, with versatile metabolic capability as the microbial platform for the SSF of biomass to products and engineering this L(+)-lactic acid producing bacterium to produce ethanol. The primary objective of this proposed study is to construct a *B. coagulans* derivative that produces ethanol as primary product of fermentation and to enhance the ethanol productivity of the engineered derivative. **Budget:** $192,000 **University:** UF
Bio gasification	
	Title: Combined Cooling, Heat, Power, and Biofuel from Biomass and Solid Waste **PI:** William Lear **Students (name/degree sought):** Minki Kim (Ph.D.); Elango Balu, (Ph.D.); Harsh Khandelwal (MS) **Description:** The goal of this project is to provide the underlying research and demonstration of a novel technology which would enable the economic utilization of dispersed biomass and solid waste resources to produce electric power, cooling, heat, and transportation fuels. This integrated gasification and power generation system combines University of Florida advances in high-temperature gasification, hydrogen generation and separation, and advanced gas turbine systems. Their integration is expected to result in significant improvements in the cost, emissions, feedstock flexibility, and water requirements, all in a relatively compact, modular plant system. This in turn will enable much greater utilization of renewable energy supplies, helping the development of a sustainable energy supply infrastructure. **Budget:** $479,813 **University:** UF
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 **Students:** Ali Gardezi, Nianthrini Balakrishnan, Bijith Mankidy **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
	Title: Integrated Florida Bio-Energy Production with Carbon Capture & Sequestration

	PI: Ali T-Raissi **Co-PIs:** Nazim Muradov, Amit Gujar, Gary Bokerman **Students:** Nathaniel Garceau (BS-Ch.E.), James Pardue (BS-M.E.) **Description:** The aim of this project is to produce liquid hydrocarbon fuels derived from Florida grown 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 electrical power source is used for electrolysis of water to oxygen (for use in the biomass gasifier) and hydrogen gas needed to supplement H_2 content of the syngas. Use of oxygen for gasification of biomass improves the overall energy conversion efficiency of the process by eliminating the need for an air separation unit. In the second step, hydrogen enriched 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 used 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 objective of the proposed research is to develop technologies to produce bio-jet and bio-diesel fuels from sustainable sources. Bio-oils and hydrogen will be produced from biomass generated synthetic gas. We will (1) produce liquid biofuels (bio-jet & bio-diesel) from renewable resources of cellulosic biomass and nonedible bio-oils; (2) demonstrate that the biofuels have comparable performance characteristics to conventional fossil fuels; (3) demonstrate that the new biofuels do not require major changes in current engine design & operation, (4) demonstrate that biofuels produced from cellulosic biomass and bio-oils can be economically competitive in current market with fossil fuels **Budget:** $420,567 **University:** FSU
THRUST 3: Harnessing Florida's Solar Resources	
Solar Thermal	
	Title: Concentrating Solar Power Program **PI:** Charles Cromer **Co-PI:** R. Reedy **Students:** Pablo Izquierdo (Ph.D.) **Description:** Solar concentrating systems use direct beam solar energy focused to produce high temperatures for power production. They hold promise for Florida given a sufficient direct beam resource and assuming the technology can meet production and cost goals. Existing measurements of direct beam solar energy are limited to a few Florida locations. The objective of this R&D project is to advance concentrating technologies by conducting an analytical study of the Florida solar resource in order to predict performance and the amortized cost of energy from this technology in the Florida environment. Later years may include experimental tests for validation of the predicted results. **Budget:** $52,000 **University:** UCF/FSEC
	Title: Enhanced and Expanded Solar Thermal Test Capabilities **PI:** J. Walters **Co-PI:** R. Reedy **Description:** The Florida Solar Energy Center (FSEC) believes that independent, third-party testing and

	certification has extensive value in the marketplace, especially for products that are not widely "proven" with consumers such as solar water heating systems and solar electrical (photovoltaic) systems. In addition, due to the resurgence of the solar industry, FSEC has received a significant increase in demand for solar collector and solar system testing and certification. This occurrence has resulted in requiring the Center to correspondingly amplify its capabilities to respond to the increased demand This project has the objective of increasing FSEC's solar thermal testing and certification activities by the following actions: test and analysis equipment and software upgrades and expansion, integration of the solar collector and system laboratories, enhancing documentation and reporting methods and streamlining and devising more comprehensive client test and certification application documents. **Budget:** $654,295 **University:** UCF/FSEC
	Title: Solar Thermal Power for Bulk Power and Distributed Generation **PI:** David Hahn **Students (Degree Sought):** Richard Stehle (Ph.D.); Michael Bobek (Ph.D.); Kyle Allen (Ph.D.); Justin Dodson (Ph.D.) **Description:** While there are many different approaches to hydrogen generation, the most attractive means is to split water molecules using solar energy. The current approach is to develop highly reactive metal oxide materials to produce intermediary reactions that result in the splitting of water to produce hydrogen at moderate temperatures (<1000 K). It is envisioned that the metal oxide reactors will ultimately be mounted within a solar concentrating reactor, and irradiated via heliostats. This Task is structured toward the overall goals of solar-driven, thermochemical hydrogen production, with associated efforts toward the enabling surface science, catalysis, particle science, material synthesis, nano-structures, multiscale-multiphase physics modeling, and process simulation that will enable the realization of solar hydrogen-based fuels to power the transportation economy. Successful efforts as targeted in this project are a critical step toward increased renewable-resource based fuels and energy, reduction of GHG emissions, and establishment of a new power industry in Florida. **Budget:** $446,400 **University:** UF
	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 **Description:** This project targets to develop a solar thermal power technology that will lead diverse energy resources in Florida and reduce greenhouse emissions by utilizing renewable sources. Also, there will be economical 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 codes for the proven solar thermal power technologies in combination with bio or fossil fuels based on Florida conditions and resources. Secondly, the project aims to set up demonstration and test facilities for these technologies for optimization for Florida conditions, and the final task is to develop and commercialize innovative technologies based on new thermodynamic cycles. **Budget:** $882,000 **University:** USF, UF, FSEC
	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
Clean Drinking Water	
	Title: Clean Drinking Water using Advanced Solar Energy Technologies **PI:** James Klausner **Student:** Fadi Alnaimat/ Ph.D **Description**: Availability of fresh water is a major societal problem facing the world. The state of Florida is vulnerable to fresh water shortages. Moreover, Florida ground water is contaminated in many locations from leaky underground tanks, agricultural pesticides, and other chemicals. Although it is possible to desalinate sea water, conventional systems are energy intensive. Solar energy can provide the needed energy, and solar vacuum (USF), humidification/dehumidification (UF), and solar still (UF) desalination systems are being investigated provide adequate fresh water for the state's needs. Systems will be developed for both bulk water desalination and small community needs/disaster response. We will also develop photocatalytic disinfection to remove contaminants and integrate these technologies with solar PV for complete water supply systems. **Budget:** $252,000 **University:** UF
	Title: Clean Drinking Water using Advanced Solar Energy Technologies **PI:** Lee Stefanakos **Co-PI's:** Yogi Goswami, Matthias Batzill, Maya Trotz, Sesha Srinivasan **Students:** M. Abutayeh, K. Dalrymple **Description:** Availability of fresh water is one of the biggest problems facing the world and Florida is one of the most vulnerable states to fresh water shortages. Moreover, Florida ground water is contaminated in many locations from leaky underground tanks, agricultural pesticides, and other chemicals. Although possible to desalinate abundant sea water, conventional systems are too energy intensive. Solar energy can provide the needed energy, and innovative new solar vacuum (USF) and humidification/dehumidification (UF) desalination systems can provide adequate fresh water for the state's needs. Systems will be developed for both bulk water desalination and small community needs/disaster response. We will also develop photocatalytic disinfection systems to remove contaminants and integrate these technologies with solar PV for complete water supply systems. **Budget:** $326,984 **University:** USF
Low Cost PV Manufacturing	
	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's PV program. **Budget:** $196,018 **University:** UCF/FSEC
	Title: Development of High Throughput CIGS Manufacturing Process **PI:** N. Dhere **Students (degree sought):** Sachin Kulkarni (Ph.D.); Vinay Hadagali (Ph.D.); Parag Vasekar (Ph.D.); Shirish Pethe (Ph.D.); Ashwani Kaul (Ph.D.); Eigo Takahashi (M.S.); Saisitaram Ramesh (Ph.D.); Bihag Joshi (Ph.D.) **Description:** A reduction in the cost of CIGS and other thin PV film modules is required for wide 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. **Budget:** $141,620 **University:** UCF/FSEC
	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). **Budget:** $81,120 **University:** UCF/FSEC
	Title: Low Cost CIGS Thin Film PV Devices and Processes **PI:** Gjs Bosman, **Co-PI:** Tim Anderson **Students:** Barrett Hicks (Ph.D.), Yige Hu (Ph.D.), Chris Muzillo (Ph.D.), Vaibhav Chaudhari (Ph.D.) **Description:** There is considerable interest in developing high-efficiency, polycrystalline thin-film α-$CuIn_xGa_{1-x}Se$ (CIGS) solar cells as a result of their high champion cell efficiency, outstanding long-term outdoor stability, excellent radiation hardness, and high absorption coefficient. Cost models suggest that decreasing the manufacturing cost and increasing the cell efficiency are direct paths to achieving the necessary price reduction. The goals of this program are to explore methods to enhance cell efficiency (e.g., tandem structures, hot electron capture) and demonstrate a low-cost, high-throughput absorber deposition process based on counter-current, chemical vapor deposition. **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 **Students:** Ryan Anders (PhD); Sree Satya Kanth Benapudi (MS); Keshavanand Jayadevan (MS) **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 15.8%, 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
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 **Students:** Kris Davis, Steven Nason **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 **University:** UCF/FSEC
	Title: Research and Develop PV Device Science and Laboratories **PI:** Nicoleta Sorloaica-Hickman, Robert Reedy **Students:** Kris Davis (PhD) **Description:** The objective of this project is to develop a world class PV cell laboratory for various cell and cell device research. The R&D to be conducted in the lab will focus on developing new and improved PV cells such as organic PV, nano-architectures, multiple excitation generation, plasmonics, and tandem/multijunction cells. This new PV lab called the Laboratory for Photovoltaic and Thermoelectric Materials and Devices (PVTMD) has been sited in a room originally used as a machine work facilities room in the Low Bay of the Florida Solar Energy Center (FSEC). The PVTMD lab is to be used as an interdepartmental laboratory and will concentrate on developing the fundamental science and engineering base required to improve PV and TE device performance and processing technologies. The end goal is to transfer these laboratory results to large-scale manufacturing and to exploring new frontiers in manufacturing research and scientific education. **Budget:** $882,507 **University:** UCF/FSEC
	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 **Students:** Rudran Ratnadurai, Electrical Engineering, Ph.D., Michael Celestin, Chemical Engineering,

	Ph.D., Samantha Wijewardane, Electrical Engineering, Ph.D. **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. It is strongly believed that this technology can reduce the present solar cost of production from $/watt to ¢/yard of flexible solar panels. **Budget:** $598,500 **University:** USF
PV Integration	
	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 **Students:** Kejiu Zhang (PhD), Souhaib Harb (PhD), Karthik Padmanabhan (PhD), Xiang Fang (PhD), Ala Alsaeed (PhD) **Description:** The objective of this project is to develop a system-driven Plug'N'Gen solar power system demonstrating architecture of decentralized, low-cost, mass-produced, PV panel-mounted micro-inverters. This system will be able to compete with today's centralized multi-kW PV inverters that require cost prohibitive professional installation. The project tasks are: 1) novel inverter topology and control concepts; 2) advanced digital control algorithms; 3) SmartTie interface with the utility grid; and 4) low cost and ultra-compact PV inverter in package. **Budget:** $1,267,000 **University:** UCF
	Title: Non-Contact Energy Delivery with Integrated DC-AC Inverter for PV System **PI:** Jenshan Lin **Students (degree sought**): Zhen Ning Low (Ph.D.); Joaquin Casanova (Ph.D.); Raul Chinga (Ph.D.); Jason Taylor (M.S.); Yan Yan(Ph.D.); Xiaogang Yu (Ph.D.); **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. **Budget: $**252,000 **University:** UF

	Title: An Integrated Sustainable Transportation System **PI:** Eric Wachsman **Co-PI:** Shirley Meng **Students (degree sought):** Dan Gostovic, Dong Jo Oh, Eric Armstrong, Byung Wook Lee, Kang Taek Lee, Nick Vito and Christopher, R. Fell (Ph.D.) Patrick Wanninkopf, Eric Klump, Nicholas Sexson, Kevin Seymor, and Thomas McGilvray (Undergrad) **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. If developed this vehicle would be a transformational change in transportation technology. **Budget:** $594,000 **University:** UF
PV/Storage/Lighting	
	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. **Budget: $15,000** **University: FSU**
	Title: PV Power Generation Using Plug-in Hybrid Vehicles as Energy Storage **PI:** J. Shen **Co-PI's:** I. Batarseh, N. Kutkut **Students:** Michael Islas, John Elmes **Description:** The objective of this project is to develop and demonstrate the architecture of an alternative PV power generation system that uses plug-in hybrid vehicle as the energy storage and transfer element. The total system cost target is $3.50/watt. The project tasks include developing efficient, reliable and inexpensive maximum power tracking DC/DC battery chargers and 3-phase converters. The developed system will be demonstrated on the UCF campus by contracting to construct a 10kW solar carport charging station. 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 operated at the station. **Budget:** $380,816 **University:** UCF

	Title: Integrated PV/Storage and PV/Storage/Lighting Systems **PI:** Franky So, **Co-PI:** Jiangeng Xue, Shirley Meng **Students:** Ming-Che (Tim) Yang, William Hammond, Edward Wrzesniewski, Cephas Small, Fred Steffy (Ph.D.). Thomas McGilvray (Undergrad) **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
THRUST 4: 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:** The objective of this proposal 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. **Budget:** $60,844 **University:** FSU
	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. **Budget:** $15,000 **University:** FSU

	Title: Biocatalytic Lignin Modification for Carbon Sequestration **PI:** Jon Stewart **Description:** After cellulose, lignin is the second most abundant form of carbon in plants. Lignin's complex structure makes it difficult to use this material in value-added products, and 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 CO_2 levels. This could be accomplished by chemically altering lignin's structure to facilitate long-term terrestrial sequestration or using it in value-added products that would not be discarded immediately. We will use Nature's catalysts (enzymes) to tailor the chemical structure of lignin for both deep-well injection (by using lignin derivatives as drilling "muds") and for materials that can be used in building, packaging, and other manufactured products.) **Budget:** $200,000 **University:** UF
	Title: Carbon Capture and Sequestration **PI:** Sabine Grunwald. **Co-PIs:** Tim Martin, Howard Beck **Students (degree sought): NA** **Description:** Cost-effective CO2 removal is required to accommodate growth and bridge our transition to greater energy diversity and efficiency. Several carbon sequestration approaches are under development by our team utilizing abundant Florida resources. Geological sequestration by CO2 injection into saline carbonate aquifers is being developed and tested by USF, representing a new sequestration technology. Biomass-based sequestration is being developed at UF using Florida forests and crops and has widespread support of its agricultural industry. Efforts in this area include the development of a terrestrial carbon information system which will provide a spatially- and temporally-explicit platform for sharing and analyzing terrestrial carbon data, and development of processes for converting by-products of renewable fuel production to a carbon sink. Chemical sequestration to useful products is being developed by UCF via a novel catalytic process that includes solar-derived H2. The resulting elemental carbon and lignin-based polymers can be stored and transported at ambient temperatures and pressures, and stored in geologic formations or used as possible commercial products. Each approach offers unique advantages to offset our transition to more carbon neutral power and transportation. Cost-effective carbon capture and sequestration is of primary interest to the major Florida power companies. They have proposed formation of a state-wide consortium to address this issue and the proposed Consortium can serve this role. Florida agricultural industries are also very interested in developing carbon sequestration as a supplemental land use. **Budget:** $199,440 **University:** UF
	Title: Creation of Carbon Sequestration Data, Technologies and Professional Cohorts for Florida **PI:** Mark Stewart, **Co-PIs:** Jeffrey Cunningham, Yogi Goswami, Maya Trotz **Students:** Shadab Anwar (Post-doctoral researcher), Drupatie Latchman (MS, Chemical & Biomedical Engineering), Roland Okwen (PhD, Civil & Environmental Engineering), Douglas Oti (PhD, Civil & Environmental Engineering), Tina Roberts-Ashby (PhD, Geology), Mark Thomas (MS, Civil & Environmental Engineering) **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. **Budget:** $479,640 **University:** USF
THRUST 5: Exploiting Florida's Ocean Energy Resources	
	Title: Center for Ocean Energy Technology **PI:** Susan H. Skemp**, Co-PI's:** R. Frederick Driscoll and Howard P. Hanson **Students:** 20 students listed in Appendix H **Description:** The Center for Ocean Energy Technology's program is structured to be the catalyst that will enable the ocean energy industry in Florida in providing solutions to 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 for ocean energy infrastructure and operation in the offshore continental shelf 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 areas. **Budget:** $8,750,000.00 **Universities:** FAU
	Title: Buoy Array for Ocean Wave Power Generation **PI:** P.I. Z. Qu, **Co-PI**: K. Lin **Students:** Shiyuan Jin (Ph.D), Steven Helkin (M.S.), Carlos Velez (B.S.) **Description:** The objective of this project is to analyze, design, and demonstrate a wave power generation system with novel multi-functional energy converting devices. The tasks include component design and modeling, system integration, system testing and evaluation. The proposed system consists of an array of buoys floating on the ocean and tethered to the floor. Each of them has one or multiple devices inside that can convert the kinetic energy of the motion of the waves into electrical energy. The electricity generated is then transmitted through the cable that goes along or inside the tether to the ocean floor, expending to an energy processing/storage station on the ocean shore. **Budget:** $150,000 **University:** UCF
THRUST 6: 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
	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 **Students:** John Dascomb (Ph.D.), Ifegwu Eziyi (Ph.D.), Jon Pandolfini (Ph.D.), Michael Gnos (M.S.) **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. The development of an indoor solar simulator capable of providing and sustaining 1 kW/m2 over an area of 10 m2 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. 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. **Budget:** $544,226 **University:** FSU
	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:** Power quality problems can lead to process disruption, unplanned downtime, shorter appliance lifetime, wasted resources, higher energy costs and value of work in progress destroyed. These problems are substantially larger in sustainable energy systems with multiple power generators. CEIDS estimates the loss due to low power quality at $119-188 B/year. The quality problems can be detected in advance by measurements and monitoring. By choosing good design practices and the right equipment

	such as active harmonic conditions most of the effects can be avoided. Typical indicator and consequences of power quality problems are computer lock-ups, equipment damage, blackouts, light flicker, nuisance tripping or overheated neutrals. To enable an universal real-time detection of power quality on the large and small scale, we will provide algorithmic as well as implementation working prototypes. **Budget:** $15,000 **University:** FSU
	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. **Budget:** $15,000 **University:** FSU
	Title: Investigating the Effect of Appliance Interface Design on Energy-use Behavior **PI:** Paul Ward**; Co-PIs:** Ian Douglas, David Eccles **Description:** Our goal in this study is primarily to examine the behavioral differences between efficient and inefficient energy consumers that are related to interface design. Specifically, we are interested in relationship between the informational feedback afforded by the device, an individual's understanding of how a device works, and their combined effect on energy use-behavior. **Budget:** $247,720 **University:** FSU
	Title: Energy Delivery Infrastructures **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 representing dynamic and transient behaviors of microgrids. Therefore, in this project we propose using simulation tools to model a microgrid and investigate how well we can reproduce its measured behavior in the field. **Budget:** $485,184 **University:** USF
	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
	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 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: Power Generation Expansion under a CO_2 Cap-and-Trade Program **PI:** Tapas Das **Co-PI's**: Ralph Fehr **Students:** Patricio Rocha (Ph. D. Candidate), Ehsan Salimi (Ph. D. Student). Industrial and Management Systems Engineering Department **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. **Budget:** $71,906 **University:** USF
	Title: Environmental Impacts of Energy Production Systems: Analysis, Evaluation, Training, and Outreach **Principal Investigator:** Amy B. Chan-Hilton **Co-PIs:** Gang Chen, Wenrui Huang, Michael Watts, Ming Ye, Paul Lee **Description:** The goal of this project is to develop tools and conduct research to objectively assess environmental and water resources needs and constraints of fuel cycle and energy production systems. The objectives of this project are to: 1. Analyze environmental and water resources demands and potential impacts, specific to Florida's unique geographical challenges, of fuel cycle systems. 2. Develop an objective environmental impact screening and evaluation tool for energy planning and policy making. 3. Provide outreach to industry, utilities, government 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. **Budget:** $118,470 **University:** FSU
	PI: Tim Chapin**; Co-PIs:** Ivonne Audirac, Jeff Brown, Chris Coutts, Jeffrey Lowe, Greg Mark, Melanie Simmons, Horner Thompson **Description:** 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. Teams of researchers will generate "issue papers" in four areas of inquiry and report their findings via events that inform legislative leaders, state agency staff, and local government officials as to how energy sustainability objectives can be achieved through

	transportation, land use, and green infrastructure programs. **Budget:** $177,460 **University:** FSU
	Title: Marketing Strategies to Incentives Entrepreneurship and Innovation in the Development of Sustainable Energy **PI:** Joe Cronin **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 knowledge that drives the purchase of sustainable goods and services. The overall objective of the research is to provide much needed market pull information for organizations embarking on "green" marketing strategies; that is, firms in the process of developing or expanding their mix of environmentally friendly goods and services. **Budget:** $191,555 **University:** FSU
	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. **Budget:** $125,424 **University:** FSU
	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-PIs:** 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. **Budget:** $79,621 **University:** FSU

	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: • Conduct needs assessment of IESES 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 IESES 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 IESES, FESC researchers, and others in the state of Florida with the research information they need to accomplish statewide energy goals and to help IESES meet the thirteen objectives it has undertaken by providing access to research information. **Budget:** $194,542 **University:** FSU
	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. **Budget:** $200,720 **University:** FSU
	Title: Experimental Investigation of Economic Incentives of Policies, Institutions, and R&D in env. Conservation **PI:** Svetlana Pevnitskaya**, Co-PI:** Dmitry Ryvkin **Description:** The objective of this proposal is to identify key features determining investment behavior in renewable energy technologies and sensitivity of response to incentives and environment. The study will combine theoretical and experimental economics methods. We will provide analysis of efficiency of existing institutions and compare them to alternative mechanisms. In addition we will study some fundamental aspects of this dynamic decision-making problem. The deliverables will include: 1. A theoretical model and experimental design of an economic environment with dynamic and uncertain negative externalities. 2. A computer program and instructions for conducting experiments 3. A set of experimental sessions exploring the investment and adoption behavior in the absence of institutions and regulation 4. A set of experimental sessions exploring the effect of several regulatory institutions on the investment and adoption behavior 5. Analysis of experimental results and conclusions about the role and efficiency of different institutional designs. **Budget:** $43,217 **University:** FSU

	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. **Budget:** $15,000 **University:** FSU
	Title: Planning Grant: Climate modeling and outreach activities **Principal Investigator:** Shawn R. Smith Co-PIs: Steve **Cocke, David Zierden, James O'Brien, Julie Harrington** **Project Description:** The objective of this proposal 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). **Budget:** $15,000 **University:** FSU
	Title: Visiting Law Professor **Principal Investigator:** JB Ruhl and Jim Rossi, **Co-PIs:** Uma Outka **Description:** The visiting law professor will conduct research and prepare a series of reports suitable for distribution to the Legislature and to Florida local governments on four topics: (1) Land use codes to identify provisions and practices that either facilitate or impede the location of renewable energy production facilities, etc. (2) Florida state and local government comprehensive plans, other policy statements, and land use litigation to identify the primary policy trade-offs associated with the location of renewable energy production facilities (3) Other states' government land use codes to identify "best practices" for facilitation of the location of renewable energy production facilities, with particular attention to how those best practices respond to the policy trade-offs (4) Then draft model local legislation designed to most effectively allow Florida local governments to facilitate the location of renewable energy production facilities and other innovative or new energy infrastructure consistent with State policy taking into account economic, social, environmental, and geographic variables. **Budget:** $214,603 **University:** FSU
Education and Outreach	
	Title: Florida Advanced Technological Education Center (FLATE) **PI:** Marilyn Barger **Students (name/degree sought): NA** **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. **Budget:** $300,000 **University:** Hillsborough Community College
	Title: Outreach Activities for FESC **PI:** Pierce Jones **Students: NA** **Description:** The Program for Resource Efficient Communities (PREC) promotes the adoption of best design, construction and management practices that measurably reduce energy and water consumption and environmental degradation in new residential community developments. Our focus extends from lot level through site development to surrounding lands and ecological systems. We support the implementation of these practices through direct training education and consulting activities, applied research projects/case studies, and partnering with "green" certification programs. As the Energy Extension Service, and through the cooperation of the Extension offices in each county in Florida, we provide and deliver continuing education courses and associated certifications for professionals involved in the design, construction, and operation of residential community developments, including "Build Green & Profit" and "Low Impact Development (LID) Practices for Florida: Stormwater." Through this network and with the assistance of our diversified faculty, we will deliver outreach activities for the Florida Energy Systems Consortium (FESC) in the areas of Energy/Climate Awareness Factsheets, demand side management programs, continuing education modules on applied energy efficient technologies, collaboration with demonstration houses throughout the state and alternatively fueled vehicle research and data collection. By working collaboratively with the FESC universities, we can help the citizens and communities of Florida make informed decisions on energy use and stimulate economic opportunities in the alternative energy and energy efficiency services sector.

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

During this period an unprecedented number of funding opportunities through the American Recovery & Reinvestment Act (ARRA) of 2009 and the fiscal 2009 federal budget became available. To facilitate faculty collaboration in response to these competitive funding opportunities, FESC has begun the process to bring together faculty with common research interests or those able to respond to a specific call. Team meetings were organized and held on multiple research themes. These one-day meetings typically open with selected senior faculty members giving overview presentations in the expertise area and identifying research needs. This is followed by a short presentation from each participating faculty about their research interests. Faculty members have an opportunity to form proposal teams during the open discussion session of the meeting. Team meetings already held include:

- Battery Team meeting on 5/5/09 (24 members, 5 universities)
- Algae Team meeting on 6/3/09 (25 members, 6 universities)
- Small Molecule Chemistry & Energy Team meeting on 6/15/09 (35 members, 6 universities)
- Solar PV Team meeting on 9/21/09 (23 members, 6 universities)

FESC Summit Team Meetings

Industry researchers and technology managers were invited to each team meeting to introduce FESC industry partners to faculty. Other team meetings are planned in the near term in the areas of Solar-Thermal, Biomass, Smart Grid, Carbon Capture, Energy Efficiency, Ocean Energy, and Policy & Systems.

FESC Summit: Algae Team Members

The inaugural FESC summit that was held on September 30th, 2009 featured Technical Team Roundtable discussions in the areas of Energy Efficiency & Conservation, Carbon Capture & Sequestration, Ocean Energy, Energy Storage, Smart Grid, Solar PV, Solar Thermal, Algae, Biomass, and Policy & Systems. The participants were faculty members, graduate students, and industry researchers and technology managers. The team meetings break the silo effect by bringing faculty members from different departments and different universities together. It is an opportunity for faculty to learn more about the research interests of the other faculty members and also the needs of the industry participants. The stimulating discussions sparked new ideas resulting in collaborative research, forming proposal teams, and partnerships with industry.

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. More than 130 funding opportunities were distributed to the FESC faculty. The list of funding opportunities is given in Appendix B. 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.

252 proposals amounting to $356,706,995 were submitted for competitive funding and 419 awards totaling $97,243,762 were received by all energy faculty within SUS. The details are given in the accountability measures section of the report in Appendix H.

Finding partners outside of Florida is critical to respond to nationwide calls such as the Energy Innovation HUBS proposed by Secretary Chu. A database of FESC expertise information, including faculty biographies, has been prepared in several areas such as Algae, Solar to Fuels, and Energy Efficiency to better communicate to potential partners the capabilities of the SUS research enterprise.

The algal fuels expertise information has been very useful in forming a partnership with Midwest Research Institute (MRI) and other participants in response to the $50M US DOE funding opportunity titled as "Development of Algal / Advanced Biofuels Consortia". As another example, FESC has been in discussions with Workforce Florida, Inc. to provide support in workforce development. FESC recently collaborated with Workforce Florida, Inc. in response to the US Department of Labor funding opportunity titled as "State Energy Sector Partnerships and Training Grants".

Consortium strategy was to prepare a series of white papers (WP) in major thrust areas to benefit from ARRA opportunities (sample listing is given in Appendix I). FESC faculty collaborated and wrote 36 White Papers (listed in Appendix C). The summary of the White Papers were submitted to the State Energy Office and shared with some of the federal agencies. The list below shows the area of focus for the white papers.

<u>36 White Papers Total - 10 WP in Demonstration</u>

- Energy Efficiency (3 WP)
- Biomass, Biofuels, Energy Crops, LCA (10 WP)
- PV, Solar Thermal, CSP, (9)
- Carbon Sequestration (1 WP)
- Ocean Energy (1 WP)
- Smart Grid, Energy Storage , Power (6 WP)
- Energy Security (1 WP)
- Wind (2 WP)
- Education & Workforce (3 WP)

INDUSTRIAL COLLABORATION AND TECHNOLOGY COMMERCIALIZATION

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.

Industrial Collaboration

The FESC Industrial collaboration program's goals are designed to leverage key relationships with industry to the benefit of FESC's education, research, and technology commercialization missions.

Industrial Collaboration Goals

- Industry involvement in planning & execution of research, education & technology commercialization programs
- Active collaboration among faculty & industry partners from conceptual stages of research, education, & outreach programs
- Relevant information provided to industrial, academic, and government partners in a timely fashion
- Facilitation of networking among academic, government, and industrial partners for pre-competitive research
- Education of a new breed of student leaders for industrial employment in myriad energy fields
- Strong commercialization programs that foster industrial collaboration and deliver a pipeline of energy technologies for commercialization

Industrial Database

FESC has identified a need in Florida's energy related programs in that no single database exists cataloging the breadth of renewable energy companies and associations across Florida. While capturing and maintaining a 100% complete dataset of industrial contacts may not be feasible, FESC has initiated an effort to create a database of important industry players in order to quickly identify synergies between FESC's research, education, and technology commercialization programs and Florida industry. Sources of information for this database include Florida energy related trade associations, researcher and university contacts, Florida energy program grantees, and other sources. To date, FESC has compiled and is maintaining a relational database of over 150 companies and other entities in Florida that have a key stake in Florida's energy strategies. This list will be constantly updated and will provide an avenue for program information dissemination, industrial needs assessments, and potential collaborations.

ARRA Project Proposal Multi-university Industrial Partnerships

The initial phase of FESC operations has been a busy period in terms of building active and future industrial collaboration across the Consortium. The America Recovery and Reinvestment Act (ARRA) has provided substantial opportunities for partnering with industry across FESC's energy research thrusts and across our universities and the Consortium leadership has taken advantage of this. FESC has adopted the strategy of preparing a series of white papers for research and development programs in collaboration with industry in which SUS energy researchers across multiple disciplines and universities partner with companies to develop 'shovel ready' projects. FESC researchers have identified 22 partnering companies and entities for 6 broad research projects as shown below. Additionally, FESC is establishing a broad external support base for a project in workforce development.

R&D of Bioenergy Alternatives from Marine / Aquatic Algae
Universities: FSU, UF, FIU
External Collaborators: Oak Ridge National Laboratory, U.S. DOE Bioenergy Science Center, Midwest Research Institute, National Renewable Energy Laboratory

Cellulosic Ethanol Pilot and Demonstration Plant
Universities: UF, FIU
External Collaborators: Verenium, Buckeye Technologies, BioEnergy International, Florida Crystals Corp.

Achieving Energy Independence by Development of >100mpg Biofuel Fuel Cell Plug-in Hybrid Cars
Universities: UF, UCF, USF
External Collaborators: Lynntech, Solid-State Energy & Technology, Planar Energy Devices

Design, Construction and Operation of CSP Solar Thermal Power Plants in Florida
Universities: USF, UF, UCF
External Collaborators: Sun Borne, Eliosol Engineering, FPL

Establishing an Efficient and Reliable Energy Delivery Infrastructure w/ Attention to Governance, Economics, and Decision Making
Universities: FSU, USF, UF, UNF
External Collaborators: JEA, Progress Energy, FPL, Publix, Siemens T&D.

PV Energy Conversion and System Integration
Universities: UCF, UF
External Collaborators: BP Solar, Petra Solar, City of Tavares

Workforce Development: Retooling Florida's Workforce for a Sustainable Energy Future
Universities: UF, FIU, FAU, UCF, USF
External Collaborators: FL utilities, Community Development Corp., Local and State government departments and agencies, Private sector auditing, Weatherization and remodeling businesses, Community Colleges, Banner Centers, FLATE.

In addition to the multi-university FESC white paper projects described above, FESC university researchers and leadership identified single university energy related projects which included industrial collaborators. These single university projects are being promoted by the individual universities rather than through FESC.

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:

- Working with Clairvoyant Energy and Gainesville Regional Utilities to Establish a Major Solar Manufacturing Facility in Florida – In March 2009, FESC and the Florida Institute for Sustainable Energy (FISE) worked with the City of Gainesville, Gainesville Regional Utilities, and the Gainesville Council for Economic Outreach to host a group of visitors from across Europe in Gainesville. This meeting was catalyzed by GRU's initiation of the nation's first Feed-in-Tariff program and the visitor's desire to explore resultant research and manufacturing collaborations. FESC was a key part of this meeting and, as a result, FESC is currently working with one of the visitors and Gainesville Regional Utilities and Progress Energy to establish a major PV manufacturing facility and a series of solar farms across the state. Details of this project are confidential at this point, but a proposal for a 25MW PV facility has been prepared and submitted to the Department of Energy for funding.

- Working with Midwest Research Institute in Establishing Multi-university Research Programs in Algae Energy – FESC arranged a meeting of UF, FSU, and FIU researchers working in novel algae energy development programs with executives of the Midwest Research Institute and the National Renewable Energy Laboratory. As a result of these meetings, a major proposal for a joint southwest / southeast US algae consortium was submitted to the Department of Energy in collaboration with a leading National Lab and a major Southwest US research university and further proposals are under consideration for development.

- Designing an Energy Security Center of Excellence with Sandia National Labs, SAIC and Florida Military Installation – FESC is preparing a major proposal to establish a Secure Energy Systems Center of Excellence in Florida in collaboration with Sandia National Labs, SAIC International, a leading defense contractor, and the Benham Group, an architectural and construction firm with a focus on renewable energy infrastructure projects. FESC is currently in discussions with several military facilities in the state including Naval Air Station (NAS)-Whiting Field, NAS-Key West, NAS-Pensacola and Naval Facilities Command Southeast (NAVFAC SE)-Jacksonville regarding partnering in implementation of a systems approach to energy efficiency and energy security at military installations.

- Exploring Electrochemical Energy Storage Programs in Collaboration with Sandia National Laboratories – A group of faculty visited Sandia National Lab in February to explore joint research programs initially in the area of stationary power storage. This visit also spawned interest in collaboration in other areas, including solar thermal. PV and energy security. At this time Sandia plans to visit UF and a series of possible projects have been presented to DOE.

- Babcock Ranch / FPL / Florida Research Consortium Renewable Energy Community Development – FESC has initiated discussions with Babcock Ranch, FPL, and the Florida Research Consortium to understand how FESC's systems approach might be beneficial to the group in development of the recently announced Babcock Ranch / FPL partnership. Of particular interest will be areas of systems integration, PV systems development and testing, smart grid / micro grid development and analysis, and energy efficiency programs. FESC and Babcock

Ranch jointly submitted a proposal to DOE for funding of smart grid applications in the first residential stage of the development.

- Sarasota County Energy Efficiency and Solar Energy Programs – FESC is in discussions with public and private sector officials of Sarasota county to explore how the Consortium might be of help to Sarasota's efforts to expand their energy efficient and solar energy programs. This project was proactively initiated by FECC Commissioner and FESC liaison Nick Gladding. The Consortium is currently exploring the possibility of providing assistance in design of energy efficiency homes and is exploring the possibility of sighting one of the Consortium's energy outreach offices in Sarasota County.

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

Advisory Board

In addition to the project level industrial collaborations discussed above, FESC is also focused on assuring industrial guidance and collaboration are provided at the overall program level. As such, the leadership team is populating the FESC Advisory Board with senior level (e.g. Division Lead, VP for Research, President) energy industry executives that can provide a range of industrial and government perspectives on energy programs and needs from the international to state levels. The Consortium has adopted a formalized process of Steering Committee and FESC Leadership nomination and selection of candidates that assures senior level, recognized energy experts are engaged. The Board's Charter has been formalized (see Appendix E) and the following executives have agreed to serve on the FESC Advisory Board as Charter Members for an initial 3-5 year period. These executives have provided FESC with high value program and project guidance and have partnered with FESC on federal funding proposals in many cases. Engagement of other Advisors that will be brought on in the coming months will lead to greater industrial collaboration and technology commercialization across the breadth of FESC research programs.

Institution	Representative
Florida Crystals Corp.	Gus Cepero, Vice President
FPL	Buck Martinez, Sr. Director of Project Development
Gulf Power	Bentina Terry, VP, External Affairs & Corp. Services
Holland & Knight, LLP	Tommy Boroughs, Partner
Milcom Venture Partners	Chris Fountas, Partner
Ocean Renewable Power	Christopher Sauer, President & CEO
Orlando Utilities Comm.	Byron Knibbs, VP Sustainable Services
Progress Energy	Rob Caldwell, VP Efficiency & Innovative Tech.
Scripps Research Inst.	Roy Periana, Director Scripps Energy Laboratories
Siemens Power	Frank Bevc, Director Technology Policy
SUS Board of Governors	Sheila McDevitt, Chair
TECO	Greg Ramon, Director Regulatory Policy & Compl.

Biographies for Advisory Board Members are provided in Appendix F.

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.

Technology Commercialization

FESC is creating a robust and active technology commercialization program that compliments the technology transfer and commercialization efforts of our partnering universities. 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. Specifically, FESC is working with the following key partners to craft and implement the multi-tiered technology commercialization program outlined in this section:

- SUS Technology Transfer Directors – FESC Leadership met with all of the core university technology transfer office directors to best understand how FESC can complement their programs and speed the licensing and commercialization of renewable energy technologies from the SUS universities. The results of these discussions to a great degree drove the multi-tiered technology commercialization program discussed below.
- Florida Research Consortium – FESC has been working with the Florida Research Consortium to promote the offerings of the Consortium to high level industry and government executives for industrial guidance across a broad range of industries. FESC leadership serves on the FRC Executive Committee and Board, providing a solid avenue for collaboration.
- Florida Institute for Commercialization of Public Research – The Institute supports development & funding of energy startup companies from technologies to entrepreneurs & investors. FESC has explored how best to work with the Institute and will provide the Institute with the results of the business plans and market research reports discussed below for bundling and presentation to entrepreneurs and other investors.
- Florida High Tech Corridor – FESC's leadership is intimately involved in the Florida High Tech Corridor Council (FHTCC) program, including managing the FHTCC matching grants research program at UF. FESC is utilizing the central Florida economic development network of FHTCC to identify collaborating organizations and potential for economic impact to the Central Florida region. This may expand to leveraging FHTCC workforce development programs in the coming year. Additionally, the FESC technology commercialization collaborative research matching grants program described below is modeled on and will work in concert with the FHTCC matching grants research program – including potential joint funding of energy development projects (FESC, FHTCC, and industry).
- Florida Incubator and Research Park Ecosystem – FESC has worked diligently to establish its research and education programs over the initial phase of the program and has held off on engaging the Florida incubator and research park network in this early stage. However, as the market research and collaborative research programs described below are initiated in the coming months, FESC will actively market the deliverables (business plans, market research and analyses, results of collaborative research projects) to this community to provide a seamless transition to the private sector.

As a result of these interactions and those with private sector entities, 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:

1. 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 were:

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 Energy

	Solar Cells	
USF	A Practical Method of CO_2 Sequestration	Carbon Capture and Sequestration

2. 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 would expect a minimum 2:1 industry match on each project, attracting in excess of $500k of industry support to these FESC funded projects.

EDUCATION AND OUTREACH

The FESC education and outreach programs are key components of the value that FESC adds to Florida's business community, populace, and policy makers. It is through our education and outreach program that many of the benefits of the state's investment in FESC directly impact our stakeholders and will change the energy face of Florida today and tomorrow.

FESC Education and Outreach Faculty
Dr. James Klausner, UF – Masters Program
Dr. Diane Schaub, UF – Community College Program
Dr. Marilyn Barger, FL ATE – Statewide Curriculum Framework Development
Dr. Aliriza Ali Haghighat, UF – Workforce Development in Nuclear Energy
Dr. Pierce Jones, UF – Outreach

To meet the education and outreach goals, FESC constituted an Education Committee that includes representatives from each institution who are involved in the education and outreach program.

Education and Outreach Committee Members
Dr. Tim Anderson, UF, Chair
Dr. James Klausner, UF
Dr. Diane Schaub, UF
Dr. Pierce Jones, UF
Dr. John Shen, UCF
Dr. Richard Gilbert, USF
Dr. Anjaneyulu Krothapalli, FSU
Dr. Ali Zilouchian, FAU
Dr. Leonel Lagos, FIU

EDUCATION

The Education program has three focus areas, 1) community college programming at the Associate of Science and certificate level, 2) nuclear energy education, and 3) 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 (FL ATE), which coordinates the design of industry specific training programs for technicians at the community colleges in Florida. FESC disseminates energy curricula in cooperation with FL ATE.

There are several Masters Programs in energy area that are in preparation. UCF will have their Professional Science Master Degree program in Energy Systems Engineering launched next year. UF is in the process of organizing a graduate education program in the area of energy. Dr. Ali Zilouchian,

Associate Dean for Academic Affairs Assistant, FAU, is leading a NSF Science Master's Program (SMP) proposal effort in collaboration with FIU, USF, and UCF to have a FESC wide energy program.

Education White Paper

Participants of the Education Summit were invited to participate in a state-wide energy education white paper development effort in response to stimulus funding opportunities. The resulting document includes over 20 education entities across the state, as well as FL ATE, the Banner Centers, FSEC, and companies that have proposed programming for weatherization, solar, biomass, and nuclear engineering. It is expected that this document will serve as a unifying effort when specific funding becomes available and will result in a coordinated effort in energy education.

Community College Program, Dr. Diane Schaub, Director, UF-DOE Industrial Assessment Center

Efforts are ongoing to establish the creation and promotion of workforce training programs. The FESC team is working with the Community Colleges and using faculty development opportunities within the SUS to coordinate technician level education.

In February 2009, FESC convened a Community College Energy Education Summit in Gainesville, Florida. Community College representatives from 14 community colleges, 5 universities, The Florida Solar Energy Center (FSEC), The Banner Center for Construction, Gainesville Regional Utilities, and FL ATE attended. Each Community College representative briefed the group on their current efforts in energy education. The group heard from experts on nuclear, biomass, and solar energy, and brainstormed regarding needs of the Community Colleges in this areas as well as ways FESC could collaborate with them.

The participants identified the following areas of need:

- Faculty development
- Curriculum collaboration
- Resource Clearing House – available facilities, experts, Community College Personnel working in energy, a newsletter
- Database of employers and campus recruiting events
- Startup funding for energy education labs
- Funding for attendance at professional conferences, travel
- Closer collaboration between paired CC-Universities
- Rotate FESC meetings around the state

FESC has reviewed these suggestions and identified ways it can best collaborate with the Community College System. FESC is positioned to provide facilitation with the Community Colleges, coordinate industry involvement through the FESC energy industry network, and leverage the requested funding with FESC resources. FESC also depends on the expertise of the FL ATE Center to help in developing customizable curricula that could be used in programs in various community colleges across the state.

The SUS has a long and successful history of providing distance education which can help train the future green workforce thereby assisting in upgrading existing tradesman's skills, retraining displaced workers, and finding future employment opportunities for US veterans through a large and diverse set of energy-related courses.

Working with existing education and outreach entities, FESC is set to deliver focused workshops on a variety of energy related topics that will qualify as continuing education. Entities within FESC include

the Florida Solar Energy Center, Program for Resource Efficient Communities, and the IFAS Extension program, which can be used to reach out to a broad community.

Florida Advanced Technological Education Center (FLATE) Program, Marilyn Barger

FLATE has the expertise to develop statewide curriculum frameworks for technical A.S./A.A.S. degree programs supporting existing and new energy business sectors. FLATE processes through the FL DOE the industry-validated student competencies of the frameworks.

FLATE will 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 works closely with the FESC Public Outreach and Industry Partnership programs to provide professional development opportunities for teachers and faculty to upgrade and update their knowledge base.

FLATE participated and hosted the following related events:

- 09/22/09 – poster presentation at USF-TECO "Energy Forum with US Senator Mel Martinez" (Tampa, FL)
- 12/08/08 – FLDOE Greenforce Florida Green Education Inventory Report Draft review (Tallahassee, FL)
- 02/06/09 – presentation at FESC Community College Summit (Gainesville, FL)
- 06/30/09 –hosted and participated in NSF ATE National Center for Energy and Environment (ATEEC) Regional Energy Conversation (Tampa, FL)

Workforce Development in Nuclear Energy, Prof, Ali Haghighat, Nuclear & Radiological Engineering

Prof. Ali Haghighat has initiated a major project on design, licensing and construction of a fully digital control system for the University of Florida Training Reactor (UFTR). In addition to FESC funding, several organizations have provided funding and made investment in terms of hardware and software. This project is the first of a kind, and is highly important for effective operations of the existing 104 power reactors, and more importantly for the next generation reactors, all of which are scheduled to have digital controls. Note that this is the only training reactor in the US with digital controls.

Masters Program, Dr. James Klausner, Professor, Mechanical and Aerospace Engineering

Graduate level courses have been identified for a M.S. degree in energy area. The Department of Mechanical and Aerospace Engineering at UF is planning to offer this program. The preliminary structure is given below:

Students will need to complete a total of 10 courses. Students must complete at least 7 of the following:

EML 5104 Classical Thermodynamics
EML 6451 Energy Conversion
EML 6417 Solar Energy Utilization
EML 6934 High Temperature Solar Thermal Energy
ECH 7938 Solar Photovoltaics
EML 5515 Gas Turbines
EML 6934 Aerodynamics
EML 6934 Fuel Cells
EMA 6226 Advanced Mechanical Metallurgy

EML 6939 Failure of Materials in Mechanical Design

In addition, **Energy Certificate Programs** will be offered via distance education. Students will complete three of the four courses listed. Courses marked with '*' must be taken.

Energy Certificate in Solar Energy

1. *EML 6417 Solar Energy Utilization
2. EML 6934 High Temperature Solar Thermal Energy
3. ECH 7938 Solar Photovoltaics
4. EML 6451 Energy Conversion

Energy Certificate in Wind Turbines

1. EML 6451Energy Conversion
2. *EML 6934 Aerodynamics
3. *EML 6934 Composites
4. EML 6939 Failure of Materials in Mechanical Design

Energy Certificate in Gas Turbines

1. EML 6451Energy Conversion
2. *EML 5515 Gas Turbines
3. *EMA 6226 Advanced Mechanical Metallurgy
4. EML 6939 Failure of Materials in Mechanical Design

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. FESC works with these existing networks to provide programming on efficient use of energy and alternative energy generation methods to the general public as well as targeted to specific audiences such builders, land planners, solar panel installers, and architects.

Following are specific outreach activities that are being launched in support of FESC:

Energy/Climate Awareness Fact Sheets
Contributed nine fact sheets available under "More Information on Home Energy Issues" including: *Caulking & Weather-Stripping*; *Dishwashers*; *House Design & Room Location*; *Radiant Barriers*; *Refrigerators & Freezers*; *The Roof*; *Swimming Pools*; *Ventilation*; and, *Whole-House Systems Approach to Energy Efficiency*. Additional fact sheets are under development.

Energy Extension Service (EES)
Faculty is serving on both the UF/IFAS Sustainable Housing and Home Environment and the Climate Variability and Change Focus Teams. One of our faculty members developed the Climate Variability and Change Shared Materials site for county and state faculty (SharePoint site).

As a major outreach activity we made 19 presentations regarding different aspects of energy efficiency at a number of functions and conferences, some of which included: county extension faculty in-service

trainings, planning & zoning commissions, Florida municipal energy efficiency committee, Gulf Coast Energy Network, Edgewater City Commission, Orange County EcoNomic Living Expo, Florida Tech's International Sustainability Conference, Florida Housing Coalition Conference, Association of Florida Community Developers, DOE Southeast Regional Workshop, Farm Foundation, Florida Environmental Resources Agencies Conference, and Southeast Builders Conference. These meetings, activities, and conferences were held around the state and included Lake Buena Vista, Tampa, Edgewater, Gainesville, Orlando, Melbourne, Plant City, and Sarasota with an additional presentation made in Little Rock, Arkansas.
Developed tentative agenda for *Emerging Energy Issues and Topics* in-service training scheduled for March 18, 2010, in Gainesville. Online registration is underway through IFAS' Program Development and Evaluation Center dedicated website for County Faculty.

Demand Side Management (DSM)
Under demand side management, worked with Gainesville Regional Utilities, St. Johns River Water Management District, Osceola County Extension Service, and Neutral Gator on a number of grant-related and other projects to compare household energy use based on consumptive use, to quantify carbon emission reductions from local weatherization programs, etc.

Continuing Education (CE)

> *Developed and will soon offer* Greenhouse Gas Reduction and Energy Conservation I: Comprehensive Planning under Florida's HB 697 *continuing education course for 5 AICP-CM credits for Planners (pending), 6 PDHs for Professional Engineers, and 6 CEUs for Landscape Architects. This one-day class, from 9:30 am to 3:30 pm is scheduled on October 27th in Broward County, October 28th in Palm Beach County, and October 29th in Miami-Dade County with the goal of presenting to local officials, planners and development professionals new growth management regulations as enacted in Florida HB 697, along with ways and means for addressing the new requirements.*

In addition, collaborating with Sarasota, Manatee and Pinellas counties to develop and deliver continuing education classes targeting built environment professionals.

Demonstration Houses (DH)
Working with Pinellas County to design and specify products for use in an energy-efficient demonstration house to be built at the County Extension Service offices. Working with Orange County to design and install a solar PV demonstration system to be built at the Orange County Extension Service offices and to be used in conjunction with educational programs.

Workforce Development (WD)
Exploring collaborative opportunities for grant funding.

Alternatively Fueled Vehicles (AFV)
Working with Progress Energy to evaluate performance of PHEV using converted Toyota Prius equipped with GPS tracking system and software to monitor performance; had discussions with TECO on natural gas powered vehicles; met with Publix to discuss fuel efficiency data from their fleet of 180+ hybrid vehicles. Made three presentations on alternatively fueled vehicles.

Collaboration on New Initiatives
Prepared nine FESC-Related Grant Applications in 2009, of which two are funded and the decision is pending on three.

FESC Web Site and Brochure

FESC web site (www.FloridaEnergy.ufl.edu) and FESC brochure were developed to promote the benefit of the state's investment in FESC to the business community and populace of Florida. The home page for the FESC web site is shown below.

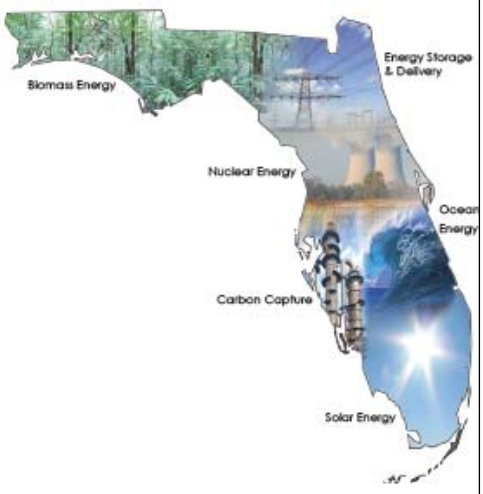
The web site lists faculty member biopages under "ABOUT US" by "university" and by "research areas". This helps to locate experts in the desired area of expertise quickly. Faculty listing by research areas may facilitate collaboration among the faculty members. This can also be useful for industry or public if they want to find an expert(s) in a specific area. The "Public Outreach" section lists fact sheets and other outreach activities.

Brochure: A trifold brochure was developed to promote the consortium. FESC brochure is posted at the FESC web site. A cover page and the other pages of the brochure are given below. The brochure gives information about the missions/ goals of the consortium and summarizes the research thrust areas. The brochure is posted at the home page of the FESC web site.

FESC

Florida Energy Systems Consortium

A Systems Approach for Florida's Energy Future



UF UNIVERSITY of FLORIDA · FAU FLORIDA ATLANTIC UNIVERSITY · UNF · FLORIDA GULF COAST UNIVERSITY · UWF · UCF · FIU FLORIDA INTERNATIONAL UNIVERSITY · USF UNIVERSITY OF SOUTH FLORIDA

Leadership In Energy Research Enabled by a Systems Approach

"Florida Universities innovating for a sustainable energy system"

The Florida Energy Systems Consortium (FESC) is a state resource that performs research and development on innovative energy systems that lead to alternative energy strategies, improved energy efficiencies, and expanded economic development for the state. The Consortium supports the Florida Energy and Climate Commission in developing and implementing the State's energy and climate agenda.

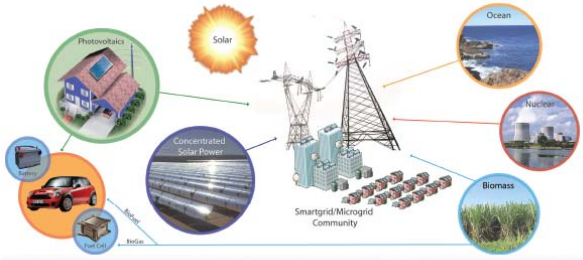
OVERARCHING - UNDERSTANDING FLORIDA'S ENERGY SYSTEMS
- Perform selected and recurring analyses
- Provide objective and quantitative assessments to the state
- Identify and evaluate research opportunities
- Evaluate alternative power delivery and transportation systems

ENHANCING ENERGY EFFICIENCY AND CONSERVATION
- Develop energy efficient technologies
- Improve existing and new construction building efficiency
- Integrate renewable energy to produce a more sustainable environment

DEVELOPING FLORIDA'S BIOMASS RESOURCES
- Florida has ~7% of the U.S. total biomass
- FESC has a broad range of programs in bio - energy ranging from conversion of biomass and waste to cellulosic ethanol by using microbial and concentrated solar power processes, and algae-based fuels.

ENSURING NUCLEAR ENERGY AND CARBON CAPTURE
- Nuclear energy provides large-scale, carbon-free electric power generation
- FESC has a nuclear training reactor. The control systems is being converted from analog to digital to provide the only digital training reactor in the U.S.

EXPLOITING FLORIDA'S OCEAN ENERGY RESOURCES
- Ocean energy uses the power of ocean currents, waves, tides, and salinity gradient to create renewable energy
- Research includes electricity generation, via underwater turbines, deep ocean water-based air-conditioning, underwater hydrogen generation, and storage



SECURING OUR ENERGY STORAGE AND DELIVERY INFASTRUCTURE
- Investigate grid topologies, equipment and systems (e.g., power electronics, transformers, and substations), resiliency of the transmission and distribution system, and batteries for energy storage

A Systems Approach for Florida's Energy Future

Bringing Energy Solutions to Serve Florida, the Nation, and the World

HARNESSING FLORIDA'S SOLAR RESOURCES
- Develop thin film and organic solar cells along with their systems intergration
- Develop concentrated solar thermal systems for conversion to power and fuels

EDUCATION AND OUTREACH
- Energy education at community colleges for A.S. degree and certificates
- Nuclear energy education and masters degree in sustainable energy
- Leverage the existing network of extension offices within Florida to deliver educational programs and products related to energy and resource-efficient community development

ENERGY INDUSTRY COLLABORATION
- Establish partnerships with companies and other organizations
- Promote 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 Florida Energy Systems Consortium (FESC) was created by Florida Statute to share energy related expertise and promote collaboration among the energy experts at its 11 public universities.

GOAL

Uniting Florida's Universities to become a leader in energy research, education, technology, and energy systems analysis.

VISION

Florida Universities innovating for sustainable energy generation, distribution and usage systems.

Dr. Tim Anderson
Director
Email: tim@ufl.edu

Ms. Canan Balaban
Associate Director of Program Development
Email: cbalaban@ufl.edu

Dr. Anne Donnelly
Associate Director of Education & Outreach
Email: adonnelly@seagep.ufl.edu

Mr. Erik Sander
Associate Director of Industrial Collaboration & Commercialization
Email: esander@ufl.edu

www.FloridaEnergy.ufl.edu
floridaenergy@ufl.edu
(352) 392-0947

FESC SUMMIT

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

A keynote address by Sam Baldwin, Chief Technology Officer and Member of the Board of Directors for the Office of Energy Efficiency and Renewable Energy with the US Department of Energy, opened the Summit. His talk, entitled "Energy Efficiency and Renewable Energy: Challenges and Opportunities," was extremely valuable and is available on the FESC website, http://www.floridaenergy.ufl.edu/wpcontent/uploads/baldwintalkflorida29september2009final.pdf

The Summit's first day also featured presentations by James Murley, Chairman of the Florida Energy and Climate Commission, and Mark Futrell of the Florida Public Service Commission, who addressed Florida's energy needs and opportunities. FESC Director Tim Anderson presented an overview of FESC activities and led a roundtable discussion that provided input toward how Florida universities can best promote research collaboration among themselves and with industry, and thereby assist the state's economic development.

A poster overview presentation followed, where 38 poster presenters were given two minutes and two slides to describe their posters. This novel approach was very well received, and allowed the audience to target posters of specific interest as the day culminated in a poster session and reception.

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

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

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

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

In addition to the Summit itself, two important Pre-Summit activities took place. The FSU Center for Advanced Power Systems (CAPS) and USF Power Center for Utility Explorations (PCUE) organized a

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

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

Next year's summit is planned for Fall 2010 at the University of Central Florida.

The summit program and the preliminary results from a survey of FESC Summit participants are given in Appendix G.

FESC Summit participants discuss energy research in the Technical Team Roundtable session.

OTHER EVENTS

FSU Workshop, February 24, 2009
FSU held a workshop on 2/24/09 to discuss accountability measures. FESC leadership team participated in the workshop. This was a good opportunity for the FESC leadership team to meet the FSU faculty and visit the facilities. Scott Minos from US DOE was one of the speakers. FESC is considering leveraging this as a model for a FESC wide accountability model.

FSU Dedication Ceremony for OGZEB, August 14, 2009
The new "Off-Grid Zero Emissions Building" (OGZEB) research facility is an 800-square-foot structure that features building-design and energy innovations. The building was developed by local architects, engineers and environmental technology companies, as well as students and faculty from the Center. http://esc.fsu.edu/homePage.html

FSU partnering with Harmony to find new ways to power community
A partnership was recently forged between Florida State University's Energy and Sustainability Center and Harmony (http://www.harmonyfl.com/) an environmentally friendly community planned in eastern Osceola County. The university plans to build a 5-megawatt power plant that uses solar thermal energy combined with the gas created by burning biomass, or organic matter. That's enough to power an average of 2,000 homes.

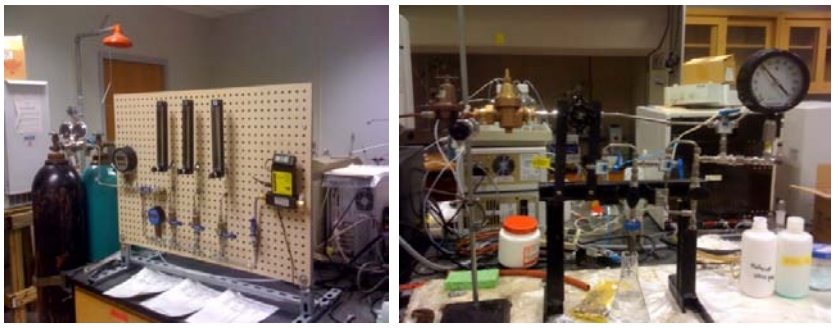
USF Kick-off Meeting, April 13, 2009
USF-FESC meeting was held at the USF campus on April 13, 2009. Dr. Karen Holbrook, USF VP Research, welcomed the gathering of FESC team. Dr. Tim Anderson, Ms. Canan Balaban, Mr. Erik Sander from the University of Florida FESC office attended the kick-off meeting and also presented the overview of FESC and strategies. Dr. Yogi Goswami, the Director of USF-FESC provided a briefing about the USF-FESC overview, activities and deliverables to PIs and Co-PIs. There were around 14 presentations made by the USF-FESC PIs for their projects and followed with interactive discussions with other members of the team.

Presentations by FESC Leadership
- FESC Leadership Team participated in the FECC meeting. Dr. Anderson presented FESC program on Jan. 15, 09.
- Canan Balaban, Associate Director, FESC, presented FESC program at the Florida Renewable Energy Meeting (FREPA) in Tallahassee on March, 2009.
- Erik Sander, FESC Associate Director, presented FESC activities at the World Congress on Industrial Biotechnology and Bioprocessing in Montreal, Canada on July 21, 2009
- Erik Sander, FESC Associate Director, presented FESC activities at the Enterprise Florida TEC Council in Ponte Vedra Beach on August 19, 2009
- Canan Balaban, Associate Director, FESC, presented FESC research program at the Southeastern Universities Research Association (SURA) Workshop in Atlanta GA on August 11-12, 2009.
- Dr. Tim Anderson, Director, FESC, presented FESC program at the Florida Municipal Energy Efficiency Committee meeting in Gainesville, FL, on October 13, 2009.

Visits

- FESC Leadership Team participated in the USF kick off meeting on April 13, 2009. The team members had a separate meeting to discuss energy security and had a brain storming session to respond to the recent NSF call on Engineering Research Centers.
- FESC Leadership Team visited FAU and FIU on Sep 1 and Sep 2, 2009 respectively.
- FESC Leadership Team visited Department of Community Affairs to introduce consortium and how consortium be of service to their weatherization efforts.
- FESC Leadership along with representatives of the FSU Center for Advanced Power Systems (CAPS) visited Naval Facilities Command Southeast (NAVFAC SE)-Jacksonville, NAS-Pensacola, NAS-Whiting Field, and NAS-Key West throughout the year to explore creation of a Center of Excellence in Secure Energy Systems. This program might be initiated at small communities such as military installations.

APPENDIX A – RESEARCH PROGRESS REPORTS

Projects	Summary
THRUST 1: Enhancing Energy Efficiency and Conservation	
	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, Anter Al-Azab, Subramanian Ramakrishnian **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. **Budget:** $30,000 **University:** FSU **Progress:** Task 1: Fabrication of silica and latex-supported membranes and oxide-based nanocomposites To help carry out this work, two students so far have been recruited – 1) Erin Holley: a graduate student (masters) has started school at FSU in the newly formed materials science and engineering department. Erin was an undergraduate at FSU in the department of chemical and biomedical engineering whom we have convinced to stay on and pursue graduate school due to her interest in the proposed research. 2) Mayra Gonzalez: A Junior in chemical and biomedical engineering has started working in our labs to help characterize the membranes and is working with Erin Holley. Recruiting these two students we feel is a key step forward in the project. Experimental setup of equipment for gas and water permeability: A considerable amount of time was spent by Erin in overcoming difficulties and in setting up the equipment for gas and water permeability measurements (Figure 1). Commercial membranes were then successfully characterized using the above equipment (Figure 2). Thus, we now have the capability to characterize membrane pore size and water permeability's in our capabilities and this will play an important role in characterizing the membranes.  Figure 1: Experimental setup to measure pore size distribution and water permeability of membranes.
	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.

Budget: $503,168

University: FSU

Progress:

Phase 1: Building Design

A team of engineers and architects were chosen to design the OGZEB. This team spent one year considering LEED certification, energy efficiency and construction optimization of the OGZEB. All design expenses were donated by the design team.

Phase 2: Building Construction

The construction of the building is complete with the issuance of the Certificate of Occupancy. The shell of the house has been designed and constructed to enable research into Sustainably Integrated Advanced Building Systems. The layout is designed to allow for new technology to be compared against a baseline technology for cost effective analysis and thorough analysis. The construction also allows for ongoing modifications allowing the newest technologies to be implemented.

Phase 3: Power Generation System Implementation

Solar panels have been installed, including inverters. Solar thermal panels are installed and a 300-gallon water tank is used to store thermal energy. These systems are oversized to allow for system integration and optimization allowing adequate research possibilities.

Phase 4: Power Storage System

Redesign of the hydrogen storage system is currently underway and will require a new water electrolysis device that is not included in the current funding. Hydrogen cylinders and a small battery array have been installed and a 5 kW fuel cell will be installed shortly.

Phase 5: Monitoring System Design and Installation

The monitoring system is being installed in two stages. The first stage is complete with the installation of an Indoor Air Quality system that measures temperature, humidity, carbon dioxide and volatile organic chemicals every 5 min. The second stage involves the installation of a power monitoring system that will track every kilowatt-hour and British thermal unit that is utilized by the OGZEB. A partnership with Johnson Controls has been established and we are currently working with them to identify all of the locations for acquiring measurements prior to system installation. The data collected by this system will be used to compare and test technologies and will be provided to the public via a web portal

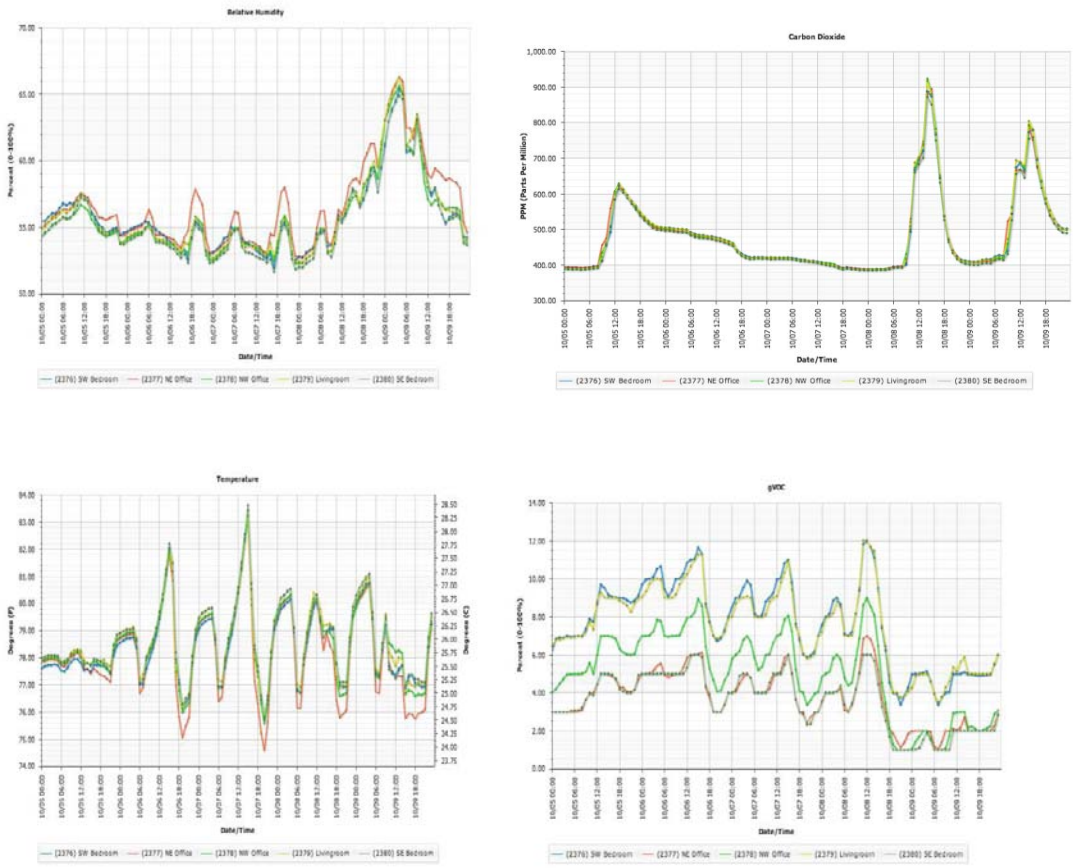
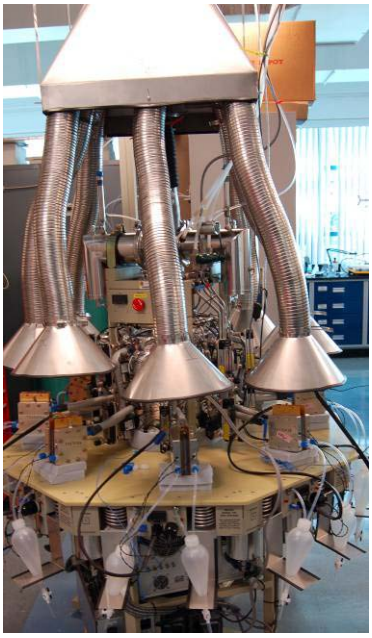


Figure 3: Plots of measured humidity, carbon dioxide, temperature and volatile organic compounds measured in the OGZEB from October 5-9, 2009

Phase 6: System Integration
The initial system integration task is the integration of the HVAC system and the solar thermal system. Students will design a system that will allow energy to move between the systems in a manner that increases the efficiency of each system.

Title: Chemical and Mechanical Degradation of Fuel Cells
PI: Darlene Slattery **Co-PI's**: Len Bonville, Xinyu Huang, Marianne Rodgers
Students: B. Pearman (Ph.D), W. Yoon (Ph.D.), W. Rigdon (Ph.D.)
Description: The objectives of the program are to gain insight into fuel cell membrane degradation mechanisms including both chemical and mechanical degradations. Topics to be researched include a detailed investigation into factors that accelerate degradation, namely OCV and high temperature operation. The chemical and mechanical durability of fuel cell membranes will be evaluated to include varying cell temperature and cell load under static testing conditions. The membrane degradation mechanism will be used to suggest membrane degradation mitigation strategies and the conductivity of more efficient tests to carry out membrane durability studies.
Budget: $324,000
University: UCF/FSEC
Progress: The objective of the program is to gain insight into membrane degradation mechanisms for the polymer electrolyte membranes used in fuel cells. To this end, a detailed investigation into factors that accelerate degradation, namely open circuit voltage (OCV) and high temperature at low relative humidity

operation is being carried out. The chemical and mechanical durability of fuel cell membranes is being determined and the data will be analyzed as a function of testing conditions. Both cell temperature and cell relative humidity are being varied under static testing conditions, while all other testing conditions are being held constant.



A major accomplishment for the year was the verification of the high-throughput MEA Durability Test System (MEADs) that was recently added to the FSEC fuel cell lab, under separate funding. This equipment, the very first machine of its kind, was designed and fabricated by Scribner Associates to FSEC specifications (see Figure 1). The MEADs allows simultaneous, independent operation of eight fuel cells at or near open circuit voltage (OCV), a fuel cell operation condition frequently used in accelerated test protocols. This unique instrument is being used to conduct chemical degradation tests on various commercial, as well as FSEC MEAs on a multiple sample basis. These MEAs are then subjected to mechanical durability testing.

Figure 1. MEADS system for accelerated durability testing

An additional accomplishment was the design and construction of test equipment for determination of pinholes in membranes. In this apparatus, a membrane is placed within a specially constructed cell and a low boiling solvent is added. An inert gas is then used to lightly pressurize one side of the cell, while the other side is observed for any bubble formation. These bubbles indicate the presence of pinholes in the membrane. A number of membranes were tested for pinholes and the location of the pinholes was documented. A surprising result from the pinhole testing is that the majority of pinholes appear to be located along the gas inlet stream. The cause for this is unknown.

Eight fuel cells were prepared for testing on the MEADs. Three of the cells had previously been through a 5-day performance test, two were freshly assembled from commercially available IonPower catalyst coated membranes (CCMs) and the final three were freshly assembled from CCMs prepared in-house. After preliminary humidification and verification steps, the membrane electrode assemblies (MEAs) prepared from these CCMs underwent a 76 hour durability test. Following the durability test, the MEAs were subjected to pinhole tests, as well as mechanical tests to determine the effect of open circuit voltage on the strength of the membrane.

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 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 current technology retrofit measures.
Budget: $1,224,000
University: UCF/FSEC
Progress: In order to maximize impact and field research value, the FESC team has joined with FSEC's Building America team, local governments and non-profits to perform retrofits to housing stock.

The local government partners are:

- Sarasota (City & County)

- Brevard County
- Orange County
- Alachua County

The non-profit partners are:

- Habitat for Humanity (HFH) International
- Neighborhood Stabilization Program 2 (NSP2) Proposal - 4 Florida sites
- HFH Partners Participating in NSP1
- HFH Broward County (FL)
- HFH of Lakeland FL
- Sarasota HFH

FSEC staff met with or teleconferenced with teams from each of these entities. They each are working on projects to retrofit existing homes. Through our partnering with them each is targeting some of their homes to reach high energy efficiency levels. As part of this program the following assistance will be provided for each partner:

- Run simulations to estimate savings from a number of options
- Work with teams to assure construction/installations are done correctly
- Meter some sites to see how energy use matched predicted
- Make suggestions for future home retrofits.

Two identical new test structures (rendering on right) are being built at FSEC's Cocoa campus to help determine the best retrofit and new home practices. The structures will serve as a control and experiment for evaluating energy saving measures. The buildings are designed to allow ready change-out of wall and window systems, as well as equipment and appliances. The initial configuration will replicate the envelope efficiency of a typical 1960s residence, with appliance and HVAC efficiency typical for a home from that era on the market today. The homes will be monitored consistent with a lab home monitoring plan being developed by the National Renewable Energy Laboratory and Building America teams. An architect was hired and construction drawings are being developed.

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. **Budget:** $72,000 **University:** UF **External Collaborators:** NA **Progress:** Water use analysis is typically done using utility-wide data since it is difficult to organize and evaluate customer level attribute and water billing data. A major breakthrough in the research of the CFWC has been the acquisition and use of customer level attributes including land use information, and utility level monthly water use data for every utility in the State of Florida. Florida, is unusual, if not unique, in making parcel level information public as part of its open government and public records laws. Thus, annually updated attribute and GIS data are available for nine million parcels in Florida and can be downloaded from the Florida Department of Revenue (FDOR) web site (ftp://sdrftp03.dor.state.fl.us/). Each of Florida's 67 counties has a property tax assessor's (CPTA) database that contains information that is included in the FDOR database and other attributes that are of interest in that county. For example, Alachua County reports which parcels have irrigation systems. The information in the county databases varies from county to county but the county data can be linked to the state database with a Unique Parcel Number. This information is of high quality since it is the basis for estimating property taxes. The key land use information for a parcel is its impervious and pervious areas. This information can be extracted directly from the FDOR/CPTA databases. The type of land use is available for about 90 land uses based on an FDOR land use code. Population information can be obtained from US Census data at the Census Block level of aggregation. Water utility service areas may not be contiguous with the political boundaries of the cities. Fortunately, the three largest of the five water management districts have developed GIS coverage that enables one to assign parcels to the appropriate utility. These data sources can be combined to estimate the long-term trends in attributes of interest. All utilities in Florida are required to submit Monthly Operating Reports (MORs) that include information on daily water supplied by each treatment plant, water quality data, and information on the population served and the number of connections. Ten years of monthly water use data are available for each utility from the FDEP web site (http://www.dep.state.fl.us/water/drinkingwater/download.htm). This information can be used to evaluate historical trends and to project future growth patterns. A detailed, customer level analysis of monthly water use, has been done for SFRs in Gainesville Regional Utilities using data for a recent year. A customer's water use pattern provides a signature of the nature of their water use. The vast majority of customers have a single meter that records their total water use. Our research indicates that indoor water use is constant throughout the year whereas outdoor water use varies widely based on the lot size, type of irrigation system, and customer preferences. Thus, it is possible to partition the total water use signal into its indoor and outdoor components.
	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** **University:** FSU **Progress:** 1. Students your have employed/funded on the grant and there current status. Michael Greenleaf, a Ph.D. student at ECE department. He is currently working on (1) development of equivalent circuit models for energy storage devices, and (2) investigation of Li-ion batteries safe due to over-charge conditions. 2. Researchers and post-doctoral people who are being funded on the grant. None 3. Travel to conferences, workshops, seminars etc. you have made from the grant and the purpose of these travels and how they help achieve the overall objectives of the research effort. 3.1 Invited seminar: High Performance Fuel Cells using Buckypaper, Louisiana State University, Baton Rouge, LA, February 13, 2009. Increase our research and develop future research projects. 3.2 Site visit for proposal of "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. Developed an international collaboration on renewable energy researches and recruit international graduate students and postdoctors. 3.3 Invited paper on 2009 China-North America Workshop on Fuel Cell Science and Technology: Highly Efficient and Stable CNT Paper-Based Electrodes for PEMFCs, Shanghai, China, August 14, 2009. 4. Status of your research efforts, what has been accomplished to date, change of direction/focus, etc. 4.1 The Pt catalytic electrode was developed using carbon nanotube film (buckypaper) as a supporting medium through use of the electrodeposition method. Buckypapers are free-standing thin films consisting of single-walled carbon nanotubes (SWNT), carbon nanofibers (CNF) held together by van der Waals forces without any chemical binders. Mixed buckypapers may be developed by layered microstructures with a dense and high-conducting SWNT networks at the surface, as well as large porous structures of CNF networks as supports. This unique microstructure may improve Pt catalyst accessibility and the mass exchange properties. Pt particles were uniformly deposited in porous buckypaper and had an average particle size of about 6 nm. A promising electrochemical surface area of about 40 m2g-1 was obtained from these electrodes. A Pt utilization of as low as 0.28 gPtkW-1 was achieved for the cathode electrode at 80 oC. Pt utilization efficiency may be further improved by optimization of the electrodeposition condition in order to reduce the Pt particle size. 4.2 Due to their unique microstructure, buckypaper-supported platinum (Pt) catalysts derived from carbon nanotube (CNT) and carbon nanofiber (CNF) have demonstrated a high Pt utilization in proton exchange fuel cells (PEMFCs). The durability of a buckypaper-supported Pt catalyst was investigated using an accelerated degradationtest (ADT) in a mimic cathode environment of PEMFC. Compared to commercial carbon black-supported Pt, Pt/buckypaper showed better catalyst durability after holding at 1.2 V for 400 hours; specifically, almost 80% of Pt electrochemical surface area was lost for Pt/carbon black, while only 43% loss for Pt/buckypaper. Transmission electron microscopy (TEM) and cyclic voltammetry (CV) were used to study the Pt degradation mechanism. It was concluded that Pt coarsening and Pt detachment from buckypaper support due to carbon corrosion make the major

	contribution to the Pt surface area loss under this condition. The Pt loss via detachment from supports after the ADT was calculated as 18% in Pt/buckypaper, while the Pt loss was 69% in Pt/C. It is supposedly due to the higher corrosion resistance of buckypaper because of its high graphitization degree which is indicated by a slower formation rate of surface oxides in buckypaper than in carbon black. 5. Papers, presentations, etc. that you have produced from the work. 5.1 Journal Papers P.L. Moss, G. Au, E.J. Plichta, and J.P. Zheng, "Investigation of solid electrolyte interfacial layer development during continuous cycling using ac impedance spectra and micro-structural analysis", *J. Power Sources*, 189, 66 (2009). J.P. Zheng, "High energy density electrochemical capacitors without consumption of electrolyte", *J. Electrochem. Soc*. 156, A500 (2009). W. Zhu, J.P. Zheng, R. Liang, B. Wang, C. Zhang, G. Au, and E. J. Plichta, "Durability Study of Carbon Nanotube/Nanofiber Buckypaper Catalyst Support for PEMFCs", *J. Electrochem. Soc*. 156, B1099 (2009). 5.2 Grants N. Da, 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. J.P. Zheng (sole PI), Title: 3-D Nanofilm Asymmetric Ultracapacitor, a phase I SBIR Project, Sponsor: Department of Energy, Budget: $30,000, Project Dates: 06/09 to12/09.
	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 **External Collaborators**: Marc Madou, University of California Irvine, Leonidas Bachas and Sylvia Daunert, University of Kentucky **Progress Report:** Since this is not a FESC funded project, no progress report is provided.

	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. **Budget:** $150,000 **Universities:** FIU **External Collaborators:** NA **Progress Report:** Since this is not a FESC funded project, no progress report is provided.
	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 project will feature the most cost-effective combination of renewable solar energy with high levels of building energy efficiency. The building will incorporate a carefully chosen package of the latest energy-.efficiency technologies and renewable energy systems to achieve the most successful and reliable results. The building will utilize Photovoltaic solar electricity and solar domestic hot water heating systems using the grid as an energy storage system, sending excess power to the grid during the day and taking power back from the grid at night. Plug-in hybrid automobile technology offers a promising means of providing distributed energy storage for such homes but has not been sufficiently tested. Using a systems approach to couple zero energy home technology with PHEVs we will explore opportunities to develop marketable products that meet Florida's energy and environmental goals. **Budget:** $344,600 **University:** USF **External Collaborators:** NA **Progress:** The Energy Efficient Technologies and The Zero Energy Home Learning Center task began with research into the current state of Zero Energy House technology in the World, the U.S., and the hot humid climate of southern Florida. Data from Case studies of Zero Energy and Near Zero Energy Houses built in a hot humid climate were compiled for reference. A list of technologies used for various building components will act as a ZEH Database to draw from during the design phase of the Learning Center. For the center's educational aspect, we also looked at facilities like the Florida House Learning Center in Sarasota built with a similar purpose of educating the public about energy efficiency in buildings. Meetings with energy efficiency and ZEH experts at FSU, UF, Sarasota, the FSEC, and housing makers in Japan, were a springboard for our research and have helped us formulate strategies for the design of the Zero Energy Home Learning Center. During this preliminary research period we have established several collaborations with members of the academic and professional communities.

	As new technological innovations continue to arise on a daily basis it is important to delve beyond what has already been done to look at the emerging technologies that will influence ZEH in the future. We have begun a list of emerging technologies that we will continue to edit as information becomes available. Conferences are a valuable source of information and input about energy efficiency and ZEH technology. I have submitted abstracts and been accepted to three international conferences where I will present our research and discuss the Zero Energy Learning Center. I will also attend a Zero Energy Building Conference in NYC in October to network with other professionals in the field and potential industry partners. Based on our research we are currently developing our own proposals for innovations in ZEH technology. This year's research will involve designing, building and testing prototypes of innovative ideas that we will incorporate in the ZEH learning center. Designing and building prototypes will require the assistance of industry partners. To date we have verbal commitments from the following companies: • **Insulation** *Acoustiblok* International Headquarters 6900 Interbay Boulevard Tampa, Florida U.S.A. 33616 • **Windows** *Pilkington Group/ Nippon Sheet glass* Spacia Vacume insulated glass windows • Photovoltaics *Kyocera Solar, Inc.* Headquarters 7812 East Acoma Dr. Scottsdale, Arizona 85260 *System Photonics* Via Ghiarola Vecchia, 73 41042 Fiorano (MO) • Structural Insulated Panels *PermaTherm, Inc.* 269 Industrial Park Road Monticello, GA 31064 *Gramatica Group* 13926 Clubhouse Drive Tampa, Fl 33618 • **Housing Manufacturers** *Misawa Homes* Tokyo Japan *Sekisui Haimu* Chiba Japan *Palm Harbor Homes* Plant City, Florida • **Others** In addition, we are currently talking with Cisco about smart connected building technology and Trane about Mechanical systems.
THRUST 2: Developing Florida's Biomass Resources	
High Energy Crops	
	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: 1. Develop sustainable, biologically-based fuel alternatives and renewable energy strategies. 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 nearterm 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. The centerpiece of the proposed project will be the development of sustainable practices for the production of transportation fuels from algal biomass feedstocks. Algal cultivation practices will also be incorporated into industrial processes such as CO2 capture and sequestration from coal-fired power plants and wastewater treatment.

	• The project will create a consortium of scientists from FESC, the Oak Ridge National Laboratory (ORNL), and the Midwest Research Institute of Palm Bay, Florida. State-of-the-art R&D facilities will drive consortium efforts: an off-grid, zero emissions algal cultivation facility at the FSU Coastal and Marine Laboratory (FSUCML), a biomass characterization facility in FSU's Chemistry department, a marine bioprospecting/ biomass conversion facility in FSU's Oceanography department, and a freshwater bioprospecting, algal cultivation and biomethanation facility at UF's Soil and Water Science department. • The proposed program is projected to create 30 undergraduate research fellowships, 15 graduate student assistantships, 8 Ph.D. level positions, 5 technician positions, 10 temporary construction jobs, and 3 highly skilled positions in the biotech work force. Undergraduate and graduate research fellowships will be offered in the natural sciences, engineering, and the social sciences at the host institutions. • Oak Ridge National Laboratory (ORNL) personnel will aid by training students through internships in next generation biotechnology and bioengineering skills, thereby enhancing the skilled workforce to build the energy industry in Florida. • The Midwest Research Institute (MRI) in Palm Bay, Florida, currently supports 6 positions in algae-related research. We expect to double their workforce in this area. MRI will provide optimization and application of harvest and extraction methods to the cultivation facilities and integrated process engineering. • The project will stimulate rural development in Franklin County, Florida, where the FSUCML is located. Architects and construction workers will be employed to build the state-of-the-art, algal cultivation facility. Permanent technicians and engineers will be employed to run the facility. Graduate students will be in residence at the FSUCML to complete their research. Federal, private, and international funds will be sought out to continue to support these positions. **Budget: $494,135** **Lead University: FSU** **Progress:** This project began a little over 6 months ago. The primary metrics as articulated in the Memorandum of Agreement were the recruitment of graduate students, contacts with the legislature and federal funding agencies, contact with the legislature, contact with federal funding agencies, and publications in refereed journals. At 6 months, it is too early to have completed publications. However, all of the remaining metrics have been addressed and substantial progress has been made on each of them. Under the Milestones and Schedules section of the Memorandum of Agreement, the following 7 Deliverables were to commence within the first 6 months of the project: visit energy facilities, recruit speakers, recruit visiting scholars, build an algal cultivation facility, survey of algal biomass, recruit graduate students, and attend meetings.
	Title: Planning Grant: Constructual Optimization of Solar Photo-Bioreactors for Algae Growth **PI:** Juan Ordonez **Description:** This planning grant money will be used for partial support of a graduate student. We will (1) design a small (lab scale) photo-bioreactor for algae growth and (2) select the type of algae for future experimentation. The main objectives are to place us in a more competitive position in future submissions in the area of biofuels. By the end of this one year effort we expect to have a complete design of a small-scale photo-bioreactor for algae growth and to obtain additional funds that will allow us to build the photo-bioreactor. **Budget:** $15,000 **University: FSU** **Progress:** None Reported
	Title: Seeding Biofuel Entrepreneurship in South Florida **PI:** George Philippidis

	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. **Budget:** $15,000 **University: FIU** **External Collaborators:** NA **Progress Report:** Since this is not a FESC funded project, no progress report is provided.
	Title: Energy Intensive Crop Development **PI:** Gary Peter **Students (name/degree sought):** **Description:** The first step in an integrated Bio-Energy industry is development of energy intensive crops. The proposed research will provide breakthroughs in identification of Florida energy crops and cultivars, development of best agricultural practices for production, and focused improvements using traditional and molecular genetics approaches. Energy crop research will focus on two groups, C-4 plants (e.g., cane and switch grass) and short rotation trees (e.g., pine and poplar). Natural cultivars will be screened for yield, and compositions that enhance digestion into ethanol. Deliberate gene changes will also be investigated to alter plant wall structure for efficient extraction and depolymerization of carbohydrates. The proposed research will: advance our knowledge of how plants partition carbon; identify genes to breed plants that are more readily extractable/digestible to increase conversion efficiency; establish best agricultural practices for production of Florida energy crops; and develop economic models to estimate costs and identify improvement opportunities. **Budget:** $432,000 **University:** UF **External Collaborators:** NA **Progress Report:** Since this is a new project, no progress report is provided.
	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 **Students (degree sought):** Arkorn Soikiew (M.S.), Chae-In Na (Ph.D.), Jeff Fedenko (M.S.) **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 <u>if</u> and <u>where</u> 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). Graduate students involved in carrying out project research include Jeff Fedenko, Arkorn Soikiew, and Chae-In Na, all of whom started their graduate programs in August 2009. External collaborators include Speedling, Inc., which has provided planting material of miscanthus.

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

Progress:
Replicated experiments studying sweet sorghum (annual grass) and six perennial grasses have been established in North Florida (Citra), Southcentral Florida (Ona), and South Florida (Belle Glade). Data collection was initiated by assessing leaf area development of the six perennial grasses, sweet sorghum biomass and sugar yields, and water-use for several of the perennial grasses. Because of the relatively short period since initiation of the research (July 1, 2009), there are limited data available at present and samples for analysis of feedstock composition of most grasses are not yet available.

Leaf area accumulation data for the six perennial grasses has been summarized and is presented in Table 1. These data illustrate the initial superiority of Merkeron elephantgrass compared to other perennial grasses in establishing a full canopy and maximizing light interception. This trait is expected to be closely associated with biomass yield, a response that will be quantified directly at the end of the growing season in December 2009. In the most recent data from Belle Glade (collected on 22 September), elephantgrass retained the highest ranking among perennial grasses with a leaf area index of 9.7 which was greater than energycane and sugarcane (6.9 and 6.5, respectively). Giant reed and erianthus were next at 5.2 and 4.2, with miscanthus having the lowest leaf area index of 2.6. These early results support a preliminary conclusion that elephantgrass, energycane, and sugarcane are the most likely to be successful biomass-producing perennial grasses in Florida.

Harvesting sorghum has occurred throughout the summer and fall, and the effects of location, planting date, and variety on biomass and sugar yield will be known by the end of 2009. Yields of the perennial grasses will be determined in December 2009, and samples will be analyzed subsequently to determine their chemical composition. Water-use data are now available for the 2009 growing season and will be summarized and analyzed during the remainder of 2009

Biochemical Conversion

Title: Biochemical Conversion of Florida's Cellulosic Biomass to Liquid Fuels and Chemicals
PI: Pratap Pullammanappallil
Description: This project will develop and demonstrate an integrated, multi-product biorefinery at pre-commercial scale to support a full economic and technical feasibility analysis for the use of Florida-grown feedstocks. The goal of this facility is to evaluate, validate, and improve processes, improve efficiency and decrease complexity, and accelerate full commercialization of cellulosic biorefineries in Florida. This facility will represent a complete test bed for new trial crops as well as existing municipal, forestry, and agricultural residues. This facility will complete the renewable cycle by converting solar energy stored in biomass from Florida fields into automotive fuels and chemicals to replace petroleum. Together with energy crop production, this project will provide a comprehensive demonstration of a "Farm to Fuel"/"Fields to Wheels" biorefinery to facilitate commercial development of renewable fuels in Florida.

	Budget: $576,000 **University:** UF **External Collaborators:** NA **Progress Report:** ***Process development for biogasification and clean up of cellulosic ethanol stillage*** • Batches of cellulosic ethanol stillage produced from conversion of hardwoods and sugar cane bagasse were obtained from biofuel pilot plant. These were characterized (chemical oxygen demand, ammonia and phosphate). • Biochemical methane potential assays were conducted on aliquots of these samples. • Hardwood derived stillage yielded more methane per volume of sample than bagasse derived stillage. • The stillages contained 160 ppm of phosphate and 17 ppm of ammonia. ***Biocatalyst development for conversion of waste PLA based plastics to ethanol*** • Extensive literature review was conducted to identify strains possessing the adequate L(+)-LDH gene. • Some strains were then obtained. All strains except Lactobacillus helveticus 53/7 has been received, rehydrated, and grown in appropriate medium in order to extract the genomic DNA used in the first set of PCR reactions. All Lactobacilli were grown into MRS medium except for Bacillus caldolyticus which has been grown into Nutrient broth at 60ºC. • Construction of the triple E.coli mutant has started.
	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. **Budget:** $1,918,306 **University:** FIU **External Collaborators:** Florida Crystals Corporation **Progress Report:** Since this is not a FESC funded project, no progress report is provided.
	Title: Engineering Biocatalysts for Hemicelluloses Hydrolysis and Fermentation **PI:** James F. Preston **Students (degree sought):** Changhao Bi (Ph.D. awarded April 2009) **Description:** Our goal is to develop biocatalysts for the cost-effective production of fuel alcohols and chemical feedstocks from underutilized sources of renewable biomass and evolving energy crops. To reach this goal protocols for efficient saccharification of hemicellulose fractions from these resources will be developed. Objectives are to: 4. Develop improved enzyme-mediated saccharification protocols of hemicelluloses with existing

bacterial biocatalysts for production of biofuels and chemical feedstocks.

5. Develop Gram positive biocatalysts for direct conversion of hemicelluloses to biobased products.
6. Develop systems with bacterial biocatalysts for efficient bioconversion of the hemicellulose fractions of perennial energy crops (poplar, eucalyptus, switchgrass, energy cane) to targeted products.

Budget: $192,000

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, Forest Resources and Conservation

Progress:

1.Development of a bacterial biocatalyst for the complete conversion of hemicellulose hydrolysates to biobased products. This support allowed Changhao Bi to complete his Ph.D. and contributed to the development of a new strains of Enterobacter asburiae JDR-1 that efficiently converted hemicelluloses hydrolysates to either D-lactate or to ethanol. Relevant publications from this effort include:

Bi, C., X. Zhang, J.D. Rice, L.O. Ingram, J.F. Preston. 2009. Genetic engineering of Enterobacter asburiae strain JDR-1 for efficient D(-) lactic acid production from hemicellulose hydrolysate. Biotechnol. Lett. 31:1551-1557.
Bi, C., X. Zhang, L.O. Ingram, J.F. Preston. 2009. Genetic engineering of Enterobacter asburiae strain JDR-1 for efficient ethanol production from hemicellulose hydrolysates. Appl. Environ. Microbiol. 75:5743-5749.

A relevant patent application from this effort is:

U.S. Provisional Application SN 61/115, 722 UF #12617 "Biocatalyst for complete conversion of hemicellulose to biobased products". Preston, J.F., C. Bi, and J.D. Rice. Filed 11/18/2008.

2. Develop improved enzyme-mediated saccharification protocols of hemicelluloses with existing bacterial biocatalysts for production of biofuels and chemical feedstocks. Endoxylanases and alpha-glucuronidases encoded by genes from mesophilic Paenibacillus sp. JDR-2 and the extreme thermophile Thermotoga maritima have been produced as recombinant enzymes in E. coli the provide catalysts for the efficient conversion of the xylans of hemicelluloses to ethanol using the biocatalysts Klebsiella oxytoca P2 and Enterobacter asburiae E1. Additional studies are in progress to refine the conditions to maximize the conversion of hemicelluloses from forest resources and agricultural residues to ethanol as a biofuel and D-lactate as a chemical feedstock for bioplastics.

3. Develop Gram positive biocatalysts for direct conversion of hemicelluloses to biobased products. The definition of the xylan-utilization regulon in Paenibacillus sp. JDR-2 has been further refined with the recently completed sequence of the genome of this bacterium. This has identified the combination of the transcriptional regulators, transporters and intracellular enzymes that collectively assimilate the products of extracellular depolymerization of xylans and convert these to fermentable xylose. This has provided evidence for a process in which assimilation and of metabolism of the products of depolymerization is coupled to the depolymerization process that is catalyzed by a cell-associated endoxylanase, allowing efficient and rapid conversion of xylans to fermentable xylose by single bacterial biocatalysts. The results of this discovery are the subject of a publication:

	Nong. G., J.D. Rice, V. Chow, and J.F. Preston. 2009. Aldouronate utilization in Paenibacillus sp. JDR-2: Physiological and enzymatic evidence for coupling of extracellular depolymerization with intracellular metabolism. Appl. Environ. Microbiol. 75:4410-4418. and also provided supporting information for a provisional patent application: U.S. Provisional Application SN 60/982,623. UF# 12619. Xylan-Utilization Regulon for Efficient Bioprocessing of Hemicellulose and Uses Thereof. Preston, J.F., V. Chow, G. Nong, J.D. Rice, and F.J. St. John. Filed 10/22/2008.
	Title: Thermophilic Biocatalysts for the Conversion of Cellulosic Substrates to Fuels and Chemicals **PI:** K.T. Shanmugam **Students:** Yue Su (Ph. D.) and Brelan Moritz (Ph. D.) **Description:** Biomass is an attractive source of sugars for a state like Florida that produces very limited amount of corn for fermentation to produce ethanol as transportation fuel or other products such as lactic acid that can be converted to bioplastics. Florida currently generates about 8.7 million tons of dry cellulosic biomass per year (US-DOE) that can be converted to about 0.7 billion gallons of ethanol. With specific energy crops and short rotation trees cultivated for energy production using the abundant sunshine and water resources, the ethanol produced from biomass can be significantly increased to meet the demand for transportation fuel in the State of Florida. Before biomass-based fuels and chemicals become an economic reality, several key steps in the depolymerization of biomass to constituent sugars need to be addressed. One is depolymerization of cellulose to glucose by fungal cellulases before fermentation to ethanol by microbes. The current estimated cost of fungal cellulases is $0.32 per gallon ethanol produced and this cost is targeted for reduction to $0.10 or less by year 2012 (DOE). We have demonstrated that by increasing the temperature of Simultaneous Saccharification and Fermentation (SSF) of cellulose from 30-35 ºC to 50-55 ºC, the amount (and associated cost) of cellulases can be reduced by the required 3-fold with the current commercial enzyme preparations. A microbial biocatalyst that produces ethanol or other chemicals as the main fermentation product and can also function at this higher temperature and pH 5.0 in conjunction with the fungal cellulases in the SSF process is a critical component of this process. We have identified a thermophilic facultative anaerobe, *Bacillus coagulans*, with versatile metabolic capability as the microbial platform for the SSF of biomass to products and engineering this L(+)-lactic acid producing bacterium to produce ethanol. The primary objective of this proposed study is to construct a *B. coagulans* derivative that produces ethanol as primary product of fermentation and to enhance the ethanol productivity of the engineered derivative. **Budget:** $192,000 **University:** UF **External Collaborators:** NA **Progress:** We have constructed B. coagulans derivatives that lack two of the three metabolic pathways that compete with ethanol production during fermentation. These deletion derivatives have lower growth rate and productivity and produced in addition to ethanol, 2,3-butanediol. These mutant strains are biochemically characterized to identify the rate-limiting steps in ethanol production for further genetic modification. Mutagenesis of these derivatives to eliminate the 2,3-butanediol pathway is in progress. Upon eliminating all the competing pathways, the specific rate of ethanol production will be enhanced by metabolic evolution to obtain a thermophilic microbial biocatalyst that can ferment biomass-derived sugars to ethanol in a cost-effective manner to support a biomass-based ethanol industry.
Bio gasification	
	Title: Combined Cooling, Heat, Power, and Biofuel from Biomass and Solid Waste **PI:** William Lear **Students (name/degree sought):** Minki Kim (Ph.D.); Elango Balu, (Ph.D.);

Harsh Khandelwal (MS)

Description: The goal of this project is to provide the underlying research and demonstration of a novel technology which would enable the economic utilization of dispersed biomass and solid waste resources to produce electric power, cooling, heat, and transportation fuels. This integrated gasification and power generation system combines University of Florida advances in high-temperature gasification, hydrogen generation and separation, and advanced gas turbine systems. Their integration is expected to result in significant improvements in the cost, emissions, feedstock flexibility, and water requirements, all in a relatively compact, modular plant system. This in turn will enable much greater utilization of renewable energy supplies, helping the development of a sustainable energy supply infrastructure.
Budget: $479,813
University: UF
External Collaborators: Siemens Power Generation, Florida Turbine Technologies, Energy Concepts Co.

Progress: Progress has been made in three broad areas: development of a system architecture and thermodynamic model, development of models and system-level experiments for the PoWER gas turbine unit, and exploration of the underlying science and demonstration of the high temperature steam gasification subsystem. These activities are structured in such a way as to allow stepwise research and development of the overall plant in outlying years.

The system architecture includes the full integration of waste heat and water produced in the gas turbine module with the gasification subsystem. This in turn allows efficiency gains, reducing the proportion of hydrogen utilized internally, and allows zero net usage of external water resources. A thermodynamic system model is operable, though more sophistication is needed for full optimization of the system and accurate prediction of performance.

The PoWER system has been implemented as an experimental system in previous programs. Experimental results from the combustion process have been obtained, allowing the quantification of soot and other emissions in flameless combustion, including the effect of biofuels. Combustion modeling supports the experimental findings. System thermodynamic models have shown the potential of the PoWER system to improve efficiency and produce fresh water. These models will later be integrated into the overall system model for improved fidelity.

On the gasification side, first we have developed a physics-based thermal-chemical high-temperature steam gasification model that is based on a completely self-sustained gasification process with no external heat source require nor water supply needed. The only input materials are the biomass feedstock and pure oxygen for the hydrogen combustor. Through the combustion of the hydrogen taken from the produced syngas with the externally supplied oxygen, the hydrogen combustor produces the high-temperature steam that is used as the gasifying agent. The water vapor in the syngas is retrieved through a condenser and re-heated by the syngas in a heat exchanger to supplement the gasifying steam stream and to conserve water. After performing a heat and mass balance analysis using the model, the results suggest that with a steam temperature of 2000C, the fraction of hydrogen taken from the syngas for the hydrogen combustor is around 60% for a steam to biomass ratio of 3. For the syngas composition, 40% in mole fraction is hydrogen and 20% is carbon monoxide at a steam to biomass ratio of 3. The rest are methane, carbon dioxide and water vapor.

We have also designed and built a trailer-scale biomass to energy system. This system will be used as an experimental apparatus and also for demonstration to the public. The system is composed of a gasifier, heat exchanger, cyclone separator, wet scrubber, radiator, engine-generator set and battery pack. The gasifier is the main part of the system and is a basic down-draft system with the capacity of handling about 40 lb of biomass per two-hour batch process.

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 **Students:** Ali Gardezi, Nianthrini Balakrishnan, Bijith Mankidy **Description:** The objective of this project is to develop technology for the economical thermo-chemical conversion of lingocellulosic biomass (non-food grade biomass such as agricultural waste, bagasse from sugar mills, citrus peels, switch grass, municipal green waste, etc.) to clean burning liquid fuels. Five of the major advantages of this process over a biochemical route to production of ethanol are: (i) it does not utilize food-grade feed stocks and therefore complements and does not compete with the agricultural food production in the state, (ii) the fuel produced is similar to those derived from petroleum unlike ethanol derived fuels which have at least a 25% lower energy content, (iii) the conversion is accomplished in using fast chemical reactions unlike the slow biological reactions for fermenting alcohol, (iv) the process does not require large amounts of water and associated energy costs of separating the water from the fuel as in bioethanol processes, (v) it can utilize a wide variety of biomass sources unlike the biochemical route which cannot work with high lignin containing biomass. **Budget:** $554,447 **University:** USF **External Collaborators:** Prado & Associates **Progress:** During the past year, we made progress on four fronts: Biomass conversion process design, Reactor testing for synthesis of liquid fuels from bio syngas, catalyst synthesis and catalyst testing. In the area of process design, we have been evaluating alternative strategies to combine the energy intensive biomass gasification step with the energy producing Fisher-Tropsch synthesis of clean liquid fuels from syngas produced in the gasification step. We are exploring ways of recycling energy by using the methane off gas produced in the FTS to fuel the steam pyrolysis of biomass. Another avenue we are exploring is a novel strategy to combine solar thermal powered steam pyrolysis with the syngas production step. We successfully tested egg-shell catalysts in our fixed bed reactor setup using both mixtures of CO and H2 as well as Biosyngas produced from poplar wood. The product liquid produced have been analyzed and report good yield in the diesel and jet fuel range. We also continue with our catalyst characterization process. We are continuing to study the mechanisms of CO dissociation on the catalyst surface using density functional theory calculations. Current focus of this effort is on the effect of catalyst nanoparticle size on the adsorption and dissociation energies. Catalyst synthesis efforts continue. We have successfully synthesized cobalt nanoparticles and placed them on silica Microparticles. These are currently being characterized and tested for activity.
	Title: Integrated Florida Bio-Energy Production with Carbon Capture & Sequestration **PI:** Ali T-Raissi **Co-PIs:** Nazim Muradov, Amit Gujar, Gary Bokerman **Students:** Nathaniel Garceau (BS-Ch.E.), James Pardue (BS-M.E.) **Description:** The aim of this project is to produce liquid hydrocarbon fuels derived from Florida grown 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 electrical power source is used for electrolysis of water to oxygen (for use in the biomass gasifier) and hydrogen gas needed to supplement H_2 content of the syngas. Use of

	oxygen for gasification of biomass improves the overall energy conversion efficiency of the process by eliminating the need for an air separation unit. In the second step, hydrogen enriched 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 used 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 **Progress:** In the results to date, the aim of this project is to produce liquid hydrocarbon fuels derived from Florida grown biomass utilizing a two-step process. In the first step, biomass is gasified with oxygen (instead of air) to synthetic gas (syngas) comprised of mostly hydrogen, carbon monoxide and a carbon rich residue (char). In the second step of the process, hydrogen enriched synthetic gas from step 1 is fed into a Fischer Tropsch (FT) synthesis unit to generate liquid hydrocarbon fuel, *e.g.*, diesel. The process is applicable to any lignocellulosic material such as crop residues, grasses, yard clippings, landfill gas, municipal solid waste (MSW), *etc*. An imbert-style downdraft oxygen gasifier has been designed and is in the process of being fabricated. The gasifer has been designed to run on southern yellow pine pellets from Green Circle Bio Energy Inc., produced in their Cottondale, FL plant. The gasifier would produce enough gas so as to produce 1 liter of gasoline or diesel fuel over the Fischer-Tropsch reactor in 8 hours. Various catalysts preparations have been tested for their activity towards producing liquid hydrocarbon fuels from synthesis gas mixtures. These catalysts include Fe, Co and Mo based bulk and supported catalysts. The potassium promoted iron catalyst was found to give the highest liquid yield amongst all the catalysts tested. One of the problems with the use of iron catalyst is that it yields olefin rich hydrocarbons. The resulting hydrocarbon product is prone to undesirable oxidation and polymerization - requiring post-treatment to convert it to saturated hydrocarbons via catalytic hydrogenation. Tests have been performed with a dual-bed catalytic system with a hydrogenating or a cracking catalyst in the downstream bed. In addition to the above tests, the effect of CO_2 on the catalyst performance has been studied. The results of the project to date can be summarized in a point-wise fashion as follows: 1. The use of cracking catalyst H^+/ZSM-5 in combination with Fe catalyst results in an increase in the yield of gasoline fraction in the liquid product and a decrease in the olefin to paraffin ratio. 2. A highly paraffinic liquid product is obtained when a dual-bed catalytic system including Fe and Ni-Mo/alumina hydrogenation catalyst is employed in the F-T synthesis. 3. Presence of Ni-Mo catalyst did not significantly alter the product slate for the liquid fraction, but practically eliminated olefins from the raw product. 4. Presence of CO_2 in the feed gas adversely affects syngas conversion and space time yield of liquid products. 5. Upon further development, the process described here can provide a more facile and direct route to production of high quality liquid hydrocarbons from biomass-derived syngas.
	Title: Biofuels Through Thermochemical Processes: a Systems Approach to Produce Bio-jet Fuel **PI**: Anjaneyulu Krothapalli **Description:** The objective of the proposed research is to develop technologies to produce bio-jet and bio-diesel fuels from sustainable sources. Bio-oils and hydrogen will be produced from biomass generated synthetic gas. We will (1) produce liquid biofuels (bio-jet & bio-diesel) from renewable resources of cellulosic biomass and nonedible bio-oils; (2) demonstrate that the biofuels have comparable performance characteristics to conventional fossil fuels; (3) demonstrate that the new biofuels do not require major changes in current engine design & operation, (4) demonstrate that biofuels produced from cellulosic biomass and bio-oils can be economically competitive in current market with fossil fuels **Budget: $420,567**

University: FSU

Progress: A laboratory-scale fluidized bed steam gasifier has been designed and a fluidized bed test loop is under construction. This test loop will employ nitrogen (N2) and carbon dioxide (CO2) to simulate the gasification process and verify that the synthesis gas does not move with the fluidized bed. Also, a commercial 10 kW downdraft gasifier has recently been purchased for comparison testing with the fluidized bed gasifier, as well as laboratory class use. The necessary infrastructure for both of the gasifiers is being implemented at the Energy & Sustainability Center.

Task 1: Production of Hydrogen enriched synthetic gas: Biomass Steam Reformer
A test loop of the dual fluidized bed steam gasifier, a schematic illustration of which is given in Figure 2, was built and tested using nitrogen and carbon dioxide to verify that the synthesis gas will not move with the fluidized bed

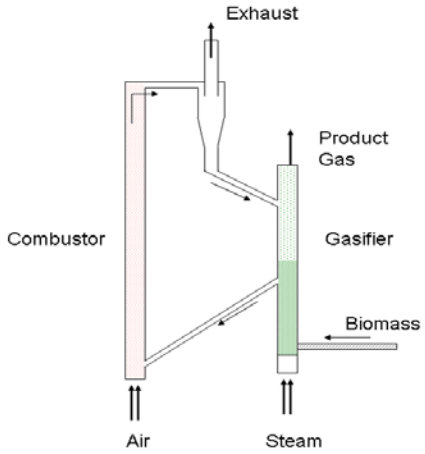


Figure 2. Schematic of the dual fluidized bed steam gasifier.

- An electric steam superheater has been ordered for use with the dual fluidized bed. It is expected to arrive by mid-October.
- Fabrication of the updraft gasifier portion of the dual fluidized bed is expected to begin by mid-October.
- A commercial 10 kW downdraft gasifier was purchased for comparison testing with the dual fluidized bed. It is currently en route and it is scheduled to arrive by mid-October. The necessary infrastructure is currently being implemented at the Energy & Sustainability Center.

Task 2: Gas clean-up technology
Analytical equipment specification for product gas analysis was completed and custom built Varian GC was purchased. Reactor furnace with special heat equalizing blocks was purchased from ATS and delivered. Wet test meter with pulse generator has been purchased from Ritter to measure product gas. Process plant control systems were evaluated and National Instruments hardware and software have been selected to control the biofuels micro unit.

Task 3: Hydroprocessing of Nonedible Bio-oils
This particular step is being carried out by our industrial partner Energia Technologies inc, of Oakland, California. Energia Technologies is currently building high pressure and temperature bench scale unit capable of independently testing bio conversion unit. This work is being carried out under a Office of Naval Research STTR phase I program (FSU is a sub contractor to this effort)

THRUST 3: Harnessing Florida's Solar Resources	
Solar Thermal	
	Title: Concentrating Solar Power Program **PI:** Charles Cromer **Co-PI:** R. Reedy **Students:** Pablo Izquierdo (Ph.D.) **Description:** Solar concentrating systems use direct beam solar energy focused to produce high temperatures for power production. They hold promise for Florida given a sufficient direct beam resource and assuming the technology can meet production and cost goals. Existing measurements of direct beam solar energy are limited to a few Florida locations. The objective of this R&D project is to advance concentrating technologies by conducting an analytical study of the Florida solar resource in order to predict performance and the amortized cost of energy from this technology in the Florida environment. Later years may include experimental tests for validation of the predicted results. **Budget:** $52,000 **University:** UCF/FSEC **External Collaborators:** FPL **Progress:** The evaluation of solar concentration systems for performance and energy production requires as input, a prediction of the solar direct beam resource throughout the year for the anticipated installation location. These systems have been previously installed in the desert southwest where direct beam data has been accumulated over many years. A problem was identified – the lack of validated direct beam measurements for the State of Florida. Literature Search Completed: Various methodologies to resolve the problem were investigated through literature search. Over 40 published papers were reviewed for information on the determination of the direct beam resource and the establishment and validation of predicting equations. Method Selected: The Heliostat-2 method was selected as the most viable to provide validated direct beam historical data for Florida. This method (developed a few years ago by Ecole de Mines de Paris) basically consist of using two parameters, turbidity (atmospheric conditions), and elevation as input, to provide an estimation of the total, beam and diffuse radiation based on a "clear sky model". That is, the amount of direct beam and diffuse radiation that would reach the ground for a totally clear sky, given location, time of year, and time of day. Then satellite images (visible band – grey level on the pixel/point of the image), are used to calculate a prediction of the cloudy level for each pixel of the satellite image. This level is then used by equation to modify the "clear sky" data to produce a predicted value of the beam and diffuse solar radiation. These values are validated with on-the-ground measurements. Once these values are calculated and validated they can be used to produce a historical data set of solar radiation for any given lat – long location across Florida. The data is also used to produce a statistically based 95% confidence interval for the expected solar radiation for any site. This information is a necessary input for existing performance/output models to determine projected cost per kWh of solar concentrating power plants in the Florida environment. Programming of Algorithms Underway: It was determined to program the equations for each stage in the calculation sequence into two separate calculation platforms: Matlab and Excel. Matlab was selected for its ability to handle and manipulate the very large number of matrices needed to make the calculations for the entire data base. Excel was selected to provide a step by step visualization of each calculation, for a single pixel and time, as a check on the programming and matrix manipulations of Matlab. Turbidity calculations have been completed and published for Europe, but are not available for the US or Florida. Thus, this must be part of the calculation sequence for the model. Programming for the model on these two platforms has begun. Proposals Written: One objective of the Consortium effort is to leverage the activity with funding from

other sources and the model developed could be used in other locations. To this end, two proposals for outside funding were written and submitted in this past review period. The Commonwealth of Puerto Rico is also interested in the viability of concentrating solar power production. They have the same difficulty as Florida, the lack of validated historical data on the direct beam solar resource needed to evaluate this opportunity. The two proposals were: a. $208K Determination of the Solar Resource for Puerto Rico, to the Puerto Rico Energy Office for an island wide study, and b. $35K Determination of the Solar Resource at the Phillips Plant, to Puerto Rico Electric Power Authority (PREPA), to do a resource evaluation for a specific site. These proposals are still under review – not yet funded.

Title: Enhanced and Expanded Solar Thermal Test Capabilities
PI: J. Walter**s Co-PI:** R. Reedy
Description: The Florida Solar Energy Center (FSEC) believes that independent, third-party testing and certification has extensive value in the marketplace, especially for products that are not widely "proven" with consumers such as solar water heating systems and solar electrical (photovoltaic) systems. In addition, due to the resurgence of the solar industry, FSEC has received a significant increase in demand for solar collector and solar system testing and certification. This occurrence has resulted in requiring the Center to correspondingly amplify its capabilities to respond to the increased demand This project has the objective of increasing FSEC's solar thermal testing and certification activities by the following actions: test and analysis equipment and software upgrades and expansion, integration of the solar collector and system laboratories, enhancing documentation and reporting methods and streamlining and devising more comprehensive client test and certification application documents.
Budget: $654,295
University: UCF/FSEC
Progress: The enhanced and expanded solar thermal test capabilities are well under way and significant progress has been achieved. The following is summary of the key aspects of the project.
Objective: Improve the capabilities of the thermal test facility through improved equipment, procedures and increasing the number of test platforms.
Measurable Results:

Year	Test Rate	Report Rate
2008 (before project)	4 collectors/year	4 reports/year
2009 (post project start)	17 collectors*/year	19 reports*/year

* These rates include the interim test and report category which allows collectors to get to market prior to performance testing while still protecting the consumer from poor quality product.

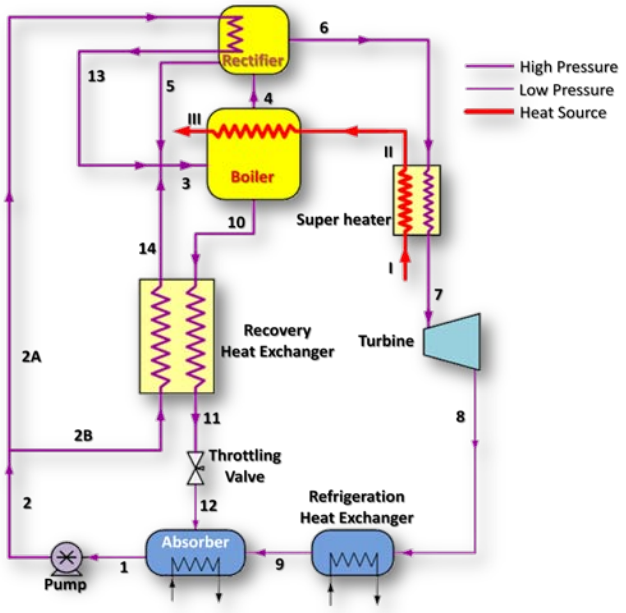
Key Elements: Ten (10) major projects were identified to attain the goal. Following is a brief project summary with an indicator of % complete.

1. Interim Test and Report for Certification – 100%
    - Provide a process that allows collectors to get to market quickly while maintaining consumer protection for quality.
2. Mobile Tracking Platform (MTP) Unit 2 Wind System – 100 %
    - Provide wind source for collector testing to meet wind requirement on demand.
3. MTP Unit 1 Wind System – 100%
    - Provide wind source for collector testing to meet wind requirement on demand.
4. MTP Unit 1 Conversion to Dual Flow – 100 %
    - Provide this test platform the capability to process the predominant collector type like the other platforms.
5. LabVIEW® based Collector Testing – 90%
    - Provide updated data logging automation for improved reliability and data transfer.
6. Sensor Improvement – 80 %
    - Research and implement new sensors and applications of sensors for more reliable and

	precise data measurement. 7. MTP Unit 4 – capacity increase – 60% • Bring into production a new test platform that has all the improvements to date with respect to sensors, automation, and wind systems. 8. Information Control System – 15 % • Provide an information control system that allows customer and user access to determine material status and report on material testing with the ultimate goal of automatically generating the test reports. 9. MTP Unit 3 – capacity increase – 0 % • Bring into production a new test platform that has all the improvements to date with respect to sensors, automation, and wind systems. 10. Fixed Stand Configuration - 0% • Provide a permanent or semi-permanent test platform to improve throughput by reducing the set up and take down time associated with mobile platforms.
	Title: Solar Thermal Power for Bulk Power and Distributed Generation **PI:** David Hahn **Students (Degree Sought):** Richard Stehle (Ph.D.); Michael Bobek (Ph.D.); Kyle Allen (Ph.D.); Justin Dodson (Ph.D.) **Description:** While there are many different approaches to hydrogen generation, the most attractive means is to split water molecules using solar energy. The current approach is to develop highly reactive metal oxide materials to produce intermediary reactions that result in the splitting of water to produce hydrogen at moderate temperatures (<1000 K). It is envisioned that the metal oxide reactors will ultimately be mounted within a solar concentrating reactor, and irradiated via heliostats. This Task is structured toward the overall goals of solar-driven, thermochemical hydrogen production, with associated efforts toward the enabling surface science, catalysis, particle science, material synthesis, nano-structures, multiscale-multiphase physics modeling, and process simulation that will enable the realization of solar hydrogen-based fuels to power the transportation economy. Successful efforts as targeted in this project are a critical step toward increased renewable-resource based fuels and energy, reduction of GHG emissions, and establishment of a new power industry in Florida. **Budget: $446,400** **University: UF** **External Collaborators: NA** **Progress:** Efforts to date have focused on two primary tasks, namely, construction of two laboratory-scale reactors for fundamental studies of the reactor processes and surface chemistry for hydrogen production. The first reactor is a monolithic configuration that is specifically designed to allow for fundamental measurements of surface kinetics during hydrogen production from reduced ferrous surfaces. This reactor is powered by resistance heating to enable precise temperature control. Real-time species measurements will be made with on-line mass spectrometry using a heated gas capillary to sample directly from the reactor stream. The second reactor design is configured around the concept of a fluidized bed to achieve high efficiency with actual reactors. Ultimately, this configuration will be extended to magnetically-assisted fluidized bed configurations. As a laboratory system, this reactor will also be configured with resistance heating to allow precise control. Ultimately, we will move toward pilot-scale radiatively heated reactors using solar simulator lamps. However, for fundamental studies, the electrically heated reactors are most efficient. The current work has focused on the use of ferrous metals, primarily elemental iron as the reduced material.

	Upon exposure to water vapor under the correct temperatures, the iron is oxidized primarily to hematite and magnetite, generating hydrogen. The goals of the above described facilities are to measure the fundamental reaction kinetics of the oxidation states, and to explore the final state of oxide, as well as gage process efficiency under highly dispersed powderized reactants. Assessment of oxidized states will be done through a combination of surface analysis tools, including micro-Raman spectroscopy for speciation, and depth analysis using a focused-ion beam (FIB), which will enable detailed analysis about the penetration of the oxide layer into the bulk iron substrate. At present, the monolithic reactor is undergoing final assembly. All fabrication and acquisition of the necessary heating elements, reactor housing, process controllers, flow controllers, and gas-sampling interfaces have been completed. The primary power is via a series of four high-temperature 400 W heater coils. These are formed around a concentric-tube annular flow reactor, designed to provide an isothermal reactor test section. Within the month of October, the system will be fully functional and initial testing and benchmarking of the system performance will be initiated. It is fully expected that hydrogen generation will be initiated in November/December of this year. At present, the fluidized bed rector is also undergoing final assembly. The reactor was constructed about a high-temperature tube furnace to provide uniform process heat. A reduced iron-oxide power will be used for assessment of the reactor performance. The time-frame is similar to the monolithic reactor, with initial testing and benchmarking of the fluidization process expected to be completed in October/November, and hydrogen-generation activities initiated in the November/December time-frame. Parallel efforts are in place with regard to magnetically-assisted fluidization. Additional efforts have focused on understanding of surface reaction processes and the relationships between surface properties and functionality, specifically on correlating catalyst properties with water splitting activity and thermal reduction, and clarifying mechanistic details of the surface reactions. Graduate students have been hired and are all fully integrated into the project. If is expected that additional graduate students will be hired in the coming months to complement the experimental efforts by focusing on computational modeling of the heat and mass transfer. These activities will be focused on the fluidized bed, in which critical transport phenomena remain to be addressed with regard to scaling to larger processes or to solar-driven processes.
	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 **Description:** This project targets to develop a solar thermal power technology that will lead diverse energy resources in Florida and reduce greenhouse emissions by utilizing renewable sources. Also, there will be economical 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 codes for the proven solar thermal power technologies in combination with bio or fossil fuels based on Florida conditions and resources. Secondly, the project aims to set up demonstration and test facilities for these technologies for optimization for Florida conditions, and the final task is to develop and commercialize innovative technologies based on new thermodynamic cycles. **Budget:** $882,000 **University:** USF, UF, FSEC **External Collaborators:** NA **Progress:** A state of the art solar thermal power test and demonstration facility is targeted for evaluation, improvement and optimization of Florida specific Solar Thermal Power technologies. In order to fulfill the project goals, several subtasks have been identified under the main tasks of the project. A solar radiation

method based on Daily Integration method is developed and an analytical model for heat loss in a solar collector is modeled and a local concentration distribution around the solar collector is found. Experimental setup of the combined cycle has been under modification at various points, such as piping, absorber heat exchanger, and strong solution pump. A scroll compressor is modified to work as an expander. A comparative study between an organic Rankine cycle and a supercritical Rankine cycle showed that the efficiency is improved up to 30% by adopting supercritical Rankine cycle. Optimization of the Goswami cycle for two different boiling temperature shows that a $\eta_{I,eff}$ of 6-10% and a $\eta_{exergy,eff}$ of 25-40% with 50-75% expander efficiency could be achieved for a boiler temperature of 125°C.



Schematic drawing of the Goswami Cycle

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
Progress: Due to the resurgence of the solar industry, FSEC has received a significant increase in demand for solar systems testing and certification. This occurrence has resulted in requiring the Center to correspondingly amplify its capabilities to respond to the increased demand. Thus, the objective of this task was to add walls, windows, doors and A/C to an existing FSEC roof only facility for the purpose of increasing conditioned laboratory space and to allow for conducting tests on solar water heating systems and PV inverters.

In 2005, FSEC constructed a slab and roof only facility on the west side of its Cocoa site. Due to the increase in testing and certification requirements, the need for conditioned laboratory space has become a critical requirement. Following a study, the most cost-effective program that could be done to add laboratory space was to design an enclosure for an existing roof facility located at FSEC. This facility is called the Applications Testing Facility (Bldg. #1940). The following photograph shows this existing

facility before any renovation has begun.

Figure 1: Ground level front view

Results to Date

The enclosing of the FSEC roof facility began in September 2008. Since that time, the following has been completed or is scheduled:

- A design build firm* was hired on April 1, 2009.
- Construction drawings were completed July 2009.
- State Fire Marshal approval was requested and received on September 15, 2009.
- A meeting was held to discuss cost and timing with the design build firm on September 8, 2009.
- Following the meeting, a purchase order for construction was issued on September 19, 2009.
- The estimated completion date of the new facility is April 30, 2010

*PPI Construction Management of Orlando, FL.

Clean Drinking Water

Title: Clean Drinking Water using Advanced Solar Energy Technologies
PI: James Klausner
Student: Fadi Alnaimat/ Ph.D
Description: Availability of fresh water is a major societal problem facing the world. The state of Florida is vulnerable to fresh water shortages. Moreover, Florida ground water is contaminated in many locations from leaky underground tanks, agricultural pesticides, and other chemicals. Although it is possible to desalinate sea water, conventional systems are energy intensive. Solar energy can provide the needed energy, and solar vacuum (USF), humidification/dehumidification (UF), and solar still (UF) desalination systems are being investigated provide adequate fresh water for the state's needs. Systems will be developed for both bulk water desalination and small community needs/disaster response. We will also develop photocatalytic disinfection to remove contaminants and integrate these technologies with solar PV for complete water supply systems.
Budget: $252,000
University: UF

	External Collaborators: NA **Progress:** 1. A theoretical model is developed to describe the heat and mass for the solar diffusion desalination process from the basic principles of mass and energy conservation. The developed model takes into account the transient variations in the water, air, and packing bed temperatures when it is subjected to a variable heat source such as solar collector. 2. The transient theoretical model has been solved numerically using a finite difference scheme. The numerical results obtained from the transient model are compared against the results obtained from the DDD steady state model using the same operating conditions. A satisfactory agreement is achieved. 3. Solar DDD facility is constructed such that the validity of the developed theoretical model can be investigated. To harvest solar energy, a solar collector is simulated using an electric heater to deliver energy to the distillation process. A set of experiments with different operating conditions are required. Experiments are currently ongoing to test the model.
	Title: Clean Drinking Water using Advanced Solar Energy Technologies **PI:** Lee Stefanakos **Co-PI's:** Yogi Goswami, Matthias Batzill, Maya Trotz, Sesha Srinivasan **Students:** M. Abutayeh, K. Dalrymple **Description:** Availability of fresh water is one of the biggest problems facing the world and Florida is one of the most vulnerable states to fresh water shortages. Moreover, Florida ground water is contaminated in many locations from leaky underground tanks, agricultural pesticides, and other chemicals. Although possible to desalinate abundant sea water, conventional systems are too energy intensive. Solar energy can provide the needed energy, and innovative new solar vacuum (USF) and humidification/dehumidification (UF) desalination systems can provide adequate fresh water for the state's needs. Systems will be developed for both bulk water desalination and small community needs/disaster response. We will also develop photocatalytic disinfection systems to remove contaminants and integrate these technologies with solar PV for complete water supply systems. **Budget:** $326,984 **University:** USF **External Collaborators:** NA **Progress:** This project report is composed of two components: (A) solar desalination and (B) solar photocatalytic disinfection. *Solar Desalination:* Objective is to develop an economically–viable and an environmentally–friendly desalination system that requires less energy and uses renewable energy for its operation. The most common desalination technique, multi–stage flash, will be modified to have its system vacuum created passively and its thermal energy requirements provided by solar radiation. The proposed modifications are expected to further the feasibility and broaden the applicability of the desalination process. A thorough literature review was conducted to assess the work that has been reported on conventional and sustainable desalination systems to date. A preliminary theoretical analysis was conducted to help design a pilot unit. Experimental simulations were carried out using a lab-scale indoor pilot unit under varying conditions. A detailed computer model is being developed to simulate the proposed desalination method. The model is built based on the original theoretical model and the obtained experimental results. **Short-Term Prospects:** These short-term prospects will be performed upon the completion of the model development: • Perform a feasibility analysis • Write a conclusion and make recommendations • Produce a final manuscript for commencement **Long-Term Prospects:** The long-term prospects will be performed by a future graduate student or a post-doctoral researcher. The following tasks represent the long-term prospects of this project:

- Modify experimental unit to generate passive vacuum
- Modify experimental unit to utilize heated brine
- Run experiments and collect data for modified unit
- Present experimental simulations results for modified unit
- Publish experimental simulations papers for modified unit
- Revise and modify the theoretical model for modified unit
- Extend the theoretical model for modified unit to represent multi-stage
- Run simulations using the optimized model for modified unit
- Present the experimentally validated model results for modified unit
- Publish the experimentally validated model results for modified unit
- Perform a feasibility analysis for modified unit
- Write a conclusion and make recommendations for modified unit
- Produce a final manuscript for modified unit

Solar Photocatalytic Disinfection: The objective for this task is to develop an economically–viable and an environmentally–friendly desalination system by lowering its energy demand and employing renewable energy to drive its operation. The most common desalination technique, multi–stage flash, will be modified to have its system vacuum created passively and use solar energy. A thorough literature review was conducted to assess the work that has been reported on the modeling of photocatalytic disinfection systems to date. The rationale for this study is that the development of a mechanistic model for photocatalytic disinfection will allow scientists and engineers to develop design and analytical tools to optimize photocatalytic disinfection systems so that their efficiency. A series of experiments were set up to test the hypothesis that overall disinfection rate is dependent on the rate of lipid peroxidation. Important parameters, which have an effect on the peroxidation rate, were varied and the overall inactivation rate for *E. coli* was observed. The bench-scale experiments are still ongoing. To ensure that our model can translate to the design of real systems, a pilot-scale system was proposed. The design of the system has been complete. Two systems will be used. One such system is already in operation and the other system is under construction. Both systems are capable of being used under solar conditions in outdoor.

Project Output Summary

- Work presented at FESC Summit at USF September 30, 2009
- Literature review completed
- Bench-scale experiments still ongoing
- Pilot system designed

Targets for the Next 3 Months: The following tasks will be completed within the next three months:

- Test model with preliminary data
- Complete construction of pilot-scale system
- Commence testing on pilot-scale system and collect data
- Complete bench-scale experiments and summarize data
- Publish review paper in peer-reviewed journal

Low Cost PV Manufacturing

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's

	PV program. **Budget:** $196,018 **University:** UCF/FSEC **Progress:** The objective of this project is to provide for enhanced and expanded PV testing and certification capabilities at the Florida Solar Energy Center. Using funding from the Consortium, this project has been used to either purchase or leverage the purchase of photovoltaic test equipment that will be used to expand the research and commercial testing capabilities at FSEC. A state of the art long-pulse simulator has been purchased and will increase the turn-around time for commercial testing and will allow more accurate testing of newer thin-film and multi-junction modules. The new solar simulator and the existing simulator will be housed in the enclosed inverter and module test facility. The simulator test area in the facility will be more than twice the size of the existing simulator lab. Plans are in progress for expanding the outdoor test area for PV module, inverter, and system testing at the FSEC site. Additional module I-V multi-tracers have been specified and will triple the number of modules that can be tested concurrently. This allows commercial short-term testing of production modules to be conducted concurrently with the long-term testing of different modules for research without conflict or interruption. Space has been allocated for expanding the fixed module exposure area to approximately double the available rack space. This planned expansion has already attracted contract research for small systems side-by-side testing at FSEC. An area is also planned for installation of a dual axis tracker to enhance the existing test capabilities.
	Title: Development of High Throughput CIGS Manufacturing Process **PI:** N. Dhere **Students (degree sought):** Sachin Kulkarni (Ph.D.); Vinay Hadagali (Ph.D.); Parag Vasekar (Ph.D.); Shirish Pethe (Ph.D.); Ashwani Kaul (Ph.D.); Eigo Takahashi (M.S.); Saisitaram Ramesh (Ph.D.); Bihag Joshi (Ph.D.) **Description:** A reduction in the cost of CIGS and other thin PV film modules is required for wide 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. **Budget:** $141,620 **University:** UCF/FSEC **Progress:** In order to attract a PV manufacturing company, it is essential to develop a PV process that has high yield and low cost of production. Therefore, multi-faceted efforts are undertaken to improve and optimize each of the process involved in the preparation of $CuIn_xGa_{1-x}Se_2$ (CIGS) thin film solar cells. Initial efforts were directed towards increasing the deposition rate for the metallic precursors that are deposited by DC magnetron sputtering. The deposition rate was increased to ~7 Å/sec. but the deposition rate was not increased further due to possibility of overheating of the sputtering targets. Next, experiments were carried out to determine if a single layered molybdenum film can be developed to replace the multi-layered molybdenum film that is currently being used. Various sputtering power and pressures were evaluated and the peel test was carried out on each sample. For samples that passed the peel test, the resistivity and average roughness were measured. From the initial experiments, it can be concluded that a single layered molybdenum film that exhibits good adhesion as well as high conductivity can be produced. Further experiments are being carried out to determine the exact process parameters of power and pressure

	needed to produce such a film. The cost of production was evaluated and the results showed that cost can be reduced by reducing the total material utilization without adversely affecting the device performance. In case of a copper based chalcogenide solar cell, the theoretical limit for absorber layer thickness is 0.5 μm. However, in practice, the device performance has been shown to reduce drastically as the thickness reduces below 0.7 μm and the yield also goes down for such low thicknesses. Therefore, experiments were carried out to reduce the absorber layer thickness in the range of ~1 μm to ~1.5 μm. The first step in reducing the absorber thickness is to reduce the metallic precursor thickness. The metallic precursor thickness was determined based on the thickness for standard processes where the absorber thickness is ~2.5 μm. However, it is essential to optimize the process parameters such as annealing time and temperature. Therefore, experiments were carried out on $CuIn_xGa_{1-x}S_2$ (CIGS2), CIGS and $CuIn_xGa_{1-x}(Se,S)_2$ (CIGSeS) absorber layers. In case of CIGS2 absorber layers, cell efficiencies exceeding 10% were achieved for ~1.5 μm thick absorber layer. Further experiments will be carried out to improve the efficiency of CIGS and CIGSeS solar cells. One experiment uses sodium. Sodium is known to have beneficial effect on CIGS absorber layer; however, excess sodium tends to degrade the device efficiency. Sodium from the sodalime glass substrate tends to out-diffuse; however, this out-diffusion is non-uniform as well as uncontrollable. When fabricating over large areas the uniformity of the electrical as well as material properties over the entire area is very important. Hence, it is essential to deposit a barrier layer to avoid the out-diffusion of sodium from the sodalime glass and to optimize the thickness of the barrier layer such that it minimizes the sodium out-diffusion and does not affect the adhesion of the thin films to the substrate. Other experiments were carried out to study the effect of varying silicon nitride layer thickness on device performance as well as adhesion of the molybdenum films to the substrate. It was concluded from the experiment that 800 Å was the optimum thickness of the silicon nitride barrier layer. An important issue involved in taking a process from lab environment to pilot plant scale is the yield of the process. Hence, it is necessary that the processes deliver absorber films that exhibit good adhesion to molybdenum back contact and good hardness along with higher efficiencies. Mechanical scribing that is used for making electrical interconnects in CIGSeS thin film solar cells can also be used to test the mechanical properties of the absorber film. Therefore, a mechanical scriber was designed and developed to make scribes with width of ~42 nm. From this design, clean and complete scribes were successfully carried out.
	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). **Budget:** $81,120 **University:** UCF/FSEC **Progress:** This project has established a data base for assisting in the establishment of PV manufacturing facilities in Florida. The following information has been determined: **Worldwide Statistics** • In 2008, the worldwide PV industry produced 6,941 Mw and experienced its strongest growth – an

	increase of 87%. • Europe leads in world production with 1,909 Mw at 27.5%, closely followed by China with 1848 Mw at 26.6%. • The U.S. only accounts 412 Mw or 5.9%. • The U.S. installed 6.4% of world installations in 2008. • The U.S. has only one manufacturer in the top 15 world companies – First Solar is at number 2. **U.S. Statistics** • The top seven U.S. manufacturers supply 96% of the U.S. total. • The two largest U.S. producers use thin film technologies and these producers account for 65% of the U.S.'s capacity – First Solar and United Solar. • For the seven U.S. manufacturers, 2 are located in Arizona, and one each in Maryland, Massachusetts, Michigan and New Mexico. • California leads in PV installations with 178.7 Mw or 62% of the U.S. total followed by New Jersey with 22.5 Mw or 8% of total. **Key Florida Results** • Four 2009 PV installations for a total of 37 Mw has moved Florida to second in U.S. PV installations. • 140 Mw of Florida PV installations are now in planning for the next 5 years – GRU, FMEA, OUC, and Lakeland. • Four PV manufacturers now have or have proposed Florida locations – Advanced Solar Photonics, Willard & Kelsey, Mustang Vacuum Systems, and Blue Sky Solar.
	Title: Low Cost CIGS Thin Film PV Devices and Processes **PI:** Gjs Bosman, **Co-PI:** Tim Anderson **Students:** Barrett Hicks (Ph.D.), Yige Hu (Ph.D.), Chris Muzillo (Ph.D.), Vaibhav Chaudhari (Ph.D.) **Description:** There is considerable interest in developing high-efficiency, polycrystalline thin-film α-$CuIn_xGa_{1-x}Se$ (CIGS) solar cells as a result of their high champion cell efficiency, outstanding long-term outdoor stability, excellent radiation hardness, and high absorption coefficient. Cost models suggest that decreasing the manufacturing cost and increasing the cell efficiency are direct paths to achieving the necessary price reduction. The goals of this program are to explore methods to enhance cell efficiency (e.g., tandem structures, hot electron capture) and demonstrate a low-cost, high-throughput absorber deposition process based on counter-current, chemical vapor deposition. **Budget:** $450,000 **University:** UF **External Collaborators:** N/A **Progress:** Recent advances in the development of high efficiency polycrystalline thin film α-$CuIn_xGa_{1-x}Se$ (CIGS) solar cells have generated considerable excitement as evidenced by the number of CIGS startups in the U.S. In addition to their high cell efficiency, CIGS thin-film solar cells exhibit outstanding long-term outdoor stability, excellent radiation hardness, and the potential for use in a CGS/CIGS tandem arrangement. Needless to state, solar cells based on CIGS show excellent promise for commercialization. Device modeling and simulation of ZnO/CdS/CIGS/Mo solar cells were carried out using the Medici simulation program. Defect morphology in the CdS/CIGS interface is analyzed. Results were obtained for Fermi level pining, carrier recombination rates, current-voltage characteristics and cell efficiency. The simulation showed that moving the electrical junction away from the interface into the CIGS absorber layer improved the efficiency from 16.1 to 16.7%.

	In addition, hot carrier solar cells are studied to improve cell conversion efficiency. Phonon dispersion properties are investigated to slow down thermalisation of photon-generated electron-hole pairs in absorber materials. The phonon dispersion of binary materials was simulated and phonon dispersion of ternary CIS will be characterized. The champion CIGS cell was demonstrated using the 3-stage NREL process by vacuum evaporation. Unfortunately, the 3-stage NREL recipe for high efficiency cells has not been developed for a practical manufacturing process. The goal of this project is to evaluate the feasibility of a countercurrent CVD process to rapidly and efficiently produce CIGS absorber layers. The process uses chlorides of the metal elements to transport In, Ga and Cu while Se transports under its own vapor pressure. It is a continuous rather than a batch process that uses two parallel substrates to form a channel flow reactor. This design minimizes wall area (less waste) and increases substrate area (higher throughput). The proposed process also specifies that the substrates move countercurrent to the gas reactant flow direction. This configuration permits the 3-stage NREL process to be emulated in a continuous manner. The countercurrent, parallel-plate design along with effluent recycling promises highly efficient reactant utilization. Complex equilibrium calculations were performed to simulate the envisioned process. All four source zones were modeled to determine suitable reaction temperatures and reaction extents. The products of the source reactions were then allowed to equilibrate in the deposition zone to product thin films. Again, this region was modeled using complex chemical equilibrium calculations. The results of this analysis suggest were favorable and a patent has been filed. In parallel to the modeling, work has begun to convert an existing CVD reactor to grow CIGS. This work has included the design of the reactor, including the source zones, modifying the multi-stage furnace assembly, and installing the safety system. Cell fabrication will require deposition of the TCO (Al:ZnO) by sputter deposition and a 50 nm CdS buffer layer by chemical bath deposition. Work was also performed on both of these systems. Device modeling and simulation of ZnO/CdS/CIGS/Mo solar cells were carried out using the Medici simulation program. Defect morphology in the CdS/CIGS interface is analyzed. Results were obtained for Fermi level pining, carrier recombination rates, current-voltage characteristics and cell efficiency. The simulation showed that moving the electrical junction away from the interface into the CIGS absorber layer improved the efficiency from 16.1 to 16.7%. In addition, hot carrier solar cells are studied to improve cell conversion efficiency. Phonon dispersion properties are investigated to slow down thermalisation of photon-generated electron-hole pairs in absorber materials. The phonon dispersion of binary materials was simulated and phonon dispersion of ternary CIS will be characterized.
	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 **Students:** Ryan Anders (PhD); Sree Satya Kanth Benapudi (MS); Keshavanand Jayadevan (MS) **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 15.8%, 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

Progress:
Photovoltaic Solar Thin Film Module Pilot Line

The primary objective of this project is to attract photovoltaic solar module manufacturing to the state. The expected outcome will be the creation of significant numbers of high-tech jobs and the means of transitioning the state and nation to a clean renewable source of energy. Faculty at USF, UCF and UF have been key and ongoing contributors to the development of thin film solar technologies that are being commercialized throughout the world. Their expertise is being joined and organized under this project to focus on its primary objective. A new thin film module processing and characterization laboratory is being developed on the USF campus. This module piloting line will be able to accommodate all thin film technologies on 1 ft^2 glass substrates. It will be fully integrated and capable of processing glass into a completed module comparable to commercial products. The initial thin film technology that will be developed in the facility is thin film copper indium gallium diselenide(CIGS). This material has the highest efficiency(20%) of the leading thin film materials, and it is also the material in which the faculty have the greatest expertise. The laboratory has been designed and is in final plan check. Facilities for the laboratory infrastructure have been designed and ordered.

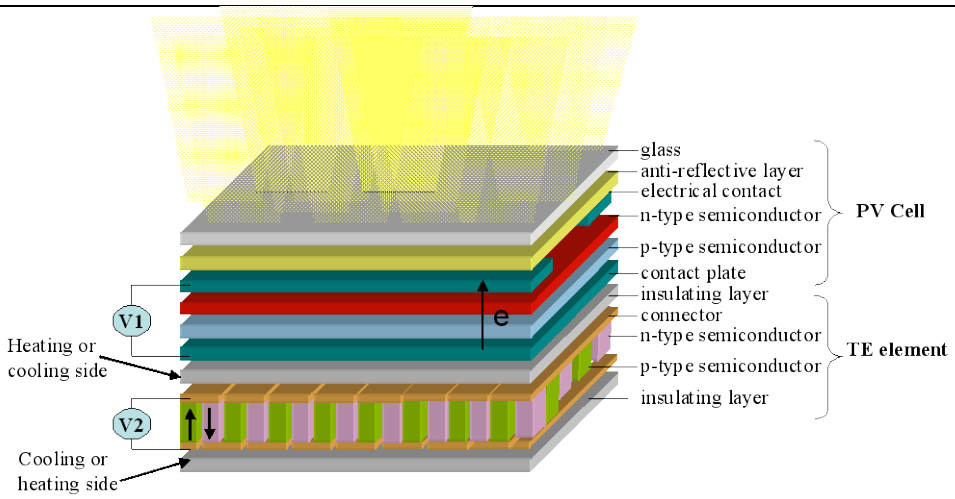
The key piece of equipment for the entire operation is the unit in which the absorber material(CIGS) for the solar cell is deposited. CIGS is a complex material that has been difficult to deposit in the large areas needed for commercialization. Consequently significant time and effort has gone into designing the deposition tool. The design that has been developed will allow evaluation of a variety of potential process recipes. It also accomplishes dual use of the sputtering chamber to also serve as the load lock for the absorber deposition chamber. The combined chambers will allow for significant variations in the utilization of several sputtering and evaporation sources. The initial configuration will be geared toward process recipes that are based upon USF patents. The system has been designed to demonstrate process yield and throughput which are essential for commercial validation. The design has been completed, and we have received initial quotes from several vendors. One of the vendors has expressed interest in partnering with us on the project, and we are currently evaluating that opportunity.

It is necessary to support the module processing lab with experiments on small area devices. USF has had ongoing federal funding to support this laboratory scale research for the past twenty years. The facilities that have been developed and supported are being upgrade to directly address the objectives for this project. One of the lab scale deposition systems is being dedicated to proof-of-concept experiments before transitioning process recipes into the module piloting system. The other is being used to develop new process pathways that address sustainability issues when production of these technologies reaches the gigawatts/year level.

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
Students: Kris Davis, Steven Nason
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 **University:** UCF/FSEC **Progress:** In the field of photovoltaic energy generation, thermoelectric materials have been underutilized. The use of such materials can increase the efficiency and longevity of the solar cells and facilitate their operation in varying weather conditions. There is also an increasing demand for new thermoelectric materials with high efficiency which can function in environments that are severe, but still have a very long life span. To solve this problem, research will be conducted on the modeling of electron and thermal transport in controlled size and shape nanocomposite thermoelectric TiNiSn based materials. This research will lead to the development of novel methods to synthesis, characterize and study thermoelectric properties via bulk synthesis. Research for improved high-temperature thermoelectric materials was done on controlled size and shape of TiNiSn based Half-Heusler phase materials. The materials also combined substitution of Zr and Hf on some of the Ti sites, Pt on the Ni sites and doping of Sb into the Half-Heusler structure. By controlling the grain boundary size and shape, control of the thermoelectric figure of merit should be accomplished. This accomplishment involved an extensive theoretical study of the thermoelectric-related transport properties of a TiNiSn system and TiNiSn based systems. Due to the research strategy adopted, these materials are expected to have low thermal conductivities, due to the mass fluctuation, the strain field effect and their complex structure. First principles methods based on quantum mechanics were used to calculate thermoelectric properties of size and shape controlled materials. These calculations included the real structural and chemical complexity of materials, which yielded quantitative predictions, both of the thermoelectric properties and their variation with chemical composition. Trends were identified and used to suggest other compositions to be analyzed by detailed calculations. Our theoretical result predicted compositions with improved thermoelectric performance. This approach was unique in that it first created a theoretical framework for predicting the electrical and thermal properties of each new structural configuration and improved the figure of merit from 0.2 to almost 0.9. From the beginning, the research strategy was to lower the lattice thermal conductivity by creating mass fluctuation and internal strain field effects and controlling the size of the micro-grains by annealing the system. Using this as a basis, improvements can be made in the efficiency of the thermoelectric materials and then used in a PV/TE hybrid system design.



Schematic of PV/thermoelectric hybrid system

Title: Research and Develop PV Device Science and Laboratories
PI: Nicoleta Sorloaica-Hickman, Robert Reedy
Students: Kris Davis (PhD)
Description: The objective of this project is to develop a world class PV cell laboratory for various cell and cell device research. The R&D to be conducted in the lab will focus on developing new and improved PV cells such as organic PV, nano-architectures, multiple excitation generation, plasmonics, and tandem/multijunction cells. This new PV lab called the Laboratory for Photovoltaic and Thermoelectric Materials and Devices (PVTMD) has been sited in a room originally used as a machine work facilities room in the Low Bay of the Florida Solar Energy Center (FSEC). The PVTMD lab is to be used as an interdepartmental laboratory and will concentrate on developing the fundamental science and engineering base required to improve PV and TE device performance and processing technologies. The end goal is to transfer these laboratory results to large-scale manufacturing and to exploring new frontiers in manufacturing research and scientific education.
Budget: $882,507
University: UCF/FSEC

Progress: A laboratory for photovoltaic and thermoelectric materials and devices (PVTMD) has been sited in a room originally as a machine shop in the low bay of Florida Solar Energy Center (FSEC). The new lab is an interdepartmental laboratory at FSEC devoted to developing the fundamental science and engineering base required to improve PV and TE device performance and processing technologies and to effectively transfer these laboratory results to manufacturing and educational programs.
Multidisciplinary research teams perform programs at the leading edge of advances in electronic, thermal and optical PV materials (nanostructures, thin film and bulk). The interdisciplinary philosophy of research within the Laboratory for Photovoltaic and Thermoelectric Materials and Devices combines the disciplines of physics, materials science, chemistry and electrical engineering leading toward attracting research opportunities. The background of students and researchers within the lab reflect this breadth, and as a result, the laboratory is vertically integrated in its activities, straddling from basic to applied research.
Five major areas of core competency underpin activities at FSEC in the Laboratory for Photovoltaic and Thermoelectric Materials and Devices:
1. Materials discovery, design, synthesis and processing
2. Analytical instrumentation/device design/fabrication
3. Integration of modeling, fundamental science, engineering and economic expertise for energy issues
4. Condensed matter theory (including photonic band gap and other novel materials)

	5. Materials characterization, We believe that these five core competencies will enable FSEC to perform a significant role in Florida's PV research laboratory systems, and to pursue its vision for scientific excellence and pre-eminence in the area of fundamental materials research for PV and TE applications. The new lab will provide the development of analytical techniques and instrumentation. This PVTMD laboratory will be state of the art and will position Florida's universities for active roles in PV research and development.
	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 **Students:** Rudran Ratnadurai, Electrical Engineering, Ph.D., Michael Celestin, Chemical Engineering, Ph.D., Samantha Wijewardane, Electrical Engineering, Ph.D. **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. It is strongly believed that this technology can reduce the present solar cost of production from $/watt to ¢/yard of flexible solar panels. **Budget:** $598,500 **University:** USF **External Collaborators:** BGS Technologies, Idaho National Laboratory **Progress:** The research objective of this project is to develop rectenna to convert thermal radiation to electrical energy through, • Fabrication, characterization and testing of Metal-Insulator-Metal tunnel junction, • Design, Fabrication and testing of antenna, • Determination of various cost point of rectenna manufacturing, and, • Integration of antenna and MIM junction. Approach: • Develop a self-aligned Metal-Insulator-Metal (MIM) junction using a novel cross-hair layout using E-beam lithography process. • Characterize the insulator layer to yield uniform and thin film. • Investigate various techniques for depositing thin film insulator for MIM application. • Design and optimize antenna structure for receiving the electromagnetic radiation. • Analytical study and development of an engineered thermal emitter. Characterize and test the intensity of the emitter Accomplishments: • MIM junctions were fabricated with (a) 1 μm x 1 μm and (b) 0.5 μm x 0.5 μm contact area with a cross-hair layout to assure alignment during the e-beam lithography process. The electrical behavior of the diodes was evaluated by measuring the current-voltage characteristic. • The roughness, thickness and composition of the insulator layer were measured using Atomic Force Microscopy, X-Ray Reflection, and X-Ray Diffraction. The thickness of the insulator was determined to be 1.3 nm.

- Thin film insulators in the MIM junctions such as HfO_2, Polyaniline and 1,6 hexanedithiol were deposited with 1 nm thickness using Atomic Layer Deposition, Langmuir-Blodgett process and Self-Aligned Monolayer deposition process, respectively.
- The antenna structures were redesigned to be packaged to improve the measurement procedure.
- Fabrication of engineering thermal emitters based on the analytical study. Emitter surface was fabricated using micromachined silicon substrate coated with Ni to emit a narrow band of blackbody radiation.

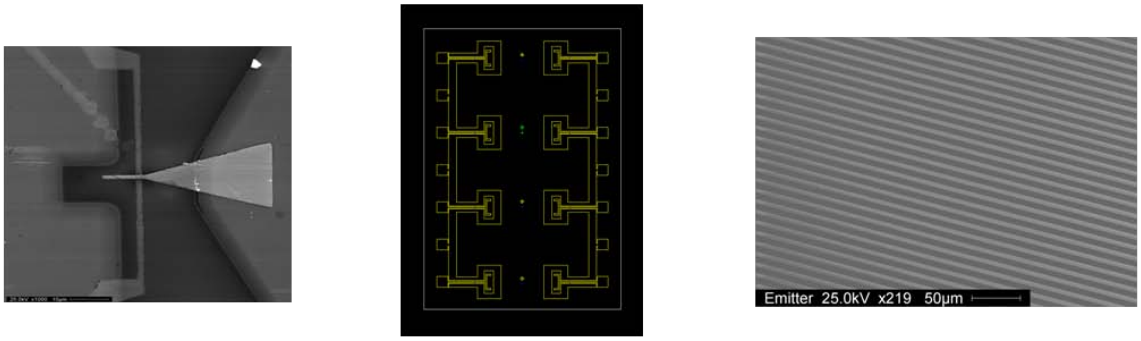


Figure 1: *Micrograph images showing (a) MIM junction with a self-aligned pattern, (b) redesigned antenna structure for packaging and testing, and (c) top view of an engineered thermal emitter.*

PV Integration

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
Students: Kejiu Zhang (PhD), Souhaib Harb (PhD), Karthik Padmanabhan (PhD), Xiang Fang (PhD), Ala Alsaeed (PhD)
Description: The objective of this project is to develop a system-driven Plug'N'Gen solar power system demonstrating architecture of decentralized, low-cost, mass-produced, PV panel-mounted micro-inverters. This system will be able to compete with today's centralized multi-kW PV inverters that require cost prohibitive professional installation. The project tasks are: 1) novel inverter topology and control concepts; 2) advanced digital control algorithms; 3) SmartTie interface with the utility grid; and 4) low cost and ultra-compact PV inverter in package.
Budget: $1,267,000
University: UCF
External Collaborators: NA

Progress: To date, analysis and simulation have been conducted on four tasks of the project. Progress on these tasks is detailed below:

• Advanced Digital Control Algorithms

A full mathematical model of the PV panel mounted inverter was developed and verified with experimental testing. The model was used to develop an optimal pulse skipping control technique that can boost the micro inverter efficiency operating at low insolation levels.

• SmartTie Interface with the Utility Grid

Inverter control schemes are being developed to allow the PV panel inverter to operate in the voltage mode for micro grid operation as well as in VAR mode to support ancillary services.

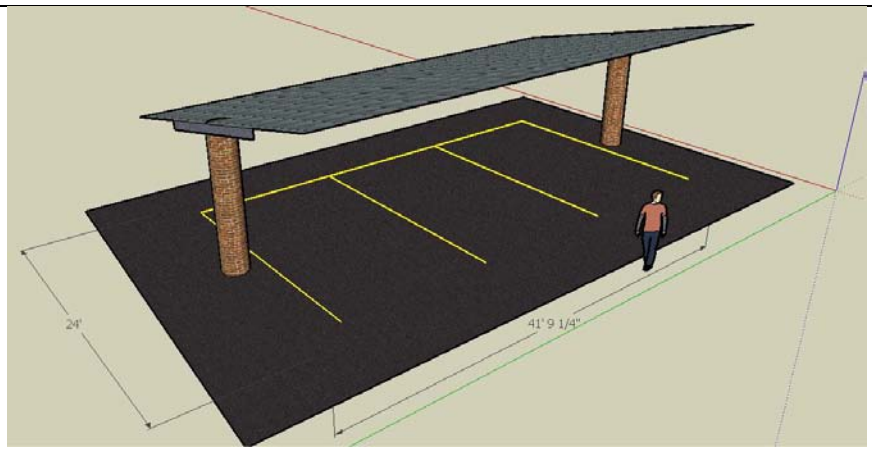
• Ultra Compact PV Inverter Packaging

A low profile planar transformer has been fully analyzed, optimized and designed using ANSOFT computer simulation. Electrical core and winding design have also been finalized. For the mechanical

	design, the heat sink size and profile has been analyzed and optimized. Using FLOWTHER, detailed modeling of the heat sink design parameters have been analyzed and optimized to yield a lighter and efficient design. The next phase will focus on building prototypes and carrying out experimental work to verify the expected results.
	Title: Non-Contact Energy Delivery with Integrated DC-AC Inverter for PV System **PI:** Jenshan Lin **Students (degree sought**): Zhen Ning Low (Ph.D.); Joaquin Casanova (Ph.D.); Raul Chinga (Ph.D.); Jason Taylor (M.S.); Yan Yan(Ph.D.); Xiaogang Yu (Ph.D.); **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. **Budget: $**252,000 **University:** UF **External Collaborators:** NA **Progress:** We have introduced a new concept of using magnetic coupling for wireless delivery of energy from outdoor photovoltaic system to indoor electrical system. Replacing traditional electrical cables penetrating through building structures, magnetic coupling using two coils separated by a distance allows power to be transferred wirelessly through building walls and roofs. While generating magnetic field, the DC electric energy from photovoltaic cells is converted to AC energy, which can potentially be merged with DC-AC inverter function required in the system. 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. High efficiency DC-AC generation and high efficiency magnetic coupling are the key challenges. We have studied different design approaches and conducted experiments to address these two challenges. The DC-AC generation requires high efficiency inverter. Previously we have demonstrated using Class-E power amplifier architecture to achieve 295W at 75% efficiency for near-field wireless power transfer. Although Class-D architecture has been commonly used in power electronics, the Class-E architecture has two advantages: only one transistor is needed rather than two in Class-D architecture and Class-E can deliver more AC power under the same DC supply voltage. Therefore Class-E architecture is used in our approach. The inverter design also requires a choice of impedance transformation network. Because of the increase in separation between inductive coils, the previously used impedance transformation network topology may not be suitable for this new application since the operating frequency may need to be changed. After the experiment, it was found out that the Series-Series topology works best. The increase in distance between coils presents the greatest challenge to the magnetic coupling because the coupling coefficient decreases as the distance increases. To overcome this challenge, it is found that the operating frequency of magnetic coupling needs to be increased and the size of coil also needs to be increased to achieve high efficiency energy transfer. It is found that the dimension of coil has to be about the distance between coils. Our first goal is to achieve energy transfer through a 50 cm gap. The coil is therefore designed as a 50 cm x 50 cm, 8-turn rectangular coil. The same coil is used in both transmitter and receiver sides. Based on these conditions, the optimum operating frequency is determined to be about

	760 kHz. Several experiments were performed to test the system. The system achieves better than 60% efficiency in a wide power delivery range when the distance between coils is 30 cm. The system can still achieve 50% efficiency when the distance between two coils is increased to 50 cm. The efficiency is end-to-end efficiency including all the losses in the inverter and the magnetic coupling. The system also shows robust performance against misalignment between coils.
	Title: An Integrated Sustainable Transportation System **PI:** Eric Wachsman **Co-PI:** Shirley Meng **Students (degree sought):** Dan Gostovic, Dong Jo Oh, Eric Armstrong, Byung Wook Lee, Kang Taek Lee, Nick Vito and Christopher, R. Fell (Ph.D.) Patrick Wanninkopf, Eric Klump, Nicholas Sexson, Kevin Seymor, and Thomas McGilvray (Undergrad) **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. If developed this vehicle would be a transformational change in transportation technology. **Budget:** $594,000 **University:** UF **External Collaborators:** Solid-State Energy Technology, Inc., Lynntech, Inc., Planar Energy Devices, Inc., CFX Battery, Inc. **Progress:** We have been developing high performance fuel cells and batteries as the critical components of a transformational transportation system. By integrating advanced materials and engineered structures we have achieved world record performance solid oxide fuel cells (SOFCs). These SOFCs have acheived ~2 W/cm2 at 650°C. Since the cells are only ~0.5 mm thick, this corresponds to a power density of ~40 W/cm3. With these exceptional power densities we can readily reduce the operating temperatures to 300-500°C. This will allow us to use conventional stainless steel interconnects and BOP, as well as simple elastomeric seals, thus reducing cost and increasing reliability. In addition, operation on reformed JP5 diesel resulted in only a 20% decrease in power density compared to H2. Thus, our SOFCs can operate directly on hydrocarbon fuels. A patent application has been filed and we are working with two companies to commercialize the technology. In addition, as part of the commercialization strategy we are scaling up the cell size (see figure) and have submitted an ARPA-E proposal. Battery development has resulted in advanced Li2MxNi0.5-x-yMn1.5+yO4 cathodes for Li-batteries. These cathodes result in a dramatic improvement in energy and power density as well as lifetime (charge-discharge cycles). A patent application has been filed and we are working with two companies to commercialize the technology.
PV/Storage/Lighting	
	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. **Budget: $15,000** **University: FSU** **Progress:** As a result of the realization that the originally proposed project has low funding priority we have recently turned our attention to a different idea which was not included in our original White Paper. The idea is to use a radically different class of materials to produce highly efficient solar cells. We have found that the photovoltaic effect, which as it is well known works with doped band insulators, works in addition, with a class of materials which are called Mott-Insulators. Namely, first, we can show that a p-n junction can be produced by making an interface between a p-doped and an n-doped Mott-insulator. Most importantly, we find that if we appropriately choose these materials to be narrow-band and narrow-gap Mott-insulators they give rise to a very high quantum efficiency. We find, theoretically, that a solar photon when it is absorbed by the type of device produces several electron/hole pairs and only very little amount of energy is dissipated by photon emission or other dissipative processes. We are in the process of using Molecular Beam Epitaxy to produce the first such device.
	Title: PV Power Generation Using Plug-in Hybrid Vehicles as Energy Storage **PI:** J. Shen **Co-PI's:** I. Batarseh, N. Kutkut **Students:** Michael Islas, John Elmes **Description:** The objective of this project is to develop and demonstrate the architecture of an alternative PV power generation system that uses plug-in hybrid vehicle as the energy storage and transfer element. The total system cost target is $3.50/watt. The project tasks include developing efficient, reliable and inexpensive maximum power tracking DC/DC battery chargers and 3-phase converters. The developed system will be demonstrated on the UCF campus by contracting to construct a 10kW solar carport charging station. 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 operated at the station. **Budget:** $380,816 **University:** UCF **External Collaborators:** City of Tavares, FL **Progress**: This project will develop and demonstrate an alternative PV power generation architecture that uses plug-in hybrid vehicle as the energy storage and transfer medium. The total system cost target is $3.50 watt. Included in the development of this project are efficient, reliable, and inexpensive maximum power tracking DC/DC battery chargers and 3-phase converters. The developed technology will result in a 10kW demonstration solar carport charging station to 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 at the charging station. The progress to date included the completion of all physical and electrical designs, finalizing contracting arrangements and obtaining all permits related to the solar carport design. Construction is planned to start in November 2009 depending upon procuring of the construction materials. The system architecture design and specifications are completed and work is being done on hardware prototyping of the conversion electronics. The technology is also planned to be implemented at the parking lot of Wooten Park in the City of Tavares. A schematic of the solar charging structure is shown below.



Title: Integrated PV/Storage and PV/Storage/Lighting Systems
PI: Franky So, **Co-PI:** Jiangeng Xue, Shirley Meng
Students: Ming-Che (Tim) Yang, William Hammond, Edward Wrzesniewski, Cephas Small, Fred Steffy (Ph.D.). Thomas McGilvray (Undergrad)

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
External Collaborators: NA

Progress: There is great interest in developing renewable resources and improving the technologies for energy interconversions. The transformations of light into electricity (electrical energy generation in photovoltaic cells), electrical energy storage (rechargeable batteries) and electricity into light (light generation in light-emitting diodes) are three important interrelated areas that have attracted considerable research and commercial interest. Organic/polymer materials have been investigated for these transformations and undoubtedly play key roles in efficient production, transformation and utilization of solar energy.

The main objective of the current work is to develop high efficiency solar energy at cheap cost for integrated PV/battery/lighting system. The development of self-contained power supplies that are suitable for electrical/lighting application depends upon the development of thin-film batteries and photovoltaic cells. In this project, we independently explore and develop the efficient and cost effective device component such as photovoltaic, batteries and organic light emitting devices.

In the PV area, our focus is to develop high efficiency transparent polymer PV cells. Our initial focus is to study the effect of anode interlayer on cell performance. Using molybdenum trioxide, we were able to demonstrate 15-20% enhancement in cell performance. In the lithium ion battery area, we have

	developed a new class of electrodes based on Co-free, Ni and Mn containing Li transition metal oxides. This class of electrode materials has a composite 'layered-spinel' structure in nano-scale and batteries made with these electrode materials offer nearly 50% more energy density than the batteries made with the current state-of-the art cathode materials. In the OLED area, using a p-i-n structure, we have demonstrated white emitting OLEDs with luminous efficiency exceeding 70 lm/W. Our next step is to demonstrate transparent PV cells and OLED devices and integrate them with the lithium ion batteries developed in this program.
THRUST 4: 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:** The objective of this proposal 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. **Budget:** $60,844 **University: FSU** **Progress:** None Reported
	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. **Budget:** $15,000 **University: FSU** **Progress:** None Reported
	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 vast majority of lignin is currently burned to provide energy for factory operations. While burning plant derived lignin does not add to global greenhouse gas levels, having options to remove lignin from the global carbon cycle would lead to diminished atmospheric CO2 levels. This could be accomplished by chemically altering lignin's structure to facilitate long-term terrestrial sequestration or using it in value-added products that would not be discarded immediately. We will use Nature's catalysts (enzymes) to tailor the chemical structure of lignin for both deep-well injection (by using lignin derivatives as drilling "muds") and for materials that can be used in building, packaging, and other manufactured products.) **Budget:** $200,000 **University:** UF **External Collaborators:N/A**

	Progress Report: Since this is a new project, no progress report is provided.
	Title: Carbon Capture and Sequestration **PI:** Sabine Grunwald. **Co-PIs:** Tim Martin, Howard Beck **Students (degree sought): NA** **Description:** Cost-effective CO2 removal is required to accommodate growth and bridge our transition to greater energy diversity and efficiency. Several carbon sequestration approaches are under development by our team utilizing abundant Florida resources. Geological sequestration by CO2 injection into saline carbonate aquifers is being developed and tested by USF, representing a new sequestration technology. Biomass-based sequestration is being developed at UF using Florida forests and crops and has widespread support of its agricultural industry. Efforts in this area include the development of a terrestrial carbon information system which will provide a spatially- and temporally-explicit platform for sharing and analyzing terrestrial carbon data, and development of processes for converting by-products of renewable fuel production to a carbon sink. Chemical sequestration to useful products is being developed by UCF via a novel catalytic process that includes solar-derived H2. The resulting elemental carbon and lignin-based polymers can be stored and transported at ambient temperatures and pressures, and stored in geologic formations or used as possible commercial products. Each approach offers unique advantages to offset our transition to more carbon neutral power and transportation. Cost-effective carbon capture and sequestration is of primary interest to the major Florida power companies. They have proposed formation of a state-wide consortium to address this issue and the proposed Consortium can serve this role. Florida agricultural industries are also very interested in developing carbon sequestration as a supplemental land use. **Budget:** $199,440 **University:** UF **External Collaborators:** NA **Progress:** Summary project: Database infrastructure for integrative carbon science research (Grunwald, Martin and Beck): Rising CO_2 concentrations in the atmosphere and effects on global climate change have been well documented, and future impacts are uncertain but potentially devastating. Florida's natural and agro-forest ecosystems have much potential to sequester carbon in biomass and soils due to unique climatic and landscape conditions. However, research gaps exist to accurately assess carbon pools and fluxes at coarse scales, ranging from county to the region and larger. The overarching objective of this project is to address these obstacles by creating a terrestrial carbon information system (called "TerraC") for the carbon science community, focused on ecosystems in Florida. The information system will be administered through the UF Carbon Resources Science Center (http://carboncenter.ifas.ufl.edu), a multi-disciplinary Center dedicated to research in support of enhanced agricultural and natural resource carbon management. The development of the information system will proceed in two phases (Figure1). The first phase (now in progress) involves defining and building the core database structure, and design and implementation of custom query and upload tools. Stage 2 will involve linking the TerraC system to a user-friendly Google Earth interface, which will allow interactive queries and the creation of maps and other products.

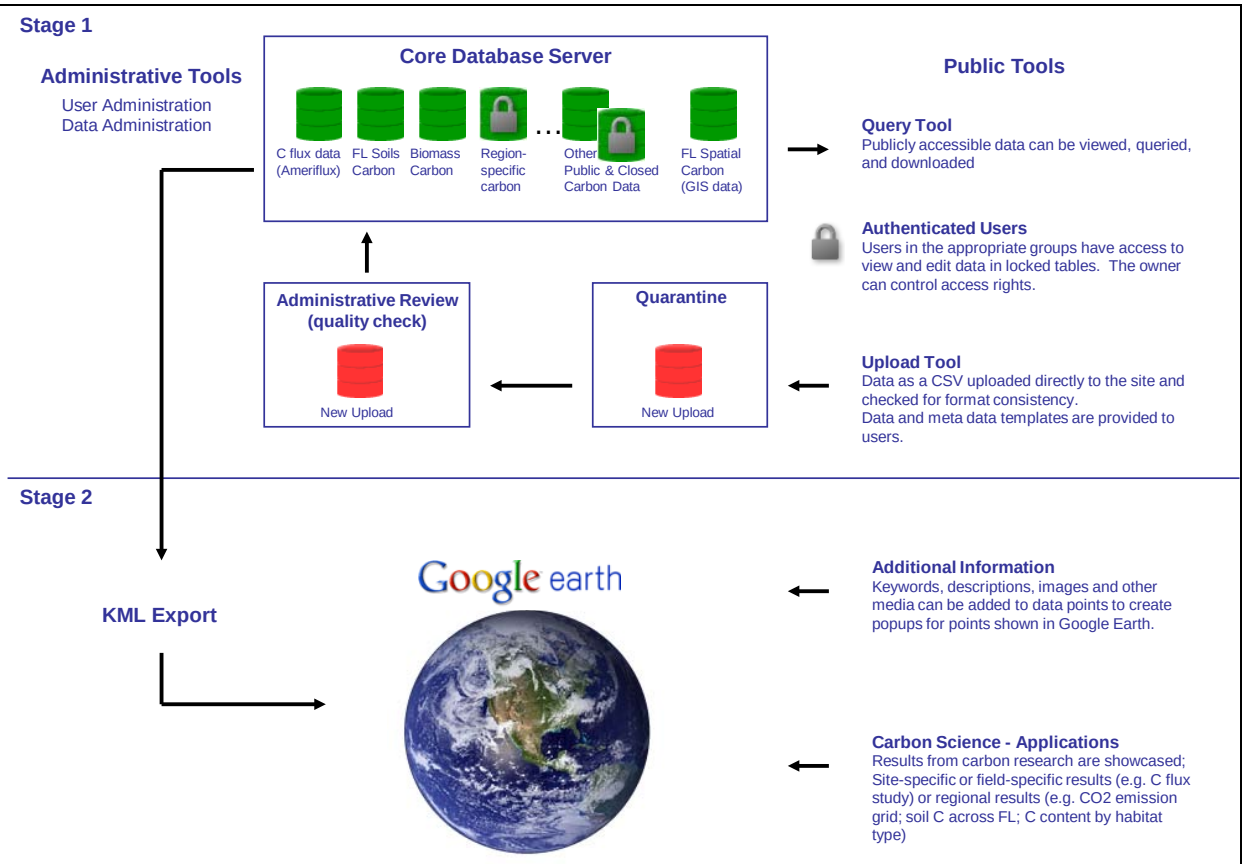


Figure 1. Schematic outlining the structure of the TerraC terrestrial carbon information system.

A project web URL has been obtained (http://terrac.ifas.ufl.edu) to house project updates and, eventually, to serve as a portal to the information system.

Title: Creation of Carbon Sequestration Data, Technologies and Professional Cohorts for Florida
PI: Mark Stewart, **Co-PIs:** Jeffrey Cunningham, Yogi Goswami, Maya Trotz

Students: Shadab Anwar (Post-doctoral researcher), Drupatie Latchman (MS, Chemical & Biomedical Engineering), Roland Okwen (PhD, Civil & Environmental Engineering), Douglas Oti (PhD, Civil & Environmental Engineering), Tina Roberts-Ashby (PhD, Geology), Mark Thomas (MS, Civil & Environmental Engineering)
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.

Budget: $479,640
University: USF
External Collaborators: Tampa Electric Company (TECO)

Progress: We have made significant progress with our analysis of the physics and chemistry of supercritical CO2 injection into deep saline aquifers, with particular application to the Cedar Key-Lawson formations, the principal geologic carbon sequestration reservoirs identified in Florida. Results of numerical simulations with the TOUGH2 code suggest injection rates up to 8 million tons per year (Mt/y) may be possible with a single vertical injection well. Horizontal injection wells allow for a higher injection rate under pressure-limited conditions. We used the tool TOUGHReact (Lawrence Berkeley National Laboratory) to investigate chemical effects at flow rates up to 20 Mt/y. Model simulations suggest solution of supercritical CO2 in native brine lowers pH, which induces solution of dolomite and calcite and precipitation of gypsum. However, the volumes of minerals dissolved and precipitated are a very small fraction of the aquifer volume, and have very little effect on aquifer porosity or permeability, suggesting that long-term injection of supercritical CO_2 is feasible.

Major progress was made on evaluation of the South Florida Basin (SFB) for geologic sequestration and enhanced oil recovery (EOR). Our analysis shows that the SFB meets the criteria for EOR, and has significant carbon dioxide storage potential beyond the oil-producing zones. The results will be presented at the Geological Society of America national meeting in November, and a journal article is in preparation. Three trips were made to the Florida Geological Survey in Tallahassee to obtain geologic data for a State-wide evaluation of carbon sequestration potential which will be completed in early 2011. Early analysis suggests that Florida has very significant carbon sequestration resources, possibly the largest resources in the Southeast. A major proposal was submitted to DOE ($5.9 million) in cooperation with Tampa Electric, Florida Geological Survey, and the Electric Power Research Institute.

The effects of injected streams of aqueous waste water, supercritical CO2 or mixtures of the two into deep aquifers pose questions that relate to water quality and well clogging. Will chemical precipitates clog injection wells? Can the solubility of CO_2 be enhanced through co-injection with aqueous waste? Will injection adversely affect water quality in the receiving formation? We are using Geochemist Workbench for simulating potential effects of injection of an aqueous waste stream which could be co-injected with a CO2 injection stream or injected in a nearby well. This arrangement has the potential to increase the solubility of CO2 in deep aquifers and hence significantly increase storage capacity. Simulated waste streams were tested and sensitivity analysis conducted using two thermodynamic databases, Thermo.dat and Thermo_minteq.dat. Based on the thermodynamic results, above ground treatment would be necessary to limit well clogging from carbonate precipitates. Simulations are currently being undertaken to look at injection of a supercritical CO2 stream and an aqueous waste stream in close proximity to each other.

Large-scale carbon sequestration requires an efficient and economic system for capture of carbon dioxide. We are investigating a high-efficiency carbon capture system that uses a metallic oxide to carbonate capture progress. A thin film of calcium or calcium-magnesium oxide is placed on a ceramic cloth substrate. Carbon dioxide is captured by conversion of the oxide to carbonate, and released by thermally converting the carbonate back to oxide. Our research is focusing on increasing the thermal efficiency of the system and increasing the cycle lifetime of the thin oxide film.

THRUST 5: Exploiting Florida's Ocean Energy Resources

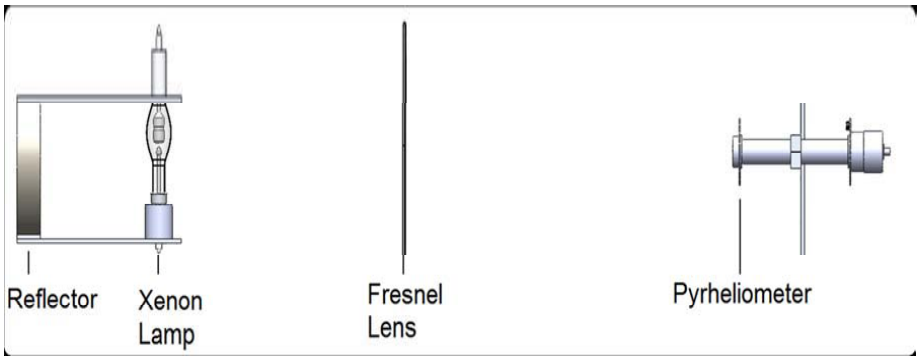
Title: Center for Ocean Energy Technology
PI: Susan H. Skemp**, Co-PI's:** R. Frederick Driscoll and Howard P. Hanson
Students: 20 students listed in Appendix H

Description: The Center for Ocean Energy Technology's program is structured to be the catalyst that will

	enable the ocean energy industry in Florida in providing solutions to 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 for ocean energy infrastructure and operation in the offshore continental shelf 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 areas. **Budget:** $8,750,000.00 **Universities:** UCF, FSU, ERAU, Oregon State University, University of New Hampshire, University of Hawaii, University of Edinburgh, Heriot-Watt University **External Collaborators:** Numerous industry and government as well as FFRDCs, such as National Renewable Energy Laboratory (See spreadsheet) **Progress:** The Center for Ocean Energy Technology (COET) was founded with a $5M award received January 2007. During FY'08, because it became apparent that regulatory jurisdiction for the offshore continental shelf was in a formative stage for both Federal and State agencies, a program re-organization was completed to accommodate regulatory efforts and to ensure ocean energy research was pursued as a total system to include: environment, resource, ecology, and technology. With the additional funding in 2009 of $8.75M the Center has moved forward in strategic research, in pursuing key technology, in defining standards criteria, and is deeply engaged in regulatory process formation which will influence the development of ocean energy in Florida, while continuing to educate and engage the public. Research and development for an ocean energy industry is being addressed with a system-level, phased approach. Joint research is ongoing at FAU, with FESC partners, and other industrial, government, and academic partners. Initial research in areas such as ocean resource analysis and modeling, prognostics and health monitoring systems, materials and anti-fouling, mooring and anchor systems, and environmental/benthic baseline assessment have been funded. COET's technology and industry support efforts are underway in three distinct but inter-related tracks. First, the Center is actively engaged in sensor and instrument acquisition, deployment, and analysis to more fully characterize offshore energy resources, as well as the benthic and ecological environment. Second, in support of ongoing research and to further an operational and technical understanding of offshore energy systems and challenges, the Center has designed, partially fabricated, and will begin testing a small-scale hydrokinetic turbine system. Testing will be completed for components, sub-systems, and major systems of the turbine, eventually evolving to full system testing in a phased, risk-reduction process. Finally, the Center is working to begin early development of, and recognition of, a National Open-ocean Energy Laboratory for system-level test operation and data collection infrastructure. This effort is intended to support and promote a phased approach for early-stage testing to minimize risk and further scaled development for the growing industry, as well as to help establish standards criteria and practice for the future sector. Notable accomplishments during the past year include completed milestones in resource assessment, research, regulatory process activity, partner relationships, infrastructure development, and outreach. Stand-alone instruments have been successfully deployed offshore in conjunction with shore-side systems to develop a baseline understanding of the kinetic and thermal energy resources in the Florida Straits. An interim draft application has been submitted and reviewed with the US Mineral Management Service for

	deployment of an ocean current research turbine, and the system has begun fabrication and testing onshore. More than twenty CDAs and five MOUs have been executed with national and international academic, government, and industrial partners to formalize collaboration with the Center. An in-lab 20kW dynamometer and test system is being finalized and installed, and through many conferences, presentations, and other events, the public continues to be engaged in the development of ocean energy.
	Title: Buoy Array for Ocean Wave Power Generation **PI:** P.I. Z. Qu, **Co-PI**: K. Lin **Students:** Shiyuan Jin (Ph.D), Steven Helkin (M.S.), Carlos Velez (B.S.) **Description:** The objective of this project is to analyze, design, and demonstrate a wave power generation system with novel multi-functional energy converting devices. The tasks include component design and modeling, system integration, system testing and evaluation. The proposed system consists of an array of buoys floating on the ocean and tethered to the floor. Each of them has one or multiple devices inside that can convert the kinetic energy of the motion of the waves into electrical energy. The electricity generated is then transmitted through the cable that goes along or inside the tether to the ocean floor, expending to an energy processing/storage station on the ocean shore. **Budget:** $150,000 **University:** UCF **Progress:** Nature offers a tremendous source of renewable energy in the kinematic motion of ocean waves. This project involves the development and optimization of a wave energy converter model that is innovative in design. For this project, a prototype has been built using machine components. The prototype was mounted onto a special motion platform that can oscillate vertically to simulate wave motion, which drives a shaft to produce electricity using a permanent magnetic generator. The project began with a literature review and a Matlab/Simulink simulation. Next, two prototypes were developed and tested. The first prototype simulated wave moving up and down with an amplitude of 15-cm, and could generate between 35 to 40 watts electricity. The experiences gained in testing of this prototype helped design and build the second prototype (Figure 2). The second prototype used two sprockets and a longer chain giving more mechanical advantages. In addition, a more efficient generator that requires less torque reduces frictional losses imposed on the shaft. Test results have shown that the power output increases from 37.3 to 206 watts. See prototype figures in next section. In order to make the generator run more continuously and, thus, generate more power for a given wave input, a load control mechanism was designed to dynamically control the electric load. This requirement is needed when there is no pulling force of the wave at the down-stroke and the load is not applied so that the flywheel runs continuously. Tests of the second prototype were done for a number of different configurations. In addition to the prototype tests, the buoyancy force of the waves on a small buoy has been studied. For these experiments, the output of the force is recorded by a computer based data acquisition system and the results will help verify the computation fluid dynamics model to be used in the future. Currently, the work is focused on the next prototype design, as well as the power conditioning circuit design. To build a system that can operate reliably in the harsh ocean environment, the current prototype will be changed and reinforced. The chain is replaced by a reliable belts, a new gear train will be used to convert excess rotational velocity into a greater driving torque for a new, powerful GL-PMG-3500 generator. The new design will replace different buoy designs under consideration. A microcontroller will be used to replace the LabView computer in future real environment to automatically control electric load and a power control strategy is being designed for stabilizing the variable frequency, variable voltage output and for satisfying the grid requirements of constant voltage,

	frequency, and power.
THRUST 6: 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 **Progress:** None Reported
	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** **Progress:** To meet Florida's renewable energy and greenhouse gas targets, there must be an aggressive sustainable energy plan. A microgrid strategy can provide a solution for meeting Florida's sustainable energy needs. Microgrids are an amalgam of: loads; distributed generation such as: photovoltaic, wind, fuel cells and other renewable energy sources; distributed energy storage devices which include: stationary (flywheels, ultracapacitors, and batteries) and non-stationary entities such as plug-in hybrid electric and electric vehicles. Possible benefits of microgrids are: • 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.

	To this end, the PI and co-PIs formed a research proposal that was submitted to IESES and subsequently, after peer review, approved for an award. Appendix A contains the original full statement of work. The PI and co-PIs have put together a team of undergraduate, graduate, post-doctoral associates, and visiting scientists to achieve the outcomes of the statement of work.
	Title: Multi-Generation Capable Solar Thermal Technologies **PI:** A. Krothapalli**; Co-PI:** Brenton Greska **Students:** John Dascomb (Ph.D.), Ifegwu Eziyi (Ph.D.), Jon Pandolfini (Ph.D.), Michael Gnos (M.S.) **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. The development of an indoor solar simulator capable of providing and sustaining 1 kW/m2 over an area of 10 m2 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. 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. **Budget: $544,226** **University: FSU** **Progress:** Task 1: Develop an indoor solar simulator Testing of the solar simulator components has begun (Figure 1). The results from two of the test configurations are shown in Figure 2. It can be seen that there is uniform light distribution without the reflector but it is only 40% of the desired intensity. With the reflector the maximum intensity rises to 80% of the desired value but it is concentrated over an unacceptably small area. A number of configurations will be tested in an attempt to address these issues.  Figure 1. Experimental setup for solar simulator design development.

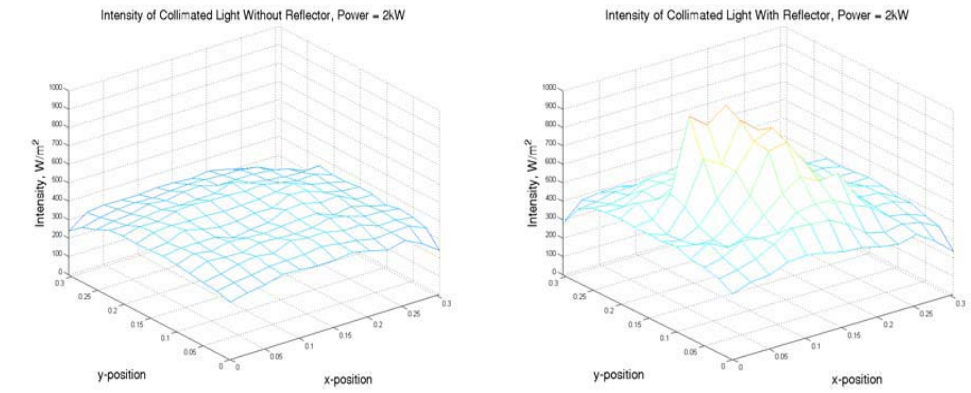


Figure 2. Measured intensity of the solar simulator light. Left – no reflector; Right spherical reflector.

- A low-cost pyreheliometer is under development at ESC for use with the simulator and other outdoor activities requiring direct beam radiation (Figure 3). The low-cost unit has been tested in tandem with a commercially available unit and Figure 4 presents some of the results from the testing. Work on the tracking system for the low-cost unit is currently underway.

Figure 3. ESC-MG-1 Prototype

Design Specifications:
Circular field of view of about 5□(similar to Eppley's NIP)
Needs to comply with the standards given by the World Meteorological Organization [2]
Reading of irradiance value in the range of volts rather than mvolts
Response time less than 140 seconds
Accuracy better than □3% compared to Eppley's NIP
Cost for pyrheliometer and tracking system ~$500

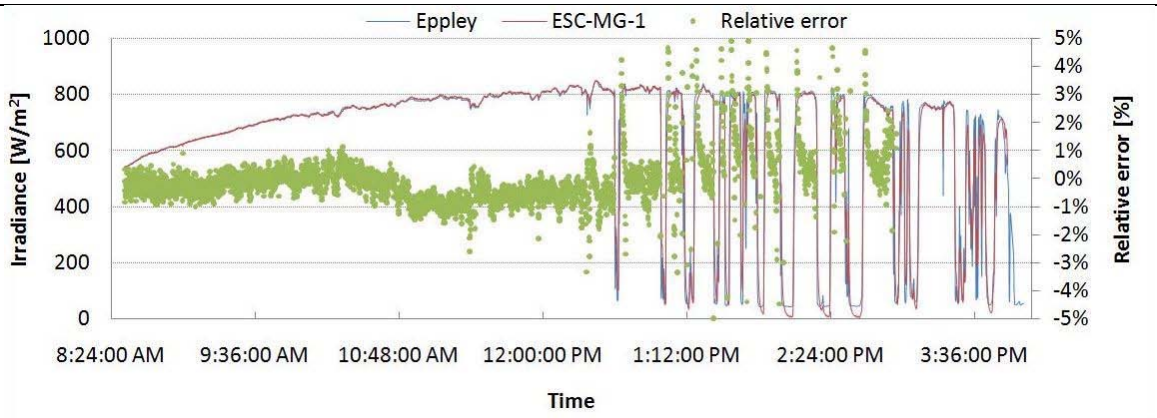


Figure 4. Comparison of the results obtained using the commercially available (Eppley) and low-cost (ESC-MG-1) pyrheliometer.
Students: John Pandolfini (Ph.D. Student) Michael Gnos (M.S. Student)

- A first generation solar generator has been built to verify the basic design principles of solar steam generation using dish system. Figure 5 is the system system installation picture on the FSU at ESC. The results of this work is described in a recent M.S thesis (John Dascomb, August 2009)

Figure 5. ESC 14 m2 parabolic dish concentrator with a steam boiler - solar steam generator.

Arrangements have been made to have a 15-foot diameter commercial concentrating dish donated by Infinia Inc. to ESC for use in the development of a small-scale cavity type steam boiler.

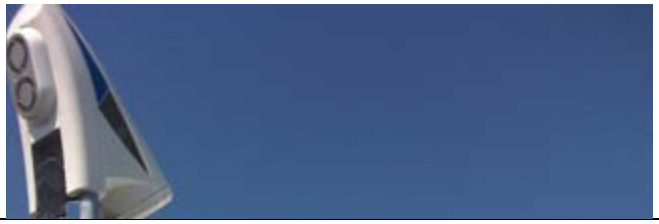


Figure 6. Infinia 3 kW dish-Stirling system.(The dish is being donated to ESC for the steam generation project)
Student: John Dascomb (Ph.D. Student) and Justin Kramer (Engineer)

Task 5: Integration of existing membrane distillation technology for use with the waste heat from the Rankine cycle and the refrigeration system (unfunded). Because of the importance of efficiency improvement in solar thermal systems, ESC has been developing waste heat recovery methods with particular emphasis on a novel water purification system (Figure 7). This work is carried out in collaboration with the Royal Institute of Technology (KTH) in Sweden. A typical multi-generation solar power system is shown schematically in Figure 8. Such systems are being studied currently with a goal of building a demonstration system during the second year of the program.

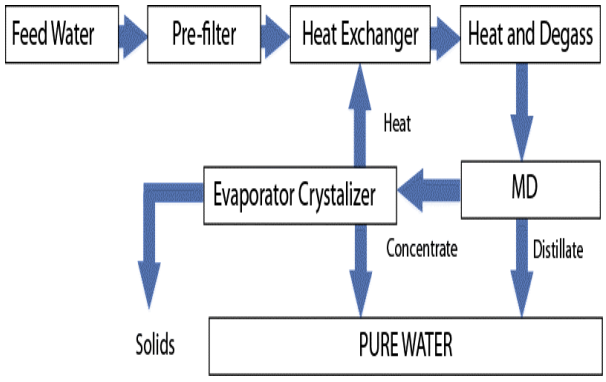


Figure 7. Membrane distillation process steps.

A multi-generation solar thermal system. MD: membrane distillation unit; ORC: Organic Rankine Cycle.

A membrane distillation (MD) unit for water purification has been purchased. This unit is capable of utilizing waste heat to operate and understanding of its operation will allow for an optimal solar thermal system design.

	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:** Power quality problems can lead to process disruption, unplanned downtime, shorter appliance lifetime, wasted resources, higher energy costs and value of work in progress destroyed. These problems are substantially larger in sustainable energy systems with multiple power generators. CEIDS estimates the loss due to low power quality at $119-188 B/year. The quality problems can be detected in advance by measurements and monitoring. By choosing good design practices and the right equipment such as active harmonic conditions most of the effects can be avoided. Typical indicator and consequences of power quality problems are computer lock-ups, equipment damage, blackouts, light flicker, nuisance tripping or overheated neutrals. To enable an universal real-time detection of power quality on the large and small scale, we will provide algorithmic as well as implementation working prototypes. **Budget: $15,000** **University: FSU** **Progress:** None Reported
	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. **Budget: $15,000** **University: FSU** **Progress:** 1. Proposal "Advancing Knowledge of Network Theory for Analysis and Design of Power System Architectures Resilient to Massive Damage" was submitted to NSF with the budget of $598,191 (PI: S. V. Poroseva, Co-PIs: P. A. Rikvold, M. Y. Hussaini) 2. Literature review for future proposals has been conducted to identify the state-of-the-art in the areas of i) power system resilience, ii) integration of power and communication systems, and iii) network analysis in application to power systems 3. Contacts of Possible Collaborators Dr. S. V. Poroseva discussed possibilities for future collaboration visiting Departments of Mathematics and Electrical and Computer Engineering, Purdue University, and participating in the following project-related meetings The 2009 ESRDC Team Meeting, Mississippi State University, May 26-28, 2009 The FREEDM Systems Center Conference, Raleigh, NC, May 18-19, 2009 The IEEE Electric Ship Technologies Symposium, Baltimore, MD, April 20-22,2009 The visit and meetings participation was supported from sources other than IESES. 4. Undergraduate and graduate student education and research Dr. S. V. Poroseva has been advising R. Ford, undergraduate student from the Electrical & Computer Engineering Department, in Spring, Summer, and Fall 2009 on the integration of power and communication systems. The research of the student was supported by IESES. Prof. P. A. Rikvold has been advising B. Israels, undergraduate student from the Department of Physics, in Summer and Fall 2009 on the network analysis in application to power systems. The research of the student

	was supported from sources other than IESES. Prof. P. A. Rikvold and Dr. S. V. Poroseva were advising A. Williamson, undergraduate student from the Department of Physics, in Spring 2009 on the network analysis in application to power systems. The research of the student was supported from sources other than IESES. A. Williamson participated at the first annual Physics Department Undergraduate Research Poster Session on April 2, 2009, and presented her poster "Topology of Power Grids" there. Conference paper "Computational Analysis of the Network Survivability due to its Topology" by S. V. Poroseva, R. Ford, and M. Y. Hussaini was submitted to International Workshop on Reliable Networks Design and Modeling. Planned Activities: 1. Proposal submission 2. Visit of granting organizations (December, 2009) 3. Advising two undergraduate students: R. Ford and B. Israels (Fall 2009) 4. Invited presentations at Graduate Student Seminars (Fall 2009) 5. Participation in three professional meetings (Fall 2009)
	Title: Investigating the Effect of Appliance Interface Design on Energy-use Behavior **PI:** Paul Ward**; Co-PIs:** Ian Douglas, David Eccles **Description:** Our goal in this study is primarily to examine the behavioral differences between efficient and inefficient energy consumers that are related to interface design. Specifically, we are interested in relationship between the informational feedback afforded by the device, an individual's understanding of how a device works, and their combined effect on energy use-behavior. **Budget:** $247,720 **University: FSU** **Progress:** In the original statement of work, we proposed nine tasks to be completed over the two year funding period for this project. These included three types of task: (a) organization and information gathering exercises, (b) task analyses and home inventories, and (c) assessment, evaluation and design recommendations. We review progress on each task relative to these foci below and, for reference, indicate the original task list # from our statement of work in parentheses. Details are included in the Annual Report. The statement of work is provided as an appendix.
	Title: Energy Delivery Infrastructures **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 representing dynamic and transient behaviors of microgrids. Therefore, in this project we propose using simulation tools to model a microgrid and investigate how well we can reproduce its measured behavior in the field. **Budget:** $485,184 **University:** USF **External Collaborators:** N/A **Progress:** We are in the stage of identifying simulation tools and different software's which will be useful for analysis of microgrids. An important aspect of microgrid is to find a suitable control strategy that will advantage of the inherent scalability and robustness benefits of distributed energy. This gives an opportunity to investigate how existing tools can be applied to properly represent dynamic and transient behaviors of microgrids.

	1. **PSS®E** is an integrated, interactive program for simulating, analyzing, and optimizing power system performance. It provides the user with the most advanced and proven methods in many technical areas, including: • Power Flow • Optimal Power Flow • Balanced or Unbalanced Fault Analysis • Dynamic Simulation • Extended Term Dynamic Simulation • Network Reduction 2. **EDSA** (Paladin DesignBase$^{TM)}$: Features of the software include • Fault Analysis: - calculate the effects of flowing faults in three-phase, single-phase and DC power distribution systems. Power Flow Analysis: - Enable users to conduct balanced three-phase and single phase load flow studies on almost any network configuration imaginable. • Power Quality Analysis and Mitigation, Dynamic Behavior Simulation, Sizing Optimization. 3. **PSCAD/EMTDC**: Power Systems CAD is a powerful and flexible graphical interface to the world-renowned, EMTDC solution engine. Contingency studies of AC networks relay coordination, transformer saturation effects, Investigation of new circuit and control concepts. 4. **SimPower Systems**: Simulink tools power flow analysis. • Mathematical computation, analysis, visualization, and algorithm development • Hardware connectivity and data analysis for test and measurement applications. Next Step: Plan to collect various parameters related to the simulation.
	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 **External Collaborators:** NA **Progress Report:** Since this is not a FESC funded project, no progress report is provided
	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 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 **External Collaborators:** NA **Progress Report:** Since this is not a FESC funded project, no progress report is provided
	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 **External Collaborators:** NA **Progress Report:** Since this is not a FESC funded project, no progress report is provided.
Policy and Other	
	Title: Power Generation Expansion under a CO_2 Cap-and-Trade Program **PI:** Tapas Das **Co-PI's**: Ralph Fehr **Students:** Patricio Rocha (Ph. D. Candidate), Ehsan Salimi (Ph. D. Student). Industrial and Management Systems Engineering Department **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. **Budget:** $71,906 **University:** USF **External Collaborators:** Argonne National Lab **Progress:** During the last year the efforts of the research team have been focused on developing a generation capacity expansion model that incorporates the implications of the implementation of a CO2 cap-and-trade program in the U.S. A CO2 cap-and-trade program will change the way generators make capacity expansion decisions, especially if the allowances (or pollution permits) created with the program are distributed via auction (as opposed to be given away for free based on historical emissions). In fact, the profitability of a particular expansion plan is measured by adding the profits obtained by the generator in the allowance and electricity markets. Furthermore, the generators' bids and profits in the electricity market are directly impacted by the additional cost generators incur in purchasing allowances. To model the interaction between the expansion decisions made by generators and the decisions they make in the allowances and electricity markets we develop a game theoretic model whose objective is to find the equilibrium expansion plan, CO2 allowances bidding strategy, and electricity bidding strategy for each generator in a particular power network. In general, each generator $\boldsymbol{i}$ maximizes the profitability of a expansion plan $\boldsymbol{x_i}$, which is a function of the decisions made by the generators in the allowances and electricity markets ($\boldsymbol{y_i}$ and $\boldsymbol{z_i}$, respectively), while taking into consideration the actions of the other generators ($\boldsymbol{x_{-i}, y_{-i}, z_{-i}}$). We have developed a solution algorithm for the game theoretic model that is included in an upcoming paper that we intend to submit to a peer-reviewed journal. In the paper, we also include an application of the game theoretic model to the Illinois electricity market. Our collaboration with Argonne National Laboratory has allowed us to have access to a significant amount of data on the operation of the electricity market in Illinois. Using the market data, we were able to develop a version of the Illinois power network, which we then assumed to be working under a cap-and-trade program similar to the Regional Greenhouse Gas Initiative. We then applied our methodology considering different choices of expansion plans for the generators in the network. We present the results in the upcoming paper. Besides the upcoming submission of this paper, the research team has presented the work at the IIE Conference and the INFORMS Annual Meeting. **The team has also made strides on topics that are directly connected with this research, namely, how to redistribute (among market participants) the revenue collected from the auction of allowances.**
	Title: Environmental Impacts of Energy Production Systems: Analysis, Evaluation, Training, and Outreach **Principal Investigator:** Amy B. Chan-Hilton **Co-PIs:** Gang Chen, Wenrui Huang, Michael Watts, Ming Ye, Paul Lee **Description:** The goal of this project is to develop tools and conduct research to objectively assess environmental and water resources needs and constraints of fuel cycle and energy production systems. The objectives of this project are to: 1. Analyze environmental and water resources demands and potential impacts, specific to Florida's unique geographical challenges, of fuel cycle systems. 2. Develop an objective environmental impact screening and evaluation tool for energy planning and policy making. 3. Provide outreach to industry, utilities, government 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. **Budget: $118,470** **University: FSU** **Progress:** Received our project budget number recently (on April 7, 2009). Submitted a Pre-Application to the US DOE/USDA Biomass Research and Development Initiative (Funding Opportunity Number: DE-PS36-09GO99016) in March 2009. Title: Comprehensive Systems Analysis of Biofuels: Environmental Impacts, Energy, Economics and Sustainability. PI: Amy Chan-Hilton (CEE). Co-PIs: Gang Chen (CEE) Julie Harrington (CEFA), Wenrui Huang (CEE), R. Mark Isaac (Economics), Michael Watts (CEE), and Ming Ye (SCS). Requested budget: $1,849,031 (4 years) Will submit a full application (invited) to the Florida Department of Environmental Protection (FDEP) Hinkley Center for Hazardous and Solid Waste in May 2009. Title: Usage of Microbial Fuel Cell Technology to Prevent Iron Release nearby Landfills in Northwest Florida PI: Gang Chen (CEE). Co-PIs: Amy Chan Hilton (CEE), Kamal Tawfiq (CEE) Progress made toward deliverables: We are in the first phase of Task 1 of this project. We are conducting literature reviews on how a wide range of energy production technologies (e.g. biomass, nuclear, renewable, fossil fuel-based), and when possible energy distribution systems, affect our environmental resources and quality will be conducted. This includes impacts on the potential contamination of water, soil, and air, demands on water resources, ecosystem and human health, and emissions of greenhouse gases.
	PI: Tim Chapin**; Co-PIs:** Ivonne Audirac, Jeff Brown, Chris Coutts, Jeffrey Lowe, Greg Mark, Melanie Simmons, Horner Thompson **Description:** 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. Teams of researchers will generate "issue papers" in four areas of inquiry and report their findings via events that inform legislative leaders, state agency staff, and local government officials as to how energy sustainability objectives can be achieved through transportation, land use, and green infrastructure programs. **Budget: $177,460** **University: FSU** **Progress:** The project began in May 2009 and will continue through the end of the spring 2010 semester. During the summer 2009 term the research team worked to review the current state of knowledge in the issue areas and to develop a resource base to inform this work. A project Blackboard site was created and has been utilized as a common pool resource for the team. Under direction of the PIs, two graduate students were hired during the summer to obtain and review materials. In fall 2009 the project moved onto the next phase, including bringing on board two new graduate assistants, initiating a review of state and local energy and climate change policies and beginning to outline the report. We have also begun identifying potential outside funding sources for future work. **Linkage to IESES Priorities and Core Mission** The IESES mission statement reads that the "primary mission is to provide Florida and the country with

	up-to-date and pragmatic tools and analysis to assist in meeting challenges, and to forge new opportunities for an unprecedented energy and climate constrained era." This research project directly serves this mission in that the project report will inform public officials and elected officials about the breadth and form of the policy options available to them. In terms of the objectives and thrusts of the IESES initiative, this project specifically targets Objective 2 (Assisting Florida's Governing Bodies) and Thrusts #5 and #6 (Enhancing Energy Efficiency and Energy System Environmental and Economic Impacts). This research project contributes directly to the IESES objective to "assist Florida's governing bodies in the successful development and implementation of a comprehensive, long-term, environmentally compatible, sustainable, and efficient energy strategic plan for the state". **Key Accomplishments to Date** Developed a Blackboard website for course materials Houses relevant reports, articles, and chapters Houses summaries of key literatures Reviewed the substantial (and growing) literatures revolving around transportation, land use, and green infrastructure. Chapin presented at the Transportation System Strategies to Reduce Greenhouse Gases (GHG) In Florida That Support Healthy Communities event in May 2009, co-hosted by the Florida Departments of Transportation and Health and 1000 Friends of Florida. The talk was entitled: Planning's Wicked Problems: The Search for Solutions to our Transportation, Land Use,Environmental, and Community Health Challenges. Chapin, Audirac, and Coutts presented a project overview to the State Agency Smart Growth Committee in October 2009. The members of this committee agreed to serve as members of Technical Advisory Committee for the project. Begun to identify possible funding sources for continued research in the project area (NSF, state agencies, local governments) Project Technical Advisory Committee Agency Membership Florida Department of Community Affairs (agreed); Florida Department of Environmental Protection (agreed); Florida Department of Transportation (agreed); Florida Department of Health (agreed); Florida Department of Elder Affairs (agreed); Florida Governor's Energy Office (invitation to be made); 1000 Friends of Florida (invitation to be made); Association of Florida Community Developers (invitation to be made); Florida Home Builders Association (invitation to be made); Florida Regional Councils Association (invitation to be made)
	Title: Marketing Strategies to Incentives Entrepreneurship and Innovation in the Development of Sustainable Energy **PI:** Joe Cronin **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 knowledge that drives the purchase of sustainable goods and services. The overall objective of the research is to provide much needed market pull information for organizations embarking on "green" marketing

	strategies; that is, firms in the process of developing or expanding their mix of environmentally friendly goods and services. **Budget: $191,555** **University: FSU** **Progress:** The specific intent is to provide deliverables, including published conference papers, journal articles, presentations, and other modes of educational knowledge transfer. To date, as is reported below, the research team has published conference papers, made conference presentations, and embarked on specific knowledge transfer activities. Specifically, four conference papers have been published, six presentations have been given, a website has been developed, a special session at 2010 AMA Winter Educator's Conference, Sustainability in Action: a professional and practitioner-oriented conference is planned for Spring 2010, and numerous journal articles are in preparation. In addition to the tasks noted, the Research Team initiated contact through Dean Caryn Beck-Dudley of the College of Business relative to securing additional funds to support sustainability research. Contact was made with the City of Tallahassee Utilities Department and their support was received for both research projects and the Sustainability in Action conference. At the suggestion of the Dean, we are engaged in an effort to secure the support of private resources for sustainability research. Specifically, the Research Team is engaged in an ongoing effort to meet with and develop a relationship with Interface, a world leader in the manufacture of sustainable commercial carpeting. Interface has made major donations to several U.S. educational institutions to support sustainability business research and are actively seeking additional research partners. Task 1: Documenting Sustainable Business Practices Progress Update: Center for Sustainability Initiatives website is approved per FSU College of Business standards and operational: csi.cob.fsu.edu Green marketing literature is collected and will be loaded onto csi.cob.fsu.edu Fall 2009 Information collected on local and regional sustainability-oriented businesses The Research Team plans to attend the University of Kentucky Sustainability Center Conference in December 2009 Task 2: Benchmarking Sustainability Practices Progress Update: Best Practices materials collected and currently stored electronically for placement on the Center for Sustainable Initiatives website These Best Practices materials will be continuously updated to reflect the growing interest in sustainability Task 3: Developing a Florida Sustainability Research Panel Progress Update: Sustainable Consumer Research Panel online participant collection website created and approved form letter developed and approved by the College of Business have received approval from FSU Foundation for use of Alumni mailing list to secure initial panel participants approval received to contact current College of Business iLab participants for participation in the Sustainable Consumer Research Panel. Research panel to be operational by end of Fall semester 2009 Task 4: Florida Sustainability Index Progress Update: Created Sustainability Index using established scales and will be implemented as part of the ongoing research related to the sustainability panel Task 5: Development of One-Two Day Sustainability Seminar

	Progress Update: We are in the preliminary planning stages of creating the Sustainability in Action conference a professional and practitioner-oriented conference The conference is tentatively planned for early Summer 2010 Task 6: Development of Sustainability Marketing Class Progress Update: After reaching out to faculty members at other institutions, we have proposed to teach this course in either the new MS in Marketing program or as an elective at the undergraduate-level Task 7: Consumer perceptions of sustainable firms: a qualitative approach Progress Update: Against the Green: A Examination of Non-Green Consumers accepted for publication at 2010 AMA Winter Educators Conference, New Orleans, LA Transumers: Motivations for Non-Ownership accepted for publication at 2009 ACR North American Conference, Pittsburgh, PA Holistic Green Behavior: The Impact of Lifestyle on Sustainable Practices in progress with an expected completion date of December 2009 Task 8: Consumer motivations for sustainable purchasing Progress Update: Segmenting Non-Green Consumers: Discovering Consumer Motivations for Non-Green Purchasing with an expected completion date of October 31, 2009 Shades of Green: Profiling Florida's Green Consumption with an expected completion data of November 2009 Task 9: The impact of sustainability messages on perceived product quality Progress Update: The Role of Eco-Labeling on Consumer Behavior Intentions presented at 2009 Academy of Marketing Science World Marketing Congress in Oslo, Norway and 2009 FESC Summit in Tampa, FL An Investigation of the Effects of Perceived Environmentally Responsive Organizations on Consumer Perceptions of Quality and Satisfaction with an expected completion date of December 2009 Task 10: Consumer motivations for sustainable purchasing Progress Update: The Affects of a Firm's Perceived Environmental Orientation and Familiarity on Consumer Perceptions. Specifically, this research investigates whether brand familiarity is detrimental to positioning green products if consumer perceptions of the brand are already established as being non-green. The expected completion date for this research is December 2009 Task 11: The impact of regret on sustainable purchase intentions Progress Update: Project on-hold until completion of other tasks Task 12: Consumer motivations for sustainable purchasing Progress Update: A dissertation entitled, Three Essays on Sustainability, is currently being completed. Specifically, data for Essays 1 and 2 has been collected and IRB approval sought for further research Task 13: Co-creation of eco-efficiencies: The role of shared values in sustainability initiatives Progress Update:

	Collaborative research project underway with an expected completion of December 2009. Specifically, the goal of this project is to collect data from a sustainable firm to develop an understanding of how firm objectives impact consumer perceptions. Task 14: Customer as partners in corporate sustainability: How does voluntary performance of pro-social behaviors impact perceived service quality Progress Update: Research on-hold pending Research Panel completion Task 15: The role of employees in promotion and adoption sustainable behaviors Progress Update: An Examination of Shared Values: How do Firms Influence Employee Attitudes toward Sustainability. Literature review in progress. Task 16: The role of transparency on the adoption of sustainable practices Progress Update: Knowledge Matters: The Impact of Knowledge and Message Framing on Attitudes toward Sustainable Behavior. Research completed with a planned revision Task 17: Online social networking: The influence of others on consumer adoption of sustainable practices Progress Update: Literature review and instrument completed. Waiting on final panel implementation to complete research.
	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. **Budget: $125,424** **University: FSU** **Progress:** RESERACH ACIVITIES: 1) Local Government Institutions and Turnover. RAs Lee and Ha have been collecting longitudinal data from Florida League of Cities and FL Association of Counties, ICMA, and online municipal codes . 2) Compilation of Information of State Energy Policy Environment. PI Audirac and RA Spector have been working on a report on state energy policy relevant to local governments 3) Survey Instrument. The Project Team was met on a weekly basis for the past two months to design the first survey instrument that will be directed to city, county and school district planning officials. 4) Proposal Preparation. PI Feiock is preparing a proposal to the NSF Political Science Directorate August 15th target date. PI Audirac is preparing a proposal for the NSF Innovation and Organizational Sciences Program September 3rd target date. OUTREARCH/INSTRUCTION ACTIVITIES: 1) Florida League of Cities and FLCIR. In June PI Feiock met with representatives of FLC and LCIR to brief them on our project and to coordinate activities.

2). Consultation with CGLFE. The Project Team met with Robert Lee, the Director of the of The Center for Florida Local Government Excellence. We discussed cooperative actions including a Webinar with on Local Government Sustainability and Energy Conservation and a workshop for local government managers on sustainability to be held in South Florida.
3) Mentoring. In addition to the funded RAs two fellowship supported doctoral students Yi (University Fellow) and Kassekert (DMC and NSF Dissertation Improvement Grant Awardee) have volunteered their time and are working closely with PI Feiock and the project and proposals and they are included as co-authors of forthcoming presentations at the American Political Science Association.

PUBLICATIONS/PRESENTATIONS
Mark Lubell, Richard Feiock and Edgar Ramierz. "Local Institutions and the Politics of Urban Growth," with Mark Lubell and Edgar Ramirez, American Journal of Political Science 53(3): 649-665, 2009.

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-PIs:** 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.
Budget: $79,621
University: FSU

Progress:
1) The "Hold-Out" project (with graduate student Sean Collins). The experimental design is complete, the programming is complete, IRB approval has been obtained, and we are conducting the experiments. This research has been invited for presentation on one of the Presidential Sessions at the 2009 Meetings of the Southern Economics Association in November in San Antonio.
The "hold-out" concept in discussed repeatedly in the context of public policies regarding land acquisition and facilities siting, but a clear definition is elusive. To economists, the most likely definition is that a profitable amalgamation of land parcels by one buyer from competing sellers does not obtain because of the failure of the private bargaining process. However, sometimes the term seems to be used more for delay instead of failure in bargaining, or even the very different concept of creation of any bilateral bargaining situation of the buyer and the "last" or "holding-out" seller, which may be inconvenient to the buyer but is immaterial in terms of economic efficiency unless efficient trades actually fail.
Our goal in this first set of experiments was simple. If "hold-out" is an empirically worrisome economic phenomenon, we ought to be able to find it in subjects who make decisions in our laboratory. Therefore, our first task was to create a "best case" scenario to observe holdout, which could then serve as a test-bed in which to examine changes in institutions and/or information conditions to ameliorate hold-out. Several design issues were obvious in creating this best-case scenario. There was no possibility, not even a threat, of any eminent domain proceeding. The buyer would have to purchase all of the parcels in order to reap the synergistic gains from amalgamation. There would be no contingent contracting, so that the buyer would face the so-called "exposure problem" of having to pay for some of the parcels before knowing whether he/she could successfully obtain all of them. And, the buyer would be capital constrained, that is, unable to borrow against the eventual value of the amalgamated properties. All of this would unfold in the context of valuations which made the amalgamation profitable to the buyer relative to the separate values placed on the parcels by the sellers. If hold-out existed, it would mean the failure of bargaining to capture mutually beneficial gains from exchange. The design conditions above were good as far as they went, but we then had to choose certain information conditions whose effects on the "best case" objective were ambiguous. For example, should the terms of the contracts be common knowledge? On the one hand, that might stoke the fires of "me last" among the sellers; on the other hand, it might be a vehicle for the development of

reasonable expectations among the sellers as to what to expect from the negotiations. What we realized was that there was an array of these information conditions that, while ambiguous as to their propensity to promote holding-out, were clearly different from what one might recognize as the archetypal approach to the facilities siting problem when approached by governments or by private parties. In the contemporary era, governments often operate in the context of "Government in the Sunshine" and "Freedom of Information" provisions that promote transparency and common knowledge. On the other hand, private acquirers of large parcels often resort to just the opposite: institutions such as non-disclosure agreements and dummy corporations to keep as little information as possible from seeping into the negotiations. Therefore, even in our "best case" scenario, we began with two information conditions. One we call "government" in which sellers know how many units the buyer has purchased, all contract prices as they occur, and they can continue to communicate with one another throughout the negotiations. In the other, "private," information condition, sellers do not know how many of the parcels the buyer has purchased, they do not know the other contract prices, and there is an enforced non-disclosure condition.
We have obtained one unambiguous result even after only 4 pilot sessions (12 groups, each making four decisions) and the first "fine tuned" baseline session (2 groups, each making four decisions): we observe the hold-out problem in our design. In fact, in about half of the cases so far, the contracting fails. This means that we have successfully created a test-bed which we can use to investigate institutional and information conditions that might ameliorate hold-out. After completing four more groups in the baseline condition, the first institutional modification we will examine is contingent contracting. We had our first test of the contingent contracting program last week, and we anticipate conducting those experiments shortly after Fall semester classes begin.

2) The "NIMBY"project (with Co-PIs Doug Norton and Svetlana Pevnitskaya). The experimental design is substantially complete. The programming is well underway. Writing the experimental instructions has begun. Completing a draft of the instructions, completing the programming, and submitting the research for IRB approval are the tasks for Summer C, so that the actual experiments can begin quickly in the Fall Term. This research has been accepted for presentation at the 2009 Meetings of the Southern Economics Association in November in San Antonio.
Just to review for anyone who did not read our original proposal, the NIMBY issues deals with siting issues in which external effects are "good" for some members of "society" and bad for others. If the debate over the alternate energy bio-mass facility in Tallahassee had not happened, people might have thought we were making things up if we had hypothesized a scenario. Different citizens with credentials as "environmentalists" ended up viewing the plant as either a "good" (because of the development of an alternative energy infrastructure with an eye to global issues of sustainability and global warning) or a "bad" (because of the local environmental effects). Examination of public goods provision problems in such a heterogeneous preferences situation is, by itself, opens a new direction for research in economics.
3) The undergraduate course (The Economics of Sustainable Energy) with Doug Norton has been approved by Economics Chair Bruce Benson for inclusion on the Spring 2010 schedule, MW 3:35-5:15. The course will be capped and set for "instructor" permission so that we can work on getting Engineering students into the course. Doug and I have met with Amy Chan-Hilton and our two undergraduate engineering major advisors regarding content and issues of "requirements satisfaction" for engineering majors. We have begun outlining early lectures, particularly those on the topic: "What exactly does the word 'sustainability' mean?"

4) IESES funded travel. Doug Norton and I traveled (with the grant paying part of the funds) to Guatemala in April. In addition to presenting previous but related work on the Association of Private Enterprise Economists, the trip allowed us to visit the ampus of and interact with faculty from Universidad Francisco Marroquin. We attended sessions at APEE on related topics that were composed entirely of economists from outside of North America. Since that visit, faculty at Francisco Marroquin have reiterated the possibilities of working jointly with our experimental social science research group. And, we met with an engineering student in Guatemala who works in the development area and discussed how issues of sustainability are impacting a developing country such as Guatemala.

	5) NSF DMUU grant. Last month, I submitted as PI a large (for the social sciences: tentatively $2,700,000+) NSF grant to the Decision Making Under Uncertainty Initiative. Several IESES-associated faculty (Chan-Hilton, Isaac, Norton, Pevnitskaya, and Ryvkin) are participating, as are several non-IESES faculty who nevertheless have research interests in this area. I have attached a copy of the "Project Description" to giveyou an idea of what a broad base of research we have going on in this area.
	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: • Conduct needs assessment of IESES 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 IESES 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 IESES, FESC researchers, and others in the state of Florida with the research information they need to accomplish statewide energy goals and to help IESES meet the thirteen objectives it has undertaken by providing access to research information. **Budget:** $194,542 **University: FSU** **Progress:** The project team designed the study to include five tasks: 1) gather background information pertaining to renewable energy research, 2) conduct needs assessment, 3) design and develop renewable energy web portal, 4) evaluate the renewable energy web portal, and 5) disseminate and publicize the renewable energy web portal. In the first six months of the project, the project team has completed the first task, and work on tasks 2 and 3 is ongoing. The project team will undertake evaluation, dissemination, and additional publicity in the next several months. Table 1 lists the tasks that have been completed to-date for each phase of the project. Table 1. Summary of Completed Activities by Task **Tasks** — **Activities** **Gather background (4/15/09 to 5/27/09)** — Review and refine project tasking Conduct literature review Create sampling frame **Conduct needs assessment** — Develop data collection instruments Survey deployment: recruitment letter mailed **(5/28/09 to Ongoing)** — Follow up emails requesting survey completion Expert interviews conducted **Design and develop** — Develop Beta versions of the portal and related applications **Web portal** — Begin collecting data to populate the project database **(4/15/09 to Ongoing)** — Begin collecting data to populate the event calendar

	Begin collecting content resources
	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. **Budget: $200,720** **University: FSU** **Progress:** Beginning in January 2009, our five member faculty team began meeting, with the addition of two quarter time doctoral graduate students funded by the grant; Jia Lu from Communication and Adam Keul from Geography. Laura Arpan and Jia Lu assembled an up to date literature review of research in the area of communication campaigns and environmental communication/persuasion. A summary of this work was presented to the group in late February 2009, with the goal of shaping the message strategy that would be emphasized in the PSAs. Arpan and Lu then went on to develop a survey questionnaire to be administered to a random sample of Florida residents. This survey data will serve as baseline data as we begin message testing specific PSAs. Data from the survey was collected in May 2009 and analysis of that data is on-going. In addition, Arpan established partnerships with the Yale Project on Climate Change and the Center for Climate Change Communication at George Mason University. These partnerships include data sharing and survey question collaboration. Based on the communication research aggregated by Arpan and Lu, Opel, Steinberg, France-Patterson, Weir, and Keul brainstormed PSA ideas resulting in over 20 potential PSA videos. This list was narrowed down to the top eight concepts through consultation with Arpan and Lu. Production plans were developed for each concept, including locations, costumes, cast, script, storyboards and props. Production plans included variations within each PSA that will allow for message testing in the fall of 2009. In May 2009, four PSAs were shot. In June, rough cuts of 3 PSAs were assembled. In July and August, two more PSAs were shot, with post production scheduled for September. **Deliverables** Power point presentation summarizing recent research on influencing audience attitudes and behavior. Three rough cuts of original PSAs. Three PSAs in production or post-production. Two PSA concepts in pre-production. Energy efficiency attitudes data from 400 person survey of Florida residents. **Scholarship** Andy Opel attended the Full Frame Documentary Film Festival in Durham, NC, April 2-6, 2009 where he took part in the Full Frame Fellows Program that connects filmmakers with producers, funders and distributors. Andy Opel presented rough cuts of two PSAs as well as some of our initial findings from the research literature at the Conference on Communication and the Environment, Portland, ME, June 27-30, 2009. **External Funding Initiatives** Opel, Arpan, and Steinberg have been in close contact with Scott Minos from the US Department of Energy over a proposed Center of Excellence in Energy Information and Communication. We have a revised draft of a proposal that we have developed with the assistance of Scott Minos and he recently circulated a white paper that will eventually serve as the basis for an RFP from the DOE. We also met with

	Chuck McClure and Chris Hinnant from the Information Institute in the College of Communication and Information and they have agreed to be active partners in pursuit of the CoE. Adam Keul developed a list of potential funding sources, ranked by applicability. From the list, we submitted a grant application to the Mazda Foundation for $25,000 in June. We have not heard anything back on this application.
	Title: Experimental Investigation of Economic Incentives of Policies, Institutions, and R&D in env. Conservation **PI:** Svetlana Pevnitskaya**, Co-PI:** Dmitry Ryvkin **Description:** The objective of this proposal is to identify key features determining investment behavior in renewable energy technologies and sensitivity of response to incentives and environment. The study will combine theoretical and experimental economics methods. We will provide analysis of efficiency of existing institutions and compare them to alternative mechanisms. In addition we will study some fundamental aspects of this dynamic decision-making problem. The deliverables will include: 1. A theoretical model and experimental design of an economic environment with dynamic and uncertain negative externalities. 2. A computer program and instructions for conducting experiments 3. A set of experimental sessions exploring the investment and adoption behavior in the absence of institutions and regulation 4. A set of experimental sessions exploring the effect of several regulatory institutions on the investment and adoption behavior 5. Analysis of experimental results and conclusions about the role and efficiency of different institutional designs. **Budget:** $43,217 **University: FSU** **Progress:** Our statement of work includes two major tasks. Task 1, scheduled to be completed by the end of the first year, serves as a foundation for the subsequent comparative study of institutions (Task 2) in year two. The goal of Task 1 is to design, implement, and test the baseline experimental environment of a global economy with climate change, within which the role of institutions will be assessed. At this point in time, six months into year one, we practically completed our research plan pertaining to Task 1, and even ran initial experiments within Task 2. The main questions we addressed in the first stage of the project are as follows. 1) Game theory and previous experimental research have shown that the behavior in dynamic games with a known *fixed end* differs from those where the *end is uncertain*. As uncertainty is critical to decision making under environmental change, we explored the role of uncertain end in our dynamic environment. We found the end-game effect of production and resulting pollution decisions that is different from the Nash equilibrium and Social Optimum predictions. 2) We studied the effect of heterogeneity in pollution, which is relevant to organizations with heterogeneous members, for example international treaties among countries with different levels of technological development. Heterogeneity was implemented via differences in pollution intensity of production. 3) We modeled the ability of firms to invest in clean technologies, resulting in endogenous rates of emissions. 4) We explored the role of values in economic decision making by framing the experiment in an environmental context. We find that subjects' decisions reflect some homegrown environmental values. The results provide a solid foundation for the direct test of the role of specific institutions in the investments in, and adoption of, sustainable technologies in a dynamic environment with climate change.

	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. **Budget:** $15,000 **University: FSU** **Progress:** None Reported
	Title: Planning Grant: Climate modeling and outreach activities **Principal Investigator:** Shawn R. Smith Co-PIs: Steve **Cocke, David Zierden, James O'Brien, Julie Harrington** **Project Description:** The objective of this proposal 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). **Budget: $15,000** **University: FSU** **Progress:** Over the first six months of the planning grant, the co-investigators have been assessing presently available information regarding off-shore wind power generation potential around Florida and in the Eastern Gulf of Mexico. According to previous research conducted by the Lawrence Berkeley National Laboratory and Navigant Consulting at the request of Florida's Public Service Commission, offshore wind has "large technical potential" in Florida, and certain sections off the northeast and northwest panhandle are economically sustainable. About 40,000 Megawatts (MW) of offshore power were identified, enough to power ~2.6 million homes and about four times the current installed capacity of wind energy in the U.S. Coastal wind (within 300 m of the coast) was also recognized as a marginally economically viable wind resource, with a potential power of 186 MW (~120,000 homes). However, this study and similar research have largely been based on climate data from land-surface and upper air meteorological observations, and little information is known about offshore wind power and its dependence on mesoscale processes or the impact of coastal circulations, like sea and land breezes, on coastal wind power. Taking advantage of COAPS expertise in marine climatology and our access to a number of off-shore observing sites, we believe we are in a good position to assess the potential for wind power in the offshore and near-shore regions around Florida. In particular, tower N7 – with a suite of weather instrumentation deployed by FSU as part of the Northern Gulf of Mexico Institute - is uniquely sited, and can collect wind measurements at a height similar to most standard offshore turbines. In Fall 2009, we initiated a pilot study that will examine the offshore climate data to compute the annual wind resource and its seasonal variability at a few select stations. We will compute the wind power density by summing the product of the air density and the cube of the hourly wind speed. The hourly wind speed is estimated at the turbine hub height so we will be using stability-dependent surface layer wind-height relationships that were developed by Prof. Mark Bourassa for the FSU marine flux program at COAPS. Once that is completed the next step will be to evaluate regional scale models to see how well they capture the wind climate at the station locations. If the pilot study shows potential based on selected stations, a fullscale study will be proposed to an appropriate state or federal agency. **Scope of effort:** The evaluation of offshore and near-shore wind power potential falls under one of the potential topic areas outlined in our IESES statement of work:

	Developing a high-resolution wind climatology for application to wind power generation Initial results for N7 indicate the potential to scale up to a full proposal. If possible, we will incorporate economic and environmental assessments, marine geospatial planning, and outreach components into the proposal. Determining the viability of offshore and near-shore wind power will target FESC and IESES goals to expand economic development in sustainable energy industry in Florida. The results will provide policy makers with essential information to determine which offshore regions are suitable for wind energy production. **Progress and plans:** To date the co-investigators have conducted the background research on wind power potential and available offshore wind products with the assistance of Dr. Mark Powell from NOAA's Atlantic Oceanographic and Marine Laboratory (currently stationed at COAPS). Dr. Powell is an unfunded collaborator with a broad interest in sustainable energy development. We have initiated the pilot study by employing an undergraduate meteorology student to assess the wind power potential at tower N7 in the northern Gulf of Mexico. A preliminary assessment of the hourly winds from N7 shows that sufficient wind exists for near-shore power generation in Apalachee Bay. We must confirm the results and conduct the comparison to available wind climatologies from models. This analysis will be complete by December 2009. Submission of a full proposal to develop improved offshore wind climatology will be developed and submitted in late 2009 or early 2010, once a suitable RFP is identified.
	Title: Visiting Law Professor **Principal Investigator:** JB Ruhl and Jim Rossi, **Co-PIs:** Uma Outka **Description:** The visiting law professor will conduct research and prepare a series of reports suitable for distribution to the Legislature and to Florida local governments on four topics: (1) Land use codes to identify provisions and practices that either facilitate or impede the location of renewable energy production facilities, etc. (2) Florida state and local government comprehensive plans, other policy statements, and land use litigation to identify the primary policy trade-offs associated with the location of renewable energy production facilities (3) Other states' government land use codes to identify "best practices" for facilitation of the location of renewable energy production facilities, with particular attention to how those best practices respond to the policy trade-offs (4) Then draft model local legislation designed to most effectively allow Florida local governments to facilitate the location of renewable energy production facilities and other innovative or new energy infrastructure consistent with State policy taking into account economic, social, environmental, and geographic variables. **Budget:** $214,603 **University: FSU** **Progress:** None Reported
Education and Outreach	
	Title: Florida Advanced Technological Education Center (FLATE) **PI:** Marilyn Barger **Students (name/degree sought): NA** **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. **Budget:** $300,000 **University:** Hillsborough Community College **External Collaborators:** Brevard Community College Tallahassee Community College Central Florida Community College Polk State 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 Florida State College at Jacksonville 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 **Progress:** Contract was fully executed, effective September 1, 2009. FLATE participated and hosted the following related events: 09/22/09 – poster presentation at USF-TECO "Energy Forum with US Senator Mel Martinez" (Tampa, FL) 12/08/08 – FLDOE Greenforce Florida Green Education Inventory Report Draft review (Tallahassee, FL) 02/06/09 – presentation at FESC Community College Summit (Gainesville, FL) 06/30/09 –hosted and participated in NSF ATE National Center for Energy and Environment (ATEEC) Regional Energy Conversation (Tampa, FL)
	Title: Outreach Activities for FESC **PI:** Pierce Jones **Students: NA** **Description:** The Program for Resource Efficient Communities (PREC) promotes the adoption of best design, construction and management practices that measurably reduce energy and water consumption and environmental degradation in new residential community developments. Our focus extends from lot level through site development to surrounding lands and ecological systems. We support the implementation of these practices through direct training education and consulting activities, applied research projects/case studies, and partnering with "green" certification programs. As the Energy Extension Service, and through the cooperation of the Extension offices in each county in Florida, we provide and deliver continuing

	education courses and associated certifications for professionals involved in the design, construction, and operation of residential community developments, including “Build Green & Profit” and “Low Impact Development (LID) Practices for Florida: Stormwater.” Through this network and with the assistance of our diversified faculty, we will deliver outreach activities for the Florida Energy Systems Consortium (FESC) in the areas of Energy/Climate Awareness Factsheets, demand side management programs, continuing education modules on applied energy efficient technologies, collaboration with demonstration houses throughout the state and alternatively fueled vehicle research and data collection. By working collaboratively with the FESC universities, we can help the citizens and communities of Florida make informed decisions on energy use and stimulate economic opportunities in the alternative energy and energy efficiency services sector. **Progress:** It is provided under EDUCATION & OUTREACH section of this report.

APPENDIX B – FUNDING OPPORTUNITIES DISTRIBUTED/POSTED

Title	Call #	Agency	Funding
Energy Innovation Hubs	NOT OUT YET	U.S. DOE	$135M per HUB – 5yr
Solar America Cities-Technical Outreach	DE-FOA-0000086	U.S. DOE/Golden Field Office	$10.5M ($500K-$6M); 1 Award; 2 Phases
Effects of Changing Transportation Energy Supplies and Alternative Fuel Sources on Transportation	NCHRP 20-83(04)	AASHTO	$1M
Low-Cost Lightweight Portable Photovoltaics (PoP) DARPA Proposers' Day Workshop	DARPA-SN-09-28	DARPA	Flexible
Survivability of Interdependent Systems and Components	DARPA-SN-09-69	DARPA	Flexible
Low-Cost Lightweight Portable Photovoltaics (PoP)	DARPA BAA09-45	DARPA	Flexible
N/MEMS S&T Fundamentals	DARPA-RA-09-42	DARPA/Microsystems Technology Offices	Flexible
Remoted Analog-to-Digital Converter with De-serialization and Reconstruction (RADER)	DARPA-BAA-09-51	DARPA: Microsystems Technology Offices	Flexible
Centers in Integrated Photonics Engineering Research (CIPhER)	DARPA-RA-09-35	DARPA: Microsystems Technology Offices	Flexible
Renewable Energy Feasibility Grants	RDBCP-09--REAP-FEASIBILITY	Department of Agriculture/Business and Cooperative programs	$0-$50K ($6M Total); 150 Awards
Fiscal Year 2010 Defense University Research Instrumentation Program (DURIP)	AFOSR-BAA-2009-5	Department of Defense	$40M ($50K-$1M); 200 Awards
Corrosion processes, control, mitigation, and technology	BAA-N00173-01: 61-09-04	Dept. of Navy/Naval Research Lab (NRL)	Flexible
Acquisition Research Program	NPS-BAA-09-02	DOD Office of Naval Research	$120K
Electronics Technology Grant	ONRBAA09-020	DoD Office of Naval Research	Flexible
Energy Innovations Small Grant Program for Natural Gas	09-01G	EISG/California Energy Commission	$95K for Hardware Projects and $50K for Modeling Projects
Indoor Environments: Reducing Public Exposure to Indoor Pollutants	EPA-OAR-ORIA-09-09	EPA	$12M to $20M for 4 years; 25 to 35 Awards
Clean Diesel Emerging Tech. Program		EPA	$20M for all

Advancing Public Health Protection through Water Infrastructure Sustainability	EPA-G2009-STAR-F1	EPA/STAR Program	$6M; 8 regular awards ($0-$600K), 4 early career projects ($0-$300K)
Doctoral Student Research Award		Government of Canada	up to $10K
Faculty Enrichment Program		Government of Canada	up to $6K
Research Grant Program		Government of Canada	up to $20K
Honda Initiation Grant (HIG) (under education)		HONDA	At least 5 grants at $50,000 each
BSF Call for proposals in Energy Research		Israel Binational Science Foundation	
Sea Level Rise Program	NOAA-NOS-NCCOS-2010-2001818	National Oceanic and Atmospheric Association	1 Award
Harmful Algal Bloom Program	NOAA-NOS-NCCOS-2010-2002063	National Oceanic and Atmospheric Association	Flexible
Climate Process and Modeling Teams (CPT)	NSF 09-568	NSF	$2.5M; 8-12 Awards
Developing Global Scientists and Engineers (International Research Experiences for Students and Doctoral Dissertation Enhancement Projects) Grant	NSF 04-036	NSF	$2.1M (Award Ceiling: $150K)
Undergraduate Research and Mentoring in the Biological Sciences Grant	NSF 06-591	NSF	$4M
NSF I/UCRC Program	NSF 09-565	NSF	Flexible
Integrative Graduate Education and Research Traineeship Program Grant	NSF 09-519	NSF	$10.8M
Centers for Chemical Innovation (CCI)	NSF 09-597	NSF	$7M-$14M; 4-8 Awards
NSF Major Research Instrumentation Program solicitation	NSF 09-561	NSF	Flexible
Academic Research Infrastructure Program: Recovery and Reinvestment (ARI-R²)	NSF 09-562	NSF	Flexible
NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM)	NSF 09-567	NSF	$50M-$70M (Awards will not exceed $600K); 80 to 100 Awards
Research Experiences for Undergraduates (REU) (under education)	NSF 09-598	NSF	$67.7M; 1800-1850 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
Emerging Frontiers in Research and Innovation 2010 (EFRI-2010)	NSF 09-606	NSF	$29M; 14 Awards

Science Master's Program (SMP)	NSF 09-607	NSF	$14.7M; 21 Awards
Building Engineered Complex Systems (BECS)	NSF 09-610	NSF	$4M; 12 to 20 Awards
Environmental Sustainability Grant	NSF PD 10-7643	NSF	Flexible
Power, Controls and Adaptive Networks	NSF PD 05-1518	NSF	Flexible
NSF: Robust electric power grids integrating power, communication and self-organizing networks	NSF PD 05-7564	NSF	Flexible
NSF: Globally Interactive Environment for Engineering Education	NSF PD 05-7564	NSF	Flexible
NSF- Sensors: Sensors and Sensing Systems (SSS)	NSF PD 08-1639	NSF	Flexible
Chemical Synthesis (SYN)	NSF PD 09-6878	NSF	Flexible
Chemical Catalysis (CAT)	NSF PD 09-6884	NSF	Flexible
Macromolecular, Supramolecular, and Nanochemistry (MSN)	NSF PD 09-6885	NSF	Flexible
Science of Science and Innovation Policy Grant	NSF PD 09-7626	NSF	$8M (Award Ceiling: $750K)
Interdisciplinary Research (IDR)	NSF PD 09-7951	NSF	$1M ($400K-$600K)
Energy for Sustainability Grant	NSF PD 10-7644	NSF	$100K
Catalysis and Biocatalysis Grant	NSF PD-10-1401	NSF	$100K
Thermal Transport Processes	NSF PD-10-1406	NSF	$100K
New Concepts in Energy Conversion and Power Management.	ONR BAA 09-038	Office of Naval Research	$2M per year/3-5 years
Multidisciplinary University Research Initiative (MURI)	BAA 10-002	Office of Naval Research	$222M (5 years); $1.5M max per year
Long Range Broad Agency Announcement (BAA) for Navy and Marine Corps Science & Technology	BAA-09-001	Office of Naval Research	Flexible
Solid Oxide Fuel Cell Tactical Electric Power Demonstration	ONR BAA 09-034	ONR/Office of Naval Research: Science & Technology	$9M
Scialog 2009: Solar Energy Conversion		Research Corp for Science Advancement	Individual Awards: $100K; Team Awards: $250K
US-China Clean Energy and Climate Partnership	USAID-RDMA-CHINA-486-09-031-RFA	Thailand USAID-Bangkok	$6M; 1 Award

ARRA/Recovery Act: Novel Materials and Device Development for High Efficiency Solar Photovoltaics	W911NF-07-R-0001-03-ARRA	U.S. Army	$3M for 2 awards
A--Efficient Powertrain Technologies (20 to 30 ton vehicle version)	TARBAATOPIC24	U.S. Army	$9.67M; 1 Award
ARRA/TRAINING AND EMPLOYMENT NOTICE	NO. 44-08	U.S. DEPARTMENT OF LABOR	$500M
ARRA/Recovery Act-Energy Training Partnership Grants	SGA-DFA-PY-08-18	U.S. DEPARTMENT OF LABOR	$100M($2M-$5M)
Request for Information (RFI) on performance, durability, and cost targets for fuel cells designed for Combined Heat and Power (CHP) and Auxiliary Power Unit (APU) applications	DE-FOA-0000111	U.S. DOE/Golden Field Office	NA
Algal Road-Mapping Request For Information (RFI)	DE-PS36-09GO39010-RFI	U.S. DOE/Golden Field Office	NA
Combined heat and Power Systems Technology Development and Demonstration	DE-FOA-0000016	U.S. DOE/NETL	$250K-$30M
Net-Zero Energy Commercial Building Initiative Supporting Consortium	DE-FOA-0000105	U.S. DOE/NETL	$1M (1 award)
Broadband Technology Opportunities Program	0660-ZA28	US Dept of Commerce	$1.6B (300 Awards)
State Broadband Data and Development Grant Program	0660-ZA29	US Dept of Commerce	$240M ($1.9M-$4.3M); 56 Awards
Computational Science Graduate Fellowships		US DOE	yearly stipend of $32,400
Advanced Synchro Phasor Research	DE-FOA-0000035	US DOE	$750K-$2.25M
ARRA/ARPA-E: Advanced Research Projects Agency – Energy	DE-FOA-0000065	US DOE	$2M to $5M
ARRA/Recovery Act: Energy Efficiency and Conservation Block Grant Program: Competitive Grants	DE-FOA-0000148	US DOE	Topic 1: 390.04M($5M-$75M), 8 to 20 Awards; Topic 2: $63.68M($1M-$5M), 15-60 Awards
PV Manufacturing Initiative	DE-FOA-0000153	US DOE	
ARRA/Recovery Act: Applications for Phase I SBIR/STTR Grants Annual Phase I Small Business Innovation Research (SBIR) Small Business Technology Transfer (STTR)	DE-PS02-09ER09-27	US DOE	$8.5M (Awarding Ceiling is $150K); 60 Awards

R&D of H2 Sensor Technologies	DE-PS36-09GO99004	US DOE	$1M
Industrial Technologies Program Save Energy Now Technical Assistance and Plant Assessment Program	DE-PS36-09GO99015	US DOE	$50M
Biomass Research and Development Initiative	DE-PS36-09GO99016	US DOE	$1 to $5M
Solar America Initiative (SAI) PV Technology Pre-Incubator	REU-9-99010	US DOE	
Recovery Act - Smart Grid Demonstrations	DE-FOA-0000036	US DOE	NA
Clean Energy Application Centers	DE-FOA-0000048	US DOE	$3M for 8 awards
ARRA/Recovery Act: (ARRA): Industrial Efficiency	DE-FOA-0000044	US DOE /NETL	$1M to $100M
Computational Materials Science Network (CMSN) Program		US DOE/Basic Energy Sciences, Division of Materials Sciences & Engineering	Funding for 3 years/Up to $320K per year
ARRA/Recovery Act: Solar Market Transformation	DE-FOA-0000078	US DOE/Golden fields office	$100K -$6M
ARRA/Recovery Act: High Penetration Solar Deployment	DE-FOA-0000085	US DOE/Golden fields office	$5M
ARRA/Recovery Act: Wind University-Industry R&D Consortium	DE-FOA-0000090	US DOE/Golden fields office	$8M-$12M ($24M total) 10% cost sharing; 2 Awards
Baseload Concentrating Solar Power Generation	DE-FOA-0000104	US DOE/Golden fields office	$15M; Topic 1: 3-6 Awards, Topic 2: 3-7 Awards
ARRA/Recovery Act: Energy Efficient Information and Communication Technology	DE-FOA-0000107	US DOE/Golden fields office	$50M ($0-$10M); 5-15 Awards
ARRA/Recovery Act: Geothermal Technologies Program	DE-FOA-0000109	US DOE/Golden fields office	$0-$5M ($170M Total); 60 Awards
Industrial Energy Efficiency Grand Challenge	DE-FOA-0000113	US DOE/Golden fields office	$15M ($100K-$300K); 50 Awards
ARRA/Recovery Act: Ground Source Heat Pumps	DE-FOA-0000116	US DOE/Golden fields office	$50M total ($0-$5M); 21 Awards
ARRA/Recovery Act: Hydoelectric Facility Modernization	DE-FOA-0000120	US DOE/Golden fields office	$32M($7M-$25M); Subtopic A (1-5 awards); Subtopic B (1-5 awards)
ARRA/Recovery Act: Community Renewable Energy Deployment	DE-FOA-0000122	US DOE/Golden fields office	$21.45M ($5M-$21.45M); 1-4 Awards

ARRA/Recovery Act: Development of Algal/Advanced Biofuels Consortia	DE-FOA-0000123	US DOE/Golden fields office	$85M; Topic 1: 1-2 Awards, Topic 2: 1
ARRA/Recovery Act: Funding for Expansion of Infrastructure for Higher Ethanol Blends	DE-FOA-0000125	US DOE/Golden fields office	$5.5M; Topic 1($50K-$200K), Topic 2($250K-$1M)
Next Generation Nuclear Plant Program-Gas Cooled Reactor Design and Demonstration Projects	DE-FOA-0000149	US DOE/Idaho Operations Office	$40M; 2 Awards
ARRA/Recovery Act: Carbon Capture and Sequestration from Industrial Sources and Innovative Concepts for Beneficial CO2 Use	DE-FOA-0000015	US DOE/NETL	Total for Phase 1 and 2 is $1,321,765,000
ARRA/Recovery Act: Geologic Sequestration Training and Research	DE-FOA-0000032	US DOE/NETL	$12.93M ($100K-$300K); 42 Awards
ARRA/Recovery Act: Site Characterization CO2 Storage	DE-FOA-0000033	US DOE/NETL	Minimum of 10 awards for total funding of $49.75M
AEEA/Recovery Act: Smart Grid Demonstration	DE-FOA-0000036	US DOE/NETL	$615M
ARRA/Recovery Act: Clean Coal Power Initiative - Round 3	DE-FOA-0000042	US DOE/NETL	$1.4B
ARRA/Recovery Act- Solid State Lighting Product Development Funding Opportunity-Round IV	DE-FOA-0000055	US DOE/NETL	$11.5M; 3 TO 7 Awards
ARRA/Recovery Act: Solid State Lighting U.S. Manufacturing-Round 1	DE-FOA-0000057	US DOE/NETL	$22M; 5-10 Awards
ARRA/Recovery Act: Resource Assessment and Interconnection-Level Transmission Analysis and Planning	DE-FOA-0000068	US DOE/NETL	$60M (6 Awards)
ARRA/Recovery Act - Systems Level Technology Development, Integration,and Demonstration for Efficient Class 8 Trucks (SuperTruck) and Advanced Technology Powertrains For Light-Duty Vehicles (ATP-LD)	DE-FOA-0000079	US DOE/NETL	$44M-$110M;11 Awards
ARRA/Recovery Act: Regional Sequestration Technology Training Grant	DE-FOA-0000080	US DOE/NETL	$500K-$995K (total $6.97M);7 Awards
ARRA/Recovery Act: Solid State Lighting Core Technologies Funding Opportunity-Round VI	DE-FOA-0000082	US DOE/NETL	$8M; 5-10 Awards
ARRA/Recovery Act: Enhancing State Government Energy Assurance Capabilities and Planning for Smart Grid Resiliency	DE-FOA-0000091	US DOE/NETL	$205,257 -$3,572,526 (total $39.5M); 56 Awards
ARRA/Recovery Act- Building America Energy Efficient Housing Partnerships	DE-FOA-0000099	US DOE/NETL	$2.5M-$31.25M (interest 1(2 to 3 awards); Interest 2(2 to 4 awards))

ARRA/Recovery Act: State Electricity Regulators Assistance	DE-FOA-0000100	US DOE/NETL	$46M ($763,577 to $1,686,869); 51 Awards
Novel Non-Precious Metal Hydrogen Separation and Production R&D	DE-FOA-0000103	US DOE/NETL	$5M for 5 Awards; 20% cost sharing
ARRA/Recovery Act: Advanced Energy Efficient Building Technologies	DE-FOA-0000115	US DOE/NETL	$25M-$75M; 45-90 Awards
ARRA/Recovery Act: Training Program Development for Commercial Building Equipment Technicians, Building Operators, and Energy Commissioning Agents/Auditors	DE-FOA-0000118	US DOE/NETL	$7.5M; 10-30 Awards
Bench-Scale and Slipstream Development and Testing of Post-Combustion Carbon Dioxide Capture and Separation Technology for Application to Existing Coal-Fired Power Plants	DE-FOA-0000131	US DOE/NETL	$55M; Bench Scale-$3M & Slipstream $15M (floor is $500K for both); Bench Scale: 3-8 Awards & Slipstream: 1-3 Awards
Support of Advanced Coal Research at U.S. Colleges and Universities	DE-FOA-0000146	US DOE/NETL	$2.041M (Ceiling-$300K); 6-7 Awards
ARRA/Smart Grid Investment Grant Program	DE-FOA-0000058	US DOE/Office of Electricity Delivery and Energy Reliability	$3.4B (Smaller projects $300K-$20M; Larger projects $20M-$200M)
Experimental Program to Stimulate Competitive Research (EPSCoR); Building EPSCoR-State/National Laboratory Partnerships	DE-PS02-09ER09-11	US DOE/Office of Science	$1.7M
Experimental Program to Stimulate Competitive Research (DOE-EPSCoR) Implementation Awards	DE-PS02-09ER09-12	US DOE/Office of Science	$1.7M; 2 Awards
Tropical Collaborations in Nuclear Theory	DE-PS02-09ER09-24	US DOE/Office of Science	
ARRA/Recovery Act: Early Career Research Program	DE-PS02-09ER09-26	US DOE/Office of Science	$25M; 30-50 Awards
Biological Systems Research on the Role of Microbial Communities in Carbon Cycling	DE-PS02-09ER09-25	US DOE/Office of Science/Office of Biological and Environmental Research	$12M
ARRA/ Recovery Act-Workforce Training for the Electric Power Sector	DE-FOA-0000152	US DOE/Richland Operations Office	$100M; Topic A: 25-35 Awards, Topic B: 15-20 Awards
Annual Notice Submission of Renewal and Supplemental Applications for Office of Science Grants and Cooperative Agreements	DE-PS02-09ER09-02	US DOE/Science and Technology	
Demonstration of Integrated Biorefinery Operations	DE-PS36-09GO99038	US DOE/USDA	$10 to $40M

Research Interests of the United States Air Force Academy	USAFA-BAA-2009-1	USAFA	Will not exceed $50M
New Era Rural Technology Competitive Grants Program (RTP)	USDA-CSREES-RTP-002295	USDA	$750K
TAT Water Resource Study Grant	RDUP-TAT-06-09	USDA (Utilities Program)	$500K (only 1 award)
National Integrated Water Quality Program	USDA-CSREES-ICGP-002324	USDA / CSREES	$12M total ($0-$660K); 15 Awards
Integrated Research, Education, and Extension Competitive Grants Program-Integrated Organic and Water Quality Program	CSREES-ICGP-002403	USDA/CSREES	$2.5M
RFP- Forest Restoration Activities on National Forest Systems Lands		USDA/Dept. of Agriculture/Forest Service	$4M($50K-$250K)

APPENDIX C – WHITE PAPERS

Focus	Summary
Education & Workforce	**Title:** Workforce Development: Retooling Florida's Workforce for a Sustainable Energy Future **PI:** Anne Donnelly (UF) **Description:** The proposed program is collaboration between community colleges, government agencies, and the SUS to prepare a workforce in several energy areas (weatherization, solar thermal and PV, nuclear, biorefineries). Focus is on currently unemployed and veterans. **Budget:** $2.2M **Universities:** UF, FIU, FAU, UCF, USF **External Collaborators:** FL utilities, Community Development Corp., Local and state government departments and agencies, Private sector auditing, Weatherization and remodeling businesses, Community Colleges, Banner Centers, FLATE.
Education & Workforce	**Title:** FIU and FAU's 21st Century Renewable Energy Workforce Development Program **PI:** Leonel E. Lagos (FIU) **Description:** This program will provide theoretical and practical training for those interested in designing, selecting, installing and maintaining PV, wind, and fuel cell technologies. **Budget:** $1.8M **Universities:** FIU, FAU **External Collaborators:** South Florida area PV companies and contractors
Education & Workforce	**Title:** 21st Century Advanced Biofuels Workforce Development Program **PI:** George Philippidis (FIU) **Description:** FIU and UF propose a curriculum of training courses in ethanol and biodiesel production (with internship opportunities at Florida biomass/bioenergy companies) to prepare the workforce required for this new industry. If funded, this will be the first biofuels/biomasscertificate program in Florida. **Budget:** $1.5M **Universities:** FIU, UF **External Collaborators:** A leading Florida biomass/bioenergy company and a leading Florida enzyme manufacturer.
Focus	**Summary**
Wind-resistant Construction	**Title:** Reviving and Modernizing Residential Construction in Florida through Hurricane-Resistant Green Building and Renewable Resource Technologies. **PI:** Forest Masters (UF) **Description:** This project will develop cost-effective high wind resistant solar and green building technologies for roof systems appropriate for coastal applications. The project team will designate a shared facility for training, testing, and documentation of roofing construction, then will transform this facility into a fully commercial business with fee-based product approval and evaluation tests. **Budget:** $1.3M **Universities:** UF **External Collaborators:** Modern Roofing Solutions, Sustainable Energy Systems, the Institute for Business and Home Safety, Honeywell, BASF, Florida utilities providers.
Efficiency	**Title:** Minimizing Duct Leakage Energy Waste in Florida Homes

	PI: James B. Cummings (UCF) **Description:** This project will document the extent of current duct leakage, document the effectiveness of duct repair programs, and train and certify AC contractors to fabricate duct systems in new homes. **Budget:** $1.26M **Universities:** UCF, UF **External Collaborators:** Pierce Jones (UF)
Zero Energy Community	**Title:** A Zero Energy Community for Central Florida **PI:** Stanley Russell (USF) **Description:** This project seeks to stimulate Florida's stagnant housing market and add jobs with an innovative zero energy community of about 100 units in Central Florida. **Budget:** $10M **Universities:** USF **External Collaborators:** Florida residential developers, Florida home builders, Florida utilities industry, clean energy industry, FSEC, Department of Energy "Building America" program.
Algae	**Title:** Research & Development of Bioenergy Alternatives from Marine/ Aquatic Algae **PI:** Joel E. Kostka (FSU) **Description:** The proposed project will blend fundamental and applied research with technology deployment. It is proposed to establish an R&D consortium spearheaded by FSU, UF, and FIU that will focus on the development of bioenergy products from photosynthetic algae. **Budget:** $25M **Universities:** FSU, UF, FIU **External Collaborators:** Oak Ridge National laboratory, U.S. DOE Bioenergy Science Center, Midwest Research Institute, National Renewable Energy Laboratory.
Biofuel	**Title:** Cellulosic Ethanol Pilot and Demonstration Plant **PI:** Lonnie O. Ingram (UF) **Description:** The goal of this facility is to develop enabling US technology that creates jobs in rural and agricultural areas of Florida by facilitating the deployment of commercial plants for biomass-based fuels and chemicals. The ethanol demonstration plant will provide a platform for all ethanol related R&D in Florida and for the training of a professional workforce. **Budget:** $20M **Universities:** UF, FIU **External Collaborators:** Verenium, Buckeye Technologies, Inc., BioEnergy Int., FL Crystals Corp.
Biogas and Fuel Cell	**Title:** Achieving Energy Independence by Development of >100mpg Biofuel Fuel Cell Plug-in Hybrid Cars **PI:** Eric Wachsman (UF) **Description:** Addresses Florida's transportation needs by utilizing renewable energy resources with advanced fuel cells (FCs) and Li-Ion batteries. Commercialization of the technologies will create 800 jobs. **Budget:** $20M **Universities:** UF, UCF. USF **External Collaborators:** Lynntech, Solid-State Energy & Technology, Inc. Planar Energy Devices, Inc.

Focus	Summary
Biomass	**Title:** Production of Power and Clean Liquid Fuels from Florida Grown Biomass Using Solar Energy Source (Demonstration) **PI:** B. Joseph, J. Wolan, Y. Goswami, (USF) **Description:** Demonstrate viability of a thermochemical process for converting 40 tons of Florida grown biomass to 2000 gal of clean burning liquid fuel and 30,000 kWh of power on a daily basis. **Budget:** $30M **Universities:** USF, UF, UCF **External Collaborators:** Prado and Associates, Inc., FL Turbine Tech., Inc., FPL, Nu-Power Technology, LLC., Sunborne Co., Aqua Fiber Technologies, Corp.
Biomass	**Title:** Gasification and Gas Turbine Based Biomass and Waste to Power System **PI:** William E. Lear (UF) **Description:** This project aims to apply Florida's abundant biomass resources toward development of high-temperature gasification and a novel quad-generation power plant called the Power, Water Extraction, and Refrigeration (PoWER) distributed energy system. If implemented, a network of such systems would dramatically increase the efficiency of biomass utilization. The project would create a short-term workforce increase for the design, manufacture, and support of these systems, and would facilitate Florida's long-term transition to a sustainable energy economy. **Budget: $**28M **Universities:** UF **External Collaborators:** Florida Turbine Technologies, Inc.; Florida Power & Light
Biomass	**Title:** Production of Clean Fuels from Florida Biomass via Thermochemical Conversion **PI:** Yogi Goswami (USF) **Description:** The objective of this project is to build and demonstrate a thermochemical process for converting 20 tons/day of Florida biomass to approximately 2000 gal/day of clean burning liquid fuel. **Budget:** $12M **Universities:** USF **External Collaborators:** Prado and Associates, Inc., Tampa, FL
Biomass	**Title:** Florida Bio-Energy Industry Development **PI:** Ali T-Raissi (UCF) **Description:** This project aims to produce liquid hydrocarbon fuels derived from Florida-grown biomass using a novel process that is significantly more efficient than conventional methods. The success of this project will directly benefit farmers employing readily available farm residues for generating liquid fuels and a valuable carbon-rich char that can be used for power generation in a carbon fuel cell or used directly as soil enhancing material. **Budget:** $2.4M **Universities:** UCF, UF, FSU, USF **External Collaborators:** UF (Lonnie Ingram, William Lear), FSU (Anjane Krothapalli), USF (Babu Joseph)
Biomass	**Title:** Low Cost Technology for Cellulosic Ethanol Production from Waste Biomass **PI:** Henry Daniell (UCF) **Description:** This project aims to take advantage of the latest patented UCF research in hydrolytic enzymes to develop an efficient and low-cost enzyme production

	system to yield fermentable sugars from waste biomass. **Budget:** $5.5M **Universities:** UCF, UF **External Collaborators:** POET, KL Energy
CSP Demonstration	**Title:** Design, Construction and Operation of CSP Solar Thermal Power Plants in Florida **PI:** Yogi Goswami (USF) **Description:** The demonstration proposal entails the design, construction and operation of 10 MW of several CSP solar thermal plants utilizing the parabolic trough technology on state university campuses in Florida. These plants will not only provide power and hydrogen to the campuses, but will also provide research sites for introducing innovations being developed in FESC. They will also be used for training of the work force and for transferring technologies to the industry. It is anticipated that 10,000 jobs will be created permanently in the State after the third year. **Budget:** $8M for one site, $5M for each additional site **Universities:** USF, UF, UCF **External Collaborators:** Sun Borne, Inc., Boston, MA, Eliosol Engineering, Raleigh, NC, FPL Energy, Juno Beach, Florida
PV Systems Integration	**Title:** PV Energy Conversion and System Integration **PI:** John Shen (UCF) **Description:** This project aims to reduce the cost of the balance of systems for PV installations and better enable its insertion into Smart Grids by integrating energy conversion and grid sensing functions into several miniature modules. **Budget:** $5M **Universities:** UCF, UF External Collaborators: **BP Solar, Petra Solar, City of Tavares**
Rectenna Technology	**Title:** Beyond Photovoltaics: Productionizing of Rectenna Technology for Conversion of Solar Radiation to Electrical Energy **PI:** Shekhar Bhansali (USF) **Description:** This project focuses on the commercialization and production scale-up of rectenna technology that can be used to convert waste heat energy to electricity. Conversion efficiency for rectenna technology approaches 80%, can potentially absorb the entire solar spectrum, and can harvest ambient radiation, enabling electricity generation 24 hours per day. Advances in materials science and nanotechnology support a manufacturing cost structure that could reduce the present solar cost of production from $/watt to ¢/yard of flexible solar panels. This proprietary and patented technology has the potential to fundamentally change the solar photovoltaic power market. **Budget:** $24M **Universities:** USF **External Collaborators:** BGS Technologies, CA
PV Manufacturing	**Title:** Solar Photovoltaic Manufacturing Facility to Enable a Significant Manufacturing Enterprise within the State and Provide Clean Renewable energy **PI:** Don L. Morel (USF) **Description:** The primary goal of this project is to enable the establishment and success of local solar photovoltaic manufacturing companies to produce clean energy products for use within the state and beyond and to generate jobs and the skilled workforce needed for them. Thin film technologies have shown record efficiencies of 15.8%, 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:** $14.5M **Universities:** UF **External Collaborators:** NovaRay Solar, Bedford, MA; Brightwats, Inc., Ft. Lauderdale, FL; US Department of Energy, National Renewable Energy Lab
PV	**Title:** Development of a Scalable Bottom-Up Nanomanufacturing Platform for Photon Management and Highly Efficient Photovoltaics **PI:** Peng Jiang (UF) **Description:** This project aims to develop a robust bottom-up nanomanufacturing platform to enable inexpensive and more efficient crystalline silicon solar cells that dominate the production of PV panels. **Budget:** $100K **Universities:** UF **External Collaborators:** Hewlett-Packard Laboratories (Information Surface Lab), REC Group (Oslo, Norway), Nano Terra (Cambridge, MA), Rohm & Haas Electronic Materials (Newark, DE), and Corning, Inc. (Corning, NY)
PV	**Title:** Test Bed for Advanced Photovoltaic Systems and Components **PI:** Gobind Atmaram (UCF) **Description:** The overall project goal is to develop fully integrated, high performance, optimized and cost effective photovoltaic (PV) system designs through the development of test beds. The test beds will be used for evaluating and monitoring the performance of individual components, subsystems and fully integrated and optimized systems. The test beds will also be used for training of students and apprentices for evaluation of different and varying system configurations. **Budget:** $600K **Universities:** UCF **External Collaborators:** NA
CIGS	**Title:** Development of a High Throughput CIGS **PI:** Neelkanth Dhere (FSEC) **Description:** The goal of this project is attract the PV industry to Florida by demonstrating a high-rate manufacturing process for CuInxGa1-xSe (CIGS) solar cells. The objective is to develop a high-rate deposition process for synthesis of CIGS absorbers. In partnership with industry, this development would serve as the cornerstone for growth of a large-area and fully integrated PV system. **Budget:** $1M **Universities:** UCF **External Collaborators:** PV Integrated, Inc. (PVI)
PV	**Title:** PV Solar System Design and Construction at the University of Florida **PI:** Panos Pardalos (UF) **Description:** This initiative uses state of the art solar photovoltaic technology that can be installed immediately in the rooftops of the University of Florida buildings, for power generation. A technically and economically viable photovoltaic system will be designed, modeled and installed. The commercialization of such a technology is immediate since all components already exist in the market. Hence there will be no time lag for the creation of jobs, prototypes and system tests.

	Budget: $44M **Universities:** UF **External Collaborators:** EST-America (Gainesville)
Focus	**Summary**
Power	**Title:** Development of GaN High Power Devices for Renewable Energy Efficiency Applications **PI:** Fan Ren (UF) **Description:** To develop GaN high power device technology for renewable energy and energy efficiency applications. **Budget:** TBD **Universities:** UF, UCF **External Collaborators:** NA
Solar Cell Balloon	**Title:** Harvest Energy Using Flexible Solar Cell Balloon **PI:** Kurt Lin (UCF) **Description:** This research studies the feasibility of "solar balloon". **Budget:** $200K **Universities:** UCF **External Collaborators:** NA
Carbon Sequestration	**Title:** Creation of Carbon Sequestration Data, Technologies and Professional Cohorts for Florida **PI:** Mark Stewart (USF) **Description:** This project seeks to increase the ability of Florida utilities to economically capture and sequester carbon dioxide so that they can use coal as an energy alternative. **Budget:** $6.75M **Universities:** USF **External Collaborators:** Tampa Electric; Florida Power & Light; ECT, Inc.
Ocean Energy	**Title:** Center for Ocean Energy Technology **PI:** R. Frederick Driscoll (FAU) **Description:** The Center of Excellence in Ocean Energy Technology (COET) is established to be the catalyst that will enable and propel the ocean energy industry in Florida towards a major economic sector answering Florida's energy challenge by providing clean renewable energy that is secure, stable, reliable, diverse, of low environmental impact, and adequate. The Center will be the world's pre-eminent location for both ocean current and thermal energy research, and technology development, to bridge the gap between concept and commercial deployment of ocean energy technologies. **Budget:** $2M **Universities:** FAU **External Collaborators:** National Renewable Energy Laboratory, Heriot-Watt University (UK), University of Edinburgh (UK), New Renewable Energy Laboratory (UK), Florida Power & Light, Aquantis (a subsidiary of Clipper Windpower)
Microgrid	**Title:** Establishing an Efficient and Reliable Energy Delivery Infrastructure w/ Attention to Governance, Economics, and Decision Making **PI:** David A. Cartes (FSU) **Description:** Utilization of existing and planned communities as in situ test beds to demonstrate how Florida can benefit from Smart Grid technologies that enables clean energy, distributed green generation, improved grid and home efficiency, and automated energy conservation. This will create a market for grid connected distribution level and residential level renewable energy sources, such as solar and

	wind technologies, as well as alternative energy, such as ethanol and hydrogen. In addition, will provide resilient grid system and reduce GHG emissions. **Budget:** $34M **Universities:** FSU,USF, UF, UNF **External Collaborators:** JEA, Progress Energy, Florida Power & Light, Publix, and Siemens T&D.
Power	**Title:** Green Super Capacitors as Next-Generation Power Supplies **PI:** Xun Gong (UCF) **Description:** This project seeks to address the energy needs of all-electric vehicles by developing high-energy-density capacitors (Super Capacitors) that can address the need of both high energy density and high power density. **Budget:** $3.99M **Universities:** UCF, UF, USF, FSU **External Collaborators:** UF (Supercapacitor), USF (Clean Energy Research Center), FSU (Supercapacitor andFuel Cell Hybrid)
Batteries	**Title:** Revolutionary Paths to Save and High Energy Lithium Ion Batteries for PHEV **PI:** Shirley Meng (UF) **Description:** The ultimate goal of the proposed work is the construction of rechargeable battery packs that can deliver energy density 500Wh/kg (current technology limited to about 100-125Wh/kg). Such a new advanced vehicle battery system will enable the plug-in hybrid vehicles (PHEV) with more than 100mpg performance. **Budget:** $4M **Universities:** UF **External Collaborators:** NEI Corporation, Planar Energy Device
Broadband	**Title:** Broadband over Power Lines for Internet Distribution to Rural Communities and Smart Grid Applications **PI:** John Shea (UF) **Description:** This proposal creates the partnerships and technology to enable BPL (broadband over power lines) for rural broadband distribution and smart grid operation. **Budget:** $20M **Universities:** UF **External Collaborators:** Intellon, Inc., CURRENT Group, LLC
Energy Security	**Title:** Center or Excellence in Energy Systems Security **PI:** TBD **Description:** The FESC/SAIC/Benham team proposes to form a joint venture to design, build, finance and operate alternative energy programs and infrastructure to provide secure and economical electric power to federal facilities, principally DoD and DOE installations. **Budget:** TBD **Universities:** TBD **External Collaborators:** Science Applications International Corporations (SAIC), The Behnam Companies
Policy	**Title:** A Policy Analysis Tool for Implementation of Microgrids in the National Electricity Infrastructure **PI:** Tapas Das (USF) **Description:** The goal of this research project is to develop a systems modeling framework for policy analysis from which decision makers can derive optimal

	federal investment strategies and incentive schemes for microgrids. **Budget:** $2M **Universities:** USF **External Collaborators:** Argonne National Laboratory (Dr. Audun Botterud), Iowa State University (Dr. Leigh Tesfatsion)
Sustainability	**Title:** Life-Cycle Effects of Expanding Bioenergy Production on Land and Water in Florida **PI:** Matthew Cohen (UF) **Description:** To develop a framework coupling life cycle analysis (LCA) and integrated decision making (equilibrium economic modeling, multi-criteria decision analysis). **Budget:** $5M **Universities:** UF, FSU **External Collaborators:** UGA, USDA-ARS
Wind Turbine	**Title:** A Novel Wind Turbine Development with Frictionless Bearing **PI:** Chan Ham (UCF) **Description:** This proposal applies Genetic Algorithms (GA) to model wind turbine design. **Budget:** TBD **Universities:** UCF **External Collaborators:** NA
Wind Turbine	**Title:** Development of Frictionless Magnetic Bearing Systems for Energy Production and Storage **PI:** Chan Ham (UCF) **Description:** This proposal seeks to study a new class of passive and active magnetic bearings and develop prototype systems applicable to wind turbine and flywheel energy storage. **Budget:** $225K **Universities:** UCF **External Collaborators:** NA

APPENDIX D – FESC TECH COMMERCIALIZATION PHASE I RFP

FESC Technology Commercialization Program - Phase I RFP

The Florida Energy Systems Consortium (FESC - www.floridaenergy.ufl.edu) was created in 2008 by Florida statue to promote collaboration among the energy experts at Florida's 11 state universities for the purposes of sharing energy-related expertise and assisting in the development and implementation of a comprehensive energy strategic plan for the state. The Consortium was charged with performing research and development on innovative energy systems that lead to alternative energy strategies, improved energy efficiencies, and expanded economic development for the state. To kick off this program, the legislature provided approximately $38M for energy research, education, outreach, and technology commercialization programs.

FESC has a limited amount of funding for industrial collaboration and technology transfer. A two-phase program has been designed that works collaboratively with and in support of the SUS technology transfer offices.

Phase I (Commencing August 2009)
FESC intends to work with the SUS technology transfer offices to identify energy related technologies with commercial potential from across all SUS universities for two purposes:

1. FESC will be building a statewide database of energy related technologies that FESC can co-promote with the universities to industry in Florida and beyond, including packaging technologies across multiple Florida universities as it makes sense
2. FESC will be funding development of business plans, market analyses, and industry/investor presentations of a subset of these energy related technologies to prepare commercialization packages and identify commercialization partners who might provide development funding and license the technologies. FESC envisions providing up to $100K total support to prepare up to 15 of these packages ($7.5K per package) as described below.

Phase 2 (Anticipated to Commence Spring 2010)
FESC anticipates providing matching funds to industry sponsored research of energy related technologies in the SUS universities. The intent is to follow the Florida High Tech Corridor Council Matching Grants Research Program model wherein FESC will provide funding to match industry sponsored research of energy related projects in our universities. This will be a competitive program and FESC envisions providing up to 5 awards of up to $50K. FESC funds will be combined with industry sponsored funding, all of which will be directed towards development of energy research programs in the universities. FESC anticipates releasing a Phase 2 RFP with further details in Spring 2010.

RFP – Phase I

Each SUS Technology Transfer Office is invited to submit a Phase I proposal package including up to six energy-related technologies that the office feels have substantial commercial potential. Energy related technologies may include, but are not limited to bio-energy, solar energy, energy efficiency and conservation, nuclear energy, ocean energy, carbon capture and sequestration, energy storage and delivery including microgrid/smartgrid applications, and energy systems/management. Rather than dictate a common submission format, descriptions of individual technologies are invited in whatever reasonable format is readily available to the technology transfer offices (e.g., invention disclosures, technology overviews, market overviews), with a 10 page limit per technology. Applicants should provide sufficient information pertaining to each technology to allow reviewers to grasp the essential elements of the

technology, development stage, and potential market applications. FESC may request more information for a technology if necessary after initial review. Confidential information should not be included.

SUS Technology Transfer Offices are asked to provide guidance to FESC on what actions would be most helpful to move each submitted technology toward commercialization. This may include creation of a summary business plan, abbreviated market analysis, investor presentation, or introductions to potential development partners and licensees.

The Phase I program objective is to assist the SUS universities in attracting further development funding and in identifying licensees for commercialization of high potential energy technologies. Experience has shown that entrepreneurs or investors that are engaged to review university technologies will sometimes act as a future source of development funds and license the technology for commercialization. As such, Technology Transfer Offices are invited to suggest groups or individuals (e.g., entrepreneurs, private or public companies, university business programs) that might perform the business plans or market studies for their technologies. FESC reserves the right to utilize these groups or others as it sees fit.

FESC will organize a review process and committee to identify up to 15 of the submitted technologies for FESC funding of up to $7.5K each for summary business plans, abbreviated market analyses, or investor presentations. FESC will also attempt to identify industrial contacts that may have an interest in submitted technologies.

Proposal packages are encouraged to be submitted by E-mail to FESC Associate Director Erik Sander at esander@ufl.edu by August 25. FESC will review technologies based on criteria such as near term commercial potential, potential for further development funding, commercialization impact to the state of Florida, significance of abbreviated business plans/market analyses to the university's ability to attract development funds and licensees. It is anticipated that FESC will advise universities of the results of the review process by September 15th.

Questions can be directed to Erik at 352-392-0947 or the above E-mail address.

APPENDIX E - FESC BOARD OF ADVISORS CHARTER

Section 1. Background

The Florida Energy Systems Consortium (FESC) was formed by Florida statue to promote collaboration among the energy experts at the 11 State University System (SUS) universities for the purposes of sharing energy-related expertise and assisting in the development and implementation of a comprehensive, long-term, environmentally compatible, sustainable, and efficient energy strategic plan for the state. The Consortium was charged to 'perform research and development on innovative energy systems that lead to alternative energy strategies, improved energy efficiencies, and expanded economic development for the state'. Importantly, the legislature appropriated funds for a one-time investment in research at five of the SUS universities as well as support for education, outreach, and technology transfer. The Consortium is thus positioned to work with the Florida Energy and Climate Commission (FECC) to assist in developing and implementing the State's energy agenda.

The SUS has considerable energy-related expertise and competitively funded research, but very little research is being directed at integration. The FESC research plan is thus based on the premise that the overarching energy-related research and innovation opportunities are at the systems level. The Consortium not only aggregates Florida's energy research expertise to leverage its value, but also enables the broad systems approach necessary to provide pathways to meet the State's energy needs. Six additional strategic research thrusts have been identified. The Consortium will focus on the use of its two most abundant renewable energy resources (biomass and solar), carbon-free electric power generation (nuclear power, carbon sequestration), tapping the energy available from the ocean along our long and populated coastline, reducing consumption through energy conservation and improved efficiency, and defining more efficient load management and energy storage systems.

Strategically, FESC has formed an enterprise to bring together the SUS experts to specifically focus on a systems approach with the governing bodies of the State as the primary customer. It is our vision that this enterprise will be the objective resource for the State for information and analysis to guide energy-related governance decisions. Both selected and recurring analyses will be performed to better understand our energy infrastructure.

The broader FESC research agenda will target barriers to commercialization of energy systems, thus leading to economic impact. At the same time, FESC aims to establish several research areas in which our researchers are recognized as world leaders.

Education and outreach are critical components of our mission. FESC will strategically focus on workforce preparation for the Florida existing and emerging energy industry. Specifically, FESC will team with the Community College system to provide training at the technical level, while advanced degrees will be developed at the university level. Both programs will make use of distance delivery. The outreach component will focus on implementing energy efficiency. This program will use the university extension system as well as other venues to reach out the residents of the State to inform them of approaches to decrease their energy consumption. FESC will also develop training centers to work with builders and urban planners to implement energy efficient living and work spaces.

Section 2. Need

FESC must be creative in developing external support mechanisms and means to guide the Consortium's research, education, outreach, industrial collaboration, and technology commercialization programs. A

Board of Advisors ("Board of Advisors" or "Board") is a useful and beneficial means of furnishing expert advice, ideas and diverse opinions to FESC's leadership and researchers. As an SUS-wide consortium, FESC will benefit from a working group of Advisors comprised of prominent, senior level individuals who broaden FESC's resource base, and who can help guide the Consortium's strategy and direction.

Section 3. Scope of Activity

Advisors will be expected to facilitate strong networking relationships with top level executives, government officials, academic leaders and respected investors, and provide appropriate strategic and operational advice. Some of the areas where advisory participation is envisioned include:

- **Domain Expertise –** i.e. skills and experience in the energy industry and technology areas in which FESC targets for research, education, outreach, industrial collaboration, and technology commercialization activities
- **Strategic Alliances** - i.e. partnering with FESC researchers and leadership in research, education, outreach, industrial collaboration, and technology commercialization activities
- **Contacts and Networking** - i.e. third party endorsements, introductions, making themselves available to attend meetings on behalf of FESC when appropriate
- **Funding** - i.e. introductions to world class venture firms and potential investors in FESC research and technology commercialization, including federal and state government energy and climate funding programs
- **Public Relations** - i.e. helping to raise FESC's profile and visibility in Florida, nationally, and internationally
- **Evaluating** – i.e. assessing FESC progress and plans in research, education, outreach, industrial collaboration, and technology commercialization activities

Section 4. Purpose and Limit of Liability

The purpose of the FESC Board of Advisors will be to provide advice, recommendations and guidance to the FESC Director, Associate Directors, and Steering Committee (Leadership Team) related to Consortium and State of Florida energy related goals and strategy. Advice and recommendations may include strategic direction, operations, infrastructure, national and state funding programs, private sector development direction or other matters felt to be generally relevant to the development and growth of FESC and the State of Florida energy programs and resources.

The Board of Advisors shall function solely as an advisory body and, as such, will assume no legal liability for decisions reached by FESC. Accordingly, there will be no conclusions reached or decisions made on behalf FESC at any official and or unofficial meetings of the Board of Advisors, as the sole purpose of these meetings is to dispense advice to independently empower FESC leadership in making decisions on behalf of the Consortium.

Section 5. Membership

Section 5.1 Appointment

Nominations of Advisors may be made by any member of the FESC Leadership Team (Director, Associate Directors, Steering Committee Members) or a sitting member of the Board of Advisors during any regular meeting of the Board of Advisors. The person nominating an Advisor will be responsible for aggregating background material and presenting the candidate to the Leadership Team and Board of Advisors for consideration. Examples of background material may include, but is not limited to, candidate's bios, examples of articles or papers they have written, URL's, and input and recommendations from the Leadership Team, and other Board of Advisor members. All nominations will be discussed

among the Leadership Team and Board of Advisors for fit with the Board of Advisors Charter and FESC needs. The Board of Advisors and Leadership Team will provide recommendations to the FESC Director for new Board of Advisors members. The FESC Director will have sole responsibility for approval and appointment of all Board of Advisors members.

Advisors will be appointed to 3-year terms. At the discretion of the FESC Director, in consultation with the Board of Advisors and Leadership Team, Advisors may be re-appointed for an unlimited number of subsequent 3-year terms.

Charter Advisors will be appointed to three, four or five year terms at the outset of the board's formation in order to allow an orderly transition of no more than approximately one third of the Board of Advisors in any given year. Charter Advisors may be reappointed by the FESC leadership as indicated above.

Section 5.2 Board Composition

Advisors will be prominent, senior level individuals whose expertise, advice and counsel will be focused on FESC goals, priorities and strategy, and help broaden FESC's network of senior level contacts. Advisors will include representatives from the following strategic regimes:

- Energy Company and Government Lab R&D Administration
- Government Energy Policy
- Academic Energy Research, Education and Commercialization
- Energy Technology Management and Commercialization
- Energy Technology Finance / Investment Community

In addition to external members, the FESC Director will serve as a member of the Board of Advisors. One-half of the membership of the Board will constitute a quorum of the Board.

Section 5.3 Board Leadership

Chair: The Board of Advisors Chair will have all general powers and duties which are generally vested in the office of the Chair, including the power to make appointments to committees from time to time as in his/her discretion may be deemed appropriate to assist in the conduct of the affairs of the committees. The Chair will serve as Chair/Facilitator of meetings of the Board of Advisors, act on behalf of, and represent the Board of Advisors as necessary. Responsibilities of the Chair will include but not be limited to:

- Reporting on Consortium progress and actions of interest to Advisors.
- Keeping Advisors informed of the latest developments, issues and initiatives in the Consortium via meetings, email and by phone.
- Aggregating and providing Board of Advisor recommendations and comments to the FESC Leadership Team.
- Meeting with Advisors individually when needed.
- Planning and facilitating meetings of the Board of Advisors.
- Acting as Point of Contact for the Board of Advisors and assisting with requests for advice and/or action by the FESC Director.

Vice Chair: The Board of Advisors Vice Chair shall be the second officer in the chain of command, and shall accept and perform the duties and exercise the power of the Chair in his/her absence. The Vice Chair shall also perform the duties incident to his/her office, as may be determined by the FESC Director or Board of Advisors Chair.

Executive Committee: In order to facilitate continuous communication with the Board of Advisors, the FESC Director, at his/her sole discretion, may form or dissolve an Executive Committee as a subset of the Board of Advisors. The Executive Committee will consist of the Chair, Vice Chair, and 4-8 other members of the Board of Advisors, as elected by the members of the Board of Advisors. The Executive Committee will meet monthly by telecon with the FESC Leadership Team to discuss issues of importance to FESC. The Executive Committee will have all of the authority of the Board of Advisors. Every member of the Committee in good standing will be entitled to one vote on any issue brought to the Committee and for which the Chair calls for a vote. Proxy voting will not be permitted. One-half of the membership of the Committee shall constitute a quorum of the Committee.

Term of Office: The Chair and Vice Chair will be elected annually by the Board of Advisors for a period of one year or until their successors have been duly elected. The Chair and Vice Chair will serve at the pleasure of the Board of Advisors and may be removed at any Board of Advisors meeting by a majority vote of the sitting members of the Board. New members of the Executive Committee will be elected by the Board members by a majority vote of those Advisors present at a regular meeting of the Board, with at least a quorum present. Executive Committee members will hold office for a term concurrent with their term of Board membership. Any member of the Executive Committee may resign at any time by giving written notice to the Chair. Any such resignation will take effect at the time specified therein or upon acceptance by the Executive Committee, whichever occurs earlier. The other members of the Committee, by majority vote at any meeting of the Committee at which a quorum is present, may remove from office a member of the Committee with or without cause whenever it is deemed in the best interests of FESC.

Section 5.4 Vacancies

Members are appointed to the Board and Executive Committee as individuals rather than as representatives of organizations. As such, vacancy appointments of members may be filled for the remainder of the unexpired term of the vacancy at the discretion of and upon the agreement of the FESC Director and Board of Advisors Chair.

Section 5.5 Compensation and Expenses

FESC will not be able to provide Advisors with compensation for their services or expenses associated with service on the FESC Board of Advisors.

Section 5.6 Resignation

Any Board of Advisors member may resign by delivering 30 days written notice to the Board of Advisors Chair. Any such resignation will take effect at the time specified therein or upon acceptance by the Chair, whichever occurs later.

Section 6. Advisor Responsibilities and Expectations

Section 6.1 Methods of Interaction

FESC recognizes that Advisors will take valuable time from their busy schedules to provide guidance and support. Therefore, FESC will make every attempt to keep each Advisor's total time that is dedicated to FESC to an average of 4-8 hours per month throughout a given year. Advisors will be expected to contribute their time to FESC primarily through four means:

1) Two semi-annual board meetings held at a FESC associated university location
2) Two additional quarterly board conference calls
3) Individual consultation at the request of FESC leadership in areas of expertise of the individual Advisor as situations arise where the Advisor can add specific value
4) Special telecons / meetings of all or part of the Board of Advisors that may be called to address specific issues or opportunities.

Additionally, Executive Committee members will be expected to participate in monthly telecons with the FESC Leadership Team. The Chair and Vice Chair may be called upon to provide further time in support of their duties.

Advisors may interact in a variety of ways depending upon their personal availability, scheduling and area of expertise. The following are examples of, but not limited to, what an Advisor could provide assistance to FESC:

- Provide guidance to FESC research, education, outreach, industrial collaboration, and/or technology commercialization programs
- Provide guidance and insight on energy policy and strategic direction which may affect FESC programs
- Provide expertise to help vet energy related technology opportunities which FESC is considering for commercialization, either through personal knowledge or industry contacts
- Provide insight into critical energy research and technology management trends
- Provide insight into energy investment community considerations that may affect FESC programs
- Promote FESC in speeches and other public opportunities related to Florida's energy future (i.e. discussing FESC as where the future is going)
- Be available for interviews from media regarding FESC, working closely with FESC's leadership.

Section 6.2. Access to Information

Advisors will be provided sufficient access to information about FESC programs so that they can offer useful advice and support. Advisors will be expected to provide regular feedback on Consortium strategies, programs and plans, and be responsive to a reasonable number of questions and requests for assistance from FESC's Leadership Team via phone and E-mail.

APPENDIX F – FESC BOARD OF ADVISORS BIO PAGES

Frank Bevc
Director, Technology Policy and Research Programs
Siemens Energy
Mr. Bevc is currently Director, Technology Policy and Research Programs at Siemens Energy, based in Orlando. He's responsible for the identifying opportunities for innovation and cooperative research, as well as working with government and industry partners to promote commercialization of clean energy technologies that serve the global energy market.

Current product initiatives cover a diverse field, including carbon capture technologies, renewable energy systems, Smart Grid distribution systems, advanced electric power transmission components, advanced turbomachinery systems, and supporting technologies. Prior assignments have included engineering management responsibility for steam turbine systems and gas turbine advanced research, product line management responsibility for marine turbine generator sets and superconducting magnet systems and commercial responsibility for advanced research programs.

Mr. Bevc received both engineering and business administration degrees from the University of Pittsburgh and is a senior member of both ASME and IEEE. He has held a number of association and advisory board positions, including past chair of the US Gas Turbine Association and the US Advanced Ceramics Association. He currently serves on industry advisory boards at the University of Central Florida, the University of Florida, the Florida Center for Advanced Aero Propulsion, Carnegie Mellon University's Electric Industry Initiative, MIT's Carbon Sequestration Initiative and Penn State's Clean Energy Forum.

Tommy Boroughs
Partner
Holland & Knight, LLP
Thomas "Tommy" Boroughs is a Partner in the Orlando office of Holland & Knight, focusing his practice in the areas of zoning and land use regulatory matters together with real estate development, acquisition and sales. He currently serves as the Co-Chair of the firm's Florida Land Use Team.

In addition to his considerable experience in zoning and land use, he also has extensive experience in various areas of real estate development, as well as transactional aspects of real estate, including purchase and sale negotiations, structuring and financing of complex commercial real estate transactions.

Recently, he has developed an expertise in energy law with an emphasis upon renewable and alternative energy. Between graduation from college and commencement of law school, he served in the U.S. Marine Corps as a Radar Intercept Officer in an F-4 fighter/bomber (Phantom II) and is a veteran of the Vietnam conflict. Mr. Boroughs has practiced law in Central Florida since graduation from law school.

Robert F. Caldwell
Vice President - Efficiency and Innovative Technology
Progress Energy
Robert Caldwell has the overall responsibility for: 1) Overseeing the development and implementation of the company's portfolio of energy-efficiency and demand-side management programs; 2) Evaluating and investing in emerging renewable generation

and alternative energy options, as well as innovative energy technologies; and 3) Managing wholesale power business.

Mr. Caldwell joined Progress Energy in 1998 as Vice President, Strategic Planning, and has held a number of other positions leading to his current one. Prior to joining Progress Energy, he served in various management positions with a Michigan utility.

He graduated from Central Michigan University with a Bachelor of Science degree in Business Administration. He earned a Master of Business Administration degree from Michigan State University.

Gustavo R. Cepero
Vice President
Florida Crystals Corporation

Gustavo Cepero has over 35 years of experience in the energy industry, including a 20 year career with Florida Power & Light (FP&L) and 15 years with Florida Crystals. He started his career with FPL as entry level engineer and progressed to head of several major departments. During this time, Mr. Cepero accumulated experience in all major functional areas of the electrical power industry, including engineering, economic and markets analysis, financial, legal and regulatory, fuel procurement, and environmental and in all conventional forms of power generation and fuels (oil, gas, coal, and nuclear).

Mr. Cepero was directly involved in most of the major power supply and delivery decisions and projects undertaken by FPL from the late 1970's through 1990.

He is currently an officer with Florida Crystals responsible for planning and business development, with a special focus on the energy business. Mr. Cepero has been directly involved in the development, construction, financing, and management of energy projects for Florida Crystals as well as the evaluation and, if applicable, the development of new technologies, with particular emphasis on renewable electricity and fuels.

Florida Crystals is a pioneer and leader in sustainable agriculture and the conversion of renewable agricultural resources (sugars, carbohydrates, and biomass) to energy, such as electricity and ethanol, and Mr. Cepero has been instrumental in all such efforts. Mr. Cepero has a Bachelor's degree in Electrical Engineering from the University of Detroit, a Master of Business Administration from Florida International University, a Juris Doctor from the University of Miami, and an Executive MBA from the Harvard Business School. He has been a member of the Florida Bar since 1982, and a member of the Institute of Electrical and Electronics Engineers since the 1970s.

Christopher Fountas
General Partner
MILCOM Venture Partners

Christopher Fountas is a General Partner of MVP. He has spent much of his career founding, building and funding early-stage technology companies, many at the intersection of the commercial and government markets. Mr. Fountas co-manages both MILCOM and OnPoint. He serves as a Trustee of OnPoint and manages several of MVP's investments, including those in The NanoSteel Company, Atraverda, Akermin, Cocona and Petra Solar. Mr. Fountas has over 20 years experience founding, advising and capitalizing emerging growth companies. Mr. Fountas has co-founded several successful start-up companies, and continues to serve as a board member and advisor to many of these companies, including Alpine Fresh.

Christopher Fountas graduated from The Ohio State University with a B.S. Degree in Finance and earned a JD (cum laude) from the University of Miami.

Byron A. Knibbs
Vice President - Sustainable Services Department
Orlando Utilities Commission
Byron A. Knibbs joined Orlando Utilities Commission (OUC) in May 1997, as Director of Business Development. As he progressed through the organization, Mr. Knibbs was promoted to Director of Business Development and Lighting in January 2000; his responsibilities included aggressively marketing OUC services and managing the daily operations of the Lighting Division. In March 2005, he was promoted to Vice President of the Energy Delivery Business Unit and was responsible for the day-to-day operation of OUC's Transmission, Substation and Distribution systems. In October 2009, Mr. Knibbs was appointed Vice President of Sustainable Services and is responsible for renewable and conservation programs, process improvements, new technology, education and sustainability awareness, shared services for OUC and OUC Cooling. Mr. Knibbs previously worked with the City of St. Cloud Electric Utility for 12 years in different capacities, four of those years as the Electric Utility Director. During his tenure with the City, his work experience in different departments spanned from engineering, substation, system operations, power production, transmission and distribution, and metering, to contract administration. Mr. Knibbs holds an Associate/Bachelor Degree in Aeronautics Electronic Engineering Technology, a Bachelor Degree in Computer Information Science and a Masters Degree in Business Administration.

J.L. Martinez
Sr. Director Project Management
FPL Group
J.L. "Buck" Martinez is the senior director of project development for FPL Group, where his responsibilities include overseeing the development of renewable energy projects in the State of Florida.

FPL Group is one of the nation's leading electricity-related services companies. Its subsidiaries include Florida Power & Light Company, Florida's largest electric utility with nearly 4.5 million customer accounts, and FPL Energy, LLC, a fast-growing independent power producer with a presence in 26 states.

Mr. Martinez joined Florida Power & Light in 1981. Prior to being named to his present position, he served as director human resource services overseeing the corporate safety department, labor relations and the corporate quality program. Before that he served the company in various management positions and special projects. Mr. Martinez holds a Bachelor of Arts degree from St. Thomas University and a Master of Business Administration degree from Nova Southeast. In addition, he is a graduate of the Boston University Leadership Program. He and his wife Silvia, and their three children, live in Palm Beach Gardens, Florida.

Sheila McDevitt
Chair
SUS Board of Governors
Sheila McDevitt is the chair of the Board of Governors, State University System of Florida. She served as Vice Chair before being elected as chair in June 2008.
Ms. McDevitt is an attorney with the law firm of Ackerman Senterfitt and a business strategist with extensive experience in the public utilities sector. Ms. McDevitt is a recognized authority on ethics and compliance with a proven track record of creating

long-term, sustainable solutions in response to complex business issues from mergers and acquisitions and other commercial transactions to litigation, governance, and political matters.

Prior to joining Ackerman Senterfitt, Ms. McDevitt retired, after 26 years, as the Senior Vice President, General Counsel, and Chief Legal Officer at TECO Energy, Inc. in Tampa, Florida where she is credited for having built the first Legal Department within a 108 year old, large, traditional utility company.

At TECO, Ms. McDevitt was a key member of the CEO's senior leadership team formulating and implementing strategic initiatives and providing solutions to many significant issues affecting the corporation and its operating companies. She led the corporation's legal affairs, all corporate compliance and governance, environmental strategy; internal and external communications; diversity and the corporate secretary duties.

Ms. McDevitt led the strategic acquisition and merger of Florida's largest regulated gas utility which expanded the company's service footprint throughout the state.

Ms. McDevitt's leadership of groundbreaking NSR pollution control negotiations with the United States Environmental Protection Agency and the Department of Justice led to an agreement that established TECO Energy as a national leader in the environmentally responsible production of electricity. She developed international utility expertise by establishing and structuring ownership and financing of power plants and other companies in Central America and Europe.

Prior to joining TECO Energy she was a trial attorney in central Florida. She began her career working with state government in the Florida and Georgia state legislatures.

She has received numerous awards including: the Outstanding Contribution Award for Pioneering in Business Ethics from the Center for Ethics at the University of Tampa; Distinguished Alum from the College of Law at Florida State University; several times she was named as one of Florida's Elite Business Lawyers by Florida Trend magazine and Corporate Counsel of the Year by the Hillsborough County Bar Association.

Ms. McDevitt has a deep commitment to public service and higher education. She chaired the Governor's Blue Ribbon Commission on Higher Education Minority Access and Diversity. She is also a Trustee of St. Leo University and served from 2005 to 2007 as the Chair of the Board. For the College of Law at Florida State University she chaired the Board of Visitors from 2004 to 2005 and has remained a member since 1996.

Among her numerous volunteer efforts within the community, Ms. McDevitt is the Co-Chair of the Alexis de Tocqueville Society at the United Way of Tampa Bay, a Trustee and member of the Executive Committee for The Florida Orchestra, and President-Elect of the Hillsborough County Bar Foundation.

Ms. McDevitt holds both a B.A. and J.D. from Florida State University in Tallahassee. She has been admitted to practice in all Florida State Courts and the U.S. District Court for the Middle District of Florida. In 1989, McDevitt was admitted to practice before the United States Supreme Court.

Roy Periana
Director
Scripps Energy Laboratories
The Scripps Research Institute

Prof. Periana immigrated to the US when he was 17 years old to pursue a career as a Chemist. Working his way through college as a busboy he graduated with honors from the University of Michigan with a BSc in Chemistry. He then joined Dow Chemical where he worked for two years. During this time his work resulted in 10 patent applications. He then left Dow Chemical to pursue a PhD in chemistry at U.C. Berkeley. At Berkeley he helped to pioneer the emerging field of low-temperature hydrocarbon chemistry and graduated summa cum laude after four years. With 15 offers in hand, Dr. Periana chose to move to the Monsanto Chemical Co. in St. Louis, MO. Quickly, realizing that he was not a large company man, he left for a position with an early startup company in the Silicon Valley, Catalytica, Inc. At Catalytica he rose through the ranks from Research Chemist to Vice President of research over the course of 10 years. In that time he was directly responsible for raising approximately $35 million. His work helped to take the company public with a $250MM capitalization. During this time he became one of the world's leading experts in the now established field of low-temperature chemistry for the conversion of hydrocarbons raw materials to fuels, chemicals, and power. His work there was highlighted by numerous invitations to the leading universities and research institutes of the world, interviews on National Public Radio, coverage by Wall Street, science shows on TV as well as two publications in Science, one of the two most prestigious scientific journals in the world. He is the key inventor on the only systems that the world has developed for the efficient, lost cost, low temperature conversion of methane to methanol. Coupled with changing management at Catalytica and the dot com meltdown, Dr. Periana chose to accept a position as Chemistry Professor at the University of Southern California in Los Angeles in order to continue his work on the development of the next generation of catalysts for the 21st Century. Here Prof. Periana was tenured and became an acknowledged leader in the field of low-temperature catalysis. His work here is highlighted by substantial funding from oil companies, as well as, the NSF and publication in Science and other leading journals. He taught and graduated 6 graduate students during this time. At this point he was discovered by Dr. Lerner, the president of Scripps and offered a position as a full Chemistry Professor. Prof. Periana chose to move to Scripps Florida as he saw this as the next hot bed for technology development. Already Prof. Periana has raised almost $1MM, with the promise for almost $7MM more in the next three to five years. His long-term plans at Scripps Florida will be to build a $100MM department focused on the development of the next generation of cleaner, cheaper fuels, chemicals, and energy for the 21st century.

Christopher R. Sauer
President and CEO
Ocean Renewable Power Company

Christopher R. Sauer, P.E. is President and CEO of Ocean Renewable Power Company, an industry leading developer of technology and projects that generate clean, predictable power from river, tidal, and deep-water ocean currents. He has more than 30 years of experience in the facility development, power generation, cogeneration, renewable energy and energy efficiency industries. He has a proven track record of success in executive management, engineering/construction, technology development, transaction structuring, marketing and sales and start-up company formation and management. He has held senior management positions with two major U.S. corporations and has been President and CEO of three startup energy/environmental technology companies. He has been in the energy transaction business since 1977 and, since that time, has played an instrumental role in the development of more than $2 billion in energy assets and companies. Chris is a registered professional engineer and a lifetime Member of the American Society of Civil Engineers.

Bentina C. Terry
Vice President - External Affairs and Corporate Services
Gulf Power Company

Bentina C. Terry is Vice President – External Affairs and Corporate Services for Gulf Power Company, a Southern Company subsidiary headquartered in Pensacola, Florida. In this role, Terry is responsible for the company's external efforts including regulatory affairs, governmental relations, environmental affairs, economic development and corporate communications. She is also responsible for the company's ethics and compliance efforts as well as the security, safety and health, labor relations, facilities and real estate organizations. Most recently she also assumed responsibility for Gulf Power's nuclear development efforts.

Terry is very active outside of Gulf Power and serves on Board of Directors or Trustees for the following: the Florida Chamber of Commerce Foundation Board, Leadership Florida, SunTrust Bank (NW Florida Board), the Florida Technology, Research and Scholarship Board, the Florida Electric Power Coordinating Group (Executive Committee), Florida's Great Northwest (Executive Board), the Pensacola Bay Area Chamber of Commerce and Economic Development Council, the Gulf Coast African American Chamber, the Community Maritime Park Association for the City of Pensacola and the Pensacola Symphony Orchestra.

Terry began her career with Southern Company in 2001 at Georgia Power Company and progressed through leadership roles in compliance, ethics and power delivery including customer service, external affairs and customer operations. In her most recent position prior to her current one she served as Vice President – External Affairs and General Counsel, Compliance Officer and Corporate Secretary for Southern Nuclear Operating Company, the Southern Company subsidiary that operates Southern's nuclear fleet.

Prior to joining Southern Company, Terry served as Associate General Counsel for Progress Energy in Raleigh, NC. She began her career practicing law as an associate with Troutman Sanders law firm in Atlanta, Georgia.

A native of Fayetteville, N.C., Terry holds a Juris Doctorate degree from the University of Michigan Law School and a Bachelor of Arts in English from North Carolina State University. She is a member of the North Carolina State Bar and the Georgia State Bar, Leadership Atlanta, Leadership North Carolina and Leadership Florida, the American Association of Blacks in Energy and Alpha Kappa Alpha Sorority, Inc. In 2008, she was selected as one of the "Twelve Young Professionals Under 40" and she was selected as a member of the "2009 IN Power List" which recognizes the top 50 most powerful and influential people in greater Pensacola. She is married to Antonio Terry.

Greg Ramon, Director
Regulatory Policy and Compliance
TECO

Biography and picture not currently available

APPENDIX G - FESC SUMMIT PROGRAM AND SURVEY

Inaugural FESC Summit held September 29-30 at the University of South Florida

2009 FESC Summit Program

All events will take place in the Marshall Student Center (MSC) unless otherwise noted

Pre-Summit Activities

MONDAY, SEPTEMBER 28:

10:30 AM – 1:30 PM Florida Smart Grid Workshop
Embassy Suites-USF

TUESDAY, SEPTEMBER 29:

8:00 – 11:00 AM Florida Energy and Climate Commission (FECC) meeting - Open to the public.
Marshall Student Center 3707 (the Oak Room), 8:00AM – 11:00AM

FESC Summit

TUESDAY, SEPTEMBER 29

9:00 – 11:00 AM Registration and Poster set-up
MSC 2100AB

General Session: **Marshall Student Center Ballroom (2100 AB)**

11:05 - 11:15 AM **WELCOME**
Karen Holbrook, Vice President for Research and Innovation
University of South Florida

11:15 – NOON **KEYNOTE ADDRESS**
Sam Baldwin, Chief Technology Officer and Member, Board of Directors, Office of the Secretary, U.S. DOE Energy Efficiency and Renewable Energy

NOON – 1:00 PM **BUFFET LUNCH**

1:00 - 2:00 PM **OVERVIEW OF FLORIDA'S ENERGY NEEDS AND OPPORTUNITIES**
James F. Murley, Chairman, Florida Energy and Climate Commission
Mark Futrell, Office of Strategic Analysis and Governmental Affairs, Florida Public Service Commission

2:00 – 2:30 PM **OVERVIEW OF FESC STRATEGIES AND PROGRAMS**
Tim Anderson, Director, FESC

2:30 – 3:15 PM **ROUND TABLE DISCUSSION**
Facilitator: Tim Anderson

- How can Florida universities best promote research collaboration among themselves and with industry, and assist the state's economic development?

3:15 – 3:45 PM **BREAK**

3:45 – 5:15 PM **POSTER OVERVIEWS**
Moderator: Dave Cartes

3:50 Research Laboratories and Facilities Development
D. Block

3:52 Concentrating Solar Power Program
C. Cromer, R. Reedy

3:54 Energy Sustainable Florida Communities
R. Feiock, I. Aurirac, T. Kassedert

3:56 Promoting Energy Sustainability through Land Use, Transportation, and Green Infrastructure Policies
T. Chapin, I. Audirac

3:58 Design and Implementation of Low Cost Pyrheliometer
M. Gnos, B. Greksa, A.Krothapalli

4:00 ESC Advanced Solar Simulator
J. Pandolfini, B. Greska, A. Krothapalli

4:02 Flooding Detection in Microjet PEM Fuel Cell
A. Badaru, B. Greska, A. Krothapalli

4:04 Dual Fluidized Bed Biomass Gasification for H_2 Production
J. Dascomb

4:06 Design of a Spiral Tube Bubble Column Photobioreactor
Q. Straub, T. Tracy, J.C. Ordonez

4:08 Multi-Objective Optimization of Power Plants to Reduce Operating Costs
G.S. Dulikravich

4:10 Impact on a Microgrid of Increased Market Penetration of Plug-In Hybrid Electric Vehicles
B. Hacker, S. Azongha, C. Edrington

4:12 Energy Delivery Infrastructure
A. Domijan, A. Islam

4:14 Effect of Cluster Size on CO Absorption and Dissociation on Cobalt Catalysts: DFT Studies using Cluster Models
N. Balakrishnan, V.R. Bethanabotla, B. Joseph

4:16 Device simulation of ZnO/CdS/CIGS/Mo solar cell using Medici
Y. Hu, G. Bosman, T. Anderson

4:18 Energy Efficient Technologies and the Zero Energy Home Learning Center
S. Russell, Y. Goswami, M. Rodriguez

4:20 Metal/Support Interaction Effects in Fischer-Tropsch Synthesis: Significance of Catalyst Preparation
S.A.Z. Gardezi, B. Joseph, J.T. Wolan

4:22 Preparing the Technical Workforce to Meet Florida's 21st Century Needs
M. Barger, R.Gilbert

4:24 Cobalt Nanoparticles on Surface Modified SiO_2 Colloids for Fischer-Tropsch Synthesis
B.D. Mankidy, V.K. Gupta

4:26 Effect of Transition Metal Oxide Interlayer on the Performance of Bulk Heterojunction Solar Cell
J. Subbiah, F. So

4:28 Combined Cooling, Heat, Power, and Biofuel from Biomass and Solid Waste
W.L. Lear, J.N. Chung

4:30 Development of High Throughput CIGS Manufacturing Process
N. Dhere

4:32 PV Power Generation Using Plug-In Hybrid Vehicles as Energy Storage
J. Shen, I. Batarseh, N. Kutkut

4:34 Wave Power Generation
Z. Qu, K. Lin

4:36 Clean Drinking Water using Advanced Solar Energy Technologies
J. Klausner, F. Alnaimant

4:38 Water-use Efficiency and Feedstock Composition of Candidate Bioenergy Grasses in Florida
L. Sollenberger, J.E. Erickson, J.M.B. Vendramini, R.A. Gilbert, L.O. Ingram, J.R. Fedenko, Z.R. Helsen, K. Woodward

4:40 High Rate Chemical Vapor Deposition of $Cu(In,Ga)Se_2$
C.P. Muzzillo; T.J. Anderson

4:42 Nanostructured Chevrel Phase for Magnesium Battery Cathodes
R.Scheffler, W. Sigmund

4:44 Aluminum Secondary Battery – Battery of the Future
A. Biswas, W.M. Sigmund

4:46 Green Networks: New Results and Next Steps to Benefit Florida
K. Christensen

4:48 Database Infrastructure for Integrative Carbon Science Research
S. Grunwald, T. Martin, G.M. Basques, B. Hoover, C.A. Gonzales, R. Bracho-Garriloo, H. Beck

4:50 Fabrication of CIS Solar Cells using Nanoparticle-based Processing Technique

R. Krishnan, U.Farva, J. Young, A. Payzant, T. Anderson, C. Park

4:52 Solid State Phase Transformation of Cadmium Selenide Nanoparticles upon Thermal Annealing
R. Krishnan, U. Farva, N.T.N. Troung, T.J. Anderson, C.H. Park

4:54 Indium Gallium Nitride Solar Cell Device Simulations
D. Wood, J. Mangum, T. Anderson, G. Bosman

4:56 An Experimental Investigation of Economic Incentives in Environmental Conservation, Sustainability, and Renewable Energy
S. Pevnitskaya, D. Ryvkin

4:58 Public and Private Solutions to the Hold-Out Problem in Infrastructure Land Acquisition
S.M. Collins, R.M. Isaac

5:00 Development of Flexible Thin Film CdTe Solar Cells
S. Bhandaru, D. Hodges, V. Palekis, D. Shen, E. Stefanakos, and C. Ferekides

5:02 Communicating Energy Efficiency through Public Service Announcements
A. Opel, L. Arpan, P. Steinberg

5:04 Development of Metal-Insulator-Metal Diode-Based Un-cooled Terahertz Detector
I-T. Wu, K. Son, J. Wang

5:30 – 7:00 PM POSTER SESSION AND RECEPTION

.

7:00 PM Dinner on your own

WEDNESDAY, SEPTEMBER 30

General Session: Marshall Student Center Ballroom (MSC 2100AB)

8:30 – 9:00 AM PRESENTATION OF RESULTS FROM ROUND TABLE DISCUSSION
FESC Leadership Team

FESC Faculty Research Presentations

9:00 – 10:30 AM ORAL PRESENTATIONS: SESSION I

MSC 3705: Energy Efficiency & Conservation, Education & Outreach, Policy
Co-Chairs: Julie Harrington, Richard Gilbert

FESC Education and Outreach Efforts
P. Jones

Early Adoption of Sustainable Energy Innovations by Florida Local Governments
R. Feiock and T. Kassekert

Off-Grid Zero Emissions Building
J. Kramer, A. Krothapalli, B. Greska

Developing a Renewable Energy Research Web Portal
C. Hinnant, I. Douglas, C. McClure

MSC 3708: Biomass Resources, Carbon Capture
Chair: George Philippidis

Thermophilic Bacterial Biocatalysts for the Conversion of Cellulosic Substrates to Fuels and Chemicals
K.T. Shanmugam

Production of Liquid Fuels Biomass via Thermo-Chemical Processes
B. Joseph, Y. Goswami, J. Bhethanabotla, J. Wolan, V. Gupta

Engineering biocatalysts for Hemicellulose Hydrolysis and Fermentation
J. F. Preston

Potential for Geologic Carbon Sequestration in Deep Saline Aquifers in Florida
T. Roberts-Ashby, R. Owen, M. Thomas, M. Trotz, J. Cunningham, M. Stewart

MSC 3709: Ocean Energy Resources, Solar Resources

Co-Chairs: Camille Coley, David Block

FAU Center for Ocean Energy Technology

S. Skemp, H. Hanson, C. Coley

Beyond Photovoltaics – Nanoscale Rectennas for Conversion of Solar and Thermal Radiation to Electricity

S. Bhansali, Y. Goswami, E. Stefanakos, S. Krishman, R. Ratnadurai, M. Celestin, S. Wijewardane

Solar Thermal Power for Bulk Power and Distributed Generation

D.Y. Goswami, M. Rahman, A. Sunol, R. Vasquez, H. Chen, G. Demirkaya

Thin Film Photovoltaic Module Processing Laboratory

D. Morel, C. Ferekides, E. Stefanakos

MSC 3711: Energy Storage and Delivery, Smart Grid

Co-Chairs: Dave Cartes, Debra Reinhardt (invited)

Non-contact Energy Delivery with Integrated DC-AC Inverter for PV System

R.A. Chinga, J.J. Kasanova, J.A. Taylor, J. Lin

Chemical and Mechanical Degradation of Fuel Cells

D. Slattery, L. Bonville, X. Huang, M. Rodgers

Reliable and Resilient Future Electrical Energy System for Florida

S. Dale, M. Seurer, T. Baldwin, P. McLaren, T. Alquthami, J. Langston, R. Meeker

Innovative Processing for Novel Energy Storage Materials

Wolfgang Sigmund

General Session: **Marshall Student Center Ballroom (2100 BC)**

10:40 AM –12:40 PM **TECHNICAL TEAM ROUNDTABLE DISCUSSIONS AND BUFFET WORKING LUNCH**
Moderator: Canan Balaban

Technical Teams

Energy Efficiency and Conservation – *Team Leader: Pierce Jones; Scribe: Gokmen Demirkaya*
Carbon Capture and Sequestration – *Team Leader: Mark Stewart; Scribe: Tina Roberts-Ashby*
Ocean Energy – *Team Leader: Howard Hanson; Scribe: Caitlin Slezycki*
Energy Storage
Battery and Super Capacitors – Team Leader: Jim Zheng; Scribe: I-Tsang Wu
Fuel Cells – Team Leader: Jim Fenton; Scribe: Ruraskandan Ratnadural
Smart Grid – *Team Leader: Dave Cartes; Scribe: Ali E. Ercelibi*
Solar PV – *Team Leader: Tim Anderson; Scribe: Kosol Son*
Solar Thermal – *Team Leader: Yogi Goswami; Scribe: Sarada Kuravi*
Algae – *Team Leader: George Philippidis; Scribe: Nianthrini Balakrishnan*
Biomass – *Team Leader: Babu Joseph; Scribe: Ricardo Vasquez Padilla*
Policy and Systems – *Team Leader: Mark Jamison; Scribe: Bijith Mankidy*

Scribes to be assigned: Raymond Scheffle, Barbara Graham, Huijan Chen

11:30 AM –12:30 PM **OVERSIGHT BOARD LUNCH HOSTED BY WIN PHILLIPS (INVITATION ONLY)**
MSC 2702

FESC Faculty Research Presentations

12:50 – 2:10 PM ORAL PRESENTATIONS: SESSION II

MSC 3705: Energy Efficiency & Conservation, Education & Outreach, Policy

Co-Chairs: Pierce Jones, Ted Kury

Energy Policy and the Environment: Challenges and Opportunities

T. Kury, J. Harrington

Multi-Objective Optimization of Power Plants to Reduce Operating Costs and Maintenance Costs
G.S. Dulikravich
Optimizing Traffic Signal Timings to Reduce Fuel Consumption, Green House Gases, and Vehicular Emissions
A. Stevanovic
Energy Efficient Building Technologies and Zero Energy Homes
R. Vieira, P. Fairey, J. Sonne

MSC 3708: Biomass Resources, Carbon Capture
Co-Chairs: George Philippidis, James Preston
Integrated Florida Bio-Energy Production with Carbon Capture and Sequestration
A. T-Raissi, N. Muradov, D. Block
Combined Cooling, Heat, Power, and Biofuel from Biomass and Solid Waste
W.L. Lear, J.N. Chung
A Model for Redistribution of Cap-and-Trade Revenue
P. Rocha, E. Salimi, T.K. Das, R. Fehr
Accounting for Carbon Emissions in Florida: Land Use, Energy, and Fuel
T. Zhao and M. Horner

MSC 3709: Ocean Energy Resources, Solar Resources
Co-Chairs: Franky So, Darlene Slattery
Research to Improve Photovoltaic (PV) Cell Efficiency by Hybrid Combination of PV and Thermoelectric Cell Elements
N. Sorlaica-Hickman, R. Reedy
PV Energy Conversion and System Integration
N. Kutkut, J. Shen, I. Batarseh, Z. Qu, X. Wu, W. Mikhael, L. Chow
VIVACE: A New Concept in Hydrokinetic Energy Conversion
M.M. Bernitsas (presented by Nicolaos Xiros)
Clean Drinking Water using Advanced Solar Energy Technologies
E. Stefanakos, D.Y. Goswami, M. Trotz, M. Batzill

MSC 3711: Future Directions
Chair: Ali T-Raissi
PV Manufacturing Database and Florida Applications
D. Block, R. Reedy
Solar Thermal Power
Y. Goswami
SURA Workshop on Energy: A brief update and summary
B. Joseph
Smart Grid
Dave Cartes

GENERAL SESSION: MARSHALL STUDENT CENTER BALLROOM (2100 BC)

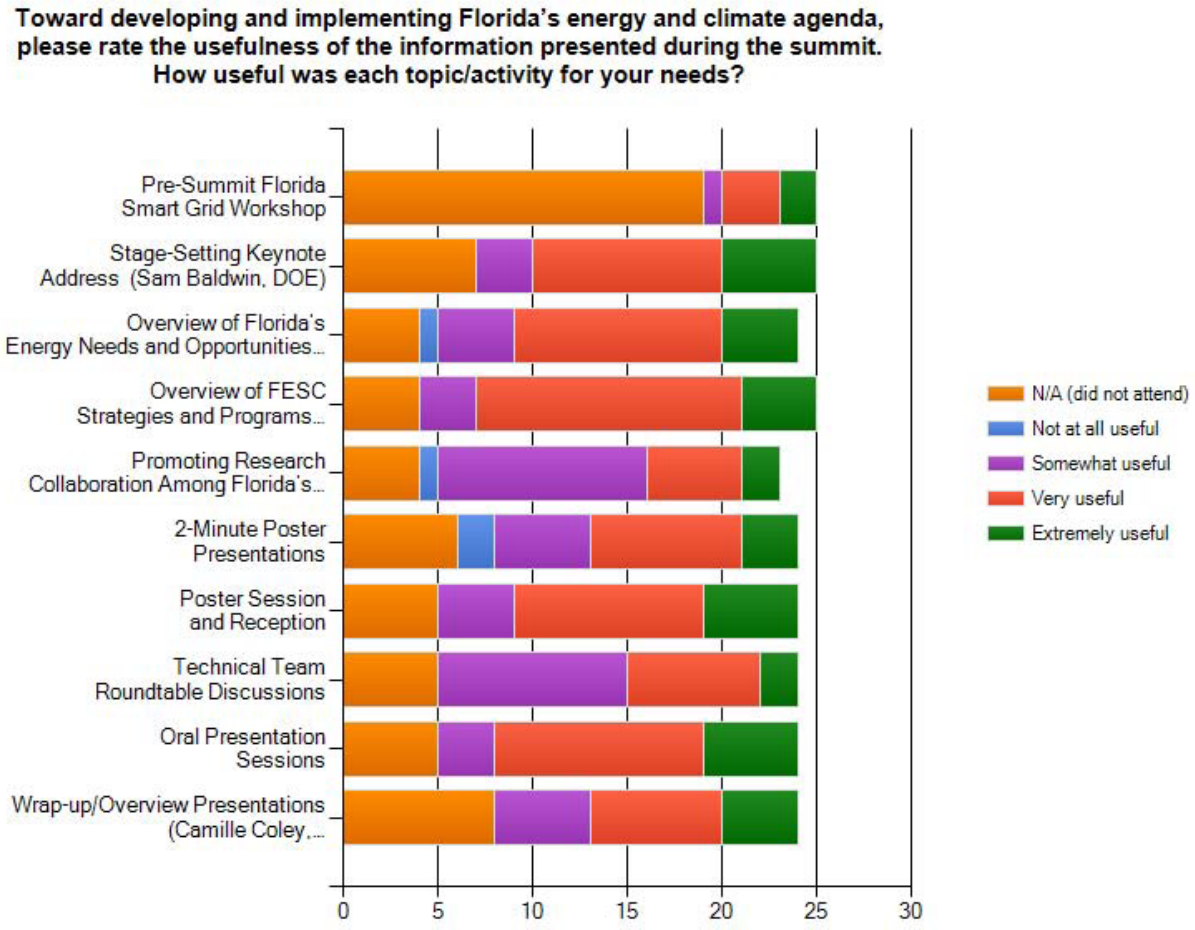
2:10 – 2:40 PM Break

2:40 – 4:10 PM OVERVIEW PRESENTATIONS
Camille Coley, Executive Assistant Vice President, FAU
Mark Jamison, Director, Public Utilitiy Research Center, UF
Jim Fenton, Director, Florida Solar Energy Center, UCF

4:10 CLOSING REMARKS
Tim Anderson

Preliminary results from the 2009 FESC Summit Survey

Preliminary results from a survey of FESC Summit participants are below. Most agenda items were rated either Very Useful or Extremely Useful.



APPENDIX H – ACCOUNTABILITY MEASURES – DATA

1. Competitive Grants Applied

SUS energy faculty submitted 252 funding proposals amounting to $356,706,995 during the eleven-month period November 1, 2008 thru October 1, 2009. The information was provided by the SUS faculty and compiled to determine the # of application and the dolar amount.

2. Competitive Grants Received

The SUS faculty received 419 research and education awards totaling $97,243,762 (None many of the awards were based on proposals prior to this period, but demonstrates the competitiveness of the SUS faculty in this arena).

3. Total Research Expenditures

	Total Budget	Funds Expended as of October 1, 09	Remaining Balance
Enhancing Energy Efficiency and Conservation	$2,279,401.00	$875,687.41	$1,403,713.59
Developing Florida's Biomass Resources	$2,671,032.00	$466,707.21	$2,204,324.79
Harnessing Florida's Solar Resources	$9,311,623.00	$2,214,817.22	$7,096,805.78
Carbon Capture and Sequestration	$785,856.00	$188,453.31	$597,402.69
Exploiting Florida's Ocean Energy Resources	$8,750,000.00	$293,117.49	$8,456,882.51
Securing our Energy Storage and Delivery Infrastructure	$1,427,392.00	$882,549.50	$544,842.50
Policy & Other	$1,023,139.00	$343,669.00	$679,470.00
Education & Outreach	$1,800,000.00	$37,406.21	$1,762,593.79
Total	**$28,048,443.00**	**$5,302,407.35**	**$22,746,035.65**

Note: The funds for administration and reserved funds for new projects are not shown in the above table.

4. Publications

During Nov. 1, 2008 to Oct. 1 2009 Period

Florida Atlantic University

1. Howard Hanson, "Diversified Renewables" Energybiz 6 (4) p 52 2009
2. Pierre Beaujean, "Ocean Turbines a Reliability Assessment" Intl Journal of Reliability,Quality and Safety Engineering- in press 2009
3. Pierre Beaujean, "Monitoring Ocean Turbines: a Reliability Assessment" ISSAT Intl' Conference August 2009 SF, CA
4. Nicholas S Asseff, "Design and Finite Element Analysis of an Ocean Current Turbine Blade" M.S. Thesis, FAU August 2009
5. Nicholas S Asseff, "Design and Finite Elemen tAnalysis of an Ocean Current Turbine Blade" OCEANS/IEEE 2009 accpt for publication

University of Central Florida (Refereed Publications):

1. Weifang Yao, Cunping Huang, Nazim Muradov, Ali T-Raissi, "Photocatlytic H2 Evolution on Visible Light Illuminated CdS Supported Pd-Cr203 Nanocomposite Cocatalyst Using Regnerable Sacrifical Donor", submitted to J. of the American Chemical Society.
2. Nazim Muradov, Karthikeyan Ramasamy, Clovis Linkous, Cunping Huang, I. Adebiyi, Frank Smith, Ali T-Raissi, J. Stevens, "Combined Pre-Reforming-Desulfurization of High-Sulfur Fuels for Distributed Hydrogen Applications", submitted to J. Fuel
3. Jian Yang, Zhihua Qu, Jing Wang, K. Conrad, "Comparison of Optimal Solutions to Real-time Path Planning for a Mobile Vehicle," IEEE Transactions on Systems, Man, and Cybernetics, Part A: Systems and Humans.
4. H. Yuan and Z. Qu, "Smooth Time-Varying Pure Feedback Control for Chained Nonholonomic Systems with Exponential Convergent Rate," IET Control Theory & Applications.
5. Jing Wang, Zhihua Qu, Yi Guo, Jian Yang, "A Reduced-Order Analytical Solution to Mobile Robot Trajectory Generation in the Presences of Moving Obstacles",
6. Tao Cheng, Zhihua Qu, Frank Lews, "Neural Network Solution for Suboptimal Control of Nonholonomic Chained Form System", special issue on computational intelligence, Transactions U.K. Institute of Measurement and Control.
7. Zhihua Qu, Jing Wang, Richard Hull, Jeffrey Martin, "Continuous Control Designs for Stabilizing Chained Systems: A Global State Scaling Transformation and A Time Scaling Method", Optimal Control, Applications and Methods, Vol. 30, No. 1, pp. 1-25, 2009.
8. Y. Xiong, S. Sun, H. Jia, P. Shea, Z. Shen, "New Physical Insights on Power MOSFET Switching Losses," IEEE Tran. Power Electronics, March 2009.
9. A. Luo, Z. Shuai, Z. Shen, W. Zhu, X. Xu, "Design Considerations for Maintaining DC-Side Voltage of Hybrid Active Power Filter with Injection Circuit," IEEE Tran. Power Electronics, January 2009.
10. D. Acharya, L. Zhou, L. Zheng, T. X. Wu, J. Kapat, L. Chow and N. K. Arakere, “Systems Design, Fabrication and Testing of a High-Speed Miniature Motor for Cryogenic Cooler,” International Journal of Rotating Machinery, to appear.
11. S. Kuravi, J. Du and L. Chow, “Encapsulated Phase Change Material slurry Flow in Manifold Microchannels,” AIAA Journal of Thermophysics and Heat Transfer, to appear
12. Huseyin Bostanci, Dan P. Rini, John Kizito and Louis C. Chow, “Spray Cooling with Ammonia on Micro-structured Surfaces: Performance Enhancement and Hysteresis Effect,” ASME Journal of Heat Transfer, Vol. 131, No. 7, 2009, 0714011-0714019.

13. Krishna M. Kota, Louis C. Chow, Jianhua Du, Jayanta Kapat, Quinn Leland and Richard Harris, "Numerical Analysis of Heat Storage Phenomenon in a Dual Latent Heat Sink," AIAA Journal of Thermophysics and Heat Transfer, Vol. 23, No. 1, 2009, pp. 148-156.
14. W. Wu, J. Du, Y.R. Lin, J. Kapat, L.C. Chow and W. Notardonato, "Heat Transfer Enhancement in a Gas-Cooled Condenser Using Carbon Foams," AIAA Journal of Thermophysics and Heat Transfer, Vol. 23, No. 1, 2009, pp. 157-161.
15. W. Wu, J.H. Du, Y.R. Lin, L.C. Chow and W. Notardonato, "Design and Experiment of Compact, Lightweight and Effective Carbon Foam Recuperative Heat Exchangers," AIAA Journal of Thermophysics and Heat Transfer, Vol. 23, No. 2, 2009, pp. 339-345
16. Sarada Kuravi, Krishna Kota, Jianhua Du and Louis Chow, "Numerical Investigation of Flow and Heat Transfer Performance of Nano-Encapsulated Phase Change Material (NEPCM) Slurry in Microchannels," ASME Journal of Heat Transfer, Vol. 131, No. 6, 2009, pp. 0629011-0629019.
17. Krishna M. Kota, Louis C. Chow and Quinn, H. Leland, Heat Transfer Performance of a Dual Latent Heat Sink for Pulsed Heat Loads," SAE International Journal of Aerospace, Vol. 1, No.1, 2009, pp. 1078-1087.
18. A.R. Griffin, A. Vijayakumar, R.H. Chen, K.B. Sundaram and L.C. Chow, "Development of a Transparent Heater to Measure Surface Temperature Fluctuations Under Spray Cooling Conditions," ASME Journal of Heat Transfer, Vol. 130, No. 11, 2008, pp. 1145011-1145014.
19. Krishna M. Kota, Louis C. Chow, Jianhua Du, Jayanta Kapat, Quinn Leland and Richard Harris, "Design of a Dual Latent Heat Sink for Pulsed Electronic Systems," AIAA Journal of Thermophysics and Heat Transfer, Vol. 22, No. 4, 2008, pp. 572-580.
20. Shangyang Xiao; Weihong Qiu; Miller, G.; Wu, T.X.; Batarseh, I., "An Active Compensator Scheme for Dynamic Voltage Scaling of Voltage Regulators," IEEE Trans. on Power Electronics, Volume 24, Issue 1, pp. 307 – 311, January 2009.
21. Feras Batarseh, Moataz Abdelwahab, Issa Batarseh, Michael Haralambous, "QuizMe – An Interactive Learning Tool with Application to Electrical Circuits," Southeast Section Conference, ASEE 2009.
22. Zhijun Qian, Osama Abdel-Rahman, Justin Reese, Hussam Al-Atrash, Issa Batarseh, "Dynamic Analysis of Three-Port DC/DC Converter for Space Applications," IEEE-APEC 2009.
23. Elmes, J.; Jourdan, C.; Abdel-Rahman, O.; Batarseh, I., "High-Voltage, High-Power-Density DC-DC Converter for Capacitor Charging Applications," IEEE-APEC 2009.
24. K. Zhang, T. X. Wu, N. Kutkut, J. Shen, D. Woodburn, L. Chow , W. Wu, H. Mustain, and I. Batarseh, "Modeling and Design Optimization of Planar Power Transformers for Aerospace Applications" National Aerospace and Electronics Conference, NAECON, Dayton, Ohio, Jul 2009.
25. Ala Al-Haj Hussein, Michael Pepper, Issa Batarseh, and Ahmad Harb "Solar Charging Considerations for Common Battery Chemistries", International Conference on Modeling, Simulation and Visualization Methods Proceedings, p.p. 249-253, 2009.
26. Ala Al-Haj Hussein, Michael Pepper, Ahmad Harb, and Issa Batarseh "An Efficient Solar Charging Algorithm for Different Battery Chemistries", The 5th IEEE Vehicle Power and Propulsion Conference Proceedings, p.p. 188-193, 2009.
27. H. Alatrash, N. Kutkut, I. Batarseh, " The AC PV Module: A New Trend in Distributed Photovoltaic Generation Systems," IEEE Energy 2030, Atlanta, Georgia, USA, November 2008.
28. M.G. Batarseh, W. Al-Hoor, L. Huang, C. Iannello,I. Batarseh "Segmented Digital Clock Manager-FPGA based Digital Pulse Width Modulator Technique" in Proceedings of IEEE Power Electronics Specialists Conf. (PESC '08), pp 3036 – 3042, June 2008.

University of Florida (Refereed Publications):

1. Novaes E., L. Osorio, D.R. Drost, B.L. Miles, C.R.D.B. Novaes, C. Benedict, C. Dervinis, Q. Yu, R. Sykes, M. Davis, T.A. Martin., G.F. Peter, M. Kirst "Genetic analysis of nitrogen effect on biomass and wood chemistry of Populus identifies a major pleiotropic locus that links tree growth and wood properties". New Phytologist 182: 878-890. 2009.

2. D.E. White, C. Courchene, T. McDonough, L.R. Schimleck, D. Jones, G.F. Peter, R. Purnell, G. Goyal “Effects of specific gravity and wood chemical content on the pulp yield of loblolly pine.” TAPPI Journal 92(4): 29-34. 2009.
3. R. Sykes, M. Yung, E. Novaes, M. Kirst, G.F. Peter, M. Davis, Biofuels: Methods and Protocols, Methods in Molecular Biology High-throughput Screening of Plant Cell-wall Composition Using Pyrolysis Molecular Beam Mass Spectrometry., Editor Mielenz J.R., Humana Press, 2009. vol 581 169-183.
4. D.R, Drost, E. Novaes, C. Boaventura-Novaes, C.I. Benedict, R.S. Brown, T. Yin, G.A. Tuskan and M. Kirst. A microarray-based genotyping and genetic mapping approach for highly heterozygous outcrossing species localizes a large fraction of the unassembled Populus trichocarpa genome sequence. Plant Journal 58: 1054-1067 2009
5. D.R. Drost, C.I. Benedict, E. Novaes, M. Kirst. Populus genomic resources. In Genetics, Genomics and Breeding of Crop Plants: Poplar, C.P. Joshi and S.P. DiFazio (Eds.) Science Publishers, Enfield, NH. 2009.
6. X. Liu, S-C. Lee, G. Casella, G.F. Peter, “Assessing Agreement of Clustering Methods with Gene Expression Microarray Data” Computational Statistics and Data Analysis 52 (12): 5356-5366 2008.
7. T., Quesada, Z. Li, C. Dervinis, Y. Li, P.N. Bocock, G.A. Tuskan, G. Casella, J.M. Davis and M. Kirst. (2008) Comparative analysis of the transcriptomes of Populus trichocarpa and Arabidopsis thaliana suggests extensive evolution of gene expression regulation in angiosperms. New Phytologist 180: 408-420.
8. E. Novaes, D.R. Drost, W.G. Farmerie, G.J. Pappas Jr., D. Grattapaglia, R.R. Sederoff and M. Kirst. (2008) High-throughput gene and SNP discovery in Eucalyptus grandis, an uncharacterized genome. BMC Genomics 9: 312-325.
9. Grattapaglia, D. and M. Kirst. (2008) Eucalyptus applied genomics: from gene sequences to breeding tools. New Phytologist 179: 911-929.
10. J. Casanova, Z. N. Low, J. Lin, "A Loosely Coupled Planar Wireless Power System for Multiple Receivers," IEEE Transactions on Industrial Electronics, Vol. 56, No. 8, pp. 3060-3068, August 2009
11. Z. N. Low, R. A. Chinga, R. Tseng, and J. Lin, "Design and Test of a High-Power High-Efficiency Loosely Coupled Planar Wireless Power Transfer System," IEEE Transactions on Industrial Electronics, Vol. 56, No. 5, pp. 1801-1812, May 2009
12. J. J. Casanova, Z. N. Low, J. Lin, R. Tseng, "Transmitting Coil Achieving Uniform Magnetic Field Distribution for Planar Wireless Power Transfer System," Proceedings of IEEE Radio and Wireless Symposium, pp. 530-533, January 2009
13. J Li, JE Erickson, G Peresta, BG Drake, "Evapotranspiration and water use efficiency in a Chesapeake Bay wetland under carbon dioxide enrichment," Global Change Biology, In Press.
14. NGM Young, JL Cisar, JE Erickson, GH Snyder, JB Sartain, KE Williams, "St. Augustinegrass response to nitrogen sources applied under contrasting application rates and frequency," International Turfgrass Society Research Journal, 11, In Press.
15. JE Erickson, JL Cisar, GH Snyder, DM Park, A Wright, "Effects of sod type irrigation, and fertilization on nitrate-N and orthophosphate-P leaching from transplanted St. Augustinegrass sod," Crop Science, Accepted.
16. . R.Y. Chein, Y.C. Chen, L.C. Chen and J. N. Chung, “Heat transfer effects on the methanol steam reforming with partially filled catalyst layers”, Int. J. Hydrogen Energy, Vol. 34, pp. 5398-5480, (2009).
17. R.Y. Chein, Y.C. Chen, C.S. Chang and J. N. Chung, “Numerical Modeling of Hydrogen Production from Ammonia Decomposition for Fuel Cell Applications”, Int. J. Hydrogen Energy, Accepted for publication, (2009).
18. Tiffany, D.R., Lear, W.E., Harris, M.R., and Crittenden, J.F., "DESIGN OF A NOVEL QUAD-GENERATION DISTRIBUTED ENERGY DEMONSTRATION PLANT,"Proceedings of ASME Turbo Expo 2009: Power for Land, Sea and Air, June 8-12, 2009, GT2009-60312, Orlando, Florida, USA

19. Singh, B., and Lear, W.E., "MODELING OF FLAME BLOWOUT AND EMISSIONS IN VITIATED COMBUSTION OF BIOFUELS,"Proceedings of ASME Turbo Expo 2009: Power for Land, Sea and Air, GT2009-60272, June 8-12, 2009, Orlando, Florida, USA
20. Singh, B., and Lear, W.E., "Flame Blowout Stability in Vitiated Combustion," AIAA-2009-4527 7th International Energy Conversion Engineering Conference, Denver, Colorado, Aug. 2-5, 2009
21. Singh, B., and Lear, W.E., "Soot Formation in Vitiated Combustion," AIAA-2009-4970, 45th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, Denver, Colorado, Aug. 2-5, 2009
22. Woodard, K.R., and L.E. Sollenberger. 2008. Production of elephantgrass for biofuel. University of Florida Cooperative Extension Pub. SSAGR297.
23. Castillo, M.S., L.E. Sollenberger, J.M.B. Vendramini, K.R. Woodard, G.A. O'Connor, and Y.C. Newman. 2009. Management of municipal biosolids affects organic nitrogen mineralization and elephantgrass yield. ASA/CSSA/SSSA Abstracts, Madison, WI.
24. Castillo, M.S., L.E. Sollenberger, J.M.B. Vendramini, K.R. Woodard, Y.C. Newman, and G.A. O'Connor. 2008. Nutrient management of elephantgrass for biomass production using municipal biosolids. ASA/CSSA/SSSA Abstracts, Madison, WI.
25. Castillo, M.S., L.E. Sollenberger, J.M.B. Vendramini, K.R. Woodard, G.A. O'Connor, and Y.C. Newman. 2008. Municipal biosolids as a nutrient source for elephantgrass biomass production. In 2008 annual meeting abstracts. Soil Crop Sci. Soc. Fla., Gainesville, FL.
26. Silveira, M.L.A., X. Sui, J.M.B.Vendramini, L.E. Sollenberger, and G.A. O'Connor. 2009. Utilization of biomass and forage crops to remediate P-impacted soils in Florida. ASA/CSSA/SSSA Abstracts, Madison, WI.
27. Sollenberger, L.E. 2009. Bioenergy feedstock from grasses in Florida: Candidate species and production challenges. In annual meeting abstracts. Soil and Crop Science Society of Florida.
28. P. H. Jones and Ujjval Vyas. "Energy Performance in Residential Green Developments: A Florida Case Study" Real Estate Issues 33(3):13-19. 2008.
29. Abhay Koppar and Pratap Pullammanappallil. 2009. Comparison of thermophilic and mesophilic single-stage, unmixed, batch anaerobic digestion of sugarbeet pulp. Sugar Industry/Zuckerindustrie. 134 (9), pp 586-591.
30. Fernando Luis Vargas, Bruce A. Welt, Arthur Teixeira, Pratap Pullammanappallil, Murat Balaban and Charles Beatty. 2009. Biodegradation of treated polylactic acid (PLA) under anaerobic conditions. Transactions of the ASABE, 52 (3), 1025-1030.
31. Sachin Gadekar and Pratap Pullammanappallil. 2009. Validation and applications of a chemical equilibrium model for struvite precipitation. Environmental Modeling and Assessment. http://dx.doi.org/10.1007/s10666-009-9193-7.
32. Luis Fernando Vargas, Bruce A. Welt, Pratap Pullammanappallil, Arthur A. Teixeira, Murat O Balaban and Charles L. Beatty. 2009. Effect of electron beam treatments on degradation kinetics of polylactic acid (PLA) plastic waste under backyard composting conditions. Packaging Technology and Science. 22(2), pp 97-106.
33. Gerasimos Lyberatos and Pratap Pullammanappallil. 2009. Anaerobic digestion in suspended growth bioreactors. Environmental Biotechnology, Handbook of Environmental Engineering Series, Volume 10, Editors: Lawrence K. Wang, Joo-Hwa Tay, Volodymyr Ivanov, Yung-Tse Hung, Humana Press. ISBN:978-1-58829-166-0
34. Takwai E. Lai, Abhay Koppar, Pratap C. Pullammanappallil and William P. Clarke. 2009. Mathematical modeling of batch, single stage, leach bed anaerobic digestion of organic fraction of municipal solid waste. In Optimization in the Energy Industry, Eds: J. Kallrath, P.M. Pardalos, S. Rebennack and M. Scheidt. pp 233-276. Springer. ISBN: 978-3-540-88964-9
35. Glynn, NC., R.A. Gilbert, B. Glaz, J.C. Comstock, M.S. Kang, C.W. Deren, P.Y.P Tai, and J.D. Miller. 2009. Repeatability between two intermediate sugarcane genotype selection stages in Florida. J. Crop Improv. 23:252-265

36. Gilbert, RA, NC Glynn, JC Comstock, and MJ Davis. 2009 Agronomic performance and genetic characterization of sugarcane transformed for resistance to sugarcane yellow leaf virus. Field Crops Res. 111:39-46
37. Comstock, JC, B Glaz, SJ Edme, RW Davidson, RA Gilbert, NC Glynn, JD Miller, and PYP Tai. 2009. Registration of CP 00-1446 sugarcane. J. Plant Reg. 3:28-34.
38. Glaz, B., SJ Edme, RW Davidson, RA Gilbert, JC Comstock, NC Glynn, JD Miller, PYP Tai. 2009. Registration of CP 00-2180 sugarcane. J. Plant Reg. 3:35-41
39. D. Oh, E. Armstrong, D. Jung, C. Kan, and E.D. Wachsman,"Mechanistic Understanding of Cr Poisoning on La0.6Sr0.4Co0.2Fe0.8O3-d (LSCF)," Solid Oxide Fuel Cells XI, ECS Transactions, S.C. Singhal, and H. Yokokawa, Ed, accepted.
40. S.C. Singhal, and H. Yokokawa, Ed,"Development of a Lower Temperature SOFC," E.D. Wachsman, Solid Oxide Fuel Cells XI, ECS Transactions, accepted.
41. S.R. Bishop, K. L. Duncan, and E. D. Wachsman,"Surface and Bulk Defect Equilibria in Strontium Doped Lanthanum Cobalt Iron Oxide (LSCF)," Journal of the Electrochemical Society, accepted.
42. T. K. Oh, H. Yoon and E. D. Wachsman,"Effect of Eu Dopant Concentration in SrCe1-xEuxO3-d on Ambipolar Conductivity," Solid State Ionics, accepted.
43. J. S. Ahn1, H. Yoon3, K. T. Lee1, M. Camaratta3, and E. D. Wachsman,"Performance of IT-SOFC with Ce0.9Gd0.1O0.1.95 Functional Layer at the Interface of Ce0.9Gd0.1O0.1.95 Electrolyte and Ni-Ce0.9Gd0.1O0.1.95 Anode," Fuel Cells, accepted.
44. H. Yoon, S. J. Song, T.-K. Oh, J. Li, K. L. Duncan, and E. D. Wachsman,"Fabrication of Thin Film SrCe0.9Eu0.1O3-δ Hydrogen Separation Membranes on Ni-SrCeO3 Porous Tubular Supports," Journal of the American Ceramic Society, accepted
45. T.-K. Oh, H. Yoon, and E. D. Wachsman,"Stability of SrCe0.9Eu0.1O3-δ under Dry/Wet Hydrogen Atmosphere," Ionics, accepted.
46. J. S. Ahn, D. Pergolesi, M. A. Camaratta, H. Yoon, B. W. Lee, E. Traversa and E. D. Wachsman,"High-Performance Bilayered Electrolyte Intermediate Temperature Solid Oxide Fuel Cells," Electrochemistry Communications, 11, 1504-1507 (2009).
47. K. L. Duncan and E. D. Wachsman,"Continuum - Level Analytical Model for Solid Oxide Fuel Cells with Mixed Conducting Electrolytes," Journal of the Electrochemical Society, 156, B1030-1038 (2009).
48. E. Fabbri, S. Licoccia, E. Traversa, and E. D. Wachsman,"Composite Cathodes for Application in Intermediate Temperature Solid Oxide Fuel Cells (IT-SOFCs) Based on Proton Conducting Electrolytes," Fuel Cells, 9, 128-138 (2009).
49. H. Yoon3, T.-K. Oh1, J. Li1, K. L. Duncan3, and E. D. Wachsman"Permeation Through SrCe0.9Eu0.1O3-δ / Ni-SrCeO3 Tubular Hydrogen Separation Membranes," , Journal of the Electrochemical Society, 156, B791-794 (2009).
50. S.R. Bishop, K. L. Duncan, and E. D. Wachsman,"Surface and Bulk Oxygen Non-Stoichiometry and Bulk Chemical Expansion in Gadolinium-Doped Cerium Oxide," Acta Materialia, 57, 3596-3605 (2009).
51. C. C. Kan and E. D. Wachsman,"Identifying Drivers of Catalytic Activity through Systematic Surface Modification of Cathode Materials," Journal of the Electrochemical Society, 156, B695-702 (2009).
52. D. S. Aidhy, S. B. Sinnott, E. D. Wachsman, S. R. Phillpot, and J. C. Nino,"Structure of δ-Bi2O3 from Density Functional Theory: A Systematic Crystallographic Analysis," Journal of Solid State Chemistry, 182, 1222-1228 (2009).
53. E. Fabbri, T.-K. Oh, S. Licoccia, E. Traversa, and E. D. Wachsman,"Mixed Protonic-Electronic Conductors as Cathode Materials for Proton Conducting Electrolytes in Intermediate Temperature Solid Oxide Fuel Cells (IT-SOFCs)," Journal of the Electrochemical Society, 156, B38-45 (2009).
54. J.R. Smith, A. Chen, D. Gostovic, D. Hickey, D. Kundinger, K.L. Duncan, R.T. DeHoff, K.S. Jones and E.D. Wachsman,"Evaluation of the Relationship Between Cathode Microstructure and Electrochemical Behavior for SOFCs," Solid State Ionics, 180, 90-98 (2009).

55. A. Jaiswall and E.D. Wachsman,“Impedance Studies on Bismuth-Ruthenate-Based Electrodes,” Ionics, 15, 1-9 (2009).
56. F. M. Van Asshe and E. D. Wachsman,“Isotopically Labeled Oxygen Studies of the NOx Exchange Behavior of La2CuO4 to Determine Potentiometric Sensor Response Mechanism,” Solid State Ionics, 179, 2225-2233 (2008).
57. S.R. Bishop, K. Duncan, and E. D. Wachsman, “Defect Equilibria and Chemical Expansion in Non-Stoichiometric Undoped and Gadolinium-Doped Cerium Oxide,” Electrochimica Acta, 54, 1436-1443 (2009).
58. J. Yoo, D. Oh, and E. D. Wachsman,"Investigation of WO3–Based Potentiometric Sensor Performance (M/YSZ/WO3, M = Pt, Au, Pd, and TiO2) with Varying Counter Electrode," Solid State Ionics, 179, 2090-2100 (2008).
59. A. C. Kan, H. H. Kan, F. M. Van Assche, E. N. Armstrong and E. D. Wachsman, “Investigating Oxygen Surface Exchange Kinetics of La0.8Sr0.2MnO3 and La0.6Sr0.4Co0.2Fe0.8O3 Using an Isotopic Tracer,” Journal of the Electrochemical Society, 155, B985-B993 (2008).
60. F. M. Van Assche, J. C. Nino and E. D. Wachsman,“Infrared and X-ray Photoemission Spectroscopy of Adsorbates on La2CuO4 to Determine Potentiometric NOx Sensor Response Mechanism,” Journal of the Electrochemical Society, 155, J198-J204 (2008).
61. A. S. Aidhy, J. C. Nino, S. B. Sinnott, E. D. Wachsman, and S. R. Phillpot,“Vacancy Ordered Structure of Cubic Bismuth Oxide from Simulation and Crystallographic Analysis,” Journal of the American Ceramic Society, 91, 2349-2356 (2008).
62. A. Chen, G. Bourne, K. Siebein, R.T. DeHoff, E. D. Wachsman, and K. Jones,“Characterization of Lanthanum Zirconate Formation at the A-Site Deficient Strontium-Doped Lanthanum Manganite Cathode /Yttrium Stabilized Zirconia Electrolyte Interface of Solid Oxide Fuel Cells,” Journal of the American Ceramic Society, 91, 2670-2675 (2008).
63. A. White, S. Chatterjee, and E. D. Wachsman,"Effect of Electrode Microstructure on the Sensitivity and Response Time of Potentiometric NOx Sensors," Journal of the American Ceramic Society, 91, 2024-2031 (2008).
64. S. Omar, E. D. Wachsman, and J. C. Nino,“Higher Conductivity Sm3+ and Nd3+ Co-Doped Ceria-Based Electrolyte Materials,” Solid State Ionics, 178, 1890-1897 (2008).
65. B. White, E. Traversa, and E. D. Wachsman,"Investigation of La2CuO4/YSZ/Pt Potentiometric NOx Sensors with Electrochemical Impedance Spectroscopy," Journal of the Electrochemical Society, 155, J11-16 (2008).
66. V. Esposito, D. Marani, E. D. Wachsman, and E. Traversa,“A Soft Chemistry Route for the Synthesis of Nanostructured Pb2Ru2O6.5 with a Controlled Stoichiometry,” Journal of the American Ceramic Society, 91, 437-443 (2008).
67. L. Chevallier, E. Di Bartolomeo, M. L. Grilli, M. Mainas, B. White, E. D. Wachsman and E. Traversa,"Non-Nernstian Planar Sensors Based on YSZ with a Nb2O5 Electrode," Sensors & Actuators: B. Chemical, 129, 591-598 (2008).
68. M. Camaratta and E.D. Wachsman,“High Performance Composite Bi2Ru2O7 - Bi1.6Er0.4O3 Cathodes for Intermediate Temperature Solid Oxide Fuel Cells,” Journal of the Electrochemical Society, 155, B135-142 (2008).
69. A. Kan, H. Kan, F. Van Assche, E. Armstrong and E. Wachsman,"Investigating Oxygen Surface Exchange Kinetics of La0.8Sr0.2MnO3 and La0.6Sr0.4Co0.2Fe0.8O3-δ Using an Isotopic Tracer," Solid State Ionic Devices V, ECS Transactions, E.D. Wachsman, F.H. Garzon, E. Traversa, R. Mukundan, and A. Manivannan, Ed., 11, 19-36 (2008).
70. J. Li, H. Yoon, T. Oh and E.D. Wachsman,"Stability of Zr-Doped SrCeO3-δ Under Wet CO/CO2 Atmospheres," Solid State Ionic Devices V, ECS Transactions, E.D. Wachsman, F.H. Garzon, E. Traversa, R. Mukundan, and A. Manivannan, Ed., 11, 81-87 (2008).
71. J. Ahn, H. Yoon and E.D. Wachsman,"Performance of IT-SOFC with Ce0.9Gd0.1O1.95 Functional Layer at the Interface of Ce0.9Gd0.1O1.95 Electrolyte and Ni-Ce0.9Gd0.1O1.95 Anode," Solid State

Ionic Devices V, ECS Transactions, E.D. Wachsman, F.H. Garzon, E. Traversa, R. Mukundan, and A. Manivannan, Ed., 11, 99-106 (2008).
72. B. Blackburn and E.D. Wachsman,"Multifunctional Gas Sensor Array With Improved Selectivity Through Local Thermal Modification," Solid State Ionic Devices V, ECS Transactions, E.D. Wachsman, F.H. Garzon, E. Traversa, R. Mukundan, and A. Manivannan, Ed., 11, 141-153 (2008).
73. F.M. Van Assche and E.D. Wachsman, "Isotopically Labeled Oxygen Studies of the Exchange Behavior of NOx over La2CuO4," Solid State Ionic Devices V, ECS Transactions, E.D. Wachsman, F.H. Garzon, E. Traversa, R. Mukundan, and A. Manivannan, Ed., 11, 155-179 (2008).
74. S. Bishop, K. Duncan, H. Hagelin-Weaver, L. Neal, J. Sanchez, H. Paul and E.D. Wachsman,"Oxygen Generation from Carbon Dioxide for Advanced Life Support," Solid State Ionic Devices V, ECS Transactions, E.D. Wachsman, F.H. Garzon, E. Traversa, R. Mukundan, and A. Manivannan, Ed., 11, 173 (2008).
75. Kwon H.-Y., S. Grunwald, H.W. Beck, Y. Jung, S.H. Daroub, T.A. Lang, and K.T. Morgan. 2009. Ontology-based simulation of water flow in organic soils applied to Florida's sugarcane. Agric. Wat. Manag. J. (in press).
76. Rivero R.G., S. Grunwald, M.W. Binford and T.Z. Osborne. 2009. Integrating spectral indices into prediction models of soil phosphorus in a subtropical wetland. Remote Sensing of Environment (in press).
77. Grunwald S. 2009. Multi-criteria characterization of recent digital soil mapping and modeling approaches. Geoderma 152: 195-207.
78. Daroub S.H., T.A. Lang, O.A Diaz and S. Grunwald. 2009. Long-term water quality trends after implementing best management practices in south Florida. J. Environ. Qual. 38(4): 1683-1693.
79. Ahn M.-Y., A.R. Zimmerman, N.B. Comerford, J.O. Sickman and S. Grunwald. 2009. Carbon mineralization and labile organic carbon pools in the sandy soils of a north Florida watershed. Ecosystems 12: 672-685.
80. Grunwald S., S.H. Daroub, T.A. Lang and O.A. Diaz. 2009. Tree-based modeling of complex interactions of phosphorus loadings and environmental factors. Sci. of the Total Environ. 407: 3772-3783.
81. Vasques G.M., S. Grunwald and J.O. Sickman. 2009. Visible/near-infrared spectroscopy modeling of dynamic soil carbon fractions. Soil Sci. Soc. Am. J. 73: 176-184.(pdf)
82. Meng Jiang, Baris Key, Shirley Meng and Clare. P. Grey, "Electrochemical and Structural Study of the Layered, "Li-Excess" Lithium-Ion Battery Electrode Material Li[Li1/9Ni1/3Mn5/9]O2", Chemistry of Materials, 21, 2733, 2009
83. Shirley Meng, M. E. A.-d. Dompablo, (invited review) "First principles computational materials design for energy storage materials in lithium ion batteries", Energy Environ. Sci., 2, 589, 2009.
84. Jacob. L. Jones, J. Hung, Shirley Meng, "Intermittent X-ray diffraction study of kinetics of delithiation in nano-scale LiFePO4", Journal of Power Sources, 189, 702, 2009.
85. Do Young Kim, Jegadesan Subbiah, Galileo Sarasqueta, Irfan, and Yongli Gao and Franky So, "The effect of molybdenum oxide on organic solar cells", Appl. Phys. Lett. Appl. Phys. Lett. 95, 093304-1-093304-3 (2009)
86. Franky So and Denis Kondokov, "Degradation mechanisms of organic light emitting diodes", Invited paper to be published in Adv. Mater.
87. Sang-Hyun Eom, Ying Zheng, Edward Wrzesniewski, Jaewon Lee, Neetu Chopra, Franky So and Jiangeng Xue, "White phosphorescent organic light emitting devices with dual triple-doped emissive layers", Appl. Phys. Lett. 95, 153303-153305 (2009)
88. Sang-Hyun Eom, Ying Zheng, Edward Wrzesniewski, Jaewon Lee, Neetu Chopra, Franky So, and Jiangeng Xue, "Effect of electron injection and transport materials on efficiency of deep-blue phosphorescent organic light-emitting devices", Organic Electron. 10, 686-191 (2009)
89. Neetu Chopra, Jaewon Lee, Ying Zheng, Sang-Hyun Eom, Jiangeng Xue and Franky So, "Investigating charge balance in blue phosphorescent organic light emitting diodes" ACS Appl. Mater. Interfaces 1, 1169-1172 (2009)

90. Evgueni Polikarpov, James Swensen, Neetu Chopra, Franky So, Asanga Padmaperuma, “An ambipolar phosphine oxide-based host for high power efficiency blue phosphorescent OLEDs”, Appl. Phys. Lett. 94, 223304-223306 (2009)
91. Jegadesan Subbiah, Pierre Beaujuge, Kaushik Roy Choudhury, Stefan Ellinger, John Reynolds, Franky So, “Efficient green solar cells via a chemically polymerizable donor-acceptor heterocyclic pentamer”, ACS Appl. Mater. Interfaces 1, 1154-1158 (2009), Selected as for the journal cover highlight.
92. Do Young Kim, Yongli Gao and Franky So, “Aluminum Phthalocyanine Chloride/C60 Organic photovoltaic cells with high open circuit voltage”, Solar Energy Mater and Solar Cells 93, 1688-1691 (2009)
93. Huanjun Ding, Kiwan Park, Yongli Gao, Do Young Kim and Franky So, “Electronic Structure and interactions of LiF doped tri (8-hydroxyquinoline) aluminum, Chem. Phys. Lett. 92, 473 (2009)
94. Do Young Kim, Franky So, “SnPc:C60 bulk heterojunction organic photovoltaic cells with MoO3 interlayer”, Solar Energy Mater. and Solar Cells 93, 1452-1456 (2009)
95. K. Roy Choudhury, A. Gupta, X. Jiang, F. Amy, and F. So, “Highly Efficient Hole Injection using Novel Polymeric Anode Materials for Small Molecule Organic Light-emitting Diodes, Adv. Funct. Mater. 19, 491-496 (2008) Selected as Advances in Advance category.
96. Jaewon Lee, Neetu Chopra, Sang-Hyun Eom, Ying Zheng, Jiangeng Xue, Franky So, and Jianmin Shi, “Effects of triplet energies and transporting properties of carrier transporting materials on blue phosphorescent organic light emitting devices”, Appl. Phys. Lett. 93, 123306-123308 (2008)
97. N. Chopra, J. Lee, Y. Zheng, S-H Eom, J. Xue and F. So, “High efficiency blue phosphorescent organic light emitting device”, Appl. Phys. Lett. 93, 143307-143309 (2008)
98. S.-H. Eom, Y. Zheng, N. Chopra, J. Lee, F. So and J. Xue, “Low voltage and very high efficiency deep-blue phosphorescent organic light-emitting devices”, Appl. Phys. Lett. 93, 133309-133311 (2008)
99. G. Sarasqueta, K. Roy Choudhury, D.Y. Kim and F. So, “Novel organic/inorganic nanocomposites for high dielectric constant materials”, Appl. Phys. Lett. 93, 123305-123307 (2008)
100. Y. Zheng, S-H Eom, N. Chopra, J. Lee, F. So and J. Xue, “Efficient deep-blue phosphorescent organic light-emitting device with improved electron and exciton confinement”, Appl. Phys. Lett. 92, 223301-223303 (2008)
101. J. Lee, N. Chopra, and F. So, “Cavity effects on light extraction in organic light emitting devices”, Appl. Phys. Lett. 92, 033303-033305 (2008)
102. K. Roy Choulhury, J.H. Yoon, and F. So, “LiF as an n-dopant in tri(8-hydroxyquinoline) aluminum thin films”, Adv. Mater. 20, 1456-1259 (2008)
103. A. So, P.E. Burrows, and J. Kido, “Organic light emitting devices for solid state lighting”, MRS Bulletin, 33, 663-668 (2008)
104. B. Liu, M. McCarthy, Y. Yoon, D. Kim, Z. Wu, F. So, P.H. Holloway, J.R. Reynolds, J. Guo, and A.G. Rinzler, “Carbon nanotube enabled vertical field effect and light emitting transistors”, Adv. Mater. 20,1-4 (2008)
105. Novaes, E., L. Osorio, D.R. Drost, B.L. Miles, C.R.D.B. Novaes, C. Benedict, C. Dervinis, Q. Yu, R. Sykes, M. Davis, T.A. Martin, G.F. Peter, and M. Kirst. 2009. Quantitative genetic analysis of biomass and wood chemistry of Populus under different nitrogen levels. New Phytologist 182: 878-890.
106. Lavoie, M., G. Starr, M.C. Mack, T.A. Martin and H.L. Gholz. Impact of prescribed fire on understory biomass production and nutrient availability in a naturally-regenerated longleaf pine-slash pine forest in north central Florida. Natural Areas Journal in press.
107. Newman, Y.C., S. Agyin-Birikorang, M.B. Adjei, J.M. Scholberg, M.L. Silveira, J.M.B. Vendramini, J.E. Rechcigl, and L.E. Sollenberger. 2009. Nitrogen fertilization effect on phosphorus remediation potential of three perennial warm-season forages. Agron. J. 101:1243-1248

108. Obour, A.K., M. L. Silveira, M.B. Adjei, J.M.B. Vendramini, and J.E. Rechcigl. 2009. Cattle manure application strategies effects on bahiagrass yield, nutritive value, and phosphorus recovery. Agron. J. 101:1099-1107
109. Dubeux, J.C.B., Jr., L.E. Sollenberger, L.A. Gaston, J.M.B. Vendramini, S.M. Interrante, and R.L. Stewart, Jr. 2009. Animal behavior and soil nutrient redistribution in continuously stocked Pensacola bahiagrass pastures managed at different intensities. Crop Sci. 49:1-8.
110. Vendramini, J.M.B. and J.D. Arthington. 2009. Effects of soybean hulls supplementation on performance of primiparous beef cows grazing warm-season pastures and receiving molasses supplement. Prof. Anim. Sci. 25:118-123.
111. Al-Raqom, F., Klausner, J.F., and Sherif, S.A., "Advances in Solar Thermal Hydrogen and Synthetic Fuel Production," Engineering Congress on Alternative Energy Applications, Kuwait, November 2nd –6th, 2009.
112. Bon, B., Guan, C.K., and Klausner, J.F., "Heterogeneous Nucleation," (keynote lecture) 7th International Conference on Boiling Heat Transfer, Florionopolis, Brazil, May 3-7, 2009.
113. Limaye, M., and Klausner, J.F., "Performance of a Flexible Evaporator for Loop Heat Pipe Applications," Proceedings of the 2008 ASME Summer Heat Transfer/Fluids/Solar/Nano Conference, 10-14 August, Jacksonville, FL, 2008.
114. Garrity, P.T., Klausner, J.F., and Mei, R., "Instability Phenomena in a Two-Phase Microchannel Thermosyphon,," Int. J. Heat and Mass Transfer, Vol. 52, pp. 1701-1708, 2009.
115. Liao, J., Mei, R., Klausner, J.F., "A Study on the Numerical Stability of the Two-Fluid Model Near Ill-Posedness," Int. J. Multiphase Flow, Vol. 34, pp. 1067-1087, 2008.
116. Knight, J.R., Klausner, J.F., Li, Y., and Mei, R., "Diffusion Driven Desalination Using Waste Heat in Air Streams," Int. J. Energy Research, Vol. 32, pp 837-846, 2008.
117. D. A. Micha and A. S. Leathers, "Reduced density matrix equations for combined instantaneous and delayed dissipation in many-atom systems, and theirnumerical treatment", Proceedings of the Paris 2007 Workshop {"Energy Transfer Dynamics in Biomolecular Systems} , co-editors E. Bittner, I.
118. Burghardt, V. May, and D. A. Micha, to appear (Springer-Verlag, Heidelberg, 2009)
119. D. S. Kilin and D. A. Micha, "Surface photovoltage at nanostructures on Si surfaces : Ab initio results", J. Phys. Chem. C 113, 3530-3542 (2009)
120. D. A. Micha, "Chemical reactions in the gas phase and in condensed matter: From wavefunctions to density operators", Intern. J. Quantum Chem.,
121. accepted (2009)
122. C. J. Obara, D. S. Kilin, and D. A. Micha, "Numerical model studies of confinement effects and optical properties of multilayer slabs of silicon" , Proc. SPIE, accepted (2009)
123. A. S. Leathers, D. A. Micha, and D. S. Kilin, "Density matrix treatment of combined instantaneous and delayed dissipations for an excited adsorbate on a solid surface", J. Chem. Phys, submitted (2009)
124. J. J. Ramirez, D. S. Kilin, and D. A. Micha, "Optical properties of the Si(111):H surface with adsorbed Ag clusters", Intern. J. Quantum Chem., submitted (2009)
125. Lee, J.G., Heaney, J.P., and C.A. Pack. 2009. Frequency Method for Evaluating Urban and Highway Stormwater Quality Control Infiltration BMPs. Jour. of Water Resources Planning and Management. Accepted for publication, 9/24/09.
126. Cornejo, C. Heaney, J. and L. Walker. 2009. Evolution of the Guide as a Tool to Develop Goal-Based Water Conservation Plans in Florida. Proc. Florida Section of AWWA Fall Conference, Orlando, December, To appear.
127. Friedman, K. and J. Heaney. 2009. Water Loss Management: Conservation Option in Florida's Urban Water Systems. Florida Water Resources Journal, August. http://www.fwrj.com/techarticles/0809%20FWRJ%20tech1.pdf.
128. Friedman, K. and J. Heaney. 2009. Validity of Water Audit and Water Loss Evaluations for Florida. Proc. Florida Section of AWWA Fall Conference, Orlando, December, to appear.
129. Heaney, J. and J. Sansalone. 2009. Urban Stormwater Management in 2050. Proc. ASCE/EWRI World Environmental and Water Congress. Kansas City, MO

130. Morales, M., Martin, J. and J. Heaney. 2009. Methods for Estimating Commercial, Industrial, and Institutional Water Use. Proc. Florida Section of AWWA Fall Conference, Orlando, December, to appear.
131. Palenchar, J., Friedman, K. and J. Heaney. 2009. Reuse and Private Wells to Offset Irrigation with Potable Water in Urban Water Systems. Florida Watershed Journal, to appear.

University of Florida (Other Publications)

1. Grunwald S., G.M. Vasques, N.B. Comerford, G.L. Bruland and C.M. Bliss. 2009. Regional modeling of carbon, nitrogen and phosphorus geospatial patterns. In Hanrahan G. (ed.) Modeling of Pollutants in Complex Environmental Systems Vol. II. ILM Publ., Hertfordshire, UK.
2. Grunwald S., B. Hoover and G.L. Bruland. 2009. An eLearning portal to teach geographic information sciences. In Syed M. (ed.) Methods and Applications for Advancing Distance Education Technologies: "International Issues and Solutions" included in the Advances in Distance Education Technologies Book Series (Vol. 3) (in press).
3. Myers D.B., N.R. Kitchen, K.A. Sudduth, S. Grunwald, R.J. Miles, E.J. Sadler and R.P. Udawatta. 2009. Combining proximal and penetrating soil electrical conductivity sensors for high resolution digital soil mapping. In: Viscarra-Rossel R. and A.B. McBratney (eds.) Soil Sensing and Digital Soil Modeling with Large Datasets (in press).
4. Newman, Y.C., L.E. Sollenberger, and J.M.B. Vendramini. 2009. Floralta limpograss (Hemarthria altissima). EDIS AG-330.
5. Vendramini, J.M.B., L.E. Sollenberger, and Y.C. Newman. 2009. Digitgrass. EDIS DS 124.
6. Sollenberger, L.E., J.M.B. Vendramini, and Y.C. Newman. 2009. Grazing management concepts and practices. EDIS AGR-92.
7. Vendramini, J.M.B. and M.L.A. Silveira. 2009. Pasture aeration. EDIS AG 331
8. Ying Zheng, Robel Bekele, Jiaomin Ouyang, and Jiangeng Xue, "Organic photovoltaic cells with vertically aligned crystalline molecular nanorods", Organic Electronics (2009, in press). (doi: 10.1016/j.orgel.2009.08.009)
9. Neetu Chopra, Jaewon Lee, Ying Zheng, Sang-Hyun Eom, Jiangeng Xue, and Franky So, "Effect of charge balance on high-efficiency blue-phosphorescent organic light-emitting diodes", ACS Applied Materials and Interfaces 1, 1169-1172 (2009)
10. Jason D. Myers, Teng-Kuan Tseng, and Jiangeng Xue, "Photocarrier behavior in organic heterojunction photovoltaic cells", Organic Electronics 10, 1182-1186 (2009).
11. Sang-Hyun Eom, Ying Zheng, Edward Wrzesniewski, Jaewon Lee, Neetu Chopra, Franky So, and Jiangeng Xue, "White phosphorescent organic light-emitting devices with dual triple-doped emissive layers", Applied Physics Letters 94, 153303 (2009).
12. Gilbert, RA, G. Kingston, K. Morgan, RW Rice, L. Braucum, JM Shine, F. Subrios. 2009. Effect of harvest method on microclimate and sugarcane yield in Florida and Costa Rica. American Socieyt of Sugar Cane Technologists Annual Meeting Abstract.
13. Gilbert, RA, 2009. Use of sugarcane and energy canes for Florida bioenergy. Soil and Crop Science Society of Florida Abstract
14. Gilbert, RA, G. Kingston, K. Morgan, RW Rice, L. Baucum, JM Shine and F. Subrios. 2009. Effect of harvest method on sugarcane growth and yield in Florida and Costa Rica. International Society of Sugacr Cahe Technologists Agronomy Workshop Abstract
15. Gilbert, R., J. Ferrell, and Z. Helsen. 2008. Production of giant reedgrass for biofuel. University of Florida Cooperative Extension Fact Sheet SS-AGR-318. 4pp. University of Florida, UF/IFAS Electronic Data Information Source (EDIS) Database http://edis.ifas.ufl.edu/AG327
16. Grainbolt, C., and R. Gilbert. 2008. Production of biofuel crops in Florida: Sugarcane/Energycane. University of Florida Cooperative Extension Service Fact Sheet SS-AGR-298. 4 pp. University of Florida, UF/IFAS Electronic Data Information Source (EDIS) Database http://edis.ifas.ufl.edu/AG303.

17. E.D. Wachsman, F.H. Garzon, E. Traversa, R. Mukundan, and A. Manivannan, Ed.,"Solid State Ionic Devices V, The Electrochemical Society Inc., Pennington, NJ, 11-33, 217 pages, ISBN 978-1-56677-674-5, 2008.
18. Cuiyang Wang; Shirley Meng; Yi Li, "Amorphous and Composite Al-Zr Thin Film Alloys as Anode Materials for Rechargeable Li Ion Batteries", Journal of Power Sources, submitted 2009
19. Hui Xia, Shirley Meng, ManOn Lai, Li Lu, "Structural and Electrochemical Properties of LiNi0.5Mn0.5O2 Thin Film Electrodes Prepared by Pulsed Laser Deposition", Journal of Physcial Chemistry, Submitted 2009
20. Maria K Chan, John Reed,Davide Donadio,Tim Mueller, Shirley Meng, Giulia Galli and Gerbrand Ceder, "Cluster Expansion and Optimization of Thermal Conductivity in SiGe Nanowires", Physical Review B, submitted, 2009.
21. Book chapter: Jiangeng Xue, "Mixed Molecular Heterojunction Photovoltaic Cells", in Organic Electronics: Materials, Physics, Processing and Device Applications, edited by Franky So, (CRC Press, in press).
22. Conference proceedings:
23. Jiangeng Xue, Ying Zheng, Jason D. Myers, Robel Bekele, and Jiaomin Ouyang, "Molecular heterojunction photovoltaic cells: photocarrier behavior and nanostructures", Proceedings of 34th Photovoltaics Specialists Conference
24. Jiangeng Xue, Sang-Hyun Eom, Ying Zheng, Edward Wrzesniewski, Neetu Chopra, Jaewon Lee, and Franky So, "High efficiency deep-blue and white phosphorescent OLEDs", Proceedings of SPIE (2009).
25. "Energy Transfer Dynamics in Biomaterial Systems", co-editors I Burghardt, V. May, D. A. Micha, and E. Bittner (Springer-Verlag, Heidelberg 2009)
26. Jaeyeon Kang and Sanjay Ranka: Energy-Efficient Dynamic Scheduling on Parallel Machines. HiPC 2008: 208-219
27. Jaeyeon Kang and Sanjay Ranka: DVS based energy minimization algorithm for parallel machines. IPDPS 2008: 1-12
28. Jaeyeon Kang and Sanjay Ranka: Dynamic Algorithms for Energy Minimization on Parallel Machines. PDP 2008: 399-406

University of South Florida (Refereed Publications):

1. Abutayeh M. and Goswami, D.Y. (submitting November 2009). "Experimental Simulation of Solar Flash Desalination," Solar Energy Engineering Journal
2. Abutayeh M. and Goswami, D.Y. (submitted October 2009), Passive Vacuum Solar Flash Desalination, American Institute of Chemical Engineers Journal.
3. Abutayeh M. and Goswami, D.Y. (submitted August 2009), "Solar Flash Desalination under Hydrostatically Sustained Vacuum," Solar Energy Engineering Journal.
4. Chen H., and Goswami, D.Y. (submitting November 2009), "Thermodynamic cycles and working fluids for the conversion of low-grade heat," Renewable and Sustainable Energy Reviews.
5. Chen H., and Goswami, D.Y. (submitting November 2009), "A supercritical Organic Rankine cycle using difluoromethane for low grade heat recovery", Renewable Energy.
6. Choudhury, P.; Srinivasan, S.; Bhethanabotla, V. R.; Goswami, Y., McGrath, K. and Stefanakos, E. (2009)."Nanocatalyzed Li-Mn-B-H System as a New Hydrogen Storage Candidate." Int. J. Hydrogen Energy, 34, 6325.
7. Demirkaya, G., Vasquez Padilla, R., Goswami, D.Y., Stefanakos, E., and Rahman, M.M. (submitted 2009). "Analysis of a Combined Power and Cooling Cycle for Low Grade Heat Sources", International Journal of Energy Research.
8. Escobar, D., Srinivasan, S., Goswami, D., Stefanakos, E., (2008), "Hydrogen Storage Behavior of Zrni 70/30 and Zrni 30/70 Composites." Journal of Alloys and Compounds, 458:1-2, pp. 223-230

9. Goswami, D.Y. (Editor-in-Chief), (2009). Passive Solar Architecture Pocket Reference, by James + James/Earthscan, London, UK (for the International Solar Energy Society), October.
10. Goswami, D.Y. (Editor-in-Chief), (2008). Wind Energy Pocket Reference, by James + James/Earthscan, London, UK (for the International Solar Energy Society), September.
11. Kislov, N. Lahiri, J. Verma, H. Goswami, D.Y. Stefanakos, E. and Batzill, M. (2009). "Photocatalytic Degradation of Methyl Orange over Single Crystalline ZnO: Orientation Dependence of Photoactivity and Photostability of ZnO" Langmuir 25, 3310
12. Lee, M.S., Goswami, D.Y., Stefanakos, E.K. (2008). “Immobilization of calcium oxide solid reactant on an yttria fabric and thermodynamic analysis of UT-3 thermochemical hydrogen production cycle,” International Journal of Hydrogen Energy, 34, pp.745 - 752.
13. Mahishi, M.R., Sadrameli, M.S., Vijayaraghavan, S., and Goswami, D.Y., (2008). “A Novel Approach to Enhance the Hydrogen Yield of Biomass Gasification using CO2 Sorbent,” Journal of Engineering for Gas Turbines and Power (ASME), 130, pp. 011501-0115018.
14. Niemann, M., Srinivasan, S., Kumar, A., Phani, A., Goswami, Y. and Stefanakos, E.K. (2008) "Nanomaterials for Hydrogen Storage Applications: A Review," Journal of Nanomaterials, article # 950967, vol. 2008, DOI:10.1155.
15. Srinivasan, S. Escobar, D. Goswami, D.Y., and Stefanakos, E. (2008), “Effects of catalysts doping on the thermal decomposition behavior of Zn(BH4)2” (2008) International Journal of Hydrogen Energy, 33, pp. 2268-2272.
16. Srinivasan, S., Escobar, D., Jurczyk, M., Goswami D.Y. and Stefanakos, E. (2008) “Nanocatalyst Doping of Zn(BH4)2 for On-board Hydrogen Storage,” Journal of Alloys and Compounds, 462, pp. 294-302.
17. Vittetoe, A.W., Niemann, M.U., Srinivasan, S.S., K. McGrath, Kumar, A., Goswami, D.Y., E.K. Stefanakos, and Thomas, S. (2009) “Destabilization of LiAlH4 by Nanocrystalline MgH2”, International Journal of Hydrogen Energy, 34:5, pp. 2333-2339.
18. Goswami, D.Y. (Editor-in-Chief), (2009). Passive Solar Architecture Pocket Reference, by James + James/Earthscan, London, UK (for the International Solar Energy Society), October.
19. Goswami, D.Y. (Editor-in-Chief), (2008). Wind Energy Pocket Reference, by James + James/Earthscan, London, UK (for the International Solar Energy Society), September.
20. Choudhury, P., Bhethanabotla V.R., and Stefanakos, E., (submitted 2009). "First principles study to identify the reversible reaction step of a multinary hydrogen storage "Li-Mg-B-N-H" system." J. Appl. Phys.
21. Choudhury, P., Bhethanabotla V.R. and Stefanakos, E., (2009). "Manganese borohydride as a hydrogen storage candidate: First-principles crystal structure and thermodynamics." J. Phys. Chem. C, 113, 13416
22. Choudhury, P.; Srinivasan, S.; Bhethanabotla, V. R.; Goswami, Y.; McGrath, K. and Stefanakos, E., (2009). "Nanocatalyzed Li-Mn-B-H System as a New Hydrogen Storage Candidate." Int. J. Hydrogen Energy, 34, 6325
23. Kislov, N. Lahiri, J. Verma, H. Goswami, D.Y. Stefanakos, E. and Batzill, M. (2009). "Photocatalytic Degradation of Methyl Orange over Single Crystalline ZnO: Orientation Dependence of Photoactivity and Photostability of ZnO," Langmuir 25, 3310.
24. A.H. Kababji, B. Joseph, J.T. Wolan; "Silica-Supported Cobalt Catalysts for Fischer-Tropsch Synthesis: Effects of Calcination Temperature and Support Surface Area on Cobalt Silicate Formation;" Catal. Lett (2009) 130: 72-78
25. B. D. Mankidy, C. A. Coutinho, and V. K. Gupta*, "Probing the Interplay of Size, Shape, and Solution Environment on Macromolecular Diffusion using a Simple Refraction Experiment", Journal od Chemical Education (Accepted).
26. C. A. Coutinho, B. D. Mankidy, and V. K. Gupta*, "A Simple Refraction Experiment for Probing Diffusion in Ternary Mixtures", Chemical Engineering Education (Accepted).
27. C. A. Coutinho and V. K. Gupta*, "Photocatalytic Degradation of Methyl Orange Using Polymer-Titania Microcomposites", J Colloid and Interface Science 333(2), 457-464 (2009).

28. S. Krishnan, Y. Emirov, E. Stefanakos, Y. Goswami, S. Bhansali, “Thermal Stability Analysis of Thin Film Ni-NiOx-Cr Tunnel Junctions,” Thin Solid Films, 2009, doi: 10.1016/j.tsf.2009.10.021
29. S. Krishnan, S. Bhansali, E. Stefanakos, Y. Goswami, “Thin Film Metal-Insulator-Metal Junction for Millimeter Wave detection,” Procedia Chemistry, 1, 2009, 409-412.
30. Hun-Young Wee, Jeffrey Cunningham, "Soil treatment by solvent extraction and catalytic hydrodehalogenation", International Journal of Environment and Waste Management, in press, 2009
31. Joshua Goldman, Russell Ferlita, Michael Keen, Jeffrey Cunningham, L Donald Duke, Daniel Yeh, "A multi-level, systematic evaluation of cleaning protocols for reverse osmosis membranes in drinking water treatment." Solutions [American Membrane Technology Association], Spring 2009, pp 10-16, 2009.
32. Jeffrey Cunningham, Itza Mendoza, "Efficient algorithms for modeling the transport and biodegradation of chlorinated ethenes in groundwater," Eos Transactions of the American Geophysical Union, vol 89, Fall meeting supplement, Abstract H21D-0838, 2008.
33. Roland Okwen, Jeffrey Cunningham, "Evaluating the effect of gravity on CO2 plume behavior in deep confined saline aquifers." Eos Transactions of the American Geophyiscal Union, vol 89, Fall meeting supplement, Abstract H23D-1010, 2008.
34. Roland Okwen, Mark Stewart, Jeffrey Cunningham, "Analytical solution for estimating storage efficiency of geologic sequestration of CO2", International Journal of Greenhouse Gas Control, accepted for publication, 2009
35. N. Kislov, J. Lahiri, H. Verma, D. Y. Goswami, E. Stefanakos, and M. Batzill, (2009). "Photocatalytic Degradation of Methyl Orange over Single Crystalline ZnO: Orientation Dependence of Photoactivity and Photostability of ZnO" Langmuir 25, 3310
36. T. Luttrell, W.-K. Li, X-Q. Gong, M. Batzill, (2009). “New Directions for Atomic Steps: Step Alignment by Grazing Incident Ion Beams on TiO2(110)” Phys. Rev. Lett. 102, 166103
37. S.L. Morrow, T. Luttrell, A. Carter, M. Batzill, (2009). “High temperature scanning tunneling microscopy of purely ion conducting yttria stabilized zirconia(YSZ)” Surf. Sci. 603, L 78
38. J. Lahiri, S. Senanayake, M. Batzill, (2008). “Soft x-ray photoemission of clean and sulfur-covered polar ZnO surfaces: A view of the stabilization of polar oxide surfaces” Phys. Rev. B 78, 155414
39. Cheng Zhang, Taina Matos, Rui Li, Eric Annih, and Sam-Shajing Sun; J. Zhang and X. Jiang, (submitted 2009). Synthesis and Characterization of Fully Regioregular Head-to-Tail Poly(3-Dodedyl-2,5-Thienylenevinylene) for Opto-Electronic Applications
40. G. Dedigamuwa, J. Lewis, J. Zhang, X. Jiang, P. Mukherjee and S. Witanachchi, , (2009). A laser-assisted spray process for the growth of surfactant-free PbSe quantum dot films, Appl Phys Lett 95, 122107
41. J. Lewis, J. Zhang and X. Jiang, (2009). Fabrication of organic solar array for applications in microelectromechanical systems, Journal of Renewable and Sustainable Energy 1, Vol. 1
42. K. Christensen, A. Roginsky, and M. Jimeno, "A New Analysis of the False-Positive Rate of a Bloom Filter," submitted to The Computer Journal in September 2009.
43. B. Nordman and K. Christensen, "Greener PCs for the Enterprise," IEEE IT Professional, Vol. 11, No. 4, pp. 28-37, July/August 2009.
44. J. Blackburn and K. Christensen, "Green Telnet: Modifying a Client-Server Application to Save Energy," Dr. Dobb's Journal, No. 414, pp. 33-38, November 2008
45. Nanduri, V., Das, T. K., and Rocha, P. 2009. “Generation Capacity Expansion in Energy Markets using a Two-Level Game Theoretic Model," IEEE Transactions on Power Systems, Vol. 24, 3, pp. 1165-1172.
46. Nanduri, V. and Das, T.K. 2009. A Reinforcement Learning Algorithm for obtaining Nash Equilibrium of Multi-player Matrix Games. IIE Transactions on Operations Engineering, Vol. 41, 2, pp. 158-167.
47. Nanduri, V. and Das, T. K. 2009. "A Survey of Critical Research Areas in the Energy Sector of Deregulated Electricity Markets", Electrical Power & Energy Systems, Vol. 31, 5, pp 181-191.

University of South Florida (Other Publications):
Nagarajan Ranganathan, a textbook on low power VLSI circuit design: Low Power High Level Synthesis for Nanoscale CMOS Circuits, S. Mohanty, N. Ranganathan, E., Kougianos and P. Patra, Springer, Jan 2008.

Florida State University (Refereed Publications):

1. Il-Yop Chung, Wenxin Liu, David A. Cartes, and Seung-Il Moon, "Control Parameter Optimization for Multiple Distributed Generators in a Microgrid Using Particle Swarm Optimization," submitted to European Transactions on Electrical Power.
2. W. Hang, J.C. Ordonez, J.V.C. Vargas, "Nondimensional Model for SOFC structure optimization", in preparation
3. P.L. Moss, G. Au, E.J. Plichta, and J.P. Zheng, "Investigation of solid electrolyte interfacial layer development
4. during continuous cycling using ac impedance spectra and micro-structural analysis", J. Power Sources, 189, 66 (2009)
5. J.P. Zheng, "High energy density electrochemical capacitors without consumption of electrolyte", J. Electrochem. Soc. 156, A500 (2009).
6. Mark Lubell, Richard Feiock and Edgar Ramierz. "Local Institutions and the Politics of Urban Growth," with Mark Lubell and Edgar Ramirez, American Journal of Political Science 53(3): 649-665, 2009.
7. P.L. Moss, G. Au, E.J. Plichta, and J.P. Zheng, "Investigation of solid electrolyte interfacial layer development and micro-structural analysis", J. Power Sources, 189, 66 (2009).
8. P.L. Moss, G. Au, E.J. Plichta, and J.P. Zheng "Study of Capacity Fade of Lithium-Ion Polymer Rechargeable Batteries with Continuous Cycling", submitted to J. Electrochem. Soc.
9. W. Zhu, D. Ku, J.P. Zheng, R. Liang, B. Wang, C. Zhang, S. Walsh, G. Au, and E. J. Plichta, "Highly-Efficient Bucky paper-Based Electrodes for PEMFC", submitted to J. Electrochem. Soc.
10. J.P. Zheng, "High energy density electrochemical capacitors without consumption of electrolyte", J. Electrochem. Soc. 156, A500 (2009).
11. W. Zhu, J.P. Zheng, R. Liang, B. Wang, C. Zhang, G. Au, and E. J. Plichta, "Durability Study of Carbon Nanotube/Nanofiber Buckypaper Catalyst Support for PEMFCs", J. Electrochem. Soc. 156, B1099 (2009).
12. B. Hacker, C. S. Edrington, and F. Bogdan, "The Future of Power Distribution", submitted to Ecoterra, 2009.
13. R. Bhuvanesawri, C. S. Edrington, D. A. Cartes, and S. Srikrishna, "Online Economic Environmental
14. Optimization of a Microgrid Using an Improved Fast Evolutionary Programming Technique", accepted to the
15. North American Power Symposium, Starkville, MS, Nov. 2009.
16. T. Bevis, B. Hacker, C. S. Edrington, and S. Azongha, "A Review of PHEV Grid Impacts", accepted to the
17. North American Power Symposium, Starkville, MS, Nov. 2009.
18. R. Bhuvaneswari, C.S. Edrington, D.A. Cartes, and S. Subramanian, "Economic Emission Generation
19. Scheduling in a Microgrid Using an Improved Fast Evolutionary Programming Technique," submitted to the
20. International Conference on Power Systems, 27-29 December 2009, IIT Kharagpur, India.
21. Il-Yop Chung, Wenxin Liu, Siyu Leng and David Cartes, "Controller Optimization for Inverter-Interfaced
22. Distributed Generators Considering Islanded Operation of a Microgrid," accepted to 2009 IEEE Energy
23. Conversion Congress and Exposition to be held in San Jose, California, USA, September 20-24, 2009.

24. B. Hacker, S. Azongha, and C. S. Edrington, “PHEV Impacts on Microgrid Systems”, submitted to the IEEE
25. Electric Power and Energy Conference, Montreal, Canada, Oct. 2009.
26. L.S. Martins, J.C. Ordonez, J.V.C. Vargas, “Experimental Validation of a simplified PEMFC Simulation
27. model”, Proceedings of ES2009, Energy Sustainability 2009, July 19-23, 2009, San Francisco, California USA.
28. L.F. Zanette, E.C. Telles, R.L.S. Marinardes, J.V.C. Varags, A.B. Mariano, J.C. Ordonez, “Development and
29. Analysis of a tri-generation System”, submitted to COBEM 2009.
30. E.M. Sommer, J.V.C. Vargas, L.S. Sanches, J.C. Ordonez, Development and Experimental Validation of a
31. Mathematical Model for Alkaline Membrane Fuel Cells (AMFC), submitted to COBEM 2009.
32. R. Hovsapian, J.V.C. Vargas, J.C. Ordonez, F.G Dias, “Experimental validation of a solar powered absorption
33. system”, in preparation.
34. L. Liu, Z.C. Wu, H. Li, “A Single-stage Grid-interactive Inverter Integrating Micro-Energy Storage (μES) with
35. Enhanced Reactive Power Compensation”, submitted to APEC 2010.
36. J.P. Zheng, “High energy density electrochemical capacitors without consumption of electrolyte”, J.
37. Electrochem. Soc. 156, A500 (2009).
38. J.P. Zheng, Invited paper on 2009 China-North America Workshop on Fuel Cell Science and Technology: Highly Efficient and Stable CNT Paper-Based Electrodes for PEMFCs, Shanghai, China, August 14, 2009.
39. P.L. Moss, G. Au, E.J. Plichta, and J.P. Zheng, “Investigation of solid electrolyte
40. interfacial layer development during continuous cycling using ac impedance spectra
41. and micro-structural analysis”, J. Power Sources, 189, 66 (2009).
42. S. V. Poroseva, R. Ford, and M. Y. Hussaini, “Computational Analysis of the Network Survivability due to its Topology” , submitted to International Workshop on Reliable Networks Design and Modeling,
43. J. Cronin, "Transumers: Motivations for Non-Ownership", accepted for publication at 2009 ACR North American Conference, Pittsburgh, PA
44. J. Cronin, "Against the Green: A Examination of Non-Green Consumers", accepted for publication at 2010 AMA Winter Educators Conference, New Orleans, LA
45. J. Cronin, "Holistic Green Behavior: The Impact of Lifestyle on Sustainable Practices", in progress with an expected completion date of December 2009
46. J. Cronin, "Segmenting Non-Green Consumers: Discovering Consumer Motivations for Non-Green Purchasing", with an expected completion date of October 31, 2009
47. J. Cronin, "Shades of Green: Profiling Florida’s Green Consumption", with an expected completion data of November 2009
48. J. Cronin, "An Investigation of the Effects of Perceived Environmentally Responsive Organizations on Consumer Perceptions of Quality and Satisfaction" with an expected completion date of December 2009
49. J. Cronin, "The Affects of a Firm’s Perceived Environmental Orientation and Familiarity on Consumer Perceptions" ,the expected completion date for this research is December 2009

Total Refereed Publications: 255
Total Other Publications: 34
Total Publications: 289

5. Professional Presentations Made

During Nov. 1, 2008 to Oct. 1, 2009 Period

#	Presenter	University	Title	Date
1	Sue Skemp	FAU	ASME Congress & Expo Boston, MA	11/3/08
2	Sue Skemp	FAU	MMS Ft Lauderdale, FL	11/13/08
3	Sue Skemp	FAU	Bahamian Counsel General Danuia Beach, FL	12/4/08
4	Sue Skemp	FAU	British Midland Economic Development Boca Raton, FL	12/10/08
5	Sue Skemp	FAU	Camp Dresser McKee Dania Beach, FL	12/15/08
6	Sue Skemp	FAU	NREL Dania Beach, FL	1/9/09
7	Sue Skemp	FAU	ASME Foundation Board Retreat Dania Beach, FL	1/12/09
8	Sue Skemp	FAU	British Consulate General Dani Beach, FL	1/14/09
9	Sue Skemp	FAU	Florida Engineering Society Orlando, FL	1/15/09
10	Sue Skemp	FAU	Museum Of Discovery & Sc Ft Lauderdale, FL	1/16/09
11	Sue Skemp	FAU	Carbon Trust Florida EOG Dania Beach, FL	1/28/09
12	Sue Skemp	FAU	OSTP Washington DC	2/2/09
13	Sue Skemp	FAU	President Brogan Visit Washington DC	2/3/09
14	Sue Skemp	FAU	President Brogan Visit Washington DC	2/4/09
15	Sue Skemp	FAU	FERC/ NOAA Washington DC	2/5/09
16	Sue Skemp	FAU	NAM Washington DC	2/6/09
17	Sue Skemp	FAU	College of the Bahamas	2/24/09
18	Sue Skemp	FAU	Rich Viens Dania Beach, FL	3/9/09
19	Sue Skemp	FAU	Green Energy Climate Conference West Palm Beach, FL	3/10/09
20	Sue Skemp	FAU	Congressman Ron Klein Dania Beach, FL	3/13/09
21	Sue Skemp	FAU	Vision Energy Dania Beach, FL	3/20/09
22	Sue Skemp	FAU	CAPS/FSU Dania Beach, FL	3/27/09
23	Sue Skemp	FAU	Florida DEP Tallahassee, FL	4/2/09
24	Sue Skemp	FAU	FAU Executive Leadership Forum Boca Raton, FL	4/7/09
25	Sue Skemp	FAU	Marine Global Energy Washington DC	4/14/09-4/15/09
26	Sue Skemp	FAU	IFA Ft. Lauderdale,	5/22/09
27	Sue Skemp	FAU	State Representative Maria Sachs Dania Beach, FL	6/23/09
28	Sue Skemp	FAU	U.S. Dept of State - Andrew Reynolds, Dep. S&T Dir. to Sec. of State	7/1/09
29	Sue Skemp	FAU	Governor Crist - Alternative Energy/Fuel Dania Beach, FL	7/23/09
30	Sue Skemp	FAU	Encompass Innovation Series III Boca Raton, FL	8/27/09
31	Sue Skemp	FAU	State Representative Evan Jenne Dania Beach, FL	8/28/09
32	Sue Skemp	FAU	FESC Briefing Dania Beach, FL	9/2/09
33	Sue Skemp	FAU	Renewable Energy Finance & Investment Summit, Hollywood, FL	9/15/09
34	Sue Skemp	FAU	NOAA NMFS Boca Raton, FL	9/16/09
35	Camille Coley	FAU	Henderson School FAU Boca Raton, FL	3/16/09
36	Camille Coley	FAU	FESC Oversight Meeting Orlando, FL	5/29/09
37	Camille Coley	FAU	Broward Climate Change Group Dania Beach, FL	7/15/09
38	Camille Coley	FAU	Florida Energy Systems Consortium Summit Tampa, FL	9/30/09

39	Camille Coley	FAU	Commissioner Jim Silverstone Dania Beach, FL	10/8/09
40	Howard Hanson	FAU	OE Seminar Series Dania Beach, FL	1/2//09
41	Howard Hanson	FAU	Greentech Inc Webinar Series online-	5/7/09
42	Howard Hanson	FAU	UCF Florida Solar Energy Center Seminar Daytona Beach, FL	5/28/09
43	Howard Hanson	FAU	ERAU Mechanical Engineering Seminar Daytona Beach, FL	5/28/09
44	Howard Hanson	FAU	Enterprise FL Inc Roadmap Conference West Palm Beach, FL	7/23/09
45	Howard Hanson	FAU	FAU Dept of Geosciences Colloquium Series Boca Raton, FL	9/11/09
46	Howard Hanson	FAU	American Water Resources Association Stuart, FL	9/11/09
47	Howard Hanson	FAU	Intl' Visitors Leadership Program US State Dept Dania Beach, FL	9/21/09
48	Howard Hanson	FAU	Florida Energy Systems Consortium Summit Tampa, FL	9/30/09
49	Leonard Berry	FAU	Florida Fish and Wildlife Conservation Commission Orlando, FL	10/03/08
50	Leonard Berry	FAU	South Florida Science museum Panel West Palm Beach, FL	4/26/09
51	Leonard Berry	FAU	Focus the Nation Planning Committee FAU Boca Raton , FL	3/18/09
52	Leonard Berry	FAU	St Gregory's Episcopal Church Lecture Series Boca Raton, FL	4/22/09
53	Leonard Berry	FAU	FAU Department of Geosciences Colloquium Boca Raton, FL	10/16/09
54	Leonard Berry	FAU	FAU MacArthur Campus Arboretum Sustainability Day Jupiter, FL	10/21/09
55	Rick Driscoll	FAU	Lockheed Martin Riveria Beach, FL	6/17/09
56	Rick Driscoll	FAU	NREL Golden, CO	7/15/09
57	Gabriel Alsenas	FAU	EH&S Dania Beach, FL	1/21/09
58	Gabriel Alsenas	FAU	MCM Impact Technologies NASA Dania Beach,	1/22/09
59	Gabriel Alsenas	FAU	McCartney Offshore Chris Howeter Dania Beach, FL	5/26/09
60	Gabriel Alsenas	FAU	Hoerbiger/Broward Alliance Dania Beach, FL	6/8/09
61	Gabriel Alsenas	FAU	Audubon Pine Jog Jupiter, FL	9/1/09
62	Gabriel Alsenas	FAU	American Classic Yachts Phil Catsman Dania Beach, FL	9/15/09
63	Gabriel Alsenas	FAU	Audubon Gumbo Limbo Boca Raton, FL	10/20/09
64	Erick Busold	FAU	Broward Youth Leadership Dania Beach, FL	12/9/08
65	Shirley Ravenna	FAU	OE Seminar Series Dania Beach, FL	4/16/09
66	Caitlin Slezycki	FAU	US Coast Guard Academy New London, CT	3/3/09
67	Caitlin Slezycki	FAU	Old Lyme High School Lyme, CT	3/3/09
68	Caitlin Slezycki	FAU	MIT Energy Club Boston, MA	3/4/09
69	Caitlin Slezycki	FAU	Johnson and Wales University Dania Beach, FL	4/16/09
70	Caitlin Slezycki	FAU	South Florida Women's Dive Club Deerfield Beach , FL	6/3/09
71	Caitlin Slezycki	FAU	Broward County Climate Change Commission Miami FL	7/15/09
72	Caitlin Slezycki	FAU	North American Power Symposium Starkville, MS	10/6/09
73	Jim VanZwieten	FAU	College Advisory Board Dania Beach, FL	4/16/09
74	Alana Smentek	FAU	Johnson and Wales University N Miami Beach, FL	5/6/09
75	Nicholas S Asseff	FAU	NREL Golden, CO	7/15/09
76	Laurie Bransdorf	FAU	DAR Nova SE University	7/11/09
77	Laurie Bransdorf	FAU	FAU Honors College Dania Beach, FL	7/16/09
78	Laurie Bransdorf	FAU	League of Women's Voters Coconut Creek, FL	9/21/09

79	Ali T-Raissi, Nazim Muradov, Clovis Linkous	UCF	"On-board Reformation and Desulfurization of High Sulfur Liquid Fuels to Hydrocarbons and Hydrogen Gas", *Naval Energy Forum*, McLean, VA,	10/1/09
80	Nazim Muradov, Ali T-Raissi, Amit Gujar, Nathaniel Garceau	UCF	"Thermochemical Conversion of Biomass to Hydrocarbon Fuels as Substitutes for Petroleum-Based Fuels", *Naval Energy Forum*, Arlington, VA,	10/1/09
81	Amit Gujar, Nathaniel Garceau, Gary Bokerman, Nazim Muradov, Ali T-Raissi,	UCF	"Fischer-Tropsch Synthesis and Product Upgrading Over Dual Bed Catalytic System", *AIChE Meeting*, Nashville, TN.	11/9/09
82	Ali T-Raissi, Nazim Muradov, David Block, Amit Gujar, Nathaniel Garceau,	UCF	"Integrated Florida Bio-Energy Production with Carbon Capture & Sequestration", *FESC Summit*, Tampa, FL.	9/9/09
83	Nazim Muradov, Ali T-Raissi, Amit Gujar, Nathaniel Garceau.	UCF	Thermochemical conversion of biomass to hydrocarbon fuels as substitutes for petroleum-based fuels", *Farm to Fuel Summit, FDACS*, Orlando, FL.	8/1/09
84	Zhihua Qu, Marwan Simaan	UCF	"A Design of Distributed Game Strategies for Networked Agents", *the 1st IFAC Workshop on Estimation and Control of Networked Systems (NecSys'09)*, Venice, Italy.	9/1/09
85	Jiangmin Chunyu, Zhihua Qu, Eytan Pollak, Mark Falash	UCF	"A New Reactive Target-tracking Control with Obstacle Avoidance in a Dynamic Environment", *2009 American Control Conference*, St. Louis, MO	6/1/09
86	Zhihua Qu, Marwan Simaan	UCF	"Power Systems with Distributed Generation: Self-Organizing Micro-Grids, Optimization, and Control", *National Workshop on New Research Directions for Future Cyber-Physical Energy Systems*, Baltimore, MD,	6/1/09
87	Y. Guo, Zhihua Qu, Y. Braiman	UCF	, "Control of Friction at the Nanoscale through Vibration", *Proceedings of 2009 NSF Engineering Research and Innovation Conference*, Honolulu, HI.	6/1/09
88	M.P. Rodgers, K. Cooper, R. Agarwal, B. Li, B.P. Pearman, D.K. Slattery, N. Mohajeri, L.J. Bonville, H.R. Kunz, and J.M. Fenton	UCF	Membrane Electrode Assembly Durability Test System (MEADS), Fuel Cells Durability and Performance, Las Vegas, Nevada.	12/1/08
89	Xinyu Huang, Wonsoek Yoon	UCF	"Inhomogenous Degradation of Polymer Electrolyte Membrane in PEM Fuel Cells," *216th ECS Meeting*, Vienna, Austria.	10/1/09
90	Ted Kury	UF	"Energy Policy and the Environment: Challenges and Opportunities" FESC Summit, Tampa, Florida.	9/1/09
91	S. R. Phadke, C. Bowers, E. D. Wachsman and J. C. Nino	UF	"Proton Conduction in Doped SnP_2O_7 by using Impedance Spectroscopy and MAS-NMR Spectroscopy", 215th ECS Meeting, San Francisco, CA,	5/1/09
92	J. Li, H. Yoon, T. Oh and E. D. Wachsman	UF	"Stability and Hydrogen Permeability of $SrCe_{0.7}Zr_{0.2}Eu_{0.1}O_3$/Ni- $SrCe_{0.8}Zr_{0.2}O_3$ Membrane under Water Gas Shift Reaction and Methane Steam Reforming Conditions", 215th ECS Meeting, San Francisco, CA,	5/1/09
93	S. R. Bishop, K. Duncan and E. D. Wachsman	UF	"Defect Formation and Thermo-chemical Strain in Fluorite and Perovskite Oxygen Conductors", 215th ECS Meeting, San Francisco, CA,	5/1/09
94	T. Oh, H. Yoon, J. Li and E. D. Wachsman	UF	"Effect of Dopant Concentration on Hydrogen Permeability of $SrZrxCe_{1-x-y}EuyO_{3-\delta}$", 215th ECS Meeting, San Francisco, CA.	5/1/09
95	Eric D. Wachsman	UF	"Fuel Cell Vehicles; Why a Systems Approach Would Have Led to a Different Technology," Power Systems Modeling 2009, , University of Florida, Gainesville, FL.	3/1/09
96	Eric D. Wachsman	UF	"Why Florida Should Lead in Sustainable Energy," ***Plenary*** 15th Annual Public Interest Environmental Conference, "Beyond Doom and Gloom: Illuminating Florida's Future," , Levin College of Law, Gainesville, FL.	2/1/09

97	Eric D. Wachsman	UF	"Why Florida Should Lead in Sustainable Energy," 36th Annual Public Utility Research Center (PURC) Conference, "Changes in Climate and Information Technologies: Who's Driving Utility Policy?" , Gainesville, FL.	2/1/09
98	Eric D. Wachsman	UF	"Deconvolution of SOFC Cathode Polarization Mechanisms" American Ceramic Society, Daytona Beach, FL.	1/1/09
99	E. Macam, B. Blackburn, R. Mendoza, and E. Wachsman	UF	"Electrochemical Analysis of the Effect of Area of La_2CuO_4 Electrodes for NO_x Sensor Applications and Its Implications on Sensing Mechanism," American Ceramic Society, Daytona Beach, FL.	1/1/09
100	E. Armstrong, T. Striker V. Ramaswamy J. Ruud and E. Wachsman	UF	"TPD/TPR Characterization of Oxide Nano-Materials for Sensor Applications," American Ceramic Society, Daytona Beach, FL.	1/1/09
101	C. Kan., and E. Wachsman	UF	"Modification of Catalytic Activity for Oxygen Reduction on $La_{0.8}Sr_{0.2}MnO_{3-\delta}$ with Catalyst Infiltration," American Ceramic Society, Daytona Beach, FL.	1/1/09
102	S. Bishop, K. Duncan, and E. Wachsman	UF	"Defect Equilibria in Perovskite SOFC Cathodes," American Ceramic Society, Daytona Beach, FL.	1/1/09
103	S. Bishop, K. Duncan, and E. Wachsman	UF	"Defect Equilibria in Ceria-based SOFC Materials," American Ceramic Society, Daytona Beach, FL.	1/1/09
104	J. Ahn, H. Yoon, and E. Wachsman	UF	"Anode Functional Layer for Intermediate Temperature Solid Oxide Fuel Cells," American Ceramic Society, Daytona Beach, FL.	1/1/09
105	J. A. Sanchez, S. R. Bishop, and E. Wachsman	UF	"Investigating the Processing and Performance of Copper Impregnated Gadolinia-Doped-Ceria Anode Supported Solid Oxide Fuel Cells," American Ceramic Society, Daytona Beach, FL.	1/1/09
106	K. T. Lee, D. W. Jung, M. A. Camaratta, J. S. Ahn, H.Yoon, B.W. Lee, and E. Wachsman	UF	"Fabrication and Characterization of High Performance IT-SOFC with Ceria/Bismuth Oxide Bilayered Electrolyte," American Ceramic Society, Daytona Beach, FL.	1/1/09
107	J. Li, T. Oh, H. Yoon, E. Wachsman	UF	"Fabrication and Hydrogen Permeation Properties of Tubular Ni-$SrCe_{0.8}Zr_{0.2}O_3$/$SrCe_{0:7}Zr_{0:2}Eu_{0:1}O_3$ Hydrogen Membrane," , American Ceramic Society, Daytona Beach, FL.	1/1/09
108	J. Li, T. Oh, H. Yoon, E. Wachsman	UF	"Hydrogen Transport Water Gas Shift Membrane Reactor," American Ceramic Society, Daytona Beach, FL.	1/1/09
109	D. Gostovic, K. Jones, and E. Wachsman	UF	"Characterization of Composite Cathodes Using FIB/SEM and TEM," American Ceramic Society, Daytona Beach, FL.	1/1/09
110	D. Gostovic, K. Jones, and E. Wachsman	UF	"Analysis of LSCF/YSZ Symmetric Cathodes Using FIB/SEM in Conjunction with EIS," American Ceramic Society, Daytona Beach, FL.	1/1/09
111	D.J. Oh, D.W. Jung, D. Gostovic, and E.Wachsman	UF	"Degradation Mechanism of LSCF," American Ceramic Society,, Daytona Beach, FL.	1/1/09
112	Eric D. Wachsman	UF	"Deconvolution of SOFC Cathode Polarization Mechanisms" Materials Research Society, Boston, MA.	12/1/08
113	Eric D. Wachsman	UF	"Conductivity in Highly Defective Fluorites" Materials Research Society, Boston, MA.	12/1/08
114	Gary Peter	UF	"Quantitative and Association Genetics of Wood Properties in Loblolly Pine," INRA, Bordeaux, France.	7/1/05
115	Gary Peter	UF	"Quantitative and Association Genetics of Wood Properties in Loblolly Pine," IUFRO Tree Biotechnology, Whistler Mountain, Canada.	7/1/05
116	Gary Peter	UF	"Genetic Control of Hydraulic Conductivity and Water Relations in Populus," University of British Columbia, Vancouver.	6/30/05
117	Gary Peter	UF	"Association Genetics to Identify Genes Controlling Wood Properties in Loblolly Pine," SFTIC, Blacksburg, VA,	7/1/05
118	Yige Hu, Gijs Bosman, Tim Anderson	UF	"Device simulation of ZnO/CdS/CIGS/Mo solar cell using Medici," Poster FESC Summit, Tampa, September 2009	9/1/09

119	Jenshan Lin,	UF	"RF Circuits and Systems – An Interleaving Course of RF Integrated Systems and Wireless Communications beyond RFIC," 10th Annual IEEE Wireless and Microwave Technology Conference, Clearwater, FL,	4/1/09
120	Joaquin Casanova	UF	"Transmitting Coil Achieving Uniform Magnetic Field Distribution for Planar Wireless Power Transfer System," IEEE Radio and Wireless Symposium, San Diego, California, .	1/1/09
121	James Heaney	UF	Heaney, J.P. 2009. Economic Efficiency and Equity Aspects of Sustainable Urban Water Infrastructure. Grand Environmental Challenges Conference, Association of Environmental Engineering Sciences Professor, U. of Iowa, Iowa City. IA, July.	7/1/09
122	James Heaney	UF	Heaney, J.P. 2009. Sustainable Urban Water Infrastructure Systems. Invited Plenary Presentation, Urban Water Management; Issues and Opportunities, 2009 Universities Council on Water Resources Conference, Chicago, IL, July.	7/15/09
123	James Heaney	UF	Heaney, J.P. 2009. Urban Stormwater Management in 2050. ASCE World Environmental and Water Resources Congress 2009, Kansas City, MO, May.	5/1/09
124	James Heaney	UF	Heaney, J.P. 2009. Overview of Conserve Florida Water Clearinghouse. Invited Presentation, Regional Water Conservation Policy Summit, Sarasota, FL, April.	4/1/09
125	John Erickson	UF	"Water-use efficiency and feedstock composition of candidate bioenergy grasses in Florida," FESC Summit, Tampa, FL.	9/1/09
126	John Erickson	UF	"Agronomic characteristics of potential biofuel crops in Florida," 1st Brazil-U.S. Biofuels Short Course, Sao Paolo, Brazil.	8/1/09
127	John Erickson	UF	"Biofuel crops for Florida," Florida Exotic Pest Plant Council's 24th Annual Symposium, Delray Beach, FL.	5/1/09
128	D.R. Tiffany, W.E. Lear, M.R. Harris, and J.F. Crittenden, J.F.	UF	"DESIGN OF A NOVEL QUAD-GENERATION DISTRIBUTED ENERGY DEMONSTRATION PLANT,"Proceedings of ASME Turbo Expo 2009: Power for Land, Sea and Air, , GT2009-60312, Orlando, Florida.USA	6/1/09
129	B. Singh, B., and W.E.Lear	UF	"MODELING OF FLAME BLOWOUT AND EMISSIONS IN VITIATED COMBUSTION OF BIOFUELS,"Proceedings of ASME Turbo Expo 2009: Power for Land, Sea and Air, GT2009-60272, , Orlando, Florida, USA.	6/1/09
130	B. Singh, B., and W.E.Lear	UF	"Flame Blowout Stability in Vitiated Combustion," AIAA-2009-4527 7th International Energy Conversion Engineering Conference, Denver, CO	8/1/09
131	B. Singh, B., and W.E.Lear	UF	"Soot Formation in Vitiated Combustion," AIAA-2009-4970, 45th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, Denver, Colorado,	6/4/09
132	M. Brooks, W.. Lear, S.A. Sherif, S. du Clou, M. Mhlongo, J. Olivier, J.	UF	"Pulse-driven Refrigeration: Progress and Challenges," AIAA-2009-4593 7th International Energy Conversion Engineering Conference, Denver, Colorado, Aug. 2-5, 2009	8/1/09
133	Lynn Sollenberger	UF	. Bioenergy feedstock from grasses in Florida: Candidate species and production challenges. Soil and Crop Science Society of Florida Annual Meeting. Jacksonville, FL.	7/1/05
134	Pierce Jones	UF	*Restoration Development Order Recommendations.Edgewater Planning & Zoning Commission. Edgewater, FL, .*	1/14/09
135	Pierce Jones	UF	*Energy & Housing in Florida. Florida Municipal Energy Efficiency Committee. Gainesville, FL.*	1/16/09
136	Pierce Jones	UF	*Energy & Housing in Florida. Gulf Coast Energy Network, Ft. Walton FL, .*	1/23/09
137	Pierce Jones	UF	Alternative Transportation in Florida. Alachua County Library System, Hawthorne FL.	1/25/09
138	Pierce Jones.	UF	*Restoration Development Order Recommendations.Edgewater Planning & Zoning Commission. Edgewater, FL.*	1/26/09
139	Pierce Jones	UF	Plug-in Hybrid Electric Vehicles: Initial Thoughts. Lakeland South Rotary, Lakeland FL.	1/25/09

140	Pierce Jones	UF	Restoration. Edgewater City Commission, Edgewater FL,	2/2/09
141	Pierce Jones	UF	"Energy & Housing in Florida", Baker & Hostetler (Lwe firm), Orlando, FL,	2/3/09
142	Pierce Jones	UF	"FESC Outreach Overview," FESC Steering Committee", Gainesville, FL.	2/4/09
143	Pierce Jones	UF	"Environmental Challenges to Florida's Future", Orange County EcoNomic Living, Orlando,FL.	2/7/09
144	Pierce Jones	UF	"Community Development and Climate Change, UF/IFAS In-service Training," Plant City, FL.	2/18/09
145	Pierce Jones,	UF	"Reduced Impact Practices at 'Restoration'", Florida Tech's International Sustainability Conference, Melbourne, FL.	3/4/09
146	Pierce Jones	UF	"Plug-in Hybrid Electric Vehicles: Initial Thoughts", UF/FISE Seminar Series, Gainesville, FL.	3/16/09
147	Pierce Jones	UF	"Green Building and Construction", Florida Housing Coalition Conference, Orlando, FL.	4/20/09
148	Pierce Jones	UF	"Monetizing Energy in Resource Efficient Communities", Association of Florida Community Developers, Orlando, FL	5/22/09
149	Pierce Jones	UF	"Resource Efficient Master Planned Communities", DOE SE Regional Workshop, Orlando, FL	5/27/09
150	Pierce Jones	UF	"Extension Resource Efficiency Programs", Farm Foundation, Little Rock, AK.	6/30/09
151	Pierce Jones	UF	"Compact Urban Form and GHG Emissions", Florida Environmental Resources Agencies Conference, Sarasota, FL.	7/30/09
152	Pierce Jones	UF	"Bright Ideas to Build On", Southeast Builders Conference, Orlando, FL.	7/31/09
153	Pierce Jones	UF	"HB 697: Carbon Credits for Measured Performance", TREEO Continuing Education Workshop, Tampa, FL.	9/28/09
154	Pierce Jones	UF	"FESC Education and Outreach Efforts", FESC Energy Summit, Tampa, FL.	9/28/09
155	Pratap Pullammanappallil	UF	"Biogasification of citrus processing waste - a case study", Pepsico/Tropicana Research Discussions, University of Florida, Gainesville, FL.	10/8/09
156	Pratap Pullammanappallil	UF	" High-solids anaerobic digestion technologies for municipal solid waste," Hennepin County, St. Paul, MN,	2/19/09
157	Pratap Pullammanappallil	UF	"Biogasification of sugarbeet processing residuals", American Society of Sugar Beet Technologists Annual Meeting, Orlando, FL	2/26/09
158	Pratap Pullammanappallil	UF	"Validation of a comprehensive chemical equilibrium model for predicting struvite precipitation", International Conference on Nutrient Recovery from waste streams, Vancouver, Canada.	5/1/09
159	Pratap Pullammanappallil	UF	"Biogas Systems", Florida Small Farms and alternative Enterprises Conference, Osceola, FL.	8/1/09
160	Pratap Pullammanappallil	UF	"Carbon and Greenhouse Gas Emissions of Biomass Processing Techniques for Aviation Fuel", Biofuels for Aviation Summit, Washington D. C.	9/1/09
161	Pratap Pullammanappallil	UF	Pratap Pullammanappallil, "Demonstration Anaerobic Digester for American Crystal Sugar Company, MN", Bioenergy Engineering, Seattle, WA.	11/1/08
162	Robert Gilbert	UF	"Producing sweet sorghum and sugarcane in Florida for bioethanol: opportunities and challenges. " International Conference on Research and Education Opportunities in Biofuel Crop Production. EARTH University, Costa Rica	11/1/08
163	Robert Gilbert	UF	"Department of Energy funding – a model for inter-institutional cooperation in biofuel research." International Conference on Research and Education Opportunities in Biofuel Crop Production. EARTH University, Costa Rica	11/1/08
164	Robert Gilbert	UF	"Effect of harvest method on sugarcane growth and yield in Florida and Costa Rica." Oral presentation. International Society of Sugar Cane Technologists Agronomy Workshop. Uberlandia, Brazil,	6/1/09

165	Robert Gilbert	UF	" Effect of harvest method on microclimate and sugarcane yield in Florida and Costa Rica." Oral presentation. American Society of Sugar Cane Technologists Joint Annual Meeting. Biloxi, MS.	6/1/09
166	Robert Gilbert	UF	"Use of sugarcane and energy canes for Florida bioenergy." Oral presentation, Soil and Crop Science Society of Florida annual meeting, Jacksonville, FL, June, 2009	6/1/09
167	Robert Gilbert	UF	"Energy grasses for Florida sandland." Oral presentation. Sandland Germplasm Workshop, Clewiston, FL,	5/1/09
168	Sabine Grunwald,	UF	"Database infrastructure for integrative carbon science research", FESC Summit, Tampa, FL.	9/1/09
169	Shirley Meng,	UF	"Combined Experimental and First Principles Studies on Factors Affecting Li Mobility in Spinel Lithium Transition Metal Oxides", MRS, Boston.	12/1/08
170	Shirley Meng	UF	"Advancee Nanomaterials for electric energy storage & conversion," UC San Diego NanoEngineering, Department Seminar,	12/1/08
171	Shirley Meng,	UF	"Electric Energy Storage - A Grant Challenge," Society for Green Moblity, U. Florida.	1/1/09
172	Shirley Meng,	UF	"High Capacity Cathode Materials for LIB - NASA/STTR Kick-off Meeting", NEI Corporation, New Jersey,	2/1/09
173	Shirley Meng,	UF	"Time-resolved X-ray Diffraction Study on Kinetics and Structural Evolution in Olivine Materials for Lithium Rechargeable Batteries", MRS, San Francisco.	4/1/09
174	Shirley Meng,	UF	"Overview of Energy Storage Research", FESC Battery Conference, UF.	5/1/09
175	Shirley Meng,	UF	"Time-resolved X-ray Diffraction Study on Structural Evolution in Olivine Materials for Lithium Rechargeable Batteries", CERMACS (ACS), Cleveland OH.	5/1/09
176	Shirley Meng,	UF	"Advanced NanoMaterials for Electric Energy Storage & Conversion", Oak Ridge National Lab, Invited Seminar.	5/1/09
177	Shirley Meng,	UF	Shirley Meng, " Advanced NanoMaterials for Electric Energy Storage & Conversion", Xiamen University, China, State Key Lab Invited Seminar.	6/1/09
178	Shirley Meng,	UF	" Advanced NanoMaterials for Electric Energy Storage & Conversion", Chinese University of Hong Kong,Department Seminar.	6/1/09
179	J.M.B Vendramini and J.D. Arthington.	UF	"Effects of supplemental cottonseed meal versus part-time annual ryegrass grazing on performance of beef heifers grazing stockpiled limpograss pastures. In: ASAS-ADSA-PSA Annual meeting. Montreal, Canada.	7/1/09
180	J.M.B. Vendramini	UF	Vendramini, J.M.B. 2009. To fertilize or not fertilize, what are the alternatives? Beef Cattle Short Course. Gainesville, FL.	5/1/09
181	Jiangeng Xue	UF	"Organic Light-Emitting Devices and Photovoltaic Cells", Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, Changchun, China,	5/13/09
182	Jiangeng Xue	UF	"Organic and Hybrid Organic-Inorganic Photovoltaic Cells", National Laboratory of Synchrotron Radiation, University of Science and Technology of China, Hefei, China.	5/8/09
183	Jiangeng Xue	UF	"Morphology Control and Charge Transport in Organic-Based Photovoltaic Cells", Department of Polymer Sciences and Engineering, Zhejiang University, Hangzhou, Zhejiang, China.	5/6/09
184	Jiangeng Xue	UF	"Organic Optoelectronic Materials and Devices", Department of Materials Science and Engineering, University of California, Berkeley, CA	Feb-09
185	Jiangeng Xue	UF	"Organic Optoelectronic Materials and Devices", Electro-Optics Graduate Program and Department of Electrical Engineering, University of Dayton, Dayton, OH,	1/1/09
186	Jiangeng Xue	UF	"Nanostructures for Photovoltaics", 2009 International Conference on Nanophotonics, Harbin, China,	5/1/09

187	Jiangeng Xue	UF	“High efficiency deep-blue and white phosphorescent OLEDs”, Optics & Photonics 2009, SPIE’s Annual Meeting, San Diego, CA.	8/1/09
188	Jiangeng Xue	UF	“Molecular heterojunction photovoltaic cells: photocarrier behavior and nanostructures”, 34th Photovoltaics Specialists Conference, Philadelphia, PA.	6/1/09
189	Jiangeng Xue	UF	“Understanding and Controlling the Morphology of Vacuum-Deposited Molecular Organic Photovoltaic Devices”, 2008 Materials Research Society Fall Meeting, Boston, MA.	12/1/09
190	M. Abutayeh, M. Batzill, K. Dalrymple, D.Y. Goswami, E. Stefanakos, M. Trotz	USF	Clean Drinking Water using Advanced Solar Energy Technologies, Florida Energy Systems Consortium Summit, Tampa, FL.	9/1/09
191	M. Abutayeh, D.Y. Goswami	USF	Experimental Simulation of Solar Flash Desalination, ASME International Mechanical Engineering Congress & Exposition, Lake Buena Vista, FL.	11/9/08
192	M. Abutayeh, D.Y. Goswami	USF	Passive Vacuum Solar Flash Desalination, AIChE National Meeting, Philadelphia, PA. (Accepted)	11/9/09
193	H. Chen, D.Y. Goswami	USF	“The conversion of moderate temperature heat into power and refrigeration with CO2 and organic binary working fluid,” Proceedings of biennial international student conference of Education without Borders”, Dubai, UAE,.	4/9/09
194	H. Chen, D.Y. Goswami	USF	“The conversion of moderate temperature heat into power and refrigeration,” Proceedings of the Annual Meeting of the American Institute of Chemical Engineers, Philadelphia, PA.	11/9/08
195	P. Choudhury, S. Srinivasan, V.R. Bhethanabotla, Y. Goswami, E. Stefanakos	USF	"LiMn(BH4)3 for on-board hydrogen storage." AIChE Annual Meeting 2009, Nashville, TN. (Accepted)	11/9/09
196	G. Demirkaya, R. Vasquez Padilla, D.Y. Goswami, E.K. Stefanakos	USF	"Utilizing Low Temperature Heat Sources by a Power and Cooling Cycle, Poster Presentation", USF College of Engineering Research Day, Tampa, Florida.	10/9/09
197	D.Y. Goswami	USF	“Prospects of Renewable Energy in the Global Energy System” at the Renewables in a Changing Climate from Nano to Urban Scene (CISBAT 2009), Lausanne Switzerland.	9/9/09
198	D.Y. Goswami	USF	“Global Energy Future” at the World Hydrogen Energy Conference, New Delhi, India.	8/9/09
199	D.Y. Goswami	USF	“New and Emerging Solar Energy Technologies – Challenges and Opportunities” Renewable Energy and Beyond Conference, Tel Aviv, Israel.	5/9/09
200	R. Vasquez Padilla, G. Demirkaya, D.Y. Goswami, E.K. Stefanakos	USF	“Parametric Study of a Combined Power and Cooling Thermodynamic Cycle for Low Temperature Heat Sources”, Proceedings of the 2009 ASME International Mechanical Engineering Congress and Exposition Conference, IMECE2009, Lake Buena Vista, FL.	11/9/09
201	P. Choudhury, V.R. Bhethanabotla, E. Stefanakos	USF	"Borohydride for reversible hydrogen storage." MRS Meeting 2009, Boston, MA (Abstract accepted).	12/9/09
202	P. Choudhury, N. Balakrishnan, V.R. Bhethanabotla, E. Stefanakos	USF	"Complex borohydride for reversible hydrogen storage." AIChE Annual Meeting 2009, Nashville, TN (Abstract accepted).	11/9/09
203	S. A.Z. Gardezi, J. T. Wolan, B. Joseph	USF	"An Integrated Approach to the preparation of effective catalyst for Biomass-to-liquid (BTL) process," 33rd Annual AIChE Clearwater Conference	6/9/09
204	Rudraskandan Rudraskandan	USF	"Thin Film based MIM diodes for Infrared Energy Conversion," 2nd Annual USF College of Engineering Research Day Symposium, Tampa, Fl	10/9/09
205	S.A. Z. Gardezi, B. Joseph, J. T. Wolan	USF	"Metal support interaction effects in Fischer Tropsch synthesis: significance of catalyst preparation", (Accepted) AIChE annual meeting	11/9/09
206	Stanley Russell	USF	“Evolution of the American Zero Energy House” at the International Conference on Building Science and Engineering held in Johor Bahru Malaysia.	12/9/09

207	B. Zhang, K. Sabhanatarajan, A. Gordon-Ross, and A. George,	USF	"Real-Time Performance Analysis of Adaptive Link Rate," Proceedings of the IEEE Conference on Local Computer Networks, pp. 282-288.	10/8/08
208	Babu Joseph, Y. Goswami, V. Bhethanabotla, J. Wolan and V. Gupta	USF	"Production of Biomass via Thermochemical Process," FESC Summit, Tampa, FL	9/9/09
209	N. Balakrishnan, V.R. Bhethanabotla, B. Joseph	USF	"In Effect of Cluster Size on CO Adsorption and Dissociation on Cobalt Catalysts: DFT Studies Using Cluster Models," (Accepted) AIChE Annual Meeting, Conference Proceedings, Nashville, TN.	11/9/09
210	N. Balakrishnan, V.R. Bhethanabotla, B. Joseph	USF	"In Effect of Cluster Size on CO Adsorption and Dissociation on Cobalt Catalysts: DFT Studies Using Cluster Models," presented in FESC summit, USF, Tampa, FL.	9/9/09
211	N. Balakrishnan, P. Choudhury,V.R. Bhethanabotla, B. Joseph	USF	"In Density Functional Theory Studies on a Reversible Hydrogen Storage 'Li-Mg-B-N-H' System", Annual Meeting, Conference Proceedings, Philadelphia, PA, United States	6/30/05
212	Bijith D. Mankidy and Vinay K. Gupta	USF	"Novel Composite Particles for Catalysis: Cobalt Nanoparticles on Silica Colloids", The Southeastern Regional Meeting of American Chemical Society, Nashville (TN).	11/8/09
213	Bijith D. Mankidy and Vinay K. Gupta	USF	"Cobalt Nanoparticles on Surface Modified SiO2 Colloids for Fischer Tropsch Synthesis", Florida Energy Systyems Consortium Summit, University of South Florida, Tampa FL.	9/9/09
214	P. Choudhury, N. Balakrishnan, V.R. Bhethanabotla, E. Stefanakos	USF	"In Complex Borohydride for Reversible Hydrogen Storage," (Accepted) AIChE Annual Meeting, Conference Proceedings, Nashville, TN.	11/9/09
215	Stanley Russell	USF	"Energy Efficiency and The Zero Energy Home Learning Center" (Accepted) ACSA 2010 National Conference, New Orleans, LA.	3/10/10
216	F. Blanquicet and K. Christensen	USF	"Managing Energy Use in a Network with a New SNMP Power State MIB," Proceedings of the IEEE Conference on Local Computer Networks, pp. 509-511.	10/8/08
217	J. Blackburn and K. Christensen	USF	"A Simulation Study of a New Green BitTorrent," Proceedings of the First International Workshop on Green Communications (in conjunction with the IEEE International Conference on Communications).	6/9/09
218	Jeffrey Cunningham, Itza Mendoza-Sanchez	USF	"Efficient algorithms for modeling the transport and biodegradation of chlorinated ethenes in groundwater." American Geophysical Union 2008 Fall Meeting, San Francisco, CA.	12/8/08
219	K. Sabhanatarajan and A. Gordon-Ross	USF	"A Resource Efficient Content Inspection System for Next Generation Smart NICs," Proceedings of IEEE Conference on Computer Design	10/8/08
220	M. Jimeno, K. Christensen, and B. Nordman	USF	"A Network Connection Proxy to Enable Hosts to Sleep and Save Energy," Proceedings of the IEEE International Performance Computing and Communications Conference, pp. 101-110.	12/8/08
221	Michael Celestin	USF	"Tunnel Diodes Fabricated using Self-Assembled Alkanethiol Films on Au," 2nd Annual USF College of Engineering Research Day Symposium, Tampa, FL.	10/9/09
222	Roland Okwen, Jeffrey Cunningham	USF	"Evaluating the effect of gravity on CO2 plume behavior in deep confined saline aquifers." American Geophysical Union 2008 Fall Meeting, San Francisco, CA.	12/8/08
223	Roland Okwen, Mark Stewart, Jeffrey Cunningham	USF	"Storage of CO2 in deep saline aquifers via injection in horizontal wells." TOUGH Symposium 2009, Berkeley, CA.	9/9/09
224	Won-Seok Kim, Anh Do, Daniel Yeh, Jeffrey Cunningham	USF	"Comparison of extraction and derivatization methods for use in GC/MS analysis of endocrine-disrupting compounds in water." American Chemical Society 237th ACS National Meeting, Salt Lake City, UT.	3/9/09

225	Won-Seok Kim, Jeffrey Cunningham,	USF	"Comparison of analytical methods with solid-phase extraction and solid-phase micro-extraction with derivatization for detecting and quantifying bisphenol-A in water", SETAC North America 29th Annual Meeting, Tampa, FL.	11/8/08
226	Stanley Russell	USF	"Zero Energy Homes" (Accepted) Eco Architecture 2010 conference, La Coruna, Spain.	4/1/10
227	Zichen Xu, Yi-Cheng Tu, and Xiaorui Wang	USF	"Exploring Power-Performance Tradeoffs in Database Systems." (Accepted) *Proceedings of 26th IEEE International Conference on Data Engineering* (*ICDE*), Long Beach, CA.	3/1/10
228	Rocha, P., Nanduri, V., and Das, T. K.	USF	Generation Expansion in Restructured Electricity Markets under a CO2 Cap-and-Trade Program. IIE Annual Conference 2009, Miami, FL.	
229	Rocha, P. Das, T. K. and Salimi, E.	USF	A Two tier Model for Joint Bidding in FTR and Energy Markets, Invited Talk, INFORMS, San Diego.	10/1/09
230	Rocha, P. Das, T. K. and Nanduri, V.	USF	Capacity Planning in Restructured Energy Markets with Carbon Cap-and-Trade, Invited Talk, INFORMS, San Diego, October 2009	10/1/09
231	Uma Outka	FSU	"Siting Renewable Energy Infrastructure in Florida: Regulatory Barriers and Key Considerations", White Paper, IESES Brown Bag, Tallahassee,	9/11/09
232	P.L. Moss, M.H. Weatherspoon, E.E. Kalu, and J.P. Zheng	FSU	"Investigation of solid electrolyte interfacial layer development during continuous cycling", Proceeding of the FREEDM Systems Center, Annual Conference, Raleigh, NC,	5/18-19/2009
233	Alex Huang, Mariesa Crow, Gerald Heydt, Jim Zheng, Steiner Dale, Yu Liu	FSU	"The Future Renewable Electric Energy Delivery and Management (FREEDM) System: The Energy Internet", submitted to *Proceedings of the IEEE.*	11/1/09
234	R. Bhuvanesawri, C. S. Edrington, D. A. Cartes, and S. Srikrishna	FSU	"Online Economic Environmental Optimization of a Microgrid Using an Improved Fast Evolutionary Programming Technique", accepted to the North American Power Symposium, Starkville, MS	
235	T. Bevis, B. Hacker, C. S. Edrington, and S. Azongha,	FSU	"A Review of PHEV Grid Impacts", accepted to the North American Power Symposium, Starkville, MS	11/1/09
236	R. Bhuvaneswari, C.S. Edrington, D.A. Cartes, and S. Subramanian	FSU	"Economic Emission Generation Scheduling in a Microgrid Using an Improved Fast Evolutionary Programming Technique," submitted to the International Conference on Power Systems, 27-29 December 2009, IIT Kharagpur, India.	12/27/09
237	Il-Yop Chung, Wenxin Liu, Siyu Leng and David Cartes	FSU	"Controller Optimization for Inverter-Interfaced Distributed Generators Considering Islanded Operation of a Microgrid," accepted to 2009 IEEE Energy Conversion Congress and Exposition to be held in San Jose, CA, USA	9/20-24/2009
238	B. Hacker, S. Azongha, and C. S. Edrington	FSU	"PHEV Impacts on Microgrid Systems", submitted to the IEEE Electric Power and Energy Conference, Montreal, Canada	10/1/09
239	L.S. Martins, J.C. Ordonez, J.V.C. Vargas	FSU	"Experimental Validation of a simplified PEMFC Simulation model", Proceedings of ES2009, Energy Sustainability 2009, July 19-23, 2009, San Francisco, California USA.	7/19/09
240	L.F. Zanette, E.C. Telles, R.L.S. Marinardes, J.V.C. Varags, A.B. Mariano, J.C. Ordonez	FSU	"Development and Analysis of a tri-generation System", submitted to COBEM 2009.	7/1/05
241	E.M. Sommer, J.V.C. Vargas, L.S. Sanches, J.C. Ordonez	FSU	, Development and Experimental Validation of a Mathematical Model for Alkaline Membrane Fuel Cells (AMFC), submitted to COBEM 2009.	7/1/05
242	R. Hovsapian, J.V.C. Vargas, J.C. Ordonez, F.G Dias	FSU	"Experimental validation of a solar powered absorption system", in preparation.	
243	L. Liu, Z.C. Wu, H. Li	FSU	, "A Single-stage Grid-interactive Inverter Integrating Micro-Energy Storage (μES) with Enhanced Reactive Power Compensation", submitted to APEC 2010.	
244	Tim Chapin	FSU	"Planning's Wicked Problems: The Search for Solutions to our Transportation, Land Use, Environmental, and Community Health Challenges", at the Transportation System Strategies to	5/1/09

			Reduce Greenhouse Gases (GHG) In Florida in May 2009, co-hosted by the Florida Departments of Transportation and Health and 1000 Friends of Florida.	
245	Tim Chapin	FSU	Ivonne Audirac, and Chris Coutts presented a project overview to the State Agency Smart Growth Committee in October 2009.	10/1/09
246	Svetlanan Pevnitskaya	FSU	"Economic Games and Mechanisms to Address Climate Change," a workshop organized by the Mathematical Sciences Research Institute at UC Berkeley, May 5, 2009	5/5/09
247	Svetlanna Pevnitskaya	FSU	"International Meeting of Economic Science Association (ESA)", Washington DC, June 26, 2009	6/26/09
248	Svetlanna Pevnitskaya	FSU	"IESES research seminar series (first talk in the series)", FSU,	7/1/09
249	Andy Opel	FSU	"Energy and Efficiency Video Public Service Announcements", Conference on Communication and the Environment, Portland, ME, June 27-30, 2009	6/27/09
250	Tim Chapin, Ivonne Audirac, and Chris Coutts	FSU	"Promoting Energy Sustainability through Land Use, Transportation, and Green Infrastructure Policies",presented a project overview to the State Agency Smart Growth Committee in October 2009	10/1/09
251	Mark Issac	FSU	"Political and Economic Institutions Regarding Siting of Energy Facilities", 2009 Meetings of the Southern Economics Association, San Antonio, TX	11/1/08
252	Jim P. Zheng	FSU	"High Performance Fuel Cells using Buckypaper", Louisiana State University, Baton Rouge, L.A., February 13,2009	2/13/09
253	Joseph Cronin	FSU	"The Role of Eco-Labeling on Consumer Behavior Intentions", presented at 2009 Academy of Marketing Science World Marketing Congress in Oslo, Norway and 2009 FESC Summit in Tampa, FL	9/29/09

Total Presentations Made: 253

6. Invention Disclosures & Patents

During Nov. 1, 2008 to Oct. 1, 2009 Period*

#	Faculty	University	Disclosure / Patent #	Title
1	Nazim Muradov, Ali T-Raissi, Amit Gujar, Nathaniel Garceau	UCF	Patent Application	Direct thermochemical conversion of biomass to hydrocarbon fuels (in preparation).
2	Nicoleta Hickman, Robert Reedy	UCF	Patent Application	Hybrid Thermal Electric PV
3	John Shen	UCF	UCF Internal	A technique to reduce electrical field in GaN power devices
4	Louis Chow	UCF	Patent Application	Thermal Conductive Porous Element-Based Recuperators
5	Louis Chow	UCF	Patent Application	Dual Latent Heat Sink
6	Louis Chow	UCF	Patent Application	Particle Enhanced Heat Exchange
7	Issa Batarseh	UCF	Patent Application	Generalized Parallel-Series Ultracapacitor Shift Circuits for Energy Storage Systems
8	Issa Batarseh	UCF	Patent #US7,471,524	Isolated DC-DC Converters with High Current Capability
9		UCF	U.S. Patent Application Serial No. 12/243,431	Hybrid Solar Cell Integrating Photovoltaic and Thermoelectric Elements for High Efficiency and Longevity
10	James Klausner	UF	UF Disclosure	Desalination Apparatus and Process
11	William Lear	UF	US Patent #7,472,550 (UF #11470)	Combined Cooling and Power Plant with Water Extraction Issued 1/6/2009
12	Elliot N. Miller, Laura R. Jarboe, Lorraine P. Yomano, Sean W. York, KT Shanmugam and L.O. Ingram	UF	UF#-13025	Furfural resistant mutant
13	Elliot N. Miller, Laura R. Jarboe, Lorraine P. Yomano, Sean W. York, KT Shanmugam, and L.O. Ingram	UF	UF#-13026	Engineering the pathway for succinate production
14	Elliot N. Miller, Laura R. Jarboe, Lorraine P. Yomano, Sean W. York, K.T. Shanmugam, and L.O. Ingram	UF	UF#-13027	MgsA mutant improves sugar utilization

15	L.O. Ingram and E.N. Miller	UF	UF # 13147	Transhydrogenase genes increase furfural tolerance
16	Preston, J.F., V. Chow, G. Nong, J.D. Rice, and F.J. St. John	UF	UF #	Bioprocessing of Hemicellulose and Uses Thereof
17	Preston, J.F., C. Bi, and J.D. Rice	UF	U.S. Provisional Application SN 61/115, 722 UF #12617 Filed 11/18/2008	Biocatalyst for complete conversion of hemicellulose to biobased products
18	Jenshan Lin	UF	UF#13206	Multi-Frequency Diagnostic Sensor for Improving Safety in Large-Scale Batteries
19	Jenshan Lin	UF	International Patent Application PCT/US2008/084970	Method and Apparatus for High Efficiency Scalable Near-Field Wireless Power Transfer
20	Pratap Pullammanappallil	UF	UF# 13079	Continuously Fed Anaerobic Digestion of Solid and Soluble Organic Wastes, By-Products and Residues
21	Shirley Meng	UF	UF12983/ US 162766	High Energy Density Cathode Materials for Lithium Ion Batteries
22	Shirley Meng, Franky So, Jiangeng Xue, John Reynolds and Karl. Zawoy	UF	UF13187/ US/183359	Integrated PV/Battery/OLED Lighting Module (SoLiOled)
23	Mark Orazem, Shirley Meng, Jenshan Lin	UF	UF13206	Multi-Frequency Diagnostic Sensor for Improving Safety in Large-Scale Batteries
24		USF	61037869	Hydrogen Storing Hydride Complexes
25	Yogi Goswami, August 2008.	USF	*U.S. Patent Serial No. 7,063,820 8/2008	Enhanced Photoelectrochemical Air Disinfection
26	Yogi Goswami,	USF	*US Patent No 7,371,351 May 13, 2008. (Licensed to King of Fans and AT&TL, Inc.)	Enhanced Photocatalytic Air Detoxification and Disinfection by Active Electron Transfer
27	M., Buckle, K.A., Stefanakos, E., Weller, T., and Goswami, Y.	USF	*US Patent No. 7,362,273 B2 April 22, 2008.	"Dual-Polarized Feed Antenna Apparatus and Method of Use",
28	Bhansali, S., Stefanakos, L., and Goswami, Y.	USF	*US Patent application 61/089,767 August 18, 2008.	"Rectenna Systems Composed of Emitters, Concentrators and Collecting Rectennas for the Conversion of Infrared Radiation to Electric Power"

29	Stefanakos, E., and Goswami, Y.	USF	*USF Patent Application (Applied August 2008)	"Rectenna Solar Energy Harvester"
30	Srinivasan, S., Jurczyk, M., Goswami, D., Stefanakos, E.	USF	*USF Ref. No. 07B147PRProvisional Patent filed on 3/19/08	"Methods and processes for producing complex hydrides exhibiting higher hydrogen storage capacity and fast sorption kinetics at moderate temperature"
31	V. K. Gupta, A. Kumar, C. Coutinho, S. Mudhivarthi	USF	US Patent Application (20090013609) January 15, 2009	Polymeric Microgels for Chemical Mechanical Planarization (CMP) Processing
32	Sarehraz, M.,Buckle, K., Stefanakos, E., Weller, T., Goswami, D.Y.	USF	US patent 7362273 B2 April 22, 2008	"Dual-Polarized Feed Antenna Apparatus and Method of Use"
33	M.Sarehraz, K. Buckle, E. Stefanakos, T. Weller, Y. Goswami	USF	US Patent Number 7,486,236 February 3, 2009	" High Frequency Feed Structure Antenna Apparatus and Method of Use"
34	M. Sarehraz, K. Buckle, E. Stefanakos, T. Weller, Y. Goswami	USF	Patent disclosure	"A method to obtain full rectification of radiation received from an antenna"
35	M.Sarehraz, K. Buckle, E. Stefanakos, T. Weller, Y. Goswami	USF	Patent disclosure	"A High Frequency Feed Structure Applicable to a Single Antenna or an Array"
36	Lee, M.S., Goswami, D.Y., Kothurkar, N., Stefanakos, E.K	USF	Provisional Patent 2008	"A practical method of CO_2 Sequestration"
37	Kababji, A. H., and Wolan, J. T.	USF	US Patent Pending Application (12/039,191) Feb. 28 2008	"VPO/SiC catalysts for the partial oxidation of n-butane to maleic anhydride"
38	Farrukh Alvi	FSU	09-157 - Disclosed 4/30/2009	High Bandwidth and Control Authority Micro-Actuators for Active Flow and Noise Control
39	Simon Foo	FSU	09-151 - Disclosed 4/29/2009	Indium Phosphide, Indium-Gallium-Arsenide and Indium-Gallium-Antimonide based High Efficiency Multijunction Photovoltaics for Solar Energy Harvesting
40	Simon Foo	FSU	09-163 - Disclosed 4/29/2009	Indium Phosphide, Indium-Gallium-Arsende and Indium-Gallium-Antimonide based High Effeciency Multijunction Photovoltaics

41	Richard Liang; Jim Zheng; Ben Wang, Chuck Zhang	FSU	10-047 - Disclosed 10/5/2009	Smithyman - Free-standing Nanocomposite Material Utilizing Carbon Nanotube Networks as the Host for Activated Carbons and Other Particles without the Use of Adhesive Binders and the Manufacturing Process Thereof
42	Richard Liang, Ben Wang, Chuck Zhang, Ben Wang	FSU	04-114 Wang US Patent Application No. 7,459,121 - Issues 12/02/2008	"A Method for Continuous Fabrication of Carbon Nanotube Networks or Membrane Materials"
43	J.P. Zheng, Z.Y. Liang, B. Wang, C. Zhang, and W. Zhu	FSU	US Patent Assigned Serial Number 61/081,851 (pending)	" Carbon nanotube and nanofiber film materials based membrane electrode assemblies for fuel cells"

* Some of these are not within the reporting period; however provided for information exchange.

7. Technologies Licensed and Revenues Received

Nothing to report during this period.

8. Collaborations with Other Postsecondary Institutions

During Nov. 1, 2008 to Oct. 1, 2009 Period

#	Faculty	University	Description of Collaboration	Name of Institution
1	Howard Hanson	FAU	Current Resource Modeling/Simul.	FSU - COAPS
2	Howard Hanson	FAU	Sea Water Hydrolysis	UCF - FSEC+E8
3	Susan Skemp, Caitlin Slezycki	FAU	Power Systems Management	FSU - CAPS
4	Howard Hanson	FAU	NSF Proposal - Array Design/Control	Embry Riddle Aeronautical University
5	Howard Hanson	FAU	CRADA -	NREL
6	Manhar Dhanak & Rick Driscoll	FAU	Research and Testing	Heriot-Watt University, UK
7	Susan Skemp	FAU	Research and Testing	University of Edinburgh, UK
8	Howard Hanson & Susan Skemp	FAU	Ocean Research and Standards	Oregon State University
9	Susan Skemp & Rick Driscoll	FAU	OTEC Research and Standards	University of Hawaii, Nat. Marine Renewable Energy Center
10	Howard Hanson, Rick Driscoll, & Susan Skemp	FAU	Resource Measurement & Assessment	University North Carolina - Wilmington
11	Susan Skemp	FAU	OTEC Research Requirements	University of New Hampshire - Coastal Response Research Center
12	Nazim Muradov	UCF	Preparing Catalysts for Testing	National Institute of Carbon Research, Oviedo, Spain
13	Ali Raissi	UCF	Catalyst Preparation	National Institute for Material Science, Tsukuba, Japan
14	Nicoleta Hickman	UCF	Nanotech -- Applied to Energy	A.I.CuZa, Iasi, Romania
15	John Shen	UCF	GaN Power Devices for Renewable Energy	University of Florida
16	Ted J. Kury	UF	Collaboration with FSU and Ohio State on Cap and Trade Evaluation for Florida	Subcontract to FSU's contract with the Florida Dept. Environmental Protection
17	Eric D. Wachsman	UF	Joint Ph.D. Program	University of Rome
18	Eric D. Wachsman	UF	MOU Joint Research Energy Program	Zhejiang University
19	Gary Peter	UF	NSF sponsored research	UC Davis, NCSU, TAMU
20	Gary Peter	UF	NSF sponsored research	NCSU, Vtech, Purdue, UGA, Umaine
21	Jenshan Lin	UF	Research on Wireless Power	Kyoto University, Japan
22	Pratap Pullammanappallil	UF	Testing engineered nano-rare earth additives for biofuel production	University of Central Florida

23	Pratap Pullammanappallil	UF	Establishing biogas laboratory scale systems in Agricultural & biosystems Eng. Department	North Dakota State University
24	Pratap Pullammanappallil	UF	Developing applications of algae for biofuel production	Air Force Research Laboratories
25	Pratap Pullammanappallil	UF	Collaborative proposals	FAMU
26	Pratap Pullammanappallil	UF	Collaborative proposals	USF
27	Robert Gilbert	UF	Managing sugarcane biomass to optimize ethanol production in sensitive watershed regions	EARTH University, Costa Rica
28	Shirley Meng	UF	All solid state thin film batteries	National University of Singapore
29	Shilrey Meng	UF	High energy layered oxides for lithium ion batteries	Stony Brook University (SUNY)
30	Shirley Meng	UF	Ab Initio computation for energy storage materials	University of Madrid (Spain)
31	Shirley Meng	UF	GGA+U computation for spinel oxides	Duke University
32	Shirley Meng	UF	Kinetic Monte Claro Simulation for oxides	University of Michigan
33	Jiangeng Xue	UF	Research collaboration, jointly applied for FHTCC funding	Sestar Technologies
34	Shawn Smith	FSU	Weather instrumentation deployed by FSU as a part of the Northern Gulf of Mexico Institute	Northern Gulf of Mexico Institute
35	Tom Baldwin	FSU	Bulk power transmission grid, Florida electric power transmission grid, integration of renewables, transmission standards, etc.	Universtity of South Florida (A. Domijan)
36	Tom Baldwin	FSU	Bulk power transmission grid, Florida electric power transmission grid, integration of renewables, transmission standards, etc.	Florida Atlantic University (R. Driscoll)
37	Andy Opel	FSU	Yale Project on Climate Change and the Center for Climate Change Communication	George Mason University
38	Melanie Simmons	FSU	Environmental Economics	FAU
39	Svetlana V. Poroseva	FSU	Departments of Mathematics and Electrical and Computer Engineering	Mississippi State University
40	Svetlana V. Poroseva	FSU	Departments of Mathematics and Electrical and Computer Engineering	Purdue University
41	Joel W. Kostka	FSU	Conversion of algal biomass to biofuels using microbial enzymes	University of Georgia
42	Efstratios Manousakis	FSU	Molecular Hydrogen and Carbon-based surface interaction	Harvard University

43	Paul Ruscher	FSU	Assistance with installation of an automated weather station and data collection	University of Technology in Jamaica
44	Mark Issac	FSU	Working jointly with experimental social science research group	Universidad Francisco Marroquin
45	Paul Ward	FSU	Design and control strategies for net-zero energy homes in hot, humid climates	University of Florida
46	Paul Ward	FSU	EFRI-SEED Advanced Feedback and Control System for Net-Zero Energy Homes	University of Nebraska (pending)
47	Uwe Meyer-Baese	FSU	Develop dynamic models for fuel cell, battery, and ultra-capacitors	University of Miami
48	Uwe Meyer-Baese	FSU	Discuss IESES mission, possible projects, and funding sources available for US/European collaborations	European Universities from Germany, Spain, Sweden, Switzerland, Greece, etc.
49	Amy Chan-Hilton	FSU	Develop and apply the energy technologies and systems	collaboration across the State University System.
50	Charles R. McClure	FSU	Conduct follow up expert interviews to determine other information resources, applications, and interactive services that these researchers perceive to be important for inclusion in the web portal	University of Florida
51	Charles R. McClure	FSU	Conduct follow up expert interviews to determine other information resources, applications, and interactive services that these researchers perceive to be important for inclusion in the web portal	University of South Florida
52	Charles R. McClure	FSU	Conduct follow up expert interviews to determine other information resources, applications, and interactive services that these researchers perceive to be important for inclusion in the web portal	Florida Atlantic University

9. Collaborations with Private Industry

SUS related faculty reported 103 collaborations with industry in this reporting period. Additionally, FESC worked with the SUS university technology transfer office to identify 27 energy related technologies with high commercial potential and FESC is funding the market studies and business plans for the top 15 inventions from 5 universities. These studies and plans will be exposed to industry to accelerate the path of FESC research to commercialization.

10. Students and Post-docs Supported

During Nov. 1, 2008 to Oct. 1, 2009

#	Faculty	University	Student Name	MS/PhD/Post -Doc
1	Jeanette Wyneken	FAU	Erin McMichael	PhD
2	Taghi Khoshgoftaar	FAU	John Sloan	PhD
3	Rick Driscoll	FAU	Alana Smentek	PhD
4		FAU	Nicholas Vanrietvelde	MS
5		FAU	Michael Seibert	MS
6		FAU	Allison Cribbs	MS
7		FAU	Anna Leland	MS
8		FAU	Justin Sobol	MS
9		FAU	Kevin Cook	MS
10	Richard Granata	FAU	Andrew Bak	MS
11	Pierre Beaujean	FAU	Mustapha Mjit	MS
12	Nick Xiros	FAU	Khalid Kaiser	MS
13	Hassan Mahfuz	FAU	Nicholas Asseff	MS
14		FAU	Wasim Akram	MS
15	Chaoki Genai	FAU	Ben Oliver	MS
16	Manhar Dhanak	FAU	Zaqie Reza	MS
17	Eric Chassonignet	FSU	Alexandra Bozec	Post Doc
18	Ananthakrishnan	FAU	Aneesh Goly	MS
19	Francisco Presuel-Moreno	FAU	Don Welling	MS
20		FAU	Nicholas Gantiva	MS
21	Nazim Muradov	UCF	Nathaniel Garceau	Post-Doc
22	Ali Raissi	UCF	Amit Gujar	Post-Doc
23	Ali Raissi	UCF	Weifan Yao	Post-Doc
24	Darlene Slattery	UCF	Paul Brooker	Post-Doc
25	Darlene Slattery	UCF	Benjamin Pearman	Ph.D.
26	Darlene Slattery	UCF	Stephen Rhoden	Ph.D.
27	Darlene Slattery	UCF	Marianne Rodgers	Post-Doc
28	Xinyu Huang	UCF	Wonsoek Yoon	Ph.D.
29	Xinyu Huang	UCF	William Rigdon	Ph.D.
30	NeelKanth Dhere	UCF	Bihag Joshi	Ph.D.
31	NeelKanth Dhere	UCF	Ashwani Kaul	Ph.D.
32	NeelKanth Dhere	UCF	Shirish Pethe	Ph.D.
33	NeelKanth Dhere	UCF	Saisitaram Ramesh	Ph.D.
34	NeelKanth Dhere	UCF	Eigo Takahashi	MS

35	Nicoleta Hickman	UCF	Albert Leyte-Vidal	MS
36	Nicoleta Hickman	UCF	Steven Nason	Ph.D.
37	Z. Qu	UCF	Steven Helkin	MS
38	Z. Qu	UCF	Shiyuan Jin	MS
39	Z. Qu	UCF	Chris Panayottii	MS
40	Z. Qu	UCF	Carlos Velez	MS
41	Louis Chow	UCF	Sarada Kuravi	Ph.D.
42	Louis Chow	UCF	Amit Gupta	Ph.D.
43	Louis Chow	UCF	Wei Wu	Post-Doc
44	Louis Chow	UCF	Jian Du	Post-Doc
45	Louis Chow	UCF	Tom Mahefkey	Post-Doc
46	Issa Batarseh	UCF	Haibing Hu	Post-Doc
47	Issa Batarseh	UCF	Xiang Fang	Ph.D.
48	Issa Batarseh	UCF	Souhaib Harb	Ph.D.
49	Issa Batarseh	UCF	Majd Batarseh	Ph.D.
50	Issa Batarseh	UCF	Ala Alsaeed	Ph.D.
51	Issa Batarseh	UCF	Wisam Al-Hoor	Ph.D.
52	Issa Batarseh	UCF	Feng Tian	Ph.D.
53	Issa Batarseh	UCF	Mi Do	Ph.D.
54	Issa Batarseh	UCF	Qian Zhijun	Ph.D.
55	Issa Batarseh	UCF	Gustavo Gamboa	MS
56	Gijs Bosman	UF	Yige Hu	PhD
57	Eric D. Wachsman	UF	Jinsoo Ahn	Ph.D.
58	Eric D. Wachsman	UF	Eric Armstrong	Ph.D.
59	Eric D. Wachsman	UF	Sean Bishop	Ph.D.
60	Eric D. Wachsman	UF	Bryan Blackburn	Ph.D.
61	Eric D. Wachsman	UF	Matthew Camarartta	Ph.D.
62	Eric D. Wachsman	UF	Danijel Gostovic	Ph.D.
63	Eric D. Wachsman	UF	Doh Won Jung	Ph.D.
64	Eric D. Wachsman	UF	Cynthia Kan	Ph.D.
65	Eric D. Wachsman	UF	Byung Wook Lee	Ph.D.
66	Eric D. Wachsman	UF	Kang Taek Lee	Ph.D.
67	Eric D. Wachsman	UF	Jianlin Lee	Ph.D.
68	Eric D. Wachsman	UF	Eric Macam	Ph.D.
69	Eric D. Wachsman	UF	Dong Jo Oh	Ph.D.
70	Eric D. Wachsman	UF	Nikolas Vito	Ph.D.
71	Eric D. Wachsman	UF	Matthew Barnett	MS
72	Gary Peter	UF	J. Vogel	Postdoc
73	Jenshan Lin	UF	Joaquin Casanova	PhD
74	Jenshan Lin	UF	Jason Taylor	MS
75	Jenshan Lin	UF	Yan Yan	PhD
76	Jenshan Lin	UF	Xiaogang Yu	PhD
77	Jenshan Lin	UF	Zhen Ning Low	PhD
78	James Heaney	UF	Ken Friedman	ME
79	James Heaney	UF	John Palenchar	ME
80	James Heaney	UF	Miguel Morales	ME
81	James Heaney	UF	John McCary	PhD
82	James Heaney	UF	Camilo Cornejos	Post-Doc

83	James Heaney	UF	Lukaz Ziemba	PhD
84	James Heaney	UF	Joong Lee	Post Doc
85	John Erickson	UF	Kenneth Woodard	Postdoc
86	John Erickson	UF	Jeffrey Fedenko	MS
87	John Erickson	UF	Arkorn Soikew	MS
88	Lynn Sollenberger	UF	Miguel Castillo	M.S.
89	Lynn Sollenberger	UF	Chae-In Na	Ph.D.
90	Pratap Pullammanappallil	UF	Diane Chaulic	PhD
91	Pratap Pullammanappallil	UF	Abhay Koppar	PhD
92	Pratap Pullammanappallil	UF	Sachin Gadekar	PhD
93	Pratap Pullammanappallil	UF	Robert Diltz	PhD
94	Pratap Pullammanappallil	UF	Zhuoli Tian	PhD
95	Pratap Pullammanappallil	UF	David Palubin	PhD
96	Pratap Pullammanappallil	UF	Patrick Dube	PhD
97	Pratap Pullammanappallil	UF	Abhishek Dhoble	MS
98	Pratap Pullammanappallil	UF	Samriddhi Buxy	MS
99	Pratap Pullammanappallil	UF	Douglas Renk	MS
100	Pratap Pullammanappallil	UF	Mandu Inyang	MS
101	Pratap Pullammanappallil	UF	Cesar Moreira	MS
102	Robert Gilbert	UF	Pedro Korndorfer	MS
103	Robert Gilbert	UF	Jim Shine	PhD
104	Sabine Grunwald	UF	Gustavo Vasques	Post-Doc
105	Shirley Meng	UF	Chris Fell	Ph.D.
106	Shriley Meng	UF	Ming-Che Yang	Ph.D.
107	Shirley Meng	UF	Alex Emly	Undergrad
108	Shirley Meng	UF	Thomas McGilvray	Undergrad
109	Franky So	UF	Fred Steffy	PhD
110	Franky So	UF	Jeg Subbiah	post-doc
111	Jiangeng Xue	UF	Ying Zheng	Ph.D.
112	Jiangeng Xue	UF	Yixing Yang	Ph.D.
113	Jiangeng Xue	UF	Zhifeng Li	M.S.
114		USF	JamieTrahan	M.S.
115	Yogi Goswami	USF	Abutayeh, Mohammad	Ph.D.
116	Yogi Goswami	USF	Michael Celestin	Ph.D.
117	John Wolan	USF	Ala'a Kababji	PhD Graduated
118	Yogi Goswami	USF	Samantha Wijewardane	Ph.D.
119	John Wolan	USF	Ali Gardezi	Ph.D
120	Vinay Gupta	USF	Bjith Mankidy	Ph.D
121		USF	Chen, Huijuan	Ph.D.
122		USF	Choudhury, Pabitra	Ph.D.
123		USF	Dalrymple, Omatoyo	Ph.D.
124		USF	Davidson, Eric	Ph.D.
125		USF	Demirkaya, Gokmen	Ph.D.
126		USF	Ehsan Salimi	Ph.D. continuing
127		USF	Eric Davidson	Ph.D.
128		USF	Huijuan Chen	Ph.D.

129		USF	Kuravi, Sarada	Post-Doct.
130		USF	Latchman, Drupatie	M.S.
131		USF	Li, Chennan	Ph.D.
132		USF	Mark Thomas	MS
133		USF	Michael Niemann	Ph.D. Graduated
134	Babu Joseph	USF	Nianthrini Balakrishanan	Ph.D
135		USF	Pabitra Choudhury	Ph.D.
136	Tapas Das	USF	Patricio Rocha	Ph.D. continuing
137	Shekhar Bhansali	USF	Ralph Hutado	MS
138	Shekhar Bhansali	USF	Rudran Ratnadurai	Ph.D
139		USF	Roland Okwen	PhD
140	Jeffrey Cunningham	USF	Shadab Anwar	Post-doc
141		USF	Trahan, Jamie	M.S.
142		USF	Vasquez-Padilla, Ricardo	Ph.D.
143		USF	Vishnu Nanduri	Ph.D.
144		USF	Wijewardane, Samantha	Ph.D.
145	Don Morel	USF	Ryan Anders	PhD
146	Don Morel	USF	Sree Satya Kanth Benapudi	MS
147	Don Morel	USF	Keshavanand Jayadevan	MS
148	R. Mark Isaac	FSU	Sean Michael Collins	Ph.D.
149	Paul Ward	FSU	Avner Dachoach	MS
150	Paul Ward	FSU	Jarrett Evans	MS
151	Paul Ward	FSU	Michael Marshall	Undergraduate
152	Paul Ward	FSU	Stephanie Roberton	Ph.D.
153	Paul Ward	FSU	Jason Torof	post-BACC
154	Paul Ruscher	FSU	Timothy Sliwinski	Undergraduate
155	Richard Feiock	FSU	Sang Chul Park	Ph.D.
156	Richard Feiock	FSU	Hyunsang Ha	Ph.D.
157	Richard Feiock	FSU	Steve Traylor	Undergraduate
158	Richard Feiock	FSU	Mary Jo Spector	MS
159	Richard Feiock	FSU	Charles Andrews	MPA
160	Richard Feiock	FSU	In Won Lee	Post Doc
161	Richard Feiock	FSU	Rizalino Cruz	Ph.D.
162	Tingting Zhao	FSU	John Sulik	Ph.D.
163	Philip Steinberg	FSU	Adam Keul	Ph.D.
164	Joel Kostka	FSU	Om Prakash	Post-Doc
165	Anjaneyulu Krothapalli	FSU	Michael Gnos	MS
166	Anjaneyulu Krothapalli	FSU	Jonathan Pandolfini	MS
167	Anjaneyulu Krothapalli	FSU	Akintunde Badaru	MS
168	Anjaneyulu Krothapalli	FSU	Malikarun Bhadrashetti	Ph.D.
169	Anjaneyulu Krothapalli	FSU	Shannon Ingersoll	MS
170	Anjaneyulu Krothapalli	FSU	John Dascomb	MS
171	Anjaneyulu Krothapalli	FSU	Justin Kramer	MS
172	David Cartes	FSU	Il Yop (David) Chung	Post-Doc

173	David Cartes	FSU	Gina Teofilak	Undergraduate
174	David Cartes	FSU	Siyu Leng	Ph.D.
175	David Cartes	FSU	Akintunde Badaru	MS
176	David Cartes	FSU	Passinam Tatcho	MS

Total # of Students and Post docs: 176
Post Docs: 22, PhD: 91, Master: 57, Undergraduate: 6

11. Students Graduated

During Nov. 1, 2008 to Oct. 1, 2009

#	Faculty	University	Student Name	MS/PhD/Post -Doc
1	Hassan Mahfuz	FAU	Nicholas Asseff	MS
2	Francisco Presuel-Moreno	FAU	Don Welling	MS
3	Z. Qu	UCF	Hongliang Yuan	Ph.D.
4	Z. Qu	UCF	Mark Snyder	M.S.
5	Z. Qu	UCF	Matthew Howard	M.S.
6	N. Dhere	UCF	Sachin Kulkarni	Ph.D.
7	N. Dhere	UCF	Vinay Hadagali	Ph.D.
8	N. Dhere	UCF	Parag Vasekar	Ph.D.
9	Louis Chow	UCF	Johan Westin	Ph.D.
10	Louis Chow	UCF	Sarada Kuravi	Ph.D.
11	Issa Batarseh	UCF	Wisam Al-Hoor	Ph.D.
12	Issa Batarseh	UCF	Ehab Shoubaki	Ph.D.
13	Issa Batarseh	UCF	Feng Tian	Ph.D.
14	Issa Batarseh	UCF	Michael Pepper	M.S.
15	Eric D. Wachsman	UF	Chiara Abate	Ph.D.
16	Eric D. Wachsman	UF	Jinsoo Ahn	Ph.D.
17	Eric D. Wachsman	UF	Sean Bishop	Ph.D.
18	Eric D. Wachsman	UF	Tak Keun Oh	Ph.D.
19	Jenshan Lin	UF	Zhen Ning Low	PhD
20	Lynn Sollenberger	UF	Miguel Castillo	M.S.
21	Pratap Pullammanappallil	UF	Wei Liu	PhD
22	Shirley Meng	UF	Yuan Wang	MS
23	Joao Vendramini	UF	Uduak Inyang	MS
24	Jiangeng Xue	UF	Ying Zheng	Ph.D.
25	Tapas Das	USF	Vishnu nanduri	Ph.D.
26	Lee Stefanakos	USF	Michael Niemann	Ph.D.
27	Anjaneyulu Krothapalli	FSU	Justin Kramer	MS

Total # of Students Graduated: 27
PhD: 18
Master: 9

12. Business Start-Ups in Florida

During Nov. 1, 2008 to Oct. 1, 2009

Business Start-ups in Florida		
	Name	# of Employees.
	NA	NA

13. Jobs Created and Jobs Saved in Florida

During Nov. 1, 2008 to Oct. 1, 2009

#	Position Title	Position Description	Employer
1	Professor	Science Director	FAU
2	Coordinator, Research Programs & Services	Program Manager	FAU
3	Coordinator, Research Programs & Services	Staff Engineer	FAU
4	Coordinator, Research Programs & Services	Office Manager	FAU
5	Director	FESC director	UF
6	Associate Director	Industry Programs	UF
7	Associate Director	New Programs	UF
8	Administrative Coordinator	Fiscal person for FESC	UF
9	Outreach Coordinator	Coordinates outreach activities	UF
10	Research Assistant	Assist with Biomass project research	USF
11	Deputy Director	Manage All IESES Day to Day Operations	IESES
12	Assistant Director, Programs	Develop and manage all IESES programs	IESES
13	Administrative Specialist	Mange all aspects of the financial tracking and reporting, HR functions and grants management	IESES
14	Admin Support Asst	Provide required support to Admin Specialist	IESES
15	Program Assistant	Assist with grant application and program implementation	IESES
16	Solar water heating installation jobs - 278 Students trained	Alternative Energy Banner Center has trained 278 students for photovoltaic and solar water heating installation jobs. Each student's personal data was input into the AWI Employ Florida Marketplace by county Workforce agencies.	Various industry
17	PV Installation Workshops	Trained 274 individuals at 25/per month for PV installation positions. Training was for entry level and for existing installer upgrades	PV Installation Contractors
18	Solar Water Heating Installation Workshops	Trained 197 individuals in three training sessions for SWH installation positions. Training was entry level and installer upgrades.	SWH Installation Contractors

19	Weatherization Training	Trained 53 individuals in three training sessions for DCA weatherization program. Training is for weatherization audits done by staff. Training is upgrading of staff.	Florida Weatherization agencies at local level
20	Fuel Cell Workshop	Trained 20 individuals on fundamentals of fuel cell technologies for all levels of fuel cell industries.	Fuel Cell Industries
21	Post-doctoral Assoc.	Coordinates and carries out research for FESC projects	UF
22	Field Research Asst.	Assists the postdoc is carrying out FESC projects	UF

14. Specialized Industry Training and Education

During Nov. 1, 2008 to Oct. 1, 2009

Outreach Activities

1. FAU - Scientific Diving, Dania Beach, Year duration
2. FAU- Energy Exhibit at the Mary Brogan Museum in Tallahassee
3. FAU-Presentation to Visitors to the Discovery Science Museum in Ft. Lauderdale
4. FAU-AD Henderson School Science Club, Boca Raton, FL
5. FAU-Cypress Elementary School Career Day, Cypress Creek, FL
6. FAU-Beacon Hill Middle School at ST on November 15th, 2008
7. UCF-Fuel Cell Workshop, J. Fenton, D. Slattery, et al., Cocoa, FL, January 2009: 5 days of training. Trained 20 individuals.
8. UCF-Weatherization Training, N. Moyer, T. Kucharski, Cocoa, FL, August/September 2009 : 5 days of training, 3 sessions to 53 individuals. Program will train 150 people.
9. UCF-Solar Water Heating Workshop, J. Harrison, B. Guiney, Cocoa, FL, Three workshops held: Trained 197 individuals.
10. UCF-PV Installation Workshop, J. Harrison, et al., Cocoa, FL, Held once a month: Trained 274 individuals in 12 months.
11. FSEC provided more than 73 short courses, which trained 1,456 professionals, qualifying many of them for state and national certifications that allow specific energy services to consumers and government agencies. Over 400 students were trained as green home certifying agents, over 300 as PV installers and over 100 as solar thermal hot water installers.
12. FSEC became an USGBC Education Provider and received approval of 5 courses in the commercial building training series “Designing and Maintaining the High Performance Green Building”. This course series has also been reviewed and accepted by AIA and Florida CILB.
13. FSEC - The educational program is a train-the-trainer program followed by individual programs offered at each of the partner institutions. FSEC’s partners for student training are: Brevard Community College in Cocoa, FL, Westside Technical School in Orlando, FL, Tallahassee Community College in Tallahassee, FL, and Broward College in Ft. Lauderdale, FL. Solar contractors through the Florida Solar Energy Industries Association (FlaSEIA), the Florida Solar Energy Research and Education Foundation (FlaSEREF), construction, plumbing, electrical industries, and Florida utility companies supply the project’s industrial affiliations. The workforce and placement partners include WorkForce Florida, Inc., the Brevard Workforce Board and the Florida Energy Office. The program also includes Katie Bolcar, head of the U.S. Department of Energy workforce development area.

14. FSEC - Partnered with the Irish Training and Employment Authority to provide 27 technicians from Irish companies three-month training sessions (Spring and Fall) and relevant work experience in solar, renewable and building energy technologies"
15. UF-EZ Guide Training Workshop (Several training sessions on new techniques for water conservation for utilities and water management districts in Florida by James Heaney), UF TREEO, November 2008
16. UF-Florida Rural Water Association Focus on Change, 6 conservation seminars in Florida during 2/09.
17. UF- Internal Training Workshop for Environmental Protection Department, Hong Kong SAR on Anaerobic Digestion and Composting for Organic Waste. 26-28 November, 2008. Hong Kong
18. UF Robert Gilbert. Energy grasses for Florida sandland. Oral presentation. Sandland Germplasm Workshop, Clewiston, FL, May, 2009
19. UF - Understanding High Solids Anaerobic Digestion Technology, December 11, 2008, Fargo, ND
20. UF (Mobility for Green Society UF, Shirley Meng, UF, Jan 29th, 2009) - Education NCMC-14 Workshop, Combinatorial synthesis and characterization of hydrogen storage materials, National Institute of Standard Technology (NIST), Maryland, 2008.
21. USF - NSF workshop on Writing Proposal and peer Reviewing Process, Summer 2008
22. USF - 21st Century Teaching Excellence Workshops, Summer/Fall 2008
23. USF - Tapas Das: NSF- GK 12 STARS Program
24. USF - Dr. Goswami: International Advisory Board of the International Conference on Hydrogen Production (ICH2P), Oshawa, Canada, 2009.
25. USF - Dr. Goswami: Chair of the International Scientific Advisory Committee, 2009 Solar World Congress, South Africa.
26. USF - Dr. Goswami: Referee for US DOE proposals

APPENDIX I – ARRA FUNDING OPPORTUNITIES

The stimulus package along with ARRA and the new federal budget resulted in multiple funding opportunities. A sample of the opportunities is listed below (Source: B&D Consulting):

Electricity Generation:

- Smart Grid: $4.5 billion to modernize the electric grid. Of this, $100M is for worker training and $80 million is to conduct a resource assessment and analysis of future demand transmission requirements. $10 million is for Smart Grid Interoperability Framework coordinated by NIST
- Advanced Research Projects Agency: $400M to support high-risk, high-payoff research to accelerate the innovation cycle for both traditional and alternative energy sources and energy efficiency. This funding is for research and construction of laboratory facilities.

Renewables and Biofuels

- Energy Efficiency and Renewable Energy Program (DOE): $2.5 billion for applied research, development, demonstration and deployment activities to include: $800 million for projects related to biomass and $400 million for geothermal. The balance of the money is for solar, wind, hydrogen, water power, and energy efficiency demonstrations for industrial and commercial practices.
- Energy Efficiency and Conservation Block Grants (DOE): $3.2 billion of which $2.8 billion is to states through the existing formula in EISA Title V subtitle V. The remaining $400 million shall be rewarded on a competitive basis as determined by the Secretary. Types of projects include energy audits, implementing building codes, and government building on-site projects that

Transportation

- Transportation Electrification (DOE): $400 million to states, local governments and metropolitan transportation authorities for qualified electric transportation projects that reduce emissions, including: truck stop electrification, airport ground support equipment and cargo-handling equipment.
- Alternative Fueled Vehicles Pilot Grant Program (DOE): $300 million in grants through the Clean Cities program to state and local governments, metropolitan transportation authorities and others for encouraging the use of plug-in electric-drive vehicles or other emerging electric vehicle technologies.
- Advanced Batteries (DOE): $2 billion in grants for the manufacturing of advanced batteries and components, including advanced lithium-ion batteries, hybrid electrical systems, component manufacturers and software designers.
- Diesel Emissions Reduction (EPA): $300 million for diesel emission reductions grants to states.

In addition, US DOE received funding for ARPA-E, an energy-equivalent to DARPA.