FLORIDA ENERGY SUMMIT – AUG 15-17, 2012

The FESC Summit is being combined with the Florida Energy Summit this year. We are assisting the Florida Energy Office in agenda preparation and finding speakers. The Florida Energy Summit is scheduled to be on August 15-17 in Orlando, at the Rosen Shingle Creek.

The Commissioner Adam Putnam wanted to partner with FESC to spotlight innovative research efforts at the state universities and to disclose the latest emerging technologies, which will have an impact on future energy production.

The preliminary agenda is given below (*http://www.floridaenergysummit.com/agenda.html*)**:**

State Policy Roundtable – Implementing HB 7117

During the 2012 legislative session, the Florida Legislature passed its first statewide energy policy in four years, which reinstates tax incentives for the production of renewable energy, reduces burdens on businesses, promotes energy efficiency and repeals the renewable portfolio standard mandate. State policy advisors will discuss how to implement the recently passed Florida energy bill and what the bill means to Florida's economy.

Panel 1: Feedstocks Nourish Rural Communities

With a year-round growing season, Florida has the potential to be a leader in the production of energy from crops and timber. Feedstocks not only provide renewable energy, but also allow Florida farmers to diversify their income and bring economic opportunity to Florida's rural communities.

Panel 2: Converting Crops to Fuel

From biomass to biofuel, businesses in Florida are converting Florida feedstocks into alternative energy products. Learn about how and which feedstocks are being utilized.

Panel 3: The Economics of Solar in the Sunshine State

In the Sunshine State, homes and businesses harness the energy of the sun to power their operations. With all the options available, what are the most cost-effective technologies?

Panel 4: On the Local Level

From the Florida panhandle to the First Coast to the Keys, local governments are promoting energy efficiency, using renewable energy and conserving transportation fuel. Learn about their creative and innovative efforts.

Panel 5: Retrofitting the Residential sector

Florida's aging inventory of homes is in the best position to capture large gains in energy efficiency. Learn how energy efficiency can transform Florida's housing market and about utility programs available to support homeowners' efforts.

Panel 6: The Cheapest Energy is the Energy Not Used

When the economy is tight, businesses are looking for ways to cut costs. Florida businesses will share how they use energy wisely and capture waste heat to keep operational costs down.

Panel 7: Where US DOEs Our Fuel Come From?

With gas prices fluctuating, Floridians want to know more about automotive fuels. Where US DOEs the fuel come from? How is the fuel distributed in Florida? How much do Florida drivers consume?

Panel 8: Running on Empty Has a New Meaning

Some Floridians are avoiding the gas pump altogether and turning to alternative transportation fuels. Explore the alternative energy sources and technologies that are being used to power vehicles around Florida.

Panel 9: Florida's Energy Outlook
Florida's supply and demand of electrical fuels and technologies have changed dramatically over the past decade. What US DOEs the next decade have in store?
Panel 10: From the Research Labs of Florida's World-Class Universities
The technologies emerging from Florida's universities today have the potential to change the way energy is created, used and stored tomorrow.

APPENDIX A – DESCRIPTION OF FESC FUNDED RESEARCH PROJECTS

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

	Description: This project focused on the development of building subsystems that minimize the use of natural resources and carbon-based energy in Florida while also using materials that are renewable and sustainable. A key component of this project was the Off-Grid Zero Emissions Building, which allowed for the testing of these subsystems. This team forms the engineering team participating in the Team Florida's Solar Decathlon Competition. Lessons learned from the Off-Grid Zero Emission Building are incorporated into Team Florida's design. This project is complete. **Budget:** $503,168 ***This project has been completed***
	Title: Insight into Membrane Degradation Mechanisms Through Verification of Chemical and Mechanical Degradation Test Capabilities **PI:** Darlene Slattery, **Co-PIs**: Len Bonville, Marianne Rodgers - UCF/FSEC **Description:** The objectives of the program were to gain insight into fuel cell membrane degradation mechanisms including both chemical and mechanical degradations. In order to achieve this objective, the Membrane Electrode Assembly Durability Test System, MEADS, was verified, after which chemical degradation tests were conducted. By performing post mechanical testing and analyzing the data, the impact of accelerated degradation tests on the cell performance decay, chemical decomposition and mechanical weakening of the membranes were evaluated. This project is complete. **Budget:** $351,518 ***This project has been completed***
	Title: Energy Efficient Building Technologies and Zero Energy Homes **PI:** R. Vieira, **Co-PIs:** P. Fairey, J. Sonne - UCF/FSEC **Description:** The project consists of two elements: 1) the construction of two flexible research homes at FSEC to conduct research on advanced building energy efficiency technologies under controlled conditions; and 2) a staged, field retrofit study in a small number of unoccupied homes to measure and document the effectiveness of a series of retrofit measures that can be deployed using current technology. The project will also conduct an annual meeting where other FESC participants, other university members and utility, industry, the U.S. Department of Energy and other stake holders who will be briefed on plans and progress. Inputs from meeting participants will be sought. **Budget:** $1,224,000
	Title: Joint Optimization of Urban Energy-Water Systems in Florida **PI:** James P. Heaney - UF **Description:** Urban water infrastructure systems for providing water supply, collecting and treating wastewater, collecting and managing stormwater, and reusing wastewater and stormwater require major energy inputs. End users of the water require even more energy to heat this water for showers and baths, clothes washing, cooking and other uses. Increasingly, cities will rely on alternative water supplies such as desalination that require much more energy per gallon of water produced. Conservation is the ideal way to save energy and water by managing the demand for these precious commodities. Major strides have been made in reducing indoor water use from about 75 gallons per person per day to as low as 40 gallons per person per day. However, these gains are being offset by concurrent increases in outdoor water use for irrigation that range from 30 to 300 gallons per person per day depending on irrigation practices and the size of the landscape. From a water use perspective, perhaps the greatest challenge will be the expected growing competition for water if certain energy options are implemented in order to reduce our current dependence on foreign oil. Several recent national studies warn of this impending energy-water crisis. This project will build on our extensive experience in evaluating urban water conservation options to include the implications for energy use and to develop integrated energy-water management systems that are compatible. **Budget: $72,000** Back to Thrust 1: Overarching

	Title: Planning Grant: High Performance and Low Cost Fuel Cells for Future Vehicles **PI:** Jim Zheng, **Co-PIs:** Richard Liang, Chuck Zhang, Ben Wang - FSU **Description:** The objective of this project is to provide an innovative approach to revolution of current energy storage and conversion technology and greatly leverage FSU position in the strategic important area for sustainable energy. The project was performed by Drs. Jim Zheng and Richard Liang at the Department of Electrical and Computer Engineering and Department of Industrial Engineering, respectively. First to demonstrate preliminary results in high performance of energy storage and conversion materials and devices in order to seek outside funding consistent with the vision of IESES. The deliverables were conference proceedings and journal papers and proposal submissions for additional funding. This project is complete. **Budget:** $15,000 **Research Integration (collaboration):** NCSU and NHMFL on advantage batteries; Industrial Engineering on fuel cells; Maxwell Technologies, Inc. and Ionova Technologies, Inc. on supercapacitors; CAPS on microgrids; MARTECH on thermoelectric; Shanghai Institute of Technical Physics on photovoltaic; N. Dai, F.Y. Huang, S.L. Wang, X.N. Li, J.P. Zheng (co-PI), and D. Wei, "An International Collaboration Group on Solar Cell Technologies Development", Sponsor: Chinese Academy of Sciences, Budget: $877,193 (￥6,000,000 RMB), Project Dates: 4/09-4/14. ***This project has been completed***
	Title: NIRT: C-MEMS/CNEMS for Miniature Biofuel Cells **PI:** Marc Madou, Co-PIs : Chunlei Wang, Sylvia Daunert and Leonidas Bachas - FIU **Description:** In recent years, the quest for alternative sources that can autonomously power bioMEMS devices, especially those geared for in vivo applications, such as monitoring and drug delivery, has been the focus of research by scientists and engineers as new power sources will prove critical for the advancement of the field. Current batteries are still less than optimal and often present drawbacks related to safety, reliability and scalability. An ideal power source for implantable devices should take advantage of natural compounds present in the body of an individual and use them as fuel to produce power in a continuous and reproducible manner, as long as the patient's physiological functions remain steady. Biofuel cells, which are capable of converting biochemical energy into electrical energy, have been deemed as a potential solution to the drawbacks presented by conventional batteries, but the power density and operational lifetime requirements for implanted devices have not been met yet. To that end, we are integrating genetically engineered catalytic proteins and carbon-based 3 dimensional (3D) MEMS/NEMS structures to create new biofuel cells. The biofuel cell electrode surfaces, especially fractal electrode array, presents significantly increased surface area as compared to traditional architecture, increasing the biocatalyst loading capacity considerably for high power throughput. The genetically engineered enzymes inherently increase enzyme stability, consequently increasing biofeul cell lifetime. The scaled fractal electrode surface plays a role in wiring the enzymes to the biofuel cell anode, which increases the electron transfer efficiency from the enzyme to the electrode for an increase in the overall performance of the biofuel cells. Furthermore, C-MEMS/C-NEMS architectures will enable the reproducible fabrication of low cost carbon-based electrode structures. **Budget:** $171,432 (PI portion) (total amount: $1,000,000) - *Not Funded by FESC.*
	Title: Fabrication of Nano Fractal Electrodes for On-Chip Supercapacitors **PI:** Chunlei Wang - FIU **Description:** Nature has always strived for the highest efficiency in all organisms. Just as nature has benefited from fractal structures in almost all of its organisms, biomimetic fractal designs in electrochemical devices such as power conversion & storage devices and sensors can also lead to benefits in scaling. Our proposed concept is geared to take advantage of the scaling relationship between interface area and overall volume. Fractal electrode design is believed as a promising solution to optimize surface

	area while minimizing the internal resistance. We will fabricate and characterize carbon-based microelectrodes pyrolyzed from photolithographically patterned photoresist, which exhibits nano fractal geometry by design. In contrast with the current research trend of, first fabricating carbon nanostructures (CNTs, CNFs, etc), and then lithographically defining an electrode at the convenient location on the substrate, our novel methods will integrate the fabrication of the micro and the nano- structures using simple process thus bridging the gap that separates these two scales. Since the fabrication methods are all based on IC manufacturing methods, it will be easy to integrate into microchips. **Budget:** $150,000 - *Not Funded by FESC.*
	Title: Energy Efficient Technologies and The Zero Energy Home Learning Center **PI:** Stanley Russell, **Co-PIs:** Yogi Goswami **Graduate Assistant**: Mario Rodriguez - USF **Description:** The project is to create and evaluate an affordable residential scale Zero Energy building that will function as an exhibition of energy efficiency and Zero Energy Home [ZEH] technology on or near the University of South Florida campus. The project will feature the most cost-effective combination of renewable solar energy with high levels of building energy efficiency. The building will incorporate a carefully chosen package of the latest energy-.efficiency technologies and renewable energy systems to achieve the most successful and reliable results. The building will utilize Photovoltaic solar electricity and solar domestic hot water heating systems using the grid as an energy storage system, producing more energy than needed during the day and relying on the grid at night. Plug-in hybrid automobile technology offers a promising means of providing distributed energy storage for such homes but has not been sufficiently tested. Using a systems approach to couple zero energy home technology with PHEVs we will explore opportunities to develop marketable products that meet Florida's energy and environmental goals. **Budget:** $344,600 **External Collaborators:** FSU College of Engineering- Justin Kramer, Brenton Greska; UF- Department of Interior Design- Maruja Torres, Nam-Kyu Park; UF Rinker School of Building Construction- Robert Ries; UCF Florida Solar Energy Center- Stephanie Thomas Ries; Beck Construction; Hees and Associates Structural Engineers.
	Title: Unifying Home Asset & Operations Ratings: Adaptive Management via Open Data & Participation **PI**: Mark Hostetler, **Co-PI:** Hal S. Knowles, III - UF **Description**: Recent environmental, social, and economic challenges are fostering a wave of interest in maximizing energy efficiency and conservation (EE+C) in existing U.S. homes. Long standing programs, ratings, and metrics are being reapplied into new stimulus initiatives such as the *Recovery through Retrofit*[1] program. Simultaneously, electric and gas utilities are expanding their demand side management (DSM) programs from weatherization and conventional technology replacement incentives to include conservation behavior campaigns with "recommendation algorithms" designed to assist in homeowner energy retrofit decision making. Furthermore, loan programs are emerging to address the financial barriers that commonly limit initiation of the necessary retrofits. Collectively, these approaches most often project future home energy performance based on engineering models of the physical characteristics of homes (i.e., "asset ratings"). Yet to date, the marketplace is inadequately integrating historical household energy consumption patterns (i.e., "operational ratings") into the decision tree to optimize retrofit program efficacy and consumer benefits. Moving toward the unification of asset and operational ratings is crucial for successful program management, proper monitoring/measurement/verification (MMV), loan risk assessment, and for the persistence of reduced home energy use over time. However, unification will not be easy. This research project combines qualitative and quantitative research methods in social science and building science using Florida case

	studies to evaluate the opportunities and constraints of asset and operational rating unification and the steps necessary to get there. Relationships between our project and the collaborative, transparent, and participatory nature of "open government" initiatives are also being explored. **Budget**: $24,000 **External Collaborators:** Nick Taylor (Ph.D. Student, UF School of Natural Resources & Environment), Jennison Kipp (Assistant In, UF Program for Resource Efficient Communities)
	Title: Meteorological Factors Affecting Solar Energy Efficiency **PI:** Paul Ruscher **Co-PIs:** (formerly Yaw Owusu, Hans Chapman **-** FSU **Description:** There are numerous meteorological factors that limit the efficiency of solar energy systems in the tropics. Depletion of available solar energy at the surface by increased water vapor, cloudiness, temperature of the solar panel system, pollution, are sometimes overlooked, because engineering specifications for design are often based upon midlatitude continental air masses. The typical tropical atmospheric reduction factors were reviewed using a state of- the-art solar energy model for this project. In addition, meteorological variability can be quite extreme in the tropics and many engineering studies on feasibility of renewable energy sources in general are often based upon "typical" year criteria, rather than longer term climatologies. It is suggested that climatological data be utilized to more accurately portray the variability of output to be expected at a typical installation. Many of these variables are already widely available from a combination of surface and upper air meteorological stations, as well as remote sensing data from satellites. We demonstrated the sources for these data as well as strategies for teaching about solar energy efficiency using routine observations from school-based weather stations. This project is complete. **Budget:** $15,000 ***This project has been completed***
THRUST 3: Developing Florida's Biomass Resources	
Algae	
	Title: Establishment of the Center for Marine Bioenergy Research: Systems Approach to BioEnergy Research (SABER) **PI:** J. Kostka (he has left FSU), **Co-PIs**: William Cooper, Ivonne Audirac, Amy Chan-Hilton,Ellen Granger – FSU **Description:** IESES' Systems Approach to Bio-Energy Research (SABER) is particularly focused on coupling algal cultivation to wastewater nutrient remediation. SABER has partnered with the City of Tallahassee's T. P. Smith Waste Water Treatment Plant in order to study the growth of local fresh water algae in waste water for use as biofuel. The two main objectives of this project are to: 1) perform both laboratory and field experiments to test for species-specific growth potentials, as well as for the effects of different environmental parameters, including light, carbon dioxide, and nutrient availability on microalgal growth rates and lipid production, and 2) determine the extent to which microbes (i.e. bacteria), which are exceptionally abundant in waste water, act as either competitors (for nutrients, carbon) or symbiotically with algae. To do this we are examining the bacterial community present in the waste water and detecting community shifts that occur during algae cultivation. We are also examining the nutrient uptake dynamics between bacteria and algae by monitoring the usage and production of nitrogen, phosphorous, and carbon-containing compounds. Finally, a number of advanced analytical chemistry techniques are being used to characterize wastewater before and after algae cultivation. With a better understanding of the microbial and biogeochemical processes occurring in waste water during algae cultivation, engineering approaches may be proposed in order to further optimize algal growth in waste water. **Budget:** $494,135 **External Collaborators:** City of Tallahassee ***This project has been completed***

	Title: Constructual Optimization of Solar Photo-Bioreactors for Algae Growth **PI:** Juan Ordonez - FSU **Description**: This was a planning grant (15K, only). The work was targeted towards placing us in a more competitive position in future submissions in the area of bio-fuels. By the end of this one-year effort we now have a complete design of a small-scale photo-bioreactor for algae growth, obtained additional funds that will allow us to build a large-scale photo-bioreactor and conduct the necessary research for its optimal design and operation. This project is complete. **Budget:** $15,000 **External Collaborators:** Federal University of Parana, Brazil ***This project has been completed***
	Title: Optimization of Algae Species for Biofuels Production Using Genetic Altration **PI:** Ed Phlips- UF **Description:** This study will begin in June, 2011, and will focus on genetically altering selected species of algae to optimize their performance in biomass production systems aimed at biofuels. Two approaches to genetic alteration will be explored: mutagenesis and transformation. **Budget:** $15,000
High Energy Crops	
	Title: Energy Intensive Crop Development **PI:** Gary Peter , Matias Kirst, Don Rockwood - UF **Description:** To build a commercially viable, industrial scale system to produce transportation fuels and electricity from biomass requires both efficient conversion technologies and environmentally sustainable, cost effective supplies of biomass. In the US, Florida ranks first in its annual growth of plant biomass, because of its large cultivable land area and its subtropical climate, even though substantial land areas that can be planted are not currently in agricultural or forest production. The development of high yielding production systems for dedicated energy crops is considered essential for a sustainable, biomass to energy industry to be established, because the long-term availability of sufficient amounts of reasonably priced biomass is one of the most important factors in the site selection for new biofuel and bioenergy facilities. Dedicated energy crops are ones that 1) have high yields with minimum energy inputs in terms of agronomic practices, water and nutrient applications, 2) can be harvested, transported and processed efficiently into fuel or power, and 3) can be grown sustainably for generations without adverse environmental affects, or significantly impacting the food supply. We will evaluate likely energy crop species, *Eucalyptus* and southern pine to provide important yield and best management practices for growing these species for bioenergy conversion. We will also provide important chemical composition information that will impact the conversion efficiency of this biomass to ethanol, and identify and characterize important genes that regulate wood chemical composition **Budget:** $432,000
	Title: Water-Use Efficiency and Feedstock Composition of Candidate Bioenergy Grasses in Florida **PI:** Lynn E. Sollenberger, **Co-PI's:** John Erickson, Joao Vendramini, Robert Gilbert - UF **Description:** Florida ranks first in the USA in annual growth of plant biomass because of a large cultivatable land area, high rainfall, and long growing season. In order to capitalize on these advantages, the agricultural production sector and biomass conversion industries require information regarding which crops are adapted to particular Florida regions and local environments, how much biomass can be produced during what times of the year, which crops produce the most biomass per unit of water used, and which crops have the desired yield and composition for particular bioenergy applications. Research conducted to date has quantified the seasonal biomass supply provided by the most likely crops for use in Florida, identified crops and management practices that result in most efficient water use, and described the chemical composition of these plants to allow estimates of potential energy production per unit of biomass.

	Florida growers and industry representatives have gained access to this information through on-line resources, presentations by several of the project investigators at the Florida Farm to Fuel Conference, and by attending the Bioenergy Crop Field Day at the University of Florida Plant Science Research and Education Unit. Seven graduate students are being trained through this project and undergraduate students are gaining invaluable research experience via internships mentored by project investigators. Faculty involved in the FESC project have formed collaborations regarding agronomic and breeding projects with Speedling, Inc., SERF, and BP. Both SERF and BP plan to construct ethanol facilities in Florida that would create an estimated 400 temporary construction jobs and 140 permanent jobs each. **Budget:** $191,981 **External Collaborators: :** Speedling, Inc., Nutri-Turf, Inc., British Petroleum (BP), and Southeast Renewable Fuels (SERF)
Biochemical Conversion	
	Title: Development of Biofuel Production Processes From Synthetic and Biomass Wastes **PI:** Pratap Pullammanappallil - UF **Description:** With the ever-increasing price of petroleum and its finite supply, it is of high priority to develop domestic sources of transportation fuel, as well as other chemicals. Ethanol is an attractive alternate fuel that is being produced from corn starch. It is necessary to target other feedstocks for biofuel production and develop processes that have a minimal environmental impact. There is considerable ongoing research on developing processes and catalysts for conversion of biomass to biofuels like ethanol (called cellulosic ethanol process). But this project addresses other feedstocks with the following objectives: 1) development of biocatalysts for the conversion of waste biodegradable poly lactic acid based plastics to ethanol and 2) development of processes that processes for the production of additional fuels like biogas, bio-oil and biochar from the waste and byproducts of a cellulosic ethanol plant for the cleanup and reuse of these waste streams **Budget:** $192,000 **External Collaborators:** University of Central Florida
	Title: Engineering Biocatalysts for Hemicelluloses Hydrolysis and Fermentation **PI:** James F. Preston **-** UF **Description:** Our goal is to develop biocatalysts for the cost-effective production of fuel alcohols and chemical feedstocks from underutilized sources of renewable biomass and evolving energy crops. To reach this goal protocols for efficient saccharification of hemicellulose fractions from these resources will be developed. Objectives are to: 1. Develop improved enzyme-mediated saccharification protocols of hemicelluloses with existing bacterial biocatalysts for production of biofuels and chemical feedstocks. 2. Develop Gram positive biocatalysts for direct conversion of hemicelluloses to biobased products. 3. Develop systems with bacterial biocatalysts for efficient bioconversion of the hemicellulose fractions of perennial energy crops (poplar, eucalyptus, switchgrass, energy cane) to targeted products. **Budget:** $192,000 **External Collaborators**: Collaborations are in various units within the University of Florida: L.O. Ingram and K.T. Shanmugam, Microbiology and Cell Science; F. Altpeter, Agronomy; G. Peter, Forest Resources and Conservation.
	Title: Thermophilic Biocatalysts for the Conversion of Cellulosic Substrates to Fuels and Chemicals **PI:** K.T. Shanmugam **-** UF **Description:** Biomass is an attractive source of sugars for a state like Florida that produces very limited amount of corn for fermentation to produce ethanol as transportation fuel or other products such as lactic acid that can be converted to bioplastics. Florida currently generates about 8.7 million tons of dry cellulosic

	biomass per year (US-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 (US DOE). We have demonstrated that by increasing the temperature of Simultaneous Saccharification and Fermentation (SSF) of cellulose from 30-35 ºC to 50-55 ºC, the amount (and associated cost) of cellulases can be reduced by the required 3-fold with the current commercial enzyme preparations. A microbial biocatalyst that produces ethanol or other chemicals as the main fermentation product and can also function at this higher temperature and pH 5.0 in conjunction with the fungal cellulases in the SSF process is a critical component of this process. We have identified a thermophilic facultative anaerobe, *Bacillus coagulans*, with versatile metabolic capability as the microbial platform for the SSF of biomass to products and engineering this L(+)-lactic acid producing bacterium to produce ethanol. *The primary objective of this proposed study is to construct a B. coagulans derivative that produces ethanol as primary product of fermentation and to enhance the ethanol productivity of the engineered derivative.* **Budget:** $192,000 ***This project has been completed***
Bio gasification	
	Title: Combined Cooling, Heat, Power, and Biofuel from Biomass and Solid Waste **PI:** William Lear, **Co-PI:** J.N. Chung - UF **Description:** The goal of this project is to provide the underlying research and demonstration of a novel technology which would enable the economic utilization of dispersed biomass and solid waste resources to produce electric power, cooling, heat, and transportation fuels. This integrated gasification and power generation system combines University of Florida advances in high-temperature gasification, hydrogen generation and separation, and advanced gas turbine systems. Their integration is expected to result in significant improvements in the cost, emissions, feedstock flexibility, and water requirements, all in a relatively compact, modular plant system. This in turn will enable much greater utilization of renewable energy supplies, helping the development of a sustainable energy supply infrastructure. **Budget:** $576,000 **External Collaborators:** Siemens Power Generation, Florida Turbine Technologies, Energy Concepts Co., Nu-Power Technologies LLC, PlanetGreenSolutions Inc., LPP Combustion, LLC. Back to Thrust 1: Overarching
Thermo-Chemical Conversion	
	Title: Production of Liquid Fuels Biomass via Thermo-Chemical Conversion Processes **PI:** Babu Joseph, **Co-PIs:** Yogi Goswami, Venkat Bhethanabotla, John Wolan, Vinay Gupta - USF **Description:** The objective of this project is to develop technology for the economical thermo-chemical conversion of lingocellulosic biomass (non-food grade biomass such as agricultural waste, bagasse from sugar mills, citrus peels, switch grass, municipal green waste, etc.) to clean burning liquid fuels. Five of the major advantages of this process over a biochemical route to production of ethanol are: (i) it US DOEs not utilize food-grade feed stocks and therefore complements and US 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 US DOEs not require large amounts of water and associated energy costs of separating the water from the fuel

	as in bioethanol processes, (v) it can utilize a wide variety of biomass sources unlike the biochemical route which cannot work with high lignin containing biomass. **Budget:** $554,447 **External Collaborators:** Prado & Associates
	Title: Feasibility, Sustainability and Economic Analysis of Solar Assisted Biomass Conversion **PI:** Babu Joseph, **Co-PI:** Q. Zhang - USF Description: The main deterrent for commercialization of biomass conversion processes is the cost of conversion; particularly the need to sacrifice as much as 30% of the energy content in the biomass for the thermo chemical conversion step. We want to research and develop the concept to use solar thermal energy from concentrating units to provide energy for the biomass gasification step. We also propose to evaluate the sustainability of such a process. Overall Objective: The overall objective is to conduct a theoretical analysis of solar assisted thermo chemical conversion of biomass from the point of view of energy efficiency, economic feasibility, environmental impact, and long term sustainability of renewable energy production. **Budget:** $45,238
	Title: Integrated Florida Bio-Energy Industry **PI:** Ali T-Raissi **Co-PIs:** N.Z. Muradov, D.L. Block - UCF/FSEC **Description:** The aim of this project continues to be production of liquid hydrocarbon fuels derived from lignocellulosic and aquatic biomass employing a two-step thermocatalytic process. In the first step, pre-treated biomass is gasified with oxygen (or air) and steam yielding synthesis gas (syngas) containing hydrogen and carbon monoxide. In the second step, syngas generated by the gasifier enters a Fischer Tropsch (FT) synthesis unit where it reacts to form a range of liquid hydrocarbon fuels – including diesel. **Budget:** $648,000
	Title: Biofuels Through Thermochemical Processes: Approach to Produce Bio-Jet Fuel **PI**: Anjaneyulu Krothapalli **-** FSU **Description:** The objective of this project was to develop technologies to produce biojet and biodiesel fuels from sustainable sources such as bio-oils and hydrogen produced from biomass generated synthetic gas. Novel processing concepts, reactor design and catalyst systems are employed in this integrated approach to convert any cellulosic biomass and any nonedible bio-oils into bio-jet fuel (Figure 1). Feedstock flexibility offers significant cost and logistic advantages to this approach. Unlike other processes which use only the oil derived from a plant, the entire plant can be used as feedstock source and the proposed approach can also convert the more challenging lignocellulosic component. This project is complete. **Budget:** $229,572 ***This project has been completed***
THRUST 4: Harnessing Florida's Solar Resources	
Solar Testing Facility	
	Title: Solar Systems Testing Facility **PI:** James Roland, David Block - UCF/FSEC **Description:** Over the past four years, the Florida Solar Energy Center (FSEC) has received a significan increase in demand for solar and PV systems testing and certification. This occurrence has resulted i requiring the Center to correspondingly amplify its capabilities to respond to the increased demand. Thus, th objective of this task was to construct a solar and PV systems testing facility by adding walls, windows, door and A/C to an existing Florida Solar Energy Center roof only facility. The enclosing of this existing spac was done for the purpose of increasing laboratory space and to allow for laboratory testing of solar wate heating systems and PV modules and inverters. The action was taken following a study which determined thi project was the most cost effective means of adding valuable indoor laboratory space. **Budget:** $600,609

	This project has been completed
Solar Thermal	
	Title: Concentrating Solar Power Program **PI:** Charles Cromer, R. Reedy - UCF/FSEC **Description:** The objective of this effort is to produce a detailed Florida map of the solar direct beam and global resource available for use in Florida whereby a potential user of solar energy can enter their location latitude and longitude and receive a table of solar energy monthly averages for that specific site as derived from the past eleven years of data. The concept is to use NOAA satellite photos and utilize the brightness of the cloud cover as a clearness factor predictor of the solar energy that gets through to the ground below. **Budget:** $52,000 **External Collaborators:** FPL ***This project has been completed***
	Title: Development of Novel Water Splitting Catalysts for the Production of Renewable Hydrogen **PI:** Helena Hagelin-Weaver - UF **Description:** This project focuses on the development of iron-based catalysts for the thermochemical splitting of water into hydrogen and oxygen. The thermochemical process of splitting water is particularly well-suited for the utilization of solar energy to provide the heat for the reaction and is a way to produce a renewable hydrogen fuel. As hydrogen is difficult to transport and store, producing hydrogen on site for power plants using proton exchange membrane (PEM) fuel cells or internal combustion engines to generate electricity or for the production of chemicals, such as liquid hydrocarbon fuels, is a very attractive approach. The project uses a two-step process in which water is passed over a reduced iron oxide to generate hydrogen while the oxygen is taken up by the oxygen-deficient iron oxide (Step 1: FeOx-1 + H2O □FeOx + H2). In the second step the resulting iron oxide is heated to desorb oxygen and regenerate the oxygen-deficient iron oxide to close the catalytic cycle (Step 2: FeOx □FeOx-1 + ½O2). The main objectives of the project are to develop mixed metal oxide catalysts that 1) will release oxygen at temperatures lower than 1500°C (Step 2), while still maintaining water-splitting activity (Step 1) and 2) are stable up to the temperature necessary for the oxygen desorption step. **Budget:** $ 100,000
	Title: Enhanced and Expanded Solar Thermal Test Capabilities **PI:** J. Del Mar**,** R. Reedy - UCF/FSEC (PI use to be J. Walters) **Description:** The Florida Solar Energy Center (FSEC) serves the State of Florida by providing independent, third-party testing and certification of solar equipment for the main purposes of providing product value in the marketplace, especially for products that are not widely "proven" with consumers such as solar water heating systems and solar electrical (photovoltaic) systems. Even more important, third-party certification provides protection to reputable manufacturers, ensuring that lower quality products, often from foreign markets, do not compete head-to-head with Florida and U.S. products unless they meet the same standards. **Budget:** $809,295 **External Collaborators:** Solar thermal manufacturers
	Title: Solar Fuels for Thermochemical Cycles at Low Pressures **PI:** Jörg Petrasch - UF **Description:** The project focuses on the production of solar fuels from solar thermochemical cycles employing metal/metal oxide redox pairs. These thermochemical cycles consist of a high temperature endothermic solar driven reduction step and a low temperature, slightly exothermic water or CO2 splitting step. The high temperature step typically proceeds at temperatures above 2000 K. Hence, it poses a range of material and design challenges. According to Le Chatelier's principle, the temperature for the solar dissociation reaction decreases as the pressure inside the reactor is reduced. The central hypothesis of the

	project is that operating the high temperature step of metal/metal oxide solar thermochemical cycles at reduced pressures will lead to significantly relaxed temperature requirements, while the work necessary to produce the pressure difference will not significantly reduce the overall efficiency of the process. The main goal of the project is to demonstrate the feasibility of carrying out high temperature thermal reduction of metal oxides in rarefied conditions using high intensity solar radiation from UF's solar simulator. **Budget:** $ 100,000 **External Collaborators:** Wojciech Lipinski, University of Minnesota
	Title: Solar Thermal Power for Bulk Power and Distributed Generation **PI:** David Hahn, **Co-PIs:** James Klausner, Renwei Mei, Helena Weaver - UF **Description:** While there are many different approaches to hydrogen generation, the most attractive means is to split water molecules using solar energy. The current approach is to develop highly reactive metal oxide materials to produce intermediary reactions that result in the splitting of water to produce hydrogen at moderate temperatures (<1000 K). It is envisioned that the metal oxide reactors will ultimately be mounted within a solar concentrating reactor, and irradiated via heliostats. This Task is structured toward the overall goals of solar-driven, thermochemical hydrogen production, with associated efforts toward the enabling surface science, catalysis, particle science, material synthesis, nano-structures, multiscale-multiphase physics modeling, and process simulation that will enable the realization of solar hydrogen-based fuels to power the transportation economy. Successful efforts as targeted in this project are a critical step toward increased renewable-resource based fuels and energy, reduction of GHG emissions, and establishment of a new power industry in Florida. **Budget:** $446,400
	Title: Design, Construction and Operation of CSP Solar Thermal Power Plants in Florida **PI :** Yogi Goswami, **Co-PIs:** Lee Stefanakos, Muhammad Rahman, Sunol Aydin, Robert Reddy - USF Florida utilities are mandated to achieve 20% renewable energy contribution to their generation mix by 2020. While technologically feasible with solar energy, the capital costs are high – presently, capital costs range from $6,000-$7,000/kW for PV and $3,500-$4,000/kW for concentrating solar thermal power. This project targets the development of solar thermal power technology for bulk power and distributed generation, which will diversify energy resources in Florida and reduce greenhouse emissions by utilizing renewable sources. Also, there will be economic impacts with the establishment of new power industry in Florida, which will help the electrical utilities of the state to meet the renewable portfolio standards. The project has three main tasks; the first one is to develop design methodologies and standards for the proven solar thermal power technologies in combination with bio or fossil fuels based on Florida conditions and resources. Secondly, the project aims to set up demonstration and test facilities for these technologies for optimization for Florida conditions, and the final task is to develop and commercialize innovative technologies based on new thermodynamic cycles. **Budget:** $882,000 **External Collaborators:** Sopogy Inc. and Gulf Coast Green Energy. Back to Thrust 1: Overarching
	Title: Multi-Generation Capable Solar Thermal Technologies **PI:** A. Krothapalli, **Co-PI:** Brenton Greska - FSU **Description:** The objective of the research was to develop and demonstrate small-scale solar thermal technologies that can be used separately, in conjunction with one another, or with existing waste heat producers, thus improving the overall system efficiency. This project is complete. **Budget:** $544,226 ***This project has been completed***
Clean Drinking Water	

	Title: Low Cost Solar Driven Desalination **PI:** James Klausner - UF **Student:** Fadi Alnaimat/ Ph.D **Description**: This work concerns the development of a cost effective, low power consumption, and low maintenance desalination process that is powered by solar energy. The solar diffusion driven desalination (DDD) process is most suitable for decentralized applications. While theoretical models have been developed to analyze the evaporation and condensation processes of the solar DDD under transient operating conditions (Alnaimat et al., 2011), experimental investigations have been conducted to validate the theoretical models. In this reporting period, the overall distillation performance of the solar DDD has been investigated under different design and operating conditions. The best operating modes have been proposed to improve the water production and reduce the specific energy consumption. **Budget:** $252,000 **University:** UF
	Title: Clean Drinking Water using Advanced Solar Energy Technologies **PI:** Lee Stefanakos **Co-PI's:** Yogi Goswami, Matthias Batzill, Maya Trotz, Sesha Srinivasan - USF **Description:** Availability of fresh water is one of the biggest problems facing the world and Florida is one of the most vulnerable to fresh water shortages. Moreover, Florida ground water is contaminated in many locations from leaky underground tanks, agricultural pesticides, and other chemicals. Although it is possible to desalinate abundant seawater, conventional systems are too energy intensive. Solar energy can provide the needed energy, and innovative new solar vacuum (USF) and humidification/dehumidification (UF) desalination systems can provide adequate fresh water for the state's needs. Systems are being developed for both bulk water desalination and small community needs/disaster response. We will also develop photocatalytic disinfection to remove contaminants and integrate these technologies with solar PV for complete water supply systems. Photocatalysis is a promising water treatment technology capable of utilizing solar light. However, the construction of an effective photocatalytic disinfection system for water purification is currently limited by the lack of reliable models to aid in the design and testing of these systems. Simplified models have been proposed, but most are inadequate because they rely on traditional disinfection theories which are not applicable to photocatalysis. Therefore, the major goal of this research is to develop a model for photocatalytic disinfection based on fundamental processes which may then be used to design water treatment systems in the state of Florida. **Budget:** $326,756 **External Collaborators:** NA
Low Cost PV Manufacturing	
	Title: Enhanced and Expanded PV Systems Testing Capabilities at FSEC **PI:** S. Barkaszi, **Co-PI:** R. Reedy - UCF/FSEC **Description:** An important FSEC function is consumer protection from poorly designed and manufactured PV modules and systems. FSEC's test capabilities were established over 10 years ago and were adequate at the time to test PV modules for certification. However, PV costs have fallen and competing electric utility rates have risen. In the last two years, these curves have crossed under some economic scenarios and incentive programs, and the demand for PV module testing and system certification has jumped. Thus, this task will provide for enhanced and expanded PV testing and certification capabilities. The task will also be done in close coordination with FSEC's work with the U.S. Department of Energy's PV program. **Budget:** $196,018
	Title: Development of High Throughput CIGS Manufacturing Process **PI:** Neelkanth Dhere **-** UCF/FSEC **Description:** A reduction in the cost of CIGS and other thin film PV modules is required for broad PV

	applications. The objective is to develop a high-rate deposition process for synthesis of CIGS absorbers and other layers by employing in-line and batch deposition techniques. The goal is finally to attract a PV manufacturing company to Florida by developing a high-rate manufacturing process for $CuIn_xGa_{1-x}Se_2$ (CIGS) solar cells. **Budget:** $141,620 Back to Thrust 1: Overarching
	Title: Florida Opportunities for PV Manufacturing and Applications **PIs:** D. Block, J Fenton, P. Fairey, W. Schoenfelds, R. Reedy - UCF/FSEC **Description:** The overall goal of this project is to assist in the development of a photovoltaic (PV) manufacturing industry in Florida. The project objective is to conduct a review of the state, national and international PV manufacturing data for the purposes of establishing industry practices and an industry data base. The data base will then be available to assist Florida in establishing PV manufacturing firm(s). **Budget:** $81,120
	Title: Development of Low Cost CIGS Thin Film Hot Carrier Solar Cells **PIs:** Gijs Bosman, **Co-PI:** Tim Anderson - UF **Description:** Our study is focused on hot carrier solar cells for cell conversion efficiency improvement in a low cost, high throughput CIGS system. The rapid thermalization loss of hot photoexited carriers interacting with the lattice can potentially be reduced through phonon engineering in the absorber layer; the subsequent extraction of the hot carriers may be realized through device engineering of energy selective contacts. **Budget:** $450,000
	Title: Solar Photovoltaic Manufacturing Facility to Enable a Significant Manufacturing Enterprise within the State and Provide Clean Renewable Energy **PI:** Don Morel – USF, **Co-PIs:** Chris Ferekides, Lee Stefanakos - USF **Description:** The primary goal of this project is to enable the establishment and success of local solar photovoltaic manufacturing companies to produce clean energy products for use within the state and beyond and to generate jobs and the skilled workforce needed for them. Thin film technologies have shown record efficiencies of 20%, and present tremendous opportunities for new Florida start-up companies. USF, UCF, and UF are collaborating to develop a pilot line facility for thin film solar technologies, which will serve as a test bed for making ongoing improvements in productivity and performance of solar modules, develop advanced manufacturing protocols, and help train a skilled workforce to ensure the success of new companies. **Budget:** $1.6M **External Collaborators:** Mustang Solar, a Division of Mustang Vacuum Systems Back to Thrust 1: Overarching
Advanced PV Device Program	
	Title: Research to Improve Photovoltaic (PV) Cell Efficiency by Hybrid Combination of PV and Thermoelectric Cell Elements. **PIs:** Nicoleta Sorloaica-Hickman**,** Robert Reedy - UCF/FSEC **Description:** Photovoltaic/thermoelectric (PV/TE) cell integration is a promising technology to improved performance and increase the cell life of PV cells. The TE element can be used to cool and heat the PV element, which increases the PV efficiency for applications in real-world conditions. Conversely, the TE materials can be optimized to convert heat dissipated by the PV element into useful electric energy, particularly in locations where the PV cell experiences large temperature gradients, i.e. use the thermoelectric module for cooling, heating and energy generation depending on the ambient weather conditions. Thus, the goal of this research effort is to research and develop nanoscale design of efficient thermoelectric material through a fundamental understanding of the materials properties and to design and build a photovoltaic thermoelectric (PV/TE) hybrid system.

	Budget: $167,820 Back to Thrust 1: Overarching
	Title: PV Devices Research and Development Laboratory **PI:** Robert Reedy **Co-PI's:** Nicoleta Sorloaica-Hickman, Neelkanth Dhere - UCF/FSEC **Description:** The primary challenge facing the PV industry is to dramatically reduce the cost/watt of delivered solar electricity by approximately a factor of 2 to 3, to increase the manufacturing volume by a factor of 10 and to improve the cell efficiencies by a factor of 2 to 3. This task will conduct R&D on basic science of PV cells and develop a world class PV cell laboratory for future cell research. The R&D will focus on developing new and improved PV cells such as organic PV, nano-architectures, multiple excitation generation, plasmonics, and tandem/multi-junction cells. **Budget:** $450,250
	Title: Beyond Photovoltaics: Nanoscale Rectenna for Conversion of Solar and Thermal Energy to Electricity **PI:** Shekhar Bhansali, **Co-PIs:** Elias Stefanakos, Yogi Goswami, Subramanian Krishnan - USF **Description:** The main objective of the proposal is to commercialize and scale up a new technology, rectenna to convert waste heat energy to electricity. Although the prediction of highly efficient (~85%) solar rectennas was published almost 30 years ago, serious technological challenges have prevented such devices from becoming a reality. Since the ultimate goal of a direct optical frequency rectenna photovoltaic power converter is still likely a decade away, we plan to convert optical solar radiation to thermal radiation (~30 THz regime) using an innovative blackbody source. Leveraging the research efforts of the world-class team members, we plan to further develop the rectenna technology that is within reach of efficient radiation conversion at 30 THz. A fully integrated, blackbody converter and 30 THz rectenna system will be capable of converting at least 50% of solar and thermal energy into usable electrical power, clearly demonstrating a truly transformational new technology in the renewable energy technology sector. **Budget:** $598,500 **External Collaborators:** Bhabha Atomic Research Center, India
PV Integration	
	Title: PV Energy Conversion and System Integration **PI:** I. Bataraseh, **Co-PI's:** J. Shen, Z. Qu, X. Wu, W. Mikhael, L. Chow – UCF (PI use to be N. Kutkut) Description: The objective of this project is to develop a system-driven Plug'N'Gen solar power system demonstrating architecture of decentralized, low-cost, mass-produced, PV panel-mounted micro-inverters. This system will be able to compete with today's centralized multi-kW PV inverters that require cost prohibitive professional installation. The project tasks are: 1) novel inverter topology and control concepts; 2) advanced digital control algorithms; 3) SmartTie interface with the utility grid; and 4) low cost and ultra-compact PV inverter in package. **Budget: $1,267,000** Back to Thrust 1: Overarching
	Title: Non-Contact Energy Delivery for PV System and Wireless Charging Applications **PI:** Jenshan Lin - UF **Description**: Innovative non-contact energy delivery method will be used in photovoltaic energy generation system to accelerate the system deployment. Instead of delivering electric power using cables penetrating through building structures, magnetic field coupling allows power to be transferred wirelessly through building walls and roofs. In the meantime, the DC electric energy from photovoltaic cells is converted to AC energy. This enables the photovoltaic system to be quickly set up or relocated, and the collected solar energy from outdoor system can be conveniently delivered to indoor appliances. Techniques to achieve high efficiency at high power delivery through different building structures will be studied for this plug-and-play architecture.

	In addition, the technique and the system can also be used for non-contact charging of electric vehicles. The transmitter/charger can be placed as a mat on garage floor or parking space. The receiver inside vehicle will pick up the energy delivery through magnetic coupling. This eliminates the need of connecting charging wires to vehicles and exposed metal contacts, which is a safer method of charging electric vehicles **Budget: $**252,000
	Title: An Integrated Sustainable Transportation System **PI:** David Norton, Keith Duncan – UF (Formerly Eric Wachsman (PI) and Shirley Meng (Co-PI);left UF) **Description:** The proposed vehicle, operating on biofuel while in transit and charged by the sun while parked, is the ultimate sustainable transportation system operating completely on renewable American energy resources. Moreover, the use of solid oxide fuel cells (SOFCs) rather than an IC engine in this hybrid vehicle results in a dramatic improvement in efficiency and reduction in emissions. SOFCs are the most efficient technology for converting energy from hydrocarbon fuels to electricity on a "well to wheels" basis. In contrast, the more conventional fuel cells require hydrocarbon fuels to first be converted to H_2, with resultant efficiency losses, followed by losses due to H_2 transport and storage. Therefore, on a system-basis SOFCs hold the potential for producing the least CO_2/kWh from conventional fuels, and if designed to operate on biofuel would in effect be carbon neutral and operating on a renewable resource. *If developed this vehicle would be a transformational change in transportation technology.* **Budget:** $594,000 **External Collaborators:** Solid-State Energy Technology, Inc., Lynntech, Inc., Planar Energy Devices, Inc., CFX Battery, Inc. Back to Thrust 1: Overarching ***This project has been completed***
	Title: PV Power Generation Using Plug-in Hybrid Vehicles as Energy Storage **PI:** J. Shen, **Co-PI:** I. Batarseh - UCF **Description:** The objective of this project is to develop and demonstrate an alternative PV power generation architecture that uses plug-in hybrid vehicle as the energy storage and transfer element with a total system cost target of $3.50/W. The tasks include developing efficient, reliable, and inexpensive maximum power tracking DC/DC battery chargers and 3-phase converters. A 10kW demonstration solar carport charging station will be built on UCF campus. A plug-in hybrid vehicle with a 25kWh battery bank (battery-only driving range of 50-100 miles) and onboard bidirectional AC charging system will be demonstrated **Budget:** $380,816 **External Collaborators:** City of Tavares, FL
	Title: Integrated PV/Storage and PV/Storage/Lighting Systems **PI:** Franky So, **Co-PI:** Jiangeng Xue - UF **Description:** The goal is to increase the efficiency and reduce the cost of solar power through the integration of PV, Li-battery, and LED lighting technologies. Since all components are in the form of thin films, the PV/battery/LED system can be integrated as a single module. Since half of the materials cost of each device is the substrate, integrated module will also reduce materials costs and processing steps. Importantly, their integration further eliminates the need for inverters since they are all low-voltage devices. Such an integrated device can be used to store energy during the day and power the LED panel for lighting in the evening. In addition, we will explore the possibility of fabricating a semi-transparent module. The success of this Task will lead to a novel solar-power lighting panel that can be used as a sky light during the day and a lighting panel during the night without using grid-power. We not only will develop the technologies, but also integrate devices and perform technology-economic evaluation, including life-cycle costs. **Budget:** $576,000 Back to Thrust 1: Overarching
THRUST 5: Ensuring Nuclear Energy & Carbon Constrained Technologies for Electric Power in Florida	

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

	that would not be discarded immediately. We will use Nature's catalysts (enzymes) to tailor the chemical structure of lignin for both deep-well injection (by using lignin derivatives as drilling "muds") and for materials that can be used in building, packaging, and other manufactured products.) **Budget:** $200,000
	Title: Database Infrastructure for Integrative Carbon Science Research **PI:** Sabine Grunwald. **Co-PI:** Tim Martin - UF **Description:** Rising CO_2 concentrations in the atmosphere and effects on global climate change have been well documented, and future impacts are uncertain but potentially devastating. Florida's natural and agro-forest ecosystems have much potential to sequester carbon in biomass and soils due to unique climatic and landscape conditions. However, research gaps exist to accurately assess carbon pools and fluxes at coarse scales, ranging from county to the region and larger. The overarching objective of this project is to address these obstacles by creating a terrestrial carbon information system (called "TerraC") for the carbon science community, focused on ecosystems in Florida. The information system will be administered through the UF Carbon Resources Science Center (http://carboncenter.ifas.ufl.edu), a multi-disciplinary Center dedicated to research in support of enhanced agricultural and natural resource carbon management. **Budget:** $199,440
	Title: Creation of Carbon Sequestration Data, Technologies and Professional Cohorts for Florida **PI:** Mark Stewart, **Co-PIs:** Jeffrey Cunningham, Maya Trotz - USF **Description:** Rising concerns over increasing levels of greenhouse gases, especially carbon dioxide, have led to suggestions to capture carbon dioxide at fixed sources, such as fossil fuel power plants, and sequester the carbon for millennia by injecting it underground. Florida overlies many thousands of feet of carbonate rocks which may be suitable for geologic sequestration of carbon dioxide. This project will investigate the potential for geologic sequestration of carbon dioxide in Florida, the physical and chemical changes that may occur as a result of injection, assess the potential for escape of injected carbon dioxide, determine the risk, if any, to aquifer systems used for water supplies, develop methodologies for Florida utilities to predict the performance and risks of proposed sequestration projects, and educate a cohort of geologic sequestration professionals to create a carbon sequestration industry in Florida. **Budget:** $479,640 **External Collaborators:** Tampa Electric Company (TECO); Florida Power and Light (FPL); Environmental Consulting and Technology (ECT), Inc.; Los Alamos National Laboratory.
THRUST 6: Exploiting Florida's Ocean Energy Resources	
	Title: Southeast National Marine Renewable Energy Center **PI:** Susan H. Skemp**, Co-PIs:** Howard P. Hanson, James VanZwieten - FAU **Description**: The research and development program being conducted by the Southeast National Marine Renewable Energy Center (SNMREC) is structured to be the catalyst that will enable the ocean energy industry in Florida toward determining solutions to answer the state's energy challenge. This project focuses on determining the potential of harnessing the ocean current resource and ocean thermal energy conversion (OTEC). The regulatory process both at State and Federal levels continues to evolve as the roles and interdependencies of the individual agencies are more clearly articulated. In addition, knowledge to make these decisions is being defined and targeted on a micro level necessary to assess individual devices. SNMREC's mission is to bridge the gap between concept and commercial deployment of ocean energy technologies by providing at-sea testing facilities for both ocean current and thermal energy research and for technology development. Research cuts across environmental, ecological, resource and

	technology. **Budget: $8,750,000** **Universities:** UCF, FSU, ERAU, University of Miami, Oregon State University, University of Washington, Pennsylvania State University, University of New Hampshire, University of Hawaii, University of Edinburgh, Heriot-Watt University, Nova Southeastern University, Virginia Polytechnical Institute, Florida Institute of Technology, Embry-Riddle Aeronautical University **External Collaborators:** Numerous industry and State and federal government as well as FFRDCs, such as National Renewable Energy Laboratory, Woods Hole Oceanographic Institution, U.S. Department of Energy, U.S. Department of Interior (Bureau of Ocean Energy Management and Regulation and Enforcement), U.S. Department of Commerce (National Oceanic and Atmospheric Administration), and Florida Department of Environmental, Protection, to name a few.
	Title: Buoy Array for Ocean Wave Power Generation **PI:** Z. Qu, **Co-PI**: K. Lin - UCF **Description:** The objective of this project is to develop a novel design that can extract ocean wave energy for commercial consumption. The design detailed herein is unique in that it is a wave point energy harvester that is small in size and contains all of the mechanical components directly within the buoy. The project focuses mainly on the mechanical system within the buoy as well as methods to control the electrical load on the system. Different mechanical systems have been developed and tested on a motion platform to simulate a vertical wave motion—these systems have been analyzed and compared in order to provide an ever-increasingly effective design. The Harris Corp. have acted as new collaborators with the project since October 1st 2010, funding four UCF senior design teams in the development of a buoy for wave power generation. **Budget:** $150,000 ***This project has been completed***
THRUST 7: Securing our Energy Storage and Delivery Infrastructure	
	Title: The Future Florida Grid: Ensuring a Reliable and Resilient Electrical Energy Transmission and Delivery System in a Changing Environment **PI:** Steinar Dale, **Co-PIs:** T. Baldwin, O. Faruque, J. Langston, P. McLaren, R. Meeker, K. Schoder, M. Steurer - FSU **Description:** The project research goal is to address the challenges of the reliable movement of electrical energy throughout the state as the power system is transformed to include far more renewable and alternative sources, increased use of distributed energy resources (including storage and electric vehicles), emergence of microgrids, possible expansion of new very-large centralized baseload (nuclear), and incorporation of new power conversion, transmission, measurement, communication and control technologies (smart grid). This project has also supported ongoing participation and contributions in national, state, and local power and energy stakeholder groups, including the Gridwise Alliance, the North American Synchrophasor Initiative (NASPI), the American Society of Mechanical Engineers' (ASME) National Energy Committee, the Institute of Electrical and Electronics Engineers (IEEE) Power Engineering Society (PES), Florida's Great Northwest Alternative Energy Advisory Council, and the Tallahassee-Leon Economic Development Council (EDC) Energy and Environment Roundtable. **Budget:** $431,982 Back to Thrust 1: Overarching ***This project has been completed***
	Title: Microgrids for a Sustainable Energy Future **PI:** Chris S. Edrington, **Co-PIs:** Helen Li, Juan Ordonez, Jim Zheng, Mischa Steurer - FSU **Description:** The primary aim of the project was to address research and development in the area of microgrids. Specifically the focus was in the area of PV and Plug in Hybrid Electric Vehicles integration,

	microgrid modeling and control, grid-tying inverters/converters, energy storage, tri-generation, and standards development for smart grids. **Budget:** $719,333 ***This project has been completed***
	Title: Real-Time Power Quality Study For Sustainable Energy Systems **PI:** U. Meyer-Baese, **Co-PIs:** Helen LI, Simon Foo, Anke Meyer-Baese, Juan Ordonez - FSU **Description:** The main objective of this project is the collection of preliminary data for IESES proposals that can be used to seek local, national and international sources of external funding from private and government sponsors. The overall project has been split up in several independent subprojects to allow a timely completion of the tasks. All tasks have been completed successfully. **Budget:** $15,000 ***This project has been completed***
	Title: Planning Grant: Advancing Knowledge of Network Theory for Analysis and Design of Smart Power Grids **PI:** Svetlana V. Poroseva. **Co-PIs:** Yousuff Hussaini, Per Arne Rikvold - FSU **Description:** With power grids evolving towards increasing size, complexity, and integration, it has become more difficult to describe and predict their behavior, even under normal operational conditions. With technological development, climate change, and activities in the political arena, adverse circumstances (natural disasters, intelligent adversary, software design errors, human errors, etc.) have become more probable and costly events. The Project seeks to provide industry and government with advanced analytical and computational tools necessary for the automated evaluation of the structural resilience and reliability of power grids. The potential applications of the Project's results go beyond power grids. Any infrastructure essential to our society and economy (e.g., computer, communication, transportation) can benefit from the Project's results. This project is complete. **Budget:** $15,000 ***This project has been completed***
	Title: Investigating the Effect of Appliance Interface Design on Energy-use Behavior **PI:** Paul Ward**, Co-PIs:** Ian Douglas, David Eccles **-** FSU **Description:** The primary objective of this research project was to identify the behavioral factors that contribute to energy in/efficiency in the home. In particular, this project was designed to (a) examine current state-of the science on behavioral factors that affect energy efficiency, (b) report on the efficiency of typical energy consuming technology used in the home as well as existing programs designed to improve efficiency, and (b) investigate the types of human-technology interactions and other behavioral factors that lead to in/efficient energy use. To achieve these objectives this project proposed to use laboratory-based experimental and field-based methods to (i) identify interface-design factors that constrain individuals to behave in locally optimal but globally sub-optimal ways, and (ii) survey how cognitive, technological, and motivational behavioral issues affect use in the home environment. **Budget:** $247,720 ***This project has been completed***
	Title: Energy Delivery Infrastructures **PI:** Lee Stefanakos **Co-PIs:** Zhixin Miao - USF (Formerly Alex Domijan (PI) and Arif Islam (Co-PI). Left USF). **Description:** The proposed project is to simulate the effects of a renewable energy generation system in a microgrid context to the distribution grid system. The proposed project is to simulate the combination of renewable distributed generation and a battery system to assess the effects during critical conditions such as power system peak. A research opportunity is to investigate how existing tools can be applied to properly representing dynamic

	and transient behaviors of microgrids. Therefore, in this project we propose using simulation tools to model a microgrid and investigate how well we can reproduce its measured behavior in the field **Budget:** $485,184
	Title: Micro Battery Defense Development **PI:** Chunlei Wang - FIU **Description:** The microbattery market for new miniature portable electronic devices such as cardiac pacemakers, hearing aids, smart cards, personal gas monitors, micro electromechanical system (MEMS) devices, embedded monitors, and remote sensors with RF capability is increasing rapidly. Thin-film lithium batteries are among the most advanced battery systems that can scale down to the dimensions that match the MEMS devices. However, these two-dimensional (2D) batteries are necessarily thin in order to maintain effective transport of Li ions. In order to power MEMS devices with limited device area (areal "footprints"), batteries must somehow make good use of their thickness. Three-dimensional (3D) configurations offer a means to keep transport distances short and yet provide enough material such that the batteries can power MEMS devices for extended periods of time. In this project, we focus on developing functional 3D microbatteries based on our carbon microelectromechanical systems (C-MEMS) technique. These microbatteries could offer order of magnitude increases in electrode surface area and charging capability than thin film batteries at the same size scale. **Budget:** , $192,418.30 – *Not Funded by FESC*
	Title: Electrostatic Spray Deposition of Nanostructured Porous Metal Oxide Composite **PI:** Chunlei Wang - FIU **Description:** Recently, conversion reactions of interstitial-free 3d metal oxide structures (such as CoO, CuO, and NiO) with structures unsuitable for intercalation chemistry have nevertheless been shown to exhibit large, rechargeable capacities in cells with lithium. The specific capacities of these materials, which are potential candidates for the negative electrode, can be as high as 1,000 mAhg-1 (about three times of commonly used graphitic carbons). However, practical implementation using these metal oxides is hampered by the large capacity loss of the first cycle and poor material cyclability. These problems are partially attributed to the significant volume changes that occur during lithium uptake and removal (molar volume change of ~100%), which causes mechanical failure and the loss of electrical contact at the anode. They are also due to aggregation of metal nanoparticles that appears during the process of discharging the metal oxide anodes. In order to overcome these two challenges and develop excellent rate capabilities and high power densities of Li-ion batteries, metal oxide composite electrodes with hierarchical mixed conducting network structures will be synthesized. We propose the preparation and testing of multi-component metal oxide anode films with a variety of morphologies using a simple and versatile method based on the electrostatic spray deposition (ESD) technique. The ESD technique enables us to reproducibly fabricate thin film ceramic materials with simple, low-cost and controllable designed morphologies. ESD-derived ceramic thin films we obtained including 3-D reticular, spongy-like, hollow sphere, dense, etc morphologies. The structures of these films can be easily tailored by changing the precursor solution component(s) and adjusting the substrate temperature. In this project, we plan to fabricate porous metal oxide materials, MxOy (M=Fe, Co). Material characterization methods (such as: SEM, TEM, AFM, BET, etc) will be used to study the correlation between ESD parameters and surface morphologies. **Budget:** $88,378.711 - *Not Funded by FESC*
	Title: Fabrication and Investigation of Porous Tin Oxide Anodes for Li-Ion Micro Batteries **PI:** Chunlei Wang - FIU **Description:** The requirement of higher energy capacity microbatteries demands the exploitation of new substitute materials with higher energy capacity than traditional graphite. SnO2 has been considered as one of the most promising substitutes for the carbon anode in Li-ion batteries due to its high Li+ storage capacity. However, the practical application of SnO2 as anode is restricted by poor cyclability and rate

	capability due to large volume change during cycling, which can cause disintegration and electrical disconnection from current collector. In this project, we propose the preparation and testing of tin oxide anode films with a variety of porous morphologies using Electrostatic Spray Deposition (ESD) technique. Our research focus will be developing an ESD processing to fabricate tin oxide electrode with different pore sizes ranging from macropores to mesopores and down to micropores; constructing hierarchical porous tin oxide electrode by controlling process parameters and introducing a surfactant or polymer additives, and material characterization and electrochemical analysis in order to investigate the correlation between morphology and electrochemical performance and understand the underlying mechanism. The proposed research will significantly enhance our understanding of fundamental issues regarding intrinsic properties of porous SnO2 films as anode for Li-ion batteries. **Budget:** $100,000 - *Not Funded by FESC*
	Title: Very High Energy-Density Ultracapacitors **PI:** E. Bakhoum, UWF **Description:** A new type of ultracapacitor that offers a capacitance density on the order of 500 Farads per cubic centimeter or higher has been created. The principle behind the new ultracapacitor structure is the insertion of a 100 nm-thick layer of barium strontium titanate as an interface between the activated carbon electrode and the electrolyte. The new ultracapacitors are highly needed in hybrid vehicle applications; as any significant increase in the energy storage capability of the ultracapacitors leads to substantial improvement in the fuel efficiency of hybrid vehicles. Two manuscripts about this new development were published in 2009. Additional research is ongoing. - *Not Funded by FESC*
	Title: Secure Energy Systems **PI**: Pramod Khargonekar - UF **Description**: The goal of this project is to investigate the concept of secure energy systems and formulate a concrete vision of a broad-based, comprehensive research program. An additional project goal is to develop architecture for modeling, analysis, and design of secure energy systems. An energy system consists of a collection of interconnected subsystems representing energy generation devices, energy consumption devices, transmission, distribution, and storage devices, and communications and computing devices. Such systems are dynamic and its operation is influenced by external perturbations. Definition of the system and it environment depends on the problem of interest. This project is motivated by strong interest among key decision makers in understanding and assuring security of energy systems in the face of various natural and man-made threats. Increasing penetration of renewable energy sources and capabilities offered by smart grid have the potential to enhance or degrade security of energy systems. Thus, these new developments present additional motivation for understanding of secure energy systems. Whereas there is an intuitive understanding of security and assurance, much work remains to be done in formulating precise definitions that cover problems of interest and devising an overall architecture that may facilitate a system level analysis and design of such secure energy systems. Taking into account rapid changes in the energy issues in a wide variety of private and public sectors, this project is a proactive effort to develop a vision and architecture for analysis and design of secure energy systems. It is expected that the results of this project will lead to future development and integration of specific analysis and design algorithms and software that will assist system designers in assessing and ensuring an appropriate level of system security. **Budget**: $220,000 Back to Thrust 1: Overarching
	Title: Optimization, Robustness and Equilibrium Modeling for the Florida Smart Grid **PI:** Panos Pardalos - UF Description: This project began in January 2011. It aims to develop algorithms for optimal design and functioning of Florida's next generation of power transmission and distribution systems that will incorporate the new realities of the grid. The goal is to create innovative real time capabilities for 1)

	optimal location of renewable energy source; 2) detection and prevention of instabilities and outages; and 3) operating models including generalized Nash equilibrium problems in the electricity market. **Budget**: $30,000
Policy	
	Title*:* Economic Impacts of Renewable Energy and Energy Efficiency Policies **PI:** Theodore Kury – UF (PI use to be Mark Jamison) **Description**: To serve its mission and contribute to FESC's fulfillment of its mission, PURC is conducting the three projects described below. These projects will be completed in two years and will deliver policy relevant reports and academic quality papers. The projects are: 1) Economic and Job Impacts of State Renewable Energy and Energy Efficiency Policies This project will provide empirical estimates of state renewable energy and energy efficiency policies on economic development and jobs. 2) Electric Grid Impacts of State Renewable Energy and Energy Efficiency Policies This project will provide an estimate of the impacts of renewable energy policies on the electric grid. It will fill a gap in the literature for Florida, which as to date focused on the impacts on electricity generation. 3) Effects of Energy Commodity Profit Margins on Effectiveness of Energy Efficiency Programs This project will test an assumption that is built into many state energy policies and that is held by many policy makers at the national level, namely that utilities would improve consumer energy efficiency practices if utility prices were decoupled from utility profits. **Budget:** $150,000
	Title: Environmental Impacts of Energy Production Systems: Analysis, Evaluation, Training, and Outreach **PI:** Amy B. Chan-Hilton, **Co-PIs:** Gang Chen, Wenrui Huang, Michael Watts, Ming Ye, Paul Lee - FSU **Description:** The goal of this project is to develop tools and conduct research to objectively assess environmental and water resources needs and constraints while developing prudent energy strategies and policies. The focus of this research will be on fuel cycle and energy production systems. The objectives of this project were to analyze the environmental and water resources demands and potential impacts, specific to Florida's unique geographical challenges, of fuel cycle systems and develop an objective environmental impact screening and evaluation tool or decision support system for energy planning and policy making by Florida's industry, utilities, and government. As Florida develops its long-term energy strategy, multiple efforts are ongoing to develop and apply a wide range of energy technologies that are sustainable and carbon-neutral. But pragmatic issues related to environmental impact and sustainability need to be addressed before these technologies may be implemented. This project directly addressed the FESC's Thrust 6 on "Energy systems and their environmental and economic impacts." This project also directly addresses IESES's Objective 4 on unique geographical challenges and Objective 5 on sustainable energy engineering, science and the sustainable energy economy. **Budget:** $118,470 **External Collaborators:** Florida Department of Environmental Protection ***This project has been completed***
	Title: Promoting Energy and Land Use Through Land Use, Transportation and Green Infrastructure Polices **PI:** Tim Chapin, **Co-PIs**: Ivonne Audirac, Chris Coutts, Greg Thompson, Mark Horner - FSU **Description:** In response to the many issues related to energy provision, energy sustainability, and GHGs, in 2007 Governor Crist created an Action Team on Energy and Climate Change. This group was tasked with investigating and recommending strategies for reducing GHG emissions, creating more sustainable energy systems in Florida, and for establishing Florida as an international leader in innovative energy provision. Related to this, the 2008 session saw the Florida Legislature pass HB 697 which, among many

	things, requires every local government in the state to address energy systems and GHG emissions explicitly within their comprehensive plans. Currently, the linkages between energy planning, environmental and economic sustainability, land use and transportation planning, and GHG reductions have never been stronger in Florida. This project is aimed at continuing the momentum in Florida for developing broad-based solutions to these problems by helping to develop a knowledge base for informing state policy in the areas of energy, sustainability, and land use and transportation planning. **Budget:** $168,185 ***This project has been completed***
	Title: Political and Economic Institutions Regarding Siting of Energy Facilities **PI**: R. Mark Isaac, **Co-PIs:** Douglas Norton, Svetlana Pevnitskaya - FSU **Description:** The "Hold-Out" project evaluates the "hold-out" concept, which is discussed repeatedly in the context of public policies regarding land acquisition and facilities siting, but a clear definition is elusive. To economists, the most likely definition is that a profitable amalgamation of land parcels by one buyer from competing sellers US DOEs not occur because of the failure of the private bargaining process. However, sometimes the term seems to be used more for delay instead of failure in bargaining, or even the very different concept of creation of any bilateral bargaining situation of the buyer and the "last" or "holding-out" seller, which may be inconvenient to the buyer but is immaterial in terms of economic efficiency unless efficient trades actually fail. The experimental design is complete, the programming is complete, Institutional Review Board approval has been obtained, and we have conducted two complete experimental treatments. This research was presented at one of the Presidential Sessions at the 2009 Meetings of the Southern Economics Association in November in San Antonio. **Budget:** $79,621 ***This project has been completed***
	Title: Experimental Investigation of Economic Incentives of Policies, Institutions and R&D in Environmental Conservation **PI:** Svetlana Pevnitskaya, **Co-PI:** Dmitry Ryvkin - FSU **Description:** Policies and institutions aiming at reducing pollution and battling climate change often do not reach desirable results because actual decisions of governments and economic agents deviate from those predicted by theory. We employed methods of experimental economics to find and explore such deviations and their causes, and used the findings to modify theory and design better policies and institutions. In this project, we constructed a theoretical model of decisions in a dynamic environment with costs of pollution and climate change, while testing the theory in laboratory experiments with human subjects. We studied actual behavior and explore responses to changes in the environment, production technologies, investment in clean technology and institutions. This project is complete. **Budget:** $43,217 ***This project has been completed***
	Other
	Title: Fusion Energy Spheromak Turbulent Plasma Experiment-STPX **PI:** Charles A. Weatherford, **Co-PIs:** Kyron Williams, Ephrem Mezolin - FAMU **Description:** The Florida A&M University's Center for Plasma Science and Technology (CePaST) has nearly completed the construction of a spheromak fusion reactor. A spheromak is one of a general class of experiments used to investigate key plasma physics principles relevant for the development of magnetically confined, controlled thermonuclear fusion as a source of electrical power. This project involves collaboration between Florida A&M University CePaST, West Virginia University, and Auburn University. The spheromak turbulent plasma physics experiment (STPX) is being constructed at FAMU in a facility especially built for the STPX experiment. Fusion research is a key element in the nation's long term energy supply strategy, The spheromak concept may be a possible alternative to the tokamak concept (deployed at

	ITER) which affords access to fundamental fusion science issues supportive of fusion while allowing us to maintain and nurture an American fusion scientific workforce. This project will determine, using a fast duty cycle between theory, experiment, and simulation, the essential elements required for full kinetic modeling of an entire spheromak plasma using ab initio MHD with direct modifications from new turbulence physics. The project will focus on the management of fluctuations and transport in a spheromak plasma using new turbulence physics models and comprehensive helicity control. We will employ high time- and spatial-resolution measurements of electron temperatures, ion temperatures, and magnetic field fluctuations to investigate, understand, and eventually control reconnection driven heating as a means of increasing the plasma temperature of spheromak plasmas. We will use divertor diagnostics of radiation and particle transport along with edge biasing for electric field control to explore the effects of driven flows on confinement and heating in spheromak plasmas with microparticles and will investigate the effects of MW pulses coupled to protons on the plasma current and confinement. **Budget:** $950,000 – *Not Funded by FESC* **Universities and External Collaborators:** Dr. Earl Scime, West Virginia University Dr. Ed Thomas, Auburn University Dr. Simon Woodruff, Woodruff Scientific, Inc
	Title: Marketing Strategies to Incentives Entrepreneurship and Innovation in the Development of Sustainable Energy **PI:** Joe Cronin - FSU **Description:** The objective of this project was to investigate the role of market pull strategies in advancing sustainability goals. Specifically, the intent is to identify what "drives" consumers' attitudes and behaviors relative to sustainable products. This includes consumers' personal attitudes, opinions, and beliefs, their perceptions of their own and organizations' abilities to affect or change the environment in which they live, and their personal characteristics (e.g., demographics). In addition, in collaboration with the College of Communications, the strengths and weaknesses of the various communication modalities that can be used to deliver sustainability knowledge to consumers (e.g., advertisements, testimonials, expert word-of-mouth communications, public relations, publicity, etc) were assessed. Specifically, the research attempts to identify the optimal market pull modality; that is, the means by which to deliver to consumers the knowledge that drives the purchase of sustainable goods and services. The overall objective of the research is to provide much needed market pull information for organizations embarking on "green" marketing strategies; that is, firms in the process of developing or expanding their mix of environmentally friendly goods and services. **Budget:** $191,555 ***This project has been completed***
	Title: Energy Sustainable Florida Communities **PI:** Richard Feiock, **Co-PIs:** Ivonne Audirac, Keith Ihlanfeldt **-** FSU **Description:** The objective of NESC is to stimulate innovation and energy investments that will accelerate energy savings by local governments by sharing best practices and organizing and managing large scale collaboration and bulk buying projects. Florida State University has been working with U.S. US DOE contributing surveys, research and outreach assistance to assist in efforts to promote investment, collaboration, and bulk purchasing by local governments that will achieve significant cost savings. This includes organizing NESC conference calls co-hosted by hosted by FSU and US DOE, conducting several surveys, and hosting a meeting of Florida local government EECBG sub-awardees. These initial research efforts and conference calls have been successful in identifying broad interest in collaboration and bulk buying. They also revealed significant barriers to collaboration that need to be

	addressed including issues related to coordination within governments, among governments and with other organizations. We are now undertaking activities to address these barriers to collaboration at three levels: First we are conducting focused regional workshops throughout the state. By bringing interested governments in each region together with experts in collaboration, governance, finance, and purchasing we will identify specific projects and design the mechanisms to put the projects in place. Second, are expanding our statewide dialogue on a more systematic basis and share the insights and successes of our regional workshops. Third, we are working with universities and other partners throughout the U.S. to share strategies and insights and help replicate our successes in other states. By expanding our efforts and formalizing the network we will make large scale energy savings a reality. **Budget:** $125,424 ***This project has been completed***
	Title: Development of a Renewable Energy Research Web Portal **PI:** Charles R. McClure, **Co-PIs**: Ian Douglas, Chris Hinnant - FSU **Description:** This project identified, organized, and made available via a web portal, research generated as part of the FESC effort as well as other selected related information resources and tools as identified by FESC participants. The goal of this project was to provide IESES, FESC, researchers, and others in the state of Florida with the research information they need to accomplish statewide energy goals. An initial product from this project was an operational web portal that identifies, organizes, and provides access to a range of FESC and other research related to renewable and alternative energy information. A second product was research results on extending technologies that allow users to share information and grow/sustain the web portal through a range of social networking techniques. This research attempts to position FSU to seek additional external funding related to interactive databases and web portals. The ultimate expected outcomes resulting from the project include increased IESES and FESC researcher productivity; increased leverage and collaboration of FESC resources and funding; and improved policy- and decision-making regarding the future uses and development of renewable and alternative energy in Florida. **Budget:** $194,542 ***This project has been completed***
	Title: Planning Grant: Hydrogen Storage Using Carbon-Based Adsorbent Materials **PI:** Efstratios Manousakis - FSU **Description:** This project was a theoretical investigation of a variety of carbon based nano-porous materials, such as activated carbon or single-wall or multi-wall carbon nanotubes, which can be used to store and transport hydrogen. We find that by doping with metallic elements, the micro-surfaces of these carbon-based porous materials provide increased van der Waals forces to the adsorbed hydrogen molecules; this effect significantly enhances the volumetric energy density for hydrogen storage and we caried out a full theoretical investigation to find the optimum conditions. This project is complete. **Budget: $15,000** ***This project has been completed***
Education and Outreach	
	Title: Florida Advanced Technological Education Center (FLATE) **PI:** Marilyn Barger - UF **Description:** FLATE (Florida Advanced Technological Education Center) is FESC's partner to develop statewide curriculum frameworks for technical A.S./A.A.S. degree programs supporting existing and new energy business sectors. FLATE develops the frameworks and facilitates their progress through the multiple sequential industry-validation, student competencies based, FLUS DOE procedure. FLATE also develops new courses and provides faculty professional development as required for each new program of

	study. Additionally FLATE helps colleges in the State College System implement the new frameworks in their institutions. To support the new curriculum, FLATE will work closely with the FESC Public Outreach and Industry Partnership programs to provide additional professional development opportunities for teachers and faculty to upgrade and update their STEM knowledge base. **Budget:** $300,000 **External Collaborators:** Brevard Community College; Tallahassee Community College; Daytona State College; Central Florida Community College; Polk State College; Florida State College at Jacksonville; Valencia Community College; School District Hillsborough County; Florida Department of Education – Division of Adult and Career Education; West Side Technical School; WFI Banner Center for Energy; Advanced Technology for Energy and Environment Center (ATEEC); University of West Florida, Dept of Construction Technology; WFI Banner Center for Construction; WFI Banner Center for Alternative Energy; USF College of Engineering; Madison Area Technical College ATE project for Alternative Energy certifications; Milwaukee Area Technical College Energy Conservation and Advanced Manufacturing Center (ECAM); Florida Energy Workforce Consortium (FEWC); TECO; Progress Energy; ISTEC (Ibero Science and Technology Education Consortium).
	Title: Outreach Activities for FESC **PI:** Pierce Jones, Kathleen C. Ruppert, Hal S. Knowles III, Nicholas Taylor, Barbra Larson, Craig Miller- UF **Description:** Developing educational outreach programs and materials designed to deliver practical, applicable information and knowledge on energy-related topics to the general public as well as targeted to specific audiences such as builders, planners, engineers, architects, small businesses, local governments, and utilities through the Cooperative Extension Service and others. By focusing educational programming on climate and efficient use of energy and water, the program aims to provide the knowledge needed by building and energy professionals, local governments, and the general public, to significantly reduce greenhouse gas emissions in Florida. **Budget:** $497,670 **External Collaborators:** Primarily DCA, FSU, UCF (FSEC), USF, and DEP with many others as well.
	Title: UFTR Digital Control System Upgrade for Education and Training of Engineers and Operators **PI:** Gabriel Ghita – UF (PI use to be Alireza Haghighat; he has left UF) **Description:** The goal of this project is to contribute to a major initiative on design, licensing and construction of a fully digital control system for the University of Florida Training Reactor (UFTR). This makes the UFTR the first operating nuclear power plant in the United States that uses a fully digital control system. This facility will provide for the training and education of the necessary workforce in the area of digital control and instrumentation for nuclear reactors. With this effort, a new focus/certificate on digital control and instrumentation will be developed at the Nuclear and Radiological Engineering (NRE) Department. Further, the UFTR facility will offer training courses for community colleges (Central Florida, Indian River, and Jacksonville) in the State of Florida, personnel from nuclear utilities and government agencies including the Nuclear Regulatory Commission (NRC). The project has already received significant funding from industry and government in form of grants, contracts, equipment/systems, and engineers' time. **Budget:** $308,000 **External Collaborators:** Several engineers from AREVA NP Inc & Siemens Corporation
	Title: Energy and Efficiency Video Public Service Announcements **PI:** Andy Opel, **Co-PIs:** Phil Steinberg, Leslie France-Patterson, Laura Arpan, Ian Weir - FSU **Description:** This interdisciplinary team produced 6-8 short (30-second/one-minute) video public service announcements (PSAs) that address issues of energy and efficiency and one 12-15 minute informational documentary targeted to Florida legislators and the Governor's office. These videos will be tailored to

	reinforce existing IESES efforts. **Budget:** $200,720 ***This project has been completed***
	Title: Planning Grant: Climate modeling and Outreach Activities **PI:** Shawn R. Smith, **Co-PIs**: Steve Cocke, David Zierden, James O'Brien, Julie Harrington - FSU The objective of the planning grant is to develop at least one external funding proposal that focuses on areas of climate modeling and/or climate outreach that support the activities of the IESES. The focus of our activities has centered on evaluating the potential offshore wind resource in the northeastern Gulf of Mexico and elsewhere in Florida's waters. Preliminary research has been completed using observations from instrumented Air Force towers and buoys in the waters around Florida. The existence of wind power capacity has been identified at the assessed locations. Due to the sparseness of in-situ wind data in the region, a numerical modeling approach will need to be pursued to develop a wind climatology with sufficient spatial and temporal scales to further define the offshore wind power capacity. A vast portion of the work conducted focused on outreach and education. When we began our project, the idea of offshore wind power in Florida was not even on the radar of the Florida Legislature or the renewable energy sector at large. We worked to raise the visibility of offshore wind as an energy resource for Florida by attending meetings, connecting with the wind power industry in Florida, and briefing two members of the Florida Legislature and presenting to the Florida Energy and Climate Commission. As a result of these connections, we submitted a preliminary proposal to Siemens Wind Power and have developed a network of colleagues both within FSU and the private sector that are interested in further developing Florida's offshore wind resource. **Budget:** $15,000 ***This project has been completed***
	Title: Visiting Law Professor **Principal Investigator:** JB Ruhl, Jim Rossi **Co-PI:** Uma Outka - FSU **Description:** Two-year Visiting Scholar, Uma Outka, at the College of Law researched the interface between land use law and innovative energy solutions and delivering academic symposia and graduate student seminars on the research scope, comprising Sustainable Energy Research Project (SERP) within Environmental and Land Use Law Program. This project is complete. **Budget:** $214,603 ***This project has been completed***
FESC Phase 2 Technology Commercialization	
	Title: Development of a Low Cost Concentrating Solar Energy System Using Solar Sausages **PIs:** David VanWinkle, Sean Barton – UF **Description:** Beginning in late 2010, weekly meetings have been held at HHH offices in Tallahassee that include representatives of the several entities involved in deploying the "Solar Sausage" concentrating system at the Yulee St. site in Tallahassee. The entities include Pro Solar Inc., Barkley Consulting Engineers Inc., Winton Engineering PA, and Applied Research and Design Inc. A series of 50-foot long prototype sausages were made and inflated on site. Many issues were identified that needed to be resolved before manufacturing and deploying several hundred solar sausages on site including methods of constructing, mounting, and operating the balloons, distribution of air and electricity, and removal of heat. **Industry Partner:** Hunter and Harp Holdings (HHH)
	Title: Stress Evolution in Solid-State Li-Ion Battery Materials **PI:** Kevin S. Jones – UF **Description:** Li-ion battery (LIB) technology is promising for use in electric drive vehicle (EDV) and stationary energy storage applications. However, challenges with materials safety, performance, cost, and manufacturing scalability have largely prohibited LIB implementation in these situations. Challenges in

	stress evolution during the fabrication and processing of the elements of the cells remain and are not well understood. In this study the roles of component fabrication and processing conditions on the resulting stresses in the materials are being evaluated. Thin film battery components will be deposited on stainless substrates using a novel fabrication method invented and patented by Planar Energy and the components will be subjected to different annealing treatments. A novel curvature measurement system will be used to characterize the stress in the component layers both after deposition and annealing and structural analysis techniques will be used to correlate the resultant component material microstructure and crystallographic phase(s) with the measured stresses. **Industry Partner:** Planar Energy
	Title: SWNT Based Air Cathodes for Fuel Cells & Metal Air Batteries **PI:** Andrew G. Rinzler – UF **Description:** The goal of this project is to develop and use novel gas diffusion oxygen reducing electrode (air cathode) based on single wall carbon nanotube (SWNT) films in zinc-air batteries and fuel cells. Metal-air batteries, utilizing surrounding air as an inexhaustible cathode material have the highest specific and volumetric energy density of any primary battery system available. Gas diffusion oxygen electrodes, where molecular oxygen is electrocatalytically reduced, are vital to battery and fuel cell performance. The air cathode should be permeable to air or another source of oxygen, but must be substantially hydrophobic so that electrolyte will not leak though it, and have an electrically conductive element connected to external circuitry. Generally, conventional air cathode is a thick multilayer film comprising carbonaceous powder mixed with nanoscale metal catalyst to promote oxygen reduction and hydrophobic polymer additive pressed onto electrically conductive layer. While noble metals such as platinum that are commonly used as catalysts in conventional air cathodes offer the advantages of intrinsic catalytic activity, their deficiency in resource, high costs, and susceptibility to catalyst poisoning, have become a serious concern for commercial applications. An optimized SWNT based air cathode catalyst that would constitute a significant improvement in existing technologies is being developed. This new system avoids precious metals, is not poisoned, is thin, light-weight, and resists electrolyte flooding. **Industry Partner:** nRadiance LL
	Title: Uni-Directional Impulse Turbine for the Powering of Offshore Monitoring Systems **PI:** Zhihua Qu, **Co-PI:** Kuo-chi Lin – UCF **Description:** Numerical modeling and experimental testing of turbine for wave energy conversion. The University of Central Florida and Harris Corporation have joined efforts to design, build and analyze a wave powered abandoned oil well monitoring system for use in the Gulf of Mexico. This system proposes a fully automated oil leak detection system which is self-powered by the local ocean energy which is converted to electricity, conditioned and sent from the surface buoy to the ocean floor to supply power for an abandoned oil well monitoring system. **Industry Partner:** Harris Corporation
	Title: Development of high efficiency polymer solar cells **PI:** Frank So – UF **Description:** Polymer solar cells have emerged as a potential alternative to conventional silicon based solar cells for sustainable energy sources. The key advantage of polymer solar cells is the ability to manufacture solar panel by low cost roll-to-roll processes. While the external quantum efficiencies at the peak response in polymer cells can exceed 70%, the power conversion efficiency of polymer solar cells has been limited to about 5-7%. There are three factors limiting the power conversion efficiency of polymer solar cells. First, the absorption bands of most polymers used in solar cells are fairly narrow. In fact, most polymers used cannot absorb all the light within the visible part of the solar spectrum and it will be desirable to extend the photoresponse to the near-IR region.

	Second, the nanophase morphology of the bulk heterojunctions needs to be well controlled. Once light is absorbed, excitions generated need to diffuse to the heterojunction interface to be dissociated. This condition requires that the dimensions of the donor and acceptor phase domains need to be less than the exciton diffusion length. Third, charge carriers need to be transported to the electrodes with least resistance once excitions are dissociated. Therefore, it is important that the carrier mobilities of both electrons and holes in the polymer blends need to be sufficiently high (10-4 to 10-3 cm2/Vs) and well-balanced. The objective of the proposed project is to synthesize broadly absorbing, black colored (PBLACK) polymers with especially high charge mobilities and to fabricate the highest performance polymer solar cells possible. Specifically, we will synthesize polymers with absorption band ranging from 400 nm to beyond 1 [illegible] cm2/Vs. Polymer-fullerene (both PC60BM and PC70BM along with more recently developed derivatives) blend morphology will be optimized using different solvent/heat treatments as well as additives to the blends. The final device will be enhanced using anode and cathode interlayers to enhance carrier extraction to the electrodes. With the ability to synthesize broadly absorbing polymers, control the donor-acceptor phase morphology and engineer the device structure, it is expected that the power conversion efficiency of polymer solar cells can reach 8% at the end of the first year and 10% at the end of the second year of the program. To commercialize the polymer photovoltaic cells developed under this program, through our sponsor Sestar, LLC., we will be working with the Denmark Technical University and Xenia, a UK commercial inkjet printing technology development company to explore high volume manufacturing of polymer solar cells **Industry Partner:** SestarTechnologies, LLC

APPENDIX B – FUNDING OPPORTUNITIES SENT TO FESC FACULTY

Title	Call #	Agency	Funding
National Geothermal Student Competition 2012	2012-13 NGSC	US DOE	
Building Construction Technology Extension Program (BCTEP) Pilot Projects	2012-BCTEP-01	NIST, DoC	$1.33M
Defense Production Act Title III	BAA-12-03-PKM	AFRL/RX	$8.5M
Advanced Propulsion Concepts and Cycles	BAA-12-03-PKP	AFRL	$44.5M
Environment & Energy Quality (E2Q) Technologies II	BAA-12-10-PKM	AFRL	$350M
A Pilot Institute for the National Network for Manufacturing Innovation (NNMI)	BAA-12-17-PKM	AFRL	$60M
Expressions of Interest: Research Leading to Predictive Theory and Modeling for Materials and Chemical Sciences	BES-EOI-2012	US DOE	$36M
Gulf of Mexico Research Initiative	BP - RFP-II	BP	$112.5M
Cost-shared Industry Partnership Program for Small Modular Reactors	DE-FOA-0000371	US DOE	$452M
U.S. Offshore Wind: Advanced Technology Demonstration Projects	DE-FOA-0000410	US DOE	$180M
Nuclear Energy Enabling Technologies (NEET) – Reactor Materials	DE-FOA-0000426	US DOE	$7M
Nuclear Energy Enabling Technologies (NEET)- Advanced Methods for Manufacturing	DE-FOA-0000427	US DOE	$3 M
U.S.-India Joint Clean Energy Research and Development Center	DE-FOA-0000506	US DOE	$125M
Energy Innovation Hub - Batteries and Energy Storage	DE-FOA-0000559	US DOE	$120M
Multidisciplinary University Research Initiative: High Operating Temperature Fluids	DE-FOA-0000567	US DOE	$10M
Proliferation Detection Research	DE-FOA-0000568	US DOE & NNSA	$20M

Electricity Delivery and Energy Reliability, Research, Development and Analysis	DE-FOA-0000579	US DOE	$8M
SunShot Concentrating Solar Power Research and Development/ Support of Advanced Fossil Resource Utilization Research by Historically Black Colleges and Universities and Other Minority Institutions Grant	DE-FOA-0000595	US DOE	$850k
Second Generation Dark Matter Experiments	DE-FOA-0000597	US DOE	$6M
SunShot Incubator Program- Soft Cost Reduction	DE-FOA-0000607	US DOE	
Stewardship Science Academic Alliances	DE-FOA-0000611	US DOE	NA
Nuclear Energy University Programs- General Scientific Infrastructure Support	DE-FOA-0000613	US DOE	$300k
Advancements in Sustainable Algal Production (ASAP)	DE-FOA-0000615	US DOE	$21M Area1: $500k-$3M Area 2: $10-15M
Accelerating the Deployment of Energy Efficiency and Renewable Energy Technologies in Indonesia	DE-FOA-0000620	US DOE	$1.2M each
Energy Savings through Improved Mechanical Systems and Building Envelope Technologies	DE-FOA-0000621	US DOE	1.5M each
Light-Duty Fuel Cell Electric Vehicle Validation Data	DE-FOA-0000625	US DOE	$6M
Validation of Hydrogen Refueling Station Performance and Advanced Refueling Components	DE-FOA-0000626	US DOE	$400k to $1M each
Research and Development for Next Generation Nuclear Physics Accelerator Facilities	DE-FOA-0000632	US DOE	$2M
Superior Energy Performance Program Administrator	DE-FOA-0000635	US DOE	$3M
Advanced Oxy-combustion Technology Development and Scale-up for New and Existing Coal-fired Power Plants	DE-FOA-0000636	US DOE	Phase 1: $10M Phase 2: $21M
Integrated Nuclear Medicine Research and Training Projects of Excellence	DE-FOA-0000646	US DOE	$10M

Atmospheric System Research	DE-FOA-0000647	US DOE	$3.5M
Predictive Modeling for Automotive Lightweighting Applications And Advanced Alloy Development for Automotive and Heavy-Duty Engines	DE-FOA-0000648		$1.2M to $6M each
Improving the Accuracy of Solar Forecasting	DE-FOA-0000649	US DOE	$9M
SunShot Incubator Program	DE-FOA-0000651	US DOE	$12M
Technologies to Ensure Permanent Geologic Carbon Storage	DE-FOA-0000652	US DOE	$800k to $1.2M each
Plug and Play Photovoltaics	DE-FOA-0000653	US DOE	$25M
Bridging Research Interactions through Collaborative Development Grants in Energy (BRIDGE)	DE-FOA-0000654	US DOE	$9M
Biomass Research and Development Initiative	DE-FOA-0000657	USDA and US DOE	USDA-NIFA: $25M; US DOE: $10M
Regional Test Centers: Validation of Photovoltaic (PV) Modules and Systems	DE-FOA-0000661	US DOE	
Reduction of Tropical Cloud and Precipitation Biases in Global High Resolution Models	DE-FOA-0000664	US DOE	$2M
Wireless Charging for Electric Vehicles	DE-FOA-0000667	US DOE	$12M
Methane Hydrate Program	DE-FOA-0000668	US DOE	$2M to $30M each
Zero Emission Cargo Transport Demonstration	DE-FOA-0000669	US DOE	$2M to $10M each
ARPA-E	DE-FOA-0000670	US DOE	$150M
Methane Opportunities for Vehicular Energy (MOVE)	DE-FOA-0000672	US DOE	
Advanced Management and Protection of Energy-Storage Devices (AMPED)	DE-FOA-0000675	US DOE	$30M
Solid State Energy Conversion Alliance (SECA) Core	DE-FOA-0000677	US DOE	$500K for each
National Laser Users' Facility (NLUF) Program	DE-FOA-0000681	US DOE	$3.2M

Bio-Oil Stabilization and Commoditization	DE-FOA-0000686	US DOE	$15M
Accident Tolerant Fuel (DRAFT)	DE-FOA-0000692	US DOE	$10M
Office of Advanced Scientific Computing Research (ASCR) Scientific Collaborations at Extreme-Scale	DE-FOA-0000695	US DOE	$4.7M each
Sustainable Cities: Urban Energy Planning for Smart Growth in China and India	DE-FOA-0000697	US DOE	$750k each
2012 Mathematical Multifaceted Integrated Capability Centers (MMICCs)	DE-FOA-0000698	US DOE	$9M
Small Scale Coal-Biomass to Liquids (CBTL) Production and Feasibility Study of a Commercial Scale CBTL Facility	DE-FOA-0000703	US DOE	$3M
In-Water Wave Energy Conversion (WEC) Device Testing Support	DE-FOA-0000705	US DOE	$500k each
Theoretical Research in Magnetic Fusion Energy Science	DE-FOA-0000707	US DOE	$4.5M
Implementation Initiatives to Advance Alternative Fuel Markets	DE-FOA-0000708	US DOE	$1.2M
Technology Research, Development, and Tools for Clean Biomass Cook Stoves	DE-FOA-0000709	US DOE	$7M
Development of LWR Fuels with Enhanced Accident Tolerance	DE-FOA-0000712	US DOE	$10M
Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR)	DE-FOA-0000715	US DOE	$7M
Novel Sensing and Monitoring Technologies for Subsurface Detection of CO_2	DE-FOA-0000732	US DOE	$5M
Safety of Oil and Gas Operations in the US Outer Continental	E12PS00004	Department of Interior	$5M
Proposed Research on Oil Spill Response Operations BAA 2012	E12PS00012	DoI	
Energy and Climate Partnership of the Americas/ Caribbean Region Climate Adaptation Partnership Initiative	ECPA/CRCA Partnership Initiative	HED/USAID	$770,500
National Clean Diesel Funding Assistance Program, FY 2012 Request for Proposals (RFP)	EPA-OAR-OTAQ-12-05	EPA	$20M

NSF/US DOE Partnership in Basic Plasma Science and Engineering	NSF 09-596	NSF	$2M
Sustainability Research Networks Competition (SRN)	NSF 11-574	NSF	$8M
Basic Research to Enable Agriculture Development	NSF 11-579	NSF	$12M
Energy for Sustainability	NSF PD 12-7644	NSF	
Sustainable Energy Pathways (SEP)	NSF-11-590	NSF	$34M
Academic Liaison with Industry (GOALI)	NSF12-513	NSF	$5M
Research on the Science and Technology Enterprise: Statistics and Surveys R&D, U.S., S&T Competitiveness, STEM Education, S&T Workforce	NSF-12-545	NSF	$750k
EERE Postdoctoral Research Award Application	ORISE	US DOE	
Defense Production Act Title III Technology Marketing Research- Addressing Availability and Cost of Fuel Cell Systems	RFI-12-16-PKM	AFRL	
Defense Production Act Title III. Advanced Drop-In Biofuels Production Project	SN-12-15-PKM	AFRL	$30M
Beginning Farmer and Rancher Development Program	USDA-NIFA-BFR-003541	USDA	$19M
SunShot Initiative Postdoctoral Research Awards		US DOE	
The Rural Jobs and Innovation Accelerator Challenge, A Coordinated Initiative to Advance Regional Competiveness		EDA/USDA	$750K each

Total: 79

APPENDIX C – IP CATALOG BY UNIVERSITY

FLORIDA ATLANTIC UNIVERSITY

Technologies Available for Licensing

ENERGY

Marine

Retrofit Cathodic Protection - Software for Marine Pipelines
Software for the Design of Cathodic Protection Systems for Deep Water Risers
Synchronous Laser Line Scan Imaging

FLORIDA INTERNATIONAL UNIVERSITY

Technologies Available for Licensing

ENERGY

Algae

Novel Library of Native Algae Species with Beneficial Health Effects

CLEAN-TECH

Computer

3-D Magnetic Memory

FLORIDA STATE UNIVERSITY
Technologies Available for Licensing

ENERGY

Solar
A High-Efficiency Multi-junction Photovoltaic Cell for Harvesting Solar Energy
Triple-Junction Solar Cells for Solar Energy Harvesting
Inflatable Solar Energy Collector (the "Solar Sausage")

Wind
Multi Piece Wind Blades, HPMI

Fuel Cells
Alkaline Membrane Fuel Cell
High Performance Fuel Cell

CLEAN-TECH

Mechanical
Solderless Joint Technology
Bidirectional Linear Nanoactuator Powered by Biomolecular Motors
Sharing Cyrogenic Cooling Systems Between Large and Auxiliary Devices

Materials
Carbon Nanotube and Polymeric Thin Film Assemblies for Pressure Sensing and Mapping
Improved Fire Retardant Materials
High Efficiency Ion Exchange in Zeolites

Computer - Communication
The SPOT Method for Detecting Compromised Computers in a Network
Method to Improve Processing Efficiency with Instruction Register File

UNIVERSITY OF CENTRAL FLORIDA
Technologies Available for Licensing

ENERGY

Solar and Thermo Electric

Improved Manufacturing of Thin Film Solar Cells With Highly Efficient Energy ConversionHybrid PV/Thermal Solar Cell with Significantly Increased Efficiency and Longevity
Shape Memory Alloy Based Thermal Conduction Switch for on Demand Heat Transfer
Compact, Lightweight and Highly effective Recuperative Heat Exchanger
Synthesis of Core/Shell/Shell Quantum Dots with Improved Luminescent and Semi-Conducting Properties For Bio Imaging and Solar Cell Applications

Biomass

Solid Acid Catalyzed Hydrolysis of Cellulosic Materials

Energy Storage

Power, Distribution, Smart Grid, Communication

The Combination of Linear and Adaptive Non-Linear Control for Fast Transient Response in Highly Efficient Voltage Regulators and DC-DC Converters
Active Transient Voltage Compensator for Improving Fast Transient Response in DC to DC Converters
Highly Efficient DC-DC Converter with a Coupled-Inductor Current-Doubler Topology
Silicon Controlled Rectifier Layout Topology for High-Voltage Electrostatic Discharge Applications

Built Environment and Energy Efficiency

High Efficiency Twisted Air Conditioner Condenser Fan Blades and Hub with Performance Enhancements
Long Lasting Anti-Mildew/Fungal Coating for Roofs, Buildings and Pools

Marine

Highly Efficient Method for Generating, Transmitting and Receiving Electrical Power via any Heat Source including Hydrothermal Ocean Vents

Fuel Cells and Hydrogen

Increased Efficiency in Hydrogen Production Using a Solar Metal Sulfate Based Water Splitting Cycle

Inexpensive Method for Producing High Purity Hydrogen from Water and Other Hydrogen Containing Compounds
Super Absorbent Palladium Filled Carbon Nanotubes for the Storage and Detection of Hydrogen Gas
Efficient Closed-Loop Method of Producing Hydrogen Fuel from Landfill Gas and Biomass Feedstocks
Low Energy Electromechanical Method for Removal of Carbon Monoxide from Hydrogen Streams for Fuel Cells
Reusable Visual Hydrogen Detecting Compound Capable of Attachment to Numerous Substrates (Polymers, Ceramics and even Tape)
Method For Zero Emission Liquid Hydrogen Production From Methane Sources and Landfill Gas
Process for Efficient Production of Pure Hydrogen Gas with Reduced CO_2 Emissions
Fast and Reliable Hydrogen Generation Utilizing a Fixable Catalyst and Borohydride Solutions

Portable Hydrogen Generator for Coupling with Currently Utilized Fuel Cell Technologies

Water Desalination
Microtextured Superhydrophobic Membranes for High Flux Water Desalination

CLEAN-TECH

Environment
Air
Use of Oxide Nanoparticles to Reduce Soot Emissions and Increase Combustion Engine Efficiency
Airborne Contamination Detection via Optical Waveform Matching
Compact and Highly Sensitive Gold Nanorod Sensor for Detecting Mercury in Both Water and Air

Waste
Sorption and Filtration Media Mixes and Systems For Passive, Inexpensive Removal and Treatment of Wastewater and Stormwater

Sensors
Micro Electro-mechanical Room Temperature Hydrogen Sensor
Highly Selective and Cost Efficient Hydrogen Nanosensor Utilizing a Single ZnO Nanorod
A Nano-Ceria Based Regenerative Radical Sensor
Ultra High Temperature Micro-Electro-Mechanical (MEMS)-Based Smart Sensors for Monitoring Gas Turbines and other Similar Extreme Environments
Fabrication of Nano-Scale Temperature Sensors and Heaters
Gas Permeable Matrix for Chemochromic Compounds with Enhanced Hydrogen Sensing Performance

Lasers & Optics
Rapid Scanning Optical Interferometer for Diagnostics and Manufacturing
Highly Reliable High-Capacity Free-space Optical Communication with Partially Coherent Beams

Nanoparticle Coated Substrates for Increasing Rates of Chemical Reactions with Laser Irradiation Eliminating the Need for Expensive Heating Elements
High Speed, Digitally Controlled and Polarization Based Optical Scanner Capable of Scanning in Three Dimensions
Signal Processing using Spectrally Phase-Encoded Optical Frequency Combs for High Speed Computing and Pattern Recognition
Effective Laser Plasma Source for Extreme Ultraviolet Lithography Using Water Droplet Target System

Highly Efficient Magnetic Foil Trap for Charged Particle Shielding
Highly Efficient Systems and Methods for Measuring Ultra-Short Light Pulses
High Intensity Mega Hertz Mode-Locked Laser
Temperature Independent Narrow Spectrum Lasers
Gain-guided Optical Fiber Laser
Inexpensive and Re-useable Liquid Crystal Power Meter for Quickly Measuring Laser Beam Intensity and Profile
Coupling of Diodes and Laser Chips to Fiber Optic Waveguides with Increased Efficiency
Composite Sol-gel Hybrid Optical Coating for Infrared (IR) Applications
Fiber Optic Photonically Controlled Ultrasonic Probe

Wavelength Independent Polarization Rotator with a Wide Field of View
Ultra-broadband Frequency Swept Lasers
Method of Producing High Quality Durable Laser Diode Arrays for Significantly Enhancing Disk Lasers

Modified Wurtzite Structure Oxide Compounds as Substrates for III-V Nitride Semiconductor Epitaxial Thin Film Light Emitting Diodes and Laser Diodes
Bulk Semiconductor Lasers at Sub-millimeter/Far Infrared Wavelengths Using a Regular Permanent Magnet
Water Laser Plasma X-Ray Target Source

Materials
Oxidase Activity of Polymeric Coated Cerium Oxide Nanoparticles
Novel Method for Creation of Multi-wall Carbon Nanotubes as Super Efficient Electron Field Emitters in Flat Panel Displays and Electron Microscopes
Composite Materials and Coatings Created by an Efficient Dispersion of Carbon Nanotubes in Copolymer Solutions
Ultra Strong and Ultra Conductive Carbon Nanotube Reinforced Metal Composites
Carbon Nanotube with a Graphitic Outer Layer for Use with Atomic Force Microscopy and as an Electron Emitter
Nanoparticles of Cerium Oxide Having Potent Antioxidant or Superoxide Dismutase Activity
Dispersion of Carbon Nanotubes in Polymer Matrices for Creation of Highly Conductive and Mechanically Strong Nanocomposites
Inexpensive Room Temperature Synthesis of High Quality Zirconia Powders for Materials Applications

Metal Nanoparticle Polymer Composites with Electronic, Computer and Adhesive Applications
Nanoparticle Coating that Increases the Oxidation Resistance of Stainless Steel at Extremely High Temperatures
Highly Effective Method of Predicting Optical Properties and Physical Characteristics to Formulate Optimum Coating System
Synthesis of Nanoparticles with Enhanced Thermal Stability
Debris-Less and Spark-Free Shape Memory Alloy Based Release Mechanism
Solid Propellant Burn Rate Optimization Using a Nano-Titania Additive
Method of Generating Frequency Tunable Resonant Scatterers
Low Coherence Apparatus for Non-Invasive Real-Time System Analysis and Process Control
Method and Apparatus for Three-Dimensional Carbon Fiber Production
Sol-Gel Coating Method Which Significantly Reduces Water Content and Increases the Coating's Efficiency
Inexpensive Method for Bulk Manufacture of Crack-Free Ceramics at Reduced Temperatures
Micro-Fluidic Device for the Creation of Hand-Held Portable Water Sensor
Inexpensive Method for Producing Whisker Formations on Metallic Fibers/Substrates and Strongly Adhering Catalysts for Filtration Applications
Inexpensive Synthesis of Carbon Nanotubes and Nanofilaments via Electrochemical Deposition
Pure Silicon Photonic Crystal Fiber Fabrication via Magnesiothermic Reduction for Operations in the Mid-IR Spectrum
Highly Efficient Magnetic Foil Trap for Charged Particle Shielding
Inexpensive One-Step Rapid Manufacturing of Metal and Composite Parts and Prototypes
Thin Film Deposition of Silicon Crystalline Layers on Polymer Substrates at Decreased Temperatures

Photosensitive Polymeric Material for High Density 3-D Optical Data Storage
Inexpensive and Highly Sensitive Amorphous Metal Alloy for Electronic Article Surveillance (EAS) Systems
Highly Efficient Method for Growing Diamond Thin Film on a Substrate at Low Temperatures
Highly Efficient 1.3µm Lasers Using Nd^{3+} doped Apatite Crystals
Highly Efficient Microwave assisted Formation of Sulfonium Photoacid Generators (PGAs) for use in Photolithography and Coatings Applications
Ultra Compact, High Current and High Temperature Semiconductor Packaging
Magnetic Components for the Manufacture of Low Cost On-Chip Power Supplies
Dual-Polarity Electrostatic Discharge Protection for Sub-Micron, Mixed Signal, CMOS/BiCMOS Technologies
Reliable ESD Protection Device and Method for Advanced Sub-micron CMOS Technologies
Efficient Liquid Droplet System as Plasma Source for EUV, XUV, and X-Ray Wavelength Emissions

Efficient Plasma Source for EUV, XUV, and X-Ray Wavelength Emissions Produced from Liquid Metal and Nanoparticles Solutions
Highly Precise Advanced Droplet and Plasma Targeting System
Method for Increasing Thermal Conductivity of a Substrate

Signal Processing
Classification/Recognition of One or Multidimensional Signals Utilizing a Self-Designing Intelligent Signal Processing System Capable of Evolutional Learning
Multi-Sensor (Multi-Sensing) Surface Acoustic Wave Network Utilizing Orthogonal Frequency Coding for Increased Performance and Security
Data Compression of One or Multidimensional Signals Utilizing an Energy Based Split Vector Quantizer via Multiple Transform Domain Representations
Hybrid Photonics Modules for Variable Time Delay Signal Processing
Chromatic Dispersion Compensation for Optical Communications
Dual Opto-Electronic Precision Clocking Protocol for Optical and Electronic Systems
Improved Optical Communications with Significantly Reduced Cost using Polarization Diversity Transmission
Optical Multichannel Signal Regeneration
Regeneration of Differential Phase-Shift-Key Optical Modulated Signals
An Optimal Signal Processing Algorithm/System That Will Allow Complex Signals to Adapt to Time-Changing/Unknown Environments
Methods and Devices for Interference Cancellation in Radio Frequency Communication Systems

Mechanical
Miniature High Speed Compressor Having Embedded Permanent Magnet Motor

Electrical
Logic Device Design and Evolvable Hardware
On-Chip Structure for Protecting Integrated Circuits from Electrostatic Discharge (ESD)

Nano/Micro Devices
Ultra Compact Micro-Lens Imaging System for High Quality Magnification within a Compact Space

Highly Efficient Nanoparticle Seeded Short-Wavelength Discharge Source

Zinc Oxide Semiconductor Nanotubes with Paint-brush like Structures for use in Electronics and Quantum Computing
Large Scale Synthesis of Single Crystalline Ultra-long Semiconducting Nanowires for Improved Electronic and Optoelectronic Devices
A Passive Micro-Mixer for Use With Micro-Fluidic Sensors in Medical, Pharmaceutical and Chemical Applications
Highly Efficient Nanoparticles Generator
Novel Method for Creating Carbon Nanotubes Collimators

Optical Display Devices
Optical Aberration Correction via Aberration Generation
Energy Efficient and Reduced Temperature White Light Generation by Up-conversion of Rare-Earth Materials Utilizing an Infrared Light Source
High Resolution Full Color Integrated Semiconductor Display
Resonant Cavity to Enhance the Efficiency of IR to Visible Light Conversion for Use in High Resolution Displays
Display Design Suitable for Projection Displays with an Increased Color Gamut

UNIVERSITY OF FLORIDA
Technologies Available for Licensing

ENERGY

Solar, Thermo Electric, LED
Method for Growing GaN on Silicon for Superior Semiconductor Applications
Silicon Nanowires for Efficient Solar Power Generation
Novel Solar Cell with Dramatically Increased Efficiency
Low-cost, Ultra-efficient Light Extraction Mechanism for Organic Light-Emitting Devices (OLEDs)
More Cost-Effective & Safer LED Theatrical Illuminating Device
Energy-efficient, Dual-mode Displays and Active Devices
A Transparent, Solar-Powered Lighting Module With Integrated Energy Storage
Miniature Thermoelectric Power Generator for Hot Fluid Streams

Biomass
Bacterial Biocatalysts for More Complete and Efficient Processing of Biomass
Methods for Enhancing Crop Production and Survival
Oxygen-Releasing Fertilizer To Improve Plant Growth
Bacterial Biocatalysts for More Complete and Efficient Processing of Biomass
Efficient, Cost-effective Ethanol Production
Polyhydroxy Fullerenes for Stimulating Biofuel Production

Energy Storage
Cathodes for Lithium-Ion Batteries With Improved Energy Density

Power, Distribution, Smart Grid
Electrodynamic Controls For Reduced Leakage and Increased Efficiency in Turbines
More Compact and Affordable Power Inductors for Portable Electronic Devices
Smaller, More Efficient Resonating Inductor for Powering Electronic Devices
Small, Efficient, Fully Integrated DC-DC Power Converters
Ultra-Compact Electromagnetic Generator
Superior Fiber Optic Fault Detection System for Underground Power Lines
Improved System for Power Generation, Refrigeration, and Water Extraction

Built Environment
Flexible, Cost-effective Jet-Grouted Deep Pile Foundation Alternative
Devices for Assessing the Condition of Buried Pipelines
Concrete Composite for Enhanced Performance

Energy Efficiency
Functionalized Fullerenes for Energy Efficient Laser Ignition Applications
Device for More Efficient Fuel Combustion, Decreased Pollution

Fuel Cells and Hydrogen
Advanced Technology Membrane Reactors for Hydrogen Production

Nuclear
Improved Heat Transfer Fluid for Nuclear Reactors

Wind
Efficient, Non-Mechanical Wind Tunnel for Improved Testing

Climate
A Method for Accurate Lightning Strike Prediction and Recording

Water Desalination
Environmentally Friendly Simultaneous Desulfurization and Desalination for Process Industries
Low-Energy Process for Producing Fresh Water

CLEAN-TECH
Environmental Technologies
Air
Efficient, Cost-Effective Air Filtration System
System that Accurately Measures Aerosols and Gases from Same Airspace
Low-Energy Process for Producing Fresh Water
Low-Energy, Self-Cleaning Air Purification Device
Inexpensive Automated Water Sampling Device
System for Controlling Wastewater Chlorine Concentration
Multipurpose Device for Sampling Water Quality
Novel Process for Increasing Liquid Extraction from Fabrics
Device for Measuring the Acidity of Airborne Contaminants
Novel Ceramic Nanotechnology for Improved Filtration of Air, Gases, or Liquid Metals

Water
Inexpensive Automated Water Sampling Device
System for Controlling Wastewater Chlorine Concentration
Multipurpose Device for Sampling Water Quality
A Filter that Efficiently Removes Phosphates from Water

Waste
Cost-Effective System that Treats Hazardous Waste for Reuse

Marine
Nontoxic Paint Additive that Prevents Marine Surface Contamination

Sensors
Compact, Hand-held Tool for Calibration-free Non-Contact Measurement of Vibration
Improved Model Predictive Control for Perfect Tracking of Performance Variables
Higher Resolution Ultrasonic Imaging Sensor
Tunable Wave Plate Manufactured from Silica Aerogel
Microscale Flow-Rate Sensor with Improved Performance and Reduced Costs

Chemical

Method for Industrial Preparation of High-Quality Inorganic Nanocrystals
Method for Fast, Inexpensive Separation of Carbon Nanotube Bundles
Novel Method for Manufacturing Improved Nanotechnology
Breakthrough Approach to Carbon Nanotube Production
Biodegradable Thermoplastic for Expedited Decomposition
Efficient, Cost-Effective Nanomotors for Micro-Electrical Devices
Cost-effective Solution for Producing Ultrahigh-Density Nanostructures
Polymerization System For Creating Eco-Friendly Commodity Plastics

Computer Science
A Novel Pulse-Based Neural Data Acquisition System
Novel Control Plane System to Safely and Accurately Transfer Large Amounts of Data
Improved Data Compression and Runtime Decompression Using Bitmasks
Efficient Intrusion Detection with Compressed Aho-Corasick Automata
Gator Communicator: A Hand Held Digital Data Mapper
Enhanced Broadcast System improves Video/Audio Quality
An Accurate and Efficient Equalizer For Communication Systems

Electrical
Efficient Heatsink Antenna for Small Wireless Electronics
Plasma-based Propulsion Device for More Efficient Space Engines
Versatile, Easily-Integrated, High-Fill-Factor Micromirrors
High-Efficiency Low-Voltage Conversion System with Self-Powered Comparator
High Electron Mobility Transistors (HEMTs) That Amplify Microwave Power More Efficiently
Electrojets for More Efficient Small-Satellite Propulsion
Low-Cost Magnet Self-Assembly Technology for Microsystems
Curved Microelectromechanical System That Is Easier to Use and Assemble
More Powerful & Durable Micro-Electro Mechanical System
Self-Powered, Wireless, Electromechanical Acoustic Liner for Noise Reduction
Increase of Integrated Antenna Gain
Novel Metal Oxide Semiconductor Field Effect Transistor
Method of Reducing Noise Between Integrated Antennas and Adjacent Circuits
Monolithic CMOS Phase Lock Loop to Increase Operating Frequency
Miniature Integrated Three-Axis Accelerometer
2-in-1 Low Power, Low Noise Amplifier/Analogue-to-Digital Converter
More Efficient Analog Circuit
Breakthroughs in Signal Processing for Radar and Wireless Communication
Performance Improvement of Packaged Semiconductors through the Application of External Bending Stress
A Low-cost Mems Device to Control Micropositioning and Method to Manufacture
Self-Assembly of Microscale Parts Using Integrated Micromagnets
Streamlined MEMS Microphone Technology for Smaller, Lower-Cost Electronic Devices
Low-Power, Low-Noise Readout Circuit for Electronic Devices Utilizing Capacitive Sensing
Isolation and Packaging Techniques for Manuracturing Microfabricated Devices

Materials
Novel Polymer Coatings for Amplification in Optical Fibers

Fabrication Process for Growing Single-Walled Carbon Nanotubes on CMOS Substrate at Room-Temperature
Novel Method for Manufacturing Improved Nanotechnology
Transparent Electrodes made from Single Wall Carbon Nanotubes (SWNT)
More Efficient, Cost-Effective Coatings for Carbon Nanotubes
Breakthrough Approach to Carbon Nanotube Production
Cost-effective Solution for Producing Ultrahigh-Density Nanostructures
More Efficient, Cost-Effective Semiconductor Devices with Superior Stability for High Power and High Frequency Applications
Engineered Nanoparticles for Inexpensive Scintillator Radiation Detectors
A Device for Collecting and Storing Highly Oriented Electrospun Fibers Without Tangles, Allowing Widespread Use of Aligned and Crossed Nano- and Microfibers in Novel Applications
Scalable Fabrication Technology for Reducing Manufacturing Costs of Nanofiltration Membrane Films
Polymerization System For Creating Eco-Friendly Commodity Plastics
Silane Functionalized Polymers with Enhanced Performance
Novel Method for Production of Gold Particles
Military Grade Solid Lubricant System that Reduces Wear Rates & Friction
Self-Assembly of Microscale Parts Using Integrated Micromagnets
High-Resolution, Green Nanolithography Resists for Microelectronics
Concurrent O_2 Generation and CO_2 Control for Advanced Life Support
Novel Optical System for Power Efficient Laser Beam Shaping
Cost-Effective, Eco-Friendly, Energy-Efficient Catalysts For Producing Chemicals
Surface-Enhanced Raman Spectroscopy Substrates for Increased Accuracy
Method for Producing Crack-free Nitride Films
Method for Producing Polyethylene Copolymers with Improved Mechanical Performance

Mechanical

Device for Enhanced Precision in Micro/Mesoscale Machine Production
Microvalves for Enhancing Efficiency of Microfluidic Devices for Simultaneous Detection of Multiple Analytes
Improved Rotating Vane Classifier To Minimize Particle Attrition
Roller Brushes for Rotating Electrical Machinery
Novel Actuation Design for Improved Performance of Micro Devices
Efficient Electromagnetic Micropump for Small Devices
Multilayer Plasma Actuator with High Performance Flow Control for Aerodynamic Surfaces
Wingless, Electromagnetic Aerial Vehicle that is Quieter and Omnidirectional
Micromirror Design For Improved Imaging
Improved Turbine Blade Film Cooling System Using Plasma Actuators
Flexible Tool-Holder and Enhanced Cutting Force Measurement Devices
Low Friction and Ultra Low Wear Polymer for Solid Lubrication Systems
Novel Molding Method for Creating Microdevices
Highly Efficient Manufacturing Technology for Polishing Mirrored Surfaces
Efficient Remote Powering System for High-Temperature Rotating Systems

UNIVERSITY OF SOUTH FLORIDA
Technologies Available for Licensing

ENERGY

Solar and Thermo Electric
Electric Field Tuning of PbS Quantum Dots
Novel Method for Solid State Crystal Growth
Tandem Structure Flexible Organic Photovoltaic Collector (FOPEC) Fabricated by all Solution Processable Vacuum Free Technology
Tunable type-II clathrate compounds for photovoltaic applications
PbTe Nanocompossites for Thermoelectric Power Generation

Biomass
Selective Catalyst for Fischer Tropsch Synthesis
A Practical Method for CO_2 Cyclic Absorption/Desorption for Sequestration

Energy Storage
Silicon topological capacitors
High energy galvanic cell from aluminum and alkali metal peroxide
Silicon topological capacitors
Nanoswitch

Power, Distribution, Smart Grid, Communication
Electric Power Distribution Interruption Risk Assessment Calculator (EPDIRAC)
Method and System for Generating Power from Low- and Mid- Temperature
Smart Zero-Order Energy (ZOE) Antenna and Repeater (ZOE-R)
Integrated Pressure Pump and Power Plant
Reception and Measurement of MIMO-OFDM Signals with a Single Receiver
Covert OFDM Transmission Using Cyclic Prefix A control layer algorithm for ad hoc networks:
Communication-assisted control for semi-autonomous robots

Built Environment and Energy Efficiency
Voided drilled shafts
End Bearing Enhancement via Post Construction Preload/Reload

Marine
3D imaging system with pre-test module
Flow Imaging System
Moleculary self Shedding Bio-hydrogel for coating marine surfaces
Bond enhancement for underwater pile repair
Particle profiling and recording
Self Shedding Hydrogel

Fuel Cells and Hydrogen
Hydrogen sensor
Hydrogen absorbing nanofoil
Fuel cell

Complex Hydrides Exhibiting High Hydrogen Storage Capacity
Zeolite-like Metal Organic Frameworks (ZMOFs)
Electrical energy from fuel cells powered by chemically generated hydrogen and oxygen

CLEAN-TECH

Environment
Air
Catalytic air purification system
Thermo chemically Treated Photocatalytic TiO2

Water
UV-LED and Laser Fluroescence for monitoring water quality
Water measuring faucet

Waste
Molecular Detection and Quantification of Enterococci
New Anaerobic Design Process for Low-Solid Wastes
An inexpensive and safe method for removal of toxic heavy metals

Sensors
Wireless MEMS sensor
Salinity/conductivity sensor
RF Microwave Circuit and Pulse Shaping Method
Compact Reconfigurable channel Emulator for Testing Wireless Systems
A novel approach of integrating nanowires to transductors without surface contamination
Inertial Masking Assembly
Integrated TSM Sensor

Electronics
Bistable Aerial Platform
Solid State Medium Voltage Switch
Dual Feed Antenna
RF Microwave Circuit and Pulse Shaping Method
Interactive Map
Differential Capacitive Readout Configuration for an Infrared (IR) Imaging Array with Wafer Level Packaged Cavity and Micromachined On-Chip Microlenses
MEMS DC-DC Switching Converter
MEMS High Speed Switching Converter
MOV Failure Mode Detection
Nanoswitch
Wireless Video for Instant Access (Wi-Via)
Novel transportation tracking system (TRAC-IT)
DNA biochip for detecting nucleic acid sequences
Covert OFDM Transmission Using Cyclic Prefix
A control layer algorithm for ad hoc networks: Communication-assisted control for semi-autonomous robots
MEMS phase shifters using cascaded slow-wave structures

A method and apparatus for reducing leakage in CMOS circuits
Wet etching process
Redundancy method for space electronics
Ultrasound treatment to improve manufacture of poly-Si thin-film transistors (TFTs)

Materials Science

a-SIC and Pd Modified Vanadium Phosphorus Oxide Catalysts for the Partial Oxidation
Novel Composites of Inorganic Oxides with PNIPAM-Siloxane-based Polymeric Microgels for Chemical Mechanical Planarization (CMP) Processing
Superconducting point contact system for measure spin-polarization of metals
Particle profiling and recording
Computer vision-based technique for objective assessment of materials properties

NASA Kennedy Space Center
Technologies Available for Licensing

Corrosion - With the KSC launch facility located within 1000 feet of the Atlantic Ocean, salt from the ocean combined with the launch vehicles' acidic rocket exhaust make corrosion protection a high priority. KSC's state-of-the-art corrosion research and testing facility has produced a number of technologies that address environmentally compliant coating systems, seawater immersion of metallic alloys and coatings, reinforced concrete protection, and more.
Smart Coating for Corrosion Detection and Protection (CleanTech)
Nondestructive Inspection and Evaluation of Corrosion Under Paint (CleanTech)
Low-Cost, Long-Lasting Liquid Coating (CleanTech)
Anti-Corrosive Powder Particles (CleanTech)
Inherently Conductive Polymer (Energy)
Microelectrochemical Cell for Corrosion Evaluation (Energy)

Cryogenics - At the Cryogenics Test Laboratory at KSC our researchers have developed technologies with a focus on thermal insulation systems, cryogenic components, low-temperature applications, and propellant servicing systems.
Cryogenic Moisture Apparatus (CleanTech)
Thermal Insulation Test Apparatuses (Energy)
Insulation-Testing Cryostat With Lifting Mechanism: Cryostat-100 (Energy)
Apparatus and Method for Testing Thermal Performance of Pipelines (Energy)

Electronics - KSC's electronics research falls into several application categories, including optics and photonics, monitoring systems, energy control, communications, imaging software, and data acquisition.
Ground Lightning Monitoring System (GLMS) (Energy)
Broadband Light Spectrometer Calibrator (CleanTech)
Infrared Camera System for Visualization of IR-Absorbing Gas Leaks (CleanTech)
Programmable Miniature Aerospace Low Voltage Circuit Breaker (Energy)
Ethernet-Enabled Power and Communication Module for Embedded Processors (CleanTech)
Windows®-Based Scaling and Measurement Software for Photographic Images (CleanTech)
Enhanced Isolated Current-to-Voltage Converter (Energy)
Modular Wireless Data Acquisition System (CleanTech)
Integral Battery Power Limiting Circuit For Intrinsically Safe Applications (Energy)

Environmental - Important projects at KSC include environmental clean up activities as well as the prevention of environmental contamination. Researchers at KSC have developed technologies that enable the safe removal of environmental toxins and that monitor levels of contamination in real time.
Improved Optical Fallout Monitor (CleanTech)
Hydrogen Peroxide Concentrator (CleanTech)
Emulsified Zero-Valent Iron (EZVI) (CleanTech)
Activated Metal Treatment System (AMTS) for Paints (CleanTech)

Materials - Addressing technology challenges and needs for advanced materials, KSC has developed numerous materials that have not only benefited the space program but are also useful in applications

outside of NASA. Technologies include Insulating materials, electrically conductive polymers, and even materials that act as sensors.

New Inorganic/Organic Materials for Thermal and Acoustic Insulation (CleanTech)
Chemochromic Detector for Sensing Hydrogen Gas Leakage (Energy)
Layered Composite Insulation (Energy)
Inherently Conductive Polymer (Energy)
Achieving Fire Retardancy (CleanTech)
Permanent Repair System for Polyimide Wire Insulation (CleanTech)