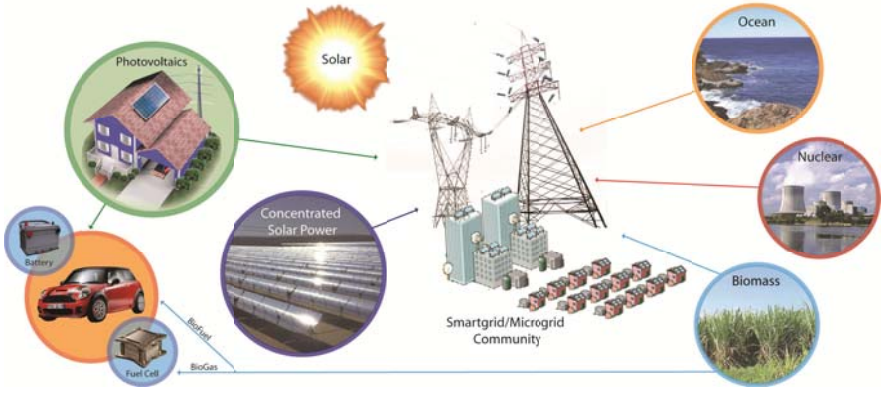
FESC
Florida Energy Systems Consortium

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

May 2011

Reporting Period: Nov 1, 2010 – May 1, 2011



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

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EXECUTIVE SUMMARY

Overview: The Florida Energy Systems Consortium continues to produce results as we begin our third year of energy research, technology transfer, education, and outreach activities. We are successfully facilitating interactions among Florida's energy industry and researchers in the 11 state universities, Florida's State and Community Colleges, and our recent addition, the Florida Institute of Technology. FESC coordinated research teams to develop and submit a significant number of joint proposals, many of which were funded as a direct result of being able to assemble a diverse set of experts and resources among FESC partners. Participation in the FESC Summit by faculty, students, and industry representatives reached an all-time high of over 270 participants. We have also enjoyed a marked increase in in-state and out-of state industries seeking partnership assistance. The FESC web site continues to be a widely used tool by energy specialists worldwide. Based on a Google Analytics report, the FESC web site was viewed by 8404 Google visitors during the period Nov 1, 2010 to May 1, 2011. Viewers were from a total of 109 countries.

Earlier this year, FESC university experts in each thrust area worked with the FESC Industrial Advisory Board to prepare a *Strategic Plan for Renewable Energy in Florida*. FESC submitted the final document to the members of the FECC and the Energy Office. The strategic plan is provided as an attachment to this report.

Over the past six months, FESC rolled out its Phase II of our Technology Commercialization program, formed proposal teams to respond to funding opportunities, contributed to energy education and outreach programs, and initiated the planning of the third FESC summit to be held at the University of Florida on September 26-28, 2011.

Research Highlights: The Principal Investigators for 80-plus FESC-funded research projects continue to make considerable progress on their research, often leading to added external support. Brief description of each FESC supported research project is contained in this report (Appendix A), which is posted at the FESC website http://www.floridaenergy.ufl.edu/. Detailed progress summaries are compiled in a separate document and provided as an attachment to this report.
After a slow period of funding opportunities in the energy arena, there have been a large number of announcements in recent months. During this reporting period, FESC distributed 84 announcements of funding opportunities with the goal of leveraging state funds. Appendix B contains the list of announcements. FESC led the formation of several proposal teams, and the administrative office supported proposal preparation and submission. All funding opportunities were also posted at the FESC web site. Significantly increased email communication from energy companies reflected that they are also benefiting from the funding opportunity postings at the FESC web site.

The FESC leadership visited or communicated via teleconference with the State of Florida offices as well as the Department of Energy, National Energy Laboratories, NASA Glenn, and NASA KSC to discuss potential FESC collaboration on their energy programs.

We anticipate a Federal Request for Proposals (RFP) in the area of energy storage. To respond to this call, FESC has formed a core planning team. Team members are already communicating with potential partners.

Third FESC Summit: The 3rd FESC Summit will be held at the University of Florida on September 26-28, 2011. The FESC administrative office has begun the planning process and identified the technical committee. In conjunction with the Summit, FESC plans to host several events, including the "Florida

Clean Energy Workshop." This workshop will be organized by the US DOE/EERE and will focus on innovation in R&D and manufacturing in Florida's Clean Energy industry.

Technology Transfer: In this reporting period, FESC made considerable progress in launching the Phase II of our Technology Commercialization Program. Phase II is modeled on the very successful Florida High Tech Corridor Council Matching Grants Research Program. In our program, FESC provides up to $50K in matching funds for each project, which requires an industry match and has so far attracted in excess of $400K of industry support. FESC has awarded six grants. Four industry contracts are already in place, with two more awaiting the industry cash match.

The Consortium continues to work closely with technology transfer and economic development offices in Florida to attract industry to our state. FESC is currently in communication with two Florida-based algae companies, a wind farm, and a biofuel company to provide technical assistance. We are also working with NASA Glenn, Spaceport Research & Technology Institute, NASA Kennedy Space Center, and a local firm for a potential "National Biofuel Biomass Test-bed" (NBBT) in Florida.

Education and Outreach: Assisting in preparing a qualified workforce is vital for Florida's evolving energy industry. FESC is strategically focused on workforce preparation for the existing and emerging energy industry. Many energy-industry educational opportunities are available throughout the state, while other exciting opportunities are being developed. FESC is working to coordinate these efforts and ensure that existing distance education facilities at each university will be utilized to make these programs available via on-line courses. The FESC outreach program is using the statewide Agricultural Extension Service as well as other avenues to provide Florida residents with new approaches to energy efficiency.

The FESC website continues to be an important communication tool for our program. It is updated regularly to remain current and to better serve our users. FESC distributes electronic newsletters by email and these are available on the FESC web site. Based on a Google Analytics report, the FESC web site was viewed by 8404 Google visitors during the period of November 1, 2010, to May 1, 2011. The viewers visited 23,864 pages. Viewers were from a total of 109 countries, including those in North and South America, Europe, Asia, Australia, and Africa.

The Florida Energy Systems Consortium has made significant progress in its research, education, industrial collaboration, and technology commercialization agenda. FESC faculty members statewide are successfully collaborating in research and proposal development. Our response to the Gulf of Mexico Research Initiative to form consortia exemplifies our success. FESC facilitated collaboration between faculty members at UF, UCF/FSEC, and Georgia Tech to form consortium teams. One of our FESC-funded researchers is also Co-PI of the recent $5M US DOE award to improve the production and sustainability of sweet sorghum as an energy crop. In addition, FESC education programs are being readied for Florida's clean energy workforce, and our industry partners are actively participating in technology transfer and commercialization of FESC-developed technologies.

At the time this report was prepared, it appears the State will sunset the Florida Energy and Climate Commission. It also appears, subject to the Governor's signature, and that FESC will now report to the Department of Agriculture.

RESEARCH PROGRAM

The FESC research program includes 82 FESC funded projects within the seven strategic thrusts. Table 1 below gives the list of the projects under each thrust area. Project descriptions are given in Appendix A. Eight projects from FIU (not funded by FESC) and 1 project from UWF (not funded by FESC) are also included. FESC funded project progress reports are given as a separate attachment. Some of the projects are collaborative multi-university projects; however since funding was appropriated to each institution, only the lead university information is given in the table.

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

Projects	Title/PI/Lead Institution
THRUST 1: Overarching	
	Power Generation Expansion under a CO_2 Cap-and-Trade Program PI: Tapas Das; Co-PI: Ralph Fehr - USF
	Joint Optimization of Urban Energy-Water Systems in Florida (Thrust 2: Efficiency) PI: James P. Heaney - UF
	Combined Cooling, Heat, Power, and Biofuel from Biomass and Solid Waste (Thrust 3: Biomass) PI: William Lear - UF
	Design, Construction, and Operation of CSP Solar Thermal Power Plants in Florida (Thrust 4: Solar) PI : Yogi Goswami; Co-PI's: Lee Stefanakos, David Hahn, Robert Reddy - USF
	Development of High Throughput CIGS Manufacturing Process (Thrust 4: Solar) PI: N. Dhere – UCF/FSEC
	Solar Photovoltaic Manufacturing Facility to Enable a Significant Manufacturing Enterprise within the State and Provide Clean Renewable Energy (Thrust 4: Solar) PI: Don Morel, USF; Co-PI's: Chris Ferekides, USF, Lee Stefanakos, USF, Tim Anderson, UF, Neelkanth Dhere, UCF/FSEC
	Research to Improve Photovoltaic Cell Efficiency (Thrust 4: Solar) PIs: Nicoleta Sorloaica-Hickman, R. Reedy – UCF/FSEC
	PV Energy Conversion and System Integration (Thrust 4: Solar) PI: N. Kutkut Co-PI's: J. Shen, I. Batarseh, Z. Qu, X. Wu, W. Mikhael, L. Chow – UCF/FSEC
	An Integrated Sustainable Transportation System (Thrust 4: Solar) PI: David Norton - UF
	Integrated PV/Storage and PV/Storage/Lighting Systems (Thrust 4: Solar) PI: Franky So, Co-PI: Jiangeng Xue, Shirley Meng - UF
	Reliable and Resilient Electrical Energy Transmission and Delivery Systems (Thrust 7: Storage & Delivery) PI: Steinar Dale - FSU
	Secure Energy Systems - Vision and Architecture for Analysis and Design PI: Pramod Khargonekar
THRUST 2: Enhancing Energy Efficiency and Conservation	
	Innovative Proton Conducting Membranes for Fuel Cell Applications & Protein Enhanced Proton PI: Ongi Englander, Co-PIs: Anant Paravastu, Subramanian Ramakrishnian - FSU
	Sustainably Integrated Advanced Building Subsystems (OGZEB) PI: A. "Yulu" Krothapalli, Co-PI: Justin Kramer

	Insight into Membrane Degradation Mechanisms Through Verification of Chemical and Mechanical Degradation Test Capabilities, **PI:** Darlene Slattery; **Co-PI's**: Len Bonville, Xinyu Huang, Marianne Rodgers – UCF/FSEC
	Energy Efficient Building Technologies and Zero Energy Homes PI: R. Vieira Co-PI's: P. Fairey, J. Sonne – UCF/FSEC
	Joint Optimization of Urban Energy-Water Systems in Florida, PI: James P. Heaney - UF
	Planning Grant: High Performance and Low Cost Fuel Cells for Future Vehicles PI: Jim Zheng, Co-PIs: Richard Liang, Chuck Zhang, Ben Wang - FSU
	NIRT: C-MEMS/CNEMS for Miniature Biofuel Cells PI: Marc Madou, Co-PIs : Chunlei Wang, Sylvia Daunert and Leonidas Bachas -FIU
	Fabrication of Nano Fractal Electrodes for On-Chip Supercapacitors PI: Chunlei Wang - FIU
	Energy Efficient Technologies and The Zero Energy Home Learning Center PI: Stanley Russell Co-PI's: Yogi Goswami - USF
THRUST 3: Developing Florida's Biomass Resources	
Algae	
	Establishment of the Center for Marine Bioenergy Research: Systems Approach to BioEnergy Research (SABER), PI: J. Kostka; Co-PIs: William Cooper, Ivonne Audirac, Amy Chan-Hilton, Ellen Granger - FSU
	Constructual Optimization of Solar Photo-Bioreactors for Algae Growth PI: Juan Ordonez - FSU
	Optimization of Algae Species for Biofuels Production using Genetic Altration PI: Ed Phlips, UF
High Energy Crops	
	Seeding Biofuel Entrepreneurship in South Florida PI: George Philippidis – FIU
	Energy Intensive Crop Development PI: Gary Peter , Matias Kirst, Don Rockwood - UF
	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
Biochemical Conversion	
	Development of Biofuel Production Processes From Synthetic and Biomass Wastes PI: Pratap Pullammanappallil - UF
	Assessment and Development of Pretreatment for Sugarcane Bagasse to Commercialize Cellulosic Ethanol Technology PI: George Philippidis - FIU
	Engineering Biocatalysts for Hemicelluloses Hydrolysis and Fermentation PI: James F. Preston - UF
	Thermophilic Biocatalysts for the Conversion of Cellulosic Substrates to Fuels and Chemicals PI: K.T. Shanmugam - UF
Bio gasification	
	Combined Cooling, Heat, Power, and Biofuel from Biomass and Solid Waste PI: William Lear - UF
Thermo-Chemical Conversion	
	Production of Liquid Fuels Biomass via Thermo-Chemical Conversion Processes PI: Babu Joseph Co-PI's: Yogi Goswami, Venkat Bhethanabotla, John Wolan, Vinay Gupta - USF
	Integrated Florida Bio-Energy Production with Carbon Capture and Sequestration

	PI: Ali T-Raissi Co-PIs: Nazim Muradov, Amit Gujar, Gary Bokerman - USF
	Biofuels Through Thermochemical Processes: a Systems Approach to Produce Bio-jet Fuel PI: Anjaneyulu Krothapalli
THRUST 4: Harnessing Florida's Solar Resources	
Solar Thermal	
	Concentrating Solar Power Program PI: Charles Cromer Co-PI: R. Reedy – UCF/FSEC
	Enhanced and Expanded Solar Thermal Test Capabilities PI: J. Walters Co-PI: R. Reedy – UCF/FSEC
	Solar Fuels for Thermochemical Cycles at low pressures PI: Jörg Petrasch – UCF/FSEC
	Solar Thermal Power for Bulk Power and Distributed Generation PI: David Hahn, James Klausner, Renwei Mei, Joerg Petrasch, and Helena Weaver - UF
	Design, Construction and Operation of CSP Solar Thermal Power Plants in Florida PI : Yogi Goswami Co-PI's: Lee Stefanakos, David Hahn, Robert Reddy - USF
	Solar Water Heating Systems Facility **PI:** James Roland, David Block – UCF/FSEC
Clean Drinking Water	
	Solar Driven Desalination PI: James Klausner and Skip Ingley
	Clean Drinking Water using Advanced Solar Energy Technologies PI: Lee Stefanakos Co-PI's: Yogi Goswami, Matthias Batzill, Maya Trotz, Sesha Srinivasan - USF
Low Cost PV Manufacturing	
	Enhanced and Expanded PV Systems Testing Capabilities at FSEC PI: S. Barkaszi Co-PI: R. Reedy - USF
	Development of High Throughput CIGS Manufacturing Process PI: N. Dhere – UCF/FSEC
	PV Manufacturing Data Base and Florida Applications PI: R. Reedy Co-PI: D. Block – UCF/FSEC
	Development of Low Cost CIGS Thin Film Hot Carrier Solar Cells PI: Gijs Bosman, Co-PI: Tim Anderson
	Solar Photovoltaic Manufacturing Facility to Enable a Significant Manufacturing Enterprise within the State and Provide Clean Renewable Energy PI: Don Morel, USF; Co-PI's: Chris Ferekides, USF, Lee Stefanakos, USF, Tim Anderson, UF, Neelkanth Dhere, FSEC
Advanced PV Device Program	
	Research to Improve Photovoltaic (PV) Cell Efficiency by Hybrid Combination of PV and Thermoelectric Cell Elements. PIs: Nicoleta Sorloaica-Hickman, R. Reedy – UCF/FSEC
	Research and Develop PV Device Science and Laboratories PI: Nicoleta Sorloaica-Hickman, Robert Reedy – UCF/FSEC
	Beyond Photovoltaics: Productionizing of Rectenna Technology for Conversion of Solar radiation to Electrical Energy PI: Shekhar Bhansali Co-PI's: Lee Stefanakos, Yogi Goswami, Jing Wang - USF
PV Integration	
	PV Energy Conversion and System Integration PI: N. Kutkut Co-PI's: J. Shen, I. Batarseh, Z. Qu, X. Wu, W. Mikhael, L. Chow - UCF

	Non-Contact Energy Delivery for PV System and Wireless Charging Applications PI: Jenshan Lin - UF
	An Integrated Sustainable Transportation System, PI: David Norton - UF
PV/Storage/Lighting	
	Planning Grant: Hydrogen storage using carbon-based adsorbent materials PI: Efstratios Manousakis - FSU
	PV Power Generation Using Plug-in Hybrid Vehicles as Energy Storage PI: J. Shen Co-PI's: I. Batarseh, N. Kutkut - UCF
	Integrated PV/Storage and PV/Storage/Lighting Systems PI: Franky So, Co-PI: Jiangeng Xue, Shirley Meng - UF
THRUST 5: Ensuring Nuclear Energy & Carbon Constrained Technologies for Electric Power in Florida	
	Reducing Residential Carbon Emission in Florida: Optional Scenarios Based on Energy Consumption, Transportation, and Land Use PI: Tingting Zhao, Co-PI: Mark Horner - FSU
	Planning Grant: Enhanced Thermal Performance and Microstructure Simulation of Nuclear Fuels Justin Schwartz - FSU
	Biocatalytic Lignin Modification for Carbon Sequestration PI: Jon Stewart - UF
	Carbon Capture and Sequestration PI: Sabine Grunwald. Co-PIs: Tim Martin, Howard Beck - UF
	Creation of Carbon Sequestration Data, Technologies and Professional Cohorts for Florida PI: Mark Stewart, Co-PIs: Jeffrey Cunningham, Yogi Goswami, Maya Trotz - USF
THRUST 6: Exploring Florida's Ocean Energy Resources	
	Southeast National Marine Renewable Energy Center PI: Susan H. Skemp, Co-PI: Howard P. Hanson - FAU
	Buoy Array for Ocean Wave Power Generation **PI:** P.I. Z. Qu, Co-PI: K. Lin - UCF
THRUST 7: Securing our Energy Storage and Delivery Infrastructure	
	Reliable and Resilient Electrical Energy Transmission and Delivery Systems PI: Steinar Dale - FSU
	Microgrids for a Sustainable Energy Future PI: Chris S. Edrington Co-PIs: Jim Zheng, Mischa Steurer, Dave Cartes - FSU
	Multi-Generation Capable Solar Thermal Technologies PI: A. Krothapalli; Co-PI: Brenton Greska –FSU
	Planning Grant: Real-Time Power Quality Study For Sustainable Energy Systems PI: Dr. U. Meyer-Baese, Co-PIs: Helen LI, Simon Foo, Anke Meyer-Baese, Juan Ordonez - FSU
	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
	Investigating the Effect of Appliance Interface Design on Energy-use Behavior PI: Paul Ward; Co-PIs: Ian Douglas, David Eccles - FSU
	Energy Delivery Infrastructure Design and Simulation PI: Alex Domijan Co-PI: Arif Islam - USF
	Micro Battery Defense Development PI: Chunlei Wang - FIU
	Electrostatic Spray Deposition of Nanostructured Porous Metal Oxide Composite PI: Chunlei Wang - FIU
	Fabrication and Investigation of Porous Tin Oxide Anodes for Li-Ion Micro Batteries

	PI: Chunlei Wang - FIU
	Very high energy-density ultracapacitors PI: E. Bakhoum - UWF
	Secure Energy Systems – Vision and Architecture for Analysis and Design PI: Pramod Khargonekar - UF
	Optimization, robustness and equilibrium modeling for the Florida Smart Grid PI: Panos Pardalos
Policy and Other	
	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
	Promoting Energy and Land Use Through Land Use, Transportation and Green Infrastructure Polices PI: Tim Chapin; Co-PIs: Ivonne Audirac, Chris Coutts, and Greg Thompson, Department of Urban & Regional Planning, and Mark Horner, Department of Geography - FSU
	Marketing Strategies to Incentivize Entrepreneurship and Innovation in the Development of Sustainable and Environmentally Friendly Goods and Services PI: Joe Cronin – FSU
	Energy Sustainable Florida Communities PI: Richard Fieock, Co-PIs: Ivonne Audirac, Keith Ihlanfeldt - FSU
	Political and Economic Institutions Regarding Siting of Energy Facilities: "Hold Out" and "NIMBY" problems, with concurrent developments in undergraduate education. PI: R. Mark Isaac, Co-PI's: Douglas Norton, Svetlana Pevnitskaya - FSU
	Development of a Renewable Energy Research Web Portal PI: Charles R. McClure, Co-PIs: Ian Douglas, Chris Hinnant - FSU
	Energy and Efficiency Video Public Service Announcements PI: Andy Opel, Co-PIs: Phil Steinberg, Leslie France-Patterson, Laura Arpan, Ian Weir - FSU
	An Experimental Investigation of Economic Incentives of Policies, Institutions and R&D in Environmental Conservation, Sustainability and Renewable Energy PI: Svetlana Pevnitskaya, Co-PI: Dmitry Ryvkin - FSU
	Planning Grant: Meteorological Factors Affecting Solar Energy Efficiency in the Tropics PI: Paul Ruscher, Co-PIs: Yaw Owusu, Hans Chapman - FSU
	Planning Grant: Climate modeling and outreach activities PI: Shawn R. Smith, Co-PI: Steve Cocke - FSU
	Visiting Scholar in Energy and Land Use Law, Florida State University College of Law PI: JB Ruhl and Jim Rossi, Co-PIs: Uma Outka - FSU
	Effectiveness and Impacts of State Renewable Energy Efficiency Programs PI: Mark Jamison - UF
	Unifying Home Asset & Operations Ratings: Adaptive Management via Open Data & Participation PI: Mark Hostetler - UF
Education and Outreach	
	Florida Advanced Technological Education Center (FLATE) PI: Marilyn Barger – Hillsborough Community College
	Outreach Activities for FESC PI: Pierce Jones, Kathleen C. Ruppert, Hal S. Knowles III, Nicholas Taylor, Barbra Larson, Craig Miller - UF
	UFTR Digital Control System Upgrade for Education and Training of Engineers and Operators PI: Alireza Haghighat - UF

NEW PROGRAM DEVELOPMENT

The new program development effort aims to facilitate the submission of multi-faculty, multi-SUS university competitive proposals in response to solicitations for major research programs. By collecting the best research expertise in the SUS, competitive funding requests to federal agencies, national and global foundations, and industry can be made. Over 80 funding opportunities were distributed to the FESC faculty during this period. The list of funding opportunities is given in Appendix B. The funding opportunities are also posted at the FESC web site: http://www.floridaenergy.ufl.edu/?page_id=912. Faculty teams were formed to respond to the funding opportunities based on the responses received from the faculty. The FESC office facilitates proposal development in a variety of ways beyond solicitation awareness, including identifying leaders, communicating with external partners in industry, national labs and other non-SUS universities, providing professional technical writing help, arranging telecons, and assisting with cost share development, budgets and boiler plates. Having the FESC wide MOU in place has been very helpful. One example is the proposal participation request from the Savannah River National Laboratory. The request was very close to the proposal submission deadline. Since we had the FESC wide MOU, FESC faculty members from 4 FESC university were able to participate.

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

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

Competitive Funding Opportunities				
#	**Title**	**Call #**	**Agency**	**Funding**
1	Theoretical Research in Magnetic Fusion Energy Science	DE-FOA-0000480	DOE	$3,300,000; awards per project vary
2	Catalytic Upgrading of Thermochemical Intermediates to Hydrocarbons	DE-FOA-0000467	DOE	$12M; $4.5M in 2011, $7.5M in 2012-13
3	Power Electronics Research and Development for Electric Utility Applications (GaN-Si technology)	DE-FOA-0000461	DOE	Up to $3M per award
4	$1/W PV Systems: Balance of Systems	DE-FOA-0000440	DOE	$5-6M per year; $2-$3M per award
5	US Wind Power: Next Gen Drivetrain Development	DE-FOA-0000439	DOE	$7.5M/ $300K - $700K in Budget Period 1; $1M - $2M in Budget Period 2
6	Solar Agile Delivery of Electrical Power Technology (Solar ADEPT)	DE-FOA-0000474	DOE ARPA-E	$10M; $250K - $5M per award
7	Rare Earth Alternatives in Critical Technologies for Energy (REACT)	DE-FOA-0000472	DOE ARPA-E	$30M; $250K - $10M per award
8	High Energy Advanced Thermal Storage (HEATS)	DE-FOA-0000471	DOE ARPA-E	$30M; $250K - $10M per award
9	Plants Engineered to Replace Oil (PETRO)	DE-FOA-0000470	DOE ARPA-E	$30M; $250K - $15M per award

INDUSTRIAL COLLABORATION AND TECHNOLOGY COMMERCIALIZATION

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

FESC has an Industrial Partnership and Innovation Strategy that assures active collaboration with the private sector and other partners that support and guide FESC's vision, collaborate with FESC in our research, education, innovation, and outreach programs.

The progress for this period is given below.

Strategic Plan By FESC- Renewable Energy in Florida

The "Strategic Plan" for renewable energy in Florida has been prepared with input from experts in each thrust area and feedback from the advisory board members. The final document has been sent to the members of the FECC and the energy office. The strategic plan is provided as an attachment to this report.

Technology Commercialization

FESC has devised a multi-tiered approach to investing its limited technology commercialization resources. In devising this strategy, FESC is focused on 1) fully complimenting the existing resources across the SUS and state of Florida's economic development community, 2) providing the maximum potential return / economic impact to Florida's economy on our investment, 3) maximum leveraging of FESC resources with industrial support, and 4) a focus on driving later stage energy technologies in the FESC university research portfolio toward commercialization. This has led to development of a two-tiered program as outlined below:

Phase I: Early Stage Market Research / Business Plans – Recognizing that a number of FESC funded technologies may have unknown, or at least undocumented, commercial potential and also recognizing that university licensing offices and technology licensees (entrepreneurs, SMEs, large corporations) alike are looking for a greater depth of understanding of potential applications of some of FESC's later stage technologies in order to optimize technology licensing and the path to market, FESC initiated a funding program of business plans and market research studies for select FESC technologies. This program was completed and program details were reported in previous reporting period.

Phase II: Matching Funds R&D Program – The second tier of the FESC technology commercialization funding program is modeled on the very successful Florida High Tech Corridor Council Matching Grants Research Program which has been ongoing at USF and UCF since 1996 and at UF since 2005. This second tier also builds off of the results of the first tier as the business plans and market research studies in tier 1 above will provide for more complete information in attracting industrial partners and selecting appropriate projects for funding in tier 2. In this program, FESC core universities will propose energy related projects for FESC funding that is matched on a 2:1 basis by industry funds. This model serves a number of purposes: 1) industry partners are by definition highly engaged in the development process in the university as they are co-funding the R&D package, 2) this provides at least a 2X leveraging of FESC funds on each project, 3) a natural pipeline of the technology deployment to the private sector partner is established as they are typically working on development aspects in parallel with the university research on the project, and 4) the FHTCC program has proven time and again that this model spawns new and long lasting R&D collaborative relationships between companies and SUS university researchers. FESC envisions providing up to $50K in matching funds for each project and with industry match (summarized in table below) on each project, attracting in excess of $500K of industry support to these FESC funded projects.

FESC Phase II Company Match:

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

The review committee has selected 6 projects for funding. The first step is to have the industry contracts signed. FESC funding is released upon signing the industry contract and receiving the industry cash match. Four industry contracts are already in place. The other two are on hold and waiting for industry cash match. The table below gives the list of the projects that are being funded.

University	Title	PI	Company
FSU	Deployment of a Low Cost Concentrating Solar Energy Systems Using Solar Sausages	David Van Winkle	Hunter Harp Holdings, LLC
UCF	UCF and Harris Corp Joint Wave Energy Projects	Zhihua Qu	Harris Corp.
UF	Cleaner, More Efficient Turbine Energy Production Using Robust, Miniature Solid-State Gas Sensors (On hold- waiting for industry cost share)	Bill Lear/ Oscar D. Crisalle	Emerald Endeavors, Inc.
UF	SWNT Based Air Cathodes for FC and Metal Air Batteries	Andrew Rinzler	nRadiance LLC, portfolio company of Nanoholdings LLC
UF	Stress Evolution in Solid-State Li-ion Battery Materials	Kevin Jones	Planar Energy Devices Corp.
UF	Development of High Efficiency Polymer Solar Cells (On Hold- waiting for industry cost share)	Franky So/ John Reynolds	Mike Starks, CEO, Sestar Technologies, LLC.

Industrial Database – Collaboration with Enterprise Florida

FESC has identified a need in Florida's energy related programs in that no single database exists cataloging the breadth of renewable energy companies and associations across Florida. While capturing and maintaining a 100% complete dataset of industrial contacts may not be feasible, FESC has initiated an effort to create a database of important industry players in order to quickly identify synergies between FESC's research, education, and technology commercialization programs and Florida industry. Sources of information for this database include Florida energy related trade associations, researcher and university contacts, Florida energy program grantees, and other sources. To date, FESC has compiled and is maintaining a relational database of over 350 companies and other entities in Florida that have a key stake in Florida's energy strategies. FESC is now collaborating with Enterprise Florida to combine their database with FESC industrial database. The combined database has over 1000 entries. Each company is being checked to insure that information is current. The database will be shared with Enterprise Florida upon completion. The database will be constantly updated and will provide an avenue for program information dissemination, industrial needs assessments, and potential collaborations.

Industrial Collaboration Project Examples

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

- Collaboration with NASA Glenn Research Center
  FESC faculty was introduced to the NASA Glenn "Green Lab" team. The team members have worked together and wrote a white paper for a potential "National Biofuel Biomass Test-bed" (NBBT) in Florida. The white paper will be shopped for funding upon NASA approval.

- Collaborations in Energy Storage Programs
  SAFT received $95M grant from the U.S. Department of Energy with $95M cost share to build a 235,000-square-foot Li-Ion rechargeable battery plant in Jacksonville FL. SAFT is planning to build up to 1MW PV on the roof of the new manufacturing facility and combine it with their grid level storage. Their plan is to utilize this resource to establish the Southeast Energy Storage Learning Center in collaboration with several partners. FESC faculty is assisting to write a proposal to obtain the required funding for the establishment of the center.

  In addition, communication with Sandia National Lab and other national labs, universities, and companies are in progress to be ready for the anticipated Energy Storage Hub.

- Collaboration with Agrisys
  FESC introduced some of the faculty members with algae expertise to Agrisys management. The CEO of Agrisys visited the University of Florida labs. Faculty members and the CEO are working together to define the scope of the collaborative projects. Agrisys is also collaborating with USF faculty.

- Collaboration with Savannah River National Lab
  FESC coordinated the SNRL visit to UF in April, 2011, and introduced the SNRL representatives to UF faculty in bioenergy area. Collaborative project opportunities were discussed.

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

EDUCATION

The Education program has three focus areas, community college programming at the Associate of Science and certificate level, nuclear energy education, and a Masters degree in sustainable energy.

The Community Colleges offer an opportunity to develop a trained energy workforce through programming for both technician level 2 year students, as well as students planning on completing a Bachelors degree.

FESC works closely with the Florida Community College system as well as with the Florida Advanced Technological Education Center (FLATE), which coordinates the design of industry specific training programs for technicians at the community colleges in Florida. FESC disseminates energy curricula in cooperation with FLATE.

On the Collegiate Level, programming includes curriculum directed at the workforce for the nuclear industry, which now operates five nuclear power plants (FPL and PEF).

Progress

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

Dr. Jay Kapat, UCF, has developed Professional Science Master (PSM) program on Energy. The initial track is on "Turbo-Power Generation (turbo-machinery based power generation that currently provides more than 98% of all electricity)" is being proposed, with significant support from related local industry. The future tracks on "Generation and Smart Grids", "Photo-Voltaics", and/or "Smart Buildings" are being discussed. This is a multidisciplinary and system focused program to address key systems in energy and power industry. It will have a highly challenging – 8 STEM courses and 5 Professional courses in 3 semesters. The industry partners will provide summer-long internship, 1:1 industrial mentor, co-instruction of key courses.

FSU added 3 new classes:

- The Economics of Sustainable Energy taught by Doug Norton (FSU, Spring, 2010)
- Sustainable Development Law taught by Uma Outka (FSU, Spring, 2010)
- Governing Sustainable Communities, Richard C. Feiock (FSU, Spring, 2010)

In addition, Southeast National Marine Renewable Energy Center (SNMREC) has developed an Educational Curriculum to enhance interest in science, mathematics, engineering, and technology and to support improvements in education for students from K-12 with original curricula and teacher workshops. Energy from Ocean Currents: the New Renewable is an ocean-energy curriculum developed for 11th and 12th grade students with funding from an award by the US Department of Energy's Office of Energy Efficiency and Renewable Energy. The curriculum is based on the "5 E's", an innovative instructional-based model used for teaching that fosters inquiry-based thinking by engagement, exploration, explanation, elaboration, an thinking by engagement, exploration, explanation, elaboration, and evaluation. There are six comprehensive lessons built around the scientific basis of SNMREC research, each aligned with the Florida Sunshine State Standards benchmarks, with hands on activities reinforcing each lesson. One such activity is building an electric generator from a soda can to demonstrate an induction coil alternating current generator. The lessons also include "Meet the Scientist" segments that feature a SNMREC engineer or scientist.

The curriculum was introduced to 40 teachers from three counties in South Florida in three workshops. Teachers who participated in the pilot workshop implemented the curriculum with their classes and gave valuable feedback. They also participated in the second and third workshops as facilitators, and they received in-service credits from their school districts. Pre- and post-lesson tests at the workshop and an online survey after utilizing the lessons in their classrooms provided the teachers with the opportunity for assessing the program, and the feedback was very positive. The second year of the program will reach additional teachers and incorporate enhancements to the original curriculum.

University of Florida Nuclear Training Reactor (UFTR) Digital Control System Upgrade for Education and Training of Engineers and Operators, Dr. Gabriel Ghita

The UFTR is being upgraded to a fully digital control system. This makes the UFTR the first operating nuclear power plant in the United States that uses a fully digital control system. This facility will provide for the training and education of the necessary workforce in the area of digital control and instrumentation for nuclear reactors. 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).

In order to make the UFTR capable of offering training to engineers and operators, it is necessary to receive approval from NRC on reactor relicensing application and on the Licensing Amendment Request (LAR) for the digital control upgrade. Then install and test the new digital system. During this reporting period, the UFTR team has worked on:

i) Licensing applications (submitted to NRC)
    a. UFTR Relicensing Application
    b. LAR for digital protection system
ii) Basic Design Documentation (submitted/to be submitted to AREVA)

iii) Application Software Development

i-a. UFTR Relicensing Application: This work was completed and waiting for the license renewal.

i-b. LAR for the digital protection system: Figure 1 below depicts the licensing process steps. A modified Final Safety Analysis Report (FSAR) was submitted based on NUEREG 1537, and various documents related to licensing of a digital protection system was referenced. 20 documents were completed and 17 of those documents were submitted to the NRC.

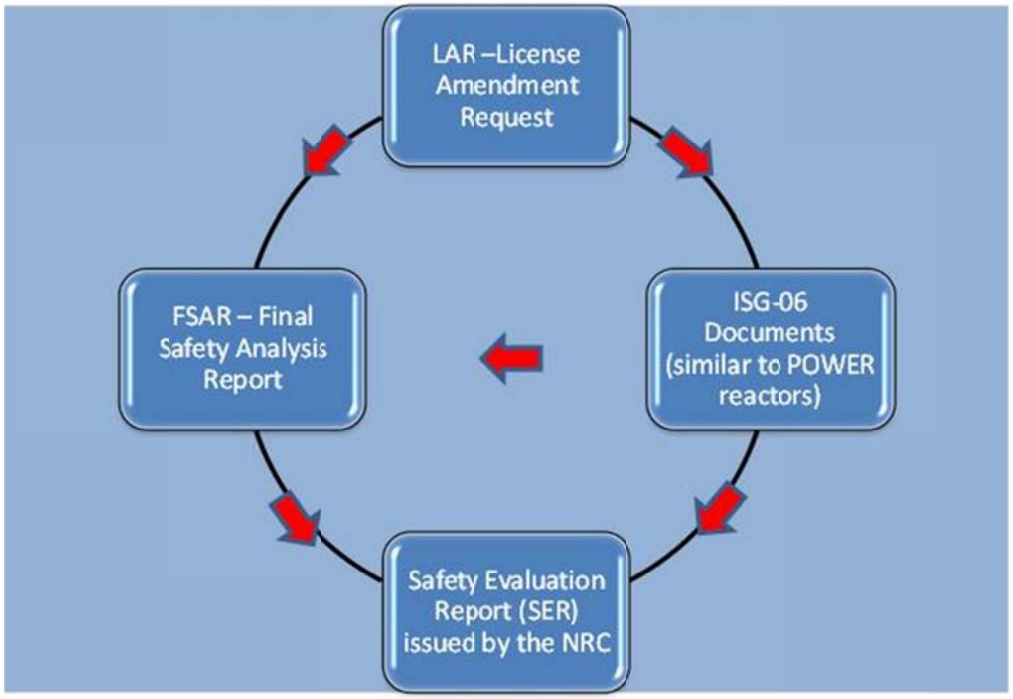

Fig. 1 - New licensing process for the UFTR Digital Control upgrade

ii) Basic Design Documentation (submitted/to be submitted to AREVA): The preparation of 9 (nine) documents is needed in support of TXS protection system manufacturing in Germany, as part of the Basic Design Documentation. So far, 2 (two) of the documents were submitted to AREVA for review, 2 (two) are in a draft stage and the other 5 (five) are scheduled to be finalized over the Summer.

iii) Application Software Development: The team has been working on the *FunBase* and *SPACE* software tools. The former tool is used in support of document preparation, particularly the SRS, and latter tool is used to prepare network diagrams, and eventually the necessary *object* file for operating the TXS system. The capabilities of these two tools are being tested to determine the limitations.

Florida Advanced Technological Education Center (FLATE), Dr. Marilyn Barger

FESC partnered with Florida Advanced Technological Education Center (FLATE) to develop statewide curriculum frameworks for technical A.S./A.A.S. degree programs supporting existing and new energy business sectors. FLATE is in the process of developing and processing through the FLDOE the industry-validated student competencies of the frameworks. FLATE will also develop new courses required for each

new program of study. Additionally FLATE will help state and community colleges implement the new frameworks in their institutions.

During the current reporting period, FLATE continued to work with several community colleges and their local industry to define curriculum standards for alternative energy to support industry needs, made several presentations both within and outside of Florida, and is continuing to work with Brevard Community College, Tallahassee Community College, and Florida State College at Jacksonville for implementation of an Alternative Energy Systems Specialization. FLATE also conducted a state-wide survey to assess Florida's current Alternative Energy course offerings at State and Community colleges for the FESC education portal.
Specific accomplishments during the period are:

A. October 2010 to December 2010
- Participated as Advisory Council Member for the Banner Center for Energy's Focus Group meeting to assess future educational needs from industry within the Indian River State College area. (Orlando, FL)
- Attended presentation from the Sustainability Education & Economic Development (SEED) on application of Nanotechnology to Solar Cells. (Brandon, FL)
- Reviewed proposed course curriculum and frameworks in the Florida Energy Workforce Consortium (FEWC) quarterly meeting. (Orlando, FL)
- Jointly with Brevard CC, Tallahassee CC, FSCJ and University of Florida's Industrial Assessment Center discussed possibilities of establishing new educational programs at the three colleges that would prepare a new workforce in commercial building and residential energy efficiency. (Gainesville, FL)
- Focus group participant for the Second Annual Gathering of Tampa Bay Sustainability Educators for idea generation and implementation plans to improve sustainability efforts in the Tampa Bay area. (Tampa, FL)
- Initiated discussions with Hillsborough CC on partnership arrangements with other Florida colleges for participation in an exchange course with Denmark for Sustainability Studies where see towns that utilize distributed power generation facilities such as CHP plant with trash as fuel source. Obtained partnership with SCF in Sarasota. (Tampa, FL)
- Completed and distributed a survey to all State/Community colleges throughout Florida to assess the state's current educational offerings in alternative/sustainable energy.

B. January 2011 to March 2011
- Worked with HCC's Sustainability Council towards its goal of reducing greenhouse gas (GHG) emissions on a yearly basis. Energy audits are to be conducted by TRANE across all campus locations as well as implementation of GHG emission mitigation projects.
- Began planning phase on a professional development summer energy workshop for middle school/high school teachers.
- Discussed with a local development company, HCC leadership, and District's House Representative, Rachel Burgin, future development of a CHP site in the Valrico, FL area and the possibility of using a portion of the site as a training facility for hands-on alternative energy education.
- Presented a poster entitled "Building the Technician Workforce for Florida's Energy Future" at the Green Energy Summit in Milwaukee, WI.

- Presented "Developing an Alternative Energy Credit Certificate for Florida" at the IREC 2011 Clean Energy Workforce Education Conference in Saratoga Springs, NY.
- Compiled data from 14 State/Community colleges that replied to the survey of alternative/renewable energy courses offered in Florida. Following up with non-respondents.
- Completed upload onto FLATE's Wiki of course curriculum EST1830 Introduction to Alternative and Renewable Energy made up of 16 individual instructional "modules". Course content is made freely available to self-learners, students and educators. Material is available here: http://flate.pbworks.com/w/page/35326400/EST1830-Introduction-to-Alternative-Energy-Course-Content

Southeast Solar Provider of Instructor Training Network by Florida Solar Energy Center of the University of Central Florida (US DOE funded program)

This project creates a southeastern region solar training network for the purpose of addressing critical needs for high-quality, local, and accessible training in solar system design, installation, sales and inspection. The southeastern region training network is a five-year effort intended to create a geographic network that will offer training programs in solar installations across the southeastern region of the U. S. The project objectives are to accelerate market adoption of solar technologies by ensuring that high-quality installations are standard and to create sustainable jobs within the solar installation industry.

The Florida Solar Energy Center (FSEC) is the operator of the Southeast Solar Provider of Instructor Training Network (SSPITN) and provides the train-the-trainer programs for the nine-member state and territory region. The training network provides the capacity to train educational instructors in photovoltaics (PV) and solar water heating and cooling (SWHC) from institutions designated by the energy offices in the nine partner states and territories. The trained faculty then conducts training in PV and SWHC at their educational institutions.

The SSPITN first established partnerships with the energy offices in the seven states and two territories. From these state and territory partnerships, faculty members from educational institutions were recommended for training. These faculty members then had their credentials reviewed by FSEC before final acceptance into the training program. The selected individuals were then trained in photovoltaics and/or solar water heating and cooling using train-the-trainer programs offered at FSEC. After training, the instructors returned to their educational institutions for the purpose of offering similar courses or programs. To track the trained faculty, a post training survey was developed and conducted.

The SSPITN also developed curriculum, needed laboratory equipment, a SSPITN web site, a newsletter and coordinated its program efforts with its educational and state partners, the solar industry, associations, workforce boards, other regional training providers, the program national administrator and DOE.

The SSPITN program has developed an instructional model for its training network that focuses on both content and delivery. By employing nationally recognized experts in solar technologies and instructional methods, the SSPITN has prepared instructors from throughout its region to deliver high quality training in their respective states and territories. The training received by the faculty/instructors involves classroom time as well as demonstration and hands-on learning. The primary training objective was to have the trained faculty/instructors offer PV and solar programs to their students, thus, creating a workforce pool for local solar contractors.

During the first phase, the SSPITN "Train the Trainer" (TTT) program has educated 108 individual faculty members from 49 different southeastern institutions in PV and SWHC technologies. Twenty-five of the institutions have committed to offering PV and SWHC training in the near term, while the remainder is in the process of developing courses. Using data collected from the trained individuals, the 25 institutions are estimated to offer PV and SWHC training to over 2100 students within the next year. With 25 institutions offering a program in the near term, the lasting impact of TTT programs appears to be excellent.

With regard to the training programs, the instructors that have taken the TTT courses are prepared to teach anything from a general education course for post-secondary and adult education, to a college course in engineering. The instructional materials are varied and cover technical topics as well as institutional and policy issues. What course is ultimately offered by the trainer will be monitored by the SSPITN during its assessment activities. As for the installer training component of the SSPITN, the curriculum for both the PV and SWHC courses have been aligned with the NABCEP task analyses. The instructional material given to each of the trainers will allow them to begin offering a similar program in one to three months at their respective institutions.

OUTREACH

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

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

Outreach Team Members:

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

The progress made is given below:

Assistantships funded directly for students working on research projects contributing to promotion of resource efficient design, construction and management of master planned communities: Sarah Dwyer-MS-Use of utility meter data for evaluating residential energy efficiency program performance; Flavio Hazan – PhD- Developing land planning GIS tools to account for resource consumption and greenhouse gas emissions; Hal Knowles-PhD-Developing internet-based social marketing tools to support quantifiable reductions in household energy consumption.

External collaborators: Tampa Bay Water, UF/IFAS County Extension Offices, American Water Works Association, River Network, Alliance for Water Efficiency, Florida Section of the American Water Works Association, American Council for an Energy Efficient Economy (ACEEE), St. Johns River Water Management District, Southwest Regional Planning Council, Florida State University, University of South Florida, University of Central Florida, Florida A&M University, Florida Atlantic University, Gainesville

Regional Utilities, Clay Electric, Florida Progress Energy, Canin Associates, Inc., Orlando Utilities Commission, City of Tallahassee, etc.

Energy/Climate Awareness Fact Sheets: Completed eight fact sheets for the FESC website with five more currently in various stages of development. Additional topics have been determined. Updated the publication *Energy Efficiency Retrofit and Renewable Energy Programs Using Property Assessed Financing: Florida Guide for Local Governments* to address developments in the PACE financing markets. The new version of the book was published in October 2010 with the title *Options for Clean Energy Financing Programs: Scalable Solutions for Florida's Local Governments*.

Energy Extension Service:

- Co-authors and/or co-reviewers for new Sustainable Floridians program the mission of which is to train and inspire a core of volunteers to deliver information to residents on the significance of sustainability; the value of lifestyle choices and its impact on the environment; and the challenge to share the responsibility for protecting Earth's limited resources. The course was piloted in Leon and Marion County to date with additional county participation planned. Module topics include: The Case for Change, Principles of Sustainability, Energy, Water, Transportation and Land Use, and Leadership and Community.
- Reviewed and promoted SAVE (Steps in Achieving Viable Energy) materials, designed for youth ages 11 to 13 that explore the different forms, sources and uses of energy, and the effects of our energy use. The curriculum materials include a teacher guide, club leader guide, and youth guide and are available online at http://florida4h.org/projects/SAVE.shtml.
- Energy Efficient Home Series three-hour course for homeowners planned to be presented three times over the next few months.
- Worked with speakers on development of a Low Impact Development (LID) - Water Resource Protection Strategies in the Built Environment web-based training for county extension agents that provides detailed information on implementation of low impact development practices for residential community development. Participants have received access to approximately 8 hours of web-based presentations and video tours to complete at their own pace (currently in progress), and the training will end with a 2-hour live web session in early May.
- Prepared for an in-service training emphasizing energy consumption and energy production in residential settings.
- Participated in the Extension Climate Variability and Change Focus Team and developed a survey for county extension offices to solicit input from local governments on their needs with respect to energy and climate issues in local planning (results not yet available).
- Published refereed publications: Jones, P., N. Taylor, M. J. Kipp, and H. Knowles. (2010). *Quantifying Household Energy Performance Using Annual Community Baselines*. International Journal of Energy Sector Management. 4(4): 593-613 and Jones, Pierce, Ujjval K. Vyas, Nicholas Taylor, and M. Jennison Ki*pp.* (2010). *Residential Energy Efficiency: A Model Methodology for Determining Performance Outcomes*. Real Estate Issues 35(2):41-47.
- Gave four presentations at the national level and eight presentations at the state/regional/local level to groups including the Federal Reserve Bank of Atlanta, American Society of Farm Managers and Rural Appraisers, Sarasota Board of County Commissioners, Northeast Sustainable Energy Association: Florida Local Environmental Resource Agencies, and the Southwest Florida Regional Planning Council.

Demand Side Management: Retrofit Analysis - DSM Analysis contracted with Utilities Commission of New Smyrna Beach; Analyzed program impact of weatherization for low income families by local non-profit Community Weatherization Coalition; Working with UF Shimberg Center and Alachua County Housing Authority to analyze impact of water heater retrofits in subsidized housing; FL DCA WAP analysis-working with utilities and municipalities across the state to gather data. Residential Green Building Programs: Residential green building program analysis and consultation for Austin Energy under contract; Working with JEA to analyze residential green building program; Working with Alachua County to develop a residential green building designation. Working with Tampa Bay Water on Energy and Carbon Costs of Water Supply: A Tampa Bay Water Case Study - This research and outreach project investigates the energy, monetary, and carbon (i.e., greenhouse gas) costs associated with water supply from Tampa Bay Water's system by evaluating facilities-level data from Tampa Bay Water, merging those data with power plant emissions data from U.S. EPA's eGRID and measuring costs associated with groundwater, surface water, and desalinated supply.

Continuing Education: Offered Greenhouse Gas Reduction and Energy Conservation I: Comprehensive Planning Under Florida's HB 697 (6 hours) – This workshop explores the implications of HB 697 as a comprehensive planning matter and examines lessons learned from other states and current best practices for the evolving approaches to compliance with the new energy- and greenhouse gas (GHG) emissions-related Comprehensive Plan requirements. Offered **to Planners, Professional Engineers,** Construction Industry Licensing Board, Landscape Architects, and Architects in Ft Myers. Offered three (Alachua, Pinellas and St. Lucie counties) Conserving and Restoring Biodiversity in Urban and Rural Environments CEU classes in which participants learn about tools, methodologies and strategies to conserve and restore urban environments and promote biodiversity and water conservation; how to evaluate the positive or negative impacts of a proposed policy or development design on biodiversity and water conservation; and, how to retrofit older neighborhoods. Offered to Landscape Architects, Architects, Professional Engineers and Planners. Green & Profit and Energy Efficient Building Construction in Florida CEU courses planned for summer 2011. Developing online CEU classes for building professionals.

Demonstration House: Continued participation with Pinellas County Extension on structuring their $475,000 earmarked grant to build an energy-efficient demonstration facility.

Workforce Development: Continued working on the USDOE (Weatherization Assistance Program Training Center) grant including Development of the Certification Training and comprehensive review of same. Corresponding training-the-trainer materials were also reviewed. Test questions were developed and prerequisites are being established with Workforce Florida and various Technical/Vocational Training Centers for student recruitment. Pilot date to test materials was set.

Alternatively Fueled Vehicles: Working with Progress Energy to evaluate performance of PHEV using converted Toyota Prius equipped with GPS tracking system and software to monitor performance. A FESC publication on AFVs is planned.

Collaboration on New Initiatives: One copyright is being processed by UF's Office of Technology Licensing. It is titled "Quantifying Household Energy Performance Using Annual Community Baselines Annual Community Baselines" (2011).

Job Creation: Through additional grants to supplement FESC funding, 5.77 FTE jobs for 6-months were retained.

FESC Web Site (www.FloridaEnergy.ufl.edu) continues to be an important communication tool for our program. It is updated regularly to remain current and to better serve our users. FESC distributes electronic newsletters by email and available on the FESC web site. Based on a Google Analytics report, the FESC web site was viewed by 8404 Google visitors during the period Nov 1, 2010 to May 1, 2011. The viewers visited 23,864 pages. Viewers were from a total of 109 countries, including those in North and South America, Europe, Asia, Australia, and Africa.

FESC SUMMIT

The second annual FESC Summit will be held at the University of Florida's Reitz Union on September 26-28, 2011. The format is expected to follow that of last year's successful 2nd summit, with pre-summit workshops, oral and poster sessions from FESC-funded or associated projects, and internationally renowned speakers.

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

Planning for the 2011 summit is well underway. An internationally renowned keynote speaker is being identified to analyze the national and international energy outlook. Invitees will include leaders from academia, government and industry. Energy researchers and educators from all 11 State University System institutions, as well as Florida's community colleges, will have targeted opportunities to come together and build new, cutting-edge energy research and education programs. A poster session will provide participating graduate students an opportunity to present their research and to meet with the industry representatives and faculty from other universities.

In conjunction with the Summit, FESC will also host several other events:

- The Florida Clean Energy Workshop (organized by DOE/EERE) will focus on innovation in R&D and manufacturing in Florida's Clean Energy industry. This one-day workshop is scheduled for September 26 at the UF Reitz Union.
- Emerging Energy Issues and Topics In-Service Training. Led by the UF/IFAS Program for Resource Efficient Communities, this proposed event will feature talks on the energy-water nexus, sustainability and behavior, home energy efficiency, and the newly-developed 4-H curriculum, "SAVE: Steps in Achieving Viable Energy" which is designed to teach youth about energy.
- Facilitating Collaboration among Local Governments for Energy: The Network of Energy Sustainable Communities. Led by Dr. Richard C. Feiock, FSU. The Network of Energy Sustainable Communities is an effort of municipalities to share innovations and best practices and to coordinate bulk purchasing of sustainable energy or energy efficient products.

Registration and the Call for Papers should be online within the next month. Plans for the Summit will be posted on our website as the program is finalized.

APPENDIX A – DESCRIPTION OF RESEARCH PROJECTS

Projects	Summary
THRUST 1: Overarching	
	Title: Power Generation Expansion under a CO_2 Cap-and-Trade Program **PI:** Tapas Das **Co-PI's**: Ralph Fehr **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 **University:** USF **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 **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 **University:** FSU
	Title: Sustainably Integrated Advanced Building Subsystems (OGZEB) **PI:** A. "Yulu" Krothapalli, **Co-PI:** Justin Kramer **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 **University:** FSU
	Title: Insight into Membrane Degradation Mechanisms Through Verification of Chemical and Mechanical Degradation Test Capabilities **PI:** Darlene Slattery **Co-PI's**: Len Bonville, Marianne Rodgers **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 **University:** UCF/FSEC
	Title: Energy Efficient Building Technologies and Zero Energy Homes **PI:** R. Vieira **Co-PI's:** P. Fairey, J. Sonne **Description:** The project consists of two elements: 1) the construction of two flexible research homes 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

	University: UCF/FSEC
	Title: Joint Optimization of Urban Energy-Water Systems in Florida **PI:** James P. Heaney **Description:** Urban water infrastructure systems for providing water supply, collecting and treating wastewater, collecting and managing stormwater, and reusing wastewater and stormwater require major energy inputs. End users of the water require even more energy to heat this water for showers and baths, clothes washing, cooking and other uses. Increasingly, cities will rely on alternative water supplies such as desalination that require much more energy per gallon of water produced. Conservation is the ideal way to save energy and water by managing the demand for these precious commodities. Major strides have been made in reducing indoor water use from about 75 gallons per person per day to as low as 40 gallons per person per day. However, these gains are being offset by concurrent increases in outdoor water use for irrigation that range from 30 to 300 gallons per person per day depending on irrigation practices and the size of the landscape. From a water use perspective, perhaps the greatest challenge will be the expected growing competition for water if certain energy options are implemented in order to reduce our current dependence on foreign oil. Several recent national studies warn of this impending energy-water crisis. This project will build on our extensive experience in evaluating urban water conservation options to include the implications for energy use and to develop integrated energy-water management systems that are compatible. Budget: **$72,000** **University:** UF Back to Thrust 1: Overarching
	Title: Planning Grant: High Performance and Low Cost Fuel Cells for Future Vehicles **PI:** Jim Zheng, **Co-PIs:** Richard Liang, Chuck Zhang, Ben Wang **Description:** The objective of this project is to provide an innovative approach to revolution of current energy storage and conversion technology and greatly leverage FSU position in the strategic important area for sustainable energy. The 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.
	Title: NIRT: C-MEMS/CNEMS for Miniature Biofuel Cells **PI:** Marc Madou, Co-PIs : Chunlei Wang, Sylvia Daunert and Leonidas Bachas **Description:** In recent years, the quest for alternative sources that can autonomously power bioMEMS devices, especially those geared for in vivo applications, such as monitoring and drug delivery, has been the focus of research by scientists and engineers as new power sources will prove critical for the advancement of the field. Current batteries are still less than optimal and often present drawbacks related to safety, reliability and scalability. An ideal power source for implantable devices should take advantage of natural compounds present in the body of an individual and use them as fuel to produce power in a continuous and reproducible manner, as long as the patient's physiological functions remain steady. Biofuel cells, which are capable of converting biochemical energy into electrical energy, have been deemed as a potential solution to the drawbacks presented by conventional batteries, but the power density and operational lifetime requirements for implanted devices have not been met yet. To that end, we 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) **University**: FIU
	Title: Fabrication of Nano Fractal Electrodes for On-Chip Supercapacitors **PI:** Chunlei Wang **Description:** Nature has always strived for the highest efficiency in all organisms. Just as nature has benefited from fractal structures in almost all of its organisms, biomimetic fractal designs in electrochemical devices such as power conversion & storage devices and sensors can also lead to benefits in scaling. Our proposed concept is geared to take advantage of the scaling relationship between interface area and overall volume. Fractal electrode design is believed as a promising solution to optimize surface area while minimizing the internal resistance. We will fabricate and characterize carbon-based microelectrodes pyrolyzed from photolithographically patterned photoresist, which exhibits nano fractal geometry by design. In contrast with the current research trend of, first fabricating carbon nanostructures (CNTs, CNFs, etc), and then lithographically defining an electrode at the convenient location on the substrate, our novel methods will integrate the fabrication of the micro and the nano- structures using simple process thus bridging the gap that separates these two scales. Since the fabrication methods are all based on IC manufacturing methods, it will be easy to integrate into microchips.

	Budget: $150,000 **Universities:** FIU
	Title: Energy Efficient Technologies and The Zero Energy Home Learning Center **PI:** Stanley Russell **Co-PI's:** Yogi Goswami **Graduate Assistant**: Mario Rodriguez **Description:** The project is to create and evaluate an affordable residential scale Zero Energy building that will function as an exhibition of energy efficiency and Zero Energy Home [ZEH] technology on or near the University of South Florida campus. The project will feature the most cost-effective combination of renewable solar energy with high levels of building energy efficiency. The building will incorporate a carefully chosen package of the latest energy-.efficiency technologies and renewable energy systems to achieve the most successful and reliable results. The building will utilize Photovoltaic solar electricity and solar domestic hot water heating systems using the grid as an energy storage system, 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 **University:** USF **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.
THRUST 3: Developing Florida's Biomass Resources	
Algae	
	Title: Systems Approach to BioEnergy Research (SABER) **PI:** Joel E. Kostka **Co-PIs**: William Cooper, Ivonne Audirac, Amy Chan-Hilton,Ellen Granger **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 **Lead University:** FSU
	Title: Constructual Optimization of Solar Photo-Bioreactors for Algae Growth **PI:** Juan Ordonez **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 **University:** FSU **External Collaborators:** Federal University of Parana, Brazil
	Title: Optimization of Algae Species for Biofuels Production using Genetic Altration **PI:** Ed Phlips **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 **Lead University**: UF
High Energy Crops	
	Title: Seeding Biofuel Entrepreneurship in South Florida **PI:** George Philippidis **Description:** FIU's Pino Global Entrepreneurship Center has provided seed funding to facilitate the development of algal biofuels technologies in South Florida. The project's goal is to identify fast-growing high-lipid content native algae that will form the basis for lipid conversion to biofuels. A collection of Florida algae will be screened to select the one(s) with promising growth and lipid potential. Growth conditions will be manipulated to understand the effect of key process variables of lipid productivity. Cells will be harvested for lipid extraction and conversion to biodiesel using FIU's pilot-scale transesterification system. In parallel, biofuels will be introduced into the FIU curriculum to seed the development of a workforce educated and skilled in renewables. **Budget:** $15,000 **University:** FIU
	Title: Energy Intensive Crop Development **PI:** Gary Peter , Matias Kirst, Don Rockwood **Description:** To build a commercially viable, industrial scale system to produce transportation

	fuels and electricity from biomass requires both efficient conversion technologies and environmentally sustainable, cost effective supplies of biomass. In the US, Florida ranks first in its annual growth of plant biomass, because of its large cultivable land area and its subtropical climate, even though substantial land areas that can be planted are not currently in agricultural or forest production. The development of high yielding production systems for dedicated energy crops is considered essential for a sustainable, biomass to energy industry to be established, because the long-term availability of sufficient amounts of reasonably priced biomass is one of the most important factors in the site selection for new biofuel and bioenergy facilities. Dedicated energy crops are ones that 1) have high yields with minimum energy inputs in terms of agronomic practices, water and nutrient applications, 2) can be harvested, transported and processed efficiently into fuel or power, and 3) can be grown sustainably for generations without adverse environmental affects, or significantly impacting the food supply. We will evaluate likely energy crop species, *Eucalyptus* and southern pine to provide important yield and best management practices for growing these species for bioenergy conversion. We will also provide important chemical composition information that will impact the conversion efficiency of this biomass to ethanol, and identify and characterize important genes that regulate wood chemical composition **Budget:** $432,000 **University:** UF
	Title: Water-Use Efficiency and Feedstock Composition of Candidate Bioenergy Grasses in Florida **PI:** Lynn E. Sollenberger **Co-PI's:** John Erickson, Joao Vendramini, Robert Gilbert **Description:** Florida ranks first in the USA in annual growth of plant biomass because of a large cultivatable land area, high rainfall, and long growing 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

	University: UF **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 **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 **Universities:** University of Florida **External Collaborators:** University of Central Florida
	Title: Assessment and Development of Pretreatment for Sugarcane Bagasse to Commercialize Cellulosic Ethanol Technology **PI:** George Philippidis **Description:** The project's objective is to identify a biomass pretreatment process that can cost-effectively convert sugarcane bagasse to an enzymatically digestible and fermentable mix of sugars as a means for determining the commercialization potential of Florida biomass conversion to ethanol fuel. The key objectives are: (1) Assess the lab-scale efficacy of pretreatment processes on sugarcane bagasse; (2) Scale up the most promising bagasse pretreatment process based on the lab scale results; (3) Optimize the pretreatment process to derive design and operation data for commercial-scale bagasse-to-ethanol facilities; and (4) Integrate the critical unit operations to assess the techno-economic feasibility of the bagasse-to-ethanol technology. The FIU-FCC team constitutes a unique public-private partnership with in-depth knowledge of the technology and its shortcomings (19 years of experience by the PI in this field) and experience in commercial agro-energy operations. **Budget:** $1,918,306 **University:** FIU
	Title: Engineering Biocatalysts for Hemicelluloses Hydrolysis and Fermentation **PI:** James F. Preston **Description:** Our goal is to develop biocatalysts for the cost-effective production of fuel alcohols and chemical feedstocks from underutilized sources of renewable biomass and evolving energy crops. To reach this goal protocols for efficient saccharification of hemicellulose fractions from

	these resources will be developed. Objectives are to: 1. Develop improved enzyme-mediated saccharification protocols of hemicelluloses with existing bacterial biocatalysts for production of biofuels and chemical feedstocks. 2. Develop Gram positive biocatalysts for direct conversion of hemicelluloses to biobased products. 3. Develop systems with bacterial biocatalysts for efficient bioconversion of the hemicellulose fractions of perennial energy crops (poplar, eucalyptus, switchgrass, energy cane) to targeted products. **Budget:** $192,000 **University:** UF **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 **Description:** Biomass is an attractive source of sugars for a state like Florida that produces very limited amount of corn for fermentation to produce ethanol as transportation fuel or other products such as lactic acid that can be converted to bioplastics. Florida currently generates about 8.7 million tons of dry cellulosic biomass per year (US-DOE) that can be converted to about 0.7 billion gallons of ethanol. With specific energy crops and short rotation trees cultivated for energy production using the abundant sunshine and water resources, the ethanol produced from biomass can be significantly increased to meet the demand for transportation fuel in the State of Florida. Before biomass-based fuels and chemicals become an economic reality, several key steps in the depolymerization of biomass to constituent sugars need to be addressed. One is depolymerization of cellulose to glucose by fungal cellulases before fermentation to ethanol by microbes. The current estimated cost of fungal cellulases is $0.32 per gallon ethanol produced and this cost is targeted for reduction to $0.10 or less by year 2012 (DOE). We have demonstrated that by increasing the temperature of Simultaneous Saccharification and Fermentation (SSF) of cellulose from 30-35 ºC to 50-55 ºC, the amount (and associated cost) of cellulases can be reduced by the required 3-fold with the current commercial enzyme preparations. A microbial biocatalyst that produces ethanol or other chemicals as the main fermentation product and can also function at this higher temperature and pH 5.0 in conjunction with the fungal cellulases in the SSF process is a critical component of this process. We have identified a thermophilic facultative anaerobe, *Bacillus coagulans*, with versatile metabolic capability as the microbial platform for the SSF of biomass to products and engineering this L(+)-lactic acid producing bacterium to produce ethanol. *The primary objective of this proposed study is to construct a B. coagulans derivative that produces ethanol as primary product of fermentation and to enhance the ethanol productivity of the engineered derivative.* **Budget:** $192,000 **University:** UF

Bio gasification	
	Title: Combined Cooling, Heat, Power, and Biofuel from Biomass and Solid Waste **PI:** William Lear **Co-PI:** J.N. Chung **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 **University:** UF **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-PI's:** Yogi Goswami, Venkat Bhethanabotla, John Wolan, Vinay Gupta **Description:** The objective of this project is to develop technology for the economical thermo-chemical conversion of lingocellulosic biomass (non-food grade biomass such as agricultural waste, bagasse from sugar mills, citrus peels, switch grass, municipal green waste, etc.) to clean burning liquid fuels. Five of the major advantages of this process over a biochemical route to production of ethanol are: (i) it does not utilize food-grade feed stocks and therefore complements and does not compete with the agricultural food production in the state, (ii) the fuel produced is similar to those derived from petroleum unlike ethanol derived fuels which have at least a 25% lower energy content, (iii) the conversion is accomplished in using fast chemical reactions unlike the slow biological reactions for fermenting alcohol, (iv) the process does not require large amounts of water and associated energy costs of separating the water from the fuel as in bioethanol processes, (v) it can utilize a wide variety of biomass sources unlike the biochemical route which cannot work with high lignin containing biomass. **Budget:** $554,447 **University:** USF **External Collaborators:** Prado & Associates
	Title: Integrated Florida Bio-Energy Production with Carbon Capture & Sequestration **PI:** Ali T-Raissi **Co-PIs:** N.Z. Muradov, D.L. Block **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 **University:** UCF/FSEC
	Title: Biofuels Through Thermochemical Processes **PI**: Anjaneyulu Krothapalli **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 **Universities:** FSU **External Collaborators:** NA
THRUST 4: Harnessing Florida's Solar Resources	
Solar Thermal	
	Title: Concentrating Solar Power Program **PI:** Charles Cromer **Co-PI:** R. Reedy **Description:** 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 **University:** UCF/FSEC **External Collaborators:** FPL
	Title: Enhanced and Expanded Solar Thermal Test Capabilities **PI:** J. Del Mar **Co-PI:** 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 **University:** UCF/FSEC **External Collaborators:** Solar thermal manufacturers
	Title: Solar Fuels for Thermochemical Cycles at Low Pressures **PI:** Jörg Petrasch **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 **Universities:** UF **External Collaborators:** Wojciech Lipinski, University of Minnesota
	Title: Solar Thermal Power for Bulk Power and Distributed Generation **PI:** David Hahn, James Klausner, Renwei Mei, and Helena Weaver **Description:** While there are many different approaches to hydrogen generation, the most attractive means is to split water molecules using solar energy. The current approach is to develop highly reactive metal oxide materials to produce intermediary reactions that result in the splitting of water to produce hydrogen at moderate temperatures (<1000 K). It is envisioned that the metal oxide reactors will ultimately be mounted within a solar concentrating reactor, and irradiated via heliostats. This Task is structured toward the overall goals of solar-driven, thermochemical hydrogen production, with associated efforts toward the enabling surface science, catalysis, particle science, material synthesis, nano-structures, multiscale-multiphase physics modeling, and process simulation that will enable the realization of solar hydrogen-based fuels to power the transportation economy. Successful efforts as targeted in this project are a critical step toward increased renewable-resource based fuels and energy, reduction of GHG emissions, and establishment of a new power industry in Florida. **Budget:** $446,400 **University:** UF
	Title: Design, Construction and Operation of CSP Solar Thermal Power Plants in Florida **PI :** Yogi Goswami **Co-PI's:** Lee Stefanakos, David Hahn, Robert Reddy 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 **Universities:** USF, UF, UCF **External Collaborators:** Sopogy Inc. and Gulf Coast Green Energy. Back to Thrust 1: Overarching
	Title: Solar Systems Testing Facility **PI:** James Roland, David Block **Description:** Over the past four years, the Florida Solar Energy Center (FSEC) has received a significant increase in demand for solar and PV systems testing and certification. This occurrence has resulted in requiring the Center to correspondingly amplify its capabilities to respond to the increased demand. Thus, the objective of this task was to construct a solar and PV systems testing facility by adding walls, windows, doors and A/C to an existing Florida Solar Energy Center roof only facility. The enclosing of this existing space was done for the purpose of increasing laboratory space and to allow for laboratory testing of solar water heating systems and PV modules and inverters. The action was taken following a study which determined this project was the most cost effective means of adding valuable indoor laboratory space. **Budget:** $600,609 **University:** UCF/FSEC
Clean Drinking Water	
	Title: Low Cost Solar Driven Desalination **PI:** James Klausner and Skip Ingley **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 **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 **Universities:** USF **External Collaborators:** NA
Low Cost PV Manufacturing	
	Title: Enhanced and Expanded PV Systems Testing Capabilities at FSEC **PI:** S. Barkaszi **Co-PI:** R. Reedy **Description:** An important FSEC function is consumer protection from poorly designed and manufactured PV modules and systems. FSEC's test capabilities were established over 10 years ago and were adequate at the time to test PV modules for certification. However, PV costs have fallen and competing electric utility rates have risen. In the last two years, these curves have crossed under some economic scenarios and incentive programs, and the demand for PV module testing and system certification has jumped. Thus, this task will provide for enhanced and expanded PV testing and certification capabilities. The task will also be done in close coordination with FSEC's work with the U.S. Department of Energy's PV program. **Budget:** $196,018 **University:** UCF/FSEC
	Title: Development of High Throughput CIGS Manufacturing Process **PI:** N. Dhere **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 **University:** UCF/FSEC Back to Thrust 1: Overarching
	Title: PV Manufacturing Data Base and Florida Applications **PI:** D. Block **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 **University:** UCF/FSEC
	Title: Development of Low Cost CIGS Thin Film Hot Carrier Solar Cells **PI:** Gijs Bosman, Yige Hu **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 **University:** UF
	Title: Solar Photovoltaic Manufacturing Facility to Enable a Significant Manufacturing Enterprise within the State and Provide Clean Renewable Energy **PI:** Don Morel, USF; **Co-PI's:** Chris Ferekides, USF, Lee Stefanakos, USF **Description:** The primary goal of this project is to enable the establishment and success of local solar photovoltaic manufacturing companies to produce clean energy products for use within the state and beyond and to generate jobs and the skilled workforce needed for them. Thin film technologies have shown record efficiencies of 20%, and present tremendous opportunities for new Florida start-up companies. USF, UCF, and UF are collaborating to develop a pilot line facility for thin film solar technologies, which will serve as a test bed for making ongoing improvements in productivity and performance of solar modules, develop advanced manufacturing protocols, and help train a skilled workforce to ensure the success of new companies. **Budget:** $1.6M **Universities:** USF, UF, UCF **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**,** R. Reedy **Description:** Photovoltaic/thermoelectric (PV/TE) cell integration is a promising technology to improved performance and increase the cell life of PV cells. The TE element can be used to cool and heat the PV element, which increases the PV efficiency for applications in real-world conditions. Conversely, the TE materials can be optimized to convert heat dissipated by the PV element into useful electric energy, particularly in locations where the PV cell experiences large temperature gradients, i.e. use the thermoelectric module for cooling, heating and energy generation depending on the ambient weather conditions. Thus, the goal of this research effort is to research and develop nanoscale design of efficient thermoelectric material through a fundamental understanding of the materials properties and to design and build a photovoltaic thermoelectric (PV/TE) hybrid system. **Budget:** $167,820 **University:** UCF/FSEC Back to Thrust 1: Overarching
	Title: PV Devices Research and Development Laboratory **PI:** Robert Reedy **Co-PI's:** Nicoleta Sorloaica-Hickman, Neelkanth Dhere **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 **University:** UCF/FSEC
	Title: Beyond Photovoltaics: Nanoscale Rectenna for Conversion of Solar and Thermal Energy to Electricity **PI:** Shekhar Bhansali **Co-PI's:** Elias Stefanakos, Yogi Goswami, Subramanian Krishnan **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 **Universities:** USF **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 Description: The objective of this project is to develop a system-driven Plug'N'Gen solar power system demonstrating architecture of decentralized, low-cost, mass-produced, PV panel-mounted micro-inverters. This system will be able to compete with today's centralized multi-kW PV inverters that require cost prohibitive professional installation. The project tasks are: 1) novel inverter topology and control concepts; 2) advanced digital control algorithms; 3) SmartTie interface with the utility grid; and 4) low cost and ultra-compact PV inverter in package. **Budget: $1,267,000** **University: UCF** Back to Thrust 1: Overarching
	Title: Non-Contact Energy Delivery for PV System and Wireless Charging Applications **PI:** Jenshan Lin **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 **University:** UF
	Title: An Integrated Sustainable Transportation System **PI:** David Norton **Co-PI:** Shirley Meng **Description:** The proposed vehicle, operating on biofuel while in transit and charged by the sun while parked, is the ultimate sustainable transportation system operating completely on renewable American energy resources. Moreover, the use of solid oxide fuel cells (SOFCs) rather than an IC engine in this hybrid vehicle results in a dramatic improvement in efficiency and reduction in emissions. SOFCs are the most efficient technology for converting energy from hydrocarbon fuels to electricity on a "well to wheels" basis. In contrast, the more conventional fuel cells require hydrocarbon fuels to first be converted to 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 **Universities:** UF **External Collaborators:** Solid-State Energy Technology, Inc., Lynntech, Inc., Planar Energy Devices, Inc., CFX Battery, Inc. Back to Thrust 1: Overarching
PV/Storage/Lighting	
	Title: Planning Grant: Hydrogen storage using carbon-based adsorbent materials **PI:** Efstratios Manousakis **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** **University: FSU**
	Title: PV Power Generation Using Plug-in Hybrid Vehicles as Energy Storage **PI:** J. Shen **Co-PI's:** I. Batarseh, N. Kutkut **Description:** The objective of this project is to develop and demonstrate an alternative PV power generation architecture that uses plug-in hybrid vehicle as the energy storage and transfer element with a total system cost target of $3.50/W. The tasks include developing efficient, reliable, and inexpensive maximum power tracking DC/DC battery chargers and 3-phase converters. A 10kW demonstration solar carport charging station will be built on UCF campus. A plug-in hybrid vehicle with a 25kWh battery bank (battery-only driving range of 50-100 miles) and onboard bidirectional AC charging system will be demonstrated **Budget:** $380,816 **University:** UCF **External Collaborators:** City of Tavares, FL
	Title: Integrated PV/Storage and PV/Storage/Lighting Systems **PI:** Franky So, **Co-PI:** Jiangeng Xue, Shirley Meng **Description:** The goal is to increase the efficiency and reduce the cost of solar power through the integration of PV, Li-battery, and LED lighting technologies. Since all components are in the form of thin films, the PV/battery/LED system can be integrated as a single module. Since half of the materials cost of each device is the substrate, integrated module will also reduce materials costs and processing steps. Importantly, their integration further eliminates the need for inverters since they are all low-voltage devices. Such an integrated device can be used to store energy during the day and power the LED panel for lighting in the evening. In addition, we will explore the possibility of fabricating a semi-transparent module. The success of this Task will lead to a novel solar-power lighting panel that can be used as a sky light during the day and a lighting panel

	during the night without using grid-power. We not only will develop the technologies, but also integrate devices and perform technology-economic evaluation, including life-cycle costs. **Budget:** $576,000 **University:** UF 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 **PI:** Tingting Zhao**, Co-PI:** Mark Horner **Description:** In 2007 the Governor of Florida established targets for greenhouse gas (GHG) emissions, which mandate that the State of Florida aims to reduce emissions to 2000 levels by 2017 and to 1990 levels by 2025. To fulfill these goals, not only is the development of renewable sources of energy and fuel needed, but it is also necessary to achieve more sustainable energy 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 **University:** FSU
	Title: Planning Grant: Enhanced Thermal Performance and Microstructure Simulation of Nuclear Fuels **PI:** Justin Schwartz **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 **University:** FSU
	Title: Biocatalytic Lignin Modification for Carbon Sequestration **PI:** Jon Stewart **Description:** After cellulose, lignin is the second most abundant forma of carbon in plants. Lignin's complex structure makes it difficult to use this material in value-added products, and ahte vast majority of lignin is currently burned to provide energy for factory operations. While burning plant derived lignin does not add to global greenhouse gas levels, having options to remove lignin from the global carbon cycle would lead to diminished atmospheric CO2 levels. This could be accomplished by chemically altering lignin's structure to facilitate long-term terrestrial sequestration or using it in value-added products that would not be discarded immediately. We will use Nature's catalysts (enzymes) to tailor the chemical structure of lignin for both deep-well injection (by using lignin derivatives as drilling "muds") and for materials that can be used in building, packaging, and other manufactured products.) **Budget:** $200,000 **University:** UF
	Title: Carbon Capture and Sequestration **PI:** Sabine Grunwald. **Co-PIs:** Tim Martin, Howard Beck **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 **University:** UF
	Title: Creation of Carbon Sequestration Data, Technologies and Professional Cohorts for Florida

	PI: Mark Stewart, **Co-PIs:** Jeffrey Cunningham, Yogi Goswami, Maya Trotz **Description:** Rising concerns over increasing levels of green house gases, especially carbon dioxide, have led to suggestions to capture carbon dioxide at fixed sources, such as fossil fuel power plants, and sequester the carbon for millennia by injecting it underground. Florida overlies many thousands of feet of carbonate rocks which may be suitable for geologic sequestration of carbon dioxide. This project will investigate the potential for geologic sequestration of carbon dioxide in Florida, the physical and chemical changes that may occur as a result of injection, assess the potential for escape of injected carbon dioxide, determine the risk, if any, to aquifer systems used for water supplies, develop methodologies for Florida utilities to predict the performance and risks of proposed sequestration projects, and educate a cohort of geologic sequestration professionals to create a carbon sequestration industry in Florida. **Budget:** $479,640 **Universities:** USF **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, Taghi Khoshgoftaar, Pierre-Phillippe Beaujean, Len Berry, Megan Davis, Jeanette Wyneken, Manhar Dhanak, Eric Chassignet, John Reed, Charles Messing, James VanZwieten, Karl vonEllenrieder, Julie Lambert, Hassan Mahfuz, Stewart Glegg, George Frisk, Bassem Alhalabi, Hari Kalva, Greg O'Corry-Crowe, Madasamy Arockiasamy, Francisco Presuel-Moreno, Isaac Elishakoff **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:** P.I. Z. Qu, **GRA**: C. Velez **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 **University:** UCF
THRUST 7: Securing our Energy Storage and Delivery Infrastructure	
	Title: Reliable and Resilient Electrical Energy Transmission and Delivery Systems **PI:** Steinar Dale **Co-PIs:** Mischa Steurer, Kamal Tawfiq, Rick Meeker, Horatio Rodrigo **Description:** The project 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 **University:** FSU Back to Thrust 1: Overarching
	Title: Microgrids for a Sustainable Energy Future **PI:** Chris S. Edrington **Co-PIs:** Jim Zheng, Mischa Steurer, Dave Cartes

	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 **University:** FSU
	Title: Multi-Generation Capable Solar Thermal Technologies **PI:** A. Krothapalli**; Co-PI:** Brenton Greska **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 **University:** FSU
	Title: Planning Grant: Real-Time Power Quality Study For Sustainable Energy Systems **PI:** Dr. U. Meyer-Baese, **Co-PIs:** Helen LI, Simon Foo, Anke Meyer-Baese, Juan Ordonez **Description:** 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 **University:** FSU
	Title: Planning Grant: Advancing Knowledge of Network Theory for Analysis and Design of Smart Power Grids **PI:** Svetlana V. Poroseva **Co-PIs:** Yousuff Hussaini, Per Arne Rikvold **Description:** With power grids evolving towards increasing size, complexity, and integration, it has become more difficult to describe and predict their behavior, even under normal operational conditions. With technological development, climate change, and activities in the political arena, adverse circumstances (natural disasters, intelligent adversary, software design errors, human errors, etc.) have become more probable and costly events. The Project seeks to provide industry and government with advanced analytical and computational tools necessary for the automated evaluation of the structural resilience and reliability of power grids. The potential applications of the Project's results go beyond power grids. Any infrastructure essential to our society and economy (e.g., computer, communication, transportation) can benefit from the Project's results. This project is complete. **Budget:** $15,000 **University:** FSU
	Title: Investigating the Effect of Appliance Interface Design on Energy-use Behavior **PI:** Paul Ward**; Co-PIs:** Ian Douglas, David Eccles

	Description: 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 **University:** FSU
	Title: Energy Delivery Infrastructure Design and Simulation **PI:** Alex Domijan **Co-PI:** Arif Islam **Description:** The Power Center for Utility Explorations (PCUE) proposes to simulate the effects of a renewable energy generation system in a microgrid context to the distribution grid system. The proposed project is to simulate the combination of renewable distributed generation and a battery system to assess the effects during critical conditions such as power system peak. A research opportunity is to investigate how existing tools can be applied to properly represent dynamic and transient behaviors of microgrids. We use test beds to study integrated systems of revolutionary distributed green generation, improved grid and home efficiency, and automated energy conservation technologies for residential, substation, and distribution scale energy systems. This project is complete. **Budget:** $485,184 **University:** USF
	Title: Micro Battery Defense Development **PI:** Chunlei Wang **Description:** The microbattery market for new miniature portable electronic devices such as cardiac pacemakers, hearing aids, smart cards, personal gas monitors, micro electromechanical system (MEMS) devices, embedded monitors, and remote sensors with RF capability is increasing rapidly. Thin-film lithium batteries are among the most advanced battery systems that can scale down to the dimensions that match the MEMS devices. However, these two-dimensional (2D) batteries are necessarily thin in order to maintain effective transport of Li ions. In order to power MEMS devices with limited device area (areal "footprints"), batteries must somehow make good use of their thickness. Three-dimensional (3D) configurations offer a means to keep transport distances short and yet provide enough material such that the batteries can power MEMS devices for extended periods of time. In this project, we focus on developing functional 3D microbatteries based on our carbon microelectromechanical systems (C-MEMS) technique. These microbatteries could offer order of magnitude increases in electrode surface area and charging capability than thin film batteries at the same size scale.

	Budget: , $192,418.30 **University:** FIU
	Title: Electrostatic Spray Deposition of Nanostructured Porous Metal Oxide Composite **PI:** Chunlei Wang **Description:** Recently, conversion reactions of interstitial-free 3d metal oxide structures (such as CoO, CuO, and NiO) with structures unsuitable for intercalation chemistry have nevertheless been shown to exhibit large, rechargeable capacities in cells with lithium. The specific capacities of these materials, which are potential candidates for the negative electrode, can be as high as 1,000 mAhg-1 (about three times of commonly used graphitic carbons). However, practical implementation using these metal oxides is hampered by the large capacity loss of the first cycle and poor material cyclability. These problems are partially attributed to the significant volume changes that occur during lithium uptake and removal (molar volume change of ~100%), which causes mechanical failure and the loss of electrical contact at the anode. They are also due to aggregation of metal nanoparticles that appears during the process of discharging the metal oxide anodes. In order to overcome these two challenges and develop excellent rate capabilities and high power densities of Li-ion batteries, metal oxide composite electrodes with hierarchical mixed conducting network structures will be synthesized. We propose the preparation and testing of multi-component metal oxide anode films with a variety of morphologies using a simple and versatile method based on the electrostatic spray deposition (ESD) technique. The ESD technique enables us to reproducibly fabricate thin film ceramic materials with simple, low-cost and controllable designed morphologies. ESD-derived ceramic thin films we obtained including 3-D reticular, spongy-like, hollow sphere, dense, etc morphologies. The structures of these films can be easily tailored by changing the precursor solution component(s) and adjusting the substrate temperature. In this project, we plan to fabricate porous metal oxide materials, MxOy (M=Fe, Co). Material characterization methods (such as: SEM, TEM, AFM, BET, etc) will be used to study the correlation between ESD parameters and surface morphologies. **Budget:** $88,378.711 **University:** FIU
	Title: Fabrication and Investigation of Porous Tin Oxide Anodes for Li-Ion Micro Batteries **PI:** Chunlei Wang **Description:** The requirement of higher energy capacity microbatteries demands the exploitation of new substitute materials with higher energy capacity than traditional graphite. SnO2 has been considered as one of the most promising substitutes for the carbon anode in Li-ion batteries due to its high Li+ storage capacity. However, the practical application of SnO2 as anode is restricted by poor cyclability and rate capability due to large volume change during cycling, which can cause disintegration and electrical disconnection from current collector. In this project, we propose the preparation and testing of tin oxide anode films with a variety of porous morphologies using Electrostatic Spray Deposition (ESD) technique. Our research focus will be developing an ESD processing to fabricate tin oxide electrode with different pore sizes ranging from macropores to mesopores and down to micropores; constructing hierarchical porous tin oxide electrode by controlling process parameters and introducing a surfactant or polymer additives, and material characterization and electrochemical analysis in order to investigate the correlation between

	morphology and electrochemical performance and understand the underlying mechanism. The proposed research will significantly enhance our understanding of fundamental issues regarding intrinsic properties of porous SnO2 films as anode for Li-ion batteries. **Budget:** $100,000 **University:** FIU
	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.
	Title: Secure Energy Systems – Vision and Architecture for Analysis and Design **PI**: Pramod Khargonekar **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 **Lead University**: UF Back to Thrust 1: Overarching
	Title: Optimization, robustness and equilibrium modeling for the Florida Smart Grid **PI:** Panos Pardalos 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 **Lead University**: UF
Policy and Other	
	Title: Environmental Impacts of Energy Production Systems: Analysis, Evaluation, Training, and Outreach **PI: Amy B. Chan-Hilton** **Co-PIs:** Gang Chen, Wenrui Huang, Michael Watts, Ming Ye, Paul Lee **Description:** 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 **University:** FSU **External Collaborators:** Florida Department of Environmental Protection
	Title: Promoting Energy and Land Use Through Land Use, Transportation and Green Infrastructure Polices **PI:** Tim Chapin; **Co-PIs**: Ivonne Audirac, Chris Coutts, and Greg Thompson, Department of Urban & Regional Planning, and Mark Horner, Department of Geography **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 **University**: FSU
	Title: Marketing Strategies to Incentivize Entrepreneurship and Innovation **PI:** Joe Cronin **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 **University:** FSU
	Title: Energy Sustainable Florida Communities **PI:** Richard Feiock**, Co-PIs:** Ivonne Audirac, Keith Ihlanfeldt **Description:** The objective of NESC is to stimulate innovation and energy investments that will accelerate energy savings by local governments by sharing best practices and organizing and managing large scale collaboration and bulk buying projects. Florida State University has been working with U.S. DOE contributing surveys, research and outreach assistance to assist in efforts to promote investment, collaboration, and bulk purchasing by local governments that will achieve significant cost savings. This includes organizing NESC conference calls co-hosted by hosted by FSU and DOE, conducting several surveys, and hosting a meeting of Florida local government EECBG sub-awardees. These initial research efforts and conference calls have been successful in identifying broad interest in collaboration and bulk buying. They also revealed significant barriers to collaboration that need to be addressed including issues related to coordination within governments, among

	governments and with other organizations. We are now undertaking activities to address these barriers to collaboration at three levels: First we are conducting focused regional workshops throughout the state. By bringing interested governments in each region together with experts in collaboration, governance, finance, and purchasing we will identify specific projects and design the mechanisms to put the projects in place. Second, are expanding our statewide dialogue on a more systematic basis and share the insights and successes of our regional workshops. Third, we are working with universities and other partners throughout the U.S. to share strategies and insights and help replicate our successes in other states. By expanding our efforts and formalizing the network we will make large scale energy savings a reality. **Budget:** $125,424 **University:** FSU
	Title: Political and Economic Institutions Regarding Siting of Energy Facilities. **PI**: R. Mark Isaac**, Co-PI's:** Douglas Norton, Svetlana Pevnitskaya **Description:** The "Hold-Out" project evaluates the "hold-out" concept, which is discussed repeatedly in the context of public policies regarding land acquisition and facilities siting, but a clear definition is elusive. To economists, the most likely definition is that a profitable amalgamation of land parcels by one buyer from competing sellers does not occur because of the failure of the private bargaining process. However, sometimes the term seems to be used more for delay instead of failure in bargaining, or even the very different concept of creation of any bilateral bargaining situation of the buyer and the "last" or "holding-out" seller, which may be inconvenient to the buyer but is immaterial in terms of economic efficiency unless efficient trades actually fail. The experimental design is complete, the programming is complete, Institutional Review Board approval has been obtained, and we have conducted two complete experimental treatments. This research was presented at one of the Presidential Sessions at the 2009 Meetings of the Southern Economics Association in November in San Antonio. **Budget:** $79,621 **Universities:** FSU
	Title: Development of a Renewable Energy Research Web Portal **PI:** Charles R. McClure, **Co-PIs**: Ian Douglas, Chris Hinnant **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 **University:** FSU
	Title: Energy and Efficiency Video Public Service Announcements **PI:** Andy Opel, **Co-PIs:** Phil Steinberg, Leslie France-Patterson, Laura Arpan, Ian Weir **Description:** This interdisciplinary team 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 **University:** FSU
	Title: An Experimental Investigation of Economic Incentives **PI:** Svetlana Pevnitskaya**, Co-PI:** Dmitry Ryvkin **Description:** Policies and institutions aiming at reducing pollution and battling climate change often do not reach desirable results because actual decisions of governments and economic agents deviate from those predicted by theory. 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 **University:** FSU
	Title: Planning Grant: Meteorological Factors Affecting Solar Energy Efficiency **PI:** Paul Ruscher**, Co-PIs:** Yaw Owusu, Hans Chapman **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 **University:** FSU
	Title: Planning Grant: Climate modeling and outreach activities **PI:** Shawn R. Smith, **Co-PI**: Steve Cocke The objective of the planning grant is to develop at least one external funding proposal that focuses on areas of climate modeling and/or climate outreach that support the activities of the 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 **University:** FSU
	Title: Visiting Law Professor **Principal Investigator:** JB Ruhl and Jim Rossi, **Co-PIs:** Uma Outka **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 **University:** FSU
	Title*:* Effectiveness and Impacts of State Renewable Energy Efficiency Programs **PI:** Mark Jamison – UF **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 **Lead University**: UF
	Title: Unifying Home Asset & Operations Ratings: Adaptive Management via Open Data & Participation **PI**: Mark Hostetler – UF **Co-PI:** Hal S. Knowles, III **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 **Lead University**: UF **External Collaborators:** Nick Taylor (Ph.D. Student, UF School of Natural Resources & Environment), Jennison Kipp (Assistant In, UF Program for Resource Efficient Communities)
Education and Outreach	
	Title: Florida Advanced Technological Education Center (FLATE) **PI:** Marilyn Barger **Description:** FLATE (Florida Advanced Technological Education Center) is FESC's partner to develop statewide curriculum frameworks for technical A.S./A.A.S. degree programs supporting existing and new energy business sectors. FLATE develops the frameworks and facilitates their progress through the multiple sequential industry-validation, student competencies based, FLDOE procedure. FLATE also develops new courses and provides faculty professional development as required for each new program of study. Additionally FLATE helps colleges in the State College System implement the new frameworks in their institutions. To support the new curriculum, FLATE will work closely with the FESC Public Outreach and Industry Partnership programs to provide additional professional development opportunities for teachers and faculty to upgrade and update their STEM knowledge base. **Budget:** $300,000 **University:** Hillsborough Community College **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 **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 **Faculty Participants:** DuWayne Schubring **Staff participants:** Matthew Berglund **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 **Universities:** UF **External Collaborators:** Several engineers from AREVA NP Inc & Siemens Corporation

APPENDIX B – FUNDING OPPORTUNITIES SENT TO FESC FACULTY

Competitive Funding Opportunities				
#	Title	Call #	Agency	Funding
1	Associated Gas Distributors of Florida	AGDF	Associated Gas Distributors of FL	Variable
2	BIRD Energy for US-Israel Joint Renewable Energy Developments		BIRD Foundation	$1M per project
3	FY 2011 Environmental Studies Program	M11AS00001	Bureau of Ocean Energy Management, Regulation, and Enforcement	$1,900K total program funding; $1K - $1.900K per award
4	Microscale Power Conversion (MPC)	DARPA BAA-11-33	DARPA	Varies
5	Trade Adjustment Assistance Community College and Career Training Grants SGA Available		Department of Labor	$205-5M for individual applicants; $2.5 - $20M per consortia
6	Research, Development and Training in Isotope Production (LAB)	LAB-11-48	DOE	Varies
7	Radioisotope Generator	IPID 16393	DOE	Varies
8	Inexpensive, Environmentally Friendly and Highly Permeable Lignin-Based Ion Exchangers	FBO231-11	DOE	NA
9	SBIR (Small Business Innovation Research) 2011	DOESBIR2011_1	DOE	Multiple awards of $70K - $100M
10	Advanced Fossil Energy Research: Novel Developments In Sensors And Controls For Fossil Energy Power Generation And Fuel Production Technologies	DE-FOA-0000518	DOE	$4.5M; $1.2-$1.5M per award
11	Scientific Discovery through Advanced Computing Institutes	DE-FOA-0000505	DOE	$150K - >$1M
12	Novel CO2 Utilization Systems, Low Rank Coal IGCC Optimization, and Improvements in Gasification Systems Availability and Costs	DE-FOA0000496	DOE	$13M; $1M-$8M depending on topic

#	Title	Call #	Agency	Funding
13	Nuclear Energy University Programs General Scientific Infrastructure Support	DE-FOA-0000481	DOE	up to $300K
14	Theoretical Research in Magnetic Fusion Energy Science	DE-FOA-0000480	DOE	$3,300,000; awards per project vary
15	Nuclear Energy University Programs – Reactor Upgrades	DE-FOA-0000469	DOE	up to $1.5M
16	Catalytic Upgrading of Thermochemical Intermediates to Hydrocarbons	DE-FOA-0000467	DOE	$12M; $4.5M in 2011, $7.5M in 2012-13
17	Power Electronics Research and Development for Electric Utility Applications (GaN-Si technology)	DE-FOA-0000461	DOE	Up to $3M per award
18	SciDAC: Earth System Model Development	DE-FOA-0000452	DOE	$3M
19	Clean Cities Community Readiness and Planning for Plug-In Electric Vehicles and Charging Infrastructure	DE-FOA-0000451	DOE	$5M; $250K - $500K per award
20	Applications of Nuclear Science and Technology Initiative	DE-FOA-0000450	DOE	$3.5M for FY 2011
21	$1/W PV Systems: Balance of Systems	DE-FOA-0000440	DOE	$5-6M per year; $2-$3M per award
22	US Wind Power: Next Gen Drivetrain Development	DE-FOA-0000439	DOE	$7.5M/ $300K - $700K in Budget Period 1; $1M - $2M in Budget Period 2
23	Superior Energy Performance Program Administrator	DE-FOA-0000435	DOE	One award of $600K - $1M
24	High Energy Density Laboratory Plasmas	DE-FOA-0000431	DOE	$12.5M; $50K-$1M per award
25	Research and Development for Hydrogen Storage	DE-FOA-0000421	DOE	$12M, subject to appropriation. $2M - $4M max
26	Fuel Cell and Hydrogen Storage System Cost Analyses	DE-FOA-0000420	DOE	$9M; $1M-$2M per award; up to 5 years
27	Research and Development of Fuel Cells for Stationary and Transportation Applications	DE-FOA-0000420	DOE	$65M over 3 years; $1-$3M per award
28	US Offshore Wind: Technology Development	DE-FOA-0000415	DOE	$800K - $1.5M depending on topic

#	Title	Call #	Agency	Funding
29	US Offshore Wind: Removing Market Barriers	DE-FOA-0000414	DOE	$200K - $4.5M depending on topic.
30	Bench-Scale and Slipstream Development and Testing of Post-Combustion Carbon Dioxide Capture and Separation Technology for Application to Existing Coal-Fired Power Plants	DE-FOA-0000403	DOE	$75M; $3M-$15M max per award
31	Integrated Process Improvements	DE-FOA-0000337	DOE	Up to $30M; $2M - $15M per award
32	FY 2011 Vehicle Technologies Program Wide FOA	DE-FOA-0000239	DOE	$184M; $1.5-10M per award
33	Deployment of Hydrogen and Fuel Cell Systems into Green Communities	020311PS	DOE	Sources sought solicitation
34	Solar Agile Delivery of Electrical Power Technology (Solar ADEPT)	DE-FOA-0000474	DOE ARPA-E	$10M; $250K - $5M per award
35	Green electricity network integration (GENI)	DE-FOA-0000473	DOE ARPA-E	$250K to $10M
36	Rare Earth Alternatives in Critical Technologies for Energy (REACT)	DE-FOA-0000472	DOE ARPA-E	$30M; $250K - $10M per award
37	High Energy Advanced Thermal Storage (HEATS)	DE-FOA-0000471	DOE ARPA-E	$30M; $250K - $10M per award
38	Plants Engineered to Replace Oil (PETRO)	DE-FOA-0000470	DOE ARPA-E	$30M; $250K - $15M per award
39	Energy Efficiency and Renewable Energy Science and Technology Policy Fellowships (SunShot Initiative Fellowships)		DOE/EERE/ORISE	$56,857-$74,872 plus travel & benefits
40	Fellowships: Investing in Innovative Clean Energy Technologies		DOE/EERE/ORISE	$65K plus travel, research allowance, benefits
41	University Turbine Systems Research	DE-FOA-0000459	Doe/NETL	$2M - $2.5M per topic, $500K per award
42	Small Scale Field Tests of Geologic Reservoir Classes for Geologic Storage	DE-FOA-0000441	Doe/NETL	$6M - $11.5M per award
43	Biomass Research and Development Initiative	DE-FOA-0000510	DOE/USDA	$30M; $3M - $7M total per award

#	Title	Call #	Agency	Funding
44	i6 Green Challenge	i6 Green	EDA/DOC	$1M each
45	SBIR Phase I Solicitation	SOL-NC-11-00012	EPA	Varies
46	Integrated Assessment of Transportation-related policies on greenhouse gases, land use change, and other economy-wide impacts	EPA-OAR-OTAQ-11-06	EPA	$500K
47	National Clean Diesel Funding Assistance Program	EPA-OAR-OTAQ-11-01	EPA	$32M; $30K-$1M
48	Integrated Assessment of Greenhouse Gases and Climate Impacts	EPA-OAR-CCD-10-13	EPA	$2M; $100K-$400K/yr
49	Environmental Impact And Mitigation Of Oil Spills	EPA-G2011-STAR-F1	EPA	$2M total; up to $500K per project
50	Dynamic Air Quality Management	EPA-G2011-STAR	EPA	$2M, up to $500K for regular and $250K for early career
51	Security and Privacy Assurance (SPAR) Program	IARPA-BAA-11-01	IARPA	Varies
52	Fiscal Year (FY) 2011 Measurement Science and Engineering Research Grants Programs	2011-MSE-01	NIST	$10,000-$100,000 depending on program
53	US Nuclear Regulatory Commission, Office of Nuclear Regulatory Research Announcement of Opportunity, FY 2011-12	RGR-FN-0910-RES	NRC	$25K-$225K
54	Research Conference Grant and Cooperative Agreement Program	CGR-FN-0110-RES	NRC	Varies
55	Research Experience for Teachers in Engineering & Computer Science	PD-11-509	NSF	$5.5M
56	Catalyzing New International Collaborations	PD-11-508	NSF	$2M
57	Research Initiation Grants in Engineering Education	PD-11-507	NSF	$3M, $150 K per proposal
58	Major Research Instrumentation Programs	PD-11-503	NSF	$90M; $100K-$4M per proposal

#	Title	Call #	Agency	Funding
59	Biotechnology, Biochemical, and Biomass Engineering	PD-11-1491	NSF	Multiple Awards $400K/yr
60	Particulate and Multiphase Processes	PD-11-1415	NSF	Multiple awards $100K/yr
61	Process and Reaction Engineering	PD-11-1403	NSF	Multiple awards $400K
62	Catalysis and Biocatalysis	PD-11 1401	NSF	Multiple awards $100K/yr
63	Electronics, Photonics, and Magnetic Devices	PD-10-1517	NSF	$100K/yr
64	Energy for Sustainability	PD 11-7644	NSF	$100K/yr
65	Engineering Design and Innovation	NSF-PD-11-1464	NSF	Varies
66	Science and Technology Centers: Integrative Partnerships	NSF 11-522	NSF	Up to $30M
67	Centers of Research Excellence in Science and Technology (CREST) and HBCU Research Infrastructure for Science and Engineering (HBCU-RISE)	NSF 11-520	NSF	$12M; $5M for CREST. Up to $500K per award
68	Paleo Perspectives on Climate Change	NSF 10-574	NSF	$10M
69	Climate Change Education (CCE) Climate Change Education Partnership (CCEP) Program, Phase I	NSF 10-542	NSF	Multiple awards of $750K - $1M
70	Energy, Power, and Adaptive Systems	10-1518	NSF	
71	Sustainable Nanomanufacturing		NSF	
72	Renewable Sustainable Expeditionary Power	ONRBAA11-002	ONR	Phase I: $500K-$1M Phase II: $1M-1.5M
73	FY 12 Communications and Networking Discovery and Invention	BAA 11-013	ONR	$300K - $500K per year per award

#	Title	Call #	Agency	Funding
74	Global Research Outreach (GRO) Program		Samsung Advanced Institute of Technology	$50K - $100K plus overhead
75	Assessing Opportunities for Alternative Fuel Distribution Programs	ACRP 02-36	TRB	$400K
76	Research Interests of the United States Air Force Academy	USAFA-BAA-2009-1	US Air Force Academy	$50M
77	Recovery Act: Novel Materials and Device Development for High Efficiency Solar PV	W911NF-07-R-0001-03-ARRA	US ARMY	$50K-$200K
78	Pre-proposal solicitation for Desalinization and Water Purification R&D	R11SF80382	US Department of the Interior	Up to $1M; $150K - $500K depending on award type
79	Energy Conservation for the US Navy	N0016711BAA01	US Dept of Navy	Varies
80	Conservative Innovation Grants Greenhouse Gas Announcement for funding		USDA	$5M
81	Woody Biomass Utilization Grant		USDA	$3.7M; max $250K/award
82	Plant Feedstock Genomics for Bioenergy: USDA, DOE	DE-FOA-0000417	USDA/DOE	$6M: $2-$5M per award
83	Green Building Design: Water Quality and Utility Management Considerations	RFP 4383	Water Research Foundation	$275K max per award
84	Challenge Projects on Low Energy Treatment Schemes for Water Reuse, Phase 1	Water reuse-10-06	Water reuse Research Foundation	$100K total, $25K per project