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

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

Strategic Plan By FESC- Renewable Energy in Florida

The "Strategic Plan" for renewable energy in Florida focusing on economic development and job creation was prepared with input from experts in each thrust area and feedback from the advisory board members in 2011. This document is being updated.

FESC Technology Commercialization Program Description

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

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

Phase II: Matching Funds R&D Program – The second tier of the FESC technology commercialization funding program is modeled on the very successful Florida High Tech Corridor Council Matching Grants Research Program which has been ongoing at USF and UCF since 1996 and at UF since 2005. This second tier also builds off of the results of the first tier as the business plans and market research studies in tier 1 above will provide for more complete information in attracting industrial partners and selecting appropriate projects for funding in tier 2. In this program, FESC core universities will propose energy related projects for FESC funding that is matched on a 2:1 basis by industry funds. This model serves a

number of purposes: 1) industry partners are by definition highly engaged in the development process in the university as they are co-funding the R&D package, 2) this provides at least a 2X leveraging of FESC funds on each project, 3) a natural pipeline of the technology deployment to the private sector partner is established as they are typically working on development aspects in parallel with the university research on the project, and 4) the FHTCC program has proven time and again that this model spawns new and long lasting R&D collaborative relationships between companies and SUS university researchers. FESC envisions providing up to $50K in matching funds for each project and with industry match (summarized in table below) on each project, attracting in excess of $500K of industry support to these FESC funded projects.

FESC Phase I Projects – Market Research or Business Plans

FESC Phase I Project titled as "Milling Technology Leads the Way to Cost Effective Ethanol Production" (PI: Dr. Blair at UCF) was funded to perform an analysis of commercialization and economic prospective. This technology was licensed by Thor Energy recently.

FESC Phase II Projects - Matching Funds R&D Program

Three FESC funded Phase II projects have been completed:

- UCF and Harris Corp. Joint "Wave Energy" project led by Dr. Zhihua Qu: *The University of Central Florida and Harris Corporation have joined efforts to design, build and analyze a wave powered abandoned oil well monitoring system for use in the Gulf of Mexico. This system proposes a fully automated oil leak detection system which is self-powered by the local ocean energy which is converted to electricity, conditioned and sent from the surface buoy to the ocean floor to supply power for an abandoned oil well monitoring system.* The final report was included in FESC Nov 2011 report.

- UF and nRadiance LLC (portfolio company of Nanoholdings LLC) joint project led by Dr. Andrew Rinzler: *The project focus is single wall nanotube (SWNT) based cathodes in metal-air batteries and SWNT based fuel cells. The FESC funded part of the project has been completed; however the research team is continuing the work with funding from the industry partner.* The final report was included in FESC Nov 2011 report.

- FSU and Hunter Harp Holdings, LLC joint project led by Dr. David Van Winkle on "Deployment of a Low Cost Concentrating Solar Energy Systems Using Solar Sausages". The executive summary of the final report is given at the end of this section.

The active FESC Phase II projects are listed below:

University	Title	PI	Company
UF	Stress Evolution in Solid-State Li-ion Battery Materials	Kevin Jones	Planar Energy Devices Corp.
UF	Development of High Efficiency Polymer Solar Cells	Franky So/ John Reynolds	Mike Starks, CEO, Sestar Technologies, LLC.

The progress reports of these two projects are given at the end of this section.

The Florida Cleantech Acceleration Network (FL CAN- http://www.flcleantech.com/)

FESC is one of the partners of the FL CAN grant funded by the Economic Development Administration ($1M US EDA funding; total project cost: $1.7M). FL CAN links Florida-based universities, incubation networks, investors and industry resources together to create a network of Proof of Concept centers to accelerate the creation and commercialization of innovative clean technology research into new technology companies or to license into existing firms.

FESC is uniquely positioned to identify clean technology research with high commercial potential and to facilitate relationships between Florida universities, entrepreneurs and licensees. FESC administration office cataloged all energy and clean technology-related intellectual property developed at Florida universities and NASA Kennedy Space center. The list is given in Appendix C. FESC works with the Technology Transfer directors at each Florida University, FL CAN Market Research team and the mentor networks to assist with technology commercialization.

To facilitate the accessibility of a network of university laboratories that are dedicated to energy and clean technology development, FESC administration office developed a catalog of user and lab facilities within the Florida University System, FIT, and NASA Kennedy Space Center. The list is given in Appendix D. Entrepreneurs, students, scientists and established companies interested in developing commercial products based on Florida-based research have access to these user facilities.

The FL CAN services available for entrepreneurs & CleanTech Companies are:

- CleanTech IP Catalog – A focal point for accessing a catalog of all energy and cleantech research conducted at Florida universities and NASA KSC.
- Lab Network – statewide network of laboratory facilities that are available to mature promising research into commercial prototypes
- Mentor Network – statewide network of business mentors, industry experts, and investors to assist in business strategy, financing, and management for new technology ventures
- Market Research – A dedicated market research team that can assist with market evaluation and business plan development
- Entrepreneurship Development – Educational programs that focus on new venture creation, financing, growth, and offer support for developing SBIR proposals that utilize university clean technology research
- Gap Fund – Gap Fund that can be used for pre-seed funding of commercial prototype development, business planning, market research, and industry expertise
- FL-CAN Showcase – Annual showcase to highlight innovative, high-growth clean technology companies in Florida and to broker introductions to investors and industry partners

Industrial Collaboration Project Examples

In addition to the above mentioned EDA funded effort, the Consortium continues to work closely with technology transfer and economic development offices in Florida to attract industry to our state. 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 aligned 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.

- *Introducing Florida University Energy Programs to FL industry*
  FESC programs have been introduced to numerous companies for potential partnership, collaborative proposal efforts, and technology transfer. These include Gaiergy, Hydrovolt, Aquion Applied Research Associates (ARA), Extreme Power, Excellatron, Culturing Solutions, Renewable Energy Strategies, Trane, Mesdi Systems Inc., Appollo Energy Systems, Mainstream Eng., Alim Innovations, SebaiCMET, Inc., Thor Energy, INEOS, JDC Inc., Hydro Energy Solution, Xerolet,

Genomeprairie (Canadian company), Biofuels Digest, Composite Innovation Center Manitoba Inc., MTN Consulting Associates, Himark BioGas Inc., Rush Eneterprises, Particle Solutions LLC, GRU, BioTork, SunEdison, Florida City Gas, RE-Gen, Green Crop Network at McGill, G4 Synergetics, Bren-Tronics, and Centurion Biofuels. FESC faculty members were introduced to some of the industry members.

- *Energy Innovation Hub "Battery and Electrochemical Storage Technology Hub"*
  Funding: $120M for 5 years
  FESC Universities: UCF/FSEC (Lead), FSU, and UF.
  Other Partners: California Institute of Technology, Case Western Reserve University, Illinois Institute of Technology, Northeastern University, Notre Dame University, Missouri University of Science and Technology, University of California, Santa Barbara, University of Kansas, University of South Carolina, University of Southern California, Vanderbilt University, Washington University, St. Louis and NREL and SEMATECH

  The proposal was submitted. The proposal team was invited to Washington DC for reverse site visit. We are waiting to hear the US DOE's award announcement.

- *Collaborations in Ocean Renewable Energy Programs*
  The Southeast National Marine Renewable Energy Center (SNMREC) at FAU is working with over forty individual companies as well as industry organizations on a research agenda that is compatible with strategic industry, government, and academic requirements. Balancing the portfolio to meet the diverse priorities is a challenge. To that end, open and inclusive venues are key to engaging the broad stakeholder base. The Center supports participation on two International Electrotechnical Commission (IEC) U.S. Technical Advisory Groups (TAG) in developing global standards and conformity assessment practices for marine renewable energy. The two areas of focus are Technical Committee's for wave, tidal and ocean current design, performance and operation (TC114) and mechanical vibrations, shock and condition monitoring (TC108).

- *Florida PV Manufacturing Consortium (PVMC)*
  Florida is well positioned to attract a PV manufacturing firm because of its winning the DOE funded PV Manufacturing Consortium (PVMC) program. The U.S. Photovoltaic Manufacturing Consortium is an industry-led consortium for cooperative R&D among industry, university, and government partners to accelerate the development, commercialization, and manufacturing of solar photovoltaic (PV) systems in the U.S. The PVMC's main mission is to accelerate the transition of new technologies into mainstream manufacturing. Consortium activities include collaborative research projects, standards development, technology road mapping, and fostering increased connectivity amongst U.S. manufacturers. The PVMC was created in 2011 as part of the U.S. Department of Energy's (DOE) SunShot Initiative and is headquartered in New York.

  The two conversion technologies presently addressed by the PVMC are Copper Indium Gallium diSelenide (CIGS) and crystalline silicon (c-Si). The c-Si area of the PVMC is located in Florida and is managed by the Florida Solar Energy Center (FSEC). c-Si dominates the world market at 87% of the total. The Florida based c-Si PVMC program areas include: (1) Feedstock/wafering and (2) Metrology. The c-Si PVMC is currently in the process of formalizing industrial membership and preparing to launch its first collaborative projects within these two program areas.

  PVMC employs an industry membership model that consists of several levels of participation, from full membership in all activities, to program area participation, to participation in selected custom activities. Members will have shared access to world-class facilities, tools, and talent located at PVMC's advanced manufacturing development facilities and analytical laboratories. Depending on their level of engagement, members have the opportunity to participate in the consortium's

technical and business decision making through various levels of advisory groups, drive the direction of program activities and set key milestones, and place their employees on assignment inside PVMC programs.

PVMC's goal is to increase the performance and speed the implementation of PV technologies while improving manufacturing processes and driving down costs. PVMC is working towards this goal by:

- Coordinating the technical agenda of the U.S. PV manufacturing industry by developing and disseminating technology roadmaps and standards.
- Establishing and supporting manufacturing development facilities to incrase U.S. PV manufacturing market share, jobs, and technology innovation
- Increasing PV manufacturing productivity
- Linking research labs, universities, and industry to establish an effective PV commercialization support structure
- Developing a highly trained PV workforce

Each of these strategic goals is supported by aggressive technical objectives, with detailed deliverables, metrics and milestones. For additional information, see uspvmc.org.

This represents only a small set of examples of the industrial collaborations that FESC has initiated. Please see "Collaborations with Private Industry for FESC Faculty" section in this report for a detailed list.

Inovation HUB at UF

The Florida Innovation Hub at UF was created to serve as catalyst for startup companies whose technologies emanated from laboratories at the University of Florida and throughout the state. Located halfway between the University of Florida campus and downtown Gainesville, the Innovation Hub created 85 jobs and secured $7.2 million in private investment after less than a year in operation. Four companies have already graduated.

Built with an $8.2 million grant from the U.S. Economic Development Administration and a $5 million contribution from UF, the 48,000-square-foot Innovation Hub is a unique innovation ecosystem that houses not only the UF Office of Technology Licensing and two dozen startup companies, but also service providers, including accountants, attorneys, venture capitalists and product designers that sponsor events, host educational workshops and donate at least eight hours of their time each month to the startup tenants.

The Innovation Hub is one of the only incubators in the nation to house a leading university technology transfer office in addition to those service providers. The Innovation Hub also houses the UF Development Corp., which is responsible for developing Innovation Square, and other partner organizations that nurture high-tech companies such as UF Tech Connect and the Florida Institute for the Commercialization of Public Research.

Uni-Directional Impulse Turbine for the Powering of Offshore Monitoring Systems

PI: Dr. Zhihua Qu, UCF and Co-PI's: Dr. Kuo-chi Lin, Electrical Engineering and Computer Science, UCF
Industry Partner: Harris Corporation

The final report was provided in FESC Nov 2011 report. Please see the link *http://www.floridaenergy.ufl.edu/?page_id=24*

SWNT Based Air Cathodes for Fuel Cells & Metal Air Batteries

PI: Dr. Andrew G. Rinzler, Department of Physics, UF
Industry Partner: nRadiance LLC

The final report was provided in FESC Nov 2011 report. Please see the link *http://www.floridaenergy.ufl.edu/?page_id=24*

Development of a Low Cost Concentrating Solar Energy System Using Solar Sausages

PI: Dr. David Van Winkle, and Sean Barton, Department of Physics, Florida State Univers*ity*
Industry Partner: Hunter and Harp Holdings (HHH)

Beginning in late 2010, weekly meetings have been held at HHH offices in Tallahassee that include representatives of the several entities involved in deploying the "Solar Sausage" concentrating system at the Yulee St. site in Tallahassee. The entities include Pro Solar Inc., Barkley Consulting Engineers Inc., Winton Engineering PA, and Applied Research and Design Inc. A series of 50-foot long prototype sausages were made and inflated on site. Many issues were identified that needed to be resolved before manufacturing and deploying several hundred solar sausages on site including methods of constructing, mounting, and operating the balloons, distribution of air and electricity, and removal of heat.

Specific accomplishments:

- We have identified the correct adhesives for bonding the PET polyester films to each other and the correct bond geometry for minimizing the pealing stresses on the adhesive.
- We have designed and partially built the actuation system for rotating the balloons to track the sun.
- We have streamlined the process of producing the balloons such that a team of 16 workers can produce about 1 balloon per hour. Currently 150 of 336 balloons have been produced. While our current manual process produces balloons of 50-foot length, HHH is investing in machinery that will produce balloons of continuous length, to be cut to the length desired. This will reduce the number of "balloon ends" in the final application. Balloon ends are undesirable from the standpoint of electrical distribution, air distribution, solar-tracking actuation, and optical end effects.
- We have designed and are generating the software required to control absolute pressure in the balloons, to control differential pressure between the compartments of the balloon to maintain the optic, and to make astronomical predictions and control the rotation of the balloons. (Specifically, an FSU led portion of the project – resulting in an in-kind cash match from HHH to FSU to purchase instrumentation from National Instruments for this part.)

- We have developed procedures for mitigation of damage during high-wind and catastrophic-wind events which include increasing the pressure in the balloons, securing the photovoltaic modules with a tensioned retainer cable, and (if time allows) removing the photovoltaic modules.
- We have identified the need for photovoltaic material with greater concentration ratios.
- We have identified a variety of alternative methods by which the balloons could be rotated to track the sun.
- We have identified several of these scenarios that eliminate the need for counterweights.
- In the future, with higher concentration PV material and longer balloons, costs may be scientifically reduced using the centralized-elevated-receiver concept.

As can be seen in the accompanying photographs, the project is well along in terms of deployment of the technology on the Yulee St. site.

The project has involved full and part-time employment of approximately 100 individuals over the last 8 months doing construction, site development, and manufacturing.

View of the Yulee St. site from the north east corner

First full-sized inflatable mirror

Plant Street facility for production of the balloons

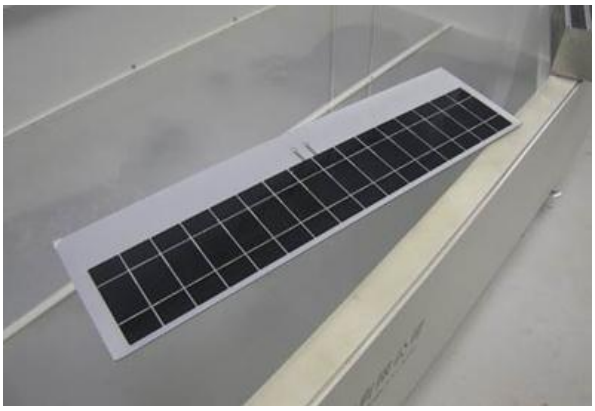
Glue machine applying glue to reflective membrane

Reheating the glue to bond the membranes together

The Solar Sausage Forming and Glue Machine

Load-adhesion testing of a 50-foot balloon

A 50-foot balloon



Encapsulated photovoltaic cells

Street View of the Yulee St. Site from the East

High Efficiency Black Polymer Solar Cells

PI: Dr. Franky So
External Collaborators: John Reynolds, Georgia Tech
Industry Partner: Sestar Technologies, LLC
Students: Cephas Small and Song Chen

Description: The objective of the proposed project is to synthesize broadly absorbing, black colored (PBLACK) polymers with especially high charge mobilities and to fabricate the highest performance polymer solar cells possible. Specifically, we will synthesize polymers with absorption band ranging from 400 nm to beyond 1 μm with carrier mobilities higher than 10^{-4} cm^2/Vs. Polymer-fullerene (both $PC_{60}BM$ and $PC_{70}BM$ along with more recently developed derivatives) blend morphology will be optimized using different solvent/heat treatments as well as additives to the blends. The final device will be enhanced using anode and cathode interlayers to enhance carrier extraction to the electrodes. With the ability to synthesize broadly absorbing polymers, control the donor-acceptor phase morphology and engineer the device structure, it is expected that the power conversion efficiency of polymer solar cells can reach 10% at the end of the two-year program.

Summary of Progress

Extensive efforts have been directed at developing polymer bulk heterojunction (BHJ) solar cells because of their potential for low-cost energy harvesting. The device geometry of typical laboratory-scale polymer solar cells comprises a bottom indium tin oxide (ITO) anode, an anode interfacial layer, a photoactive layer and a low-work-function top metal cathode. Because vacuum deposition of low-work-function metals is required for these top cathode devices, it is not viable to use this device architecture in large-scale roll-to-roll (R2R) processing.

To avoid the low-work-function metals used in such devices, two strategies have been adopted. In the first, the low-work-function metal is replaced with a transition-metal oxide such as TiO_x or ZnO. In the second, the polarity of the BHJ devices is inverted. Specifically, these so-called 'inverted cells' have an oxide electron-transporting layer (ETL)-coated ITO as the bottom cathode and a screen-printed silver layer as the top anode; to date, this device architecture is prototypical for R2R processing. To fabricate the ETL, solution-processed metal oxides have been widely used in large-scale inverted solar cells to reduce the ITO work function. In particular, ZnO colloidal nanoparticles are used for the ETL because of their low work function, high electron mobility and optical transparency, as well as their ease of synthesis. However, the major challenges in using ZnO nanoparticle films as ETLs are the presence of defects with adsorbed oxygen and the poor spatial distribution of the nanoparticles over a large area. Accordingly, there is a need to develop low-defect and uniform ZnO films so as to realize high-efficiency inverted polymer solar cells.

Here, we report a new method for enhancing charge collection in inverted polymer BHJ solar cells using a ZnO–poly(vinyl pyrrolidone) (PVP) composite sol–gel film as the ETL, and demonstrate inverted polymer solar cells that operate with laboratory-measured PCEs in excess of 8% and certified efficiencies of 7.4% under AM 1.5G illumination at 100 mW cm^{-2}. The composite film, termed 'ZnO–PVP nanocomposite' for clarity, consists of ZnO nanoclusters whose growth is mediated by a PVP polymeric matrix. ZnO–PVP nanocomposite films have been studied previously in relation to chemical/biosensing applications and have the following advantages over conventional ZnO sol–gel films. First, the ZnO nanocluster size and its concentration can be tuned by controlling the Zn^{2+}/PVP ratio. Second, the distribution of ZnO nanoclusters in the PVP polymer is uniform compared to the aggregation observed in ZnO sol–gel films without PVP. We hypothesized that inverted solar cells using this composite would demonstrate enhanced device performance. Furthermore, because the sol–gel processing for the ZnO–PVP nanocomposite is performed in air, this approach to depositing the ZnO ETLs is compatible with large-scale R2R processes.

We recently reported the synthesis and BHJ solar cell performance of a dithienogermole (DTG) containing an alternating conjugated donor–acceptor polymer, in which N-octylthienopyrrolodione (TPD) was used as

the acceptor. Inverted polydithienogermole-thienopyrrolodione (PDTG-TPD):[6,6]-phenyl-C71-butyric acid methyl ester ($PC_{71}BM$) solar cells demonstrated a higher short-circuit current density (J_{sc}) and fill factor (FF) than devices with an analogous polydithienosilole-containing polymer (PDTS–TPD), leading to inverted polymer solar cells with PCEs of 7.3%. To determine whether our ZnO–PVP nanocomposite films would enhance charge collection for inverted solar cells, we fabricated inverted PDTG–TPD:$PC_{71}BM$ BHJ solar cells using the nanocomposite as an ETL.

Progress Report

The photo J–V characteristics for inverted PDTG–TPD:$PC_{71}BM$ solar cells were measured under AM 1.5G solar illumination at 100 mW cm^{-2}. The photovoltaic (PV) performance results for the inverted cells with ZnO–PVP nanocomposites are shown in Figure 1. On initial light exposure the inverted solar cells had a low FF of 25.5% and J_{sc} of 10.9 mA cm^{-2}. With continuous illumination, device performance was enhanced significantly over time. After 10 min of light soaking, an enhanced FF of 63.7% and J_{sc} of 12.9 mA cm^{-2} were obtained, resulting in an average PCE of 7.0%. Previously, we reported inverted PDTG–TPD-based polymer solar cells with a FF of 68% using colloidal ZnO nanoparticlesas the ETL. We suspected that by using ZnO-PVP composite as the ETL, the ZnO-PVP surface would be compositionally rich in PVP, creating a contact barrier between the ZnO nanoclusters and $PC_{71}BM$ leading to the lower FF of our present devices.

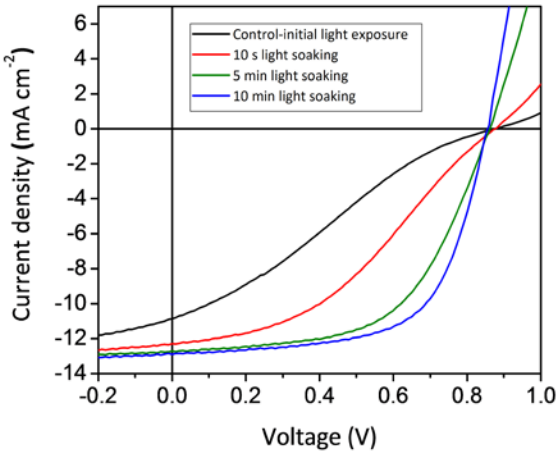


Figure 1. Effect of light soaking on device performance for inverted solar cells with as-prepared ZnO-PVP nanocomposite ETL.

To ensure a good contact between the ZnO nanoclusters and $PC_{71}BM$, we performed UV-ozone treatment on the ZnO–PVP nanocomposite films to remove PVP from the surface. Previous work has shown that UV-ozone treatment can remove PVP on colloidal nanoparticle film surfaces34. The removal of PVP did not alter the size, shape or distribution of the nanoclusters in the films. Based on these findings, we believed that the UV-ozone treatment would improve electronic coupling between the photo-active layer and the ZnO nanoclusters. The photo J–V characteristics for the inverted PDTG–TPD:$PC_{71}BM$ solar cells with UV-ozone treated ZnO–PVP nanocomposites are shown in Fig. 2a. All devices were tested under initial light exposure, and no additional light soaking was applied to the devices. The ZnO–PVP nanocomposite films were UV-ozone treated for 5, 10, 20 and 30 min, leading to significant enhancements in the J_{sc} and FF values for the inverted PDTG–TPD:$PC_{71}BM$ solar cells compared to cells with as-prepared nanocomposite films. Table 1 summarizes the device performance for inverted solar cells with treated ZnO–PVP nanocomposite films. UV-ozone treating the ZnO–PVP nanocomposite films for 10 min led to an optimal device with enhancements in both J_{sc} and FF compared to the light-soaked devices without UV-ozone treatment, and resulting in an average PCE of 8.1%. This average PCE of 8.1+0.4% is based on measurements from 102 fabricated solar cells. Our best device had a J_{sc} of 14.4 mA cm^{-2}, V_{oc} of 0.86 V, FF

of 68.8% and PCE of 8.5%. For devices with ZnO–PVP nanocomposite films that had been UV-ozone treated for less than or more than 10 min, a reduction in FF was observed. For the shorter treatment, we attribute this reduction in FF to incomplete removal of the PVP from the surface of the composite film. For the longer treatment, excess oxygen is present on the ZnO film surface, which reduces the electron extraction efficiency. Based on these findings, we conclude that removal of extra PVP from the ZnO–PVP nanocomposite film surface by UV-ozone treatment greatly enhances the charge collection efficiency of these devices.

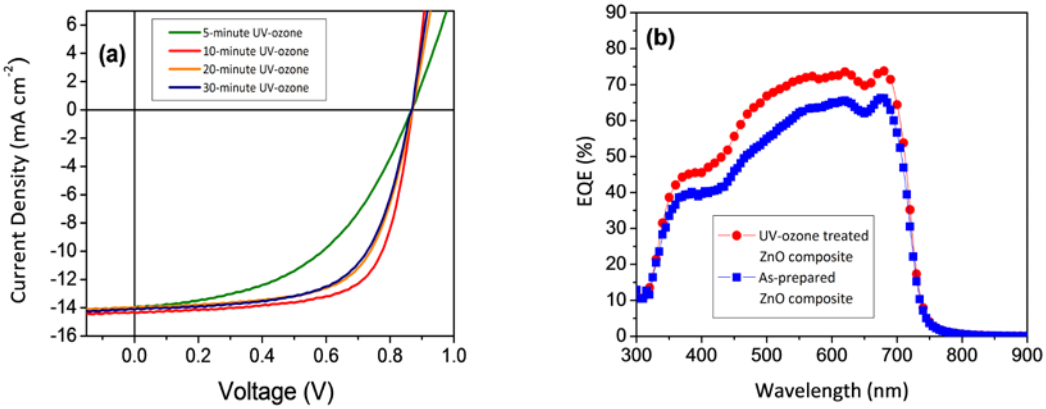


Figure 2. (a) Photo J-V curves of inverted PDTG-TPD:$PC_{71}BM$ solar cells with UV-ozone treated ZnO-PVP nanocomposite films as ETLs for various treatment times (5, 10, 20, 30 min) under initial AM 1.5G solar illumination at 100 mW cm^{-2}. (b) Corresponding EQE for the devices with as-prepared and 10 min UV-ozone treated ZnO-PVP nanocomposite films.

To confirm the accuracy of the photo J–V measurements, the external quantum efficiency (EQE) spectra for the solar cells with as-prepared and 10 min UV-ozone treated ZnO–PVP nanocomposite films were measured; these are compared in Fig. 2b. An enhanced efficiency is observed throughout the full spectral range from 350–700 nm for cells with UV-ozone treated ZnO–PVP nanocomposite films when compared to cells without UV-ozone treatment. The maximum EQE for the optimized inverted PDTG–TPD:$PC_{71}BM$ solar cell with UV-ozone treated nanocomposite films was 73.6%. The J_{sc} value was then calculated by integrating the EQE data with the AM 1.5G spectrum. The calculated J_{sc} value of 14.5 mA cm^{-2} is in good agreement with the directly measured J_{sc} value.

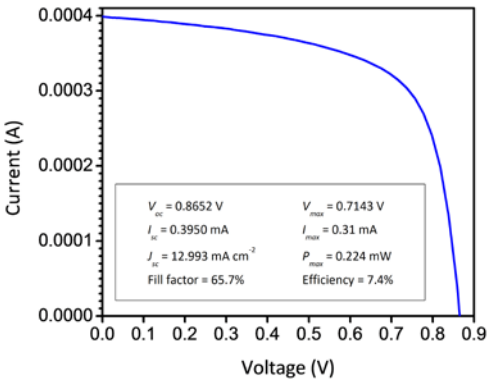


Figure 3. Certified I-V characteristics for an inverted PDTG-TPD:$PC_{71}BM$ solar cell with 10 min UV-ozone treated ZnO-PVP nanocomposite ETL.

Encapsulated devices with UV-ozone treated ZnO–PVP nanocomposite films were then sent to NEWPORT Corporation for certification. The photo J–V characteristics and the corresponding solar cell parameters are shown in Figure 3. A PCE of 7.4+0.2% was certified for the devices. Although this certified efficiency is 9% less than that measured in our laboratory because of a reduction in J_{sc} and FF in the certified device, we attribute the reduction in PCE in the certified cells to degradation because of a non-optimized encapsulation process. The devices were retested in our laboratory after certification and we obtained an efficiency (7.2%) comparable to the certified results.

The enhanced device performance with UV-ozone treated ZnO–PVP nanocomposite films is believed to be attributable to the modified surface composition promoting charge collection. The nanoscale surface morphologies of the as-prepared and UV-ozone treated ZnO–PVP nanocomposite films were investigated by atomic force microscopy (AFM). Figure 4a,b shows the threedimensional surface topography images for the nanocomposite film before and after UV-ozone treatment. The ZnO–PVP nanocomposite film shows an increase in r.m.s. roughness from 7.07 nm to 9.18 nm following UV-ozone treatment, suggesting that PVP is removed with this treatment, leaving the ZnO nanoclusters exposed at the surface. This removal of the PVP is more clearly shown in the AFM phase images in Figure 4c,d. For the nanocomposite film without UV-ozone treatment, no nanoclusters can be observed, indicating that the surface is covered by a thin layer of PVP. However, the phase image for the UV-ozone treated ZnO–PVP nanocomposite film shows that the PVP domain size has been reduced to 50–100 nm and that the ZnO nanoclusters are now exposed on the surface. The PVP-rich and ZnO nanocluster rich surfaces of the nanocomposite films before and after UVozone treatment, respectively, are shown schematically in Figure 4e,f. This change in surface morphology from being PVP-rich before UV-ozone treatment to ZnO-rich after treatment supports our idea that the removal of PVP from the nanocomposite film by UV-ozone treatment leads to improved charge collection in our inverted polymer solar cells due to better electronic coupling between the ZnO nanoclusters within the nanocomposite film and $PC_{71}BM$ in the active layer.

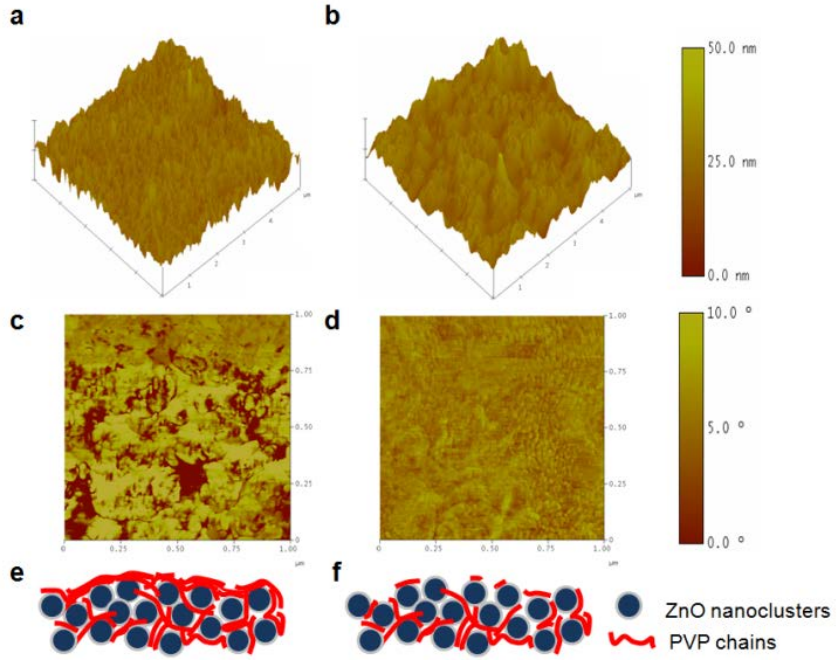


Figure 4. AFM images of a ZnO-polymer composite film before and after surface modification. (a), (c), and (e) shows the 3-D topography, phase image, and the schematic image for the composite film before surface treatment. (b), (d), and (f) shows the 3-D topography, phase image and schematic image for the same film after treatment.

To further confirm that the compositional changes determined from the AFM data were due to the removal of PVP, X-ray photoemission spectroscopy (XPS) was performed on the ZnO–PVP nanocomposite films. Considering the period of UV-ozone treatment required to optimize device performance, it is believed that

some changes in the chemical composition of the ZnO might be plausible. The core-level XPS spectra for C 1s, O 1s and Zn 2p were measured for the as-prepared and 10 min UV-ozone treated ZnO–PVP nanocomposite films. The binding energies were calibrated by taking the C 1s peak (284.6 eV) as a reference. The O 1s XPS spectra for as-prepared and UV-ozone treated ZnO–PVP nanocomposite films are shown in Figure 5a. UV-ozone treatment increased the relative magnitude of the peak at 531.4 eV (corresponding to the oxygen atoms bonded to the zinc in the ZnO matrix) by 37%. Thus the number of Zn–O bonds in the wurtzite structure of ZnO at the surface of the film is increased. UV-ozone treatment also increased the relative magnitude of the peak at 530.0 eV, which corresponds to O^{2-} ions present in the porous ZnO clusters, but not chemically bonded to zinc in the ZnO wurtzite structure. Figure 5b shows the Zn 2*p*3/2 XPS spectra for the as-prepared and UV-ozone treated ZnO–PVP nanocomposite films. The intensity of the peak at 1,021.6 eV, which corresponds to the Zn–O bonds, increases after UV-ozone treatment. These results are in agreement with the result for the O 1s XPS spectra. Based on the O 1s and Zn 2p XPS spectra, we conclude that the chemical composition of the ZnO nanoclusters on the surface of the nanocomposite film has become oxygen-rich after UV-ozone treatment.

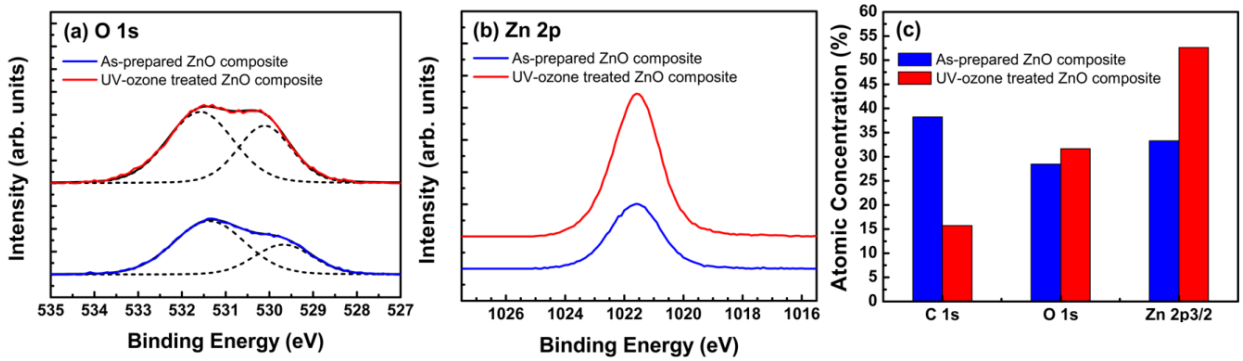


Figure 5. XPS data for the as-prepared and 10 min UV-ozone treated ZnO-polymer composite films. (a) O 1s and (b) Zn 2p XPS spectra for the composite films. (c) Atomic concentrations of carbon, zinc, and oxygen before and after UV-ozone treatment based on the corresponding XPS spectra.

The atomic concentrations of carbon, oxygen and zinc in the as-prepared and 10 min UV-ozone treated ZnO–PVP nanocomposite films based on the C 1s, O 1s and Zn 2p XPS spectra are summarized in Figure 5c. The atomic concentration of carbon from the PVP in the nanocomposite is significantly reduced by UV-ozone treatment (from 38.2% to 15.7%). Conversely, the atomic concentrations of oxygen and zinc present in the nanocomposite film both increase from 28.5% and 33.3% for the untreated film to 31.6% and 52.6%, respectively, for the treated film. The relatively smaller increase in oxygen atomic concentration compared to zinc is due to the competition between the increases in oxygen content arising from UV-ozone treatment and the decrease in oxygen content coming from the removal of PVP. These results strongly support our assertion that UV-ozone treatment removes PVP from the surface of the ZnO–PVP nanocomposite film.

To conclude, improved charge collection efficiency has been demonstrated in inverted PDTG–TPD BHJ solar cells using a UV-ozone treated ZnO–PVP nanocomposite film as the ETL to obtain organic polymer solar cells with PCEs in excess of 8% under AM 1.5G illumination at 100 mW cm^{-2}. The use of PVP as an organic capping molecule and polymeric matrix for ZnO produced electron-transporting nanocomposite films, which had excellent film-forming characteristics. We found that UV-ozone treatment was required to remove PVP from the surface of the film, and consequently exposed the ZnO nanoclusters to the film charge collection by the nanocomposite film.

Stress Evolution in Solid-State Li-ion Battery Materials

PI: Dr. Kevin Jones, UF
Industry Partner: Planar Energy Devices Corp. (operation part was shut down)
Students: Nicholas Vito (PhD)

Summary of Annual Progress

ZnS powders were synthesized using the solvothermal approach. The powders were characterized using secondary electron microscopy (SEM), transmission electron microscopy (TEM), x-ray powder diffraction (XRD), and energy dispersive x-ray spectroscopy (EDX). The Zn_xCu_yS powders are manufactured as cathodes in coin cells to test their viability in Li-ion batteries. The initial comparison is between cathodes prepared at Planar Energy using the streaming protocol for electroless electrochemical deposition (SPEED) with and without solid state electrolyte and tape-cast cathodes using polyvinylidene (PVDF) and carboxymethyl cellulose sodium salt (Na-CMC) as a binder. Results show a beneficial effect of the solid state electrolyte on the SPEED cathodes and improved cyclability of the Na-CMC cathodes over PVDF.

Annual Progress Report

ZnS powders have been fabricated by solvothermal synthesis in a Teflon lined pressure vessel. Precursors to the synthesis include zinc nitrate, copper nitrate, thiourea, ammonium hydroxide, ethanol, and water. The solution is heated in the pressure vessel for 3 hours at 160 °C. After being collected through the use of a centrifuge, the resulting powder is then rinsed and dried in air at 110 °C. The ZnS powder contains particles that range from 10 nm to a few micrometers in size, although morphologies differ as seen by SEM in figure 1. Powder XRD and selected area electron diffraction (SAD) were utilized to identify the structure of the sulfide particles. The Williamson-Hall method of determining particle size from peak broadening suggests that particle size is on the order of 20 nm. The fine particle and grain sizes were confirmed by TEM shown in figure 2.

The ZnS powders were then used to form a cathode for a lithium ion battery. The theoretical capacitance of ZnS is 550 mAhr/g based on the complete conversion of ZnS into Li_2S. The sulfide batteries were discharged to 0.5 V and charged to 2.5 V. The cathode was prepared by adding together 75 wt% ZnS, 15 wt% carbon, and 10 wt% polyvinylidene fluoride (PVDF). The product was then ball-milled for 2 hours. After ball-milling, the product was added to 1-methyl-2-pyrrolidone, which acts as a solvent to form a slurry. The slurry was tape-cast onto a Cu substrate. The tape-cast slurry was then dried in air at 110 °C overnight. The cathode and Cu current collector were placed into a pouch cell opposite of Li metal with a Celgard polypropylene separator between. The electrolyte used is a solution of 1 M $LiPF_6$ in 1:1 ethylene carbonate (EC):dimethyl carbonate (DMC) solvents. An alternate water-based slurry was made by replacing the PVDF with a 300,000 kDa carboxymethyl cellulose sodium salt (Na-CMC) binder at the same weight ratio.

Slurries were also created at Planar Energy using the same solvothermal powders. The Planar slurry was spray deposited onto a stainless steel substrate and annealed in a sulfur ambient atmosphere of 325 °C for 5 min. Afterwards, sections were cut out and made into pouch cells. Planar Energy also provided solid state electrolyte coatings of $LiAlGaSPO_4$.

ZnS cathodes made with PVDF and Na-CMC were compared. A ZnS-PVDF type cathode was tested at a current of C/20 with an initial discharge capacity of 335 mAhr/g discharged to 0.5 V. The cyclability of the cathode is very poor in the liquid electrolyte as seen in figure 3. A similarly tested A similarly tested ZnS cathode with a Na-CMC binder had an initial discharge capacity of 320 mAhr/g when discharged to 0.5 V. Unlike the case with the PVDF, the Na-CMC binder cathode retained some cyclability as seen in figure 4. Ongoing research is being done to determine the role of the Na-CMC and improve the binding of ZnS cathodes to a substrate.

To determine the effectiveness of a solid state electrolyte in a hybrid cell configuration, ZnS cathodes prepared through the SPEED technique were tested. The ZnS-SPEED cathodes were tested at a discharge rate of C/10 and showed an initial discharge capacity of 360 mAhr/g at 0.5 V. The ZnS-SPEED cathodes had varying performance between each sample, but on average, the discharge capacity would reach 200 mAhr/g by the 3rd cycle and 100 mAhr/g by the 5th cycle. With the addition of a $LiAlGaSPO_4$ layer, the ZnS-SPEED cathodes displayed some consistency in performance between the samples. The capacity retention is also improved with the additional solid state electrolyte layer since the discharge capacity would not reach 200 mAhr/g until the 7th cycle and 100 mAhr/g at >25 cycles. A summary of the results is shown in figure 5.

The $LiAlGaSPO_4$ solid state electrolyte was also tested with the Na-CMC cathode, however, the cathode lost integrity in the annealing process. A similar benefit of the solid electrolyte has not been seen in non-ZnS-SPEED cathodes so far. The expected benefit of the solid state electrolyte is to reduce the Li_2S dissolution during cycling and improve the long term cyclability. However, changes in the electrochemical properties have also appeared between the ZnS-SPEED and ZnS-SPEED with the solid state electrolyte. These electrochemical reactions are still under investigation.

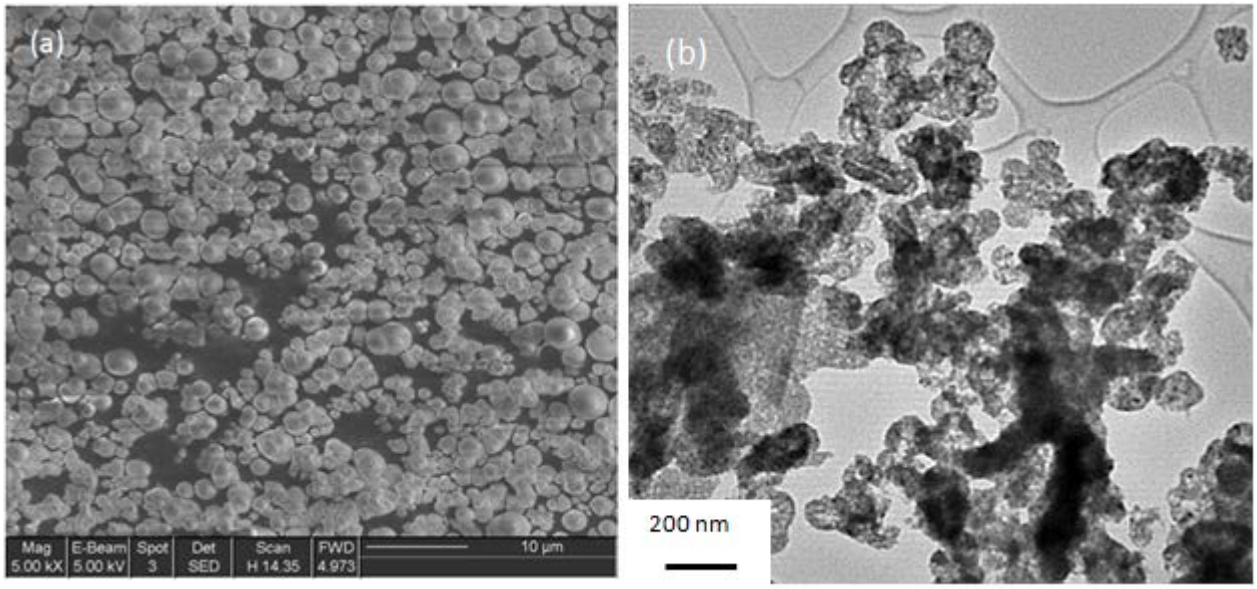


Figure 1. (a) Top-down SEM images of ZnS and (b) bright field TEM image of ZnS

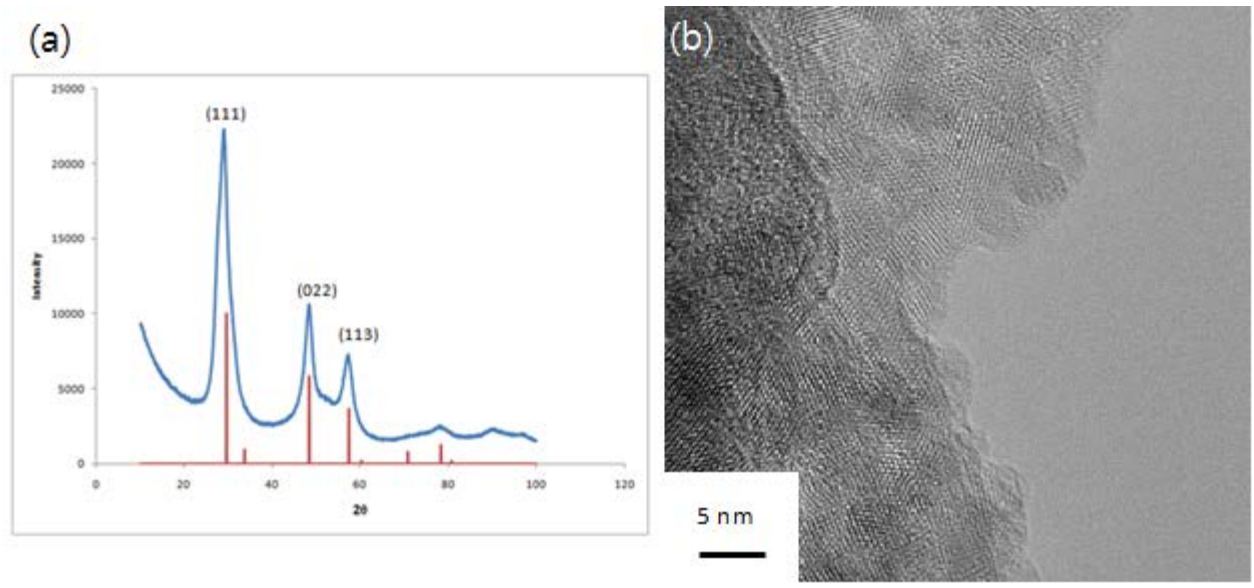


Figure 2. (a) XRD of synthesized ZnS and sphalerite reference pattern, (b) bright field TEM of synthesized ZnS show small crystal size

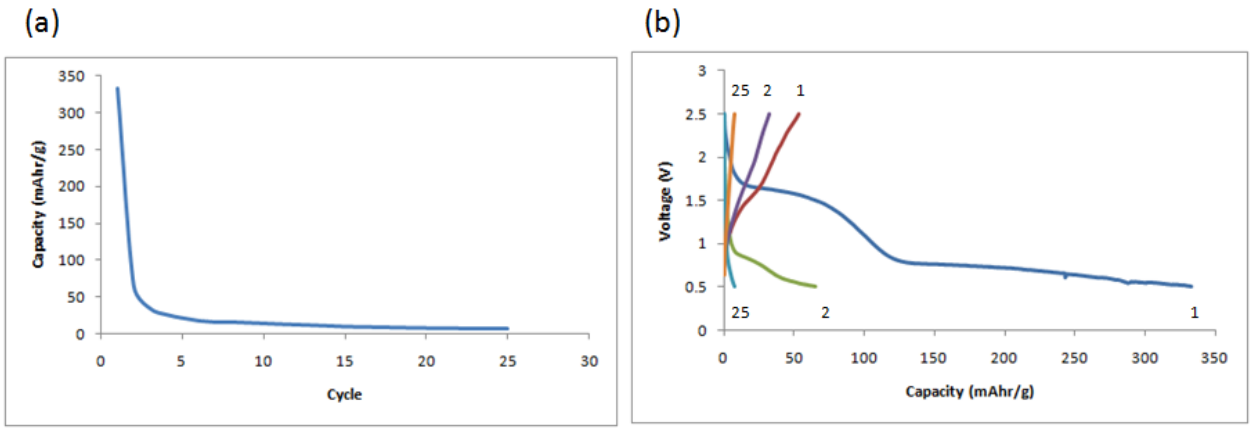


Figure 3. (a) Cycle life of ZnS-PVDF battery, (b) Charge/Discharge profile of ZnS-PVDF battery at C/20

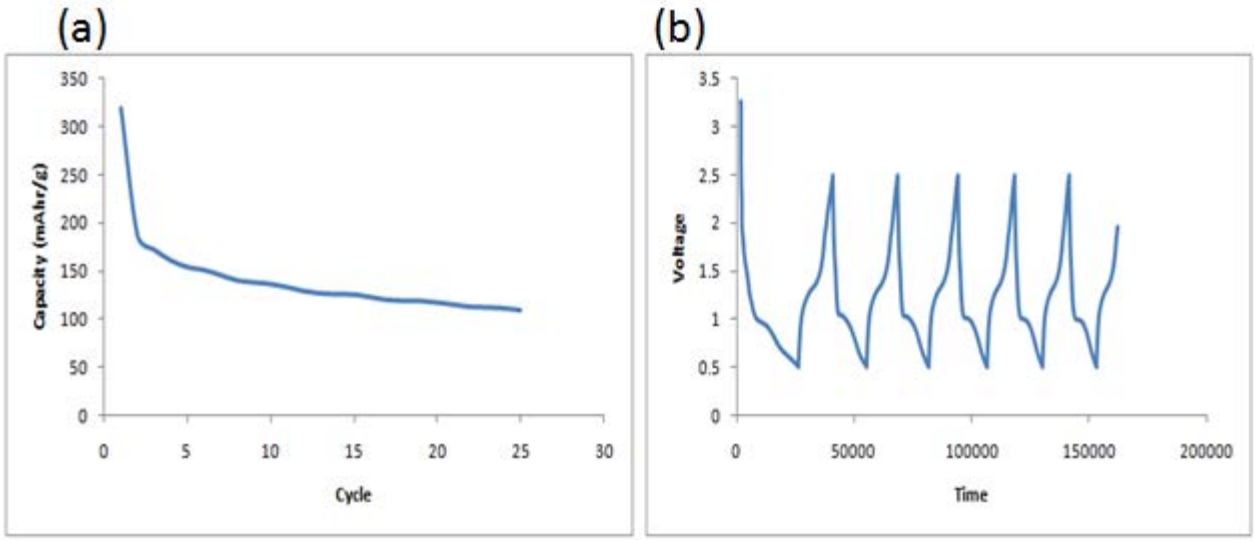


Figure 4. (a) Cycle life of Na-CMC ZnS battery, (b) Charge/Discharge profile of Na-CMC ZnS battery at C/10

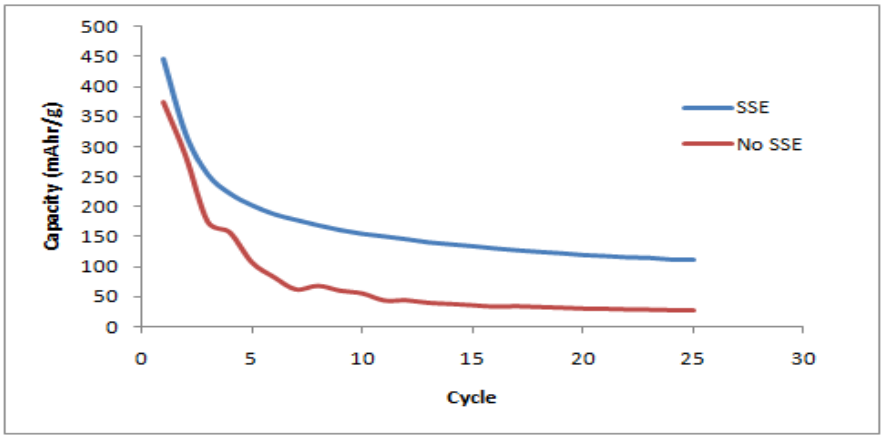


Figure 5. Comparison of ZnS-SPEED with solid state electrolyte and without solid state electrolyte. Results are an average of 4 samples each.

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.

Progress made is given below:

Graduate Education Support in Ocean Renewable Energy Programs

Research at the Southeast National Marine Renewable Energy Center is supported through various funding sources, most specifically State of Florida and US Department of Energy. Some research is also attributed to industry and other Federal agencies. Over four dozen MS and PhD graduate students as well as two Post-doctoral associates have been funded across multi-disciplinary research supportive of ocean renewable energy. The areas of multidisciplinary research cut across science, engineering, policy and education and engage students from FAU as well as UCF, FSU and Embry Riddle Aeronautical University. The SNMREC submitted and NSF Integrative Graduate Education and Research Traineeships proposal entitled "Marine Renewable Energy for STEM Synthesis".

University of Florida Nuclear Training Reactor (UFTR) Digital Control System Upgrade for Education and Training of Engineers and Operators, Dr. Kelly Jourdan *(Project was initiated by Dr. Aliriza Haghighat)*

The UFTR is implementing the first ever fully digital control and safety system at a nuclear reactor in the United States. This is the key piece in a full renovation of the facility, which has been in operation since 1959. This upgrade will replace the analog system with a digital control system from Siemens Energy. 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 upgrade ensures that the UFTR is on a footing to continue its research and education missions over the next decades.

As nuclear power plants age, analog safety technologies become harder to maintain. Adoption of digital technologies in the nuclear sector has significantly lagged that of other technological industries. Utilities have been slow to implement these systems due to regulatory licensing uncertainty and a lack of internal expertise with new systems. As the previous generation of the nuclear workforce retires, the pool of

available expertise in analog technology declines. The experience at Japan's Fukushima Power Station shows us the need to continually modernize and augment reactor safety and operational systems.

The University of Florida has undertaken an ambitious project to replace its 50-year old protection and control system with a new, modern digital system. This project was conceived in 2008 and initiated in late 2011. All progress on design and implementation has taken place in the latest reporting period.

Once modified, the facility will provide training and education for the future workforce in the area of digital control and instrumentation for nuclear reactors. This effort ushers in a new focus on digital control and instrumentation, and augments the existing Nuclear Engineering Program at UF. Further, the UFTR facility will offer training courses for other educational institutions in the State, as well as training for personnel from nuclear utilities and government agencies, including the Nuclear Regulatory Commission.

The UFTR is upgrading its current analog control and protection systems, last refurbished in 1970, to encompass two independent digital systems, a protection system and a control system, both implemented using the T-3000 hardware from Siemens. This will be a first of its kind fully digital safety-and-control system that will become an operational testing and training platform for these technologies, helping shepherd future commercial nuclear power plants. Adoption and licensing in a training facility paves the way for acceptance in larger power reactors. The wider adoption of this technology further requires a trained base of operators and experts who are familiar with this new technology. The UFTR will be the most advanced training platform in an operating reactor environment. University of Florida students will have an unparalleled exposure to these technologies and an opportunity to graduate ready to help industry pursue and implement the next generation of digital facilities.

This project will contribute to safe operation of existing and future nuclear reactors by providing the means for training and education in the nuclear workforce needed to help the industrial transition to digital technologies. Because of the renewed interest in building new nuclear plants, and plans for life extension of existing plants, the utility industry has become interested in the use of digital safety and control systems. As a result, the Nuclear Regulatory Commission (NRC) has placed renewed effort on establishing new and updated regulation.

Funds leveraged/new partnerships created: We have obtained $167,000 in new federal funding for equipment at the UFTR relating to the upgrade from the Department of Energy. We have also progressed in discussions with Siemens Energy to provide a donation of controls equipment.

Annual Progress Report:

System Design Details: Originally, UF was partnered with AREVA to supply both a reactor protection system and a reactor control system. The control system was to be supplied by subcontract by Siemens. After the dissolution of this agreement, UF approached Siemens about continuing with their portion of the partnership, and assumption of the AREVA deliverables. This was accepted in principle by Siemens management. Therefore the system design concept is based exclusively on Siemens equipment.

There are two important design decisions that are reflected in this concept, namely a choice of independent Control and Shutdown subsystems, and an implementation of an additional analog shutdown system using relay logic. These features reduce the engineering scope of the project by completely eliminating the legacy UFTR control system, and provide us with more control within the regulatory licensing process.

Combined vs. Separated Control and Shutdown systems: Implementing a combined system reduces hardware requirements, as only one application server is required. It is a simpler conceptual design, however, by combining the systems, all inputs, hardware, and software must be treated as a safety system. This implies that we must engineer the entire system to a System Integrity Level 3 (SIL 3, defined in IEEE

1012), imposing substantial engineering overhead on the implementation. Equally important is the preference expressed by the NRC in public meetings for a two, independent system solution. By making the systems independent, we may reduce the scope of software verification and validation (V&V) processes to the shutdown system alone.

Since we have chosen to implement separate shutdown and control systems, network isolation is needed to obtain full regulatory benefit. The entirety of the control system will functions as an analog input into safety system, which will provide complete digital isolation.

This system provides a regulatory hedge against adverse developments in the licensing process due to NRC discomfort with digital systems. It provides a simple, mechanical, fully analog shutdown capability to backstop the digital system. With this system, we retain the option to proceed with an install of the digital system via the 10CFR50.59 process. All safety trip functions would be covered by the analog relay system, rendering the digital system non-safety relevant. Retention of the 10CFR50.59 option is the mechanism for the UFTR to guarantee scheduling.

The reactor will not be recommissioned before install of digital control system. Once the legacy system is removed, we will have reached a point of no return – only with a successful digital upgrade will the reactor be restored. During the duration of the project, the reactor will not be available for operation.

Licensing strategy for the DCP: In November 2011, with the advice of the UFTR Advisory board, and due to feedback from the August 2011 NRC audit, it was decided to change licensing strategy away from power reactor space to research reactor space. This means that the UFTR will no longer pursue industrial-level certifications for the equipment. The equipment will be identical, however the level of QA testing and, for example, seismic qualification will be reduced. This is both a cost-saving measure and will streamline the licensing process with the NRC.

The NRC, up to now, has not had a formal process for licensing digital upgrades in research reactors. New draft regulation – an update to NUREG 1537 – is being written, which will formalize the process for approving these upgrades. The switch to a research reactor licensing strategy combined with better definition of requirements from the regulatory agency will enhance our ability to make these upgrades with confidence that they will be accepted by the NRC.

20-year NRC Relicensing of the UFTR: NRC relicensing, a prerequisite for evaluation of the Digital Controls license amendment, was expected in December 2011. The relicensing has not yet occurred, and is now expected for the mid 2013. Outstanding issues relate to a reworking of the technical specifications for the reactor, a change in the way security procedures are regulated, and analysis of effluent monitoring methodology.

In May 2012, the UFTR was awarded a $180k infrastructure grant for gaseous effluent monitoring equipment from DOE. This money will resolve the licensing issue.

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 is also developing and coordinating faculty professional development activities as required. FLATE develops new courses required for each new program of study. Finally FLATE helps state and community colleges implement the new frameworks in their institutions.

Specific Accomplishments for the current reporting period:

- Worked on Researching and defining energy career pathways. Created and published flowchart illustrating pathways.
- Researched an identified current energy related course articulations.
- Researched and identified all High Schools, Colleges and Universities offering energy-related courses/programs, building on the "Survey of Colleges Offering Energy Programs" administered in January 2011.
- Attended 2011 Beyond Sustainability 36th Annual Conference at Hillsborough Community College, Plant City in November.
- Participated in Sustainability Education & Economic Development (SEED) Webinar-Alternative Fuel Vehicles: New Technology, Refined Workforce Programs in November 2011.
- Attended Sustainability Education & Economic Development (SEED) Webinar-Community Colleges Leading Rural-Based Green Economy Initiatives (December 2011).
- Updated FESC Web Education pages.
- Updated the list of Energy Programs and Institutions offering them on the FESC web site.
- Continuous update of FESC pages housed on FLATE's site.
- In March 2012, designed and administered an online survey to gather data for development of the new Energy Efficiency Specialization for the ET Degree.
- Participated (remotely) in the FEWC State and National Outreach Meeting (March 2012)
- Attended Train-the-Trainer Energy Workshop at Florida State College, Jacksonville in May, to prepare for Summer Energy Camps.
- Hosted a second summer energy program for under-represented middle school students (July, 2012) and an Energy-related Professional Development Workshop for middle and high school teachers (June, 2012), in conjunction with the EST2 grant partners (BCC, TCC and FSCJ) and the University of South Florida.
- FLATE took a delegation of eight students, five faculty members and two administrators from Florida's community and state colleges on a 21 day international technician training program to Spain (June, 2012). The three week program provided students with an outstanding technical and cultural learning experience. For the second year, students enrolled in the engineering technology A.S. degree program and faculty members at Hillsborough Community College, Polk State College, State College of Florida, and Brevard Community College, participated in a structured technical education and training experience at IEFPS Usurbil GLBHI—a technical college in the Basque region of Spain.
- Presented a poster at the 2012 Energy Summit in Orlando.
- Was instrumental in the selection of Hillsborough Community College as a winner of the (Sustainability Education and Economic Development) Green Genome Award which

recognizes exemplary community colleges nationwide that have taken a strategic leadership role in sustainability and green economic and workforce development.

- Will be presenting at the Florida Association of Science Teachers Conference in October, 2012.
- Community College Energy workshop at the Florida Solar Energy Center (FSEC) in Cocoa planned for February/March 2013.

Energy Efficiency Specialization Curriculum Framework Development

Collaborating with the National Science Foundation-funded Energy Systems Technology Technicians (EST^2) project team to design a new specialization for the Engineering Technology (ET) Degree and associated College Credit Certificate. (The EST^2 project team comprises individuals from Brevard Community College, Florida State College at Jacksonville, Tallahassee Community College and Hillsborough Community College). Framework details are being refined.

A short survey was conducted in March to gather data to ensure the new framework is comprehensive and covers all areas necessary to produce the skilled workforce needed in this area. In addition, it provided an opportunity to identify individuals interested in collaborating to work on the new curriculum framework. More than a third of survey respondents indicated that they were currently working on curriculum including energy efficiency in industrial/commercial settings components. The vast majority of respondents were very interested in collaborating to craft the new curriculum framework. The EST^2 team plans to submit the framework to the Florida Department of Education in the fall of this year so colleges can implement it in the 2012-2013 academic year.

Summer Energy Workshop for Secondary Teachers

This workshop, held at the University of South Florida, from June 26-27, was designed to arm teachers with fun, yet challenging content and hands-on activities to help their students make real-life connections to the world of renewable energy technologies. Teachers were provided with current, in-depth content about wind energy, solar energy, fuel cells and nuclear energy, as well as participating in several exciting hands-on activities to take back to their classrooms. Unfortunately bad weather led to the cancellation of the first day of the workshop and only 13 attendees (out of 25 confirmed registrants) were present for the remaining two days. Feedback received was positive and we plan a similar workshop next summer.

Summer Energy Camp

2012 marked the second year of the middle school summer energy camp held July 9 -12 at Hillsborough Community College's SouthShore Campus. Participating students were rising 7th and 8th graders in the AVID (Advancement Via Individual Determination) ELCR (English Language College Readiness) program at Beth Shields Middle School in Ruskin, FL. Students learned about many aspects of renewable energy technologies. They were introduced to energy concepts including fossil fuels with their environmental impacts and the

science of electricity generation through several hands-on activities.

The camp was planned for 25 students and 25 students were confirmed by the Hillsborough County Public School System. However, due to daily bus issues student attendance fluctuated daily from 10 – 13 students. Next year's camp schedule will be modified to eliminate problems with bussing/transportation.

Overall the camp was a resounding success, with great media coverage – newspaper and TV (Bay News 9), coverage! The kids really enjoyed the hands-on activities and the pre-/post-test data showed the average camper learning increase to be 24%. All students agreed that attending the camp has helped them in making future career choices and showed that 75% are now considering a career in a STEM area.

FLATE Participation in the Florida Energy Summit

At the summit, FLATE highlighted curriculum development and educational outreach efforts in partnership with FESC during the last year. FLATE's poster presentation, "Energy Education for Florida's Future Technician Workforce", described the past work of the FLATE – FESC partnership as well as outlining the new Industrial Energy Efficiency specialization for the Associate of Science (ET) degree and associated College Credit Certificate, designed to match training directly to industry needs. FLATE materials were also displayed on the FESC table in the Energy Summit Exhibit Hall.

Florida Association of Science Teachers (FAST) Conference

FLATE and Tallahassee Community College will be presenting, "Energy Camps that are Energizing" at the FAST annual conference in October. The presentation will highlight Summer Energy Camps and Teacher Energy Workshops held at Hillsborough and Tallahassee Community Colleges over the summer. The resources provided to participants to host their own energy education events will be summarized.

FESC Community College Energy Workshop planned

Following the success of the 2011 Workshop held at Santa Fe College's Center for Innovation and Economic Development in Gainesville, a similar event is planned for later this year, or in early 2013, at the Florida Solar Energy Center in Cocoa.

Education/Outreach Activites at FSEC

The Florida Solar Energy Center (FSEC) provided more than 50 short courses, which trained 664 professionals, qualifying many of them for state and national certifications that allow specific energy services to consumers and government agencies. Over 20 students were trained as green home certifying agents, over 200 took Residential Energy Rater training, over 90 took ENERGY STAR 3.0 training, over 100 trained as PV installers, over 70 as PV technical sales personneland over 20 as solar water heating installers. FSEC provided a five-day training class to 110 students from a total of 29 weatherization agencies. The program includes a one-day follow-up at home sites audited by the newly trained personnel.

FSEC continued to work on a program funded by the US DOE money via the state code office and the Florida Energy Office to conduct a Florida Energy Code Compliance Train-the-Trainer Program. FSEC provides training for others to use to train interested contractors and building officials. FSEC completed two online training modules as an additional task under the contract.

FSEC facilitated 15 professional development opportunities in renewable energy for approximately 325 K-12 teachers, hosted study trips to FSEC for 964 students , organized the renewable energy educational event known as the EnergyWhiz Olympics, May 7, 2011, for approximately 1000 participants. Students participated in the following events: Junior Solar Sprint, High School Hydrogen Sprint, Energy Innovations and the Bright House Solar Energy Cook-off.

FSEC received over $1 million dollars from Progress Energy and $130,000 from Tampa Electric to oversee the installation of photovoltaic systems with battery backup on 10 shelter/schools as part of the Sunsmart E-Shelter Plus-UP (Utility Provided) program. Installations were completed by December 31, 2011. Work continued on the $10 million SunSmart Schools Emergency Shelter program. By the end of 2011, twenty-two (22) ARRA schools and 10 Plus-UP schools had systems completed. Interior electrical work, two webinars for the facilities managers and four teacher workshops were held reaching a total of 143 participants as part of this program. Partnered with FPL to provide four professional development opportunities to 110 teachers within the FPL service area through the FPL Solar Station program, which uses the FSEC curriculum and educational kit.

FSEC completed the 4th year and wrote the final report to the U.S. Department of Energy funded cooperative partnership with the University of North Carolina at Charlotte. The program's objective is to develop courses that will result in a Bachelor of Science-Engineering Technology – Hydrogen and Fuel Cell Education Program Concentration.

FSEC completed the Clean Energy Banner Center program. The Banner Center program, funded by Workforce Florida, Inc., has expanded from four partners in 2008 to more than 22 educational training partners. The program continues to provide workforce training in solar thermal and photovoltaics.

FSEC completed the 2nd year of a 5 year, $2.0 million U.S. Department of Energy (DOE) funded project to **operate the** DOE Solar Installer Instructor Training for the Southeast **region.** The Southeast Solar Training Network (SSTN) program established a seven state and two territory network of state energy offices and associated education institutions, conducted the offering of eleven photovoltaic (PV) and solar water heating and cooling (SWHC) train-the-trainer courses, the development and upgrading of training curriculum, the development of laboratory equipment lists, numerous outreach activities, participation in the national coordination efforts and the development of a web-based course offering. The "train-the-trainer" program educated 176 individual faculty from 67 different educational institutions. With regard to the training programs, the instructional materials are varied and cover technical topics as well as institutional and policy issues. The curriculum for both the PV and SWHC courses has been aligned with the NABCEP learning objectives and task analyses. The instructional material given to each of the faculty trainers have allowed them to begin offering a similar program in one to three months at their respective institutions. In addition, having appropriately trained faculty allows their institutions to become NABCEP approved for administering the PV entry level exam with 18 institutions now offering the exam.

Continued providing technical assistance to the USGBC and FGBC to certify 8 green local government cities and counties, 46 LEED for Homes units and 1,200 FGBC green homes. Partnered with the Space Coast Energy Consortium to host the first annual Space Coast Energy Symposium featuring over 200 local and regional business and community leaders whose objective is to transition the region's economic focus from space to energy.

OUTREACH

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

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

Outreach Team Members:

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

The progress during the reporting period is given below.

FESC Outreach Team

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 metered utility 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 improve household energy management and applying fractal geometry-based nonlinear time-series analytical methods to diagnose the health of a home and its occupants as a unified system.

External collaborators

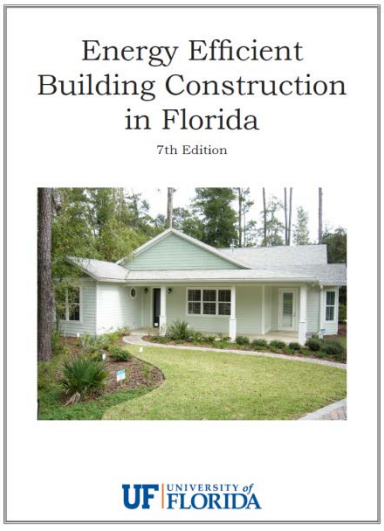
Gainesville Regional Utilities (GRU), Clay Electric, Jacksonville Electric Authority (JEA), Orlando Utilities Commission (OUC), Kissimmee Utility Authority (KUA), Osceola County (Osceola Energy Initiative), Florida Progress Energy, City of Tallahassee, University of Central Florida (Florida Solar Energy Center), University of Nebraska, Tampa Bay Water, UF/IFAS County Extension Offices, American Water Works Association (AWWA), River Network, Alliance for Water Efficiency, Florida Section of the AWWA, American Council for an Energy Efficient Economy (ACEEE), St. Johns River Water Management District (SJRWMD), Southwest Regional Planning Council, Florida State University, University of South Florida, Florida A&M University, Florida Atlantic University, Canin Associates, Inc., Indian River State College, etc.

Energy/Climate Awareness Fact Sheets

Completed three new publications*: Institutional Sustainability: The Personal Story of a Collegiate Solar Champion, Algae: A Future Fuel Source,* and *The Smart Grid: What it is and what it isn't*. Revised twelve fact sheets in the Energy Efficient Homes series that were made available during this reporting period: *Introduction to LED Lighting*; *Landscaping*; *The Duct System*; *Water Heaters*. *Ceiling Fans*; *Indoor Air Quality and Energy*; *Fluorescent Lighting*; *Appliances in General*; *Air Conditioning*; *Home Inspections*; *Windows and Skylights*; and *Incentive Programs for Energy Efficiency*.

Energy Extension Service

- Accepted State Coordinator role for the Sustainable Floridians[SM] program with the responsibility to assist county faculty in their training and inspiring of consumers and/or volunteers regarding the significance of sustainability; the value of lifestyle choices and their impact on the environment; and the challenge to share the responsibility for protecting Earth's limited resources. The course continued in Leon, Marion, and Pinellas counties with Brevard, Lee, Monroe, Osceola, and Sarasota counties expressing an interest in offering the program later this year or beginning next year. Module topics include: *The Case for Change; Principles of Sustainability; Energy; Water; Transportation and Land Use;* and *Leadership and Community*. Development of new modules on such topics as *Food Systems* and *Climate Variability* is being discussed.
- Promoted SAVE (Steps in Achieving Viable Energy) educational materials, designed for youth ages 11 to 13, which 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/programs/4H_Project_Guide_for_SAVE.pdf. Other states, including Michigan and Montana, are interested in adapting the materials to meet their explicit educational requirements, specifically as related to STEM education.
- Conducted twelve invited presentations at the state/regional/local level to groups including the Urban Forestry Institute, Envision Alachua (Plum Creek), Volusia County Commissioners, and the St Johns River Water Management District. Also to UF classes in Architecture, Building Construction, Soil and Water Science and Law.
- The book *Energy Efficient Building Construction in Florida* has been updated to reflect the *2010 Florida Building Code, Energy Conservation* that went into effect March 15, 2012. Since March, over 1400 books have been sold to those preparing for the Florida Contractors Exam. The continuing education training



course based on the book has also been updated to reflect the appropriate energy code changes.

- Worked with a Marion County Extension Agent to produce an online training course on green building certifications, which is expected to be available in 2013.
- Conducted 12 *Save Money on Your Electric Bill* homeowner education seminars for 72 participants in Osceola County.

Demand Side Management

Working with the Public Utilities Research Center at UF on a review of the Florida Energy Efficiency and Conservation Act legislation to help the Florida Legislature determine if the act remains in the public interest.

Worked with utilities across Florida to provide housing research data to the US Department of Energy's National Renewable Energy Laboratory and researchers at the University of Florida, University of Maryland, Carnegie Mellon University, and Vanderbilt University. The data will be used to help calibrate engineering models related to residential energy consumption.

Retrofit and DSM program analysis: contracted with the Orlando Utilities Commission and JEA; Analyzed program impact of weatherization for low income families by local non-profits; Community Weatherization Coalition and EarthGivers; Working with UF Shimberg Center and Alachua County Housing Authority to analyze consumption patterns in assisted housing, to analyze the impact of energy efficiency retrofits in subsidized housing; working with utilities and municipalities across the state to gather data.

Analysis of impact of Florida HERS (article in review): Residential green building program analysis and consultation for Austin Energy under contract; Working with JEA to analyze residential energy audit program; Working with Alachua County to develop a residential green building designation.

Worked with OUC and Accelerated Data Works to create a website (http://ouc.toolsfortenants.com/) that provides multi-family housing *Tools for Tenants* to save energy, and thus money, through comparative feedback and conservation advice. The tool is based upon work supported in part by GRU, the City of Gainesville, OUC, the US DOE (via both SBIR and ARRA funding), and the Florida Department of Agriculture and Consumer Services Office of Energy (under grant agreement number ARS 134). This tool serves as a complement to a multi-family housing energy-efficient building improvement and performance analysis project backed by $429,000 in grant funded OUC rebate incentives for five apartment complex owners.

Continued work on the OEI Energy Efficiency Finance Program (EEFP) including the procurement of a financial consultant to assist with the solicitation and contract negotiation of a single local financial institution to leverage $100,000 in grant-funded credit enhancement and to partner with UF/PREC on the design and implementation of the residential sector loan program. The OEI EEFP will include unique integration of UF/IFAS Cooperative Extension capacities including the following:

- Prescreening/performance M&V via Community Baselines© (Dr. Pierce Jones, Nicholas Taylor, Jennison Kipp)
- Contractor networking & building science technical training via *Energy Efficient Building Construction in Florida* (EEBCF) program (Craig Miller)
- Financial literacy outreach via *Florida Master Money Mentor* (FMMM) program (Dr. Michael Gutter)
- Lifestyle management and empowerment via *Home Flow* program (Dr. Randy Cantrell)

Continuing Education

- A 6-hour, CEU approved, *Greenhouse Gas Reductions and Energy Conservation* (GhGREC) employee and citizen educational workshop was delivered to 19 participants on December 02, 2011 from 9:00 am to 4:00 pm. This GhGREC workshop included local government staff from the City of Kissimmee, the City of St. Cloud, and Osceola County.
- Conducted three *Remodel Green* contractor training CEU programs for Pinellas and Sarasota County Block Grant Programs for 31 licensed contractors.
- Two 3-hour "save Money on Your Electric Bill" (SMOYEB) homeowner seminars were conducted (36 homeowners)
- The *Conserving Biodiversity in Subdivision Development* four-webinar series is now available online for CEU's for Board of Landscape Architecture, Board of Architects and Interior Designers, and the American Institute of Certified Planners.
- *Green Advantage* or *Energy Efficient Construction/Retrofitting* CEU programs were conducted around the state (Escambia, Osceola, St Johns counties) for 52 licensed contractors, architects, building inspectors and engineers.
- *Energy Efficient Building Construction in Florida* 8-hour CEU program was conducted in partnership with South Florida Community College (Avon Park) for 23 licensed contractors.

Workforce Development

- Continued working on the US DOE (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 test of the materials was conducted.
- The basic weatherization course that was developed for in-person training is being developed and pilot-tested as an online training opportunity that is targeted to be available in the fall of 2012.
- Developed training materials (20 hours) for commercial energy analysis (including commercial lighting, plug loads, and energy management) for a curriculum developed with the University of Nebraska to train commercial energy auditors. The training is being adapted for Florida and has been prepared for web-based delivery. Continuing Education Hours (CEHs) are being pursued through the Department of Business and Professional Regulation (DBPR).
- 12 students successfully completed the first 4-week (120-hour) *Weatherization Fundamentals/Technical and Intermediate/Technical* training for OEI. These students have been paired with an OEI participating licensed contractor to gain field experience through a 12-week job-site apprenticeship stage of the training program. They are being assessed weekly by the instructor in consultation with the contractor. Preliminary feedback indicates that all the students are performing above expectations. A second group of 14 students successfully completed the second 4-week (120 hour) Weatherization Fundamentals/Technical and Intermediate/Technical training. These students were also paired with an OEI participating licensed contractor and completed apprenticeship training. These students and the 12 that completed the first training are being assessed weekly by the instructor in consultation with the contractor. Feedback indicates that all the students are performing above expectations and 4 of the 12 have been offered permanent employment.
- A second training curriculum was developed in partnership with the University of Nebraska (Lincoln) for mechanical contractors. The Advanced Building Analyst Training Program for Mechanical Contractors *"Mechanical Systems Efficiency and Management for Light Commercial Buildings"* provides the mechanical worker/building manager with the knowledge and tools necessary to improve equipment and system performance. Specific focus areas include light (less than 20,000 sq. ft.) commercial building heating, ventilation, air-conditioning and refrigeration systems. The training is designed to be delivered in a two-day format and will consist of approximately 16 contact hours, which may, in whole or in part, be credited toward continuing

education units (CEUs) required for licensure in Florida. The curricula included an instructor's manual of presentation materials (e.g. PowerPoint slides) and a comprehensive student workbook/resource guide for each unit. Unit modules include a list of objectives, skills, requirements (e.g. instructional spaces, equipment, PPE, etc.) and a table of contents. Most modules consist of an exercise and/or activities. At some point, these materials will also be transferred to a web-based delivery.

- The Florida Weatherization Training Center (FWTC), in efforts to network with other state and national training providers and to establish a sustainability plan beyond the DOE grant period participated in or conducted the following activities:
    - Met with WorkNet Pinellas (WAP Training Center provider) to further discuss partnership opportunities.
    - Attended the Florida Energy Summit in Orlando and met with a broad contingent of weatherization specialists and legislators. Also had a meeting with Bill Lazar, Director of the St. Johns Housing Authority (CAA) and Nina Powers, Sustainability Outreach Coordinator at Sarasota County Government to develop training opportunities in support of their efforts.
    - Met with Colleen Kettles from Florida Solar Energy Center (FSEC) and the Banner Center for Energy to discuss future partnership opportunities through the Centers.
    - Met with representatives from the Florida Masonry Apprenticeship and Education Foundation to discuss training and future planning.
    - Provided the keynote for the WTC Directors call on utilizing existing training center assets to create sustainability.
    - Worked with the Florida Green Energy Works in Lantana, Florida to review their workbook which they are publishing for commercial Property Assessed Clean Energy (PACE) programs. Florida Green Energy Works is a program of the Florida Green Finance Authority, a partnership of local governments from across Florida. They offered the first commercially-focused PACE program in Florida, to help commercial property owners finance energy efficiency, renewable energy and wind resistance improvements to their properties.
    - Met with representatives from Hillsborough Community College, Pinellas Technical Center, and WorkNet Pinellas to discuss future partnership opportunities in weatherization training and management of resources.

Collaboration on New Initiatives

- With Florida State University's Institute for Energy Systems, submitted a grant proposal to EDA and USDA titled *Florida Rural Regions Job Accelerator* to train farm energy auditors.
- With Evident Energy, submitted proposals to the Energy Trust of Oregon and to the Ontario Power Authority to perform energy-efficiency measurement and verification services.
- Worked on development of a proposal in response to an RFP from the Vermont Department of Public Service Planning and Energy Resources Division entitled "Evaluation of Energy Efficiency Programs and Market Research in Vermont's Single Family Existing Buildings Market." PREC would be a project partner and would provide measurement and verification services related to the Home Performance with Energy Star in Vermont.
- Collaborating with UF's College of Design, Construction, and Planning to seek funding for development of computer-based tools to demonstrate energy and water impacts of planning scenarios.
- Collaborated with the College of Design, Construction and Planning (DCP) and Plum Creek in offering the Practicum in Sustainability and the Built Environment (DCP 4941) six-hour credit course for undergraduate students during Fall 2011 term. The end result was a report (*From Food to Community: A Systems Perspective for Urban Development*) on the energy, water, and material

resource considerations of how residents might optimally eat, move, dwell, and commune within the 23,000 acre Plum Creek parcel under evaluation for development in Eastern Alachua County. Also, as a result of offering the course, one of the students received a summer 2012 internship in the area of sustainability with the Pinellas County Extension Service Office in Largo. Plans are to offer the class again, working with UF's Office of Sustainability, in the Fall of 2012 with an emphasis on auditing DCP for their degree of sustainability and updating/creating additional materials for the Sustainable Floridians Program.

- Collaborated with private and public sector leaders on the Alachua Clean Energy (ACE) effort to catalyze a local energy finance framework for energy-efficient building improvements and renewable energy implementation in the residential and commercial sectors.
- Contracted by Plum Creek (the largest private landowner in the United States, Florida, Alachua County, and Gainesville) to conduct research, analysis, and conceptual development of practices, processes, and procedures for addressing issues of food, water, shelter, mobility, and community within the Envision Alachua planning framework for eastern Alachua County. This effort involved a multi-faceted interdisciplinary approach across three synergistic college courses among diverse institutional partners including, the UF College of Design, Construction, and Planning, the UF Institute of Food and Agricultural Sciences, and the UF Program for Resource Efficient Communities.
- Contracted by the Gilchrist Club in collaboration with the UF College of Design, Construction, and Planning and the UF Program for Resource Efficient Communities to conduct site scenario planning and impact analysis of potential urban development possibilities for a multi-thousand-acre stretch of land near Trenton, Florida.
- Procured a third-party financial partner (FAIRWINDS Credit Union) to leverage $100,000 to $300,000 in federal funds into a multi-million dollar energy finance program to catalyze residential energy efficiency property improvements in Osceola County. This program will be designed and administered by the UF Program for Resource Efficient Communities in partnership with FAIRWINDS Credit Union as part of the Osceola Energy Initiative (OEI), an ARRA/EECBG project proposed and being realized by Osceola County, UF Osceola County Cooperative Extension, and a suite of key public and private sector local partners.

Outreach Activities at Southeast National Marine Renewable Energy Center (SNMREC)

SNMREC is engaged in creating and implementing a summer internship program with Harbor Branch Oceanographic Institute (HBOI), and the United States Coast Guard Academy for the summer of 2013. The students will be working on the internship program at HBOI. This ongoing initiative will run from July 2012- the summer of 2013

A seventh lesson is in development for the SNMREC curriculum for high school based on civics/social studies. This lesson instructs the students on the important role that the government has in renewable energy production and advancement. The lesson is based on the same educational model as the original curriculum, the "5E's"; Engaging, Exploring, Explaining, Elaborating and Evaluation. Appropriate activities and Sunshine State Standards are included.

Two MOU's were executed in May and August 2012, to support collaboration with the South Florida Science Museum in West Palm Beach and the Museum of Discovery and Science (MODS) in Ft. Lauderdale to create an interactive display, featuring the SNMREC ocean current turbine in the Gulfstream current. SNMREC is working with professors and students at FAU's School of Communications and Multimedia Studies to create the interactive educational display game. FAU's Harbor Branch Oceanographic Institute is also collaborating with SNMREC to design and install a kiosk in the Ocean Discovery Center with the ocean turbine interactive game. Additional public funding has been secured through the University Club of FAU Foundation Inc., and from FAU's Broward Undergraduate Student Research Awards. A collaborative effort has been initiated between SNMREC and Florida Power and

Light to include ocean renewable energy research and development from SNMREC in their museum display at the MODS.

SNMREC partnered with Nova SE University's marine science program, hosting the Miami Aquatic Life and Nature Camp, sponsored by Miami-Dade County Parks and Recreation Department, for two camp visits on June 11th and July 23rd. The focus was on the environmental aspects of marine renewable energy. This event highlighted SNMREC's partnership with Nova Southeastern University, and the importance of SNMREC's ocean renewable energy research combined with Nova SE University's sea turtle preservation and protection program. The campers were 8-14 years of age. A similar event, sponsored by South Broward High School's Marine Magnet Program; Ocean Science, Technology, Engineering and Math (OSTEM) for Girls Program was held in July bringing together the same partnership. Using the SNMREC curriculum as a basis, the focus of this program was on the technology also highlighting the interactions of the technology with the environment.

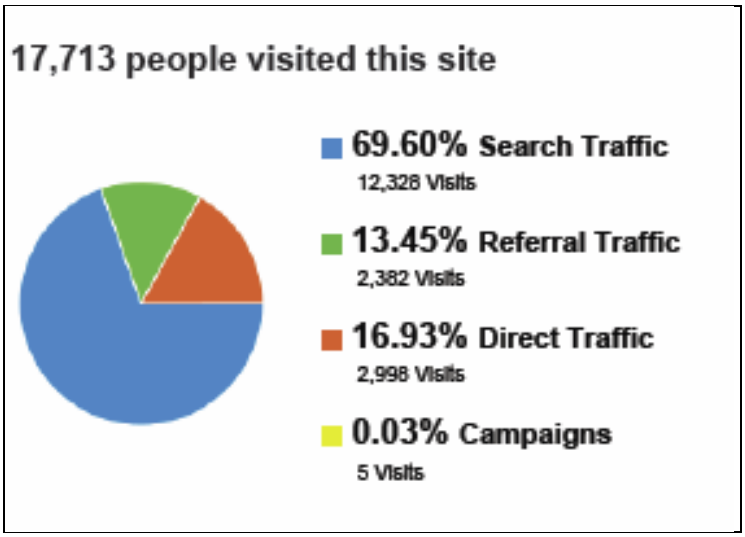
FESC Web Site (www.FloridaEnergy.ufl.edu)
The FESC website continues to be an important communication tool for our program. It is updated regularly to remain current and to better serve our users. Based on a Google Analytics report, the FESC web site was viewed by 17,713 Google visitors during the period of September 30, 2011-October 1, 2012. The viewers visited 45,739 pages. Viewers were from a total of 134 countries, including those in North and South America, Europe, Asia, Australia, and Africa. The data compiled from Google Analytics are given below:

Activity overview of the FESC's website from September 30, 2010-October 1, 2011.

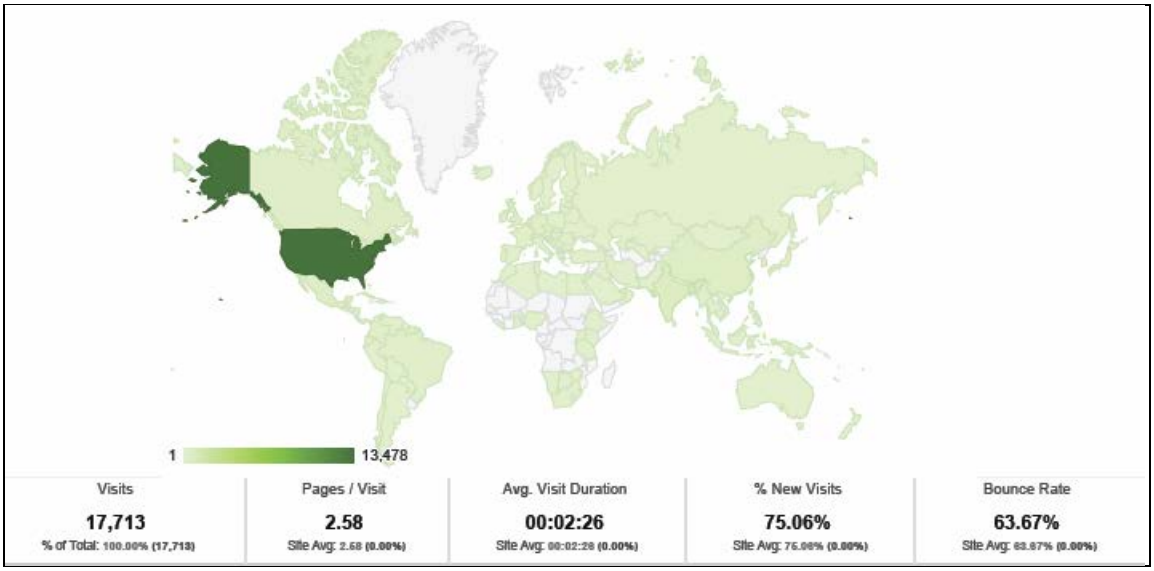
Activity	9/30/2011-10/1/2012
Total Visitors	17,713
Unique Visitors	13,678
Page Views	45,739

The chart below displays the website traffic sources.

FESC Web Site Traffic Sources



Countries Visited FESC Web Site



FLORIDA ENERGY SUMMIT

This year, the FESC summit was combined with the Florida Energy Summit that was held at the Rosen Shingle Creek in Orlando, FL on August 15-17, 2012. The summit agenda is given at: http://www.floridaenergysummit.com/agenda.html.

FESC faculty members presented the latest emerging technologies at the "From the Research Labs of Florida's World-Class Universities" session. The speakers were:

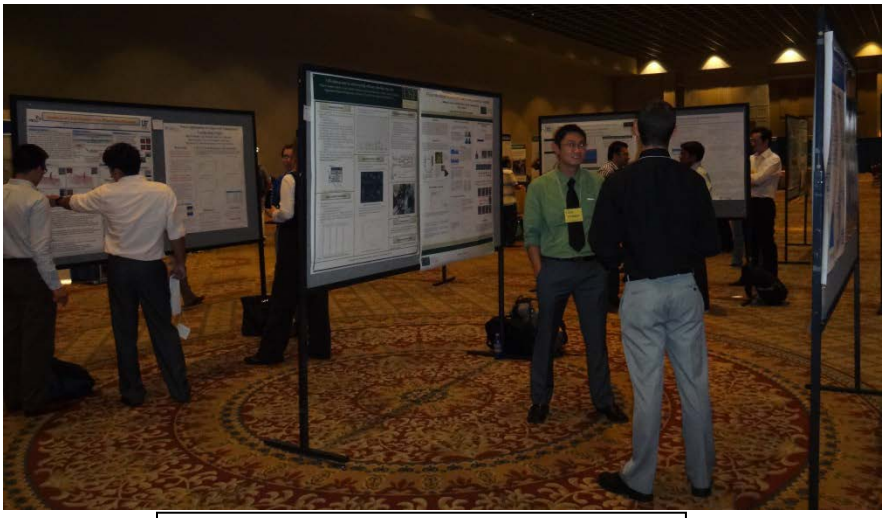
David Van Winkle, *Professor of Physics, Florida State University,* ***Presentation (PDF)***
James Klausner, *Professor, University of Florida,* ***Presentation (PDF)***
Yogi Goswami, *John and Naida Ramil Professor, Co-Director, Clean Energy Research Center, Editor-in-Chief, Solar Energy Journal, Editor-in-Chief, Progress in Solar Energy, University of South Florida,* ***Presentation (PDF)***
Jim Fletcher, *Assistant Professor, University of North Florida,* ***Presentation (PDF)***
Jim Zheng, *Professor, Florida State University,* ***Presentation (PDF)***

FESC faculty and students presented 40 posters. More information can be found on the Florida Energy Summit website at the link: *http://www.floridaenergy.ufl.edu/?page_id=11053*.

FESC universities shared a booth and presented new technologies developed at FESC universities.

Photos from the Summit

Commissioner Putnam



FESC Poster Session

FESC Booth

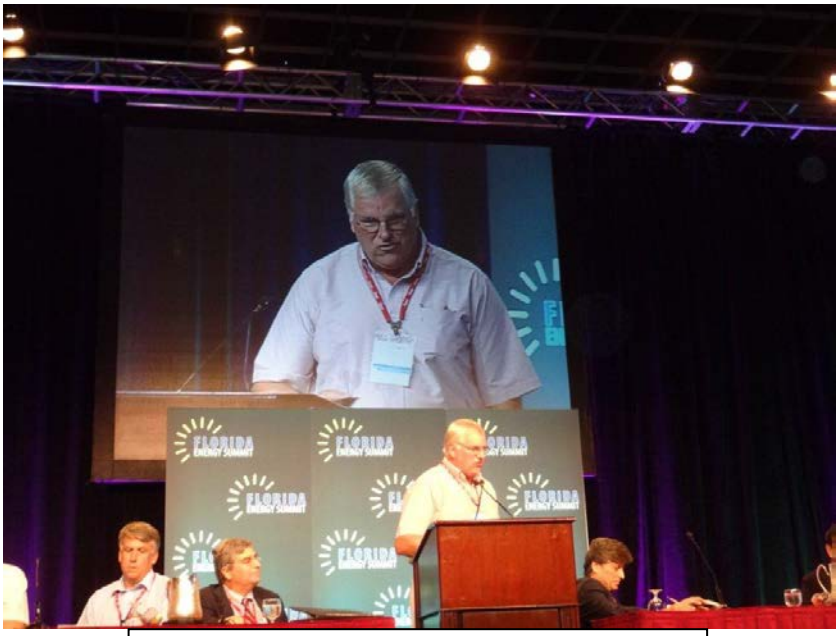
FESC Booth

Dr. Tim Anderson, FESC Director

Dr. James Klausner, University of Florida

Dr. Jim Fletcher, University of North Florida

Dr. Yogi Goswami, University of South Florida



Dr. David Van Winkle, Florida State University

Dr. Jim Zheng, Florida State University

Greg Ramon, TECO (FESC Advisory Board Member)

For More Photos please visit: http://www.floridaenergy.ufl.edu/?page_id=11283

OTHER ACTIVITIES

SNMREC at FAU: Engagement with the general public as well as other interested stakeholders is an important and necessary step in the Federal and State Environmental Assessment process. To that end the Southeast National Marine Renewable Energy Center (SNMREC) at Florida Atlantic University organized and hosted seven forums from Ft. Pierce to Ft. Lauderdale between January and April to engage their perspectives on ocean renewable energy. Over 750 attendees participated in the forums. One session was video-taped and is located on the SNMREC website at: http://snmrec.fau.edu.

Sustainable Planning: FSU's Sustainable Systems and Urban and Regional Planning strengths exist to find new pathways to sustainable land use and justice in ways that simulate the economy and eliminates the ravages of poverty. FSU seeks to stimulate and enable practicing planners, aspiring planners, decision makers, and interested publics to understand urban and regional systems, public decision making, institutions of planning, and activities of planners; develops and critically examines theories and methods useful to understanding urban and regional systems, public decision making, institutions of planning and activities of professional planners; and utilizes and applies these theories and methods to issues of importance to communities and professionals.

Sustainable Economic Development: FSU's Sustainable Systems and Economic Development team focuses on the roles of institutions, bargaining, and networks on economic development policy choices and infrastructure development. Current research applies game theoretic, institutional rational choice and ICA frameworks to investigate development policy choices, investment and joint ventures, to find organizational relationships that balance the need for technology acceptance and the development of liberal markets with the need for resource sustainability, equitable land use and social justice.