2011 FESC Semi-Annual Report

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Florida Atlantic University

Southeast National Marine Renewable Energy Center

Marine Renewable Energy (MRE) is the resource embodied in ocean currents, waves, tides, and thermal gradients. Tapping MRE resources will reduce our reliance on fossil fuels and help Florida along the road to energy self-sufficiency. Research areas of focus include improving understanding of ocean current and thermal-gradient resources, implementing testing capabilities to expedite commercial development of these resources, and understanding potential environmental impacts and how to mitigate them.

PI: Susan H. Skemp, **Co-Investigators (at FAU):** Howard P. Hanson, Taghi Khoshgoftaar, Pierre-Phillippe Beaujean, Len Berry, Megan Davis, Peter Tatro, Mohammad Ilyas, Jeanette Wyneken, Manhar Dhanak, John Reed, James VanZwieten, Karl vonEllenrieder

Students:

Student Name	Thesis/Dissertation Title	Degree
Lynn Rauchenstein	Global and Local Ocean Thermal Energy Conversion Resource Assessment	MS
Fisher, Aaron Donnelly	Development and implementation of an Adaptive Controller for Station Keeping of Small Outboard-Powered Vessels	graduated Dec. 2010 - MS
Hacker, Jr., Basil Lee	numerical simulation of ocean current turbines	MS
Seibert, Michael	Analysis of anchoring methodologies suitable for mooring ocean energy systems off the Southeast coast of Florida.	Spring 2011 - MS
Krupski, Andrew	Design of a dynamically positioned ocean current turbine testing platform	MS
Lovenbury, James	FAU Center for Ocean Energy Technology Proposed Shear Profile and Frequency Spectra	MS
Young, Matthew	Ocean Current Turbine Prototype hydrodynamic performance and motion quantification for the validation of numerical models	MS
Psarrou, Dimitrios	Electromechanical energy conversion, modeling & control w/applications to renewable power-plants	MS
Akram, Mohammad Wasim	Fatigue Modeling of Composite Ocean Current Turbine Blade	Graduated Fall 2010 - MS
Zhou, Fang	Finite Element and Experimental Studies of Composite Ocean Current Turbine Blades under Dynamic Loading."	MS
Cribbs, Allison	NUMERICAL ANALYSIS OF A MOORING SYSTEM FOR AN OCEAN CURRENT TURBINE TESTING PLATFORM	Graduated Dec 2010 - MS
Smentek, Alana	Practical Assessment of Producible Energy from the Gulf Stream off the Southeast Coast of Florida	Ph.D
Guerra, Julian	Estimates of Water Turbine Noise Levels	Spring 2011
Thew, Ryan	Analysis and Deterction of Marine Animals by their Sound	MS
Bulek, Savaskan	Blind Separation of Speech Signal	Ph.D. Dec. 2010
Esfahanian, Mahdi	Detection and Tracking of Marine Animals using Passive Means in Gulf Stream	MS
Oliver, Benjamin Garry	CFD Simulations of underwater turbine in Gulf Stream using Reynolds Average Navier Stokes Method	MS
Chen, Qingde	Structural Design & Optimization of Underwater Turbine Blade	MS
Perez, Jorge Joaquin, Jr.	CFD and stress modeling of turbine blade (exact title not determined yet)	MS

Miglis, Yohann	Stress Corrosion Problems in Probabilistic and Interval setting and Tidal Energy Reliability Issues (exact title not determined yet)	MS
Hurley, Shaun	Reliability - based Fatigue Design of Marine Current Turbine Blades: Load and Resistance Factors	MS
Senat, Junior	Fatigue Load Modeling for Marine Current Energy System.	MS
Singh, Amit Janesh	Structural Design & Optimization of Underwater Turbine Blade	MS
Duhaney, Janell	Application of Data Fusion in Monitoring Ocean Turbines	MS
Sloan, John	Finite Safety Models for High-Assurance Systems	graduated August 2010** Now Post-doc.
Wald, Randall	Prognostics and Health Management Techniques for Autonomous Ocean Systems	MS
Aghera, Sagar	Design and Development of an Areal Video Aquistion System	MS
Reza, Waazim	Detection and Classification of Marine Animals from Areal Video	graduated 12/2010 - MS
Friedel, Reena Ursula	Thesis topic: 3D modeling and visualization	MS
Giusti, Rafael	Design and Development of a Web-based Video Annotation and Browsing System	MS
Rahman, Asif	Web-based interfaces for video browsing and querying	MS
Tavlilov, Timur	Adaptive Resourse Management for Sensor Information Delivery over Constrained Wireless Link	MS
Vailbav. Lad	Finding functional equivalent genes in micro-array expression data under Prof. Hill Zhu	graduated 12/2010 - MS
Duraiswamy, Abishek	Embedded Data Gateway for Prognostic Health Monitoring Systems for Ocean Energy	MS
Gadipudi, Raviteja	Developing a Software Framework for Prognostic Health Monitoring	MS
McMichael, Erin	Ontogenetic habitat selection and resource use in green (*Chelonia mydas*) and loggerhead (*Caretta caretta*) sea turtles.	Ph.D
Wojtisek, Elizabeth	MBA Program does not require a dissertation	MBA
Bozec, Alexandra	Development of a local ocean prediction model of the Fort Lauderdale region for energy extraction purpose	FSU post doc

Description: The SNMREC mission is to catalyze ocean-based solutions to the Florida's energy challenge. A primary focus is on determining the potential of Florida's ocean-current resource and on ocean thermal energy conversion in waters offshore. Part of this involves the regulatory process at State and Federal levels for ocean energy infrastructure and operation in the offshore continental shelf, which is neither clearly defined nor have the roles and interdependencies of the individual agencies been clearly articulated. In addition, knowledge to make these decisions is more on a macro- rather than the micro-level necessary to assess individual devices. SNMREC's role is to bridge the gap between concept and commercial deployment of ocean energy technologies by providing at-sea testing facilities for both ocean current and thermal energy research and for technology development. Research cuts across environmental, ecological, resource, and technology areas.

Universities: Florida Atlantic University, with UCF, FSU, USF, ERAU, University of Miami, Oregon State University, University of Washington, Pennsylvania State University, University of New Hampshire, University of Hawaii, University of Edinburgh, Heriot-Watt University, Nova Southeastern University, Virginia Polytechnic Institute and State University, and Florida Institute of Technology

External Collaborators: Numerous industry and State and federal government as well as FFRDCs, such as the National Renewable Energy Laboratory, Oak Ridge National Laboratory, Pacific Northwest National Laboratory, Woods Hole Oceanographic Institution, U.S. Department of Energy (Office of Energy Efficiency and Renewable Energy, U.S. Department of Interior (Bureau of Ocean Energy Management, Regulation, and Enforcement), U.S. Department of Commerce (National Oceanic and Atmospheric Administration), Florida Department of Environmental Protection, and others as well as numerous industry partners.

Progress Summary

Mooring and Telemetry Buoy

- Buoy constructed and initial dockside and tow testing complete
- Sensor and power systems final development and testing
- Communications and telemetry under development

July 2011 readiness

Motor-Generator Dynamometer

- 20kW onshore grid-connected coupled motor dynamometer
- Full simulation of offshore power and monitoring system(s): configuration, integration, and testing
- Dynamic offshore rotor behavior emulation with in situ data
- Smart grid and heterogeneous device-to-grid research

Florida State University

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

PI: A. Krothapalli

Description: To develop technologies to produce biojet and biodiesel fuels from sustainable sources such as bio-oils and hydrogen produced from biomass generated synthetic gas. Novel processing concepts, reactor design and catalyst systems are employed in this integrated approach to convert any cellulosic biomass and any nonedible bio-oils into bio-jet fuel (Figure 1). Feedstock flexibility offers significant cost and logistic advantages to this approach. Unlike other processes which use only the oil derived from a plant, the entire plant can be used as feedstock source and the proposed approach can also convert the more challenging lignocellulosic component.

Budget: $229,572
Universities: FSU

Progress Summary

Through molecular manipulations, the inherent chemistry of the proposed approach allows the production of "designer biofuels" and offers a means to tailor product properties through saturation of double bonds to give better shelf life, cleaving long chain hydrocarbons to produce the jet cut, controlling aromatics content for better combustion characteristics and isomerization to achieve better performance

We are now hydro-processing the bio-oils. This particular step is being carried out by our industrial partner Energia Technologies Inc., of Oakland, California. Energia Technologies is currently building high pressure and temperature bench scale unit capable of independently testing bio conversion unit. This work is being carried out under a Office of Naval Research STTR phase I program where FSU is a sub contractor to this effort.

Funds Leveraged/New Partnerships:
Energia Technologies Inc. in Oakland California

Florida State University

Planning Grant: Constructual Optimization of Solar Photo-Bioreactors for Algae Growth

PI: Juan Ordonez
Students: Quinn Straub (MS), Tom Tracy (MS)

Description: This planning grant has allowed us to enhance our laboratory capabilities and personnel qualifications to support competitive proposals in the area of bio-fuels. By the end of this one-year effort, we have a complete design of a small-scale photo-bioreactor for algae growth and obtained additional funds that will allow us to build a large-scale photo-bioreactor and conduct the necessary research for its optimal design and operation.

Budget: $15,000
Universities: FSU
External Collaborators: Federal University of Parana, Brazil

Progress Summary

This project is complete. Graduate students Straub and Tracy attended a 2-day seminar hosted by the University of Texas at Austin. The seminar exposed the students to fundamentals of the biological interactions of micro-algae, culturing techniques, culture maintenance, as well as, proper use of lab equipment. They also toured a culture collection, that is one of the best in the world with over 3,000 species of algae.

Funds leveraged/new partnerships:
Shih and Ordonez have received a 2010 US Higher Education Consortia program grant for $185,000

Florida State University

Environmental Impacts of Energy Production Systems: Analysis, Evaluation, Training, and Outreach

Principal Investigator: Amy B. Chan-Hilton **Co-PIs:** Gang Chen (CEE), Wenrui Huang (CEE), Michael Watts (CEE), Ming Ye (Scientific Computing), and Paul Lee (Florida Department of Environmental Protection)

Students: Andres Lastra, M.S. Civil Engineering; F. Rios, M.S. Scientific Computing; Gustavo Munoz, B.S. Civil Engineering; Libo Cui, Ph.D. Civil Engineering

Description: The goal of this project is to develop tools and conduct research to objectively assess environmental and water resources needs and constraints while developing prudent energy strategies and policies. The focus of this research will be on fuel cycle and energy production systems. The objectives of this project were to analyze the environmental and water resources demands and potential impacts, specific to Florida's unique geographical challenges, of fuel cycle systems and develop an objective environmental impact screening and evaluation tool or decision support system for energy planning and policy making by Florida's industry, utilities, and government.

As Florida develops its long-term energy strategy, multiple efforts are ongoing to develop and apply a wide range of energy technologies that are sustainable and carbon-neutral. But pragmatic issues related to environmental impact and sustainability need to be addressed before these technologies may be implemented. This project directly addressed the FESC's Thrust 6 on "Energy systems and their environmental and economic impacts." This project also directly addresses IESES's Objective 4 on unique geographical challenges and Objective 5 on sustainable energy engineering, science and the sustainable energy economy.

Budget: $64,738

Progress Summary

A literature review of environmental impacts of energy production systems is complete. We conducted an extensive literature reviews on how biofuel production systems, with a focus on cellulosic ethanol, affect our environmental resources and quality. Approximately 400 journal papers, reports, and permit applications were reviewed for this task to date. This includes impacts on the potential contamination of water, soil, and air, demands on water resources, ecosystem and human health, and emissions of greenhouse gases. We have found that the local impacts and downstream issues such as effluent and by-products from biorefineries have largely been overlooked in the literature. However, these issues are relevant and are significant when siting and permitting these facilities. Two manuscripts to peer-reviewed

Julie Harrington and Ming Ye at the 2010 FESC Summit. Ming Ye participated in the Project "Environmental Impacts of Energy Production Systems: Analysis, Evaluation, Training and Outreach."

Science, December 2009, declined; and Environmental Science & Technology, August 2010, published 2011. A spread-sheet based evaluation and decision support tool was developed. Also, a GIS-tool used to evaluate the impact of nutrients from point sources was developed. This helps in assessing the environmental impacts of feedstock growth and biorefinery processes from biofuels.

Funds Leveraged/New Partnerships

We will continue research on the environmental impacts of cellulosic biofuel production. In particular a Ph.D. candidate in Civil Engineering will conduct dissertation research on the development of an improved life cycle assessment methodology to include uncertainty analysis as well as expanded environmental impacts measures to evaluate biofuel production and aid in decision making related to biofuels. This will help technology developers, regulators, and industry develop sustainable plans for biofuel production.

Florida State University

Planning Grant: Climate modeling and outreach activities

PI: Shawn R. Smith
Co-PIs: Steve Cocke, David Zierden, James O'Brien, Julie Harrington
Students (name/degree sought): Cristina Collier / B.S. Meteorology (completed May 2010)

Description:
The objective of the planning grant is to develop at least one external funding proposal that focuses on areas of climate modeling and/or climate outreach that support the activities of the IESES. The focus of our activities has centered on evaluating the potential offshore wind resource in the northeastern Gulf of Mexico and elsewhere in Florida's waters. Preliminary research has been completed using observations from instrumented Air Force towers and buoys in the waters around Florida. The existence of wind power capacity has been identified at the assessed locations. Due to the sparseness of in-situ wind data in the region, a numerical modeling approach will need to be pursued to develop a wind climatology with sufficient spatial and temporal scales to further define the offshore wind power capacity.

A vast portion of the work conducted focused on outreach and education. When we began our project, the idea of offshore wind power in Florida was not even on the radar of the Florida Legislature or the renewable energy sector at large. We worked to raise the visibility of offshore wind as an energy resource for Florida by attending meetings, connecting with the wind power industry in Florida, and briefing two members of the Florida Legislature and presenting to the Florida Energy and Climate Commission. As a result of these connections, we submitted a preliminary proposal to Siemens Wind Power and have developed a network of colleagues both within FSU and the private sector that are interested in further developing Florida's offshore wind resource.

Budget: $15,000
Universities: FSU
External Collaborators: Mark Powell (National Oceanographic and Atmospheric Administration)

Progress Summary

The preliminary research confirms the existence of an offshore wind resource; however, the winds are not as strong as they are in regions where offshore development is underway on the U. S. East Coast. There continues to be a need for a more detailed wind resource assessment and the work of this IESES project has stimulated interest at the National Renewable Energy Laboratory to complete the coastal wind resource maps. Once a good resource assessment is complete, more effort will be needed in the areas of marine spatial planning, economics, and engineering to build a case for which regions have economically viable wind. There will be a need for technological improvements in turbine technology to produce at lower wind speeds.

Dave Cartes, IESES Director with Mark Powell of NOAA who is a co-PI on the Climate Modeling and Outreach Activities.

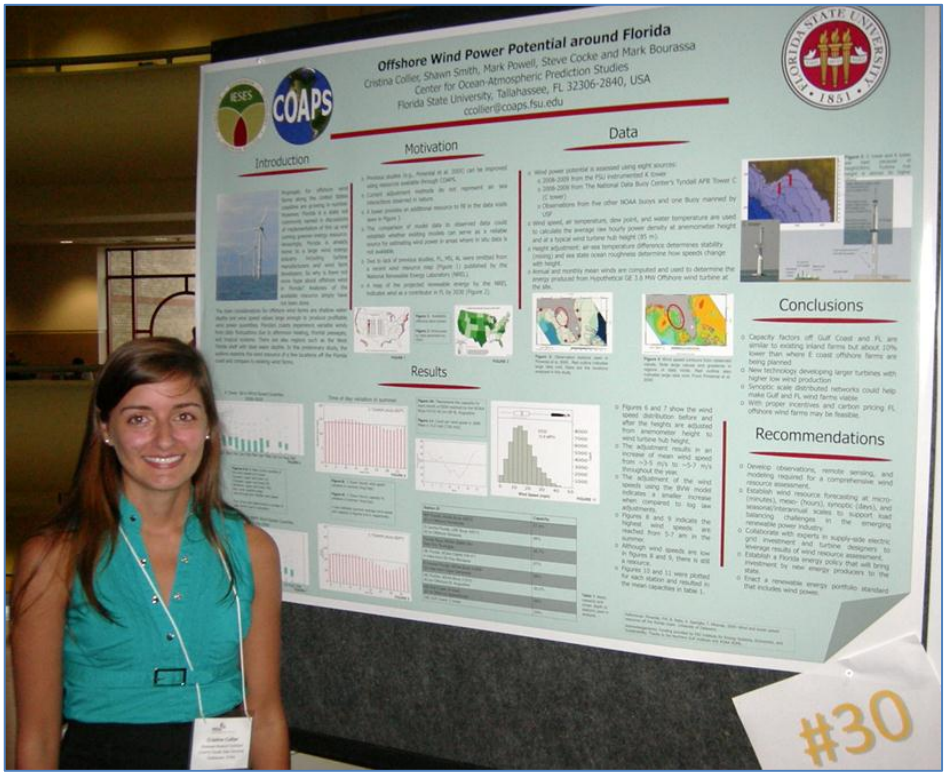
In terms of outreach, the project has worked to change the attitudes within the renewable energy community and the state legislature that wind needs to be considered for Florida.

Funds Leveraged/New Partnerships:

Through the planning grant, we completed the necessary background research to initiate a full scale project. In March and April 2011, we participated with a large multidisciplinary team to submit preproposals for U.S. Offshore Wind: Removing Market Barriers Funding Opportunity Announcement Number: DE-FOA-0000414 and U.S. Offshore Wind: Technology Development Funding Opportunity Announcement Number: DE-FOA-0000415.

We are working towards hosting a regional offshore wind workshop, which will focus on the issues related to wind power around Florida and in the northern Gulf of Mexico. These regions all have similar wind resources.

If we can achieve a critical mass of researchers and industry partners, we believe we can make a case for offshore wind in this region. The resource is not one that can be immediately developed, but if the proper investments are made in technology, planning, and economic assessment over the next decade, then this resource may be tapped in the 10-15 year time frame.



Christina Collier at the 2010 FESC Summit

Florida State University
Visiting Law Professor

PI: JB Ruhl and Jim Rossi, **Co-PIs**: Uma Outka
Student: Rebecca Lowrence

Description: Two-year Visiting Scholar at the College of Law researching the interface between land use law and innovative energy solutions and delivering academic symposia and graduate student seminars on the research scope, comprising Sustainable Energy Research Project (SERP) within Environmental and Land Use Law Program.

Budget: $79,879
Universities: Florida State University, College of Law

Progress Summary

During the reporting period completed a second lengthy written work: *The Renewable Energy Footprint.* This article is the first to take a critical view of existing and emerging siting frameworks in light of the millions of acres that energy development will consume over the coming decades. The piece builds on Ms. Outka's state-level analysis of the first article, *Siting Renewable Energy: Land Use and Regulatory Context*, which was revised for publication in Ecology Law Quarterly (University of California-Berkeley) during the reporting period. *The Renewable Energy Footprint* argues that site-fixated regimes fail to address cumulative land impacts and that the siting context alone is insufficient to do so. The article develops instead the claim that cumulative land impacts must be a central consideration in the development and implementation of energy policy.

The article begins by addressing existing frameworks and emerging approaches to offer a critical look at energy land use law in the broadest terms as it currently stands. This broad-based assessment fills a gap in the legal scholarship, which to date has focused on siting a particular form of infrastructure, the regulatory context for siting within a particular state, or factors that complicate siting, in general terms. These are all valuable, but none considers the role of applicable law in facilitating potentially vast *cumulative* land use for energy across the nation. The federal and state policy context supporting renewable energy makes this cumulative perspective uniquely important.

The article then suggests that we can do better, both in siting projects more quickly and in siting projects well so that the worst-case cumulative land impact might not occur. To date and across the board, regulatory apparatus for siting is almost exclusively fixated on site-specific land use, reflecting a worrisome myopia given the land impacts at stake. The article first considers the promise of federalism as a primary means for addressing the flaws in current law. While some scholars have proposed solutions in the form of new governance models, the paper argues that federalism norms in land use are too entrenched to offer much hope for structural reform. This article take a different and fundamentally practical approach, asking what might be done today, making use of existing regimes and institutions, to minimize the energy footprint and still promote growth within the sector. During the reporting period, the article was submitted and accepted for publication in the Stanford Environmental Law Journal (forthcoming 2011). This research was accepted for presentation at the Vermont Law School's Annual Colloquium on Environmental Law Scholarship. Ms. Outka also presented this research as part of the Florida Climate Institute Research Series and by invitation at the Georgia State University College of Law, the University of Washington School of Law, the University of West Virginia University College of Law, the Florida

International University School of Law, the St. Mary's School of Law, the University of Kansas School of Law, and Pace University Law School.

Other research progress during the reporting period included the following:

(1) Research was completed for and began composition on a third article, this time co-writing with Professor Rick Feiock, consistent with IESES's goal of fostering interdisciplinary collaboration. This article, tentatively entitled *Local Promise for Climate Mitigation: An Empirical Assessment.* Significant attention in the legal scholarship on climate change has focused on questions of federalism – the balance of authority and interrelationship between the federal government and the states. At the same time, many have argued that local governments are uniquely positioned to address a range of activities that directly contribute to climate change, from land use decisions to residents' individual behavior. This work-in-progress will advance the literature by measuring optimism for local governments' impact against Professor Feiock's recent empirical work that probes local progress and capacity for energy sustainability with data gathered across Florida.

(2) Ms. Outka completed a substantial amount of the research for another work-in-progress – an article that will examine the legal context for bioenergy for electric power production. This article considers the varied ways in which "renewable energy" and "biomass" are defined in U.S. federal and state law. Biomass may include agricultural and timber by-products, but also other non-traditional forms of biomass, such as landfill gas and municipal solid waste. This work will offer a critical examination of the legal and environmental issues that these broad definitions raise from perspectives of public participation, land use, and energy and waste policy.

In addition to research activities and presentations, I focused a substantial amount of time during the fall organizing a national symposium entitled Law and Sustainability Symposium: The Energy-Land Use Nexus, scheduled for February 25, 2011. This event provided opportunities for law student involvement with IESES and sustainable energy issues via the College of Law's esteemed student-edited Journal of Land Use and Environmental Law, which will publish symposium proceedings. Also during this reporting period, the course syllabus for Sustainable Development Law was updated in anticipation of offering the seminar in the spring 2011 semester. A third-year law student, Rebecca Lowrance, started as a SERP student researcher during the fall semester. Also Rebecca Lowrance, SERP Student Researcher (third-year law student) and Ms. Outka presented as speakers to Public Policy graduate student Tony Kassekert's undergraduate Energy Policy course, Nov. 23, 2010).

Florida State University

The Future Florida Grid: Ensuring a Reliable and Resilient Electrical Energy Transmission and Delivery System in a Changing Environment

PI: Steinar Dale
Co-PIs: Tom Baldwin, Ph.D., P.E., Omar Faruque, Ph.D., James Langston, Peter McLaren, Ph.D., Rick Meeker, P.E., Karl Schoder, Ph.D., Mischa Steurer, Ph.D.
Students: Thamer Alquthami, Harsha Ravindra (MS Electrical Engineering)

Description: The project research goal is to address the challenges of the reliable movement of electrical energy throughout the state as the power system is transformed to include far more renewable and alternative sources, increased use of distributed energy resources (including storage and electric vehicles), emergence of microgrids, possible expansion of new very-large centralized baseload (nuclear), and incorporation of new power conversion, transmission, measurement, communication and control technologies (smart grid).

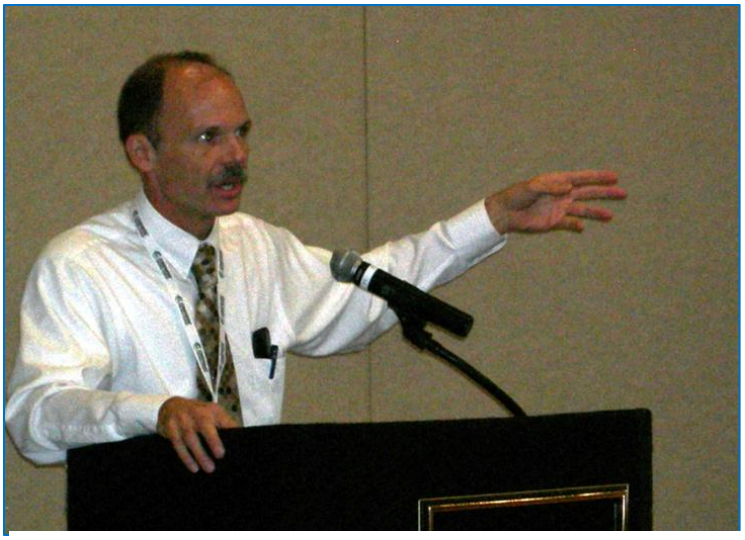
This project has also supported ongoing participation and contributions in national, state, and local power and energy stakeholder groups, including the Gridwise Alliance, the North American Synchrophasor Initiative (NASPI), the American Society of Mechanical Engineers' (ASME) National Energy Committee, the Institute of Electrical and Electronics Engineers (IEEE) Power Engineering Society (PES), Florida's Great Northwest Alternative Energy Advisory Council, and the Tallahassee-Leon Economic Development Council (EDC) Energy and Environment Roundtable.

Budget: $359,642
Universities: FSU
External Collaborators:

- Florida Reliability Coordinating Council (FRCC)
  - Florida Grid Modeling and Simulation, Utility-University Engagement, including Collaborative Proposals
- FRCC member utilities (most FL utilities, through FRCC committees)
  - Florida Grid Modeling and Simulation, Utility-University Engagement, including Collaborative Proposals
- City of Tallahassee Electric Utility
  - System Restoration Simulation and Analysis

Progress Summary

There has been substantial progress in the development of research-oriented models of the Florida electric power grid, the ultimate aim being models with sufficiently representative in behavior for investigation of wide-ranging scenarios and options in future development of the grid. The analysis of the Florida Power Grid Disturbance has been used as a means for comparing and validating behavior against real grid response. This approach has been demonstrated using an aggregated 14-Bus dynamic model with refinements in the data and protection related switching events, with results matching the recorded data observed in the incident report with minor discrepancies. Results suggest that the reduced, 14-bus model version may be useful, with reasonable assumptions, for some simplistic studies. Work is underway to construct parametric studies to determine the parameters sensitivity in the simulation using factor screening and other statistical techniques.



Rick Meeker of the FSU Center for Advanced Power Systems presenting the Florida Grid project at the FESC Summit.

Though the 14-bus Florida grid model may be sufficient for some simple studies, the project's objective requires a more detailed benchmark system of the Florida grid. Therefore, a 154-bus notional electrical grid of Florida was built with detail representation using data available in the public domain. Reasonable model power flow results have been produced, and, efforts have proceeded to develop a dynamic model for the 154-bus system. The dynamic model requires data for each unit of generators, exciters, turbine governors, power system stabilizers, automatic generation controls and all the required protective devices with accurate settings. Development of a notional dynamic model of the Florida gird is underway, with most of the dynamic data obtained from a variety of public resources. Where lacking complete details on each power plant's generation units, models for generators, exciters, and governors were chosen for the large plant or known plant at that bus. If information is available, models for the exact type of generation units are chosen. Typical data were assigned for the specified dynamic model parameters.

The development of a dynamic solar PV model with Maximum Power Point Tracking has been initiated and completed in this period. The model will contribute to the general power system modeling and simulation community as we intend to make it publically available and to the envisioned Florida Grid studies of future load and generation growth specifically. Initial studies of the impact of solar PV-based resources have been undertaken, and significant implications for power system operation and stability have been observed. The depicted bus frequency traces after tripping of a solar PV-power plant at different penetration levels reveal unacceptable frequency deviations.

A simulation effort was completed for a major municipal electric utility in the state to examine power system restoration from a complete system outage. This is expected to continue with further examination of system dynamics under different scenarios and possible development of simulation-assisted training.

Proposals: FOA 313 Smart Grid Topic 3 Voltage Regulation

Florida State University

Energy and Efficiency Video Public Service Announcements

PI: Andy Opel, **Co-PIs:** Phil Steinberg, Leslie France-Patterson, Laura Arpan, Ian Weir

Description: This interdisciplinary team will produce 6-8 short (30-second/one-minute) video public service announcements (PSAs) that address issues of energy and efficiency and one 12-15 minute informational documentary targeted to Florida legislators and the Governor's office. These videos will be tailored to reinforce existing IESES efforts.

Budget: $200,720
University: FSU

Progress Summary

Beginning in January 2009, our five member faculty team began meeting, with the addition of two quarter time doctoral graduate students funded by the grant; Jia Lu from Communication and Adam Keul from Geography. Laura Arpan and Jia Lu assembled an up to date literature review of research in the area of communication campaigns and environmental communication/persuasion. A summary of this work was presented to the group in late February 2009, with the goal of shaping the message strategy that would be emphasized in the PSAs.

Images from the Energy and Efficiency Public Service Announcement Videos.

Arpan and Lu then went on to develop a survey questionnaire to be administered to a random sample of Florida residents. This survey data will serve as baseline data as we begin message testing specific PSAs. Data from the survey was collected in May 2009 and analysis of that data is on-going. In addition, Arpan established partnerships with the Yale Project on Climate Change and the Center for Climate Change Communication at George Mason University. These partnerships include data sharing and survey question collaboration.

Based on the communication research aggregated by Arpan and Lu, Opel, Steinberg, France-Patterson, Weir, and Keul developed PSA ideas resulting in over 20 potential PSA videos. This list was narrowed down to the top eight concepts through consultation with Arpan and Lu. Production plans were developed for each concept, including locations, costumes, cast, script, storyboards and

props. Production plans included variations within each PSA that will allow for message testing in the fall of 2009. The messages were developed and tested on different demographic groups for preference testing.

Funds Leveraged/New Partnerships:

Opel, Arpan, and Steinberg have been in close contact with Scott Minos from the US Department of Energy over a proposed Center of Excellence in Energy Information and Communication. We have a revised draft of a proposal that we have developed with the assistance of Scott Minos and he recently circulated a white paper that will eventually serve as the basis for an RFP from the DOE. We also met with Chuck McClure and Chris Hinnant from the Information Institute in the College of Communication and Information and they have agreed to be active partners in pursuit of the CoE.

Florida State University

Planning Grant: Enhanced Thermal Performance and Microstructure Simulation of Nuclear Fuels

PI: Justin Schwartz

Description: The objective of this proposal was to perform preliminary investigations to determine the viability of improved oxide nuclear fuels through high thermal conductivity coatings such as "BeO." To meet Florida's sustainable energy demands, we pursued the option of enhanced oxide nuclear fuel performance by considering the potential for improved thermal behavior through high thermal conductivity oxide coatings. This work included a literature search of past investigations of the impact of enhanced thermal conductivity on nuclear fuel and reactor performance, the temperature and irradiation dependence of the thermal conductivity of BeO and other high thermal conductivity oxides, the chemical and thermal compatibility of BeO and nuclear fuels (UO_2, PuO_2, ThO_2 and MO_X), and initial studies into BeO coatings on HfO_2 particles, where HfO_2 serves as a benign surrogate for nuclear fuel oxides. We conducted an evaluation of possible coating processes and measured their thermal behavior. We used these findings to pursue external funding.

Budget: $15,000
University: FSU

Progress Summary

Project is complete.

Florida State University

Development of a Renewable Energy Research Web Portal

PI: Charles R. McClure, **Co-PIs**: Ian Douglas, Chris Hinnant
Students: Bradley Wade Bishop (MA Information Institute), Nicole D. Alemanne (MS Information Institute), Karen Doster, MS, Jiangna Han (MS Learning Systems Institute), Mike Falcon (B.A Information Institute)

Description: This one-year project will identify, organize, and make available via a web portal, research generated as part of the FESC effort as well as other selected related information resources and tools as identified by FESC participants. The goal of this project is to provide IESES, FESC, researchers, and others in the state of Florida with the research information they need to accomplish statewide energy goals. An initial product from this project will be an operational web portal that identifies, organizes, and provides access to a range of FESC and research related to renewable and alternative energy information. A second product will be research results on extending technologies that allow users to share information and grow/sustain the web portal through a range of social networking techniques. This research will position FSU to seek additional external funding related to interactive databases and web portals. Expected outcomes resulting from the project include increased IESES and FESC researcher productivity; increased leverage and collaboration of FESC resources and funding; and improved policy and decision making regarding the future uses and development of renewable and alternative energy in Florida.
Budget: $194,543
University: FSU

Progress Summary


Chuck McClure


Chris Hinnant


Ian Douglas

The project team designed the study to include five tasks: 1) gather background information pertaining to renewable energy research, 2) conduct a needs assessment, 3) design and develop the renewable energy web portal, 4) evaluate the renewable energy web portal, and 5) disseminate and publicize the renewable energy web portal. In the first six months of the project the team completed the first task and began to work on tasks 2 and 3. Tasks 2 and 3 were completed and tasks 4 and 5 initiated by the project team during the next six-month period as the portal itself was developed and improved. The project team continued to refine the portal, evaluate its usage, and disseminate and publicize the portal to the renewable energy research community. Furthermore, the project team also attempted to explore additional means of pursuing funding opportunities from several research foundations, as well as government agencies.

During the project period, the project team developed, launched, evaluated, and improved the renewable energy research web portal. Furthermore, the project team publicized the portal and its features to the broader renewable energy community. During the no-cost extensions, the project team also pursued additional sources of external funding from private foundations and government agencies. The project team will continue to pursue funding as future opportunities arise. The portal is currently available to the renewable energy research community and the public at the following URL: http://energyportal.cci.fsu.edu/.

Funds Leveraged/New Partnerships:
The project team will continue to pursue funding as future opportunities arise.

Florida State University

Promoting Energy and Land Use Through Land Use, Transportation and Green Infrastructure Polices

PI: Tim Chapin; **Co-PIs**: Ivonne Audirac, Chris Coutts, and Greg Thompson (Department of Urban & Regional Planning), and Mark Horner (Department of Geography)
Students 3 graduate students

Description: In response to the many issues related to energy provision, energy sustainability, and GHGs, in 2007 Governor Crist created an Action Team on Energy and Climate Change. This group was tasked with investigating and recommending strategies for reducing GHG emissions, creating more sustainable energy systems in Florida, and for establishing Florida as an international leader in innovative energy provision. Related to this, the 2008 session saw the Florida Legislature pass HB 697 which, among many things, requires every local government in the state to address energy systems and GHG emissions explicitly within their comprehensive plans. Currently, the linkages between energy planning, environmental and economic sustainability, land use and transportation planning, and GHG reductions have never been stronger in Florida. This project is aimed at continuing the momentum in Florida for developing broad-based solutions to these problems by helping to develop a knowledge base for informing state policy in the areas of energy, sustainability, and land use and transportation planning.

Budget: $168,185
Universities: FSU, Griffith University (Bisbane, Australia), University of Florida

Progress Summary

The project began in May 2009 and continued through the end of the 2010 calendar year. During the spring and summer 2010 terms, the research team finalized its review of the current state of knowledge in the issue areas, as well as completed our review of state and local energy and climate change policies and outlined the report. We have also completed interviews with key informants at key state agencies and with planners in local governments that have taken the lead on this issue in the state, and discussed our findings with key informants in non-profit agencies and within the land development industry. We also continue to identify potential outside funding sources for continued work on this initiative.

We continue to work on generating a report similar to the *Tough Choices: Shaping Florida's Future and Facing Florida's Revenue Shortfall* document prepared by the Collins Institute. This report summarizes the literature on the links between urban development patterns and energy sustainability/climate change and makes recommendations for state policies and programs to address these issues. The intention is to author a report that is easy-to-read, including graphics, and will highlight the key policies and programs the state should pursue to achieve its energy sustainability and climate change goals.

The IESES "primary mission is to provide Florida and the country with up-to-date and pragmatic tools and analysis to assist in meeting challenges, and to forge new opportunities for an unprecedented energy and climate constrained era." This research project directly serves this mission in that the project report will inform public officials and elected officials about the breadth and form of the policy options available to them. In terms of the objectives and thrusts of the IESES initiative, this project specifically targets Objective 2 (Assisting Florida's Governing Bodies) and Thrusts #5 and #6 (Enhancing Energy Efficiency and Energy System Environmental and Economic Impacts). This research project contributes directly to the IESES objective to "assist Florida's governing bodies in the successful development and implementation of a comprehensive, long-term, environmentally compatible, sustainable, and efficient energy strategic plan for the state".

Florida State University

Marketing Strategies to Incentives Entrepreneurship and Innovation in the Development of Sustainable Energy

PI: Joe Cronin **Faculty:** Dr. Jeff Smith
Students: Mark Gleim (PhD), Stephanie Lawson (PhD), Jeremy Wolter (PhD)

Description: The objective of this project was to investigate the role of market pull strategies in advancing sustainability goals. Specifically, the intent is to identify what "drives" consumers' attitudes and behaviors relative to sustainable products. This includes consumers' personal attitudes, opinions, and beliefs, their perceptions of their own and organizations' abilities to affect or change the environment in which they live, and their personal characteristics (e.g., demographics). In addition, in collaboration with the College of Communications, the strengths and weaknesses of the various communication modalities that can be used to deliver sustainability knowledge to consumers (e.g., advertisements, testimonials, expert word-of-mouth communications, public relations, publicity, etc) were assessed. Specifically, the research attempts to identify the optimal market pull modality; that is, the means by which to deliver to consumers the knowledge that drives the purchase of sustainable goods and services. The overall objective of the research is to provide much needed market pull information for organizations embarking on "green" marketing strategies; that is, firms in the process of developing or expanding their mix of environmentally friendly goods and services.

Budget: $278,778 (total), $102, 564 (yr 2)
University: FSU

Progress Summary

The research team has made tremendous strides during the reporting period in meeting many of the goals. Currently five papers have been published in the proceedings of national or regional conferences, including our premiere American Marketing Association conferences. Further, six conference presentations have been given on sustainability related topics funded through the IESES grant. In addition, four invited presentations have been given at different universities across the country. Numerous articles of research are also under review at various journals, or nearing the process of submission to select premiere marketing journals.

In particular, we have published a paper entitled "Green marketing strategies: an examination of stakeholders and the opportunities they present," in one of the premiere marketing journals, *Journal of the Academy of Marketing Science*. This paper was part of a special issue on sustainability and has been the most downloaded article from that issue, and one of the most downloaded articles of the year. Further, we have been invited to revise and resubmit a paper entitled "Against the Green: A Multi-Method Examination of the Barriers to Green Consumption" in another premiere journal, *Journal of Retailing*.

Securing additional funds has also been a priority for the newly formed College of Business-Center for Sustainability Initiatives (CSI). As such, members of the research team were recently awarded a research grant from the Von Allmen Center for Green Marketing in the Gatton College of Business and Economics at the University of Kentucky. The proposal, entitled "The Adoption of Sustainable Practices: Overcoming Perceived Barriers to Socially Responsible Initiatives" won the highly competitive award. Several members of the research team also attended the second annual

Sustainability in Marketing Colloquium hosted by the University of Kentucky where Dr. Cronin was invited to present the research of the award winning proposal.

In addition, members of the CSI research team have been active within the FSU and local communities. Members of the research team have been invited to speak at number professional and practitioner-oriented seminars at the state and local level. Within the university, the research team is exploring potential partnerships with other groups to incorporate a sustainability-oriented approach to business strategies. The development of a sustainability-oriented marketing class is also in the works, potentially as an undergraduate course or as a part of the MS in Marketing program. In addition, the undergraduate basic marketing course has gone green by requiring students to utilize an online textbook.

The online research panel housed in the CSI has made tremendous progress as well. The panel has nearly 1,000 members and we hope to dramatically increase that number very soon with the help of the FSU Alumni Office. Current panel members are already actively engaged in our research and eager to participate in future endeavors.

Florida State University

Energy Sustainable Florida Communities

PI: Richard Fieock**, Co-PIs:** Ivonne Audirac, Keith Ihlanfeldt
Student: Christy Smith, PhD in Public Administration

Description: The objective of NESC is to stimulate innovation and energy investments that will accelerate energy savings by local governments by sharing best practices and organizing and managing large scale collaboration and bulk buying projects.

Florida State University has been working with U.S. DOE contributing surveys, research and outreach assistance to assist in efforts to promote investment, collaboration, and bulk purchasing by local governments that will achieve significant cost savings. This includes organizing NESC conference calls co-hosted by hosted by FSU and DOE, conducting several surveys, and hosting a meeting of Florida local government EECBG sub-awardees.

These initial research efforts and conference calls have been successful in identifying broad interest in collaboration and bulk buying. They also revealed significant barriers to collaboration that need to be addressed including issues related to coordination within governments, among governments and with other organizations.

We are now undertaking activities to address these barriers to collaboration at three levels: First we are conducting focused regional workshops throughout the state. By bringing interested governments in each region together with experts in collaboration, governance, finance, and purchasing we will identify specific projects and design the mechanisms to put the projects in place. Second, are expanding our statewide dialogue on a more systematic basis and share the insights and successes of our regional workshops. Third, we are working with universities and other partners throughout the U.S. to share strategies and insights and help replicate our successes in other states. By expanding our efforts and formalizing the network we will make large scale energy savings a reality.

Budget: $125,424
University: FSU

Progress Summary

We sent out monthly activity updates to our members, held a regional workshop in Palm Beach County, and co-hosted with FCCMA an Energy Efficiency and Sustainability symposium in Tallahassee. We held our second regional workshop scheduled for the Jacksonville area on March 15, 2011, and have tentative plans to hold workshops in central Florida as well as the western Panhandle area. In addition to our outreach efforts related to local governments in the state via the workshops and symposium, we are also networking with sustainability directors at Arizona State, Washington State, Notre Dame, and Michigan to share best

Richard Feiock, center left in blue coat, with students and Dave Cartes of IESES at the FESC Summit.

practices. Christy Smith organized our first conference call and Julia Parzen of the network coordinator for the Urban Sustainability Directors Network, a national sustainability network, joined the call. We have also developed relationships with the State Energy Office, Johnson Controls, Inc., GE, and Metal Essence, the only LED manufacturing company in the state. We are hoping to continue to develop these relationships to facilitate our outreach efforts as well as to jump-start the bulk purchasing aspect of our mission. We have also developed a website that provides resources to local governments looking for information on using the state term contract, performance contracts, and the EECBG program in general.

Proposals Submitted:

Faculty	Source/Agency	Project Title	Date Submitted	Amount
Feiock, Rick	NSF	Collective Action and the Diffusion of Policy Innovation: Adoption of Energy and Climate Change Initiatives by US Cities	2011-01-15	$363,475
Feiock, Rick	NSF	Innovation and Organizational Sciences	2011-02-02	$373,716
Feiock, Rick	US DOH	The Unfulfilled Promise of Smart Growth	2011-02-04	$350,000

Grants Awarded:

#	Faculty	University	Code	Source/ Agency	Project Title	Start Date	End Date	Amount
1	Feiock, Richard	FSU	Federal	NSF	Rapid Study Of Economic Stimulus On Local Government Energy Innovation	2009-07-15	2010-07-14	$ 97,503

Florida State University

Innovative Proton Conducting Membranes for Fuel Cell Applications

PI: Ongi Englander **Co-PIs:** Anant Paravastu**,** Subramanian Ramakrishnian

Students Supported

Erin Holley (MS Materials Science, graduated August 2010)
Nicola Kissoon (MS Materials Science , to graduate Spring 2011
Velencia Witherspoon (BS Chemical Engineering (Honors Thesis), to graduate Spring 2011)

Description: This project was initiated in January 2009 as an interdisciplinary effort among Englander (Mechanical Engineering), Paravastu (Chemical and Biomedical Engineering) and Ramakrishnan (Chemical and Biomedical Engineering). The work was divided into two main tasks: (1) the fabrication and characterization of silica and latex-supported membranes, and (2) the incorporation of protein nanomaterials inside the silica membranes. Three female students have participated and contributed to the project (see below). Two of the students (Holley and Kissoon) have received/will receive MS degrees in Materials Science. Two of the students (Kissoon and Witherspoon) belong to underrepresented groups.

Budget: $30,000
University: FSU

Progress Summary

Project Impact and Conclusions:

Synthesis and Characterization of Latex Composite Membranes using monodisperse particles:
Particles of 200 nm, 650 nm and 900 nm were successfully synthesized using an emulsion polymerization technique. Membranes were then fabricated by depositing these particles on commercial supports and by heat stabilizing them.

Incorporation of protein nanomaterials inside silica membranes:
Physical incorporation of protein nanofibers into silica-based membranes requires the preparation of highly well-dispersed protein nanofiber arrays. Additionally, the functional integration of these materials with silica membranes requires that their electrical transport properties become better understood. Thus, our efforts have focused on both the synthesis of well-dispersed protein nanofibers and their integration with microfabricated electrodes as a means for the evaluation of electrical transport properties. We have successfully integrated well-dispersed protein nanofibers within the membranes, but have yet to realize a sample which is suitable for transport characterization studies.

Proposed Future Activities and their Potential Impact:
Develop methods and testing capabilities for characterizing the protein nanofibers within the membrane. For example, frequency-based transport measurements are needed as we suspect that ionic transport may play a significant role the overall transport characteristics in these materials.

Funds leveraged/new partnerships created

Faculty	University	Source/Agency	Project Title	Date Submitted	Amount
Englander, Paravastu	FAMU	MIT-HBCU program	Integration of Self Assembled Protein Nanofibers into Sensing Architectures	4/2010	$200K

FLORIDA STATE UNIVERSITY

Planning Grant: Advancing Knowledge of Network Theory for Analysis and Design of Smart Power Grids

PI: Svetlana V. Poroseva **Co-PIs:** Yousuff Hussaini, Per Arne Rikvold

Description: With power grids evolving towards increasing size, complexity, and integration, it has become more difficult to describe and predict their behavior, even under normal operational conditions. With technological development, climate change, and activities in the political arena, adverse circumstances (natural disasters, intelligent adversary, software design errors, human errors, etc.) have become more probable and costly events. The Project seeked to provide industry and government with advanced analytical and computational tools necessary for the automated evaluation of the structural resilience and reliability of power grids. The potential applications of the Project's results go beyond power grids. Any infrastructure essential to our society and economy (e.g., computer, communication, transportation) can benefit from the Project's results.

Budget: $15,000

Progress Summary

Project is complete.

FLORIDA STATE UNIVERSITY

Establishment of the Center for Marine Bioenergy Research: Systems Approach to BioEnergy Research (SABER)

PI: Joel Kostka **Co-PIs**: William Cooper, Ivonne Audirac, Amy Chan-Hilton,Ellen Granger
Students: Claire Smith (Ph.D.), Kristina Welch (M.S.)

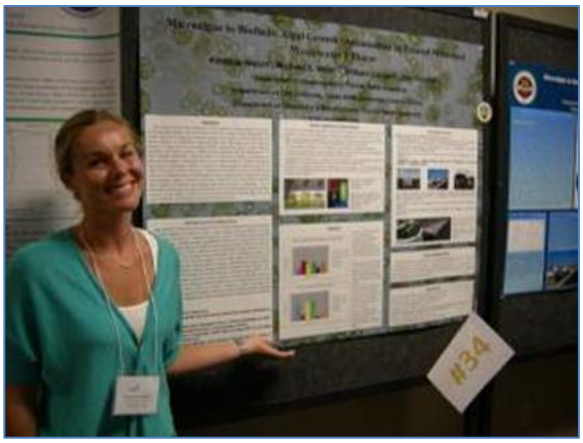
Description: IESES' Systems Approach to Bio-Energy Research (SABER) is particularly focused on coupling algal cultivation to wastewater nutrient remediation. SABER has partnered with the City of Tallahassee's T. P. Smith Waste Water Treatment Plant in order to study the growth of local fresh water algae in waste water for use as biofuel. The two main objectives of this project are to: 1) perform both laboratory and field experiments to test for species-specific growth potentials, as well as for the effects of different environmental parameters, including light, carbon dioxide, and nutrient availability on microalgal growth rates and lipid production, and 2) determine the extent to which microbes (i.e. bacteria), which are exceptionally abundant in waste water, act as either competitors (for nutrients, carbon) or symbiotically with algae. To do this we are examining the bacterial community present in the waste water and detecting community shifts that occur during algae cultivation. We are also examining the nutrient uptake dynamics between bacteria and algae by monitoring the usage and production of nitrogen, phosphorous, and carbon-containing compounds. Finally, a number of advanced analytical chemistry techniques are being used to characterize wastewater before and after algae cultivation. With a better understanding of the microbial and biogeochemical processes occurring in waste water during algae cultivation, engineering approaches may be proposed in order to further optimize algal growth in waste water.

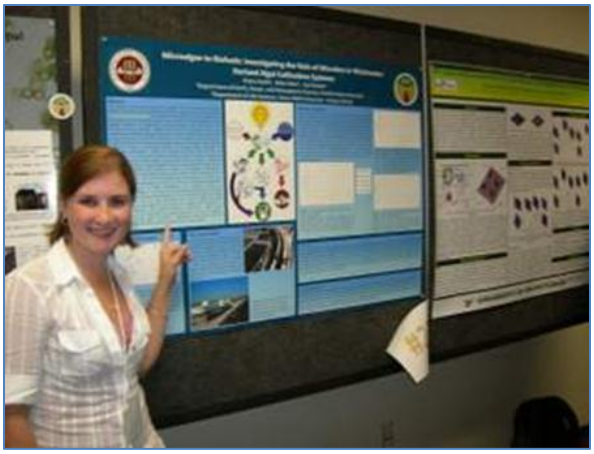
Budget: $494,135
University: FSU
External Collaborators: City of Tallahassee

Progress Summary

Joel Kostka directs the Systems Approach to Bio-Energy Research (SABER) facility until August, 2011, when he leaves for Georgia Tech. Afterward, Jeff Chanton has agreed to become director and lead the program into the future. Bill Cooper of the Chemistry department and Mike Watts of the FAMU-FSU College of Engineering both serve as SABER Co-PIs and they will continue to support the program by directing students. Timeline and Operation of Facility: Maintenance and day-to-day operations of the facility will be carried out by graduate students, Claire Smith and Kristina Welch. Both of these students will pursue the M.S. degree in the Earth, Ocean and Atmospheric Sciences (EAOS) department. The students plan to finish their degrees in 2012. Both student theses will be directed by Professor Chanton. Kostka will co-direct Claire's thesis research as a courtesy faculty member of EOAS, while Mike Wetz will continue to codirect Kristina's thesis project. Kostka will also serve as a member of Kristina's thesis committee. Bill Cooper has participated in SABER as a coPI since its inception. He has agreed to help run the algal cultivation facility and will serve on the thesis committees of both Claire and Kristina. This arrangement should work quite well.

The SABER group (the students, Kostka, Wetz, Cooper) already has monthly meetings by video chat with Mike Wetz at Texas A&M to discuss the research being conducted by the students. Michael Watts has also participated in SABER PI meetings. The chair of EOAS has agreed to keep the Kostka and Wetz laboratory space intact until the students finish. Kostka has agreed that any and all equipment necessary for both student's research will remain in the Kostka laboratory space until the students finish their theses. All of Kostka's graduate students have helped to run the algal cultivation facility at the Tallahassee Wastewater Treatment Plant and they will continue to do so. Third year Ph.D. students in EOAS, Puja Jasrotia and Andy Canion, will remain at FSU and will continue to be supported on Kostka's federal grants until they complete their dissertations. Puja and Andy will assist Claire and Kristina as needed. Claire and Kristina feel that the algal cultivation system is not difficult to train someone to use. Thus, they have agreed to prepare protocols for operation of the facility, so that future FSU students will be able to step in and continue the research. They will also train students recruited by FSU faculty members to run the facility. Chanton will oversee the operations into the future. Students will be recruited from the EOAS department (Chanton), Chemistry department (Cooper), and the FAMU-FSU College of Engineering (Mike Watts) to continue SABER research.





SABER Graduate Students at the FESC Summit

The SABER team has recently made contact with two organizations that can help to move this project forward in subsequent years. Sustainable Tallahassee is a local non-profit organization that promotes environmental stewardship and economic development through education and collaboration (http://sustainabletallahassee.org/). Sharon Liggett, Executive Director of
Sustainable Tallahassee, has agreed to promote our algae-to-biofuels program in their Good Green News and Events newsletter and to help recruit volunteers to work at the facility.
Volunteers from Sustainable Tallahassee and from the FSU Green Student organization will be trained by graduate students to grow and process algal biomass to supply city bioreactors to produce diesel fuel for the City of Tallahassee fleet.

A second major product of this project will be an environmentally-friendly pilot scale algal cultivation facility that will demonstrate the

production of biodiesel and/or hydrogen from algal biomass grown on wastewater from the Tallahassee Wastewater Treatment plant. The goal is to grow enough biomass to produce diesel fuel and/or hydrogen at the demonstration scale.

Oil that is dewatered and pressed from algal biomass will be converted to fuel in a reactor that the City of Tallahassee operates in conjunction with it's automobile fleet. Buddy Driggers is the Parts and Fuel Representative for the City of Tallahassee. At present, he produces 300 gallons of biodiesel per week from cooking oil waste. He estimates his capacity is 300 gallons of biodiesel per day. Mr. Driggers has agreed to test algal biomass in his transesterification reactor. The reactor can be scaled from 5 to 150 gallons depending upon the amount of oil that can be dewatered and squeezed from the algae. Our initial goal will be to produce 5 gallons of pressed oil from algae produced in our open raceway ponds. Biomass will also be thermochemically converted to hydrogen in collaboration with students from Yulu Krothapalli's research group.

Protocols developed by SABER's graduate students will be utilized by new students recruited into the program and by volunteers recruited from the local community by Sustainable Tallahassee.

What is unique about this program is that it offsets the environmental and economic costs of renewable biomass production by utilizing municipal wastewater nutrients. Fertilizers are one of the more costly inputs into the biomass production value chain and traditional biofuel crop production that leads to significant nutrient (fertilizer) runoff to adjacent waterbodies. Our approach will yield significant nutrient remediation capability to the City of Tallahassee along with the production of biofuel. That is, algae will sequester nutrients that would otherwise be discharged to adjacent waterbodies.

Student(s) Supported: Claire is currently being supported by IESES. Claire has a fellowship proposal pending at NSF. If that is approved, she will be funded through the summer by NSF. Regardless, after the IESES funding runs out, she will be supported by Kostka by working as an RA on his oil spill research projects. Claire has agreed to this arrangement.
Kristina will continue to be supported by the Dean until she graduates. Kristina has a small budget for materials and supplies, also supported by the Dean.

Use of Facility and Final Product: The SABER algal cultivation facility is, and will be, critical for training students to support the bioenergy industry in Florida. One major product of this facility will be that it allows for the training of skilled workers for the bioenergy industry. The bioenergy industry is undergoing burdgeoning growth in the state of Florida. Two biomass-to-biofuels companies in particular, Algenol of Bonita Springs and Petroalgae of Melbourne, are growing very rapidly. SABER has made contact with both of these companies and supervisors there have talked about their needs for the hiring of trained personnel. Petroalgae in particular has close ties to FSU as high level officials there are alumni and one has a child attending FSU.

Faculty	Source/ Agency	Project Title	Start Date	End Date	Amount
Kostka, Joel E.	BP/FIO	Penetration, accumulation and degradation of BP DWH oil in Florida sandy beaches	8-1-2010	7-31-2012	$255,259
Kostka, Joel E.	NSF	Rates and mechanisms controlling the microbial degradation of crude oil from the MC252 spill in Gulf of Mexico beach sands	2010	2011	$169,591
Kostka, Joel E.	NSF	Request for funds for an oil extraction system and gas chromatograph with mass spectrometer for the extraction and analysis of DWH crude oil in Gulf sands	2010	2012	$100, 850

FLORIDA STATE UNIVERSITY

Microgrids for a Sustainable Energy Future

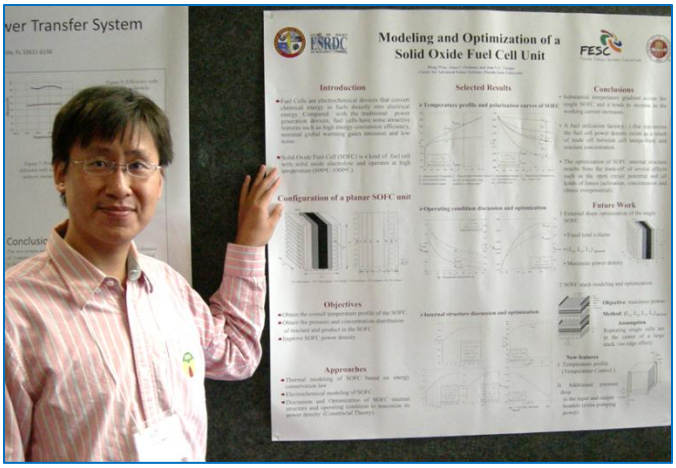
PI: Chris S. Edrington
Co-PIs: Jim Zheng, Mischa Steurer, Dave Cartes, Hui (Helen) Li, Juan Ordonez
Students: Brian Hacker, Jianwu Cao

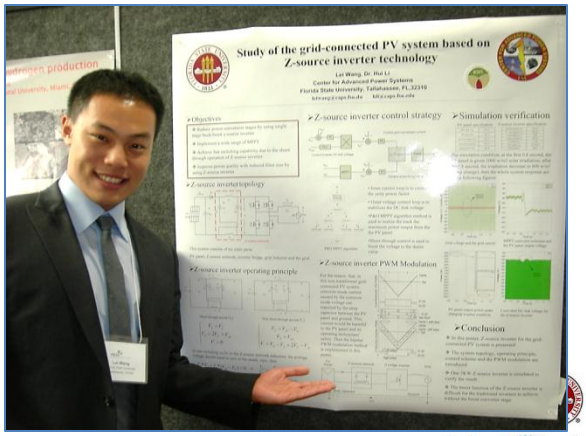
Description The primary aim of the project was to address research and development in the area of microgrids. Specifically the focus was in the area of PV and Plug in Hybrid Electric Vehicles integration, microgrid modeling and control, grid-tying inverters/converters, energy storage, tri-generation, and standards development for smart grids.

Budget: $719,333.00
University: FSU

Progress Summary

Several students were able to participate in the research effort and thus able to obtain their graduate degrees, this helping in the overall goal of increasing an educated energy-oriented workforce. Additionally many publications were written that helped not only to disseminate the results of the work, but also to improve the reputation of research initiatives in the State of Florida. This project is complete.





Clockwise from bottom left: Lei Wang, Brian Hacker, and Hang Wei at the 2010 FESC Summit

Dr. Helen Li, second from left, and FSU Center of Advanced Power Systems students participated in the FESC summit and were also part of the Microgrids for a Sustainable Energy Future Project.

Proposals:

Faculty	Source/Agency	Project Title	Date Submitted	Amount
Chris S. Edrington, Saritha Balathandayuthapani, and Shawn Henry	National Science Foundation	PV Inverters with Anti-islanding and Grid-Support Functions	2010-10-07	$303,054
Chris S. Edrington	Department of Energy	Advanced Computational Tools for DER-Integrated Power Systems	2010-10-30	$752,727

Funded Awards:

Faculty	Source/ Agency	Project Title	Start Date	End Date	Amount
Chris S. Edrington and Sanjeev Srivastava	National Science Foundation – Engineering Research Center	Addressing Nonlinearities and Complexity in FREEDM Systems	2010-09-01	2011-08-31	$40,000
Chris S. Edrington	Department of Energy	A Nationwide Consortium of Universities to Revitalize Electric Power Engineering Education by State-of-the-Art Laboratories	2010-06-01	2013-05-31	$25,000

FLORIDA STATE UNIVERSITY

Planning Grant: Hydrogen storage using carbon-based adsorbent materials

PI: Efstratios Manousakis

Description: We propose to theoretically investigate a variety of carbon based nano-porous materials, such as activated carbon or single-wall or multi-wall carbon nanotubes, which can be used to store and transport hydrogen. We find that by doping with metallic elements, the micro-surfaces of these carbon-based porous materials provide increased van der Waals forces to the adsorbed hydrogen molecules; this effect significantly enhances the volumetric energy density for hydrogen storage and we propose to carry out a full theoretical investigation to find the optimum conditions.

Budget: $15,000
University: FSU

Progress Summary

This project is complete.

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Multi-Generation Capable Solar Thermal Technologies

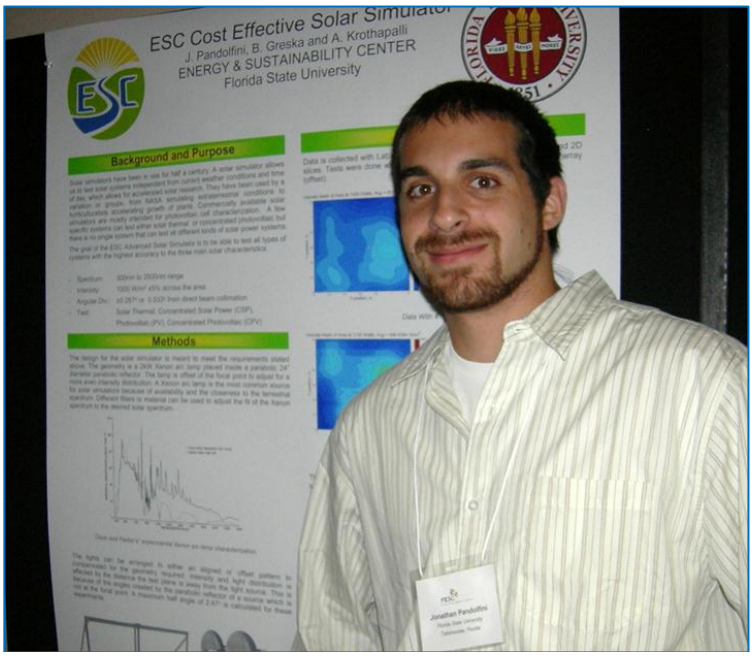
PI: A. Krothapalli
Students: Jon Pandolfini (Ph.D.)

Description: The objective of the proposed research is to develop and demonstrate small-scale solar thermal technologies that can be used separately, in conjunction with one another, or with existing waste heat producers, thus improving the overall system efficiency.

Budget: $544,226
University: FSU

Progress Summary

The solar simulator has been ordered and constructed. A frame for the array is built out of 80/20 extruded aluminum. Power supplies and control circuits allow the lights to be controlled to a desired constant power. Analysis was conducted by graduate student J. Pandolfini under the direction of B. Greska and A. Krothapalli. The solar simulator was determined to be cost effective.



Jon Pandolfini at the 2010 FESC Summit

FLORIDA STATE UNIVERSITY

Planning Grant: Meteorological Factors Affecting Solar Energy Efficiency in the Tropics

PI: Paul Ruscher**, Co-PIs:** Yaw Owusu, Hans Chapman
Student: Tim Sliwinski (BS, Meteorology)

Description: There are numerous meteorological factors that limit the efficiency of solar energy systems in the tropics. Depletion of available solar energy at the surface by increased water vapor, cloudiness, temperature of the solar panel system, pollution, are sometimes overlooked, because engineering specifications for design are often based upon midlatitude continental air masses. The typical tropical atmospheric reduction factors are reviewed using a state of- the-art solar energy model for this project. In addition, meteorological variability can be quite extreme in the tropics and many engineering studies on feasibility of renewable energy sources in general are often based upon "typical" year criteria, rather than longer term climatologies. It is suggested that climatological data be utilized to more accurately portray the variability of output to be expected at a typical installation. Many of these variables are already widely available from a combination of surface and upper air meteorological stations, as well as remote sensing data from satellites. We demonstrate the sources for these data as well as strategies for teaching about solar energy efficiency using routine observations from school-based weather stations.

Budget: $15,000 (February 2009 – December 2010)
University: FSU
External Collaborators: NOAA/National Weather Service Key West, University of the West Indies and Caribbean Solar Energy Center (Trinidad & Tobago), University of Technology (Jamaica), NOAA Global Systems Division, Earth Science Resource Laboratory (Boulder, CO)

Progress Summary

The establishment of new monitoring stations allows for the collection and integration of meteorological and solar energy data will improve our ability to ascertain solar energy efficiency as well as the role that various meteorological factors play in decreased efficiency, compared to that expected from industrial ratings of solar systems. The utility of a Department of Energy approved model called SMARTS, has also been demonstrated. This model allows for a wide range of experiments designed to focus on those factors that can have the most benefit (or detriment) to an efficiently and well-designed solar energy system for those pursuing such applications. It also helps to understand some unmet needs, particularly with respect to the adverse affects of cloudiness which are not directly treated in SMARTS, and which are only crudely attempted in most engineering applications.

Paul Ruscher

Funds Leveraged/New Partnerships:
The team plans to submit a proposal to DOE/NREL for proposed improvements to monitoring and modeling solutions that were brought about during this research. It will also help to develop further applications of these methods with our Caribbean partners and other locations where solar energy can be expected to be of widespread use. A long-term goal is the development of a new standard for solar energy rating systems appropriate for the tropics.

FLORIDA STATE UNIVERSITY

Political and Economic Institutions Regarding Siting of Energy Facilities

PI: R. Mark Isaac; **Co-PIs:** Douglas Norton, Svetlana Pevnitskaya
Students: Sean Collins and David Johnson.

Description: The "holdout" problem occurs when one economic agent attempts to construct a portfolio of economic assets (often land) from multiple sellers. When a public good has diffuse public benefits but costs concentrated on a few, a "NIMBY" problem (Not In My Back Yard) may exist.

Budget: $43,663
University: FSU

Progress Summary

The "Hold-Out" project (with graduate student Sean Collins). The experimental design is complete, the programming is complete, Institutional Review Board approval has been obtained, and we have conducted two complete experimental treatments. This research was presented at one of the Presidential Sessions at the 2009 Meetings of the Southern Economics Association in November in San Antonio.

Mark Isaac of the FSU Economics Department

The "hold-out" concept is discussed repeatedly in the context of public policies regarding land acquisition and facilities siting, but a clear definition is elusive. To economists, the most likely definition is that a profitable amalgamation of land parcels by one buyer from competing sellers does not occur because of the failure of the private bargaining process. However, sometimes the term seems to be used more for delay instead of failure in bargaining, or even the very different concept of creation of any bilateral bargaining situation of the buyer and the "last" or "holding-out" seller, which may be inconvenient to the buyer but is immaterial in terms of economic efficiency unless efficient trades actually fail.

Our goal in this first set of experiments was simple. If "hold-out" is an empirically worrisome economic phenomenon, we ought to be able to find it in subjects who make decisions in our laboratory. Therefore, our first task was to create a "best case" scenario to observe holdout, which could then serve as a test-bed in which to examine changes in institutions and/or information conditions to ameliorate hold-out. Several design issues were obvious in creating this best-case scenario. There was no possibility, not even a threat, of any eminent domain proceeding. The buyer would have to purchase all of the parcels in order to reap the synergistic gains from amalgamation. There would be no contingent contracting, so that the buyer would face the so-called "exposure problem" of having to pay for some of the parcels before knowing whether he/she could successfully obtain all of them. And, the buyer would be capital constrained, that is, unable to borrow against the eventual value of the amalgamated properties. All of this would unfold in the context of valuations which made the amalgamation profitable to the buyer relative to the separate values placed on the parcels by the sellers. If hold-out existed, it would mean the failure of bargaining to capture mutually beneficial gains from exchange.

The design conditions above were good as far as they went, but we then had to choose certain information conditions whose effects on the "best case" objective were ambiguous. For example, should the terms of the contracts be common knowledge? On the one hand, that might stoke

the fires of "me last" among the sellers; on the other hand, it might be a vehicle for the development of reasonable expectations among the sellers as to what to expect from the negotiations.

What we realized was that there was an array of these information conditions that, while ambiguous as to their propensity to promote holding-out, were clearly different from what one might recognize as the archetypal approach to the facilities siting problem when approached by governments or by private parties. In the contemporary era, governments often operate in the context of "Government in the Sunshine" and "Freedom of Information" provisions that promote transparency and common knowledge. On the other hand, private acquirers of large parcels often resort to just the opposite: institutions such as non-disclosure agreements and dummy corporations to keep as little information as possible from seeping into the negotiations. Therefore, even in our "best case" scenario, we began with two information conditions. One we call "government" in which sellers know how many units the buyer has purchased, all contract prices as they occur, and they can continue to communicate with one another throughout the negotiations. In the other, "private," information condition, sellers do not know how many of the parcels the buyer has purchased, they do not know the other contract prices, and there is an enforced non-disclosure condition.

Our results are unambiguous: we observe the hold-out problem in our baseline design. In fact, in about half of the cases the contracting fails. This means that we have successfully created a test-bed which we can use to investigate institutional and information conditions that might ameliorate hold-out. Our second experimental treatment has been completed, and again the results are unambiguous: contingent contracting significantly ameliorates the hold-out problem.

A version of this research was one of the chapter's Dr. Sean Collins' dissertation. Sean has just joined the faculty of Fordham University. We are working on restructuring the paper from a dissertation chapter format to that of a journal article, and our intention is to submit it to *The Journal of Law and Economics.*

The "NIMBY"project (with Co-PIs Doug Norton and Svetlana Pevnitskaya).

The project operates at the intersection of economics and sustainable energy and the environment, the fundamental nexus of IESES, because the siting of alternative energy facilities is often driven by economic, organizational, and environmental considerations. The Tallahassee experience with the bio-mass plant was a perfect example of the heterogeneous public goods valuation problem.

The experimental design and programming are complete, IRB approval was obtained, and the first twelve experimental sessions have been conducted. The first presentations of the design were at the 2009 Southern Economics Association meetings and the 2010 American Economics Association meetings. The first public presentation of the results was at the 2010 World Meetings of the Economic Science Association in Stockholm in July, and it will also be presented at the International Social Dilemmas Conference at Rice University in September and the Southern Economic Association Meetings in November.

The NIMBY issues deals with siting issues in which external effects are "good" for some members of "society" and bad for others. If the debate over the alternate energy bio-mass facility in Tallahassee had not happened, people might have thought we were making things up if we had hypothesized a scenario. Even as our research was underway, a similar scenario played out with the cancellation of the bio-mass facility in Gadsden County. Different citizens with credentials as "environmentalists" ended up viewing the plant as either a "good" (because of the development of an alternative energy infrastructure with an eye to global issues of sustainability and global warning) or a "bad" (because of the local environmental effects). Examination of public goods provision problems in such a heterogeneous-preferences situation is, by itself, opens a new direction for research in economics.

In initial presentations of the design, it is clear that our decision mechanism, the generalized voluntary contributions mechanism will be received as an important institution in its own right. We completed the last experimental session during Finals Week, so we are only now beginning to

analyze the data. The aggregate data reveals effects of the nature of the conflict (what we call "censored" versus "uncensored" conflicts), from whether the groups have a majority positive or negative valuation, and also from the intensity of minority preferences either for or against the projects.

Funds Leveraged/New Partnerships

We have applied to the NSF for funding to continue research on this project. In addition, Isaac has been listed as a Co-PI on the large DOE grant relating to energy improvement districts, and a new evolved grant that shares many of the goals for undergraduate education as our "Economics of Sustainability" course.

FLORIDA STATE UNIVERSITY

Reducing Residential Carbon Emission in Florida: Optional Scenarios Based on Energy Consumption, Transportation, and Land Use

PI: Tingting Zhao**, Co-PI:** Mark Horner
Students: John Sulik, Tim Kelleher, PhD students

Description: In 2007 the Governor of Florida established targets for greenhouse gas (GHG) emissions, which mandate that the State of Florida aims to reduce emissions to 2000 levels by 2017 and to 1990 levels by 2025. To fulfill these goals, not only is the development of renewable sources of energy and fuel needed, but it is also necessary to achieve more sustainable energy/fuel consumption patterns. This project is dedicated to the latter objective, i.e., exploring the effectiveness of optional scenarios for households' consumption of energy and transportation fuels with respect to CO_2 mitigation. Human land use is another major concentration of this research, as changes in the built environment and vegetation cover may create sources or sinks of CO_2 and hence affect the intensity and origins of carbon emissions.

Budget: $21,707
University: FSU

Progress Summary

Tingting Zhao

Mark Horner

The initial proposal of this project consisted of three major steps: 1) calculating the Florida baseline CO_2 emissions from residential energy and fuel consumption as well as human land uses; 2) developing models of household behavior regarding various energy/fuel conservation and incentive options based on a residential survey; and 3) forecasting energy/fuel demand and CO_2 emission levels in 2017 and 2025 throughout the state of Florida based on the scenarios created in step two.

This project was planned to be completed within two years. The PIs concentrated mainly on 1) journal publications on carbon inventory analysis at the state level; 2) finalizing the household energy consumption survey (including sampling design), which is composed of over 30 questions dedicated to household energy practice and responses to energy-saving incentives; and 3) preparation for the external grant application to the NSF Geography and Spatial Sciences (GSS) program. Data collection from the survey is complete and data analysis is underway.

FLORIDA STATE UNIVERSITY

Investigating the Effect of Appliance Interface Design on Energy-use Behavior

PI: Paul Ward; **Co-PIs:** Ian Douglas, David Eccles

Students:

Avner Dachoach / Ph.D., Psychology (Cognitive)
Jarrett Evans / Ph.D., Psychology (Cognitive)
Jason Torof / Post-bacc, Psychology / Masters, Educational Psychology & Learning Systems
Stephanie Robertson / Ph.D., Educational Psychology & Learning Systems
Katerina Kudluckova / Ph.D., Educational Psychology & Learning Systems
Guler Arsal / Ph.D., Educational Psychology & Learning Systems

Description: The primary objective of this research project is to identify the behavioral factors that contribute to energy in/efficiency in the home. In particular, this project was designed to (a) examine current state-of the science on behavioral factors that affect energy efficiency, (b) report on the efficiency of typical energy consuming technology used in the home as well as existing programs designed to improve efficiency, and (b) investigate the types of human-technology interactions and other behavioral factors that lead to in/efficient energy use. To achieve these objectives this project uses laboratory-based experimental and field-based methods to (i) identify interface-design factors that constrain individuals to behave in locally optimal but globally sub-optimal ways, and (ii) survey how cognitive, technological, and motivational behavioral issues affect use in the home environment.

Budget: $163,949
University: FSU

Progress Summary

First, there is some important information to report. In August of 2010, the PI on this project, Dr Paul Ward, left FSU to take a position at another institution and was unable to continue to run the project. Dr Ward had taken on the sole responsibility for the day-to-day supervision of the student assistants. To this point, the role of the Co-PIs on the project had been to provide conceptual support on ad hoc, needs-led basis to the PI. With only 4 months remaining, it was not possible to move the project beyond the trajectory it had taken under the previous PI. Consequently, the report prepared reports mainly on the activities of the graduate students who had worked on the project prior to the PI's departure and who assumed much of the remaining work on the project.

An extensive literature review and summary were prepared. A data base of existing energy efficiency initiatives, programs and reports pertaining to energy conservation, interface design and energy-use behavior was developed. A database was created that contains Energy Project Organizations and Contacts, which contains about 20 references for organizations and contacts related to this area. A survey entitled "Energy Survey" and designed to collect data about householder energy use behavior. The graduate students working on the project administered this survey to households in the local area and received response from 30+ households. These data are currently being analyzed and the results will be submitted at least as a conference presentation but potentially as a journal article publication.

Proposals:

Dr Douglas was involved in two relevant grant applications with Charles Kilbert (UF) and Richard Feiock; one of which was NSF EFRI-SEED proposal Advanced Feedback and Control System for Net Zero Energy Homes.