FESC
Florida Energy Systems Consortium

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)

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 are to: 1. Analyze the environmental and water resources demands and potential impacts, specific to Florida's unique geographical challenges, of fuel cycle systems; (2) Develop an objective environmental impact screening and evaluation tool (i.e. decision support system) for energy planning and policy making by Florida's industry, utilities, and government; (3) Provide outreach to industry, utilities, government to allow for discussion and better informed decisions on energy strategy, regulation, and permitting; and (4) Provide training on "Energy and the Environment" to ensure environmental stewardship without sacrificing energy production.

Budget: $64,738

Progress Summary

Scope of Work

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 addresses the FESC's Thrust 6 on "Energy systems and their environmental and economic impacts." This project also directly addresses the IESES's Objective 4 on unique geographical challenges and Objective 5 on sustainable energy engineering, science and the sustainable energy economy.

Progress Made in Tasks and Towards Deliverables

- *Task 1: Analyze potential environmental impacts of energy production systems*
  - *Deliverable 1.1: Literature of environmental impacts of energy production systems.*

We have conducting 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 have been 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 (e.g. 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 journals were submitted: *Science*, December 2009, declined; and *Environmental Science & Technology*, August 2010, in review.

  - *Deliverable 1.2: Laboratory investigation and numerical modeling of environmental and water resources impacts of energy production systems*. This is planned for 2010 (Table 1). We also hope to obtain data from other IESES projects that focus on biofuel production systems.

- *Task 2: Develop evaluation tool for energy production systems*
  - *Deliverable 2.1: Spread-sheet based evaluation and decision support tool*
  - In progress as part of Years 2-3 activity (Table 1).
- *Task 3: Outreach*
  - *Deliverable 3.1: Participate in and assist in organizing SABER and IESES workshops.*
  - *Deliverable 3.2: Participate in and assist in organizing in a SABER seminar series.*
  - We will participate in planned SABER seminars and workshops. We have participated in informal SABER meetings.
  - We have been in contact with FDEP and plan to meet with them to discuss our findings from our literature reviews on environmental impacts of biorefineries. They are interested in topics that related to permitting. We hope to provide a service to FDEP by sharing our knowledge and insights that may assist in their concerns and tasks.
- *Task 4: Training*
  - *Deliverable 4.1: Develop and offer the course "Energy and the Environment" for students*
  - *Deliverable 4.2: Develop and implement training material on Energy and the Environment for Florida's governing bodies*
  - Work on Tasked 4 is planned as Years 2-3 activities (Table 1). A graduate course "Energy and the Environment" is planned for spring 2011. This will focus on the environmental impacts of a range of energy production systems and include life cycle analysis.

Table 1: Planned Milestones and Schedules

Deliverables	Start (months after contract start)	Completion (months after contract start)
1.1 Literature review summary	1	8
1.2 Lab investigations and modeling	6	30
2.1 Evaluation tool	12	34
3.1 Participate in SABER workshop	3	12
3.2 Participate in SABER seminar series	3	30
4.1 Develop and offer an "Energy and the Environment" course	13	30
4.2 Develop and implement training material for legislative bodies	15	36

Progress Made Towards Performance Metrics

A summary of our current progress in meting the performance metrics identified in our Statement of Work submitted to IESES in January 2009 is presented in Table 2. Assuming a similar pace of progress during the 2nd 6-month period as the 1st 6-month period, we expect to meet or exceed the target performance metrics for Year 2 of this project.

Table 2: Performance Metrics for Year 2 (2010)

	Year 1 (2009)		Year 2 (2010)	
Metric	**Target**	**Progress**	**Target**	**Progress**
National recognition				
# Journal manuscript submitted	0	1	1	1+2 in prep
# Conference publications/presentations	1	1	2	2
Growth in funding				
# Proposals submitted	1	5	1	2
Training				
# Graduate students supported	1	3	1	3
# Undergraduate students supported	2	1	2	0
Outreach				
# Workshops/seminars	1	1	2	0
Curriculum activities				
# Courses developed/taught	0	0	1	1

Summary of Recent Achievements and Milestones (for period 11.01.09-9.30.10)

Proposals

- Planned proposal submission to the National Science Foundation (NSF) in March 2011.

o Title: Microbial Fuel Cell for Remediation of Pharmaceuticals and Power Generation

o PIs: Gang Chen, Michael Watts, Amy Chan Hilton

Conference Presentations

- Subramaniam, P. (student) (2009). Usage of microbial fuel cell technology to preventiron release nearby landfills in Northwest Florida. Poster presentation at 95th Annual American Society of Microbiology Southeastern Branch Conference, Savannah, GA: American Society of Microbiology Southeastern Branch. Presented November 2009.
- Rios, F. (student), M. Ye, P. Lee, R. Fernandes, T. Zhao (2010), Developing an ArcGIS Extension for Estimating Nitrate Fate and Transport, ESRI Southeast Regional User Group Conference, April 26-28, Charlotte, NC. Presentation slides are available at: http://proceedings.esri.com/library/userconf/serug10/papers/abstracts/pap32.html
- Rios, F. (student), M. Ye, P. Lee, R. Fernandes, T. Zhao, and A. Chan-Hilton (2010), Estimation of Hydrologic Environmental Impacts of Nitrate Contamination from Energy Biomass Resources Development, FESC Summit, September 28-29, Orlando, FL.

Journal Articles

- McGee, C. and A. Chan-Hilton (2010), Analysis of Federal and State Policies and Environmental Regulations for Bioethanol Production Facilities, *Environmental Science & Technology*, in review (submitted August 2010).
- McGee, C. and A. Chan-Hilton (2009), Anticipating local effects of cellulosic biofuel production, *Science*, submitted December 2009. Declined.
- Rios, F., M. Ye, P. Lee, R. Fernandes (2010), Developing an ArcGIC extension for estimating nitrate fate and transport, *Environmental Modeling & Software*, in preparation.
- Rios, F., M. Ye, P. Lee, R. Fernandes (2010), Numerical investigation of relations between topography and water table depth in a surficial aquifer, E*nvironmental Geology*, in preparation.

Master Thesis (In Preparation)

- Rios, F. (2010), A GIS-Based Model for Estimating Nitrate Fate and Transport in Surficial Aquifers, Department of Scientific Computing, Florida State University.

2010 Annual Report

Summary of Past Achievements and Milestones (for period 1.01.09-10.31.09)

- Received project budget number on April 7, 2009.

Proposals

- Submitted a Pre-Application to the US DOE/USDA Biomass Research and Development Initiative (Funding Opportunity Number: DE-PS36-09GO99016) in March 2009.
  - Title: Comprehensive Systems Analysis of Biofuels: Environmental Impacts, Energy, Economics, and Sustainability.
  - PI: Amy Chan-Hilton (CEE). Co-PIs: Gang Chen (CEE) Julie Harrington (CEFA), Wenrui Huang (CEE), R. Mark Isaac (Economics), Michael Watts (CEE), and Ming Ye (SCS).
  - Requested budget: $1,849,031 (4 years)
  - Status: Declined
- Submitted a full proposal (by invitation) to the Florida Department of Environmental Protection (FDEP) Hinkley Center for Hazardous and Solid Waste in May 2009.
  - Title: Usage of Microbial Fuel Cell Technology to Prevent Iron Release nearby
  - Landfills in Northwest Florida
  - PI: Gang Chen (CEE). Co-PIs: Amy Chan Hilton (CEE), Kamal Tawfiq (CEE)
  - Requested budget: $39,207 (1 year)
  - Status: Funded. Award budget $35,000, September 2009 – August 2010.
- Proposal submitted to the Florida Department of Environmental Protection (FDEP).
  - Title: Developing a GIS-Based Software for Estimating Nitrate Fate and Transport from Septic Systems in Surficial Aquifers
  - PIs: Ming Ye (Scientific Computing), Paul Lee (FDEP)
  - Budget: $81,035
  - Status: Funded, 7/2009-8/2011
- Proposal submitted to the Water Environment Research Foundation in July, 2009.
  - Title: Freshwater and marine microalgal growth on wastewater nutrients: an environmentally friendly and cost-effective approach for making biomass for biofuels production?
  - PI: Mike Wetz (Oceanography). Co-PI: Mike Watts (CEE)
  - Requested budget: $161,455
  - Status: Declined
- Proposal submitted to the National Science Foundation (NSF) in July 2009.
  - Title: DMUU: Collaborative Groups in Energy, the Environment, and Sustainability
  - PIs: Robert Isaac (Economics). Co-PIs: Dmitry Ryvkin, Svetlana Pevnitskaya,
  - Douglas Norton, Amy Chan-Hilton (CEE)
  - Requested budget: $2,794,206
  - Status: Declined
- Proposal submitted to the National Science Foundation (NSF) in December 2009.
  - Title: Interdisciplinary approach to maximizing beneficial algal growth in treated wastewaters
  - PI: Mike Wetz (Oceanography). Co-PIs: Mike Watts (CEE), William Cooper
  - (Chemistry), Joel Kostka (Oceanography), Amy Chan-Hilton (CEE)
  - Requested budget: $876,536
  - Status: Declined

- Planned submission to the National Science Foundation (NSF) in March 2010.
  - Title: “Downstream" impacts of biofuel-algae: wastewater treatment and receiving waters
  - PI: Mike Watts (CEE). Co-PI: Mike Wetz (Oceanography)
- Discussions with other IESES SABER members (Mike Wetz and Joel Kostka) on planned joint research activities and proposal submissions related to growth of microalgae in domestic wastewater and environmental impacts. Ongoing.
- Participated in SABER group meeting in September 2009, presenting our work and identifying potential synergies with group members.
- Discussions with other IESES members (Mark Isaacs et al.) on submitting an agent-based modeling earmark white paper and also a NSF IGERT (Integrative Graduate Education and Research Traineeship) proposal (planned preliminary proposal submission in March, 2010). Ongoing.

Outreach

- Participated in meeting between Greenpointe LLC and SABER members on potential collaboration.
- Discussions with the Florida Department of Environmental Protection (FDEP) on how we can share our knowledge on environmental impacts of biofuel production facilities (biorefineries). Ongoing.
- Attended the 2009 Farms to Fuels summit in Orlando, FL, July 2009.