



Florida Energy Systems Consortium

The Florida Energy Story

Presented to
Energy and Utilities Subcommittee
House of Representatives

Dr. Tim Anderson
FESC Director



Florida Energy Systems Consortium

Created by Florida Statute to share energy related expertise and promote collaboration among the energy experts at its 11 public universities.

Goal

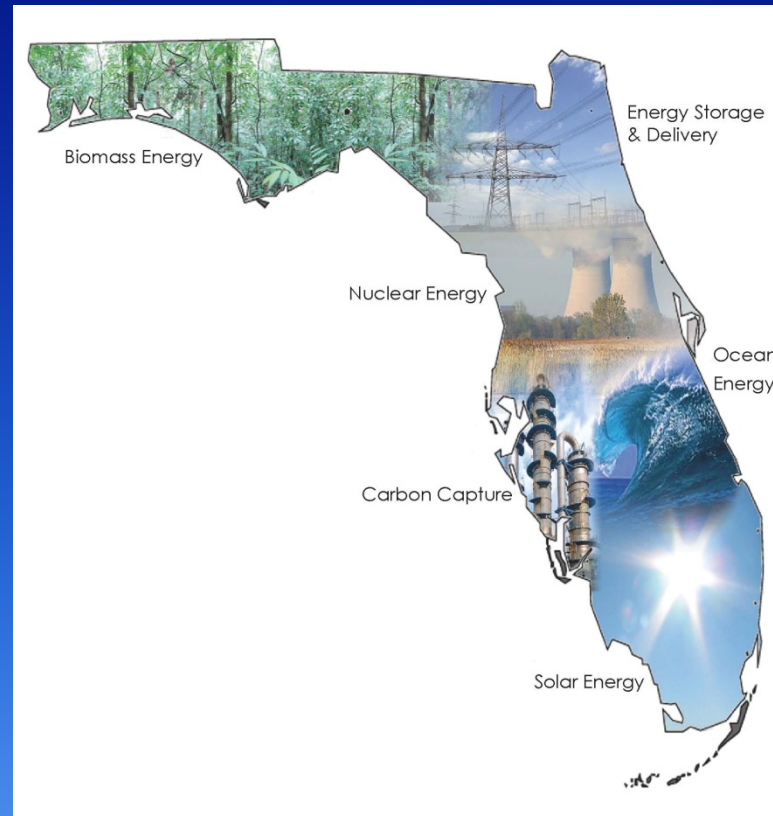
Uniting Florida's Universities to become a leader in energy research, education, technology, and energy systems analysis.

Vision

Florida Universities innovating for sustainable energy generation, distribution, and usage systems.



Florida Energy Systems Consortium

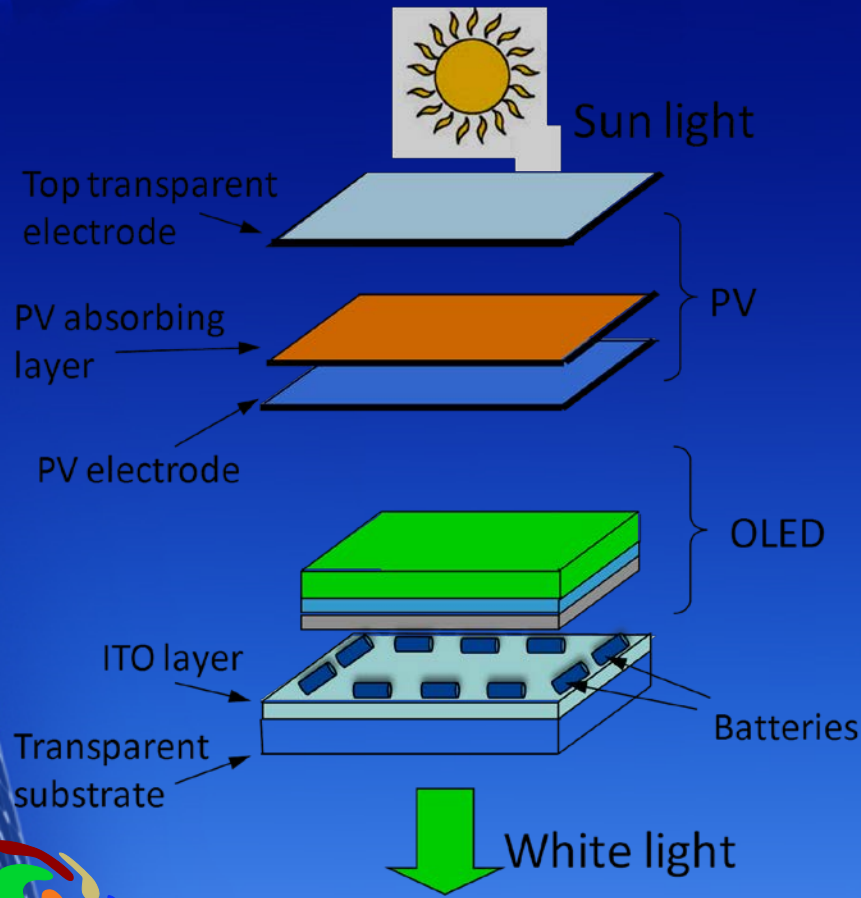


Strategic Research Thrusts

- Overarching - Understanding Florida's Energy Systems



Integrated PV/Battery/Lighting Module



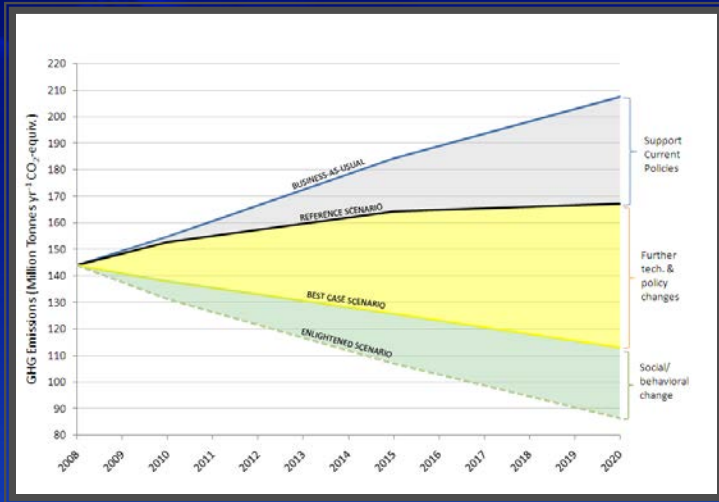
Objectives

- Integrating a transparent organic PV device, lithium ion batteries and organic light emitting device into a solar-powered lighting panel
- Development of both organic PV cells and organic LEDs with transparent electrodes
- Development of high volumetric energy density lithium batteries

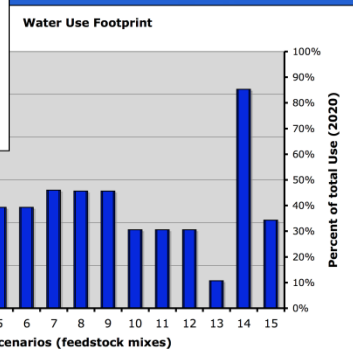
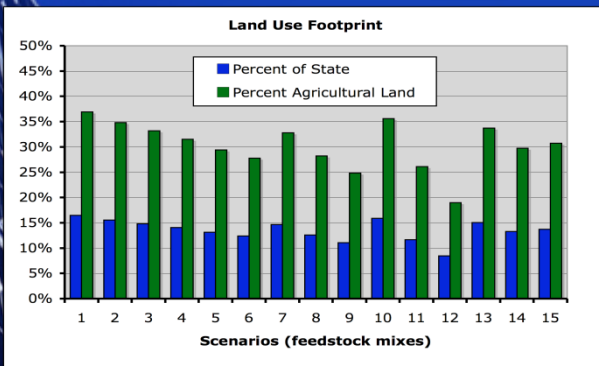
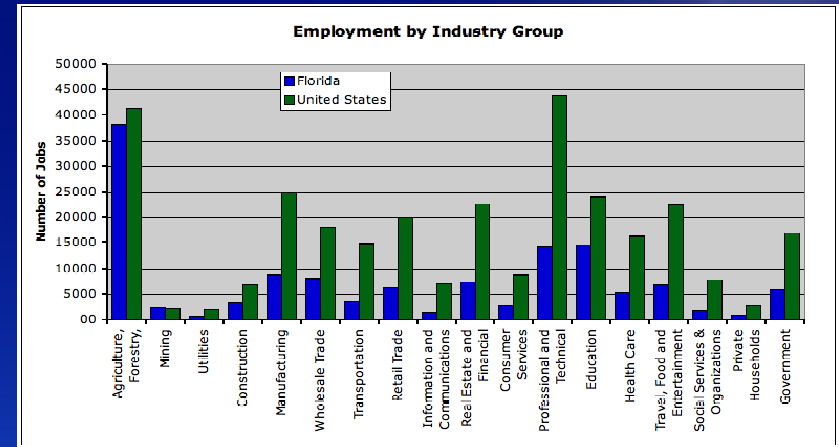
Assessment of Greenhouse Gas Emissions for Selected Renewable Fuels

Prof. Mark Brown, Dept. Env. Eng. Sci. - UF

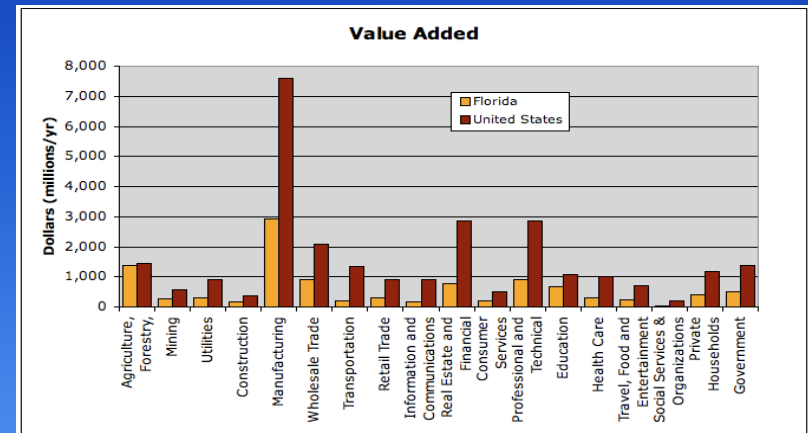
Total annual GHG emissions predicted: various scenarios of policy, technology, and social/behavioral changes



Employment generation from biofuel production to meet Florida's needs in 2020



Value added resulting from biofuel production to meet Florida's needs in 2020

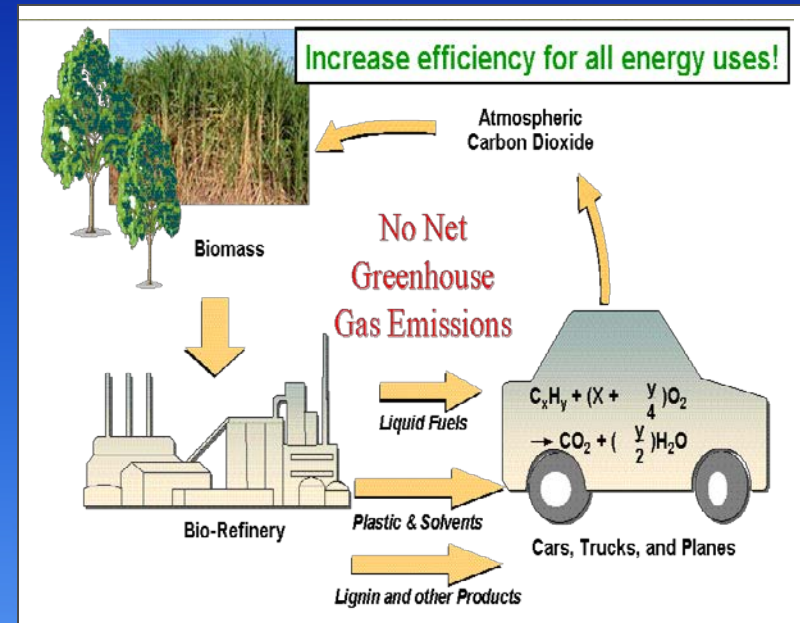
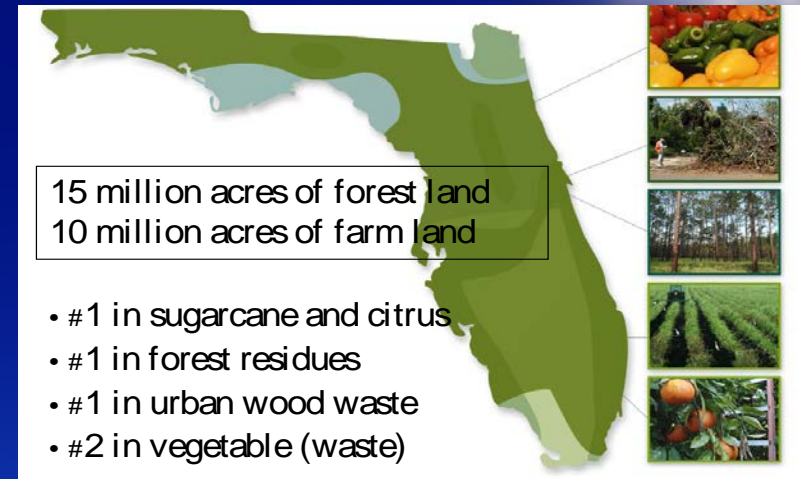
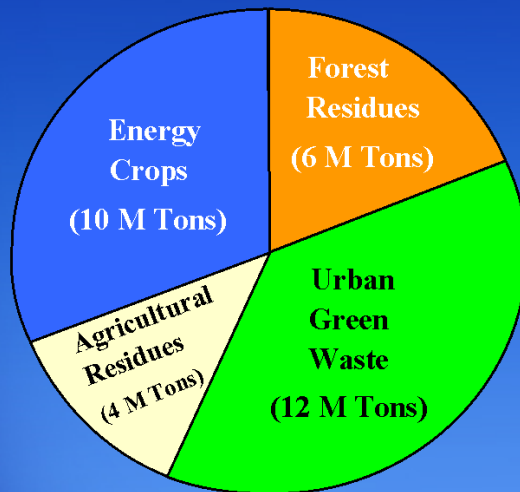


Strategic Research Thrusts

- Overarching - Understanding Florida's Energy Systems
- **Developing Florida's Biomass Resources -**
Production of liquid fuels & other chemical intermediates (cellulosic ethanol, biodiesel) & gaseous fuels & feed stocks (gasification, anaerobic digestion), efficient conversion of biofuels to electric power (SOFCs, turbines), energy intensive crops, solid waste as a biomass resource
- Harnessing Florida's Solar Resources
- Ensuring Nuclear Energy & Carbon Constrained Technologies for Electric Power in Florida
- Exploiting Florida's Ocean Energy Resources
- Securing our Energy Storage and Delivery Infrastructure
- Enhancing Energy Efficiency & Conservation

Developing Florida Biomass Resources

- Florida has ~10% of US biomass resources, ~7% wood
- Transportation costs high
 - ~75 mile limit
- Biomass to Energy Options
 - Burn to produce steam
 - Convert to chemicals
 - Biologically, thermally, extraction

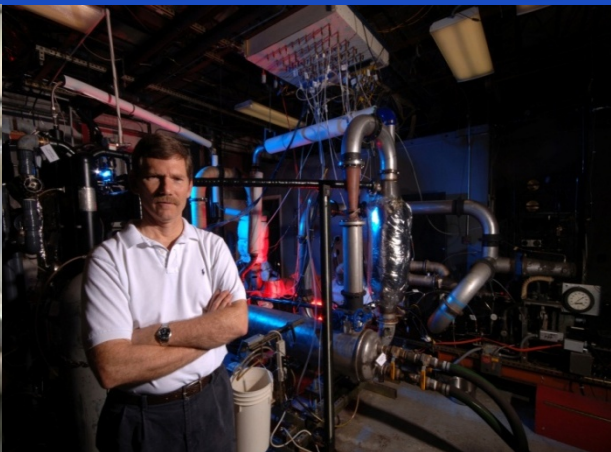


Biomass Challenges and Opportunities

- Reduce costs of biomass growth, harvesting, and processing
 - Increase crop yield, automated harvesting, optimal plant distribution, more efficient conversion efficiency
- Ensure sustainable implementation
 - Water quality, waste processing, fuel for food
- Full scale plant not demonstrated
 - Uncertainty increases cost of financing
- Florida could be leader in bio-energy
 - Large resource, significant investment in R&D, target is to become the center for knowledge-based industry

Bio-Energy Research Focus Areas

- Energy Intensive Crop Development – molecular genetics
- Energy From Algae: Fresh water, marine algae; Genetic transformation; Solar photo-bioreactors; Lipids to fuels
- Thermo-Chemical Conversion of Biomass to Liquid Fuels
- Biochemical Conversion Biomass to Liquid Fuels & Chemicals
- Integrated Biofuel, Hydrogen, and Electricity Cogeneration from Biomass and Solid Waste

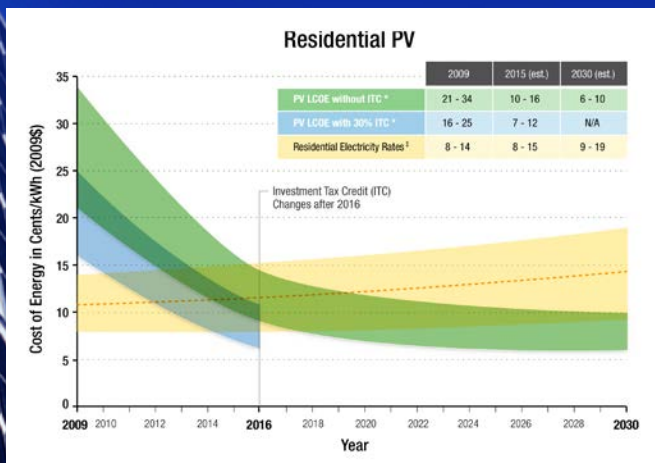
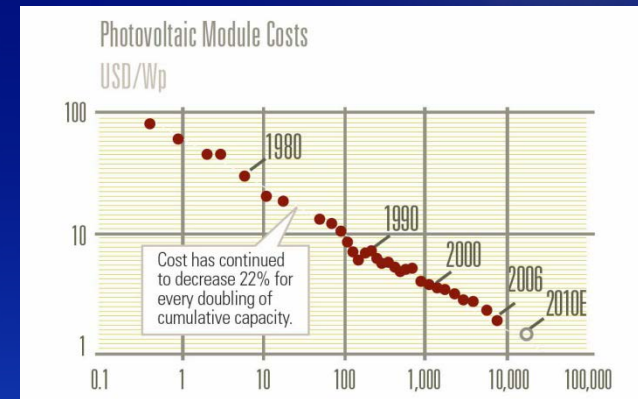


Strategic Research Thrusts

- Overarching - Understanding Florida's Energy Systems
- Developing Florida's Biomass Resources
- **Harnessing Florida's Solar Resources - Photovoltaics, solar concentrators (fuel production, gasification), outreach and education in broad solar technologies**
- Ensuring Nuclear Energy & Carbon Constrained Technologies for Electric Power in Florida
- Exploiting Florida's Ocean Energy Resources
- Securing our Energy Storage and Delivery Infrastructure
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PV Challenges for Florida

- The levelized cost of PV is more expensive than fossil fuels ($\sim \$0.17/\text{kWhr}$)¹
 - Cost declining steadily (22% decrease with doubling on production)
 - Grid parity expected in Florida in ~ 2015 ²



- Production intermittency makes grid integration difficult at high penetration
- Florida has not been competitive in attracting industry.
 - Important factors: secure market for PV installations, low manufacturing costs, skilled workforce



¹<http://www.solarbuzz.com/SolarIndices.htm>; 500 kW_p flat roof mounted system, grid connected, sunny climate

²www1.eere.energy.gov/solar/pdfs/dpw_lushetsky.pdf

Florida Potential

- Very high solar radiation (>25% capacity factor with unobstructed 1D tracking at FPL DeSoto Plant)
- Large coastal population/available interior land in southern half of State, thus minimizing average transmission distance.
- High per capita residential electricity use with potential for significant distributed deployment (increase resilience to catastrophic events, reduce transmission need).
- PV electricity production well matched to demand.
- Our current cost of electricity is relatively high (~12 ¢/kWhr residential), thus making PV more attractive.
- PV manufacturing in nearby regions (SE US, Caribbean, South and Central America) is minimal - represents an export potential.



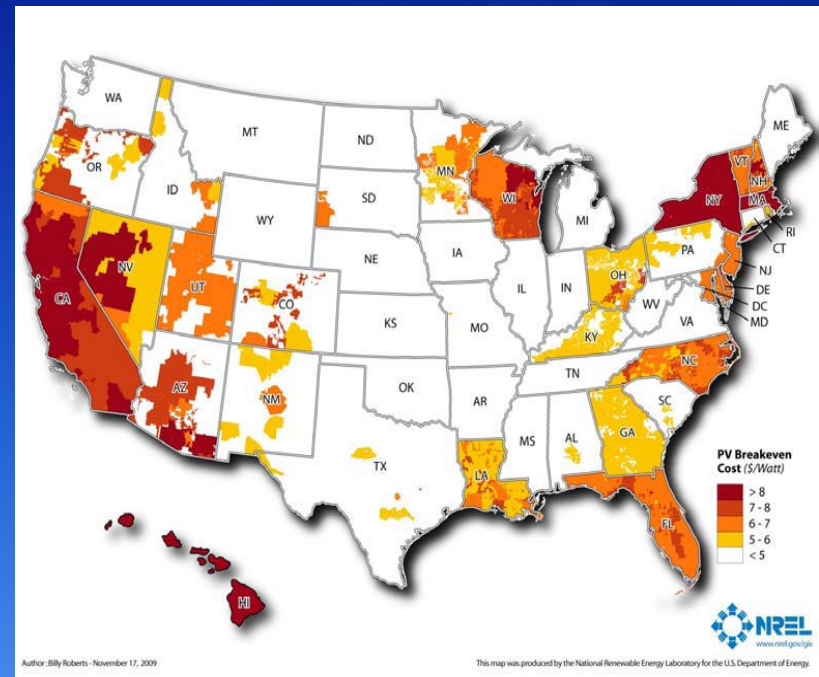
Where Will the PV Hubs be Located?

The opportunity for Florida is to become an exporter of PV systems to the Southeast US, Caribbean, Americas, and beyond, and thus create direct and indirect jobs related to manufacturing, assembly, design, & research.

World's fastest growing industry (~32%/yr)

7.2GW_p of new PV capacity was installed in 2009 (\$38.5 billion in global revenues)¹.

Estimated annual production rate of ~250GW_p at 10% PV penetration.



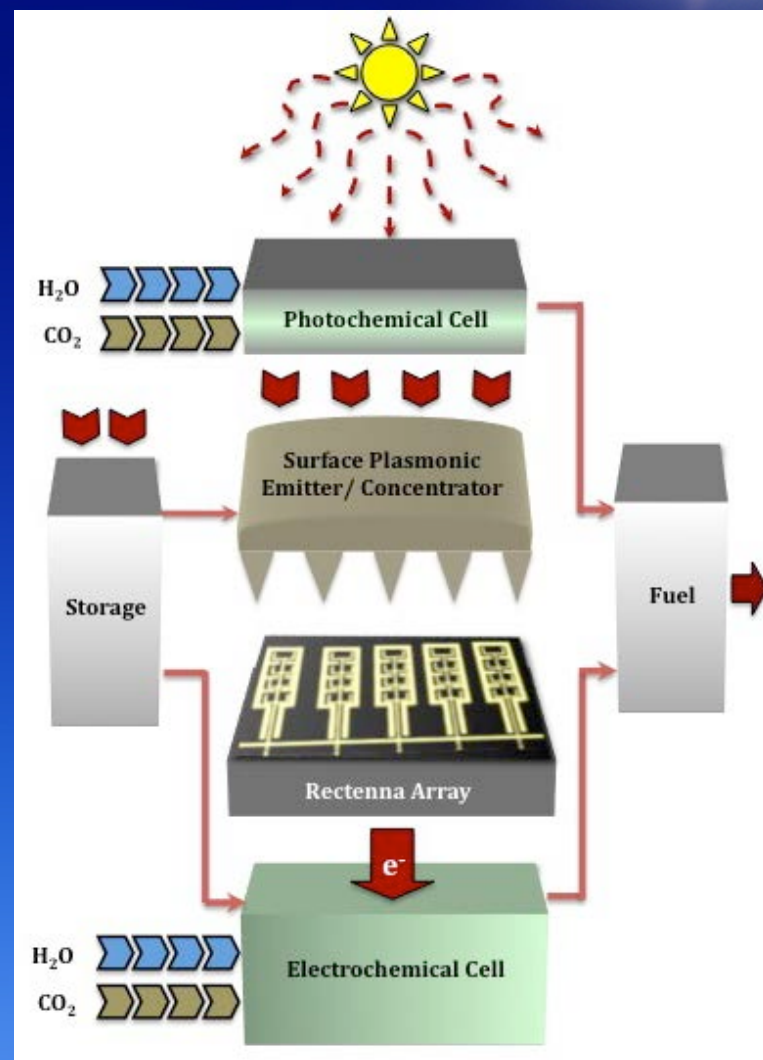
Harnessing Florida's Solar Resources

- A broad spectrum of solar projects covering
 - Solar Resource Mapping and Test Facility
 - Solar Thermal Power for Bulk Generation
 - PV Manufacturing Pilot Line
 - Development of Low Cost Solar Cells
 - Plug n Gen PV Power System
 - Beyond Photovoltaics – Rectenna Development
 - High temperature Thermo-chemical Hydrogen Production
 - Solar Technologies for Clean Water
 - Solar PV Charging Station
 - Zero Energy Homes (Solar Decathlon)
- Florida SUS Has National Profile in Solar
 - Extensive Industry Collaborations
 - Significant External Funding

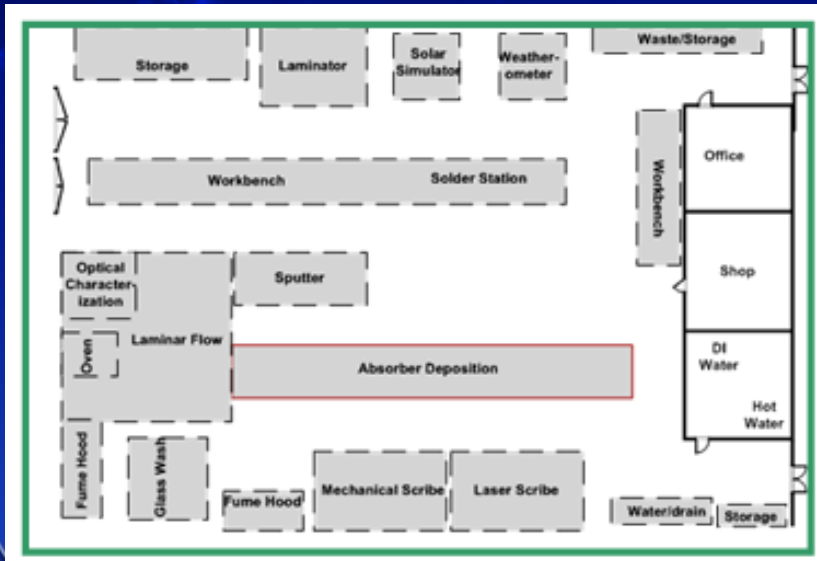
Solar Fuels

Strategies

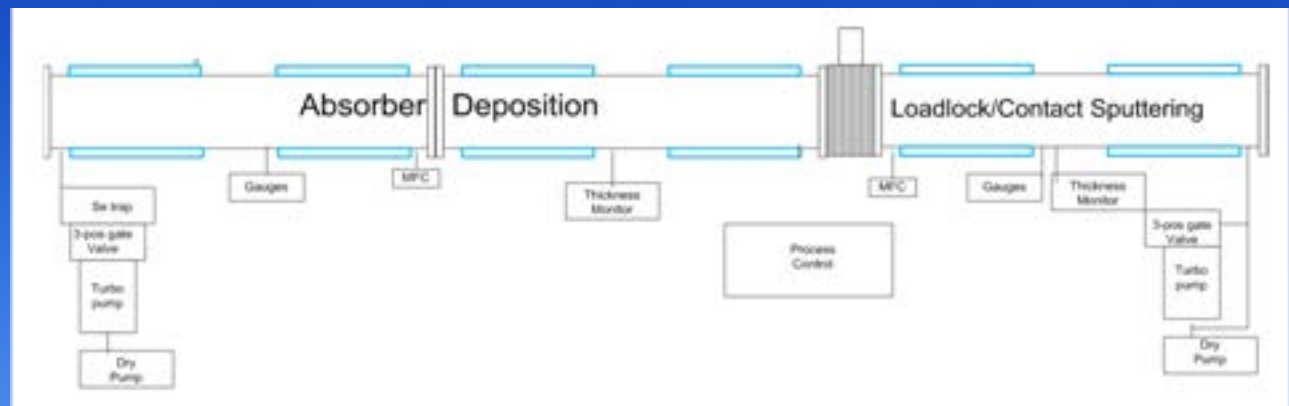
- Use readily available small molecules
- Use every light photon
- Combine processes to make cheaper (process intensification)



PV Thin Film Pilot Line at USF



- Large area thin film deposition, flexible roll- to-roll to 13.5" width.
- Physical vapor deposition of metal and transparent contacts.
- Deposition of CIGS novel deposition and growth pathways.
- Evaluation of novel deposition tools, inks, on-line metrology tools.

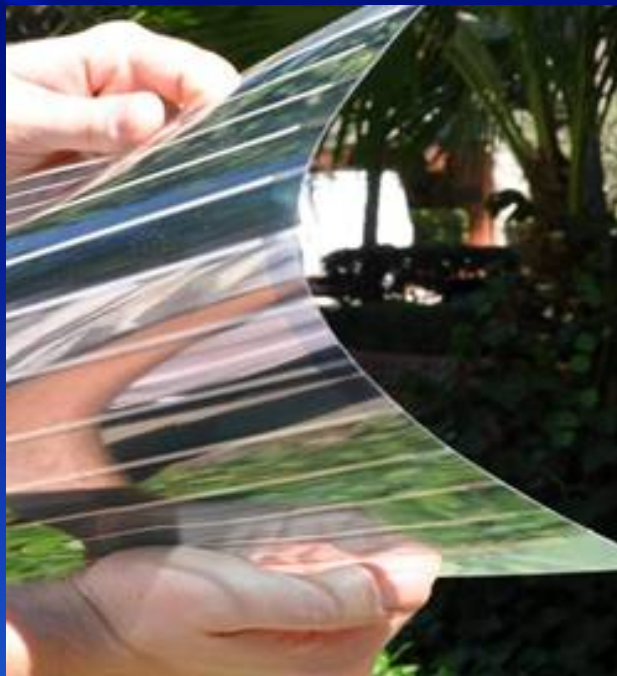


New Test Stand at FSEC



Florida Energy Systems Consortium

Flexible polymer solar modules by roll-to-roll printing (Dr. Franky So)



14"x14" polymer solar modules have been printed. 12 cells are connected.

Collaborators:

Materials: John Reynolds, University of Florida

Roll-to-roll printing: Frederik Krebs, RISO, Denmark



Energy Storage Consortium

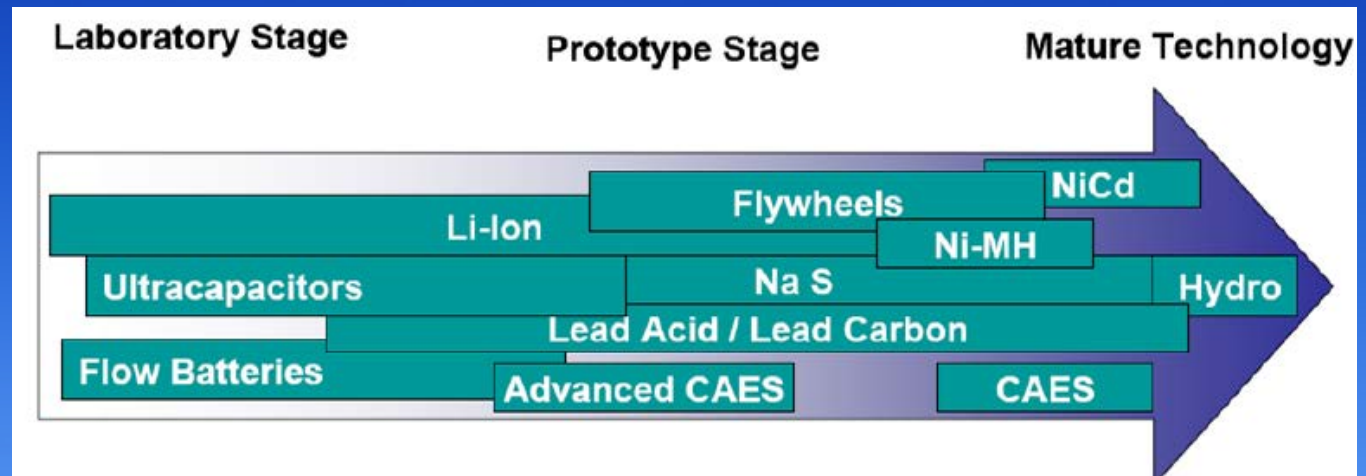


Strategic Research Thrusts

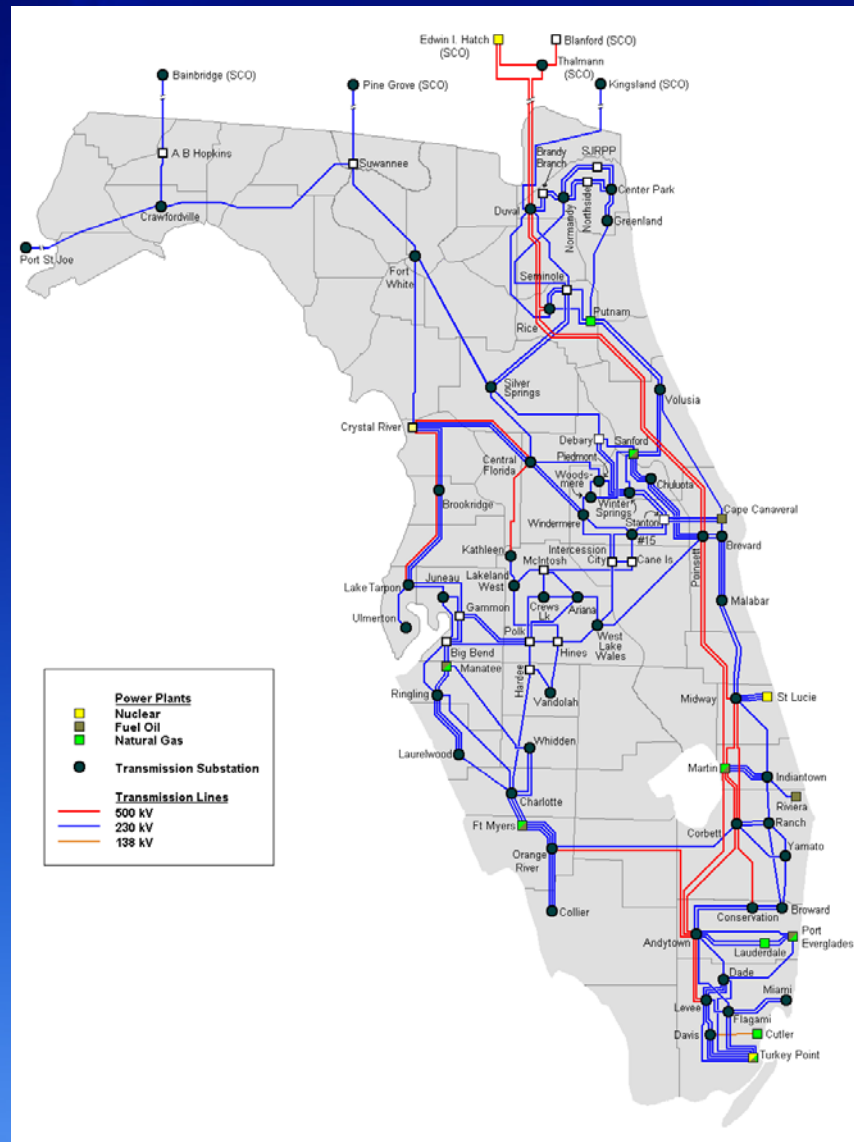
- Overarching - Understanding Florida's Energy Systems
- Developing Florida's Biomass Resources
- Harnessing Florida's Solar Resources
- Ensuring Nuclear Energy & Carbon Constrained Technologies for Electric Power in Florida
- Exploiting Florida's Ocean Energy Resources
- Securing our Energy Storage and Delivery Infrastructure - Transmission & distribution, grid reliability and resiliency, continuous energy delivery, integrated renewable systems, customer owned microgrids, power quality, energy storage, location aware systems, and efficiency
- Enhancing Energy Efficiency & Conservation

Electrical Energy Storage

- Grid Level Storage
 - Pumped hydroelectric storage (<\$100/kWh)
 - Compressed air energy storage (cost effective)
 - Batteries: Flooded lead-acid, valve regulated lead-acid, NaS and lithium-ion (new), flow batteries
- Power Quality Control
 - Flywheels, Superconducting magnets, Supercapacitors



FRCC Region



Demand Response in Florida

- Florida peak demand – 50 GW (2010), 62.5 GW in 2019
- Peak reduction estimates by 2014:
 - BAU = 5% or > 2.5 GW
 - EBAU = 9% or > 4.5 GW
 - Achievable participation = 13% or > 6.5 GW
- By 2019, the achievable participation could be 18% or more than 11 GW
- Key drivers: very central AC penetration and direct load control programs
- These represent very large avoided capital costs

Energy Storage & Delivery Infrastructure

- Smart Grids / Micro Grids
- Advanced energy storage systems
- Energy security and integrity
- Policy and economics
 - Requirements validation
 - Performance assessment
 - Risk management and mitigation
 - Environmental impact
 - Investment and insurance drivers
 - Public needs assessment, Economic necessity, Market pull Issues
- System design
 - Hardware / software design & integration testing
 - Sensor, communication and control technologies
 - Operational concepts development
 - Reduced design cycle time



Strategic Research Thrusts

- Overarching - Understanding Florida's Energy Systems
- Developing Florida's Biomass Resources
- Harnessing Florida's Solar Resources
- Ensuring Nuclear Energy & Carbon Constrained Technologies for Electric Power in Florida - Nuclear and electric power workforce training, partnerships with industry in critical research needs, power systems, power electronics & conditioning, carbon sequestration
- Exploiting Florida's Ocean Energy Resources
- Securing our Energy Storage and Delivery Infrastructure
- Enhancing Energy Efficiency & Conservation

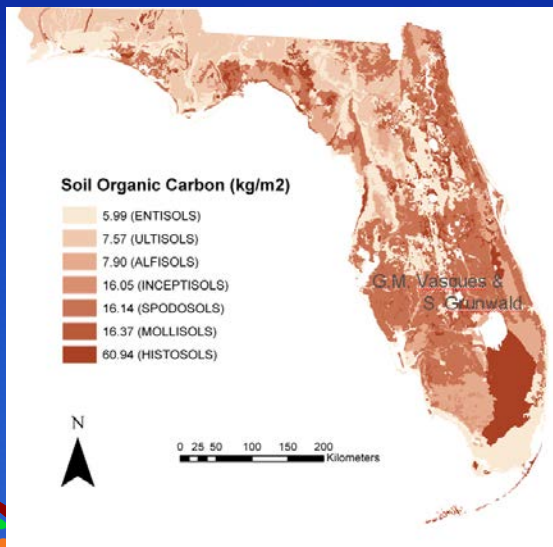
UF Nuclear Training Reactor

- Design, license, & construct fully digital control system
 - Partners: Progress Energy, Siemens, DoE, AREVA, Canberra, FESC
- Working on Licensing Amendment Request (LAR) to pave path for future
- Establish certificate on digital control and instrumentation in NRE Dept.
- Training courses with state colleges (C. FL, Indian River, and N. FL), utilities, and government (e.g. NRC)



Carbon Capture and Sequestration Projects

Geological Sequestration: Cedar Keys/Lawson Formation (deep saline aquifer)



Optimize: Transportation, Energy Consumption, and Land Use

Total Soil Organic Carbon Stock

2.26 giga ton

FL CO₂ Production

0.26 giga ton/yr

Strategic Research Thrusts

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- Harnessing Florida's Solar Resources
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- Exploiting Florida's Ocean Energy Resources – Ocean and thermal differential energy harvesting
- Securing our Energy Storage and Delivery Infrastructure
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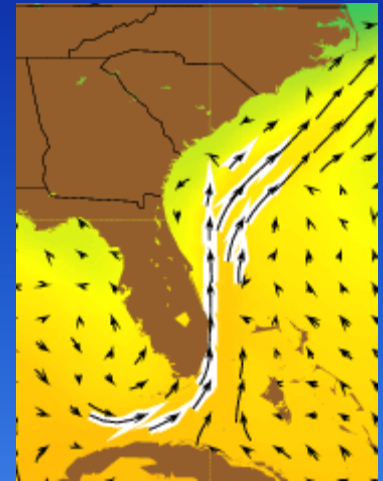
Exploiting Florida's Marine Energy Resources



- Harness ocean currents & thermal gradients
- Develop, fabricate & deploy 20 kW underwater turbine

Deliverables

- 10-year program potential is as much as 5 GW of capacity generated from the Gulf Stream and up to 2 GW of equivalent cold-water-based AC
 - Estimated 10,000 engineering / tech. jobs
 - New high-tech Florida-based sector

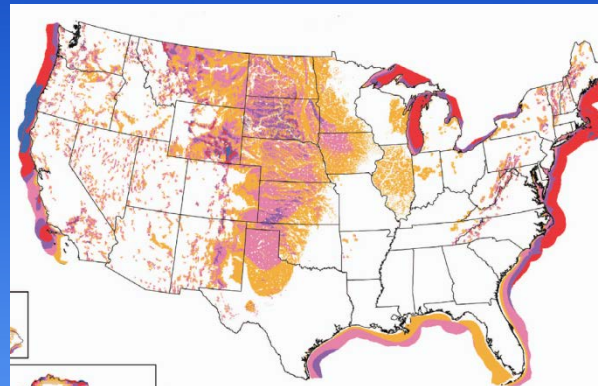


<http://oceancurrents.rsmas.miami.edu/>

Off-shore Wind Energy



- Energy potential offshore Florida's Atlantic coast estimated as 10.3 GW
 - Comprehensive analysis of Florida's offshore wind resources needed
- Wind energy industry already in Florida
 - NextEra Energy is largest U.S. wind developer
 - GE manufactures wind turbine generators (Pensacola)
 - Siemens, NA Wind Power headquarters (Orlando)
- Florida has wide, shallow continental shelf (cheaper if <30 m).



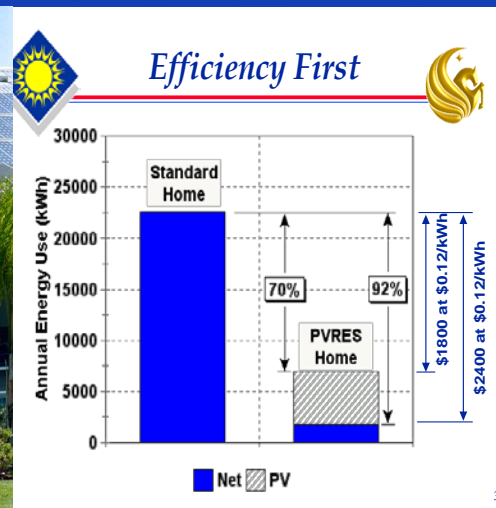
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- Enhancing Energy Efficiency & Conservation - Improvement of existing & new building efficiency, industry energy auditing & efficiency, outreach & education.



Enhancing Energy Efficiency & Conservation

- Residences consume more than 40% of Florida's electricity
- 2008 Florida Energy Act calls for new homes to use only 50% of 2007 code minimum within 10 years
- Home retrofits must also be addressed – existing stock outnumbered new homes by 50 to 1.
- Demonstration homes at multiple campuses - UCF, UF, FSU, USF, FIU, UWF: Used for research, training, outreach.



Program Development

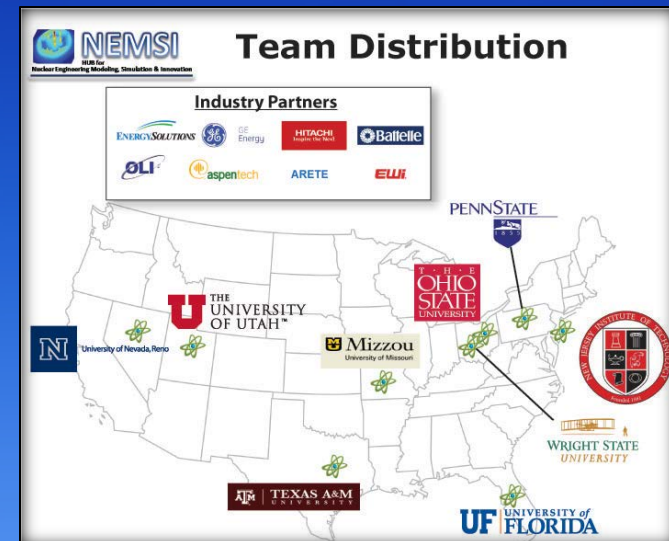
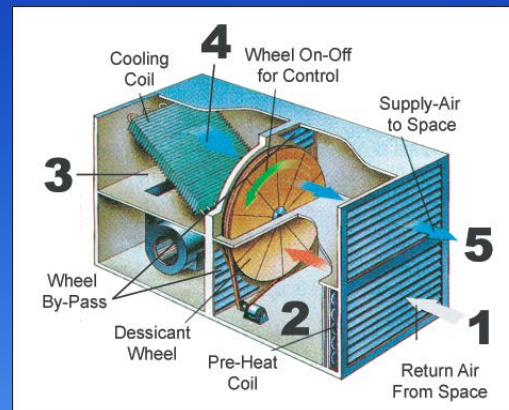
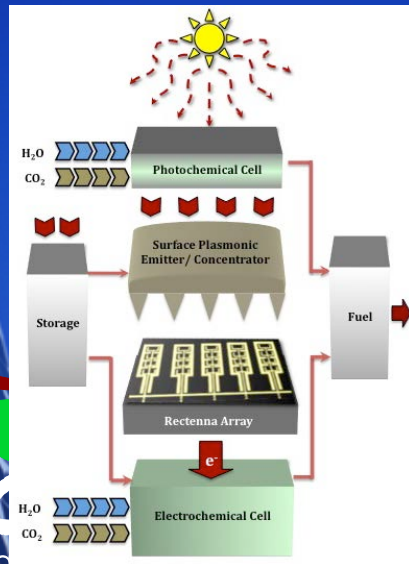
- Provide exploratory research funding
- Inform faculty about funding opportunities
- Facilitate proposal team formation
- Facilitate proposal development

More than 100 funding opportunities from various agencies distributed to faculty.

- Competitive Contracts & Grants: 10/1/09-9/30/10
531 Applications with \$581M total request
374 awards in the amount: \$84M

Large Proposal Efforts

- PV Manufacturing Initiative, \$25M – **UF**
- Energy Efficient Building Systems Regional Innovation Cluster Initiative, \$129.7 M – **UCF**
- SolarFuel Hub, \$122M – **USF**
- Nuclear Hub (NEMSI), \$122M – **U of Utah**



Key Activities – Tech Commercialization

- Two Tiered Model
 - Early vetting of technologies for path to market
 - Proven model for spawning long-term collaborative R&D
 - Engage industry in development process in the university
 - Provides 2X leveraging of FESC funds on each project
 - Natural pipeline of technology deployment to private sector
- Early Stage Market Research / Business Plans –
Funded 15 business plans / market studies. –
Completed. OTL matching technologies.
- Matching Funds R&D Program – Up to \$50k / project
for 5 later stage projects with a 2:1 industry match –
Funded 6 projects. Industry contracts being executed.

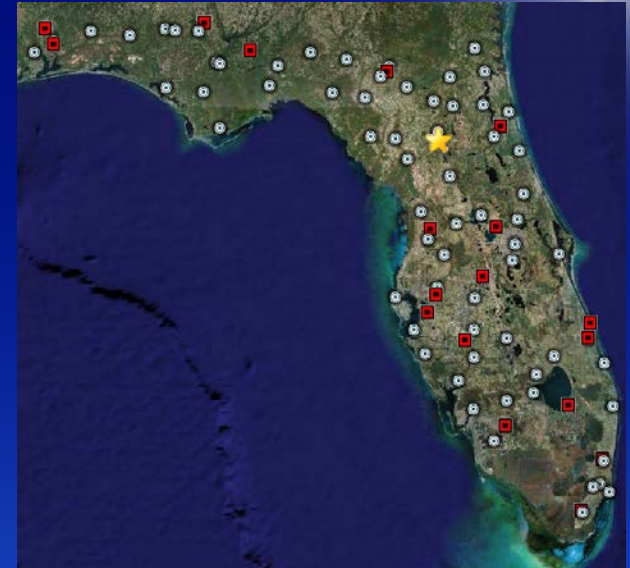
Education – Focus on Workforce Development

- Four Focus Areas
 - Community College Training
 - AS/BS Degree Programs
 - Certificate Program
 - Professional Development
 - Nuclear Engineering Education
 - Built Environment Education
 - Masters Level Education
- Close integration with Outreach and Industrial Collaboration
- Program implementation with Florida Advanced Technological Education Center (FLATE). Mission elements:
 - Create State-wide technician educational delivery system
 - Provide curriculum development, best practice demonstrations, student involvement and outreach activities necessary to meet the workforce capacity in target sectors



Outreach – Focus on Energy Efficiency

- Targets the general public & built environment
- Utilizes Florida's extension education system and FESC partners
- Collaborates with the home builders and construction industry
- Create an online compendium of current, accurate publications
- Develop / conduct technical & continuing education programs
- Produce public service pieces (NPR, PBS, public access...)
- Partner with utilities to implement performance-based demand side management programs
- Work with “green” certification (FGBC, USGBC, GBI...)



TOWARD DEVELOPING A STRATEGIC PLAN ON ENERGY FOR THE STATE OF FLORIDA

- Solar (PV and Thermal)
- **Bio-Energy**
- Grid Technologies & Electricity Distribution
- **Ocean Energy**
- Nuclear Education
- **Secure Energy Systems**
- Energy Efficiency and Conservation, Geothermal
- **Energy Storage**
- Carbon Capture
- **Wind Energy**
- Policy



Messages

- FESC is doing very well
 - Your support is making a difference – thank you
- The Consortium is a key State resource for economic development
 - Improving climate for attracting energy industry
 - Better prepared workforce
 - Accessible research enterprise
 - Energy represents opportunity for economic growth
 - Particularly in bioenergy, solar, and smart grid
 - Systems approach connecting research to commercial product

Web Site: www.FloridaEnergy.ufl.edu

[Contact Us](#) | [Site Map](#) [SEARCH](#)



Florida Energy Systems Consortium
Universities Addressing Florida's Energy Needs





Home	<h2>Bringing Energy Solutions to Florida, the Nation and the World</h2> <p>The Florida Energy Systems Consortium (FESC) was created by the Florida State government to promote collaboration among the energy experts at its 11 supported universities to share energy-related expertise. The consortium assists the state in the development and implementation of an environmentally compatible, sustainable, and efficient energy strategic plan. The Consortium was charged to <i>'perform research and development on innovative energy systems that lead to alternative energy strategies, improved energy efficiencies, and expanded economic development for the state'</i>. The legislature appropriated funding for research at five of the universities as well as support for education, outreach, and technology commercialization. The Consortium reports to and supports the Florida Energy and Climate Commission in developing and implementing the State's energy and climate agenda.</p>
About Us	
Florida Energy Facts	
Energy Policy	
FESC Expertise	
FESC Facilities and Resources	
Research Projects	
Industry	
Education	
Public Outreach	
FESC Summit	Overarching to the Consortium's research strategy is an energy systems approach to identify innovation opportunities, prepare an energy workforce, and guide economic development.
Publications	
Funding Opportunities	Through collaborative research and development across the State University System and the industry, the goal of the consortium is to become a world leader in energy research, education, technology, and energy systems analysis. In so doing, the consortium shall:
Links	(a) Coordinate and initiate increased collaborative interdisciplinary energy research among the universities and the energy industry.
Energy-Related Conferences & Meetings	(b) Assist in the creation and development of a Florida-based energy technology industry through efforts that would expedite commercialization of innovative energy technologies by helping
Frequently Asked Questions	
Contact Us	

Ways to Save Energy

- 2011-01-26
[Biodiversity Workshops](#) at 8:00 AM
- 2011-02-02
[PURC Annual Conference](#) at 8:00 AM
- 2011-02-04
[ASME Smart Grid Course](#) at 8:00 AM
- 2011-02-05
[Eco Nomic Living Expo](#) at 8:30 AM
- 2011-02-08
[Global Energy Outlook 2030](#) at 10:30 AM
- 2011-02-25
[Law and Sustainability](#) at 8:00 AM

NEWS & EVENTS

Smart Grid Technologies Professional Development Course to be offered by ASME

This professional development (PD) course provides basic

Renewable Energy Research Portal (FSU)


- <http://energyportal.cci.fsu.edu/>

Renewable Energy Research Portal

[Useful links](#) | [About](#) | [Contact](#)

Projects DB

Find renewable energy projects and research centers on an interactive map.



Events Calendar

Conferences, seminars, workshops, and other events you can subscribe.


September 2009						
M	T	W	T	F	S	
	1	2	3	4	5	
7	8	9	10	11	12	
14	15	16	17	18	19	
21	22	23	24	25	26	
28	29	30				

Events

- [Healthy Buildings 2](#)
- [WATTS 2009 the 11th](#)
- [ApMA Wind Resour](#)


Researchers DB

A pathway of finding people in renewable energy area with various research topics.



Articles DB

Currently includes behavior, technology, and interaction with technology research articles.





About the Project

The goal of **Renewable Energy Research Portal** is to provide Institute for Energy Systems, Economics and Sustainability (IESES), Florida Energy Systems Consortium (FESC), researchers, and others in the state of Florida with the research information they need to accomplish statewide energy goals. It will identify, organize, and make available via a web portal, research generated as part of FESC effort as well as other selected related information resources and tools as identified by FESC participants.

This project is being conducted by the Information Use Management & Policy Institute and the Learning Systems Institute at Florida State University.

Contact us...



Why Florida Should Lead in Sustainable Energy

It has the most to lose if we don't



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