

The Florida Energy Systems Consortium: A Case Study in Energy Research, Investment, and Applications

**EIE Turkey Energy Summit
Jan 5-6, 2014**

UF UNIVERSITY of
FLORIDA



FAU
FLORIDA
ATLANTIC
UNIVERSITY



USF UNIVERSITY OF
SOUTH FLORIDA



FLORIDA
POLYTECHNIC
UNIVERSITY

Outline

- **Background About the Consortium**
- **FESC Leadership Structure**
- **Research Thrust Areas**
- **Research Projects in Electricity**
- **Technology Commercialization**
- **Education and Outreach**

Florida Energy Systems Consortium (FESC)

BACKGROUND – INITIAL INVESTMENT

- \$50M Collaborative Proposal to the State of Florida by 4 State Universities on Energy in 2008
- The proposal was well liked and the proposal team was invited to present to the review committee and legislatures working on the state energy bill
- Legislatures decided to create an Energy Consortium and provided \$38M funding.



Florida Energy Systems Consortium (FESC)

Created by Florida Statute in 2008

Purpose... Unite Florida energy experts including Florida's 12 Universities so that the State leads in energy research and develops innovative energy systems giving rise to...

Improved energy efficiency, innovative energy technologies, and expanded economic development

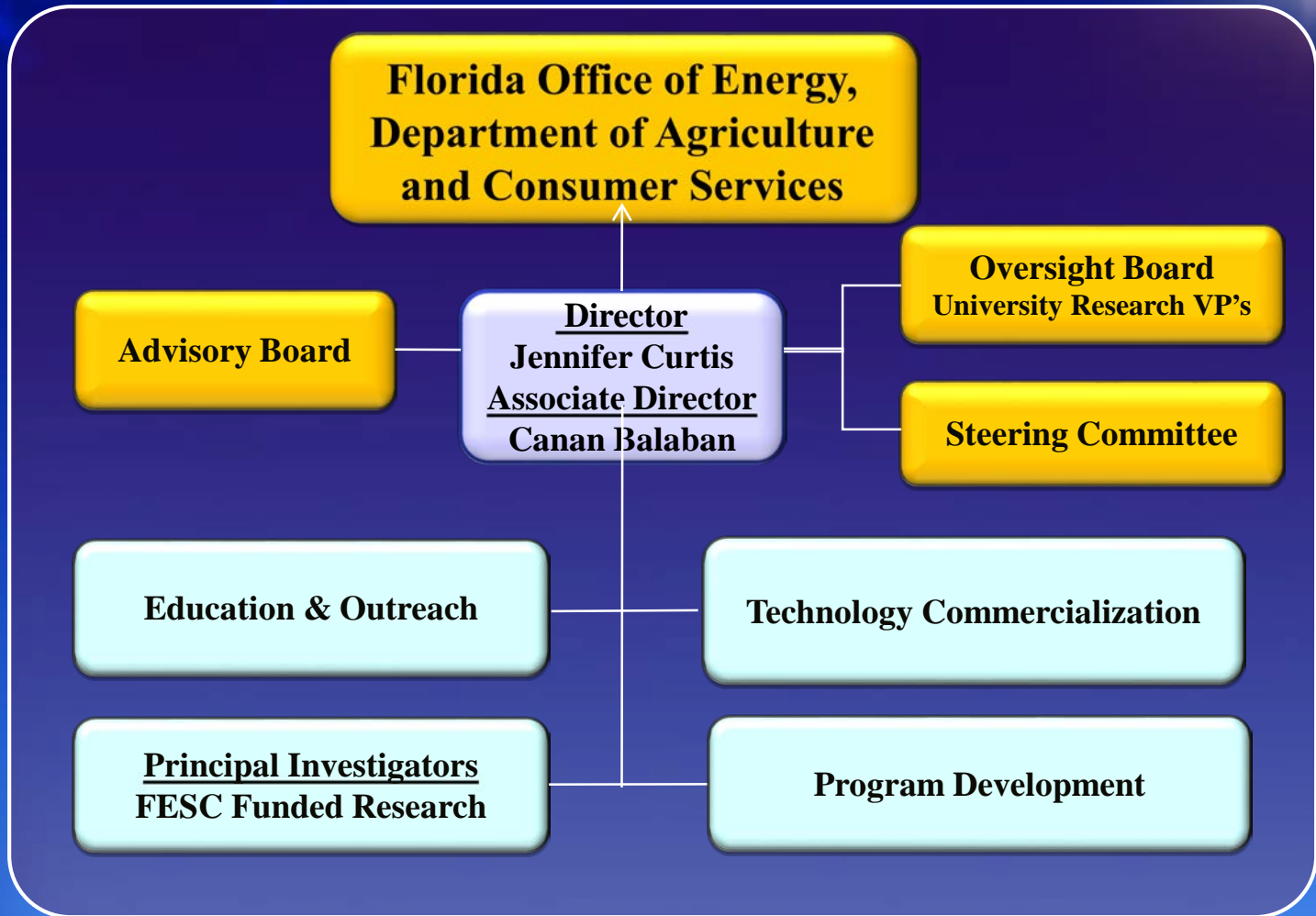


Florida Energy Systems Consortium (FESC)

- Strategic Activities
- Research
- Technology Commercialization
- Education and Outreach

- FESC involves more than
- Over 400 Faculty
- Over 1000 Graduate Students
- 100 Centers and Institutes
- Over 200 Industry Partners

FESC Leadership Structure



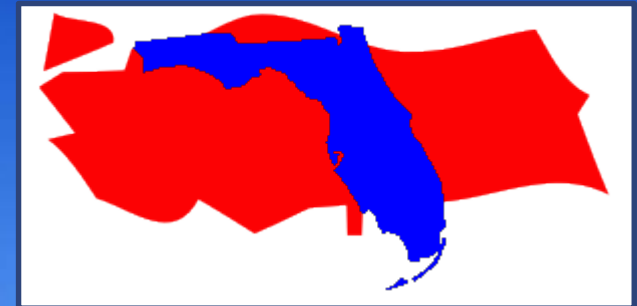
FLORIDA

- Florida is 719x581 km long peninsula with ~2,000 km of shoreline
- Mean elevation: 30 meters
- Population: 19 Millions in 2012
- Energy Resources: Solar, Biomass, Marine Energy
- Buys NG, coal for power plants and transportation fuel
- Total Energy Cost: ~\$60 Billion/year
- Net Electricity Generation: 221,096,136 MWh

Turkey is 4.6 times larger than Florida

Florida: 170,304 km²

Turkey : 783,562 km²



Turkey vs. Florida

Florida (EIA Energy - Historic Data - CON)

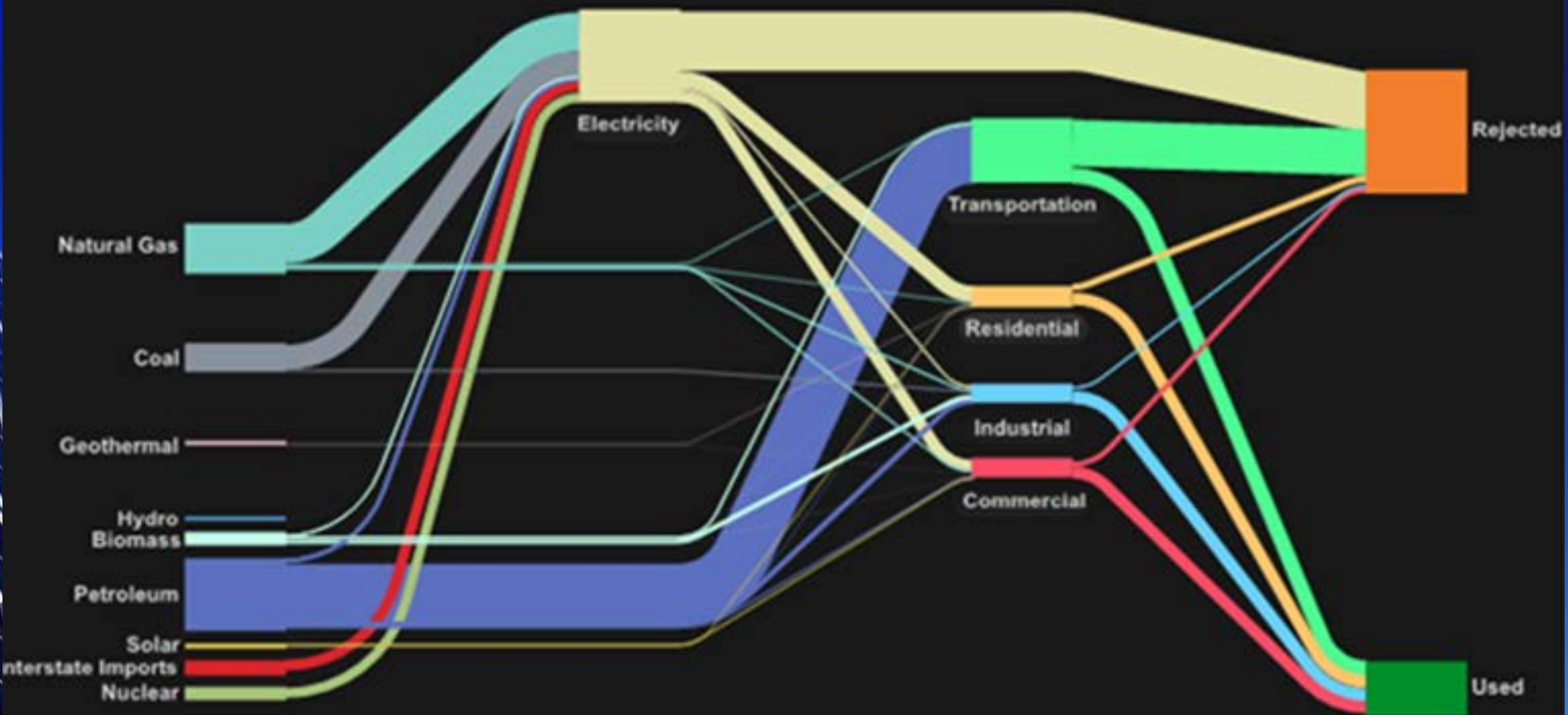
Energy Supply

Energy Demand

Energy Flows

Energy Forecast

2010

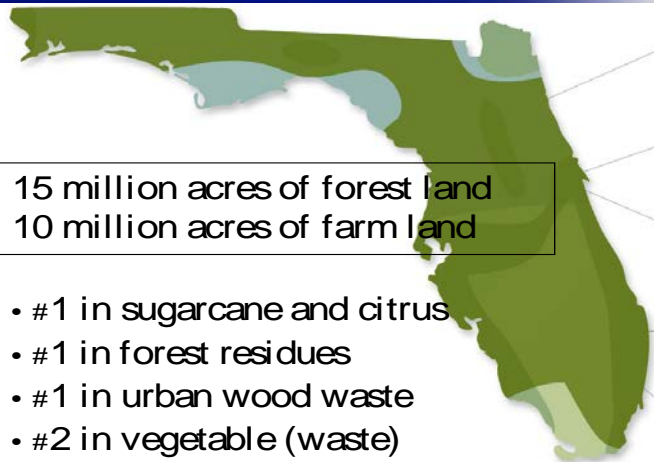


Strategic Research Thrusts


- Developing Florida's Biomass Resources
- Harnessing Florida's Solar Resources
- Capturing Florida's Marine Energy Resources
- Securing Energy Delivery Infrastructure and Energy Storage
- Nuclear Energy (Education) & Carbon Capture
- Enhancing Energy Efficiency & Conservation
- Understanding Florida's Energy Systems



Developing Florida Biomass Resources

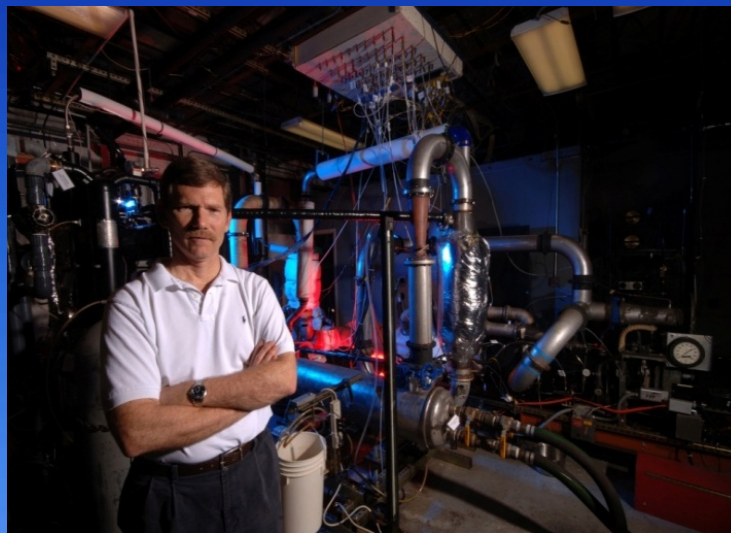
- Florida has ~10% of US biomass resources
 - 51% statewide tree coverage
 - 80% of it is commercial
- 

15 million acres of forest land
10 million acres of farm land

 - #1 in sugarcane and citrus
 - #1 in forest residues
 - #1 in urban wood waste
 - #2 in vegetable (waste)
- Climate allows year around energy crop growth, high crop yield and conversion efficiency
 - 100MW Biomass Power Plant - Gainesville Renewable Energy Center
 - 1 Full scale Biomass to ethanol plant - INEOS
 - 2 Large scale pilot plants:
 - University of Florida cellulosic ethanol biorefinery
 - Algae to ethanol pilot plant - Algenol

Biomass to Energy

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



Biomass to Energy (Continued)



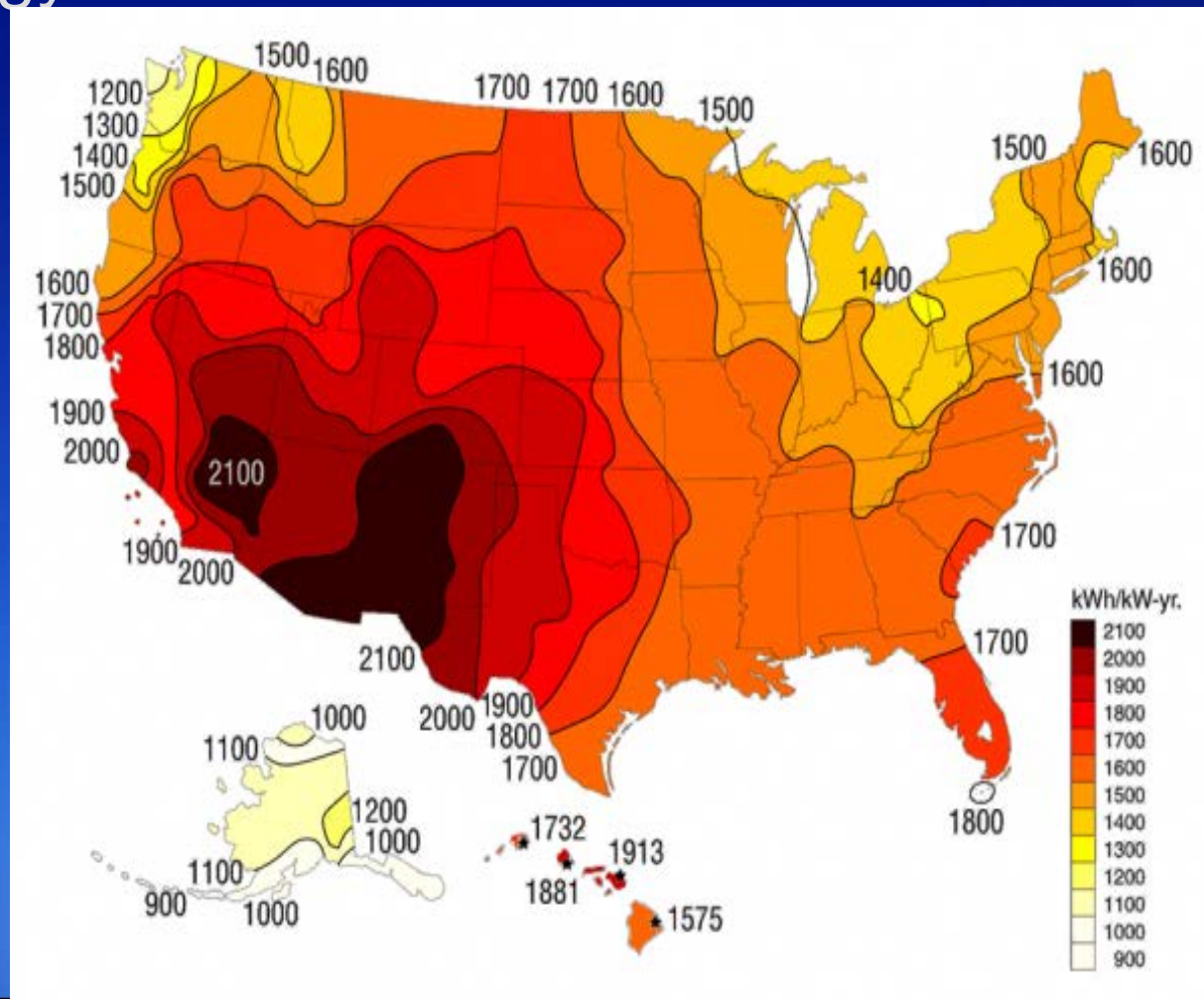
Biomass to Electricity Demo Units



UF Stan Mayfield Biorefinery

Harnessing Florida's Solar Resources

Solar energy is Florida's most abundant domestic energy resource



Solar Energy Research Focus Areas

- Design, Construction and Operation of Concentrated Solar Power Plant - **Operational**
- Low Cost CIGS Thin Film PV Process
- Non-Contact Energy Delivery for PV System
- PV Panel-mounted Micro-inverter
- Integrated PV/Storage and PV/Storage/Lighting Systems



Solar Thermal Power Plant at USF



Solar Field for 50 kW_e Power Generation

Solar Thermal Power Plant at USF

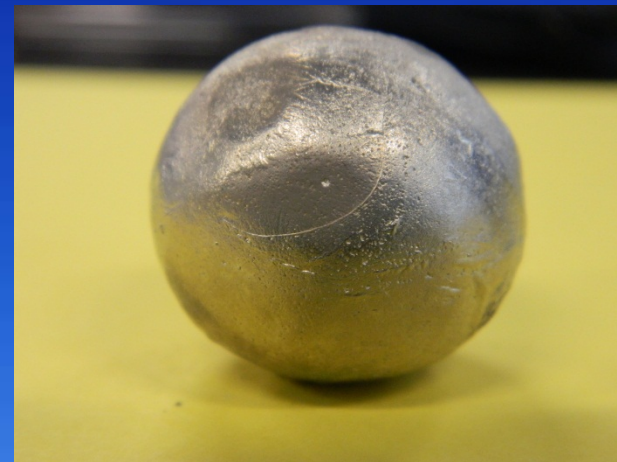


A row of parabolic trough solar collectors

Thermal Energy Storage

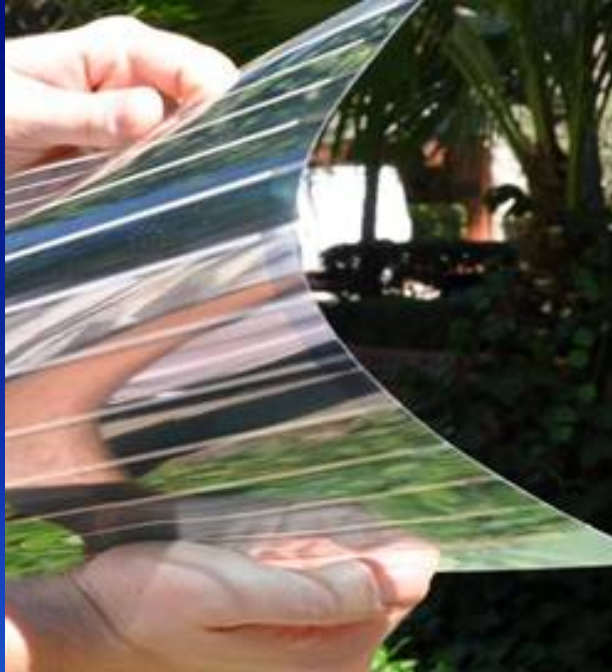


**Ceramic encapsulated
Phase Change Material
(PCM) for high temperature
thermal energy storage**



**Metal encapsulated PCM for medium
temperature thermal energy storage**

Flexible Polymer Solar Modules by roll-to-roll Printing



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

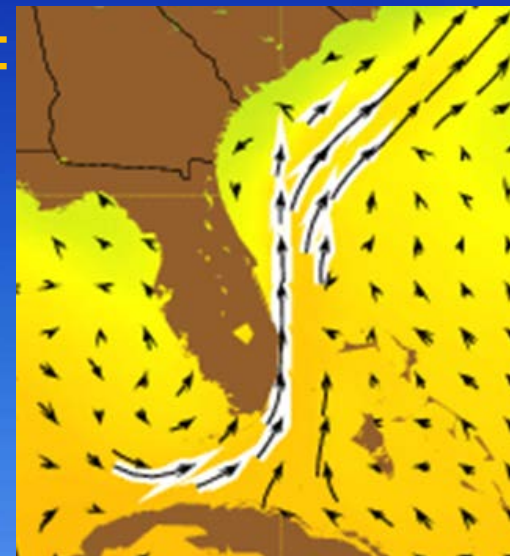
Collaborator for roll-to-roll printing: Frederik Krebs, RISO, Denmark

Capturing Florida's Marine Energy Resources

US DOE designated Florida Atlantic University's (FAU's) Marine Energy Center as a Southeast National Marine Renewable Energy Center (SNMREC)

- **Marine and Hydrokinetic (MHK) Research:** Harnesses ocean current energy to generate electricity
- **An MHK Lease Application** on the outer continental shelf was submitted to the U.S. Department of Interior, Bureau of Ocean Energy Management (BOEM).
- **Ocean Thermal Energy Conversion (OTEC):** Harnesses solar energy absorbed by the oceans to generate electric power.

The global analysis of ocean thermal energy conversion (OTEC) potential was completed, producing a publically available GIS database that is accessible at http://maps.nrel.gov/mhk_atlas

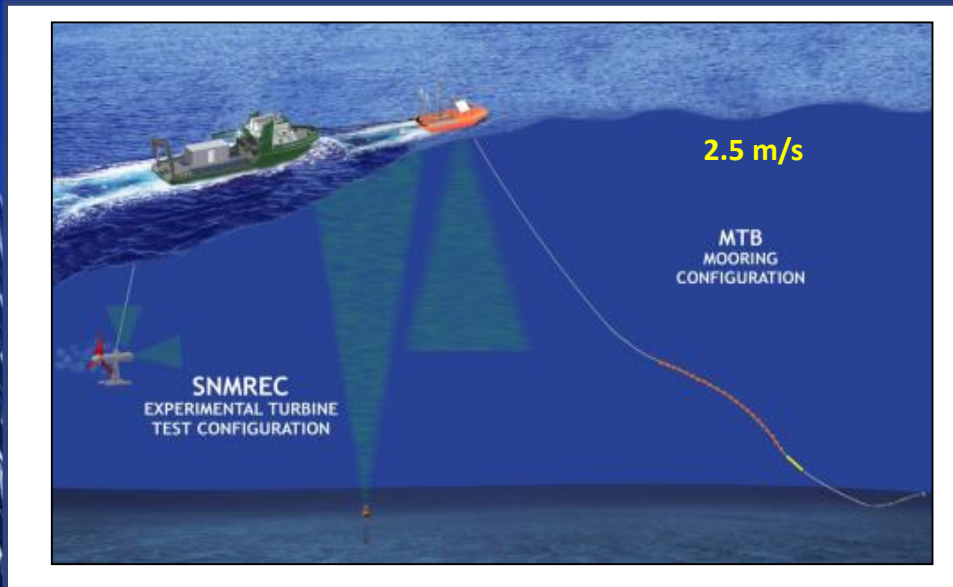


<http://oceancurrents.rsmas.miami.edu>

Capturing Florida's Marine Energy Resources

FAU Developing Demonstration-scale Turbine Test Berth

- Deploy a single-anchor mooring attached to a mooring and telemetry buoy, and test, equipment designed to use the Florida Current to generate electricity
- Plans to deploy turbines up to 100 kW or 7 meter rotor diameter for surface-tethered validation tests.



**3-meter diameter Rotor, 20kW
Instantaneous Max Power
Prototype Turbine - At sea
after successful deployment**20

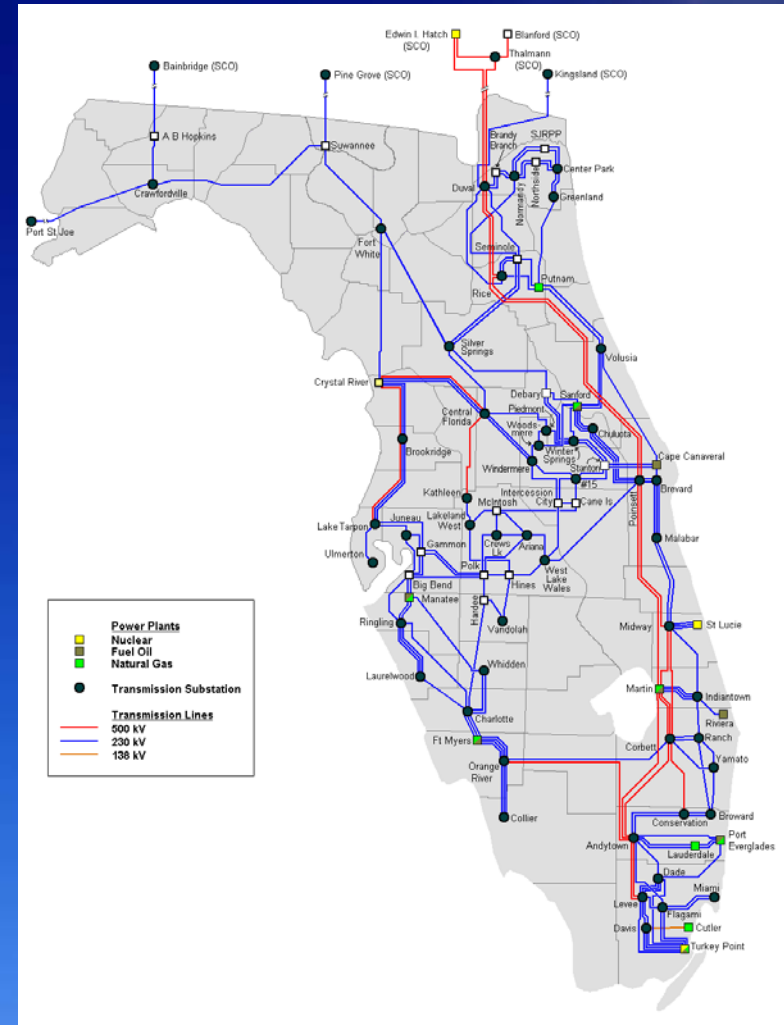
Capturing Florida's Marine Energy Resources

- First MHK Environmental Assessment and Finding of No Significant Impact (FONSI) on Outer Continental Shelf (OCS) in U.S.
- Mooring and Telemetry Buoy (MTB) sea trials complete and design verified
- Preliminary turbine tow tests complete
- Permit for Lease Offer is expected in July, 2014



Florida Grid

- Florida is surrounded by water on 3 sides
- Can receive power from north side only in case of natural disasters
- Distributed generation and micro-grids can be advantageous in hurricane prone areas



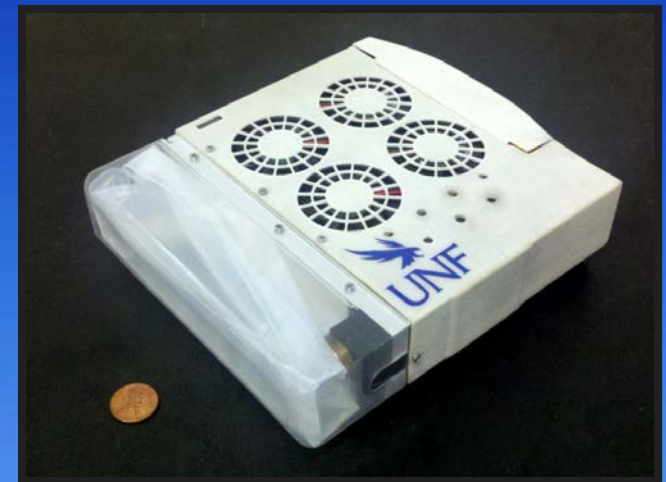
Securing Energy Delivery Infrastructure

- **Smart Grid Demonstration Project at USF in collaboration with Duke Energy:** Implementation of a “Smart Grid” with advanced sensors, communication and control technologies
- **Micro-grids:** PV and PHEV integration, micro-grid modeling and control, grid-tying inverters/converters, and energy storage
- **Real Time Digital Simulation (RTDS):** By FSU Center for Advanced Power Systems
- **Grid Security**
- **Power Electronics, Micro Invertors**
- **Power Systems**
- **Energy Use Behavior**



Electrical Energy Storage & FC

- Li-Ion Batteries, nano materials, characterization
- Super capacitors – Company formed with university technology (General Capacitors)
- PEM Fuel Cells – Company formed with university technology (Bing Energy): Membrane electrode assemblies (MEAs) by using carbon nanotube “bucky paper”
- Direct Methanol FC



Technology Commercialization Program

➤ 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

➤ **Phase I:** Early Stage Market Research / Business Plans – Fund up to 15 business plans or market research studies at \$10K each for later stage technologies.

➤ **Phase II:** Matching Funds R&D Program – Up to \$50K / project for later stage projects with a 2:1 industry match

Education & Outreach

Education

1. Training for workforce development
2. Nuclear Engineering Education
3. Masters Level Education



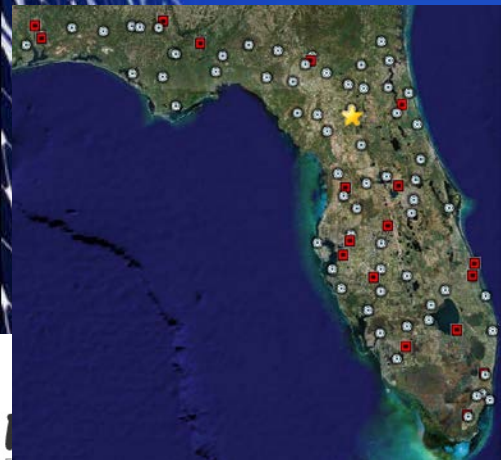
Outreach

- Targets the general public & built environment
- Collaborates with the home builders and construction industry

Created over 50 Fact Sheets

Conducted technical & continuing education programs

Partnered with utilities to implement performance-based demand side management programs



Content-Rich Web Site: floridaenergy.ufl.edu/

FESC Florida Energy Systems Consortium
Universities Addressing Florida's Energy Needs

UF UNIVERSITY OF FLORIDA UCF UNIVERSITY OF CENTRAL FLORIDA USF UNIVERSITY OF SOUTH FLORIDA FAU FLORIDA A&M UNIVERSITY FIU FLORIDA INTERNATIONAL UNIVERSITY UNF UNIVERSITY OF NORTH FLORIDA FLORIDA POLYTECHNIC UNIVERSITY

Home
About Us
Florida Energy Facts
FESC Expertise
FESC Funded Projects
FL University Research
Technology Commercialization
Facilities and Resources
FL Energy Industry
Energy Education/ Energy Jobs
Public Outreach: Events, Fact Sheets, Summits, and Symposiums
Annual Reports, Publications and Presentations
Funding Opportunities
Links
Frequently Asked Questions
Contact Us

Energy Events
Today, Saturday, May 17
Friday, June 8
2nd Annual GO Solar & Renewable Energy Fest
Saturday, June 7
2nd Annual GO Solar & Renewable Energy Fest
Monday, June 9
30th International Fuel Ethanol Workshop & Expo
Tuesday, June 10
30th International Fuel Ethanol Workshop & Expo
Wednesday, June 11
Florida Energy Systems Consortium (FESC) Workshop

2014 Florida Energy Systems Consortium (FESC) Workshop
May 12-13, 2014
Hilton University of Florida Conference Center
Gainesville, Florida

News
Unlimited Clean Renewable Energy – Crowd Energy
Crowd Energy, having completed construction and successful testing of its first generation prototype of the Ocean Energy Turbine, will launch a major Kickstarter campaign in March 2014 to construct a second generation turbine and move the project to (SENRREC) Southeast National Marine Renewable Energy Center at Florida Atlantic University for verification and open water testing.

FAMU Awarded More Than 1.3 Million in USDA Grants
Florida A&M University (FAMU) has been awarded three grants worth more than \$1.3 million from the United States Department of Agriculture's (USDA) National Institute of Food and Agriculture (NIFA).

FAU's Southeast National Marine Renewable Energy Center Successfully Tests Research Turbine Offshore
Florida Atlantic University's Southeast National Marine

Also communicate with FESC network through **bi-monthly newsletter**, in addition to biannual reports, e-mails, telecons and other meetings

Some of the Accomplishments since 2009

New Funding: Leveraged **\$38M** in state funding to obtain **\$373M** in energy research funding from third parties

Startup Companies: **23 companies** formed based on university developed technologies

New Technologies

- **89 Technologies** licensed
- **376 Invention Disclosures** submitted

MOU with BioFuelNet (BFN) Canada: BFN links Canadian universities in biomass research



Education

Over 300 students educated
Over 1000 publications and
Over 1000 presentations

Why Florida Should Lead in Sustainable Energy

It has the most to lose if we don't



Should either West Antarctica or Greenland surrender its ice sheet to the ocean, much of the southern half of Florida would be under water

Ref: <http://earthobservatory.nasa.gov/Features/TimeShelf/>

Contact Information

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Q&A