

## *Educational Modules in Support of Sustainable Energy Courses*

### May 2015 Progress Report

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Project Description: A series of educational modules on sustainable energy are proposed. The modules will be incorporated initially into existing courses in sustainable energy, thermal fluids and senior design at the FAMU-FSU College of Engineering and later components will be used in non-engineering courses on sustainable energy. The period of performance of this proposal is one year, and during this time modules and supporting material will be developed. The departments and centers involved are committed to give continuity to this effort. The midterm goal is that what is initiated in this project will progress towards a collection of modules that can be assemble into self-standing online courses with hundreds of students as well as hand-picked material to support courses in the energy field. The proposed modules emphasize on real systems and devices to elaborate on relevant aspects of sustainable energy, differing in this way from available online course material. In particular, we propose to develop the modules around FSU's Off-Grid Zero Emissions Building (OGZEB), designed by FSU's Energy and Sustainability Center (ESC) to serve as an energy efficient prototype for developing and testing cutting edge, sustainable energy technologies in both residential and commercial settings. The modules will refer to the OGZEB and use its systems to illustrate different concepts. This will provide continuity to the material, and motivate students through exposure to concrete systems.

The modules proposed are structured into three parts:

- Part I provides an overview of the current energy situation and the status of sustainable technologies that are expected to play a significant role in the future of energy conversion.
- Part II deals with sustainable energy conversion technologies. It covers aspects of photovoltaics, biofuels from microalgae, solar thermal, and fuel cells.
- Part III is on sustainable energy utilization and it covers three modules on two of the major energy demanding sectors: transportation and space heating as well as a module introducing control techniques for energy systems aimed at consumption reduction and improved efficiency.

These modules will be incorporated initially to courses in Mechanical Engineering (EML 4450/5451 Energy Conversion Systems for Sustainability and EML 4452/5453 Sustainable Power Generation), and Electrical Engineering (EEL 4280/ 5285 – Renewable Energy I). Also, due to the nature of the modules and demos, it is expected that they will incorporate well into capstone senior design courses in engineering, and support graduate and undergraduate technical elective classes with energy components. We expect that the incorporation of hardware demos, will enhance the student experience and contribute to motivate them to further pursue developments relevant to the future of Florida's economy in the energy field.

The project will be conducted in two phases. Phase I will have a budget of \$40K to produce two videos. After evaluation to satisfaction \$35K will be made available for Phase II to continue the project. The videos in Module 5 and Module 8 will be produced during Phase I. In the content below, items in *italic* font indicate a demo/module component that will be developed making use of FSU Off-grid Zero Emissions Building subsystems (OGZEB) and supporting infrastructure at the Energy Sustainability Center (ESC). Items in normal font will be part of the material developed but will not necessarily use hardware demonstrations or videos. (\*) Refers to a module that will make use of materials/supplies.

#### **Module 5: Solar Photovoltaic**

The solar resource: \*OGZEB -solar irradiance measurements (pyrheliometer and pyranometer).  
 Semiconductors  
 Solar cells  
 Solar tracking: \*Solar tracking lab demo at the OGZEB  
 Power converters for photovoltaic systems: \*Demo of PV converters used in the OGZEB.  
 Current and future outlook

**Module 8: Biofuels from Microalgae**

Introduction, algae strands, oil content, current status  
 Algae productivity, biofuel potential?  
 Methods of cultivation  
 Methods of extraction  
 Current research efforts (e.g. hydrogen production from microalgae, and compact photobioreactors): \* *Microalgae cultivation*

We had an initial planning meeting and met members of the Learning Systems Institute to discuss possibilities to partner in the video production and leverage resources.

New Collaborations		
Partner name	Title or short description of the collaboration	Funding, if applicable
FSU, Learning Systems Institute	Collaboration on educational video production	Each part effort is funded separately

At the moment the contract is being finalized and we expect to begin work soon.