

Integrating Environmental Sustainability Concepts and Practices into Florida's Engineering Technology Education System

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Abstract

Engineering Technology education in two-year A.S. programs is an ever-evolving area given the many new technologies that have become vital to the success of manufacturing and advanced technology companies across the state of Florida. Over the last three years, FLATE, the Florida Advanced Technological Education Center of Excellence, together with the Florida Energy Systems Consortium (FESC) and its community college partners, has worked diligently to respond to regional and statewide industry interest and needs focused on energy. Industry workforce needs center around 2-year degreed technicians prepared for a variety of jobs supporting industry's emerging focus on sustainability, energy efficiency in their industrial and commercial facilities, and implementation and integration of alternative energy technologies. This paper will review the development process and strategies used to develop the industry-driven programs for industrial energy efficiency and alternative energy technologies within the context of "engineering technologies". It will also outline the state review process that requires industry review of the benchmarks and standards that define statewide curriculum. This process provides the opportunity to integrate sustainability concepts and practices into the technical standards.

The Florida Advanced Technological Education Center of Excellence

FLATE is a National Science Foundation funded Center of Excellence under the Advanced Technological Education program. Its mission is to improve the education and training for 2-year technicians supporting the diverse manufacturing companies in the state through curriculum reform, professional development and student recruitment. Currently there are thousands of unfilled technical manufacturing jobs in Florida. Florida's award-winning A.S. Engineering Technology degree program was designed by FLATE to accommodate emerging or changing technologies as quickly as possible without having to add full two-year degree programs. The one-plus-one design includes one year of general education and an engineering technology technical core. The second year allows the student to select one of the specialization tracks that are offered at their home institution from the ten available in Florida Department of Education-approved degree curriculum frameworks. All ten of the engineering technology specializations build on the core skills of the "ET Core". FLATE is also the home of the "Made in Florida" outreach campaign, which supports a variety of vehicles to connect students, educators and the community to manufacturers and their companies and help recruit students into the Engineering Technology programs statewide.

The Florida Energy Systems Consortium (FESC)

As the intensity of attention on optimizing energy generation and use as well as bringing renewable energy technologies into all aspects of mainstream life increases, the need for engineering and implementing technical professionals to support the 21st Century energy age is also apparent. In 2008, Florida's legislature directed the Florida Energy Systems Consortium (FESC), and the State's University and State College systems to develop applied research and specific technical education pathways to allow Florida to meet its 2020 energy generation and demand criteria. The current strategy is entertaining a mix of conventional, nuclear, solar and bio-fuels for generation and a range of options to make Florida "green" within a "smart" grid. In that same legislative action, the National Science Foundation Advanced Technological Education Center of Excellence for Florida (FLATE) was commissioned to determine the expected skills that would be needed to support this new energy reality. Part of this assignment is to find the common skills that will cross various alternative energy technologies and assess the current and projected status of curriculum for such engineering and technical education. The strategy that FLATE and FESC developed for providing the formal technical education to cover this skill set at various levels within the Florida University, state college, and community college systems will be discussed.

FESC was created by the Florida State legislature in 2008 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 "perform research and development on innovative energy systems that lead to alternative energy strategies, improved energy efficiencies, and expanded economic development for the state" ⁽⁵⁾. The legislature appropriated funding for research at six 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 ⁽¹⁾.

The Consortium's energy research strategy is a systems approach for a systemic solution to identify innovation opportunities, prepare an energy workforce, and guide economic development. Through collaborative research and development across the State University System and the industry as well as partnership with FLATE as the conduit to the state college and community college system, the goal of the consortium is to become a world leader in energy research, education, technology, and energy systems and analysis. FESC's focus on education is to be sure that Florida has the talent needed to meet the workforce needs of the developing and emerging industries that it's supporting. The system's approach to energy education requires the integration of three independent education infrastructures; K-12, the state and community colleges, and the universities.

Workforce Education in the Florida State College System

Florida has recently (2008) adopted a hybrid version of the California academic model by blending its previous autonomous community college structure into a joint State College and Community College entity, the Florida College System (FSC). FSC allows existing community

colleges to expand to include selective four- year programs. The State Colleges, therefore, provide an interesting blend of A.A., A.S., A.A.S., specific B.S. and B.A.S. (Bachelor Degree of Applied Science) programs for their regional service area. At this point, it is not envisioned that any four-year degree programs focused specifically on energy will emerge at the state colleges. Therefore, the FESC/FLATE attention is directed to the state’s Curriculum Framework mechanism to define degree and college certificate structures.

A Curriculum Framework is the structure used to define the expected skill development for A.S. degree programs within the Florida College System ⁽²⁾. A Florida Department of Education (FLDOE)-approved A.S. degree must be governed by a FLDOE-approved framework. Additionally, all Career and Workforce high school diplomas and post-secondary technical education (PSAV) programs must also be associated with an appropriate framework.

The guiding principles for the development of any approved framework include several specific inputs including industry review and validated technical skills, the targeted Florida occupations list, the U.S. Department of Labor occupation codes; regional workforce needs projections, workplace and employability skills and a general education component. These are typical inputs to workforce education programs across the country. An additional and unique input requirement in Florida workforce education programs is the alignment to an industry-validated and valued credential.

Associate Degree and College Certificates in Alternative Energy Systems

The Engineering Technology degree specialization “Alternative Energy Systems” and a new, associated college certificate under the specialization has recently been developed to provide technician level education and training in growing alternative /renewable energy and green technology fields. Solar energy technologies have certainly continued to lead Florida’s efforts to

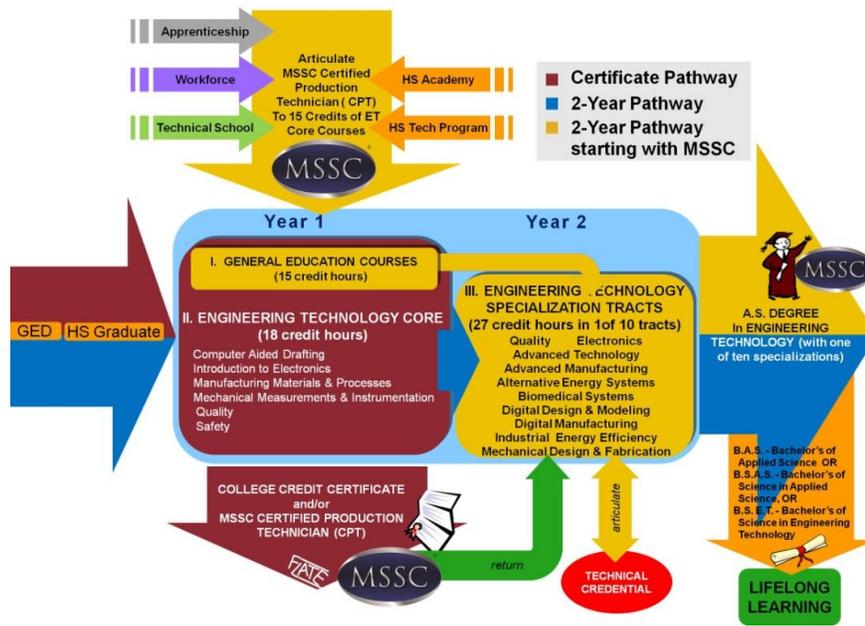


Figure 1. Florida's Engineering Technology Educational Pathways

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meet its 2020 energy generation and usage goals⁽⁴⁾ and the Engineering Technology specialization does emphasize that particular energy source. All Engineering Technology Degree specializations have 24-27 credit hours of courses to focus on the specialization topic/application beyond the general education and engineering technology technical core. A schematic of the degree is provided in Figure 1, illustrating its multiple entry and exit pathways as well as the role that the articulation of the MSSC certification adds to the program. The specializations “Alternative Energy Systems” and “Industrial Energy Efficiency” are found in the list of specializations defined in the “Year 2” side of the diagram.

The Alternate Energy Systems specialization was developed with input from stakeholders (industry and academic) across the state, over a six-month period. This specialization and the associated 15 credit college certificate was first offered at Brevard Community College (now Eastern Florida State College) in 2010, and subsequently at Broward College, Gulf Coast State College, and the State College of Florida. The curriculum frameworks are available for all colleges to adopt as regional and local needs arise. The 12 credit hour college certificate has its own framework and CIP number in the FLDOE, and defines a set of standards that characterize an employable set of skills. Table 1 outlines the five standards that define this Alternative Energy specialization in the Engineering Technology A.S. Degree. Each standard has a number of benchmarks defining specific skills, competencies and knowledge that students must accomplish by the program’s end. Full curriculum frameworks can be downloaded from the FLDOE website⁽³⁾.

Table 1: Framework Standards for the Alternative Energy Systems Specialization

#	Curriculum Framework Standards
01.0	Interpret AC and DC circuit fundamentals related to energy technologies
02.0	Characterize alternative energy sources and technologies
03.0	Apply energy storage, distribution and conversion systems principles
04.0	Characterize the operation and performance of solar energy systems
05.0	Apply policy, regulation, and good business practices for alternative energy systems

Associate Degree and College Credit Certificate for Industrial Energy Efficiency Technologies

Together with the National Science Foundation-funded Energy Systems Technology Technicians (EST²) project team (comprising individuals from Brevard Community College, Florida State College at Jacksonville, Tallahassee Community College and Hillsborough Community College), FLATE has developed a new Industrial Energy Efficiency specialization for the Engineering Technology (ET) Degree and associated College Credit Certificate. Engineering Technicians are widespread in a variety of occupational areas, including electronics, applied technologies, manufacturing, and composites fabrication to name a few. Industry partners have indicated a need for energy efficiency measures to help their bottom line, and as a result the new Specialization/CCC is designed to prepare students for entry-level employment as energy auditor assistants, engineering technicians and operations managers, helping to provide energy efficient techniques to industrial or manufacturing facilities.

This program of study also helps students prepare to become a SEP-Superior Energy Performance Certified Systems Practitioners and CEM Certified Energy Managers. In addition, the program will help train workers who will assist a company in achieving the ISO 50001 standards related to energy management, as well as ISO 14001:2004 to assure a company's stakeholders that measures are being taken to decrease environmental impact. Credits earned in this certificate will transfer into the Associate in Science (A.S.) degree in Engineering Technology. Full curriculum frameworks can be downloaded from the FLDOE website ⁽³⁾.

Table 2: FLDOE Curriculum Framework Standards for Industrial Energy Efficiency Technologies Specialization

#	Curriculum Framework Standards
01.0	Evaluate energy efficiency strategies used for industrial/commercial systems
02.0	Evaluate energy assessment methodologies for the industrial/commercial sectors
03.0	Collect appropriate data to determine energy efficiency of industrial/commercial systems
04.0	Implement efficient operation of industrial/commercial system components
05.0	Implement energy efficiency strategies in industrial/commercial systems
06.0	Troubleshoot integrated industrial/commercial utility equipment systems

Project partners held a focus group meeting that was essentially a scaled down Designing a Curriculum (DACUM) in February 2013. Attendees included industry, university faculty, tech center faculty and state college personnel/faculty who together produced potential courses and course content for the proposed IEET program. The course creation validated the IEET program framework content submitted to the Florida Department of Education for approval this year, and colleges will be able to implement it in the 2014-2015 academic year. Curriculum content modules are currently being developed by subject matter experts to support the newly defined courses (from the DACUM), which will be available in December 2013.

Engineering Technology Core Framework Review and Update

In 2012, the Engineering Technology Curriculum Frameworks came up for review for their regular review cycle. The review process is required by Florida statute to be conducted by the Florida Department of Education Adult and Career Education Division every three years. This division developed a standard process for all framework reviews. A review form is developed by the division and sent to colleges or schools offering the program under review. The review must be conducted by an equal number of industry and education representatives. The form allows each standard and benchmark to be noted as: keep as is; keep with modification; delete; update or add new. There is also a column for capturing changes.

It was during the 2012 review of the frameworks for the ET Technical Core frameworks that a number of sustainability-focused benchmarks were added to some of the 11 ET Technical Core standards. (Other changes were also made to update the framework). No new standards were added. "Dispose of electronic waste in a sustainable manner" was one new benchmark added to the standard that supports basic skills in electronics.

Summary and Closing Remarks

The two new specialization tracks housed at the Florida Department of Education in the Division of Adult and Career Education and where they are currently offered, are summarized in Table 3.

Table 3. Energy Curriculum offered in the Florida State College System

COLLEGE CREDIT CERTIFICATES	COLLEGES OFFERING
Alternative Energy Systems Specialist (CCC) Career Cluster: Manufacturing CIP #: 0615000003 Program Length: 18 (Primary) or 15 (Secondary) Credits	Broward College, Eastern Florida State College, Gulf Coast State College, State College of Florida, Tallahassee Community College
Industrial Energy Efficiency Specialist (CCC) Career Cluster: Manufacturing CIP #: 061500000x Program Length: 21 (Primary) or 24 (Secondary) Credits	Florida State College at Jacksonville (2014)
A.S. ET DEGREE SPECIALIZATIONS (60 credit hours)	COLLEGES OFFERING
A.S. Engineering Technology Alternative Energy Systems Technology	Eastern Florida State College, State College of Florida, Gulf Coast State College
A.S. Engineering Technology Industrial Energy Efficiency	Florida State College at Jacksonville (2013)

The workforce education divisions within the Florida College System (FCS) focus on the technicians and technologists who may work in a multitude of upcoming or evolving energy-related jobs. These employment opportunities include positions triggered by the ever-increasing need to increase productivity, lower costs, and the evolving awareness of the importance of being good stewards of our natural resources. Although these are national efforts, Florida is especially poised to take advantage of the emerging energy-related industry sector. This will ultimately create the need for educational institutions to offer programs to support the needed technician workforce. Engineering Technicians are prevalent in a multitude of occupational areas, including various energy sectors, electronics, applied technologies, manufacturing and composites fabrication, to name a few.

Many examples of potential employment opportunities can be found around the state weekly as new, alternatively-fueled energy production facilities are announced by public utilities, academic institutions, government agencies and private citizens. The public utilities in Florida have already integrated solar energy production sites into their transmission grids. This includes a 10 Mw system being built in Brevard County, plans to build an additional 100Mw farm in Brevard, a large system at TECO farms in Polk County and a solar/biomass system proposed for Harmony, FL. The need for more technicians educated in renewable and alternative energy technologies will increase over time. The FCS is designed to seed that initial technical

workforce with these new and emerging skills, and will feed directly into the Engineering Technology A.S. degree program for career advancement.

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- 4) URL: www.myfloridaclimate.com
- 5) FESC: 2008 Florida Senate Bill 1544 and House Bill 7135

Biography

MARILYN BARGER, Ph.D., P.E.

Dr. Marilyn Barger is the Principal Investigator and Executive Director of FLATE, the Florida Regional Center of Advanced Technological Education, funded by the National Science Foundation and housed at Hillsborough Community College in Tampa, Florida since 2004. FLATE serves the state of Florida and is involved in outreach and recruitment of students into technical career pathways; has produced award winning curriculum design and reform for secondary and post-secondary Career and Technical Education programs; and provides a variety of professional development for SETM and technical educators focused on advanced technologies. She earned a B.A. in Chemistry from Agnes Scott College and both a B.S. in Engineering Science and a Ph.D. in Civil Engineering (Environmental) from the University of South Florida, where her research focused on membrane separation science and technologies. She has over 20 years of experience in developing and delivering curricula for engineering and engineering technologies for and to K-20 educators across the country.

RICHARD GILBERT, Ph.D.

Richard Gilbert is a professor of Chemical and Biomedical Engineering at the University of South Florida's College of Engineering. Research interests include the application of STEM principles for the development of applicators and protocols for human applications of electric field mediated drug and gene delivery. Dr. Gilbert is also a Co-PI for the National Science Foundation supported Advanced Technological Education Center for Florida (FLATE). This NSF long term funded center of excellence has developed a working partnership between Florida's Department of Education, the various technical degree programs within the Florida State College System, The Florida Energy Systems Consortium, and Florida's manufacturing sector to implement A.S. degree programs to meet the needs of 21st century manufacturing in Florida.

NINA STOKES, Ed.S.

Nina Stokes joined the Florida Advanced Technological Education Center (FLATE) at HCC in 2011 as Florida Energy Systems Consortium (FESC) Project Manager. She graduated from the University College of North Wales, U.K., with a B.S. in Marine Biology/Zoology before moving to Florida in 1993. She worked at the Department of Environmental Protection's Florida Marine Research Institute in St. Petersburg as an Environmental Specialist for five years before embarking on a high school science teaching career. She graduated from the University of South Florida in 1996 with an M.A. in Secondary Science Education, and in 2010 with an Ed.S. in Interdisciplinary Science Education. She worked for the City of Tampa for 10 years first as a Water Conservation Education Coordinator, and later moved to the Department of Solid Waste as Recycling Coordinator.