2012 – 2013

Florida Department of Education
Curriculum Framework

Program Title: **Solar Energy Technology**
Program Type: **Career Preparatory**
Career Cluster: **Energy**

	Secondary	PSAV
Program Number	8006100	A600200
CIP Number	0715050500	0715050500
Grade Level	9-12, 30,31	30,31
Standard Length	3 Credits	450 Hours
Teacher Certification	**All Courses:** ELECTRICAL @7G IND ENGR @7G TEC ED 1@2	**All Courses:** ELECTRICAL @7G IND ENGR @7G TEC ED 1@2
	Introduction to Alter. Energy AGRICULTUR 1@2 TEC ED 1@2 EARTH SCI @4 SCIENCE 4 PHYSICS 1,4 CHEM 1,4 EARTH SCI 4,2 **Energy Foundations (Energy Industry Fundamentals)** AGRICULTUR 1@2	
CTSO	SkillsUSA	SkillsUSA
SOC Codes (all applicable)	47-2231	47-2231
Facility Code	245 - http://www.fldoe.org/edfacil/sref.asp (State Requirements for Educational Facilities)	
Targeted Occupation List	http://www.labormarketinfo.com/wec/TargetOccupationList.htm	
Perkins Technical Skill Attainment Inventory	http://www.fldoe.org/workforce/perkins/perkins_resources.asp	
Industry Certifications	http://www.fldoe.org/workforce/fcpea/default.asp	
Statewide Articulation	http://www.fldoe.org/workforce/dwdframe/artic_frame.asp	
Basic Skills Level	N/A	Mathematics: 9 Language: 9 Reading: 9

Special Note Certification

When Solar Certifications are codified Instructors will be required to have Solar Certification.

Purpose

This program offers a sequence of courses that provides coherent and rigorous content aligned with challenging academic standards and relevant technical knowledge and skills needed to prepare for further education and careers in the Energy career cluster; provides technical skill proficiency, and includes competency-based applied learning that contributes to the academic knowledge, higher-order reasoning and problem-solving skills, work attitudes, general employability skills, technical skills, and occupation-specific skills, and knowledge of all aspects of the Energy career cluster.

The purpose of this program is to present information that will assist Florida in increasing the number and skill level of workers who are available to meet the workforce needs of Florida's current and emerging alternative energy industries.

Program Structure

This program is a planned sequence of instruction consisting of one occupational completion point. When offered at the postsecondary level, this program is comprised of courses which have been assigned course numbers in the SCNS (Statewide Course Numbering System) in accordance with Section 1007.24 (1), F.S. Career and Technical credit shall be awarded to the student on a transcript in accordance with Section 1001.44 (3) (b), F.S.

The following table illustrates the **PSAV** program structure:

OCP	Course Number	Course Title	Course Length	SOC Code
A	EEV 0200	Solar Energy Technician	450 Hours	47-2231

The following table illustrates the **Secondary** program structure:

OCP	Course Number	Course Title	Length	SOC Code	Level
	8006110	Energy Foundations (Energy Industry Fundamentals)	1 Credit		3
	8006120	Introduction to Alternative Energy	1 Credit		3
A	8006130	Solar Energy Technician	1 Credit	47-2231	3

Laboratory Activities

Laboratory activities are an integral part of this program. These activities include instruction in the use of safety procedures, tools, equipment, materials, and processes related to these occupations. Equipment and supplies should be provided to enhance hands-on experiences for students.

Special Notes

Academic Alignment

Some or all of the courses in this program have been aligned to the Next Generation Sunshine State Standards contained in specific math and science core academic courses. This alignment resulted from a collaborative review by Career and Technical Education (CTE) teachers and core academic teachers. The table below contains the results of the alignment efforts. Data shown in the table includes the number of academic standards in the CTE course, the total number of math and science standards contained in the academic course, and the percentage of alignment to the CTE course. The following academic courses were included in the alignment (see code for use in table).

Academic Subject Area	Academic Course
Math	Algebra 1 (ALG1) Algebra 2 (ALG2) Geometry (GEO)
Science	Anatomy/Physiology Honors (APH) Astronomy Solar/Galactic Honors (ASGH) Biology 1 (BIO1) Chemistry 1 (CHM1) Earth-Space Science (ESS) Genetics (GEN) Marine Science 1 Honors (MS1H) Physical Science (PS) Physics 1 (PHY1)

Course	Math			Science								
	ALG1	ALG2	GEO	APH	ASGH	BIO1	CHM1	ESS	GEN	MS1H	PS	PHY1
Energy Foundations (Energy Industry Fundamentals)	**	**	**	#	1/52 2%	#	2/55 4%	1/58 2%	#	4/42 10%	6/56 11%	4/53 8%
Introduction to Alternative Energy	**	**	**	2/53 4%	5/52 10%	2/56 4%	3/55 5%	3/58 5%	2/35 6%	6/42 14%	7/56 13%	8/53 15%
Solar Energy Technician	**	**	**	2/53 4%	5/52 10%	3/56 5%	5/55 9%	4/58 7%	2/35 6%	6/42 14%	8/56 14%	8/53 15%

** *Alignment pending* # *Alignment attempted, but no correlation to academic course.*

Career and Technical Student Organization (CTSO)

SkillsUSA (secondary only) is the appropriate career and technical student organization for providing leadership training and reinforcing specific career and technical skills. Career and Technical Student Organizations provide activities for students as an integral part of the instruction offered. The activities of such organizations are defined as part of the curriculum in accordance with Rule 6A-6.065, F.A.C.

Cooperative Training – OJT

On-the-job training is appropriate but not required for this program. Whenever offered, the rules, guidelines, and requirements specified in the OJT framework apply.

Essential Skills

Essential skills identified by the Division of Career and Adult Education have been integrated into the standards and benchmarks of this program. These skills represent the general knowledge and skills considered by industry to be essential for success in careers across all career clusters. Students preparing for a career served by this program at any level should be able to demonstrate these skills in the context of this program. A complete list of Essential Skills and links to instructional resources in support of these Essential Skills are published on the CTE Essential Skills page of the FL-DOE website (http://www.fldoe.org/workforce/dwdframe/essential_skills.asp).

Basic Skills

In PSAV programs offered for 450 hours or more, in accordance with Rule 6A-10.040, F.A.C., the minimum basic skills grade levels required for postsecondary adult career and technical students to complete this program are: Mathematics 9, Language 9, and Reading 9. These grade level numbers correspond to a grade equivalent score obtained on a state designated basic skills examination.

Adult students with disabilities, as defined in Section 1004.02(7), Florida Statutes, may be exempted from meeting the Basic Skills requirements (Rule 6A-10.040). Students served in exceptional student education (except gifted) as defined in s. 1003.01(3)(a), F.S., may also be exempted from meeting the Basic Skills requirement. Each school district and Florida College must adopt a policy addressing procedures for exempting eligible students with disabilities from the Basic Skills requirement as permitted in Section 1004.91(3), F.S.

Students who possess a college degree at the Associate of Applied Science level or higher; who have completed or are exempt from the college entry-level examination; or who have passed a state, national, or industry licensure exam are exempt from meeting the Basic Skills requirement (Rule 6A-10.040, F.A.C.) Exemptions from state, national or industry licensure are limited to the certifications listed at http://www.fldoe.org/workforce/dwdframe/rtf/basicskills-License-exempt.rtf.

Accommodations

Federal and state legislation requires the provision of accommodations for students with disabilities as identified on the secondary student's IEP or 504 plan or postsecondary student's accommodations' plan to meet individual needs and ensure equal access. Postsecondary students with disabilities must self-identify, present documentation, request accommodations if needed, and develop a plan with their counselor and/or instructors. Accommodations received in postsecondary education may differ from those received in secondary education. Accommodations change the way the student is instructed. Students with disabilities may need accommodations in such areas as instructional methods and materials, assignments and assessments, time demands and schedules, learning environment, assistive technology and special communication systems. Documentation of the accommodations requested and provided should be maintained in a confidential file.

In addition to accommodations, some secondary students with disabilities (students with an Individual Educational Plan (IEP) served in Exceptional Student Education or ESE) will need modifications to meet their needs. Modifications change the outcomes or what the student is expected to learn, e.g., modifying the curriculum of a secondary career and technical education course. Note postsecondary curriculum cannot be modified.

Some secondary students with disabilities (ESE) may need additional time (i.e., longer than the regular school year), to master the student performance standards associated with a regular Occupational Completion Point (OCP) or a Modified Occupational Completion Point (MOCP). If needed, a student may enroll in the same career and technical course more than once. Documentation should be included in the IEP that clearly indicates that it is anticipated that the student may need an additional year to complete an OCP/MOCP. The student should work on different competencies and new applications of competencies each year toward completion of the OCP/MOCP. After achieving the competencies identified for the year, the student earns credit for the course. It is important to ensure that credits earned by students are reported accurately. The district's information system must be designed to accept multiple credits for the same course number (for eligible students with disabilities).

Articulation

The PSAV component of this program has no statewide articulation agreement approved by the Articulation Coordinating Committee. However, this does not preclude the awarding of credits by any college through local agreements.

For details on statewide articulation agreements which correlate to programs and industry certifications, refer to http://www.fldoe.org/workforce/dwdframe/artic_frame.asp.

Bright Futures/Gold Seal Scholarship

Course substitutions as defined in the Comprehensive Course Table for this program area may be used to qualify a student for Florida's Gold Seal Vocational Scholarship, providing all other eligibility requirements are met. Eligibility requirements are available online at https://www.osfaffelp.org/bfiehs/fnbpcm02_CCTMain.aspx.

Fine Arts/Practical Arts Credit

Many courses in CTE programs meet the Fine Arts/Practical Arts credit for high school graduation. A listing of approved CTE courses is published each year as a supplemental resource to the Course Code Directory (http://www.fldoe.org/articulation/CCD/default.asp).

Standards

After successfully completing this program, the student will be able to perform the following:

01.0 Demonstrate knowledge of the basic and emerging principles and concepts that impact the energy industry.
02.0 Apply compliance with procedures necessary to ensure a safe and healthy work environment.
03.0 Understand electric power generation.
04.0 Understand electric power transmission.
05.0 Understand electric power distribution
06.0 Identify and describe careers and entry requirements.
07.0 Evaluate and analyze energy 'hot topics'.
08.0 Describe the roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment.
09.0 Explain the importance of employability and entrepreneurship skills.
10.0 Use information technology tools.

11.0 Discuss the value of alternative energy.
12.0 Investigate the viability of biomass and biofuel.
13.0 Describe the importance of professional ethics and legal responsibilities.
14.0 Investigate the use of nuclear power.
15.0 Demonstrate leadership and teamwork skills needed to accomplish team goals and objectives.
16.0 Investigate the viability of solar energy.
17.0 Demonstrate personal money-management concepts, procedures, and strategies.
18.0 Investigate the viability of wind energy.
19.0 Demonstrate knowledge of solar energy.
20.0 Describe safe work practices.
21.0 Conduct a site assessment.
22.0 Design a solar system.
23.0 Install subsystems and components at the site.
24.0 Inspect and troubleshoot solar systems.
25.0 Maintain solar systems.
26.0 Demonstrate the importance of health, safety, and environmental management systems in organizations and their importance to organizational performance and regulatory compliance.
27.0 Use oral and written communication skills in creating, expressing and interpreting information and ideas.
28.0 Demonstrate language arts knowledge and skills.
29.0 Demonstrate science knowledge and skills.
30.0 Demonstrate mathematics knowledge and skills.
31.0 Solve problems using critical thinking skills, creativity and innovation.

2012 – 2013

Florida Department of Education
Student Performance Standards

Program Title: **Solar Energy Technology**
PSAV Number: **A600200**

Course Number: EEV 0200
Occupational Completion Point: A
Solar Energy Technician – 450 Hours – SOC Code 47-2231

01.0 Demonstrate knowledge of the basic and emerging principles and concepts that impact the energy industry--The student will be able to:

01.01 Explain the flow of energy from generation through distribution to the customer.
01.02 Discuss the history of the United States energy industry/infrastructure (refer to Energy Information Administration www.eia.doe.gov).
01.03 Identify the role and function of generation, transmission and distribution organizations.
01.04 Explains the role of regulatory bodies in the energy industry (Federal Energy Regulatory Commission www.ferc.gov; Public Service Commission of the State of Florida www.psc.state.fl.us) (highlight “obligation to serve”).
01.05 Discuss environmental laws and regulations that impact the energy industry (local, state, and federal) and explain importance of proper documentation to ensure compliance.
01.06 Explain the different structures of energy companies, including investor-owned utilities, municipalities (and associated utility practices such as water/wastewater), electric cooperatives, independent power producers and can explain the different lines of energy business, including electric and gas.
01.07 Describe the process of electric metering and billing for energy consumption.

02.0 Apply compliance with procedures necessary to ensure a safe and healthy work environment--The student will be able to:

02.01 Review the role of the U.S. Department of Labor/ Occupational Safety and Health Administration in work place safety. (http://www.complianceregs.com/29cfr/1910/subR/1910-269.html)
02.02 Identify both potential hazards and accident scenarios in the work environment.
02.03 Follow established safety procedures (OSHA regulations and utility company procedures).
02.04 Evaluate changes in the environment with respect to their impact on safety of self and others.
02.05 Promote effective local, state, and national security operations for the protection of people, data, property and institutions.
02.06 Comply with energy industry safety procedures and proper ways to perform work.
02.07 Name potential threats created by deviation from safety procedures and improper use of tools and equipment.
02.08 Use safety equipment as specified by user manuals and safety training.
02.09 Use Personal Protective Equipment (PPE) including safety glasses, hearing protection, gloves, work boots, and hard hats.

02.10 Keep personal safety equipment in good working order.
02.11 Use tools and equipment in compliance with user manuals and training.
02.12 Call attention to potential and actual hazardous conditions as they arise.
02.13 Alert coworkers and supervisory personnel to hazardous conditions and deviations from safety procedures in a timely manner.
02.14 Maintain appropriate certification and is knowledgeable in first aid or first response procedures.
02.15 Demonstrate understanding and knowledge of lock/tag out practices in the work place.
02.16 Notify person in charge and/or coworkers of unsafe work conditions.
02.17 Stop the job if there are unsafe working conditions.

03.0 Understand electric power generation--The student will be able to:

03.01 Explain the conventional electric power generation systems and process (coal, gas, hydroelectric, and nuclear).
03.02 Identify electric power generation equipment and systems.
03.03 Identify various conventional electric power generation fuel sources and the cost/ efficiency/ environmental issues associated with each:
03.04 Explain how oil was created and list its advantages and disadvantages
03.05 Explain how coal was created and what are its advantages and disadvantages
03.06 Explain how natural gas was created and what are its advantages and disadvantages.
03.07 Explain how water is used in hydroelectric power generation and what are its advantages and disadvantages.
03.08 Explain how uranium is created and what are its advantages and disadvantages
03.09 Discuss emerging and alternative electric power generation technologies and fuel sources.
03.10 Explain how solar energy is used to produce electricity in photovoltaic systems and what are its advantages and disadvantages.
03.11 Explain how solar energy is used to produce electric energy using steam and what are its advantages and disadvantages.
03.12 Explain how wind energy is used to produce electric energy and what are its advantages and disadvantages.
03.13 Explain how geothermal energy is used to produce electric energy and what are its advantages and disadvantages.
03.14 Explain how biomass energy is used to produce electric energy and what are its advantages and disadvantages.
03.15 Explain how ocean wave energy is used to produce electric energy and what are its advantages and disadvantages.
03.16 Discuss pros and cons of various energy producing technologies and fuels in the electrical infrastructure (including fossil, nuclear and emerging alternative energy systems).

04.0 Understand electric power transmission--The student will be able to:

04.01 Explain the electric power transmission process.
04.02 Discuss the application of different electric power transmission principles (including AC vs. DC).
04.03 Name electric power transmission equipment and systems.

04.04 Discuss the emerging technologies in electric power transmission (including Smart Grid).
04.05 Explain ownership/governance of the electric transmission system.

05.0 Understand electric power distribution--The student will be able to:

05.01 Explain the electric power distribution process.
05.02 Discuss the need for electric distribution systems and how they are designed to operate.
05.03 Name electric power distribution system equipment and what the various components do.
05.04 Discuss the emerging technologies in electric power distribution, including distribution automation and SmartGrid systems.

06.0 Identify and describe careers and entry requirements--The student will be able to:

06.01 Describe entry-level careers available in energy generation, transmission, distribution and the education/experience requirements for entry into those positions, along with career development and advancement opportunities from those positions.
06.02 Identify entry-level careers available in business and corporate support functions of the energy industry; describes the education/experience requirements for entry into those positions, and career advancement opportunities from those positions.
06.03 Describe general wage/salary, benefits, and other advantages of careers in the energy industry.
06.04 Explain the educational pathways available to gain training necessary for entry into energy careers at secondary and post-secondary levels (Partner to create Energy Education Portal).

07.0 Evaluate and analyze energy 'hot topics'--The student will be able to:

07.01 Discuss the major sources of biomass.
07.02 Define biofuels (e. g. ethanol, biodiesel, and methanol).
07.03 Outline the pyramid energy flow including the different trophic levels.
07.04 Describe the major sources, scale, and impacts of biomass energy.
07.05 Draw and label a diagram of biomass plantations.
07.06 List the advantages and disadvantages of using biomass for energy (e.g. CO_2 emissions, photosynthetic efficiency, cost, etc.).

08.0 Describe the roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment--The students will be able to:

08.01 Describe the nature and types of business organizations. SY1.0
08.02 Explain the effect of key organizational systems on performance and quality.
08.03 List and describe quality control systems and/or practices common to the workplace. SY2.0
08.04 Explain the impact of the global economy on business organizations.

09.0 Explain the importance of employability and entrepreneurship skills--The student will be able to:

09.01 Identify and demonstrate positive work behaviors needed to be employable.ECD1.0
09.02 Develop personal career plan that includes goals, objectives, and strategies.ECD2.0
09.03 Examine licensing, certification, and industry credentialing requirements. ECD3.0
09.04 Maintain a career portfolio to document knowledge, skills, and experience.ECD5.0
09.05 Evaluate and compare employment opportunities that match career goals.ECD6.0
09.06 Identify and exhibit traits for retaining employment. ECD7.0
09.07 Identify opportunities and research requirements for career advancement.ECD8.0
09.08 Research the benefits of ongoing professional development. ECD9.0
09.09 Examine and describe entrepreneurship opportunities as a career planning option. ECD10.0

10.0 Use information technology tools--The students will be able to:

10.01 Use Personal Information Management (PIM) applications to increase workplace efficiency. IT1.0
10.02 Employ technological tools to expedite workflow including word processing, databases, reports, spreadsheets, multimedia presentations, electronic calendar, contacts, email, and internet applications. IT2.0
10.03 Employ computer operations applications to access, create, manage, integrate, and store information. IT3.0
10.04 Employ collaborative/groupware applications to facilitate group work. IT4.0

11.0 Discuss the value of alternative energy--The student will be able to:

11.01 Investigate the reasons for seeking alternatives to fossil fuels.
11.02 Summarize the contributions to world energy supplies of conventional alternatives to fossil fuels.
11.03 Discuss the three alternative energy sources that are currently the most developed and widely used (hydroelectric, nuclear, and biomass).

12.0 Investigate the viability of biomass and biofuel--The student will be able to:

12.01 Discuss the major sources of biomass.
12.02 Define biofuels (e. g. ethanol, biodiesel, and methanol).
12.03 Outline the pyramid energy flow including the different trophic levels.
12.04 Describe the major sources, scale, and impacts of biomass energy.
12.05 Draw and label a diagram of biomass plantations.
12.06 List the advantages and disadvantages of using biomass for energy (e.g. CO_2 emissions, photosynthetic efficiency, cost, etc.).

13.0 Describe the importance of professional ethics and legal responsibilities--The student will be able to:

13.01 Evaluate and justify decisions based on ethical reasoning. ELR1.0
13.02 Evaluate alternative responses to workplace situations based on personal, professional, ethical, legal responsibilities, and employer policies. ELR1.1

13.03 Identify and explain personal and long-term consequences of unethical or illegal behaviors in the workplace. ELR1.2
13.04 Interpret and explain written organizational policies and procedures. ELR2.0

14.0 Investigate the use of nuclear power--The student will be able to:

14.01 Explain the process of nuclear fission.
14.02 Define radio-isotopes and half-life.
14.03 Evaluate the advantages and disadvantages of nuclear power.
14.04 Draw and label a diagram of a Light-Water Reactor (LWR) (e.g. control rods, coolant, containment vessel, dry casks, turbine, etc.).
14.05 Describe nuclear energy and how it is harnessed.
14.06 Describe the Chernobyl Nuclear Power Plant accident.
14.07 Outline the societal debate over nuclear power.

15.0 Demonstrate leadership and teamwork skills needed to accomplish team goals and objectives--The students will be able to:

15.01 Employ leadership skills to accomplish organizational goals and objectives. LT1.0
15.02 Establish and maintain effective working relationships with others in order to accomplish objectives and tasks. LT3.0
15.03 Conduct and participate in meetings to accomplish work tasks. LT4.0
15.04 Employ mentoring skills to inspire and teach others. LT5.0

16.0 Investigate the viability of solar energy--The student will be able to:

16.01 Describe solar energy and how it is harnessed.
16.02 Explain the significance and historical foundations of solar energy and its pioneers (Horace de Saussure and Clarence Kemp).
16.03 Explain the difference between passive solar and active solar.
16.04 Draw and label a diagram of PV cells (e.g. array, panel, module, boron-enriched silicon).
16.05 Describe a central receiver system.
16.06 Draw and label a diagram of a solar thermal plant.
16.07 Evaluate the advantages and disadvantages of using solar energy.

17.0 Demonstrate personal money-management concepts, procedures, and strategies--The students will be able to:

17.01 Identify and describe the services and legal responsibilities of financial institutions. FL2.0
17.02 Describe the effect of money management on personal and career goals. FL3.0
17.03 Develop a personal budget and financial goals. FL3.1
17.04 Complete financial instruments for making deposits and withdrawals. FL3.2
17.05 Maintain financial records. FL3.3
17.06 Read and reconcile financial statements. FL3.4
17.07 Research, compare and contrast investment opportunities.

18.0 Investigate the viability of wind energy--The student will be able to:

18.01 Describe wind energy and the way it is harnessed.
18.02 Explain the significance of wind energy and its pioneers (Charles Brush).
18.03 Define kinetic energy.
18.04 List and describe the topography and weather patterns of the states that are considered the “Saudi Arabia of wind power.”
18.05 Explain the acronym NIMBY (Not In My Backyard).
18.06 Explain why farmers and ranchers are amenable to wind technology.
18.07 Evaluate the advantages and disadvantages to wind technology.

19.0 Demonstrate knowledge of solar energy--The student will be able to:

19.01 Define basic solar terms (e.g. irradiation, Langley, azimuth).
19.02 Determine true (solar) south from magnetic (compass) south given a declination map.
19.03 Describe basic solar movement and effect of the Earth’s tilt.
19.04 Predict solar position using solar path diagrams.
19.05 Describe angular effects on the irradiance of array.
19.06 Identify factors that reduce/enhance solar irradiation.
19.07 Determine average solar irradiation on various surfaces.
19.08 Describe how a photovoltaic solar cell works.
19.09 Draw and label a diagram of PV cells (e.g. array, panel, module, boron-enriched silicon [p-type], phosphorus-enriched silicon [n-type], and the n-p junction).
19.10 Explain the differences between monocrystalline, polycrystalline, thin-film, and nano-solar cells.
19.11 Convert solar irradiation into a variety of electrical units.
19.12 Determine effect of horizon on solar irradiation (shading).
19.13 Demonstrate use of Solar Pathfinder or sun charts.

20.0 Describe safe work practices--The student will be able to:

20.01 Demonstrate safe and proper use of required tools and equipment.
20.02 Identify personal and environmental safety hazards and accepted practices.
20.03 Explain the importance of basic first aid and CPR in the solar energy work setting.
20.04 Identify and implement Occupational Safety and Health Administration (OSHA) codes and standards concerning installation, operation, public safety and maintenance of solar systems and equipment.

21.0 Conduct a site assessment--The student will be able to:

21.01 Identify traditional tools and equipment required for conducting site surveys for solar installation and demonstrates proficiency in their use.
21.02 Establish suitable location with proper orientation, area, access and structural integrity for solar systems.
21.03 Diagram possible layouts and locations for array and equipment, including existing building or site features.
21.04 Identify and assess any site-specific safety hazards or other issues associated with the installation of the system.
21.05 Obtain and interpret solar radiation and temperature data for site for purposes of establishing performance expectations.

21.06 Quantify the customer electrical load and energy use through review of utility bills and meter readings.
21.07 Conduct an energy audit.
21.08 Estimate the peak load and average energy use in order to determine the size and amount of solar equipment needed.
21.09 Determine the requirements for installing a solar system for the proper interface with a utility system.

22.0 Design a solar system--The student will be able to:

22.01 Identify appropriate system design and configurations based on the customer's consumption needs based on desired energy, peak power production, autonomy requirements, size, and costs.
22.02 Estimate time, materials and equipment required for installation based on optimizing use of time and materials.
22.03 Identify mechanical design that is consistent with environmental, architectural, structural, code requirements and other conditions of the site.
22.04 Determine the electrical design to be compatible with the existing electrical currents.
22.05 Select appropriate conductor types and rating for each electrical circuit in the open or closed system.
22.06 Determine the derated ampacity of system conductors, and select appropriate sizes based on design currents.
22.07 Determine appropriate size, ratings and locations for all system over-current and disconnect devices.
22.08 Determine appropriate size, ratings and locations for grounding, surge suppression and associated equipment.
22.09 Determine voltage drop for any electrical circuit based on size and length of conductors.
22.10 Select an appropriate utility interconnection point, and determine the size, ratings and locations for over-current and disconnect devices.

23.0 Install subsystems and components at the site--The student will be able to:

23.01 Utilize, draw and label schematics, instructions and recommended procedures in installing equipment while implementing all applicable personal and personnel safety and environmental protections measures.
23.02 Visually inspect and quick test PV modules.
23.03 Assemble modules, panels and support structures as specified by the manufacturer.
23.04 Install module array interconnect wiring; implement measures to disable array during installation.
23.05 Complete final assembly, structural attachment and weather sealing of array to building or other support mechanism(s).
23.06 Install and provide required labels on inverters, controls, disconnects and over-current devices, surge suppression and grounding equipment, junction boxes, batteries and enclosures, conduit and other electrical hardware.
23.07 Label, install and terminate electrical wiring; verify proper connections, voltages and phase/polarity relationships.
23.08 Verify continuity and measure impedance of grounding system.

23.09 Program, adjust and or configure inverters and controls for desired set points and operating modes.

24.0 Inspect and troubleshoot solar systems--The student will be able to:

24.01 Visually inspect the entire installation, identifying and resolving any deficiencies in materials or workmanship.
24.02 Check system mechanical installation for structural integrity and weather sealing.
24.03 Check electrical installation for proper wiring, polarity, grounding and integrity terminations.
24.04 Activate the system and verify overall system functionality and performance based on initial expectations.
24.05 Demonstrate procedures for connecting and disconnecting the system and equipment from all sources.
24.06 Identify and verify all required markings and labels for the system and equipment.
24.07 Identify, provide documentation, and explain all safety issues associated with operations and maintenance of the system.

25.0 Maintain solar systems--The student will be able to:

25.01 Identify the tools and equipment required for maintaining and troubleshooting the system.
25.02 Identify maintenance needs and implement service procedures for modules, arrays, batteries, power conditioning equipment, safety systems, structural and weather sealing systems, and balance of systems equipment.
25.03 Measure system performance and operating parameters, compare with specifications and expectations, and asses operating condition of system and equipment.
25.04 Perform diagnostics and interpret results.
25.05 Identify performance and safety issues, and implement corrective measures.
25.06 Verify and demonstrate complete functionality and performance of system, including start-up, shut-down, normal operation and emergency bypass operations.
25.07 Compile and maintain record of system operation, performance and maintenance.

26.0 Demonstrate the importance of health, safety, and environmental management systems in organizations and their importance to organizational performance and regulatory compliance--The students will be able to:

26.01 Describe personal and jobsite safety rules and regulations that maintain safe and healthy work environments. SHE1.0
26.02 Explain emergency procedures to follow in response to workplace accidents.
26.03 Create a disaster and/or emergency response plan. SHE2.0

27.0 Use oral and written communication skills in creating, expressing and interpreting information and ideas--The students will be able to:

27.01 Select and employ appropriate communication concepts and strategies to enhance oral and written communication in the workplace. CM1.0

27.02 Locate, organize and reference written information from various sources. CM3.0
27.03 Design, develop and deliver formal and informal presentations using appropriate media to engage and inform diverse audiences. CM5.0
27.04 Interpret verbal and nonverbal cues/behaviors that enhance communication.CM6.0
27.05 Apply active listening skills to obtain and clarify information. CM7.0
27.06 Develop and interpret tables and charts to support written and oral communications. CM8.0
27.07 Exhibit public relations skills that aid in achieving customer satisfaction. CM10.0

28.0 Demonstrate language arts knowledge and skills--The students will be able to: AF2.0

28.01 Locate, comprehend and evaluate key elements of oral and written information.AF2.4
28.02 Draft, revise, and edit written documents using correct grammar, punctuation and vocabulary. AF2.5
28.03 Present information formally and informally for specific purposes and audiences.AF2.9

29.0 Demonstrate science knowledge and skills--The students will be able to: AF4.0

29.01 Discuss the role of creativity in constructing scientific questions, methods and explanations. AF4.1
29.02 Formulate scientifically investigable questions, construct investigations, collect and evaluate data, and develop scientific recommendations based on findings.AF4.3

30.0 Demonstrate mathematics knowledge and skills--The students will be able to: AF3.0

30.01 Demonstrate knowledge of arithmetic operations. AF3.2
30.02 Analyze and apply data and measurements to solve problems and interpret documents. AF3.4
30.03 Construct charts/tables/graphs using functions and data. AF3.5

31.0 Solve problems using critical thinking skills, creativity and innovation--The students will be able to:

31.01 Employ critical thinking skills independently and in teams to solve problems and make decisions. PS1.0
31.02 Employ critical thinking and interpersonal skills to resolve conflicts. PS2.0
31.03 Identify and document workplace performance goals and monitor progress toward those goals. PS3.0
31.04 Conduct technical research to gather information necessary for decision-making.PS4.0

2012 – 2013

Florida Department of Education
Student Performance Standards

Course Title: **Energy Foundations (Energy Industry Fundamentals)**
Course Number: **8006110**
Course Credit: **1**

Course Description:

This course is designed to develop competencies in the areas of energy history and the global impact of renewable and non-renewable resources; career opportunities; scientific and research concepts; biological and physical science principles; environmental principles; and solar energy safety. Laboratory-based activities are an integral part of this course. These include the safe use and application of appropriate technology, scientific testing and observation equipment.

Standards included in this course of instruction have been aligned to the academic courses shown below. This table shows the number of aligned benchmarks, the total number of academic benchmarks, and the percentage of alignment.

Math		Science					
Algebra 1	**	**Biology 1**	#	**Anatomy/Physiology Honors**	#	**Astronomy Solar/Galactic Honors**	1/52 2%
Algebra 2	**	**Chemistry 1**	2/55 4%	**Genetics**	#	**Marine Science 1 Honors**	4/42 10%
Geometry	**	**Physics 1**	4/53 8%	**Earth-Space Science**	1/58 2%	**Physical Science**	6/56 11%

** *Alignment pending* # *Alignment attempted, but no correlation to academic course.*

01.0 Demonstrate knowledge of the basic and emerging principles and concepts that impact the energy industry--The student will be able to:

This standard supports the following Next Generation Sunshine State Standards: SC.912.E.6.6; SC.912.L.17.17; SC.912.N.4.2

01.08 Explain the flow of energy from generation through distribution to the customer.
01.09 Discuss the history of the United States energy industry/infrastructure (refer to Energy Information Administration www.eia.doe.gov).
01.10 Identify the role and function of generation, transmission and distribution organizations.
01.11 Explains the role of regulatory bodies in the energy industry (Federal Energy Regulatory Commission www.ferc.gov; Public Service Commission of the State of Florida www.psc.state.fl.us) (highlight “obligation to serve”).
01.12 Discuss environmental laws and regulations that impact the energy industry (local, state, and federal) and explain importance of proper documentation to ensure compliance.
01.13 Explain the different structures of energy companies, including investor-owned utilities, municipalities (and associated utility practices such as

water/wastewater), electric cooperatives, independent power producers and can explain the different lines of energy business, including electric and gas.

01.14 Describe the process of electric metering and billing for energy consumption.

02.0 Apply compliance with procedures necessary to ensure a safe and healthy work environment--The student will be able to:

02.01 Review the role of the U.S. Department of Labor/ Occupational Safety and Health Administration in work place safety. (http://www.complianceregs.com/29cfr/1910/subR/1910-269.html)
02.02 Identify both potential hazards and accident scenarios in the work environment.
02.03 Follow established safety procedures (OSHA regulations and utility company procedures).
02.04 Evaluate changes in the environment with respect to their impact on safety of self and others.
02.05 Promote effective local, state, and national security operations for the protection of people, data, property and institutions.
02.06 Comply with energy industry safety procedures and proper ways to perform work.
02.07 Name potential threats created by deviation from safety procedures and improper use of tools and equipment.
02.08 Use safety equipment as specified by user manuals and safety training.
02.09 Use Personal Protective Equipment (PPE) including safety glasses, hearing protection, gloves, work boots, and hard hats.
02.10 Keep personal safety equipment in good working order.
02.11 Use tools and equipment in compliance with user manuals and training.
02.12 Call attention to potential and actual hazardous conditions as they arise.
02.13 Alert coworkers and supervisory personnel to hazardous conditions and deviations from safety procedures in a timely manner.
02.14 Maintain appropriate certification and is knowledgeable in first aid or first response procedures.
02.15 Demonstrate understanding and knowledge of lock/tag out practices in the work place.
02.16 Notify person in charge and/or coworkers of unsafe work conditions.
02.17 Stop the job if there are unsafe working conditions.

03.0 Understand electric power generation--The student will be able to:

This standard supports the following Next Generation Sunshine State Standards: SC.912.E.7.2; SC.912.L.17.11, 15, 19; SC.912.P.10.1

03.01 Explain the conventional electric power generation systems and process (coal, gas, hydroelectric, and nuclear).
03.02 Identify electric power generation equipment and systems.
03.03 Identify various conventional electric power generation fuel sources and the cost/ efficiency/ environmental issues associated with each:
03.04 Explain how oil was created and list its advantages and disadvantages
03.05 Explain how coal was created and what are its advantages and disadvantages
03.06 Explain how natural gas was created and what are its advantages and disadvantages.

03.07 Explain how water is used in hydroelectric power generation and what are its advantages and disadvantages.
03.08 Explain how uranium is created and what are its advantages and disadvantages
03.09 Discuss emerging and alternative electric power generation technologies and fuel sources.
03.10 Explain how solar energy is used to produce electricity in photovoltaic systems and what are its advantages and disadvantages.
03.11 Explain how solar energy is used to produce electric energy using steam and what are its advantages and disadvantages.
03.12 Explain how wind energy is used to produce electric energy and what are its advantages and disadvantages.
03.13 Explain how geothermal energy is used to produce electric energy and what are its advantages and disadvantages.
03.14 Explain how biomass energy is used to produce electric energy and what are its advantages and disadvantages.
03.15 Explain how ocean wave energy is used to produce electric energy and what are its advantages and disadvantages.
03.16 Discuss pros and cons of various energy producing technologies and fuels in the electrical infrastructure (including fossil, nuclear and emerging alternative energy systems).

04.0 Understand electric power transmission--The student will be able to:

04.01 Explain the electric power transmission process.
04.02 Discuss the application of different electric power transmission principles (including AC vs. DC).
04.03 Name electric power transmission equipment and systems.
04.04 Discuss the emerging technologies in electric power transmission (including Smart Grid).
04.05 Explain ownership/governance of the electric transmission system.

05.0 Understand electric power distribution--The student will be able to:

05.01 Explain the electric power distribution process.
05.02 Discuss the need for electric distribution systems and how they are designed to operate.
05.03 Name electric power distribution system equipment and what the various components do.
05.04 Discuss the emerging technologies in electric power distribution, including distribution automation and SmartGrid systems.

06.0 Identify and describe careers and entry requirements--The student will be able to:

06.01 Describe entry-level careers available in energy generation, transmission, distribution and the education/experience requirements for entry into those positions, along with career development and advancement opportunities from those positions.
06.02 Identify entry-level careers available in business and corporate support functions of the energy industry; describes the education/experience requirements for entry into those positions, and career advancement opportunities from those positions.

06.03 Describe general wage/salary, benefits, and other advantages of careers in the energy industry.
06.04 Explain the educational pathways available to gain training necessary for entry into energy careers at secondary and post-secondary levels (Partner to create Energy Education Portal).

07.0 Evaluate and analyze energy 'hot topics'--The student will be able to:

This standard supports the following Next Generation Sunshine State Standards: SC.912.P.10.2, 8

07.01 Discuss the major sources of biomass.
07.02 Define biofuels (e. g. ethanol, biodiesel, and methanol).
07.03 Outline the pyramid energy flow including the different trophic levels.
07.04 Describe the major sources, scale, and impacts of biomass energy.
07.05 Draw and label a diagram of biomass plantations.
07.06 List the advantages and disadvantages of using biomass for energy (e.g. CO_2 emissions, photosynthetic efficiency, cost, etc.).

08.0 Describe the roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment--The students will be able to:

08.01 Describe the nature and types of business organizations. SY1.0
08.02 Explain the effect of key organizational systems on performance and quality.
08.03 List and describe quality control systems and/or practices common to the workplace. SY2.0
08.04 Explain the impact of the global economy on business organizations.

09.0 Explain the importance of employability and entrepreneurship skills--The student will be able to:

09.01 Identify and demonstrate positive work behaviors needed to be employable.ECD1.0
09.02 Develop personal career plan that includes goals, objectives, and strategies.ECD2.0
09.03 Examine licensing, certification, and industry credentialing requirements. ECD3.0
09.04 Maintain a career portfolio to document knowledge, skills, and experience.ECD5.0
09.05 Evaluate and compare employment opportunities that match career goals.ECD6.0
09.06 Identify and exhibit traits for retaining employment. ECD7.0
09.07 Identify opportunities and research requirements for career advancement.ECD8.0
09.08 Research the benefits of ongoing professional development. ECD9.0
09.09 Examine and describe entrepreneurship opportunities as a career planning option. ECD10.0

10.0 Use information technology tools--The students will be able to:

10.01 Use Personal Information Management (PIM) applications to increase workplace efficiency. IT1.0
10.02 Employ technological tools to expedite workflow including word processing, databases, reports, spreadsheets, multimedia presentations, electronic calendar, contacts, email, and internet applications. IT2.0

10.03 Employ computer operations applications to access, create, manage, integrate, and store information. IT3.0
10.04 Employ collaborative/groupware applications to facilitate group work. IT4.0

2012 – 2013

Florida Department of Education
Student Performance Standards

Course Title: **Introduction to Alternative Energy**
Course Number: **8006120**
Course Credit: **1**

Course Description:

This course is designed to develop competencies in the areas of energy history and the global impact of renewable and non-renewable resources; career opportunities; scientific and research concepts; biological and physical science principles; environmental principles; and solar energy safety. Laboratory-based activities are an integral part of this course. These include the safe use and application of appropriate technology, scientific testing and observation equipment.

Standards included in this course of instruction have been aligned to the academic courses shown below. This table shows the number of aligned benchmarks, the total number of academic benchmarks, and the percentage of alignment.

Math		Science					
Algebra 1	**	**Biology 1**	2/56 4%	**Anatomy/Physiology Honors**	2/53 4%	**Astronomy Solar/Galactic Honors**	5/52 10%
Algebra 2	**	**Chemistry 1**	3/55 5%	**Genetics**	2/35 6%	**Marine Science 1 Honors**	6/42 14%
Geometry	**	**Physics 1**	8/53 15%	**Earth-Space Science**	3/58 5%	**Physical Science**	7/56 13%

** *Alignment pending* # *Alignment attempted, but no correlation to academic course.*

11.0 Discuss the value of alternative energy--The student will be able to:

This standard supports the following Next Generation Sunshine State Standards: SC.912.E.6.6; SC.912.L.17.11, 17; SC.912.N.1.1; SC.912.P.10.1, 2

11.01 Investigate the reasons for seeking alternatives to fossil fuels.
11.02 Summarize the contributions to world energy supplies of conventional alternatives to fossil fuels.
11.03 Discuss the three alternative energy sources that are currently the most developed and widely used (hydroelectric, nuclear, and biomass).

12.0 Investigate the viability of biomass and biofuel--The student will be able to:

This standard supports the following Next Generation Sunshine State Standards: MA.912.S.3.2; SC.912.L.17.19, 20

12.01 Discuss the major sources of biomass.
12.02 Define biofuels (e. g. ethanol, biodiesel, and methanol).
12.03 Outline the pyramid energy flow including the different trophic levels.

12.04 Describe the major sources, scale, and impacts of biomass energy.
12.05 Draw and label a diagram of biomass plantations.
12.06 List the advantages and disadvantages of using biomass for energy (e.g. CO_2 emissions, photosynthetic efficiency, cost, etc.).

13.0 Describe the importance of professional ethics and legal responsibilities--The student will be able to:

13.01 Evaluate and justify decisions based on ethical reasoning. ELR1.0
13.02 Evaluate alternative responses to workplace situations based on personal, professional, ethical, legal responsibilities, and employer policies. ELR1.1
13.03 Identify and explain personal and long-term consequences of unethical or illegal behaviors in the workplace. ELR1.2
13.04 Interpret and explain written organizational policies and procedures. ELR2.0

14.0 Investigate the use of nuclear power--The student will be able to:

This standard supports the following Next Generation Sunshine State Standards:
MA.912.S.3.2; SC.912.E.6.6; SC.912.L.17.11; SC.912.N.4.2

14.01 Explain the process of nuclear fission.
14.02 Define radio-isotopes and half-life.
14.03 Evaluate the advantages and disadvantages of nuclear power.
14.04 Draw and label a diagram of a Light-Water Reactor (LWR) (e.g. control rods, coolant, containment vessel, dry casks, turbine, etc.).
14.05 Describe nuclear energy and how it is harnessed.
14.06 Describe the Chernobyl Nuclear Power Plant accident.
14.07 Outline the societal debate over nuclear power.

15.0 Demonstrate leadership and teamwork skills needed to accomplish team goals and objectives--The students will be able to:

15.01 Employ leadership skills to accomplish organizational goals and objectives. LT1.0
15.02 Establish and maintain effective working relationships with others in order to accomplish objectives and tasks. LT3.0
15.03 Conduct and participate in meetings to accomplish work tasks. LT4.0
15.04 Employ mentoring skills to inspire and teach others. LT5.0

16.0 Investigate the viability of solar energy--The student will be able to:

This standard supports the following Next Generation Sunshine State Standards:
MA.912.S.3.2; SC.912.E.6.6; SC.912.L.17.11; SC.912.P.10.1, 13, 18; SC.912.P.12.9

16.01 Describe solar energy and how it is harnessed.
16.02 Explain the significance and historical foundations of solar energy and its pioneers (Horace de Saussure and Clarence Kemp).
16.03 Explain the difference between passive solar and active solar.
16.04 Draw and label a diagram of PV cells (e.g. array, panel, module, boron-enriched silicon).

16.05 Describe a central receiver system.
16.06 Draw and label a diagram of a solar thermal plant.
16.07 Evaluate the advantages and disadvantages of using solar energy.

17.0 Demonstrate personal money-management concepts, procedures, and strategies--The students will be able to:

17.01 Identify and describe the services and legal responsibilities of financial institutions. FL2.0
17.02 Describe the effect of money management on personal and career goals. FL3.0
17.03 Develop a personal budget and financial goals. FL3.1
17.04 Complete financial instruments for making deposits and withdrawals. FL3.2
17.05 Maintain financial records. FL3.3
17.06 Read and reconcile financial statements. FL3.4
17.07 Research, compare and contrast investment opportunities.

18.0 Investigate the viability of wind energy--The student will be able to:

This standard supports the following Next Generation Sunshine State Standards: SC.912.E.6.6; SC.912.L.11, 19; SC.912.P.10.1

18.01 Describe wind energy and the way it is harnessed.
18.02 Explain the significance of wind energy and its pioneers (Charles Brush).
18.03 Define kinetic energy.
18.04 List and describe the topography and weather patterns of the states that are considered the “Saudi Arabia of wind power.”
18.05 Explain the acronym NIMBY (Not In My Backyard).
18.06 Explain why farmers and ranchers are amenable to wind technology.
18.07 Evaluate the advantages and disadvantages to wind technology.

2012 – 2013

Florida Department of Education
Student Performance Standards

Course Title: **Solar Energy Technician**
Course Number: **8006130**
Course Credit: **1**

Course Description:

This course is designed to develop competencies in the areas of energy history and the global impact of renewable and non-renewable resources; career opportunities; scientific and research concepts; biological and physical science principles; environmental principles; and solar energy safety. Laboratory-based activities are an integral part of this course. These include the safe use and application of appropriate technology, scientific testing and observation equipment.

Standards included in this course of instruction have been aligned to the academic courses shown below. This table shows the number of aligned benchmarks, the total number of academic benchmarks, and the percentage of alignment.

Math		Science					
Algebra 1	**	**Biology 1**	3/56 5%	**Anatomy/Physiology Honors**	2/53 4%	**Astronomy Solar/Galactic Honors**	5/52 10%
Algebra 2	**	**Chemistry 1**	5/55 9%	**Genetics**	2/35 6%	**Marine Science 1 Honors**	6/42 14%
Geometry	**	**Physics 1**	8/53 15%	**Earth-Space Science**	4/58 7%	**Physical Science**	8/56 14%

** *Alignment pending* # *Alignment attempted, but no correlation to academic course.*

19.0 Demonstrate knowledge of solar energy--The student will be able to:

This standard supports the following Next Generation Sunshine State Standards: SC.912.E.5.4; SC.912.E.6.6; SC.912.L.11, 15, 20; SC.912.N.1.1, 2, 3; SC.912.P.10.1, 2, 3, 9

19.01 Define basic solar terms (e.g. irradiation, Langley, azimuth).
19.02 Determine true (solar) south from magnetic (compass) south given a declination map.
19.03 Describe basic solar movement and effect of the Earth's tilt.
19.04 Predict solar position using solar path diagrams.
19.05 Describe angular effects on the irradiance of array.
19.06 Identify factors that reduce/enhance solar irradiation.
19.07 Determine average solar irradiation on various surfaces.
19.08 Describe how a photovoltaic solar cell works.
19.09 Draw and label a diagram of PV cells (e.g. array, panel, module, boron-enriched silicon [p-type], phosphorus-enriched silicon [n-type], and the n-p junction).
19.10 Explain the differences between monocrystalline, polycrystalline, thin-film, and nano-solar cells.

19.11 Convert solar irradiation into a variety of electrical units.
19.12 Determine effect of horizon on solar irradiation (shading).
19.13 Demonstrate use of Solar Pathfinder or sun charts.

20.0 Describe safe work practices--The student will be able to:

20.01 Demonstrate safe and proper use of required tools and equipment.
20.02 Identify personal and environmental safety hazards and accepted practices.
20.03 Explain the importance of basic first aid and CPR in the solar energy work setting.
20.04 Identify and implement Occupational Safety and Health Administration (OSHA) codes and standards concerning installation, operation, public safety and maintenance of solar systems and equipment.

21.0 Conduct a site assessment--The student will be able to:

21.01 Identify traditional tools and equipment required for conducting site surveys for solar installation and demonstrates proficiency in their use.
21.02 Establish suitable location with proper orientation, area, access and structural integrity for solar systems.
21.03 Diagram possible layouts and locations for array and equipment, including existing building or site features.
21.04 Identify and assess any site-specific safety hazards or other issues associated with the installation of the system.
21.05 Obtain and interpret solar radiation and temperature data for site for purposes of establishing performance expectations.
21.06 Quantify the customer electrical load and energy use through review of utility bills and meter readings.
21.07 Conduct an energy audit.
21.08 Estimate the peak load and average energy use in order to determine the size and amount of solar equipment needed.
21.09 Determine the requirements for installing a solar system for the proper interface with a utility system.

22.0 Design a solar system--The student will be able to:

22.01 Identify appropriate system design and configurations based on the customer's consumption needs based on desired energy, peak power production, autonomy requirements, size, and costs.
22.02 Estimate time, materials and equipment required for installation based on optimizing use of time and materials.
22.03 Identify mechanical design that is consistent with environmental, architectural, structural, code requirements and other conditions of the site.
22.04 Determine the electrical design to be compatible with the existing electrical currents.
22.05 Select appropriate conductor types and rating for each electrical circuit in the open or closed system.
22.06 Determine the derated ampacity of system conductors, and select appropriate sizes based on design currents.

22.07 Determine appropriate size, ratings and locations for all system over-current and disconnect devices.
22.08 Determine appropriate size, ratings and locations for grounding, surge suppression and associated equipment.
22.09 Determine voltage drop for any electrical circuit based on size and length of conductors.
22.10 Select an appropriate utility interconnection point, and determine the size, ratings and locations for over-current and disconnect devices.

23.0 Install subsystems and components at the site--The student will be able to:

23.01 Utilize, draw and label schematics, instructions and recommended procedures in installing equipment while implementing all applicable personal and personnel safety and environmental protections measures.
23.02 Visually inspect and quick test PV modules.
23.03 Assemble modules, panels and support structures as specified by the manufacturer.
23.04 Install module array interconnect wiring; implement measures to disable array during installation.
23.05 Complete final assembly, structural attachment and weather sealing of array to building or other support mechanism(s).
23.06 Install and provide required labels on inverters, controls, disconnects and over-current devices, surge suppression and grounding equipment, junction boxes, batteries and enclosures, conduit and other electrical hardware.
23.07 Label, install and terminate electrical wiring; verify proper connections, voltages and phase/polarity relationships.
23.08 Verify continuity and measure impedance of grounding system.
23.09 Program, adjust and or configure inverters and controls for desired set points and operating modes.

24.0 Inspect and troubleshoot solar systems--The student will be able to:

24.01 Visually inspect the entire installation, identifying and resolving any deficiencies in materials or workmanship.
24.02 Check system mechanical installation for structural integrity and weather sealing.
24.03 Check electrical installation for proper wiring, polarity, grounding and integrity terminations.
24.04 Activate the system and verify overall system functionality and performance based on initial expectations.
24.05 Demonstrate procedures for connecting and disconnecting the system and equipment from all sources.
24.06 Identify and verify all required markings and labels for the system and equipment.
24.07 Identify, provide documentation, and explain all safety issues associated with operations and maintenance of the system.

25.0 Maintain solar systems--The student will be able to:

25.01 Identify the tools and equipment required for maintaining and troubleshooting the system.

25.02 Identify maintenance needs and implement service procedures for modules, arrays, batteries, power conditioning equipment, safety systems, structural and weather sealing systems, and balance of systems equipment.
25.03 Measure system performance and operating parameters, compare with specifications and expectations, and asses operating condition of system and equipment.
25.04 Perform diagnostics and interpret results.
25.05 Identify performance and safety issues, and implement corrective measures.
25.06 Verify and demonstrate complete functionality and performance of system, including start-up, shut-down, normal operation and emergency bypass operations.
25.07 Compile and maintain record of system operation, performance and maintenance.

26.0 Demonstrate the importance of health, safety, and environmental management systems in organizations and their importance to organizational performance and regulatory compliance--The students will be able to:

26.01 Describe personal and jobsite safety rules and regulations that maintain safe and healthy work environments. SHE1.0
26.02 Explain emergency procedures to follow in response to workplace accidents.
26.03 Create a disaster and/or emergency response plan. SHE2.0

27.0 Use oral and written communication skills in creating, expressing and interpreting information and ideas--The students will be able to:

27.01 Select and employ appropriate communication concepts and strategies to enhance oral and written communication in the workplace. CM1.0
27.02 Locate, organize and reference written information from various sources. CM3.0
27.03 Design, develop and deliver formal and informal presentations using appropriate media to engage and inform diverse audiences. CM5.0
27.04 Interpret verbal and nonverbal cues/behaviors that enhance communication.CM6.0
27.05 Apply active listening skills to obtain and clarify information. CM7.0
27.06 Develop and interpret tables and charts to support written and oral communications. CM8.0
27.07 Exhibit public relations skills that aid in achieving customer satisfaction. CM10.0

28.0 Demonstrate language arts knowledge and skills--The students will be able to: AF2.0

28.01 Locate, comprehend and evaluate key elements of oral and written information.AF2.4
28.02 Draft, revise, and edit written documents using correct grammar, punctuation and vocabulary. AF2.5
28.03 Present information formally and informally for specific purposes and audiences.AF2.9

29.0 Demonstrate science knowledge and skills--The students will be able to: AF4.0

29.01 Discuss the role of creativity in constructing scientific questions, methods and explanations. AF4.1
29.02 Formulate scientifically investigable questions, construct investigations, collect and evaluate data, and develop scientific recommendations based on findings.AF4.3

30.0 Demonstrate mathematics knowledge and skills--The students will be able to: AF3.0

- 30.01 Demonstrate knowledge of arithmetic operations. AF3.2
- 30.02 Analyze and apply data and measurements to solve problems and interpret documents. AF3.4
- 30.03 Construct charts/tables/graphs using functions and data. AF3.5

31.0 Solve problems using critical thinking skills, creativity and innovation--The students will be able to:

- 31.01 Employ critical thinking skills independently and in teams to solve problems and make decisions. PS1.0
- 31.02 Employ critical thinking and interpersonal skills to resolve conflicts. PS2.0
- 31.03 Identify and document workplace performance goals and monitor progress toward those goals. PS3.0
- 31.04 Conduct technical research to gather information necessary for decision-making.PS4.0