

Florida Department of Education
Curriculum Framework

Program Title: Solar Photovoltaic System Design, Installation and Maintenance – Entry Level
Program Type: Career Preparatory
Career Cluster: Energy

Career Certificate Program	
Program Number	X600400
CIP Number	0615050502
Grade Level	30, 31
Standard Length	600 Hours
Teacher Certification	Refer to the <u>Program Structure</u> section.
CTSO	SkillsUSA
SOC Codes (all applicable)	47-2231 - Solar Photovoltaic Installers 49-9099 - Installation, Maintenance and Repair Workers, All Other
CTE Program Resources	http://www.fldoe.org/academics/career-adult-edu/career-tech-edu/program-resources.stml
Basic Skills Level	Mathematics: 9 Language: 9 Reading: 9

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 content includes but is not limited to Solar Photovoltaic (PV) System Design, Installation and Maintenance program which 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.

Additional Information relevant to this Career and Technical Education (CTE) program is provided at the end of this document.

Program Structure

This program is a planned sequence of instruction consisting of two occupational completion points.

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.

To teach the courses listed below, instructors must hold at least one of the teacher certifications indicated for that course.

The following table illustrates the postsecondary program structure:

OCP	Course Number	Course Title	Teacher Certification	Length	SOC Code
A	EEV0205	Solar Photovoltaic Design Installation and Maintenance Helper	ELECTRICAL @7 7G AC HEAT ME @7 7G BLDG MAINT @7 7G	150 Hours	49-9099
B	EEV0206	Solar Photovoltaic Design, Installation and Maintenance Technician	BLDG CONST @7 7G TEC CONST @7 7G	450 Hours	47-2231

Common Career Technical Core – Career Ready Practices

Career Ready Practices describe the career-ready skills that educators should seek to develop in their students. These practices are not exclusive to a Career Pathway, program of study, discipline or level of education. Career Ready Practices should be taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of study.

1. Act as a responsible and contributing citizen and employee.
2. Apply appropriate academic and technical skills.
3. Attend to personal health and financial well-being.
4. Communicate clearly, effectively and with reason.
5. Consider the environmental, social and economic impacts of decisions.
6. Demonstrate creativity and innovation.
7. Employ valid and reliable research strategies.
8. Utilize critical thinking to make sense of problems and persevere in solving them.
9. Model integrity, ethical leadership and effective management.
10. Plan education and career path aligned to personal goals.
11. Use technology to enhance productivity.
12. Work productively in teams while using cultural/global competence.

Standards

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

- 01.0 Demonstrate the importance of health, safety and environmental management systems in organizations and their importance to organizational performance and regulatory compliance.
- 02.0 Identify systems and their components.
- 03.0 Identify global environmental impact issues and issues specific to the industry.
- 04.0 Describe alternative forms of energy and the benefits of environmental awareness.
- 05.0 Demonstrate mathematics knowledge and skills.
- 06.0 Demonstrate science knowledge and skills.
- 07.0 Explain the importance of employability and entrepreneurship skills.
- 08.0 Identify, use and maintain the tools used in the industry.
- 09.0 Adapt a PV design.
- 10.0 Conduct a site assessment.
- 11.0 Read and interpret basic blueprints, job specifications and codes.
- 12.0 Demonstrate a practical knowledge of basic electricity skills and electrical components.
- 13.0 Install PV systems.
- 14.0 Install operation and identification tags and labels.
- 15.0 Perform a system checkout.
- 16.0 Maintain and troubleshoot a solar PV system.
- 17.0 Layout and coordinate a job.
- 18.0 Install solar collectors.
- 19.0 Demonstrate knowledge of PV and electrical wiring.
- 20.0 Install PV and electrical wiring.

**Florida Department of Education
Student Performance Standards**

Program Title: Solar Photovoltaic System Design, Installation and Maintenance – Entry Level
Career Certificate Program Number: X600400

Course Number: EEV0205	
Occupational Completion Point: A	
Solar Photovoltaic Design Installation and Maintenance Helper – 150 Hours – SOC Code 49-9099	
01.0	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:
01.01	Describe personal and jobsite safety rules and regulations that maintain safe and healthy work environments.
01.01	Demonstrate safe and proper use of required tools and equipment.
01.02	Demonstrate safe and accepted practices for personal protection.
01.03	Demonstrate awareness of safety hazards and how to avoid them.
01.04	Identify and implement appropriate codes and standards concerning installation, operation and maintenance of solar PV systems and equipment.
01.05	Identify and implement appropriate codes and standards concerning worker safety and public safety.
01.06	Identify personnel safety hazards associated with solar PV installations.
01.07	Identify environmental hazards associated with solar PV installations through demonstrated awareness of pertinent Material Safety Data Sheets (MSDS) and other appropriate documents.
01.08	Explain emergency procedures to follow in response to workplace accidents.
01.09	Describe "Right-to-Know" Law as recorded in (29 CFR-1910.1200).
01.10	Explain the law that describes the Material Safety Data Sheet (MSDS).
02.0	Identify systems and their components--The student will be able to:
02.01	Identify and compare active and passive solar systems and their components.
02.02	Understand the concept of solar domestic hot water and pool systems.
02.03	Identify components for solar domestic hot water and pool systems.
02.04	Compare open loop, closed loop and drain back solar thermal systems.

03.0	Identify global environmental impact issues and issues specific to the industry--The student will be able to:
03.01	Define climate change and the causes of global warming.
03.02	Discuss greenhouse gas emission and its role in global warming.
03.03	Discuss the ozone layer, the major cause for its depletion and the resulting consequences.
03.04	Define acid rain and its effect on the environment.
03.05	Discuss the negative effects of chemical pollution.
03.06	Discuss the concept of carbon footprint.
03.07	Discuss the major environmental issues specific to your industry.
03.08	Discuss local environmental concerns related to your industry.
03.09	Identify changes in business or industry that are considered to be "green".
03.10	Identify the new "green collar" jobs that have been created in the industry.
04.0	Describe alternative forms of energy and the benefits of environmental awareness--The student will be able to:
04.01	Describe renewable and non-renewable forms of energy.
04.02	List the various alternative forms of energy to fossil fuels.
04.03	Describe the benefits and challenges of using alternative forms of energy to society and the environment.
04.04	Discuss the benefits of conserving natural resources.
04.05	Describe and calculate energy efficiency.
04.06	Define biodegradable materials.
04.07	Describe the benefits of reducing, reusing and recycling materials.
04.08	Identify the incentives being offered for "going green".
05.0	Demonstrate mathematics knowledge and skills--The students will be able to:
05.01	Read and interpret measuring devices.
05.02	Demonstrate knowledge of arithmetic operations.

05.03	Operate a calculator.
05.04	Use standard metric units related to the industry.
05.05	Convert inches to millimeters and millimeters to inches.
05.06	Analyze and apply data and measurements to solve problems and interpret documents.
05.07	Measure size within a specified tolerance.
05.08	Add, subtract, multiply and divide using fractions, decimals and whole numbers.
05.09	Determine the correct sales price of a job, to include sales tax for a materials list containing a minimum of six items.
05.10	Construct charts/tables/graphs using functions and data.
06.0	Demonstrate science knowledge and skills--The students will be able to:
06.01	Discuss the role of creativity in constructing scientific questions, methods and explanations.
06.02	Formulate scientifically investigable questions, construct investigations, collect and evaluate data, and develop scientific recommendations based on findings.
06.03	Understand chemical reaction of a battery in use.
06.04	Understand chemical reaction of a battery under charging.
06.05	Identify health related problems which may result from exposure to work related chemicals and hazardous materials, and know the proper precautions required for handling such materials.
07.0	Explain the importance of employability and entrepreneurship skills--The students will be able to:
07.01	Identify and demonstrate positive work behaviors needed to be employable.
07.02	Develop personal career plan that includes goals, objectives and strategies.
07.03	Examine licensing, certification and industry credentialing requirements.
07.04	Maintain a career portfolio to document knowledge, skills and experience.
07.05	Evaluate and compare employment opportunities that match career goals.
07.06	Identify and exhibit traits for retaining employment.
07.07	Identify opportunities and research requirements for career advancement.
07.08	Research the benefits of ongoing professional development.

07.09	Examine and describe entrepreneurship opportunities as a career planning option.
08.0	Identify, use and maintain the tools used in the industry--The student will be able to:
08.01	Identify and use: <ul style="list-style-type: none"> a. Basic hand tools and tool accessories b. Power tools (electric, mechanical and pneumatic, if available) c. Conduit, Benders, Electrical Metallic Tubing (EMT) d. Specialized tools of the trade
08.02	Demonstrate the procedures/techniques for the selection, use, care and storage of tools and equipment.
08.03	Identify tools and equipment and the safety hazards associated with them.

Course Number: EEV0206	
Occupational Completion Point: B	
Solar Photovoltaic Design, Installation and Maintenance Technician – 450 Hours – SOC Code 47-2231	
09.0	Adapt a PV design--The student will be able to:
09.01	Determine stand-alone system components' location and system layout and configuration.
09.02	Determine grid tie system components' location and system layout and configuration.
09.03	Determine PV system components' location and system layout.
09.04	Determine tracking and non-tracking system components' location and system layout and configuration.
09.05	Apply for building permits.
09.06	Estimate time, materials, tools and labor required for installation.
09.07	Determine installation sequence to optimize use of time and materials.
09.08	Inspect all provided system components for damage prior to installation.
10.0	Conduct a site assessment--The student will be able to:
10.01	Determine the required installation area, orientation and tilt for proposed collector installation.
10.02	Establish whether there is suitable installation area with unobstructed solar access for installing collector.
10.03	Determine the extent of current and future shading for any proposed collector location using typical sun path calculators or similar methods.
10.04	Assure structural integrity and suitability of collector site. Determine soil conditions and integrity for footing design and pipe path.

(Local codes or site conditions might then require involving an engineer.)	
10.05	Practice all personal safety requirements.
10.06	Identify any other constraints and options for the installation related to local and state code requirements.
10.07	Verify that system to be installed is appropriate for the building and climate.
10.08	Verify with the homeowner the proposed location of the collector and other major components.
11.0	Read and interpret basic blueprints job specifications and codes--The student will be able to:
11.01	Read and interpret measuring devices.
11.02	Draw and interpret basic wiring diagrams.
11.03	Identify the basic symbols used in the electrical trade.
11.04	Read and interpret manufacturers' schematics and specifications.
11.05	Describe the importance of following the local, state and national codes regarding article 690.
11.06	Read and interpret current standards and codes for PV systems and electrical systems.
11.07	Read and interpret basic building codes in the electrical industry.
11.08	Recognize and identify PV and electrical symbols.
11.09	Identify basic electrical systems from the blueprint.
11.10	From the blueprints and specifications, identify the electrical equipment and materials required for the electrical job.
11.11	Relate the blueprint to all applicable (local, state and federal) PV and electrical codes.
12.0	Demonstrate a practical knowledge of basic electricity skills and electrical components--The student will be able to:
12.01	Explain the principles of electricity.
12.02	Explain single- and three-phase power distribution.
12.03	Define and explain watts, ohms, volts and amps.
12.04	Identify and explain electrical measuring tools and devices.
12.05	Explain the standards for and ways to measure watts, resistance, voltage and amperage, using appropriate instruments or devices.

12.06	Identify and explain appropriate electrical wiring symbols.
12.07	Draw and explain a wiring schematic diagram for a control system.
12.08	Create a wiring schematic for a solar photovoltaic system, using all components and symbols for safe and effective operation and interpretation.
12.09	Explain codes and standards and safety requirements for working with necessary electrical components.
12.10	Troubleshoot protection devices, such as fuses and breakers.
12.11	Interpret tables and charts from the National Electrical Codes (NEC).
13.0	Install PV systems--The student will be able to:
13.01	Determine the location of the PV modules.
13.02	Design and install series and parallel circuits.
13.03	Install photovoltaic modules.
13.04	Install a PV mounting system.
13.05	Install DC and AC wiring.
13.06	Select ultraviolet radiation protective method for external wiring.
13.07	Protect external wiring from ultraviolet degradation.
13.08	Test operation of DC components.
13.09	Test operation of AC components.
13.10	Determine the area for the electrical equipment and batteries.
14.0	Install operation and identification tags and labels--The student will be able to:
14.01	Determine components that require identification tag and/or label as per National Electric Code (NEC).
14.02	Install identification tags and/or label as per NEC.
15.0	Perform a system checkout--The student will be able to:
15.01	Identify any deficiencies in materials, workmanship, function or appearance by visually inspecting entire installation.
15.02	Determine that the system mechanical installation has structural integrity.

15.03	Determine that the system PV installation is correctly installed.
15.04	Determine that the electrical installation is correctly installed.
15.05	Verify system start-up and shut-down functionality.
15.06	Verify overall system operation and functionality.
15.07	Demonstrate to the owner operation and functionality of system.
15.08	Demonstrate to the owner start-up and shut-down procedures for system.
15.09	Demonstrate to owner simple maintenance and diagnostic procedures.
15.10	Identify for owner all markings and labels for system service and owner interaction.
15.11	Identify for owner safety issues associated with operation and maintenance of system.
15.12	Complete and transfer documentation package to system owner/operators.
15.13	Review system/component warranties and requirements with owner.
16.0	Maintain and troubleshoot a solar PV system--The student will be able to:
16.01	Demonstrate proficiency in using tools and materials required for maintenance and troubleshooting.
16.02	Interpret installation manual, wiring diagrams, drawings and other specifications to plan maintenance or repair work.
16.03	Determine evaluation points for system monitoring, maintenance and troubleshooting (i.e., batteries, PV modules).
16.04	Identify cause of problems based on evaluation results.
16.05	Determine what repairs or system modifications are needed to restore the system to its baseline operating conditions.
16.06	Perform any identified repairs or modifications to restore system to manufacturer's or operator's satisfaction.
17.0	Layout and coordinate a job--The student will be able to:
17.01	Identify specifications.
17.02	Make a list of materials required to lay out a job.
17.03	Determine the work aids required and the sequence of installations, according to building plans, specifications and working drawings.
18.0	Install solar collectors--The student will be able to:

18.01	Identify manufacturer mounting product specifications and materials.
18.02	Identify typical roof attachment details (designs).
18.03	Identify different collector mounting methods suitable for roof types or other installation areas.
18.04	Identify different system (due to extra weight and components) mounting methods suitable for roof type.
18.05	Identify locations for roof/wall, foundation penetrations and structural attachments.
18.06	Evaluate the suitability of selected mounting structural attachments and compliance with applicable local codes.
18.07	Determine array layout for roofs with multiple installation locations.
18.08	Install racking systems.
18.09	Tilt PV modules for maximum output.
18.10	Attach mounting bracket and struts (if required) to collector.
18.11	Connect PV system at point of interconnection.
19.0	Demonstrate knowledge of PV and electrical wiring--The student will be able to:
19.01	Describe and explain the purpose of PV and electrical codes.
19.02	Apply electrical PV theory and principles to corresponding sections of the codes.
19.03	Read and locate information in the applicable PV and electrical codes.
19.04	Define and explain the terms used in the PV and electrical codes.
19.05	Explain why the code may supersede the manufacturer's specifications.
20.0	Install PV and electrical wiring--The student will be able to:
20.01	Install conduit, types of and fittings.
20.02	Install equipment grounding.
20.03	Select PV mounting solutions for various applications.
20.04	Install roof mounting hardware.
20.05	Install rail systems.

20.06	Determine conductor ampacity.
20.07	Determine ampacity correction factors.
20.08	Calculate conductor fill in conduits.
20.09	Estimate residential loads.
20.10	Determine how voltage drop is calculated.
20.11	Determine how to calculate conductor ambient temperature changes.
20.12	Calculate box fill.
20.13	Install DC over current protection.
20.14	Install AC over current protection.
20.15	Install Transient Volt Surge Suppressor (TVSS) protection.

Additional Information

Laboratory Activities

Laboratory investigations that include scientific inquiry, research, measurement, problem solving, emerging technologies, tools and equipment, as well as, experimental, quality, and safety procedures are an integral part of this career and technical program/course. Laboratory investigations benefit all students by developing an understanding of the complexity and ambiguity of empirical work, as well as the skills required to manage, operate, calibrate and troubleshoot equipment/tools used to make observations. Students understand measurement error; and have the skills to aggregate, interpret, and present the resulting data. Equipment and supplies should be provided to enhance hands-on experiences for students.

Special Notes

MyCareerShines is an interactive resource to assist students in identifying their ideal career and to enhance preparation for employment. Teachers are encouraged to integrate this resource into the program curriculum to meet the employability goals for each student. Access MyCareerShines by visiting: www.mycareershines.org.

Career and Technical Student Organization (CTSO)

SkillsUSA is the intercurricular 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.

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.

Basic Skills (if applicable)

In Career Certificate 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/core/fileparse.php/5423/urlt/2014-15-basicskills-with-License-exempt.rtf>.

Accommodations

Federal and state legislation requires the provision of accommodations for students with disabilities 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.

Note: postsecondary curriculum and regulated secondary programs cannot be modified.

Additional Resources

For additional information regarding articulation agreements, Bright Futures Scholarships, Fine Arts/Practical Arts Credit and Equivalent Mathematics and Equally Rigorous Science Courses please refer to:

<http://www.fldoe.org/academics/career-adult-edu/career-tech-edu/program-resources.stml>