

Course Outline

Energy, Environment, and Utilities

REVISED: August/2020

72-65-70

Job Title

PV Technician

Career Pathway:

Energy and Power Technology

Industry Sector:

Energy, Environment, and Utilities

O*NET-SOC CODE:

47-2231.00

CBEDS Title:

Energy and Environmental Technology

CBEDS No.:

5691

Photovoltaics/3

Credits: 15

Hours: 180

Course Description:

This competency-based course is the last in a sequence of three designed for alternative and renewable energy technology. It provides students with project-based experiences in photovoltaic (PV) installation. Technical instruction includes an introduction and reviews of workplace safety procedures, resource management, and trade mathematics as well as basic entrepreneurship. Emphasis is placed on the electrical design adaptations for PV systems, installation of subsystems and components, maintenance procedures and troubleshooting techniques for PV system malfunctions, and exploration of local, national, and global markets for PV applications. The competencies in this course are aligned with the California High School Academic Content Standards and the California Career Technical Education Model Curriculum Standards.

Prerequisites:

Enrollment requires the successful completion of the Photovoltaics/2 (72-65-60) course.

NOTE: For Perkins purposes this course has been designated as a **capstone** course.

Tasks designated by an asterisk (*) meet the North American Board of Certified Energy Practitioners (NABCEP) 10 Learning Objectives for the PV Entry Level exam. The competencies of this course are aligned with the knowledge requirements set by the NABCEP's Entry Level 10 Learning Objectives.

This course cannot be repeated once a student receives a Certificate of Completion.



COURSE OUTLINE COMPETENCY-BASED COMPONENTS

A course outline reflects the essential intent and content of the course described. Acceptable course outlines have six components. (Education Code Section 52506). Course outlines for all apportionment classes, including those in jails, state hospitals, and convalescent hospitals, contain the six required elements:

(EC 52504; 5CCR 10508 [b]; Adult Education Handbook for California [1977], Section 100)

COURSE OUTLINE COMPONENTS

LOCATION

GOALS AND PURPOSES

Cover

The educational goals or purposes of every course are clearly stated, and the class periods are devoted to instruction. The course should be broad enough in scope and should have sufficient educational worth to justify the expenditure of public funds.

The goals and purpose of a course are stated in the COURSE DESCRIPTION. Course descriptions state the major emphasis and content of a course and are written to be understandable by a prospective student.

PERFORMANCE OBJECTIVES OR COMPETENCIES

pp. 7-14

Objectives should be delineated and described in terms of measurable results for the student and include the possible ways in which the objectives contribute to the student's acquisition of skills and competencies.

Performance Objectives are sequentially listed in the COMPETENCY-BASED COMPONENTS section of the course outline. Competency Areas are units of instruction based on related competencies. Competency Statements are competency area goals that together define the framework and purpose of a course. Competencies fall on a continuum between goals and performance objectives and denote the outcome of instruction.

Competency-based instruction tells a student before instruction what skills or knowledge they will demonstrate after instruction. Competency-based education provides instruction which enables each student to attain individual goals as measured against pre-stated standards.

Competency-based instruction provides immediate and continual repetition and in competency-based education the curriculum, instruction, and assessment share common characteristics based on clearly stated competencies. Curriculum, instruction, and assessment in competency-based education are explicit, known, agreed upon, integrated, performance oriented, and adaptive.

COURSE OUTLINE COMPETENCY-BASED COMPONENTS
(continued)

COURSE OUTLINE COMPONENTS	LOCATION
<p>INSTRUCTIONAL STRATEGIES</p> <p>Instructional techniques or methods could include laboratory techniques, lecture method, small-group discussion, grouping plans, and other strategies used in the classroom.</p> <p>Instructional strategies for this course are listed in the TEACHING STRATEGIES AND EVALUATION section of the course outline. Instructional strategies and activities for a course should be selected so that the overall teaching approach takes into account the instructional standards of a particular program, i.e., English as a Second Language, Programs for Adults with Disabilities.</p>	p. 15
<p>UNITS OF STUDY, WITH APPROXIMATE HOURS ALLOTTED FOR EACH UNIT</p> <p>The approximate time devoted to each instructional unit within the course, as well as the total hours for the course, is indicated. The time in class is consistent with the needs of the student, and the length of the class should be that it ensures the student will learn at an optimum level.</p> <p>Units of study, with approximate hours allotted for each unit are listed in the COMPETENCY AREA STATEMENT(S) of the course outline. The total hours of the course, including work-based learning hours (community classroom and cooperative vocational education) is listed on the cover of every CBE course outline. Each Competency Area listed within a CBE outline is assigned hours of instruction per unit.</p>	Cover pp. 7-14
<p>EVALUATION PROCEDURES</p> <p>The evaluation describes measurable evaluation criteria clearly within the reach of the student. The evaluation indicates anticipated improvement in performances as well as anticipated skills and competencies to be achieved.</p> <p>Evaluation procedures are detailed in the TEACHING STRATEGIES AND EVALUATION section of the course outline. Instructors monitor students' progress on a continuing basis, assessing students on attainment of objectives identified in the course outline through a variety of formal and informal tests (applied performance procedures, observations, and simulations), paper and pencil exams, and standardized tests.</p>	p. 15
<p>REPETITION POLICY THAT PREVENTS PERPETUATION OF STUDENT ENROLLMENT</p> <p>After a student has completed all the objectives of the course, he or she should not be allowed to reenroll in the course. There is, therefore, a need for a statement about the conditions for possible repetition of a course to prevent perpetuation of students in a particular program for an indefinite period of time.</p>	Cover

ACKNOWLEDGMENTS

Thanks to AARON SAENZ for editing this curriculum. Acknowledgment is also given to ERICA ROSARIO for designing the original artwork for the course covers.

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CALIFORNIA CAREER TECHNICAL EDUCATION MODEL CURRICULUM STANDARDS

Energy, Environment and Utilities Industry Sector

Knowledge and Performance Anchor Standards

1.0 Academics

Analyze and apply appropriate academic standards required for successful industry sector pathway completion leading to postsecondary education and employment. Refer to the Energy, Environment, and Utilities academic alignment matrix for identification of standards.

2.0 Communications

Acquire, and accurately use Energy, Environment, and Utilities sector terminology and protocols at the career and college readiness level for communicating effectively in oral, written, and multimedia formats.

3.0 Career Planning and Management

Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans.

4.0 Technology

Use existing and emerging technology to investigate, research, and produce products and services, including new information, as required in the Energy, Environment, and Utilities sector workplace environment.

5.0 Problem Solving and Critical Thinking

Conduct short, as well as more sustained, research to create alternative solutions to answer a question or solve a problem unique to the Energy, Environment, and Utilities sector using critical and creative thinking, logical reasoning, analysis, inquiry, and problem-solving techniques.

6.0 Health and Safety

Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the Energy, Environment, and Utilities sector workplace environment.

7.0 Responsibility and Flexibility

Initiate, and participate in, a range of collaborations demonstrating behaviors that reflect personal and professional responsibility, flexibility, and respect in the Energy, Environment, and Utilities sector workplace environment and community settings.

8.0 Ethics and Legal Responsibilities

Practice professional, ethical, and legal behavior, responding thoughtfully to diverse perspectives and resolving contradictions when possible, consistent with applicable laws, regulations, and organizational norms.

9.0 Leadership and Teamwork

Work with peers to promote divergent and creative perspectives, effective leadership, group dynamics, team and individual decision making, benefits of workforce diversity, and conflict resolution as practiced in the SkillsUSA career technical student organization.

10.0 Technical Knowledge and Skills

Apply essential technical knowledge and skills common to all pathways in the Energy, Environment, and Utilities sector.

11.0 Demonstration and Application

Demonstrate and apply the knowledge and skills contained in the Energy, Environment, and Utilities anchor standards, pathway standards, and performance indicators in classroom, laboratory, and workplace settings, and through the SkillsUSA career technical student organization.

Energy, Environment, and Utilities Sector Pathway Standards

B. Energy and Power Technology Pathway

The Energy and Power Technology pathway provides learning opportunities for students interested in preparing for careers in the energy and power industries.

Sample occupations associated with this pathway:

- ◆ Energy Efficiency Evaluation Specialist
- ◆ Energy Engineer
- ◆ Energy Generation/Power Distribution, Maintenance, Inspection, and Repair Technicians
- ◆ Energy/Building Retrofit Specialist
- ◆ Plant/Field Weatherization Installer

- B1.0 Explore the basic conventional and emerging principles and concepts of the energy industry, including energy production, energy transmission, and alternative energy technologies.
- B2.0 Identify various conventional electric power generation fuel sources and the cost and efficiency issues associated with each.
- B3.0 Investigate emerging and alternative electric power generation technologies and fuel sources.
- B4.0 Understand nonnuclear power generation plant operations (coal, oil, natural gas, solar, wind, geothermal power, hydroelectric, or biofuel).
- B5.0 Understand and apply basic knowledge and skills necessary for nuclear power generation and nuclear power plant personnel.
- B6.0 Research methods of energy procurement, transmission, distribution, and storage.
- B7.0 Understand the interrelationships among components of systems.

CBE
Competency-Based Education

COMPETENCY-BASED COMPONENTS
for the Photovoltaics /3 Course

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>A. INTRODUCTION</p> <p>Review and evaluate classroom and workplace policies and procedures used in accordance with federal, state, and local regulations.</p> <p>(2 hours)</p>	<ol style="list-style-type: none"> 1. Review the scope and purpose of the course. 2. Review the overall course content as a part of the Linked Learning Initiative. 3. Review classroom policies and procedures. 4. Review the different occupations in the Energy and Utilities Industry Sector which have an impact on the role of photovoltaic installers. 5. Review the opportunities available for promoting gender equity and the representation of non-traditional populations in computer technology. 6. Review and demonstrate the procedures for contacting proper authorities for the removal of hazardous materials based on the EPA standards. 7. Review the role of the Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ in increasing the use of clean and renewable technology in California. 8. Review the City of Los Angeles Building and Safety Codes and their applications to the photovoltaic field. 9. Review the provisions of the California Title 24 Energy Efficiency Standards (a.k.a. 2008 California Green building Standards Code) as they relate to the Energy and Utilities Industry Sector. 10. Review OSHA-10 policies, procedures, and regulations for the workplace environment. 	<p>Career Ready Practice: 1, 2, 3, 5, 6, 7, 9</p> <p>CTE Anchor: Communications: 2.5 Career Planning and Management: 3.4 Health and Safety: 6.2, 6.3, 6.4, 6.6, 6.7, 6.9, 6.11, 6.12, 6.15 Ethics and Legal Responsibility: 8.2 Leadership and Teamwork: 9.6 Technical Knowledge and Skills: 10.2</p> <p>CTE Pathway: B1.7</p>
<p>B. SAFETY</p> <p>Review and evaluate classroom and workplace policies and procedures used in accordance with federal, state, and local safety and environmental regulations.</p>	<ol style="list-style-type: none"> 1. Review the California Occupational Safety and Health Administration (Cal/OSHA) and its electrical safety standards governing photovoltaic installers/craftsmen. 2. Review the impact of Environmental Protection Agency (EPA) legislation on Engineering and Design Industry Sector practices in protecting and preserving the environment. 3. Review and demonstrate the procedures for contacting proper authorities for the removal of hazardous materials based on the EPA standards. 	<p>Career Ready Practice: 1, 2, 3, 5, 6, 7, 9, 11, 12</p> <p>CTE Anchor: Communications: 2.5</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(2 hours)	<ol style="list-style-type: none"> 4. Review the National Electrical Code (NEC) and its role in safeguarding the work conditions of photovoltaic installers/craftsmen. 5. Review and demonstrate the use of the Safety Data Sheet (SDS) as it applies to the photovoltaic field. 6. Describe the role of the Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ in increasing the use of clean and renewable technology in California. 7. Describe the City of Los Angeles Building and Safety Codes and their applications to the photovoltaic field. 8. Describe the provisions of the California Title 24 Energy Efficiency Standards (a.k.a. 2008 California Green building Standards Code) as they relate to the Energy and Utilities Industry Sector. 9. Review classroom and workplace first aid and emergency procedures based on the American Red Cross (ARC) standards. 10. Review how each of the following insures a safe workplace: <ol style="list-style-type: none"> a. employees' rights as they apply to job safety b. employees' obligations as they apply to safety c. employees' training on how to accurately test high voltages d. employees' training on how to identify potential electrical/non-electrical hazards e. employees' training on how to use safety equipment 11. Pass the online safety exam with 100% accuracy. 	<p>Career Planning and Management: 3.4</p> <p>Health and Safety: 6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.7, 6.8, 6.9, 6.11, 6.12, 6.15</p> <p>Responsibility and Flexibility: 7.7</p> <p>Ethics and Legal Responsibility: 8.2</p> <p>Leadership and Teamwork: 9.6</p> <p>Technical Knowledge and Skills: 10.2</p> <p>Demonstration and Application: 11.1</p>
<p>C. RESOURCE MANAGEMENT REVIEW</p> <p>Review resource management principles and techniques applied in the photovoltaic field.</p>	<ol style="list-style-type: none"> 1. Review the following definitions: <ol style="list-style-type: none"> b. resources c. management d. sustainability 2. Review the management of the following resources in the photovoltaic field: <ol style="list-style-type: none"> a. time b. materials (including sustainable and green) c. personnel 3. Review specific examples of effective management of the following resources in the photovoltaic field: <ol style="list-style-type: none"> a. time b. materials (including sustainable and green) c. personnel 4. Review the benefits of effective resource management in the photovoltaic field: <ol style="list-style-type: none"> a. Profitability b. sustainability c. company growth 	<p>Career Ready Practice: 1, 2, 3, 5, 7, 8, 9</p> <p>CTE Anchor: Career Planning and Management: 3.5 Responsibility and Flexibility: 7.1, 7.2, 7.4, 7.6</p> <p>CTE Pathway: B2.4</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(1 Hour)	5. Review the economic benefits and liabilities of managing resources in an environmentally responsible way.	
<p>D. TRADE MATHEMATICS REVIEW</p> <p>Review and apply the mathematical requirements in the photovoltaic field.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> 1. Review the practical applications of math in the photovoltaic field. 2. Review and demonstrate problem-solving techniques involving whole number problems using arithmetic operations (addition, subtraction, multiplication, and division). 3. Review and demonstrate problem-solving techniques involving various fraction problems using arithmetic operations. 4. Review and demonstrate problem-solving techniques involving various decimal problems using addition, subtraction, multiplication, and division. 5. Review and demonstrate techniques for changing fractions to decimals. 6. Review and demonstrate techniques for changing decimals to fractions. 7. Review the English and metric systems of measuring length. 8. Review the English and metric systems of measuring weight. 9. Review the English and metric systems of measuring volume or capacity. 10. Review and demonstrate English and metric problem-solving techniques for various measuring problems using arithmetic operations. 11. Review and demonstrate English and metric measuring techniques of objects by using tools common to the trade. 12. Review metric units in ascending and descending powers of ten. 13. Review the conversion of the English numbering system to metric system. 14. Review the conversion of the metric system to English numbering system. 15. Review the calculation of square roots of English numbers. 16. Review and demonstrate problem-solving techniques for geometric problems. 17. Review and demonstrate problem-solving techniques for algebraic problems. 18. Review and demonstrate problem-solving techniques using percentages. 19. Review and demonstrate techniques for reading and interpreting graphs. 20. Review and demonstrate techniques for using a calculator. 	<p>Career Ready Practice: 1, 3, 5</p> <p>CTE Anchor: Academics: 1.0 Communication: 2.5 Problem Solving and Critical Thinking: 5.1, 5.2 Technical Knowledge and Skills: 10.1 Demonstration and Application: 11.1</p> <p>CTE Pathway: B2.4, B3.1</p>
<p>E. ELECTRICAL DESIGN ADAPTATION</p> <p>Understand, apply, and evaluate the various PV</p>	<ol style="list-style-type: none"> 1. Define derated ampacity. 2. Describe and demonstrate the following: <ol style="list-style-type: none"> a. determining the design currents for any part of a PV system electrical circuit b. selecting appropriate conductor types and ratings for each electrical circuit in the system based on application c. determining the derated ampacity of system conductors 	<p>Career Ready Practice: 1, 3, 4, 5, 9, 10, 12</p> <p>CTE Anchor: Communications: 2.1, 2.5</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>electrical design criteria and adaptations.</p> <p>(35 hours)</p>	<ul style="list-style-type: none"> d. selecting appropriate system conductors based on design currents e. determining the appropriate size, ratings, and locations for all system overcurrent and disconnect devices f. determining the appropriate size, ratings, and locations for grounding, surge suppression, and associated equipment g. determining voltage drop for any electrical circuit based on size and length of conductors h. verifying that the array operating voltage range is within acceptable operating limits for power conditioning equipment, including inverters and controllers i. selecting an appropriate utility interconnection point and determining the size, ratings, and locations for overcurrent and disconnect devices <p>3. Analyze and document the load demand for the following in residential, commercial, and industrial applications:</p> <ul style="list-style-type: none"> a. PV in simple, stand-alone systems b. PV systems with battery storage c. PV with backup generator power d. PV in hybrid power systems e. PV connected to the utility grid <p>4. Describe and demonstrate the following:</p> <ul style="list-style-type: none"> a. determining the series/parallel PV array arrangement based on module and inverter specifications for at least three systems b. selecting the BOS components for three specific systems c. determining the voltage drop between major components of at least three systems d. selecting the correct wire size for each different array arrangement in at least three systems e. determining the proper grounding of array and equipment for at least three systems f. designing a grid-tied PV system for the following: <ul style="list-style-type: none"> i. a residence in a rural setting ii. new apartment development with 60 units iii. a three story-commercial building 	<p>Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4</p> <p>Health and Safety: 6.1, 6.6, 6.8, 6.9, 6.11, 6.16</p> <p>Ethics and Legal Responsibilities: 8.1, 8.2, 8.3</p> <p>Technical Knowledge and Skills: 10.1, 10.2, 10.3</p> <p>Demonstration and Application: 11.1</p> <p>CTE Pathway: B1.4, B6.4, B7.1, B7.3, B7.4, B7.6</p>
<p>F. SUBSYSTEM AND COMPONENT INSTALLATION</p> <p>Understand and apply the installation techniques used for PV subsystems and components.</p>	<ul style="list-style-type: none"> 1. Define the following: <ul style="list-style-type: none"> a. drawing b. schematics c. impedance 2. Describe and demonstrate the following: <ul style="list-style-type: none"> a. utilizing drawings, schematics, instructions, and recommended techniques in installing equipment b. implementing all applicable personnel safety and environmental protection measures c. visually inspecting and quick testing PV modules d. assembling modules, panels and support structures as specified by module manufacturer or design 	<p>Career Ready Practice: 1, 3, 4, 5, 10</p> <p>CTE Anchor: Communications: 2.1, 2.5</p> <p>Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4</p> <p>Health and Safety:</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
(40 hours)	<ul style="list-style-type: none"> e. installing module array interconnect wiring f. implementing measures to disable array during installation g. completing final assembly, structural attachment, and weather sealing of array to the building or other support mechanism h. installing and providing required labels on: <ul style="list-style-type: none"> i. inverters ii. controls iii. disconnects and overcurrent devices iv. surge suppression and grounding equipment v. junction boxes vi. batteries and enclosures vii. conduit and other electrical hardware i. labeling, installing, and terminating electrical wiring j. verifying proper electrical connections, voltages, and phase/polarity relationships 	<p>6.6, 6.8, 6.9, 6.11, 6.16</p> <p>Ethics and Legal Responsibilities: 8.1, 8.2, 8.3</p> <p>Technical Knowledge and Skills: 10.2, 10.3</p> <p>CTE Pathway: B1.4, B6.4, B7.1, B7.3, B7.4, B7.6</p>
<p>G. SYSTEM CHECK-OUT INSPECTION</p> <p>Understand, apply, and evaluate the check-out and inspection techniques for PV systems.</p> <p>(30 hours)</p>	<ul style="list-style-type: none"> 1. Describe and demonstrate the following: <ul style="list-style-type: none"> a. visually inspecting the entire installation b. determining and resolving deficiencies in materials or workmanship c. checking system mechanical installation for structural integrity and weather sealing d. checking electrical installation for: <ul style="list-style-type: none"> i. proper wiring practice ii. polarity iii. grounding iv. integrity of terminations e. activating system f. verifying overall system functionality and performance g. comparing performance with expectations h. connecting and disconnecting the system and equipment from all sources i. locating and verifying all the required system and equipment markings and labels j. explaining to owner/operator all safety issues associated with system operation and maintenance k. providing the required documentation to the system owner/operator 	<p>Career Ready Practice: 1, 3, 7, 8</p> <p>CTE Anchor: Communications: 2.1, 2.5 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Health and Safety: 6.6, 6.8, 6.9, 6.11, 6.16 Ethics and Legal Responsibilities: 8.1, 8.2, 8.3 Technical Knowledge and Skills: 10.1, 10.2, 10.3 Demonstration and Application: 11.1</p> <p>CTE Pathway: B1.4, B6.4, B7.1, B7.3, B7.4, B7.6</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>H. MAINTENANCE AND TROUBLESHOOTING</p> <p>Understand, apply, and evaluate the maintenance and troubleshooting techniques for PV systems.</p> <p>(50 hours)</p>	<ol style="list-style-type: none"> 1. Define the following: <ol style="list-style-type: none"> a. actual system power output b. expected system power output 2. Identify the following: <ol style="list-style-type: none"> a. tools and equipment needed for system performance analysis and repair b. maintenance needs and service procedures for the following: <ol style="list-style-type: none"> i. modules ii. arrays iii. batteries iv. power conditioning equipment v. safety systems vi. structural and weather sealing systems vii. balance-of-systems equipment 3. Describe and demonstrate the following: <ol style="list-style-type: none"> a. measuring system performance and operating parameters b. comparing specifications with expectations c. assessing operating condition of system and equipment d. performing diagnostic procedures and interpreting results e. determining performance and safety issues, and implementing corrective measures f. verifying complete functionality and performance of system, including: <ol style="list-style-type: none"> i. start-up ii. shut down iii. normal operation iv. emergency/bypass operation g. compiling and maintaining record of system operation, performance, and maintenance 4. Research and document the following: <ol style="list-style-type: none"> a. troubleshooting system design problems in: <ol style="list-style-type: none"> i. PV in simple, stand-alone systems ii. PV systems with battery storage iii. PV with backup generator power iv. PV in hybrid power systems v. PV connected to the utility grid b. troubleshooting system performance problems in the following: <ol style="list-style-type: none"> i. a residence in a rural setting ii. new apartment development with 60 units iii. a three story-commercial building 	<p>Career Ready Practice: 1, 3, 4, 5, 10</p> <p>CTE Anchor: Communications: 2.1, 2.5 Problem Solving and Critical Thinking: 5.1, 5.2, 5.3, 5.4 Health and Safety: 6.1, 6.6, 6.8, 6.9, 6.11, 6.16 Ethics and Legal Responsibility: 8.1, 8.2, 8.3 Technical Knowledge and Skills: 10.2, 10.3 Demonstration and Application: 11.1</p> <p>CTE Pathway: B1.4, B6.4, B7.1, B7.3, B7.4, B7.6</p>
<p>I. PV MARKETS AND APPLICATIONS</p> <p>Understand, apply, and evaluate the local, national,</p>	<ol style="list-style-type: none"> 5. Research the current economic conditions for the manufacture, distribution, and installation of PV systems for the following: <ol style="list-style-type: none"> a. Local markets b. National market c. Global markets 	<p>Career Ready Practice: 1, 2, 3, 11, 12</p>

COMPETENCY AREAS AND STATEMENTS	MINIMAL COMPETENCIES	STANDARDS
<p>and global markets and applications for PV systems.</p> <p>(5 hours)</p>	<ol style="list-style-type: none"> 2. Research and analyze the local, national, and global demands for the following PV applications: <ol style="list-style-type: none"> a. PV in simple, stand-alone systems b. PV systems with battery storage c. PV with backup generator power d. PV in hybrid power systems e. PV connected to the utility grid 3. Design a marketing strategy to create and/or increase local, national, and global demands for residential, commercial, and industrial PV applications. 	<p>CTE Anchor: Communications: 2.5, 2.6 Technology: 4.1, 4.2, 4.3, 4.6 Problem Solving and Critical Thinking: 5.3, 5.4 Responsibility and Flexibility: 7.1, 7.8 Ethics and Legal Responsibility: 8.2 Technical Knowledge and Skills: 10.1 Demonstration and Application: 11.1</p> <p>CTE Pathway: B1.1, B1.6, B2.1, B6.3</p>
<p>J. ENTREPRENEURIAL SKILLS</p> <p>Understand, apply, and evaluate the process involved in becoming an entrepreneur in the photovoltaic field.</p> <p>(10 hours)</p>	<ol style="list-style-type: none"> 1. Define entrepreneurship. 2. Identify the necessary characteristics of successful entrepreneurs. 3. Describe the contributions of entrepreneurs to the photovoltaic field. 4. Explain the purpose and components of a business plan. 5. Examine personal goals prior to starting a business. 6. Evaluate sources of monetary investment in a business opportunity. 7. Describe various licensing requirements in the photovoltaic field. 8. Develop a scenario depicting the student as the photovoltaic business owner. 9. Differentiate between LEED business practices and standard business practices. 	<p>Career Ready Practice: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12</p> <p>CTE Anchor: Career Planning and Management: 3.7, 3.9 Technical Knowledge and Skills: 10.2 Demonstration and Application: 11.3, 11.4, 11.5</p> <p>CTE Pathway: B1.6, B1.7</p>

SUGGESTED INSTRUCTIONAL MATERIALS and OTHER RESOURCES

TEXTBOOKS

Kemp, William H. The Renewable Energy Handbook Revised Edition, 3rd edition. Aztex Press, 2009.

Schaeffer, John. Real Goods Solar Living Source Book – Special 30th Anniversary Edition. Gaiam Real Goods, 2007.

Strong, Steven J. The Solar Electric House. Sustainability Press, 1994.

Williams, Neville. Chasing the Sun. New Society Publishers, 2005.

RESOURCES

Employer Advisory Board members

CTE Model Curriculum Standards

<http://www.cde.ca.gov/ci/ct/sf/documents/energyutilities.pdf>

Barnett, Dave and Kirk Bjornsgaard. Electrical Power Generation: A Nontechnical Guide. Pennwell Books, 2000.

International Association of Plumbing and Mechanical Officials. Uniform Solar Energy Code. International Association of Plumbing and Mechanical Officials, 2009.

Michael Casey, Douglas Hansen, and Redwood Kardon. Code Check: Electrical: An Illustrated Guide to Wiring a Safe House. 4th edition, Taunton Press, 2006.

National Fire Protection Association. National Electrical Code 2011. National Fire Protection Association, 2011.

www.americangreenjobs.net

www.ases.org

www.careers.pennenergyjobs.com

www.cleantechrecruits.com

www.irecusa.org

www.renewableenergyjobs.com

www.solarenergy.org

www.solarelectricpower.org

www.seia.org

www1.eere.energy.gov

COMPETENCY CHECKLIST

TEACHING STRATEGIES and EVALUATION

METHODS AND PROCEDURES

- A. Lecture and discussion
- B. Multimedia presentations
- C. Demonstrations and participations
- D. Individualized instruction
- E. Peer teaching
- F. Role-playing
- G. Guest speakers
- H. Field trips and field study experiences
- I. Projects

EVALUATION

SECTION A – Introduction – Pass all assignments and exams on introduction with a minimum score of 80% or higher.

SECTION B – Safety – Pass the safety test with 100% accuracy.

SECTION C – Resource Management Review – Pass all assignments and exams on resource management review with a minimum score of 80% or higher.

SECTION D – Trade Mathematics Review – Pass all assignments and exams on trade mathematics review with a minimum score of 80% or higher.

SECTION E – Electrical Design Adaptation – Pass all assignments and exams on electrical design adaptation with a minimum score of 80% or higher.

SECTION F – Subsystem and Component Installation – Pass all assignments and exams on subsystem and component installation with a minimum score of 80% or higher.

SECTION G – System Check-Out and Inspection – Pass all assignments and exams on system check-out and inspection with a minimum score of 80% or higher.

SECTION H – Maintenance and Troubleshooting – Pass all assignments and exams on maintenance and troubleshooting with a minimum score of 80% or higher.

SECTION I – PV Markets and Applications – Pass all assignments and exams on PV markets and applications with a minimum score of 80% or higher.

SECTION J – Entrepreneurial Skills – Pass all assignments and exams on entrepreneurial skills with a minimum score of 80% or higher.

Standards for Career Ready Practice

1. Apply appropriate technical skills and academic knowledge.

Career-ready individuals readily access and use the knowledge and skills acquired through experience and education. They make connections between abstract concepts with real-world applications and recognize the value of academic preparation for solving problems, communicating with others, calculating measures, and performing other work-related practices.

2. Communicate clearly, effectively, and with reason.

Career-ready individuals communicate thoughts, ideas, and action plans with clarity, using written, verbal, electronic, and/or visual methods. They are skilled at interacting with others: they are active listeners who speak clearly and with purpose, and they are comfortable with terminology that is common to workplace environments. Career-ready individuals consider the audience for their communication and prepare accordingly to ensure the desired outcome.

3. Develop an education and career plan aligned with personal goals.

Career-ready individuals take personal ownership of their educational and career goals and manage their individual plan to attain these goals. They recognize the value of each step in the educational and experiential process, and they understand that nearly all career paths require ongoing education and experience to adapt to practices, procedures, and expectations of an ever-changing work environment. They seek counselors, mentors, and other experts to assist in the planning and execution of education and career plans.

4. Apply technology to enhance productivity.

Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring and using new technology. They understand the inherent risks—personal and organizational—of technology applications, and they take actions to prevent or mitigate these risks.

5. Utilize critical thinking to make sense of problems and persevere in solving them

Career-ready individuals recognize problems in the workplace, understand the nature of the problems, and devise effective plans to solve the problems. They thoughtfully investigate the root cause of a problem prior to introducing solutions. They carefully consider options to solve a problem and, once agreed upon, follow through to ensure the problem is resolved.

6. Practice personal health and understand financial literacy.

Career-ready individuals understand the relationship between personal health and workplace performance. They contribute to their personal well-being through a healthy diet, regular exercise, and mental health activities. Career-ready individuals also understand that financial literacy leads to a secure future that enables career success.

7. Act as a responsible citizen in the workplace and the community.

Career-ready individuals understand the obligations and responsibilities of being a member of a community and demonstrate this understanding every day through their interactions with others. They are aware of the impacts of their decisions on others and the environment around them, and they think about the short-term and long-term consequences of their actions. They are reliable and consistent in going beyond minimum expectations and in participating in activities that serve the greater good.

8. Model integrity, ethical leadership, and effective management.

Career-ready individuals consistently act in ways that align with personal and community-held ideals and principles. They employ ethical behaviors and actions that positively influence others. They have a clear understanding of integrity and act on this understanding in every decision. They use a variety of means to positively impact the direction and actions of a team or organization, and they recognize the short-term and long-term effects that management's actions and attitudes can have on productivity, morale, and organizational culture.

9. Work productively in teams while integrating cultural and global competence.

Career-ready individuals contribute positively to every team, as both team leaders and team members. To avoid barriers to productive and positive interaction, they apply an awareness of cultural differences. They interact effectively and sensitively with all members of the team and find ways to increase the engagement and contribution of other members.

10. Demonstrate creativity and innovation.

Career-ready individuals recommend ideas that solve problems in new and different ways and contribute to the improvement of the organization. They consider unconventional ideas and suggestions by others as solutions to issues, tasks, or problems. They discern which ideas and suggestions may have the greatest value. They seek new methods, practices, and ideas from a variety of sources and apply those ideas to their own workplace practices.

11. Employ valid and reliable research strategies.

Career-ready individuals employ research practices to plan and carry out investigations, create solutions, and keep abreast of the most current findings related to workplace environments and practices. They use a reliable research process to search for new information and confirm the validity of sources when considering the use and adoption of external information or practices.

12. Understand the environmental, societal, and economic impacts of decisions.

Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact other people, organizations, the workplace, and the environment. They are aware of and utilize new technologies, understandings, procedures, and materials and adhere to regulations affecting the nature of their work. They are cognizant of impacts on the social condition, environment, workplace, and profitability of the organization.

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