

Alignment Document

Renewable Energy CTAG Alignments

This document contains information about 3 Career-Technical Articulation Numbers (CTANs) for the Agriculture and Environmental Systems pathway Career-Technical Assurance Guide (CTAG).

The CTANs are:

- 1. Introduction to Alternative and Renewable Energy**
- 2. Wind Energy**
- 3. Solar Photovoltaic**

1. Introduction to Alternative and Renewable Energy:

CTAN alignment with the Agriculture and Environmental Systems in the Career Field Technical Content Standards of the Ohio Department of Education

This CTAN is a continuing CTAN in the Renewable Energy CTAG and an approved OAN in the Solar Energy and Wind Energy TAGs. The CTAG number is CTAE001 and the TAG number is ORE001 – Introduction to Alternative and Renewable Energy.

Course Description: This course will provide a comprehensive review of various types energy sources, including conventional and new alternative energy. Students will be aware of the problems associated with the existing conventional energy sources. Knowledge about the types, components, construction and basic installation of the various advanced and renewable energy sources will be interpreted. Other subjects that will be explored are the alternative energy generation, storage, transportation, and efficiency. The students will also be familiarized with economic impact of the alternative energy.

Advising Notes:

- Student must access credit within 3 years of program completion.

Semester Credit Hours: 3

Alignment:

Outcomes marked with an asterisk (*) are essential.

Learning Outcomes The student will be able to:	Realignment – Competencies from Agriculture and Environmental Systems Career Field Technical Content Standards
1. Introductory knowledge of renewable and alternative energy sources*	9.1.1. Identify, compare and contrast fossil fuel sources and the technology used to generate energy. 9.1.2. Identify, compare and contrast renewable energy sources and the technology used to generate energy. 9.1.3. Identify, compare and contrast alternative energy sources and technology used to generate energy (e.g., fuel cells, hydrogen, nuclear). 9.1.4. Identify the social, economic and environmental drivers and barriers that influence the development and use of energy sources. 9.1.8. Perform an energy evaluation to determine the best social, economic and environmental solution. 9.2.6. Identify the different processes for producing, treating, compressing, transporting, processing and storing crude oil and natural gas. 9.3.9. Manage storage and distribution systems for biofuels. 9.4.1. Identify the different types of solar energy devices (e.g., photovoltaic [PV], solar thermal, concentrating solar power [CSP]) and how they produce energy. 9.4.3. Select the appropriate solar energy application for commercial and residential solar power.
2. Knowledge of energy and energy systems for commercial and/or residential use*	1.10.6. Discuss the importance of correct pricing to support a product's or service's positioning in the marketing mix. 1.11.4. Determine how the quality, quantity and pricing of goods and services are affected by domestic and international competition in a market economy. 1.11.8. Identify the relationships between economy, society and environment that lead to sustainability. 9.1.5. Calculate fuel equivalents among energy sources. 9.1.6. Trace the transformations of energy within a system (e.g., mechanical to electrical, chemical to mechanical).

	<p>9.1.7. Determine best management practices (e.g., carbon sequestration, conservation, animal safety, efficiency) that lessen environmental impact.</p> <p>9.1.8. Perform an energy evaluation to determine the best social, economic and environmental solution.</p>
<p>3. Introductory knowledge about the types, components, construction and basic installation of the various advanced and renewable energy sources*</p>	<p>9.1.2. Identify, compare and contrast renewable energy sources and the technology used to generate energy.</p> <p>9.1.3. Identify, compare and contrast alternative energy sources and technology used to generate energy (e.g., fuel cells, hydrogen, nuclear).</p> <p>9.2.2. Assess how crude oil and natural gas wells are sited, designed and installed.</p> <p>9.3.1. Identify applications for biomass energy.</p> <p>9.3.2. Describe the thermal, chemical and biochemical methods of converting biomass into energy.</p> <p>9.3.9. Manage storage and distribution systems for biofuels.</p> <p>9.4.5. Identify and describe technical standards and regulations for a solar energy installation.</p> <p>9.4.7. Install, test and maintain a solar energy installation.</p> <p>9.5.1. Describe the internal and external components of wind energy installation.</p> <p>9.5.2. Conduct a site evaluation to identify an appropriate wind turbine installation.</p> <p>9.5.5. Select and design an appropriate wind energy installation for commercial and residential applications.</p>
<p>4. Knowledge of the roles, responsibilities, regulations, and economics pertaining to advanced and renewable energy*</p>	<p>1.3.1. Analyze how regulatory compliance (e.g., United States Department of Agriculture [USDA], Food and Drug Administration [FDA], United States Department of Interior [USDI], Ohio Livestock Care Standards, water quality standards, local water regulations, building codes) affects business operations and organizational performance.</p> <p>1.6.7. Identify the effect of supply and demand on products and services.</p> <p>1.6.10. Describe the impact of globalization on an enterprise or organization.</p> <p>1.11.2. Identify the difference between monetary and nonmonetary incentives and explain how changes in incentives cause changes in behavior.</p> <p>1.11.4. Determine how the quality, quantity and pricing of goods and services are affected by domestic and international competition in a market economy.</p>

5. Knowledge of disciplines and career areas associated with advanced and renewable energy*

1.1.1. Identify the knowledge, skills and abilities necessary to succeed in careers.

1.1.2. Identify the scope of career opportunities and the requirements for education, training, certification, licensure and experience.

1.1.3. Develop a career plan that reflects career interests, pathways and secondary and postsecondary options.

Wind Energy: CTAN alignment with the Agriculture and Environmental Systems Pathway in the Career Field Technical Content Standards of the Ohio Department of Education.

This CTAN is already an approved OAN in the Wind Energy TAG. The OAN number is ORE005 – Wind Energy.

Course Description: This course will explain the wind physics and geographic considerations as well as the site assessment and sizing the wind plant. An overview of wind turbines will be given in terms of the structure and the components of the turbines such as nacelle, generator, gearbox and controllers. The basic considerations, regulations, and criteria for constructing a wind turbine in a given area will also be covered.

Advising Notes:

- Student must access credit within 3 years of program completion or within currency of certificate.

Semester Credit Hours: 3

Alignment:

Outcomes marked with an asterisk (*) are essential.

Learning Outcomes The student will be able to:	Realignment – Competencies from Agriculture and Environmental Systems Career Field Technical Content Standards
1. Determine the potential wind available from a given area and calculate the electrical energy that could be achieved*	5.3.3. Complete a site inventory and analysis, including physical conditions, code and utilities requirements and the environmental impact. 9.5.3. Identify and describe technical standards and regulations for wind turbines. 9.5.5. Select and design an appropriate wind energy installation for commercial and residential applications.
2. Summarize the sizes and variations of different wind turbines including residential and commercial systems*	9.5.1. Describe the internal and external components of wind energy installation. 9.5.3. Identify and describe technical standards and regulations for wind turbines. 9.5.4. Describe and differentiate the manufacturing processes for producing wind turbines. 9.5.5. Select and design an appropriate wind energy installation for commercial and residential applications. 9.5.7. Test and maintain wind energy components.

3. Recognize the main components and construction of a wind turbine*	<p>9.5.1. Describe the internal and external components of wind energy installation.</p> <p>9.5.4. Describe and differentiate the manufacturing processes for producing wind turbines.</p> <p>9.5.6. Interpret an electric schematic for a wind energy installation.</p>
4. Discuss the basic considerations, regulations, and criteria for constructing a wind turbine in a given area*	<p>1.3.1. Analyze how regulatory compliance (e.g., United States Department of Agriculture [USDA], Food and Drug Administration [FDA], United States Department of Interior [USDI], Ohio Livestock Care Standards, water quality standards, local water regulations, building codes) affects business operations and organizational performance.</p> <p>9.1.4. Identify the social, economic and environmental drivers and barriers that influence the development and use of energy sources.</p>
5. Evaluate relevant conditions and determine size of and energy potential of a wind turbine in a given area*	<p>9.1.8. Perform an energy evaluation to determine the best social, economic and environmental solution.</p> <p>9.5.2. Conduct a site evaluation to identify an appropriate wind turbine installation.</p> <p>9.5.5. Select and design an appropriate wind energy installation for commercial and residential applications.</p>
6. Evaluate various monitoring devices related to turbine construction and use*	<p>1.10.2. Determine the customer's needs and identify solutions.</p> <p>5.2.4. Calculate service requirements for an electrical installation and evaluate for safe capacity.</p> <p>5.3.3. Complete a site inventory and analysis, including physical conditions, code and utilities requirements and the environmental impact.</p> <p>5.3.4. Develop a program list, including intended use, budget, economics, customer wants and needs and maintenance.</p>

3. Solar Photovoltaic

CTAN alignment with the Agriculture and Environmental Systems in the Career Field Technical Content Standards of the Ohio Department of Education

This CTAN is already continuing CTAN in the Renewable Energy CTAG. The CTAN number is CTSP001– Solar Photovoltaic

Course Description: This course will introduce the PV electricity and PV modules. Different types of solar cells will be discussed and their characteristic compared. PV system components will be interpreted. The operation and the connection to the power grid of the PV systems will be taught. Then the electrical and mechanical consideration in PV site assessment and installation will be explained. The safety issues and market of the PV technology will also be covered.

Advising Notes:

- Prerequisite: College Algebra Note: Career-technical students from (CT)² approved institutions would not receive credit for Solar Photovoltaic Energy until they have completed the requirement for College Algebra.
- Student must access credit within 3 years of program completion or within currency of certificate.

Semester Credit Hours: 3

Alignment:

Outcomes that marked by an asterisk (*) are essential. Submitted course work or content must include proof of laboratory component.

Learning Outcomes The student will be able to:	Realignment – Competencies from Agriculture and Environmental Systems Career Field Technical Content Standards
1. Photovoltaic (PV) markets and applications*	1.6.6. Identify the target market served by the organization, the niche that the organization fills and an outlook of the industry. 1.11.4. Determine how the quality, quantity and pricing of goods and services are affected by domestic and international competition in a market economy. 9.4.1. Identify the different types of solar energy devices (e.g., photovoltaic [PV], solar thermal, concentrating solar power [CSP]) and how they produce energy.
2. PV specific safety basics*	1.3.1. Analyze how regulatory compliance (e.g., United States Department of Agriculture [USDA], Food and Drug Administration [FDA], United States Department of Interior [USDI],

	<p>Ohio Livestock Care Standards, water quality standards, local water regulations, building codes) affects business operations and organizational performance.</p> <p>1.3.4. Identify how federal and state consumer protection laws affect products and services.</p> <p>1.3.5. Access and implement safety compliance measures (e.g., quality assurance information, safety data sheets [SDSs], product safety data sheets [PSDSs], United States Environmental Protection Agency [EPA], United States Occupational Safety and Health Administration [OSHA]) that contribute to the continuous improvement of the organization.</p> <p>1.12.6. Identify procedures for the handling, storage and disposal of hazardous materials.</p> <p>1.12.7. Select, use, store, maintain and dispose of personal protective equipment (PPE), appropriate to job tasks, conditions and materials.</p> <p>1.12.8. Identify safety hazards and take corrective measures.</p> <p>1.12.9. Identify, inspect and use safety equipment appropriate for the task.</p> <p>1.12.14. Identify the source of electrical hazards and use shutdown and established lock-out/tag-out procedures.</p> <p>9.4.8. Compare and contrast equipment disposal methods.</p>
<p>3. PV electricity basics*</p>	<p>5.1.1. Interpret symbols and wiring diagrams.</p> <p>5.1.8. Differentiate the relationships between voltage, current, resistance and power in circuits.</p> <p>5.1.11. Describe the purpose of grounding and common methods used for grounding.</p> <p>9.1.6. Trace the transformations of energy within a system (e.g., mechanical to electrical, chemical to mechanical).</p> <p>9.4.1. Identify the different types of solar energy devices (e.g., photovoltaic [PV], solar thermal, concentrating solar power [CSP]) and how they produce energy.</p> <p>9.4.6. Interpret an electric schematic for a solar energy installation.</p>
<p>4. Solar energy PV module fundamentals*</p>	<p>9.4.1. Identify the different types of solar energy devices (e.g., photovoltaic [PV], solar thermal, concentrating solar power [CSP])</p> <p>9.4.2. Conduct a site evaluation to identify an appropriate solar panel installation.</p> <p>9.4.3. Select the appropriate solar energy application for commercial and residential solar power.</p> <p>9.4.4. Design a layout of solar arrays and associated equipment.</p>

	<p>9.4.5. Identify and describe technical standards and regulations for a solar energy installation.</p> <p>9.4.6. Interpret an electric schematic for a solar energy installation.</p> <p>9.4.7. Install, test and maintain a solar energy installation.</p>
5. System components and PV system sizing principles*	<p>1.10.5. Monitor customer expectations and determine product/service satisfaction by using measurement tools.</p> <p>5.2.3. Map circuits and label the service panel directory to reflect devices installed on each circuit.</p> <p>5.2.4. Calculate service requirements for an electrical installation and evaluate for safe capacity.</p> <p>5.2.5. Identify types of cable, conduit, boxes, switches, outlets and other common wiring devices.</p> <p>9.4.2. Conduct a site evaluation to identify an appropriate solar panel installation.</p> <p>9.4.3. Select the appropriate solar energy application for commercial and residential solar power.</p>
6. PV system electrical design and mechanical design*	<p>5.2.3. Map circuits and label the service panel directory to reflect devices installed on each circuit.</p> <p>5.2.4. Calculate service requirements for an electrical installation and evaluate for safe capacity.</p> <p>5.2.5. Identify types of cable, conduit, boxes, switches, outlets and other common wiring devices.</p> <p>5.2.7. Select materials and lay out rough-in wiring runs according to specifications, drawings and code requirements.</p> <p>9.4.4. Design a layout of solar arrays and associated equipment.</p> <p>9.4.5. Identify and describe technical standards and regulations for a solar energy installation.</p>
7. Performance analysis, maintenance and troubleshooting*	<p>4.1.3. Identify potential hazards and limitations related to the use of hand tools, power tools and stationary equipment.</p> <p>4.1.4. Maintain machinery, equipment, instrument and facility cleanliness, appearance and safety.</p> <p>4.1.5. Inspect and service the electrical connections and lamps.</p> <p>4.1.11. Calibrate metering, monitoring and sensing equipment.</p>

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| | <ul style="list-style-type: none">4.2.1. Follow manufacturer's recommended operating procedures and adjustment specifications.4.2.2. Differentiate the functions, limitations and proper use of equipment, equipment controls and instrumentation.4.2.3. Perform pre- and post-operation inspections and adjustments and report malfunctions.4.2.4. Perform appropriate start-up, operating and shut-down procedures.4.2.5. Select and operate the equipment and attachments needed to complete the task including levers, pedals or valves. |
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