Scope and Sequence

Course Name		**Course Details** **Course = 0.50 Carnegie Unit Credit**	Credit = 1.0 Prerequisite: Introduction to Manufacturing CTE Credential: CTE Manufacturing
Course Description	Power and energy is a fundamental study of conventional energy sources and the generation and conversions of energy to power. Emphasis will be placed on heat engines or internal combustion engines, the control of mechanisms, solar energy, electricity, and the future sources of energy.		
Note:	This is a suggested scope and sequence for the course content. The content will work with any textbook or instructional resource. If locally adapted, make sure all essential knowledge and skills are covered.		
SCED Identification #		Schedule calculation based on 60% of a semester instructional time. Scope and sequence allows for additional time for guest speakers, student presentations, field trips, remediation, or other content topics.	

All courses taught in an approved CTE program must include Essential Skills embedded into the course content. The Essential Skills Framework for this course can be found at **https://www.cde.state.co.us/standardsandinstruction/essentialskills**

Resources that align with this scope and sequence can be found

Unit Number, Title and Brief Description	CTE or Academic Standard Alignment	Competency / Performance Indicator	Outcome / Measurement	CTSO Integration
Career Development	Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans. Identify and describe careers and the entry requirements for occupations in the Energy Industry.	Investigate and research career opportunities in the energy and power fields. Student is expected to: (A) Identify employers' expectations and appropriate work habits; (B) identify career development, employment, and entrepreneurship opportunities and certification requirements for the field of energy and power of transportation systems; and	Report about career opportunities in the energy and power fields. Include information on knowledge and skills, industry credentials or certifications, and experience or specialized training that are required.	Updates to ICAP

		(C) discuss certification requirements to meet state academic standards and qualifications for employment in selected fields of study.		
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. Relate and follow safety rules pertaining to moving mechanical systems	Student is expected to: (A) apply safety rules based on Occupational Safety and Health Administration (OSHA) Standards; and (B) understand hazards associated with working with power equipment and mechanical systems	Demonstrate proper method of lifting, and cleanup method for fluids. List which extinguisher will fight which type of fire. Demonstrate proper personal protective equipment (PPE). Identify color coding safety standards	
Work, Energy and Power	Examine the relationship between power and energy sources Understand how energy converts from one form to another. Interpret and explain terminology and practices specific to the Energy, Environment, and Utilities sector.	Student is expected to: (A) Define work, power, and Energy; (B) Describe sources of energy; and (C) Apply mathematics formula that calculates power. (D) Examine the relationship between power and energy; (E) Understand the categories of energy; (F) Explain the Law of Conservation of Energy; and	Describe energy sources: • Thermal • Radiant • Nuclear • Chemical • Electrical • Mechanical • Fluid Determine uses of work, power and energy. Apply equations to find missing information pertaining to work, energy and power. Summarize various methods of transferring energy. Compare efficiency of various types of light bulbs. Investigate examples of renewable energy sources.	

		(G) Define the Law of Thermodynamics.	Investigate examples of nonrenewable energy sources. Explain how you would design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. Create a graphic of the design	
Power Transmission	Understand the transmission of energy and power. Understand how a mechanical system operates. Research methods of energy procurement, transmission, distribution, and storage.	Understand the interrelationships among components of power transmission systems. Student is expected to: (A) Understand the types of simple machines used to transmit energy and power; (B) Identify the parts of a power train; (C) Understand both liquid and gas forms of power transmission; and (D) Understand the laws that govern electricity	Identify the six simple machines and classify the mechanical advantage of various simple machines Solve problems involving simple machines, input and output forces, and mechanical advantage. Describe the relationship of force and speed when either is changed by the advantage of a mechanical device. List the various forms of fluid power. Apply characteristics of Boyle's Law, Charles Law, and Archimedes principle. Describe how a fluid is able to transfer force as well as change the relationship between force and distance or speed Apply and memorize Ohm's Law: • Differentiate between accelerating current and direct current. • Explain differences between series, parallel, and series parallel circuits. • Define voltage, current, and Resistance	

			Calculate current, voltage, and resistance in a circuit by using Ohm's Law. • Recognize and apply when Kirchoff's Law is demonstrated. Define electrical quantities. Design and construct an electrical circuit with a power generation source. Explain the flow of energy from generation through distribution to the customer.	
Tools	Select and use tools and equipment appropriately for services and repair of power and energy system machines and technology.	The student knows the functions and applications of the tools, equipment, technologies, and materials used in the field of energy and power of transportation systems. The student is expected to: (A) discuss the safe use of hand and power tools and equipment commonly used in the maintenance and repair of engines; and (B) discuss the use of audits and inspections to maintain compliance with safety, health, and environmental regulations	Demonstrate safe and appropriate use of tools, machines, and materials in power and energy technology: • Common hand tools (screwdrivers, hammers, wrenches, pliers, hacksaws, punches, chisels, drills, files, tin snips, taps, and dies) • Basic electrical hand tools • Demonstrate the safe use of portable power tools, drills, belt and disc sanders, grinders, circular saws, saber saws, metal shears, electric and pneumatic impact wrenches, rotary and pneumatic chipping hammers, drill presses, and bench grinders. • Electrical testing tools • Common pipefitting tools • Common sheet-metal	

			tools	
Power and Energy Systems	Understand key concepts and components of power and energy systems	Demonstrate technical knowledge and skills related to power and energy systems. The student will be able to: (A) identify and define key terms, categories, and parts of a steam power system; (B) identify and define key terms, categories, and parts of a hydraulic or pneumatic system; (C) identify and define key terms, categories, and parts of an electric power system; (D) identify and define key terms, categories, and parts of a solar power system; (E) identify and define key terms, categories, and parts of a nuclear power system; and (F) construct, test, and evaluate a variety of systems	Classify the components of electrical generating systems, including boilers, generators, alternators, turbines, motors, engines, pumps, and switchgear. Discriminate the differences and similarities of power generation, including use of different fuel types and different power plant uses. Summarize the basic operating principles of fossil, hydroelectric, and internal combustion systems. Describe the location of equipment in the plant, how the equipment operates, and normal operating parameters. Describe the theory, construction, and application of the mechanical components of various types of power generation systems. Examine energy systems in buildings. Investigate the policies and codes for the systems and report on the findings. Design a hydraulic system to perform a specific task, applying the principles of fluid kinematics and hydrostatics to outline how the system functions. The design should include specifications for pumps, pipes, and flow rates.	
Engines and Motors	nderstand components and operations of compact engines.	Investigate two-cycle and four-cycle engine operations and explain its principles. Student is	Describe the four-cycle engine operation and explain the purpose of each. Explain valve timing and its	

		expected to: (A) describe the basic components of a small engine (B) describe twocycle engine operation; and (C) explain the difference between a 4-cycle and 2-cycle engine.	parts. Compare the lubrication system in a four-cycle engine to the system of a two-cycle engine. Compare and contrast the advantages and disadvantages of two-cycle and four-cycle engines. Disassemble and reassemble a basic compact engine Identify and differentiate between the different types of fuel and power sources used in conjunction with engines and motors. Recommend the types and sizes of engines/motors best suited for a range of applications. Provide a written justification, citing specific textual evidence, to support the Recommendations	
Industrial electricity	Examine principles of industrial electricity systems and components	Apply concepts of electricity to industrial circuit and components. Student is expected to: (A) identifies components of electrical circuits and how to measure them; (B) examines the principles of AC circuits and understand how certain components react; (C) calculate the effects of AC components in circuits;	Describe the safety requirements and precautions for troubleshooting electrical circuits. Disconnect and reconnect electric motors. Identify the parts and function of electrical control equipment. Explain maintenance procedures and how to troubleshoot a sequence of events	

		(D) explores the electrical motors; and practice electrical motor maintenance procedures. different types of		
Industrial equipment and machines	Demonstrate knowledge of the use of current manufacturing processes Operate, repair, and test machines, devices, and equipment based on electrical or mechanical principles in order to diagnose machine malfunctions, using basic hand and small electric tools and equipment. Demonstrate an understanding of the importance and impact of routine maintenance of machines and equipment	Apply knowledge of scientific principles and technical skills to the operation and repair of industrial machines and equipment. Student is expected to: (A) identify common machinery used in manufacturing and energy and power industries; (B) understand the basic operations of common machines; (C) examine the machines and identify common systems and components; and (D) investigate and apply general maintenance and repair practices	Identify and demonstrate common bench work skills to repair or maintain machines including: cutting and repair o threads, installing dowel pins, hole-reaming, removing damaged screws and hardware, deburring work pieces, etc.) Identify preventative maintenance processes and procedures for common industrial machines. *Machines may vary by industry and local business applications.	
Alternative Energy	Understand the sources of alternative energy. Research the environmental implications of energy conversion processes and energy transmission systems.	The student determines and evaluates the importance and scope of energy and natural resources. The student is expected to: (A) identify various types of natural resources; (B) identify renewable, nonrenewable, and sustainable		

		energy resources and determine their availability; (C) evaluate the impacts of energy production on natural resources and the economy; (D) analyze the geographic and demographic uses of natural resources; and (E) explore alternative energy systems, machines, and technologies		

Academic Standards Alignment

Colorado CTE courses are required to integrate academic and essential skills into course content. The following academic standards have been identified as aligned to this course and should be integrated throughout instruction.

CO CTE Academic Standards Resources **(Rubrics, integration strategies, etc)**

CDE Colorado Academic Standards Online **(Online standards lookup tool)**

Standard 1: Oral Expression and Listening

- Prepared Graduate 1: Collaborate effectively as group members or leaders who listen actively and respectfully; pose thoughtful questions, acknowledge the ideas of others; and contribute ideas to further the group's attainment of an objective.
    - Students collaborate to investigate power generation systems, analyze industrial equipment operations, evaluate energy technologies, and develop solutions related to energy production, distribution, and maintenance systems.

Standard 2: Reading for All Purposes

- Prepared Graduate 4: Read a wide range of informational texts to build knowledge and to better understand the human experience.
    - Students analyze technical manuals, engineering specifications, safety procedures, environmental regulations, operational guidelines, and industry information related to power generation, engines, industrial electricity, manufacturing systems, and alternative energy technologies.
- Prepared Graduate 5: Understand how language functions in different contexts, command a variety of word-learning strategies to assist comprehension, and make effective choices for meaning or style when writing and speaking.

    - Students develop and apply specialized vocabulary related to steam, hydraulic, pneumatic, solar, nuclear, and e ine operation; industrial electricity; manufacturing equipment; and alternative energy technologies.

Standard 3: Writing and Composition

- Prepared Graduate 6: Craft arguments using techniques specific to the genre.
    - Students evaluate power generation methods, energy resources, engine applications, and alternative energy technologies and justify recommendations using technical evidence, operational data, and environmental considerations.
- Prepared Graduate 7: Craft informational/explanatory texts using techniques specific to the genre.
    - Students develop technical explanations, design specifications, maintenance documentation, and reports describing power generation systems, hydraulic systems, industrial electrical systems, equipment maintenance, and alternative energy applications.
- Prepared Graduate 9: Demonstrate mastery of their own writing process with clear, coherent, and error-free polished products.
    - Students create technical reports, system analyses, equipment recommendations, and maintenance documentation that communicate engineering concepts, operational procedures, and energy system evaluations clearly and accurately.

Standard 4: Research Inquiry and Design

- Prepared Graduate 10: Gather information from a variety of sources; analyze and evaluate its quality and relevance; and use it ethically to answer complex questions.
    - Students investigate power generation systems, industrial equipment, electrical systems, engines, maintenance practices, energy conversion processes, and alternative energy technologies by gathering and analyzing technical information, operational data, environmental impacts, and industry standards to address complex energy and engineering challenges.