get into energy

ENERGY & NATURAL RESOURCES

CONTENT STANDARDS



SECONDARY (GRADES 9-12)

ENERGY & NATURAL RESOURCES

Scope: The Energy & Natural Resources Career Cluster spans careers in traditional and renewable fuel production, power generation and energy conversion, utilities, environmental preservation, ecological research, and resource extraction. These industries focus on efficient and responsible resource management, including conservation, transmission, distribution and storage, to minimize environmental impacts and meet global energy needs. Careers in this Cluster are dedicated to creating a sustainable future, innovating cleaner energy solutions, and preserving our planet's natural resources for generations to come.

Purpose: The career pathway content standards outline technical knowledge and skills required for future success within this discipline. The content standards are intended to provide state education leaders and educators with a forward-thinking guide for what students should know and be able to do after completing a program of study in this career pathway. State leaders and local educators are encouraged to use the standards as a basis for the development of well-planned curriculum and assessments for Energy & Natural Resources-related Career and Technical Education (CTE) programs. Adoption and use of these standards is voluntary; states and local entities are encouraged to adapt the standards to meet local needs.

Sample Careers:

Energy: Corrosion-Control Fitter, Electrical Meter Technician, Engineering Technician, Estimator, Gas Control Technician, Gas Meter Mechanic, Gas Pipefitter, Gas System Operator, Hydro Electrician, Hydro Stationary Engineer, Lineworker, Power Distributor and Dispatcher, Power Plant Instrument and Control Technician, Power Plant Operator, Relay Technician, Substation Technician, Telecommunication Technician, Transmission System Operator, Utilities Locator, Utility Service Specialist.

Natural Resources: Aquaculturist, Range Conservationist, Rangeland Scientist, Silviculturist, Timber Manager, Trapper, Logging Operations, Inspector, Natural Resource Scientist, Park Manager, Water Resources Manager, Wildlife Manager, Forest Ranger

Thank you to the partners who contributed content expertise and guidance and to Breakthrough Energy for supporting the creation of these Energy & Natural Resources Content Standards.

DEFINITIONS

Standards: These are the standards set forth by the Center for Energy Workforce Development for Energy & Natural Resources. They define what students should know and be able to do after completing instruction in a program of study.

Performance Indicators: These statements distill each standard into more discrete indicators of the knowledge and skills students should attain through a program of study in this pathway. Attainment of the knowledge and skills outlined in the performance indicators is intended to demonstrate an acceptable level of proficiency with the related standard at the conclusion of a program of study in this area.

Sample Measurements: These statements are sample measurable activities that students might carry out to indicate attainment of each performance indicator. Sample Measurements in the same row begin from a lower level of academic rigor and progress to a higher level of academic rigor. Each sample measurement does not need to be taught but should be considered by the teacher when determining the desired level of academic rigor when measuring student mastery of the indicator. The first sample measurement in the row is the beginning level. These sample measurements require students to be able to remember, understand, identify, explain, and summarize information. The second sample measurement is the intermediate level. These sample measurements require students to apply, analyze, compare, distinguish, and examine information and scenarios. The third sample measurement is the advanced level. These sample measurements require students to assess, evaluate, justify, improve, and create.

The standards document is organized into eight sections aligned closely with the Advance CTE subclusters:

- Energy Foundations
- Clean Energy
- Conservation & Land Management
- Ecological Research & Development
- Environmental Protection
- Resource Extraction
- Transmission, Distribution, & Storage
- Utilities

ENERGY FOUNDATIONS

Energy is all around us. Yet, we often take it for granted, not thinking about energy until something we depend on doesn't work. Gaming consoles, cell phones, lights, computers, cooking appliances, and heating and cooling systems are just a few things we routinely touch that are powered and fueled by energy. There has been an incredible evolution in energy over the last several decades, and even newer and more modern advancements are occurring at lightning speed. Many people work in energy careers in the United States, and that number is growing. Among them are future-focused innovators and engineers exploring new ways to harness and store power to skilled tradespeople who are diagnosticians and problem solvers. The work of these professionals is essential, rewarding, and always in demand in rural communities, urban towns, and metropolitan cities. This section provides a baseline for the study of key energy topics.

ENERGY FOUNDATIONS

Standard: EF.01. Examine foundational energy concepts and career opportunities in the energy industry.

Performance Indicator	Sample Measurements		
	Beginning	Intermediate	Advanced
EF.01.01. Demonstrate an understanding of workplace safety in the energy sector.	**EF.01.01.01.a.** Explain the role of the Occupational Safety and Health Administration (OSHA).	**EF.01.01.01.b.** Follow established safety procedures and guidelines.	**EF.01.01.01.c.** Evaluate various workplace scenarios to identify potential hazards and ways to mitigate risk.
EF.01.02. Understand the relationship between power and energy and how it relates to the production and usage of electricity.	**EF.01.02.01.a.** Define power, energy, force, and work.	**EF.01.02.01.b.** Compare different units for energy and power and their use cases.	**EF.01.02.01.c.** Use dimensional analysis to explain the relationship between the standard units of force, energy, and power.
EF.01.03. Understand the scientific laws that govern electricity.	**EF.01.03.01.a.** Define key terms and scientific laws related to electricity.	**EF.01.03.01.b.** Construct an electrical circuit.	**EF.01.03.01.c.** Modify a circuit to improve efficiency.
EF.01.04. Discuss the history of the United States energy sector.	**EF.01.04.01.a.** List key milestones in the history of the United States energy sector.	**EF.01.04.01.b.** Describe key milestones in the history of the United States energy sector.	**EF.01.04.01.c.** Prioritize key milestones in the history of the United States energy sector based on their importance.
EF.01.05. Examine various energy sources and their impact on the environment.	**EF.01.05.01.a.** List the primary sources and forms of energy.	**EF.01.05.01.b.** Diagram examples of human-made energy systems from source to end use.	**EF.01.05.01.c.** Compare the efficiency of different methods of electricity production.
	EF.01.05.02.a. Describe the difference between renewable and nonrenewable energy sources.	**EF.01.05.02.b.** Categorize energy sources as renewable or nonrenewable.	**EF.01.05.02.c.** Compare and contrast energy sources based on their impact on the environment.
	EF.01.05.03.a. Explain how greenhouse gases are generated.	**EF.01.05.03.b.** Analyze the impact of greenhouse gases (e.g., carbon dioxide, methane, and nitrous oxide) on the economy and environment.	**EF.01.05.03.c.** Appraise strategies for reducing greenhouse gas emissions (fuel-efficient vehicles, energy conservation marketing campaigns, regulations, incentives, etc.).
EF.01.06. Examine career opportunities in the energy sector.	**EF.01.06.01.a.** Describe the diversity of careers in the energy sector.	**EF.01.06.01.b.** Discuss the attributes of different energy career pathways of interest.	**EF.01.06.01.c.** Analyze careers in the energy industry by assessing factors such as total compensation (including salary and benefits), education and training requirements, and working conditions aligned with career goals.

CLEAN ENERGY

Careers focused on energy generation and infrastructure development from clean energy sources such as low-carbon fuels, natural gas, nuclear, biofuels, hydrogen processes, and other alternative sources to address climate change impacts. Professionals in this field develop and implement technologies that harness natural elements, including solar, nuclear, wind, and hydropower while advancing efforts in electrification and energy storage solutions. This Sub-Cluster includes recycling batteries and waste, carbon capture, and other energy and mineral reuse and reclamation.

Professionals develop and implement technologies that harness natural elements.

CLEAN ENERGY

Standard: CE.01. Investigate clean energy, including emerging technology and economic and environmental impacts.

Performance Indicator	Sample Measurements		
	Beginning	Intermediate	Advanced
CE.01.01. Describe various power generation systems.	CE.01.01.01.a. Explain how various power generation systems operate (e.g., coal, natural gas, steam-electric, nuclear, hydro-electric, etc.).	CE.01.01.01.b. Diagram the components of power generation systems (boilers, generators, alternators, turbines, motors, engines, pumps, etc.).	CE.01.01.01.c. Compare and contrast the different types of power generation systems (e.g., fuel sources, environmental impact, human impact, uses, centralized, distributed, etc.).
CE.01.02. Classify clean energy sources.	CE.01.02.01.a. Define clean energy.	CE.01.02.01.b. Identify the advantages and disadvantages of various clean energy sources.	CE.01.02.01.c. Evaluate the complementary nature of clean energy sources.
CE.01.03. Explain how clean energy is produced.	CE.01.03.01.a. Describe how various clean energy sources are converted into electricity.	CE.01.03.01.b. Diagram the main components of various clean energy systems (e.g., wind turbines, photovoltaic systems, geothermal power plants, etc.).	CE.01.03.01.c. Evaluate clean energy production methods based on their economic and environmental impact.
	CE.01.03.02.a. Explain the role of low-carbon fossil fuels in pursuing clean energy solutions.	CE.01.03.02.b. Examine energy reuse and reclamation methods.	CE.01.03.02.c. Analyze carbon emissions from various energy production methods.
CE.01.04. Identify emerging trends in clean energy.	CE.01.04.01.a. Describe emerging trends in clean energy.	CE.01.04.01.b. Discuss the advantages and disadvantages of various emerging trends in clean energy.	CE.01.04.01.c. Justify which clean energy trend will become more prevalent.

CONSERVATION & LAND MANAGEMENT

Careers rooted in environmental and natural sciences, focusing on protecting and managing natural resources and landscapes. Professionals in this field operate local, state, and national parks; safeguard forests and waterways; maintain national lands and rangelands; and manage wildlife and marine life. This field merges ecological conservation with recreational spaces, aiming to preserve nature while enhancing community well-being and environmental stewardship through public accessibility. *This section aligns with the Agriculture, Food, and Natural Resources (AFNR) "Natural Resource Systems" Pathway.*

CONSERVATION & LAND MANAGEMENT

Standard: CLM.01. Plan and conduct natural resource management activities.

Performance Indicator	Sample Measurements		
	Beginning	Intermediate	Advanced
CLM.01.01. Assess the impact of human activities on the availability of natural resources.	CLM.01.01.01.a. Describe how consumer decisions are related to the depletion of natural resources.	CLM.01.01.01.b. Analyze possible solutions to reduce the depletion of natural resources.	CLM.01.01.01.c. Design a solution to reduce the depletion of natural resources affected by consumer decisions.
	CLM.01.01.02.a. Summarize how recreational uses of natural resources can be changed to improve sustainability.	CLM.01.01.02.b. Assess different options for improving the sustainability of outdoor recreation based on its impact on natural resources and the likelihood of acceptance.	CLM.01.01.02.c. Recommend how an outdoor recreation activity can be made more sustainable in a manner that is accessible and equitable to those who take part in that activity.
	CLM.01.01.03.a. Identify characteristics of natural resources that make them desirable for recreational purposes.	CLM.01.01.03.b. Discuss management techniques for improving outdoor recreation opportunities.	CLM.01.01.03.c. Evaluate the impact of recreational activities on natural resources.
CLM.01.02. Demonstrate natural resource protection and management techniques.	CLM.01.02.01.a. Identify characteristics of various natural resources (e.g., streams, forests, wildlife, rangeland, etc.).	CLM.01.02.01.b. Determine the health of various natural resources (e.g., streams, forests, wildlife, rangeland, etc.) using data.	CLM.01.02.01.c. Evaluate strategies for managing various natural resource systems (e.g., streams, forests, wildlife, rangeland, etc.).
	CLM.01.02.02.a. Identify techniques associated with sustainable management of natural environments (e.g., timber stand improvement, soil erosion control, reforestation, etc.).	CLM.01.02.02.b. Analyze data about natural environments (forests, waterways, etc.) to determine which management techniques would improve that habitat.	CLM.01.02.02.c. Create an environment management plan that improves the habitat while optimizing the use of natural resources.
	CLM.01.02.03.a. Identify examples of invasive species.	CLM.01.02.03.b. Analyze factors that influence the establishment and spread of invasive species.	CLM.01.02.03.c. Devise a plan to manage invasive species in a given area.

CONSERVATION & LAND MANAGEMENT

Standard: CLM.01. Plan and conduct natural resource management activities.

Performance Indicator	Sample Measurements		
	Beginning	Intermediate	Advanced
CLM.01.03. Sustainably manage wildlife and marine life.	**CLM.01.03.01.a.** Identify characteristics of a healthy wildlife habitat.	**CLM.01.03.01.b.** Discuss the impacts of different methods of wildlife habitat management.	**CLM.01.03.01.c.** Create a comprehensive improvement plan for a wildlife habitat.
	CLM.01.03.02.a. Describe methods by which wildlife can be sustainably harvested (e.g., controlled harvests, hunting licenses, regulations, etc.).	**CLM.01.03.02.b.** Discuss techniques for harvesting wildlife regarding sustainability, practicality, and other factors.	**CLM.01.03.02.c.** Develop a method for the sustainable harvest of wildlife species.
	CLM.01.03.03.a. Categorize aquatic species used for commercial and recreational purposes.	**CLM.01.03.03.b.** Analyze the effects of the techniques used to harvest aquatic species for their sustainability.	**CLM.01.03.03.c.** Develop recommendations for the sustainable harvest of aquatic species.
CLM.01.04. Analyze how social perceptions of natural resource management change and develop over time.	**CLM.01.04.01.a.** Explain the Tragedy of the Commons.	**CLM.01.04.01.b.** Explain how the management of public lands has changed in the U.S. over the last 300 years.	**CLM.01.04.01.c.** Design a management plan for a large tract of public land that addresses the interests of multiple stakeholder groups while protecting natural resources.

ECOLOGICAL RESEARCH & DEVELOPMENT

Careers emphasizing the scientific study of and research in ecological, geological, electrical, chemical, nuclear, biological, environmental engineering, and other sciences as they relate to energy production, sustainability, and the management of natural resources. Professionals in this field employ scientific methods to understand ecosystems, biodiversity, and the impacts of energy systems on the environment. *This section aligns with the Agriculture, Food, and Natural Resources (AFNR) "Environmental Sustainability Systems" Pathway.*

ECOLOGICAL RESEARCH & DEVELOPMENT

Standard: ERD.01. Use scientific methods to understand the connection between energy production, environmental conditions, natural resource management, and ecological sustainability.

Performance Indicator	Sample Measurements		
	Beginning	Intermediate	Advanced
ERD.01.01. Analyze ecological systems.	ERD.01.01.01.a. Define ecological system.	ERD.01.01.01.b. Compare and contrast various ecological systems.	ERD.01.01.01.c. Determine the condition of an ecological system by examining various indicators.
ERD.01.02. Analyze laboratory and field samples in environmental monitoring situations.	ERD.01.02.01.a. Identify sample types (e.g., air, water, soil, organism populations, etc.) and sampling techniques for collecting laboratory and field data.	ERD.01.02.01.b. Determine the appropriate sampling techniques needed to generate data.	ERD.01.02.01.c. Prepare sample measurements using appropriate data collection techniques and instruments.
ERD.01.03. Perform assessments of environmental conditions.	ERD.01.03.01.a. List ways in which pollution can be managed and prevented.	ERD.01.03.01.b. Conduct tests (water, soil, air, ecological health, etc.) to determine the presence and extent of pollution.	ERD.01.03.01.c. Create a plan for pollution remediation, management, or prevention for a given area.
	ERD.01.03.02.a. Define land uses, capability factors, and land capability classes.	ERD.01.03.02.b. Determine the land capability classes for a parcel of land using a soil survey.	ERD.01.03.02.c. Design a master land-use management plan for a given area that utilizes land capability classes to minimize environmental degradation.
	ERD.01.03.03.a. Explain how meteorological conditions influence air quality.	ERD.01.03.03.b. Compare the relationships between meteorological conditions, air quality, and air pollutants.	ERD.01.03.03.c. Interpret data measuring air pollution, its threat to human populations, and ecological interactions.
	ERD.01.03.04.a. Describe how climate change impacts regional ecological sustainability systems.	ERD.01.03.04.b. Assess the potential environmental, economic, and social consequences of climate change on a specific geographical location.	ERD.01.03.04.c. Propose mitigation strategies to address specific environmental, economic, and social impacts of climate change.
	ERD.01.03.05.a. Describe the purpose and applications of life cycle assessments to ecological sustainability systems.	ERD.01.03.05.b. Conduct a life cycle assessment for a given product.	ERD.01.03.05.c. Propose improvements and/or efficiencies to an industrial life cycle to reduce waste of raw materials, energy, and water.

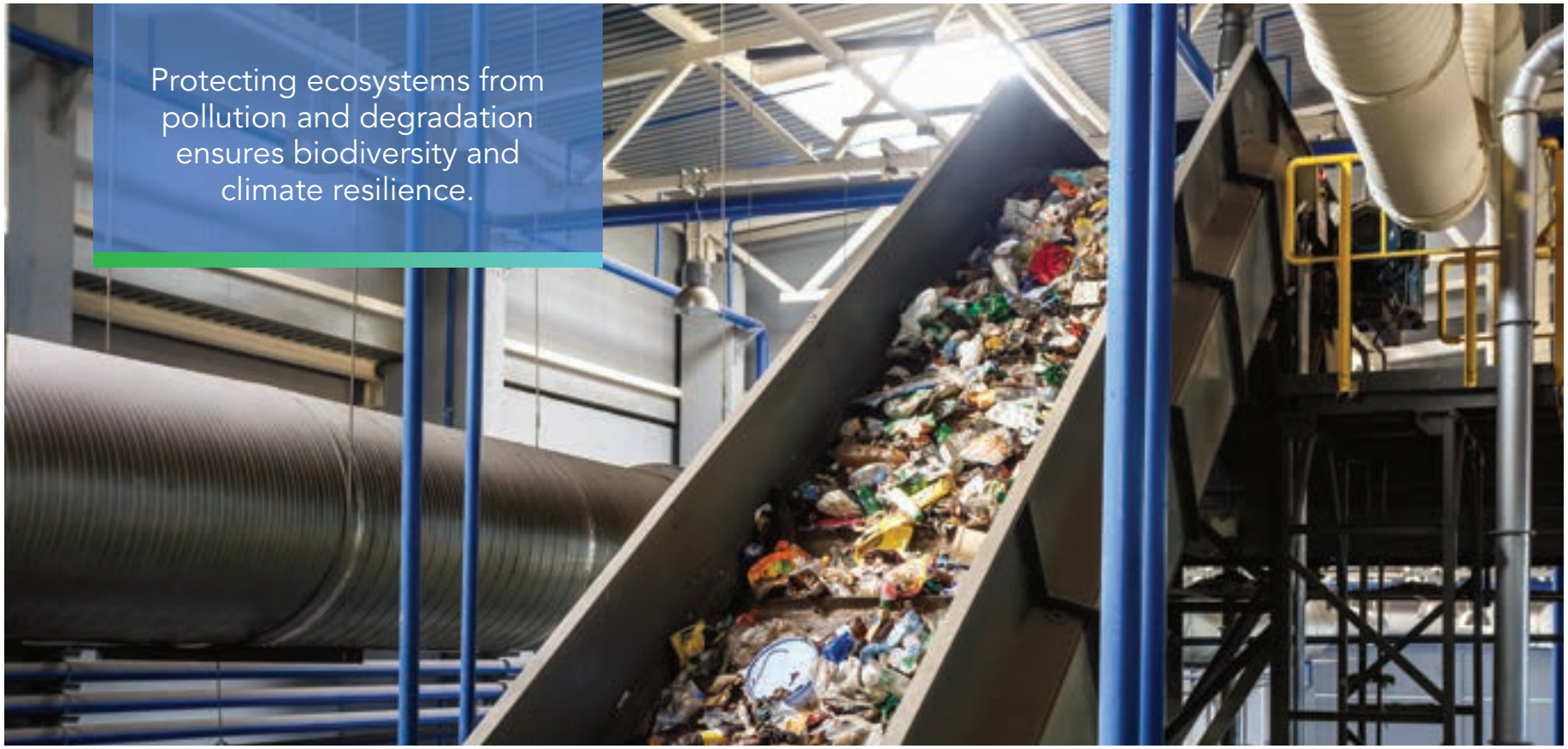
ECOLOGICAL RESEARCH & DEVELOPMENT

Standard: ERD.01. Use scientific methods to understand the connection between energy production, environmental conditions, natural resource management, and ecological sustainability.

Performance Indicator	Sample Measurements		
	Beginning	Intermediate	Advanced
ERD.01.04. Compare different types of waste management.	ERD.01.04.01.a. List the types of solid waste and options for treating solid waste.	ERD.01.04.01.b. Analyze environmental hazards created by different types of solid waste.	ERD.01.04.01.c. Develop a plan for solid waste management for a given situation.
	ERD.01.04.02.a. Describe the importance and potential impact of recycling.	ERD.01.04.02.b. Discuss tradeoffs of different recycling methods.	ERD.01.04.02.c. Evaluate recycling programs and procedures.
ERD.01.05. Discuss the impact of energy conservation and consumption on ecological sustainability.	ERD.01.05.01.a. List energy sources and conservation measures to reduce the impact on the environment.	ERD.01.05.01.b. Compare the advantages and disadvantages of using different energy sources in regards to ecological sustainability.	ERD.01.05.01.c. Propose a clean energy transition plan for a given location that considers impacts on the local environment.
	ERD.01.05.02.a. List factors that affect energy consumption.	ERD.01.05.02.b. Describe how the main categories of energy consumption contribute to greenhouse gas emissions.	ERD.01.05.02.c. Recommend an effective course of action to reduce energy consumption in consideration of the needs of ecological systems.
	ERD.01.05.03.a. Describe factors that affect the earth's balance of energy.	ERD.01.05.03.b. Analyze how the changes in various greenhouse gas concentrations impact the earth's balance of energy.	ERD.01.05.03.c. Create an action plan to mitigate the impact of climate change on Earth's energy balance.
	ERD.01.05.04.a. Explain the importance of environmental monitoring as it relates to the carbon cycle and energy consumption.	ERD.01.05.04.b. Choose one impact of climate change related to carbon cycle imbalance and analyze the financial and/or ecological cost.	ERD.01.05.04.c. Create an action plan to implement a method of removing carbon dioxide from the atmosphere or implementing technology that prevents greenhouse gas emissions in a specific geographic location.
ERD.01.06. Examine government and non-government organizations associated with ecological sustainability systems.	ERD.01.06.01.a. Identify different types of government and non-government organizations associated with ecological sustainability systems.	ERD.01.06.01.b. Analyze the specific purpose of government and non-government agencies associated with ecological sustainability systems.	ERD.01.06.01.c. Evaluate the impact of government and non-government agencies associated with ecological sustainability systems.

ENVIRONMENTAL PROTECTION

Careers centered on regulating and managing the impacts of both natural processes and human activities, such as resource production and consumption. This Sub-Cluster involves developing and enforcing policies to protect all ecosystems, including space, air, land, and water, from natural disasters, pollution, and degradation. This field focuses on conserving natural habitats and biodiversity and applying scientific and engineering principles to solve environmental problems and improve climate resilience.



ENVIRONMENTAL PROTECTION

Standard: EP.01. Analyze issues, legislation, and regulations related to energy and the environment.

Performance Indicator	Sample Measurements		
	Beginning	Intermediate	Advanced
EP.01.01. Examine the importance of air quality.	EP.01.01.01.a. Describe the sources of common air pollutants.	EP.01.01.01.b. Analyze the impacts of poor air quality on human health and the environment.	EP.01.01.01.c. Appraise measures taken to improve outdoor air quality.
EP.01.02. Investigate the impact of pollution on various water sources.	EP.01.02.01.a. Identify common pollutants found in various water sources (e.g., lakes, oceans, wetlands, groundwater, and drinking water).	EP.01.02.01.b. Assess the impacts of poor water quality on human health and the environment.	EP.01.02.01.c. Critique measures taken to improve water quality.
EP.01.03. Recognize the impacts of land use on the environment.	EP.01.03.01.a. Discuss the sources of land pollution.	EP.01.03.01.b. Compare the environmental impacts of various land uses.	EP.01.03.01.c. Judge the impact of various measures taken to mitigate land degradation.
EP.01.04. Discuss environmental regulations that impact the energy sector.	EP.01.04.01.a. List major policies related to energy production.	EP.01.04.01.b. Examine how policies and regulations impact energy production and consumption from different sources.	EP.01.04.01.c. Modify an existing policy to aid in the transition to lower carbon emissions.
	EP.01.04.02.a. List major regulations and policies that protect space, air, land, and water from pollution and degradation.	EP.01.04.02.b. Summarize how various regulations and policies protect space, air, land, and water from pollution and degradation.	EP.01.04.02.c. Propose a new regulation or policy to protect space, air, land, and water from pollution and degradation.
EP.01.05. Examine organizations that regulate the environmental impacts of the energy sector.	EP.01.05.01.a. Identify local, state, and federal organizations that regulate the environmental impacts of energy production and consumption.	EP.01.05.01.b. Explain the role of local, state, and federal organizations that regulate the environmental impacts of energy production and consumption.	EP.01.05.01.c. Evaluate the effectiveness of a local, state, or federal organization in mitigating adverse impacts of energy production and consumption.
	EP.01.05.02.a. List the environmental areas of focus overseen by the U.S. Environmental Protection Agency (EPA).	EP.01.05.02.b. Describe the ways the U.S. Environmental Protection Agency (EPA) carries out its mission.	EP.01.05.02.c. Assess the impact of the U.S. Environmental Protection Agency (EPA) on the energy industry.

RESOURCE EXTRACTION

Careers on the efficient extraction of natural materials including fossil fuels, minerals, natural gas, and geothermal resources that are essential for fuel production in energy and manufacturing. This Sub-Cluster includes careers in exploration, drilling, mining, fracking, mineral processing, geoscience, quarrying, and petroleum engineering.

RESOURCE EXTRACTION

Standard: RE.01. Examine resource extraction methods and their economic and environmental impacts.

Performance Indicator	Sample Measurements		
	Beginning	Intermediate	Advanced
RE.01.01.Understand history of natural resource extraction and use.	RE.01.01.01.a. Survey the natural resources humans have leveraged over time.	RE.01.01.01.b. Evaluate the environmental and economic impacts provided by various natural resources.	RE.01.01.01.c. Develop a strategy to leverage natural resources while minimizing environmental impact.
RE.01.02. Contextualize the necessity of natural resource extraction.	RE.01.02.01.a. Discuss the interventions necessary to meet net-zero greenhouse gas emission goals.	RE.01.02.01.b. Compare the impact of various energy technologies on natural resources.	RE.01.02.01.c. Evaluate the costs and benefits of natural resource extraction in the context of climate mitigation.
RE.01.03. Understand trends in resource extraction and recovery.	RE.01.03.01.a. Define resource extraction.	RE.01.03.01.b. Summarize how technological innovations have impacted energy resource extraction methods.	RE.01.03.01.c. Evaluate various trends in energy resource extraction and recovery.
	RE.01.03.02.a. Describe how various energy resources are extracted.	RE.01.03.02.b. Explain the advantages and disadvantages of various energy resource extraction methods.	RE.01.03.02.c. Compare the environmental and economic impact of various energy resource extraction methods.
RE.01.04. Understand the global implications of natural resources.	RE.01.04.01.a. List known resources of fuels and minerals around the world.	RE.01.04.01.b. Identify leading nations in the extraction of various resources.	RE.01.04.01.c. Evaluate security risks for various resources in the context of projected demand increases.
RE.01.05. Understand the role of permitting in resource extraction.	RE.01.05.01.a. List influential U.S. laws and regulations surrounding resource extraction.	RE.01.05.01.b. Describe the permitting process during the development of a new resource extraction operation.	RE.01.05.01.c. Identify the critical points in the permitting process for which project managers should be prepared.

TRANSMISSION, DISTRIBUTION, & STORAGE

Careers focused on supporting the integrated and interconnected networks that contain transmission facilities and power lines, distribution facilities and power lines, and distributed energy resources. These systems are designed to work cooperatively to provide consistent, reliable, and affordable power to customers in cities, rural areas, and everywhere in between.

TRANSMISSION, DISTRIBUTION, & STORAGE

Standard: TDS.01. Understand key concepts and components of power and energy systems.

Performance Indicator	Sample Measurements		
	Beginning	Intermediate	Advanced
TDS.01.01. Examine energy transmission, distribution, and storage systems.	**TDS.01.01.01.a.** Define the equipment used in the electric power transmission process.	**TDS.01.01.01.b.** Evaluate emerging technologies in electric power transmission.	**TDS.01.01.01.c.** Propose a viable solution to a significant issue related to electric power transmission.
	TDS.01.01.02.a. Describe the electric power distribution process.	**TDS.01.01.02.b.** Evaluate emerging technologies in electric power distribution.	**TDS.01.01.02.c.** Propose a viable solution to a significant issue related to electric power distribution.
	TDS.01.01.03.a. Identify types of energy storage systems.	**TDS.01.01.03.b.** Describe important characteristics of energy storage systems.	**TDS.01.01.03.c.** Compare and contrast emerging technologies of energy storage systems.
TDS.01.02. Define challenges related to energy storage.	**TDS.01.02.01.a.** Describe the challenges of technologies available for energy storage.	**TDS.01.02.01.b.** Identify advantages and disadvantages related to various energy storage options.	**TDS.01.02.01.c.** Evaluate energy storage options for specific sites.
TDS.01.03. Assess the importance of resiliency and efficiency in the transmission and distribution of energy.	**TDS.01.03.01.a.** Explain the flow of energy from generation through distribution to the customer	**TDS.01.03.01.b.** Diagram the flow of energy from generation through distribution to the customer.	**TDS.01.03.01.c.** Compare innovative methods energy companies are using to improve grid resiliency.
	TDS.01.03.02.a. Explain the difference between efficiency and conservation.	**TDS.01.03.02.b.** Identify various power losses across transmission and distribution systems.	**TDS.01.03.02.c.** Recommend improvements to an energy system to increase efficiency.
TDS.01.04. Discuss the importance of resiliency and reliability to the energy industry.	**TDS.01.04.01.a.** Define resilience and reliability for different components of the power system (e.g., transmission, distribution).	**TDS.01.04.01.b.** Explain how resilience and reliability are important to the energy business.	**TDS.01.04.01.c.** Propose improvements to a system in a specific geographic region that would improve resiliency and reliability and justify your choice of solutions.
TDS.01.05. Understand how components of the power system are planned.	**TDS.01.05.01.a.** Describe how generation and transmission systems must be planned to accommodate future demand growth.	**TDS.01.05.01.b.** Explain how generation and transmission systems are planned based on load forecasts in both Regional Transmission Organization (RTO) and non-RTO areas of the country.	**TDS.01.05.01.c.** Analyze how changes to costs and/or policies impact generation and transmission planning results.

UTILITIES

Careers involving the transmission and maintenance of utility systems for clean and alternative energy, electricity, water, waste remediation, and telecom/broadband; distribution and infrastructure development; and storage. Professionals in this field ensure reliable connectivity to energy sources, energy efficiency, and other essential services. Opportunities exist in public utilities, as well as commercial and industrial companies, with a focus on operations, maintenance, and security of systems to guarantee uninterrupted access to vital resources. *This section aligns with the Agriculture, Food, and Natural Resources (AFNR) "Power, Structural, and Technical Systems" Pathway.*

UTILITIES

Standard: UT.01. Understand the operation and maintenance of utility systems.

Performance Indicator	Sample Measurements		
	Beginning	Intermediate	Advanced
UT.01.01. Examine the business of utilities.	**UT.01.01.01.a.** List the different types of utility systems.	**UT.01.01.01.b.** Compare the different types of utility systems.	**UT.01.01.01.c.** Investigate different types of ownership structures of utility systems.
UT.01.02. Explain metering and billing in the utility industry.	**UT.01.02.01.a.** Describe the process of metering and billing based on consumption.	**UT.01.02.01.b.** Interpret utility bills.	**UT.01.02.01.c.** Explain how changes in metering capabilities will impact bill options for utility companies.
UT.01.03. Examine regulatory frameworks for utilities.	**UT.01.03.01.a.** Identify which state agencies regulate each utility type in your state.	**UT.01.03.01.b.** Explain the interactions between state and federal agencies in regulating local utilities.	**UT.01.03.01.c.** Investigate how deregulation impacted utility regulation across the United States.
UT.01.04. Examine energy pricing structures in regulated and deregulated states.	**UT.01.04.01.a.** Summarize how energy prices are determined in regulated versus deregulated states.	**UT.01.04.01.b.** Explain the utility pricing structure in your state.	**UT.01.04.01.c.** Evaluate the advantages and disadvantages of energy pricing structures in regulated versus deregulated states, using specific examples and data to support your argument.
UT.01.05. Discuss security measures taken by utility companies.	**UT.01.05.01.a.** Explain why security is critical to the functioning of utility companies.	**UT.01.05.01.b.** Compare methods utility companies use to secure their systems.	**UT.01.05.01.c.** Assess the impacts of a security breach.
UT.01.06. Demonstrate knowledge of safety precautions and potential hazards for utility systems.	**UT.01.06.01.a.** List safety and maintenance standards used in various utility industries.	**UT.01.06.01.b.** Identify potential safety hazards within the utility industry.	**UT.01.06.01.c.** Demonstrate appropriate selection of personal protective equipment.

UTILITIES

Standard: UT.01. Understand the operation and maintenance of utility systems.

Performance Indicator	Sample Measurements		
	Beginning	Intermediate	Advanced
UT.01.07. Demonstrate knowledge of utility service equipment.	UT.01.07.01.a. List examples of utility service equipment.	UT.01.07.01.b. Summarize the steps to operate utility service equipment safely.	UT.01.07.01.c. Demonstrate proficiency in utilizing utility service equipment (e.g., using training simulations).
UT.01.08. Recognize the importance of inspection and maintenance on equipment used in the utility industry.	UT.01.08.01.a. Identify the tools, machines, and equipment needed to perform maintenance projects in the utility industry.	UT.01.08.01.b. Outline the steps to perform inspection and maintenance in the utility industry.	UT.01.08.01.c. Recommend a program of preventative maintenance for a utility's infrastructure.
UT.01.09. Examine the components needed to install utility systems.	UT.01.09.01.a. Identify the tools needed to install utility system components.	UT.01.09.01.b. Explain the steps to install utility system components.	UT.01.09.01.c. Demonstrate proficiency in the installation of utility system components (e.g., using training simulations).