Energy Supply: Sustainability and Efficiency

ES8411 36 weeks

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Office of Career, Technical, and Adult Education
Virginia Department of Education

Course Description

Suggested Grade Level: 9 or 10

Students in this course will explore the principles of energy supply with an emphasis on sustainability and efficiency. Concepts include energy supply and sources (such as wind, solar, nuclear, and biomass), energy generation, innovations in energy, and career exploration. Students apply knowledge by designing, mapping, and modeling energy systems and will recognize their role as energy stewards of tomorrow.

Task Essentials Table

- Tasks/competencies designated by plus icons (⊕) in the left-hand column(s) are essential
- Tasks/competencies designated by empty-circle icons (○) are optional
- Tasks/competencies designated by minus icons (⊖) are omitted
- Tasks marked with an asterisk (*) are sensitive.

Task Number	ES8411	Tasks/Competencies	
Exploring Sustainability and Efficiency			
39	⊕	Define *energy sustainability*.	
40	⊕	Define *energy efficiency*.	
41	⊕	Discuss sustainability and efficiency as they apply to social, economic, and environmental considerations.	
Exploring Energy Supply and Sources			
42	⊕	Identify various energy sources.	
43	⊕	Evaluate nonrenewable, renewable, and inexhaustible energy sources.	
44	⊕	Develop a timeline of energy innovation throughout history.	
45	⊕	Demonstrate methods for energy storage.	
46	⊕	Summarize how technology affects energy sources and utilization.	
Understanding Renewable Energy			

47	⊕	Evaluate the use of renewable energy sources globally, nationally, and locally.	
48	⊕	Demonstrate a given renewable energy technology.	
49	⊕	Describe the challenges of using renewable energy sources.	
Exploring Distributed Energy Resources			
50	⊕	Define *distributed energy resources*.	
51	⊕	Design a distributed energy system.	
52	⊕	Describe microgrids.	
53	⊕	Illustrate a microgrid.	
Understanding Energy Generation			
54	⊕	Identify types of facilities for energy generation.	
55	⊕	Compare electrical power generation facilities.	
56	⊕	Describe the basic principles of electricity.	
57	⊕	Describe the basic principles of electric power generation.	
58	⊕	Identify electric power generation equipment and systems.	
59	○	Present design choices for energy generation facilities.	
60	⊕	Diagram an energy generation facility.	
Understanding Utilities Facility Management			
61	⊕	Identify the roles within a utilities facility.	
62	⊕	Relate facilities management to sustainability and efficiency.	
63	⊕	Research career opportunities within utilities facility management.	
Understanding Regulations			
64	⊕	Explain the purpose of energy regulation.	
65	⊕	Identify the agencies involved in energy regulation.	
66	⊕	Research the processes of regulatory compliance.	

Applying Energy Supply Concepts			
67	⊕	Map an energy supply process.	
68	⊕	Evaluate an energy supply process.	
Exploring Innovation in Energy Supply			
69	⊕	Research new and emerging technologies in energy supply.	
70	⊕	Research a new technology affecting a given geographical area.	
71	⊕	Present research on innovation in energy supply.	

Legend: ⊕Essential ○Non-essential ⊖Omitted

Curriculum Framework

Exploring Sustainability and Efficiency

Task Number 39

Define *energy sustainability*.

Definition

Definition should include components such as

- conservation and efficiency
- renewable energy
- diversity of energy sources
- environmental and economic effects and considerations
- innovation.

Process/Skill Questions

- What is the difference between conservation and efficiency?
- How is a diverse set of energy sources beneficial?
- How are renewable and sustainable energy sources the same and how are they different?

ITEEA National Standards

16. Energy and Power Technologies

2. The Core Concepts of Technology

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

4. The Cultural, Social, Economic, and Political Effects of Technology

5. The Effects of Technology on the Environment

Task Number 40

Define *energy efficiency*.

Definition

Definition should include

- inputs and outputs (the importance of getting more output from less input)
- physical limitations of various technologies and energy sources
- the relationship between efficiency and sustainability.

Process/Skill Questions

- How are efficiency and sustainability related?
- Why are there physical limitations to contend with? Why can't any energy system be 100% efficient?
- Why is energy lost when energy is converted from one form to another?

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16. Energy and Power Technologies

Task Number 41

Discuss sustainability and efficiency as they apply to social, economic, and environmental considerations.

Definition

Discussion should include

- social effects
- cultural and personal philosophies
- government policies
- business practices
- the environment and natural resources.

Process/Skill Questions

- What are the consequences of using different energy sources?
- How do business practices affect sustainability and efficiency?
- How do government policies enable or burden energy development?

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4. The Cultural, Social, Economic, and Political Effects of Technology

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Exploring Energy Supply and Sources

Task Number 42

Identify various energy sources.

Definition

Identification may include

- fossil fuels (coal, oil, natural gas)
- solar (thermal, photovoltaic, and concentrating)
- nuclear (fission, fusion)
- hydroelectric (impoundment vs. run-of-river)

- wind (onshore, offshore)
- ocean energy (wave, tidal/current, ocean thermal energy conversion [OTEC])
- geothermal
- biomass
- waste-to-energy.

Process/Skill Questions

- What is an advantage and a disadvantage of using each energy source?
- Why are there so many different sources of energy? Why is it beneficial to have such a variety?
- Which sources are considered to be renewable? Which are inexhaustible?

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16. Energy and Power Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

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Task Number 43

Evaluate nonrenewable, renewable, and inexhaustible energy sources.

Definition

Evaluation should include

- definitions of *nonrenewable*, *renewable*, and *inexhaustible* energy sources
- examples of energy sources categorized as nonrenewable, renewable, and inexhaustible
- uses for nonrenewable, renewable, and inexhaustible energy sources in specific geographic locations
- positive and negative effects of nonrenewable, renewable, and inexhaustible energy sources on the global environment, society, and the individual.

Process/Skill Questions

- What is the difference between a renewable and an inexhaustible energy source?
- What are examples of each type of energy source?
- Where, globally, do these energy sources thrive?

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16. Energy and Power Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

5. The Effects of Technology on the Environment

Task Number 44

Develop a timeline of energy innovation throughout history.

Definition

Development should include

- historic examples of energy conversion
- examples of energy development within the last century
- current examples of energy innovation.

Process/Skill Questions

- What is meant by the phrase, "*Necessity is the mother of invention*"? How does this apply to energy innovation throughout history?
- What are some examples of how technology has evolved to enable energy conversion?

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3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

6. The Role of Society in the Development and Use of Technology

7. The Influence of Technology on History

Task Number 45

Demonstrate methods for energy storage.

Definition

Demonstrations may include

- batteries
- compressed air
- hydrogen
- gravity (e.g., pumped storage)
- thermal.

Demonstrations should also include an explanation of methods chosen.

Process/Skill Questions

- Why does energy need to be stored?
- How is hydrogen used as an energy storage method?
- How is gravity used for energy storage?
- Where is the largest pumped storage facility in the world and how much power can it deliver?

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Task Number 46

Summarize how technology affects energy sources and utilization.

Definition

Summary should include

- discovery of energy sources
- the effects of energy availability and demand on innovation and technology
- social and environmental stewardship
- energy generation and storage technologies (including energy transformation)
- the evolution of energy production and use.

Process/Skill Questions

- Why is environmental stewardship important?

- What drives the evolution of energy production?

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16. Energy and Power Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

6. The Role of Society in the Development and Use of Technology

7. The Influence of Technology on History

Understanding Renewable Energy

Task Number 47

Evaluate the use of renewable energy sources globally, nationally, and locally.

Definition

Evaluation should include

- geographical advantages and disadvantages
- the effects of demand
- economic viability
- available technologies
- public perception and acceptance.

Process/Skill Questions

- How does demand affect the viability of renewable energy?
- Why are renewable energies sometimes blended?
- Why are public perception and acceptance important to the use of renewable energy?

ITEEA National Standards

4. The Cultural, Social, Economic, and Political Effects of Technology

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Task Number 48

Demonstrate a given renewable energy technology.

Definition

Demonstration could include considerations of

- sustainability
- efficiency
- available technologies.

Process/Skill Questions

- How do solar photovoltaic cells work to generate electricity?
- How does geothermal energy work?
- How is wind converted to useful energy?

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16. Energy and Power Technologies

4. The Cultural, Social, Economic, and Political Effects of Technology

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Task Number 49

Describe the challenges of using renewable energy sources.

Definition

Description should include

- technical challenges
- economic challenges
- political and regulatory challenges
- siting challenges
- deployment challenges
- workforce challenges

- supply chain challenges
- environmental and natural resources challenges.

Process/Skill Questions

- What is keeping us from moving toward 100 percent renewable energy?
- What are some workforce challenges associated with renewable energy?
- Why aren't electric cars powered by photovoltaics on the car roof?

ITEEA National Standards

4. The Cultural, Social, Economic, and Political Effects of Technology

5. The Effects of Technology on the Environment

Exploring Distributed Energy Resources

Task Number 50

Define *distributed energy resources*.

Definition

Definition should include energy sources that supply power onsite or locally, such as

- rooftop solar panels or solar gardens
- biogas digesters
- wind turbines powering a facility
- solar-thermal resources
- backup generators.

Process/Skill Questions

- What is *cogeneration*?
- What are aggregated distributed energy resources?
- Why is it important to have a backup energy resource?

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16. Energy and Power Technologies

Task Number 51

Design a distributed energy system.

Definition

Design may include

- a simulation
- a drawing
- a model
- 3D printing
- prototyping
- computer-aided design (CAD).

Process/Skill Questions

- What is a *distributed energy system*?
- How does scale influence the design of a distributed energy system?
- What are the best sources for distributed energy? Why?

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16. Energy and Power Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

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Task Number 52

Describe microgrids.

Definition

Description should include the concept that a microgrid

- facilitates the distribution of power from an energy resource
- can stand alone

- reinforces/adds stability to the primary grid (e.g., load balancing, frequency regulation)
- adds resiliency.

Process/Skill Questions

- What is a *microgrid*?
- Where do microgrids exist?
- What are the benefits of a microgrid?

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Task Number 53

Illustrate a microgrid.

Definition

Illustration should include

- energy source
- connection to facilities
- storage
- control
- backup energy source
- connection to a larger grid.

Process/Skill Questions

- What are some sources of microgrid energy?
- How is energy controlled in a microgrid?
- How is energy stored and distributed in a microgrid?

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Understanding Energy Generation

Task Number 54

Identify types of facilities for energy generation.

Definition

Identification could include

- electrical power plant
- solar farm
- natural gas processing plant
- wind farm.

Process/Skill Questions

- What differentiates the facilities that generate energy?
- What is the difference between base load and load following?
- What is the difference between dispatchable and intermittent energy resources?

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Task Number 55

Compare electrical power generation facilities.

Definition

Comparison should include

- design attributes
- operating principles
- fuel source (e.g., coal, gas, solar, nuclear, diesel, wind)
- scale (i.e., utility scale vs. distributed vs. onsite).

Process/Skill Questions

- What is *capacity factor*? Why is it important?

- What are the primary fuel sources for electricity generation in Virginia?
- Why might one choose to build or close a particular type of power plant (e.g., nuclear, coal)?

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Task Number 56

Describe the basic principles of electricity.

Definition

Description should include

- Ohm's law
- alternating current (AC) and direct current (DC)
- types of conductors and insulators and their uses
- parallel and series circuits
- magnetism.

Process/Skill Questions

- What is Ohm's law?
- How is electricity generated?
- What is the difference between a parallel and series circuit?

Task Number 57

Describe the basic principles of electric power generation.

Definition

Description should include defining the principles of electricity and magnetism, with examples of permanent and temporary magnets.

Process/Skill Questions

- What are the principles of electricity generation?
- How does a generator produce electricity?

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16. Energy and Power Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

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Task Number 58

Identify electric power generation equipment and systems.

Definition

Identification should include

- generators
- turbines
- batteries
- photovoltaic cells
- instrumentation and controls (I&C).

Process/Skill Questions

- What do generators produce?
- How does a turbine work?
- Why are I&C essential for plant operations?

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Task Number 59

Present design choices for energy generation facilities.

Definition

Presentation should include

- a comparison of design choices

- an evaluation of the advantages and disadvantages of each design choice
- justification for design choice.

Presentation may be made using a model, drawing, slide deck, or other media.

Process/Skill Questions

- How does efficiency affect design choices for a power generation facility?
- What other factors influence decision making for the selection of an energy generation facility?

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16. Energy and Power Technologies

Task Number 60

Diagram an energy generation facility.

Definition

Diagram should include

- equipment
- connections between systems and equipment
- process flow (inputs to outputs).

Process/Skill Questions

- How is a gas plant different from an electric power plant?
- What are the inputs and outputs of an energy generation facility?
- What equipment is needed to support an energy generation facility?

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16. Energy and Power Technologies

Understanding Utilities Facility Management

Task Number 61

Identify the roles within a utilities facility.

Definition

Identification should include roles such as

- operations staff
- administration
    - human resources
    - communications
    - accounting/finance
    - training
    - support services (e.g., legal services)
- maintenance
- safety
- security
- logistics and transportation
- engineering
- environmental compliance.

Process/Skill Questions

- What are the academic and/or skill requirements for a selected role?
- What potential changes could occur in a selected role?
- How would one find a contact person in a specific role within a utility company or energy organization?

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3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

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Task Number 62

Relate facilities management to sustainability and efficiency.

Definition

Relation should include

- considering site location
- optimizing process flow
- complying with environmental standards
- providing training and professional development.

Process/Skill Questions

- How does interaction among the roles in a facility affect sustainability and efficiency?
- How do contracting considerations affect sustainability and efficiency?
- How can an individual advocate for improved sustainability or efficiency?

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3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

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Task Number 63

Research career opportunities within utilities facility management.

Definition

Research could include

- online resources
- interviews
- site visits
- career databanks
- job forecasting (e.g., labor market data from CTE Trailblazers).

Process/Skill Questions

- What education and/or training is required for a selected role?
- What is the anticipated growth or demand for a selected role?
- What is the compensation outlook for a selected role?
- Where are positions advertised for a selected role?
- How do companies (small, medium, and large) recruit potential employees?

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3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

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Understanding Regulations

Task Number 64

Explain the purpose of energy regulation.

Definition

Explanation should include

- sustainability and efficiency
- health and safety
- environmental stewardship
- waste management
    - transportation
    - storage
    - protection of wildlife
    - protection of cultural and historic resources
- fair trade
- national security
- reliability
- security
- communications
- protection of intellectual property.

Process/Skill Questions

- Why is energy regulated?
- How does national security relate to energy?
- How does politics influence energy regulation?

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16. Energy and Power Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

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Task Number 65

Identify the agencies involved in energy regulation.

Definition

Identification should include

- localities
- state agencies
  - Virginia Department of Environmental Quality (DEQ)
  - Virginia Department of Transportation (VDOT)
  - Virginia Department of Mines, Minerals, and Energy (DMME)
  - Virginia's State Corporation Commission (SCC)
  - Virginia Department of Labor and Industry (DOLI) and Virginia Occupational Safety and Health (VOSH) Safety Compliance Division
  - Virginia Department of Health (VDH)
- federal agencies
  - Federal Energy Regulatory Commission (FERC)
  - Rural Utilities Service (RUS)
  - Federal Communications Commission (FCC)
  - Federal Aviation Administration (FAA)
  - U.S. Department of Defense (DOD)
  - U.S. Environmental Protection Agency (EPA)
  - U.S. Nuclear Regulatory Commission (NRC)
  - Occupational Safety and Health Administration (OSHA)
  - Bureau of Ocean Energy Management (BOEM)
  - U.S. Fish and Wildlife Service
  - U.S. Forest Service
  - U.S. Department of Energy
  - U.S. Department of Homeland Security
  - U.S. Army Corps of Engineers
- international organizations
  - North American Electric Reliability Corporation (NERC).

Process/Skill Questions

- How does agency leadership and funding affect regulation enforcement?
- What is the purpose and function of the Virginia SCC?

- What is the process by which a utility in Virginia gains approval to build a new power plant?

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16. Energy and Power Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

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Task Number 66

Research the processes of regulatory compliance.

Definition

Research could include

- origin of regulations (e.g., advocacy, incident)
- applicability of regulations to a specific situation or entity
- local and state permitting
- compliance and reporting requirements
- enforcement of regulations.

Process/Skill Questions

- Why do various agencies overlap in their oversight of the energy sector?
- What happens when an entity is not in compliance with a regulation?
- What tools or strategies do facilities and/or organizations use to comply with regulations?
- How can regulation affect economic growth?
- How can an individual influence the regulatory process?

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16. Energy and Power Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

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Applying Energy Supply Concepts

Task Number 67

Map an energy supply process.

Definition

Map should include a diagram that includes

- energy sources
- process flows (from raw material to finished product)
- transmission/transportation and storage
- distribution to end-user (e.g., commercial, residential).

Map should also include considerations related to

- sustainability
- efficiency
- regulation.

Process/Skill Questions

- What are examples of considerations that influence the energy supply process?
- What tools are used to evaluate potential energy supplies?
- What tools are used to evaluate potential obstacles in a design?

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16. Energy and Power Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

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Task Number 68

Evaluate an energy supply process.

Definition

Evaluation may include identifying areas to improve, such as

- sustainability
- efficiency
- reliability
- resiliency
- economic feasibility
- safety and security.

Process/Skill Questions

- What fiscal contributions does the energy sector make to the economy?
- Why are utilities mandated to be reliable?
- What is the importance of diverse energy source portfolios?

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16. Energy and Power Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

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Exploring Innovation in Energy Supply

Task Number 69

Research new and emerging technologies in energy supply.

Definition

Research should include the effect of technology on energy sustainability and efficiency.

Process/Skill Questions

- How has artificial intelligence (AI) affected energy supply?
- How has environmental stewardship affected energy supply?

- What is the meaning of *energy democracy*?

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16. Energy and Power Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

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Task Number 70

Research a new technology affecting a given geographical area.

Definition

Research should include the effect of technology on energy sustainability and efficiency in a given geographical area.

Process/Skill Questions

- What three innovations are considered part of the solution to climate change?
- What evolving technology is influencing local supply choices?
- What technologies used in other parts of the world are not yet available in the local area? Why might these not be available?

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16. Energy and Power Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

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Task Number 71

Present research on innovation in energy supply.

Definition

Presentation may include

- a portfolio
- multimedia
- a prototype.

Process/Skill Questions

- What are sources of energy supply information?
- Why are innovators such as Nikola Tesla relevant today? How is the Tesla coil used?
- What are the arguments for and against using AC or using DC as a means of electricity transmission?

ITEEA National Standards

16. Energy and Power Technologies

3. The Relationships Among Technologies and the Connections Between Technology and Other Fields

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SOL Correlation by Task

39	Define *energy sustainability*.	English: 9.5, 10.5 History and Social Science: WG.17, WHII.14 Science: ES.6
40	Define *energy efficiency*.	English: 9.5, 10.5 History and Social Science: WG.17, WHII.14 Science: ES.6
41	Discuss sustainability and efficiency as they apply to social, economic, and environmental considerations.	English: 9.1, 10.1 History and Social Science: WG.17, WHII.14
42	Identify various energy sources.	English: 9.5, 10.5 History and Social Science: WG.17, WHII.14

		Science: ES.6
43	Evaluate nonrenewable, renewable, and inexhaustible energy sources.	English: 9.3, 9.5, 10.3, 10.5 History and Social Science: WG.17, WHII.14 Science: ES.6
44	Develop a timeline of energy innovation throughout history.	English: 9.1, 9.5, 9.8, 10.1, 10.5, 10.8 History and Social Science: VUS.8, WG.17, WHII.4, WHII.14 Science: ES.6
45	Demonstrate methods for energy storage.	
46	Summarize how technology affects energy sources and utilization.	English: 9.5, 10.5 History and Social Science: WG.17, WHII.14
47	Evaluate the use of renewable energy sources globally, nationally, and locally.	English: 9.5, 10.5 History and Social Science: WG.17, WHII.14 Science: ES.6
48	Demonstrate a given renewable energy technology.	History and Social Science: WG.17, WHII.14 Science: ES.6
49	Describe the challenges of using renewable energy sources.	English: 9.5, 10.5 History and Social Science: WG.17, WHII.14 Science: ES.6
50	Define *distributed energy resources*.	English: 9.3, 9.5, 10.3, 10.5 History and Social Science: WG.17, WHII.14
51	Design a distributed energy system.	English: 9.1, 10.1
52	Describe microgrids.	English: 9.1, 10.1
53	Illustrate a microgrid.	
54	Identify types of facilities for energy generation.	English: 9.1, 10.1

		History and Social Science: WG.17, WHII.14
55	Compare electrical power generation facilities.	English: 9.5, 10.5 History and Social Science: WG.17, WHII.14
56	Describe the basic principles of electricity.	English: 9.5, 10.5 History and Social Science: WHII.4, WHII.8 Mathematics: A.1, A.3, A.4, A.8, AII.3, AII.10 Science: PH.10, PH.11
57	Describe the basic principles of electric power generation.	English: 9.3, 9.5, 10.3, 10.5 History and Social Science: WHII.4, WHII.8 Science: PH.10, PH.11
58	Identify electric power generation equipment and systems.	English: 9.3, 9.5, 10.3, 10.5 History and Social Science: WHII.4, WHII.8
59	Present design choices for energy generation facilities.	English: 9.1, 9.5, 10.1, 10.5
60	Diagram an energy generation facility.	
61	Identify the roles within a utilities facility.	English: 9.3, 9.5, 10.3, 10.5
62	Relate facilities management to sustainability and efficiency.	English: 9.5, 10.5
63	Research career opportunities within utilities facility management.	English: 9.8, 10.8
64	Explain the purpose of energy regulation.	English: 9.5, 10.5 History and Social Science: WG.17, WHII.14
65	Identify the agencies involved in energy regulation.	English: 9.5, 9.8, 10.5, 10.8 History and Social Science: WG.17, WHII.14
66	Research the processes of regulatory compliance.	English: 9.5, 9.8, 10.5, 10.8 History and Social Science: VUS.14, WG.17, WHII.14

67	Map an energy supply process.	English: 9.1, 10.1, 11.1 History and Social Science: WG.17, WHII.14
68	Evaluate an energy supply process.	English: 9.5, 9.8, 10.5, 10.8 History and Social Science: WG.17, WHII.14
69	Research new and emerging technologies in energy supply.	English: 9.5, 9.8, 10.5, 10.8 History and Social Science: WG.17, WHII.14
70	Research a new technology affecting a given geographical area.	English: 9.5, 9.8, 10.5 History and Social Science: WG.17, WHII.14
71	Present research on innovation in energy supply.	English: 9.5, 9.8, 10.5, 10.8

Appendix: Credentials, Course Sequences, and Career Cluster Information

Industry Credentials: Only apply to 36-week courses

- Building Science Principles Examination
- College and Work Readiness Assessment (CWRA+)
- Energy Industry Fundamentals Certificate Assessment
- National Career Readiness Certificate Assessment
- Workplace Readiness Skills for the Commonwealth Examination

Concentration sequences: *A combination of this course and those below, equivalent to two 36-week courses, is a concentration sequence. Students wishing to complete a specialization may take additional courses based on their career pathways. A program completer is a student who has met the requirements for a CTE concentration sequence and all other requirements for high school graduation or an approved alternative education program.*

- Energy Demand: Sustainability and Efficiency (ED8411/36 weeks)

Career Cluster: Energy	
Pathway	**Occupations**
Energy Efficiency	**Electrical Engineer** **Electrician** **Environmental Engineer** **Environmental Engineering Technician** **Environmental Science and Protection Technician** **Environmental Scientist** **Geoscientist** **HVAC and Refrigeration Mechanic or Installer**
Fuels Production	**Chemical Engineer** **Chemist** **Continuous Mining Machine Operator** **First-Line Supervisor of Transportation and Material-Moving Machine and Vehicle Operator** **Geological Technician** **Petroleum Engineer** **Petroleum Technician** **Service Unit Operator, Oil, Gas, and Mining** **Wellhead Pumper**

Career Cluster: Energy	
Pathway	**Occupations**
Power Generation	**Control and Valve Installer, Repairer** **Electrical Engineering Technician** **Electronics Engineer** **Electronics Engineering Technician** **Engineering Manager** **Health and Safety Engineer** **Mechanical Engineer** **Nuclear Engineer** **Nuclear Power Reactor Operator** **Nuclear Technician** **Solar Photovoltaic Installer**
Transmission and Distribution	**Electrical and Electronics Repairer, Powerhouse, Substation and Relay** **Electrical Power Line Installer/Repairer** **Electro-Mechanical Technician** **Gas Compressor and Gas Pumping Station Operator** **Pipefitter, Steamfitter** **Plumber** **Power Distributor, Dispatcher** **Wind Turbine Service Technician**

Career Cluster: Science, Technology, Engineering and Mathematics	
Pathway	**Occupations**
Engineering and Technology	**Chemical Engineer** **Civil Engineer** **Civil Engineering Technician** **Computer Programmer** **Computer Software Engineer** **Electrical Drafter** **Electrical Engineer** **Electrical Engineering Technician** **Electro-Mechanical Technician** **Electronic Drafter** **Electronics Engineering Technician** **Environmental Engineer** **Mechanical Drafter** **Mechanical Engineer** **Mechanical Engineering Technician** **Network and Computer Systems Administrator** **Nuclear Engineer** **Petroleum Engineer** **Pipeline Drafter** **Power Systems Engineer** **Project Manager** **Quality Engineer** **Quality Technician** **Statistician** **Systems Analyst**

Career Cluster: Science, Technology, Engineering and Mathematics	
Pathway	**Occupations**
Science and Mathematics	**Atmospheric Scientist** **Chemist** **Ecologist** **Environmental Scientist** **Geodetic Surveyor** **Geoscientist**