

# Energy Source Life Cycle

LC8411 36 weeks

## Table of Contents

Acknowledgments.....	1
Course Description.....	2
Task Essentials Table.....	3
Curriculum Framework.....	5
Distinguishing Among Sources of Energy.....	5
Understanding Extraction Techniques.....	12
Understanding Refinement Techniques.....	15
Understanding Fuel Transport Logistics.....	17
Exploring Energy Generation.....	20
Exploring Transmission, Distribution, and Storage.....	22
Exploring Environmental, Health, and Safety Aspects of Energy Production.....	28
Exploring Energy Markets.....	32
SOL Correlation by Task.....	34
Appendix: Credentials, Course Sequences, and Career Cluster Information.....	37

## Acknowledgments

The components of this instructional framework were developed by the following curriculum development panelists:

Charles Barksdale, Utilities and Performance Contracting Manager, Department of Mines, Minerals and Energy, Richmond  
Brandi F. Bestpitch, Energy Data Analyst, Division of Energy, Department of Mines, Minerals and Energy, Richmond  
Richard Champigny, Instructor, Chesterfield Career and Technical Center at Courthouse, Chesterfield County Public Schools  
Jim Egenrieder, Engineering Education Research Faculty and Director, Virginia Tech National Capital Region, Falls Church  
Sasha Furdak-Roy, Operations Center Manager, Columbia Gas, Warrenton  
Matt Kellam, Military and Recruitment Program Coordinator, Dominion Energy,

Richmond

Greg Meinweiser, Engineer II, Dominion Energy, Henrico

Catherine Mosley, Director of Community Relations, sPower, Richmond

Beth Murtha, Project Manager, Framatome Inc., Lynchburg

Remy Pangle, Director of Education and Outreach, Center for the Advancement of Sustainable Energy (CASE) and State Facilitator, Wind for Schools (WfS), James Madison University

Beth Stockner, Public Relations Manager, Virginia Oil and Gas Association, Abingdon

Dana Willingham, Technical Training Manager, Columbia Gas/NiSource, Chester

Cathy Woody, Workforce Development Manager, Planning, Framatome Inc., Lynchburg

Correlations to the Virginia Standards of Learning were reviewed and updated by:

Leslie R. Bowers, English Teacher (ret.), Newport News Public Schools

Vickie L. Inge, Mathematics Committee Member, Virginia Mathematics and Science Coalition

Anne F. Markwith, New Teacher Mentor (Science), Gloucester County Public Schools

Michael Nagy, Social Studies Department Chair, Rustburg High School, Campbell County Public Schools

The framework was edited and produced by the CTE Resource Center:

Debi F. Coleman, Writer/Editor

Kevin P. Reilly, Administrative Coordinator

Virginia Department of Education Staff

Dr. Lynn Basham, Specialist, Technology Education and Related Clusters

J. Anthony Williams, Curriculum and Instruction Coordinator

Dr. David S. Eshelman, Director, Workforce Development and Initiatives

George R. Willcox, Director, Operations and Accountability

Office of Career, Technical, and Adult Education

Virginia Department of Education

---

Copyright © 2020

## Course Description

**Suggested Grade Level:** 9 or 10

Exploring concepts, trends, challenges, and careers, students will build an understanding of energy, from source to end-user. Students participate in hands-on activities, such as illustrating

and modeling electrical grids, gas systems, and other renewable- and nonrenewable-energy systems. Students explore markets, grid modernization, efficiency, innovation, and careers in energy.

## 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	LC8411	Tasks/Competencies
Distinguishing Among Sources of Energy		
39	⊕	Define <i>energy</i> .
40	⊕	Identify units of measure for power.
41	⊕	Define <i>life cycle</i> as it relates to energy sources.
42	⊕	Describe the primary forms of energy and their uses.
43	⊕	Identify sources of energy.
44	⊕	Evaluate energy sources that are nonrenewable, renewable, and inexhaustible.
45	⊕	Compare the footprints of various energy sources.
46	⊕	Investigate career options within the energy sector.
Understanding Extraction Techniques		
47	⊕	Describe the difference between extraction and the harnessing of energy sources.
48	⊕	Identify energy sources that are mined and the techniques used for extraction.
49	⊕	Identify energy sources extracted using drilling and the techniques used for extraction.
50	⊕	Identify energy sources that are harnessed.

Understanding Refinement Techniques		
51	⊕	Define <i>refinement</i> .
52	⊕	Describe which energy sources require refinement.
53	⊕	Research refinement techniques.
Understanding Fuel Transport Logistics		
54	⊕	Trace the transport of oil and natural gas from extraction to energy production.
55	⊕	Trace the transport of solid fuel from extraction to energy production.
56	⊕	Create a model of a fuel transportation method.
Exploring Energy Generation		
57	⊕	Describe how energy sources are used to generate electricity.
58	⊕	Describe other uses of energy sources (aside from electricity).
59	⊕	Model a method of energy generation.
Exploring Transmission, Distribution, and Storage		
60	⊕	Define the (electrical) <i>grid</i> .
61	⊕	Explain the role of electrical transmission, distribution, and storage.
62	⊕	Outline electricity's path from producer to consumer.
63	⊕	Illustrate the grid.
64	⊕	Analyze grid modernization efforts.
65	⊕	Differentiate transmission, distribution, and storage of gas and electricity.
66	⊕	Model components of a natural gas system.
Exploring Environmental, Health, and Safety Aspects of Energy Production		
67	⊕	Identify decommissioning and reclamation.

68	⊕	Diagram the life cycle of energy sources.
69	⊕	Identify environmental, health, and safety aspects of the energy life cycle.
70	⊕	Explain the role of regulatory agencies.
Exploring Energy Markets		
71	⊕	Define <i>energy markets</i> .
72	⊕	Identify factors that influence energy markets.
73	⊕	Research an aspect of the energy market.

Legend: ⊕ Essential ○ Non-essential ⊖ Omitted

## Curriculum Framework

### Distinguishing Among Sources of Energy

#### Task Number 39

#### Define *energy*.

##### Definition

Definition should include

- quantitative property that must be transferred to an object to perform work on or to heat the object
- kinetic vs. potential energy
- distinction between energy and power
  - energy—the capacity to do work
  - power—the rate at which work is done.

##### Process/Skill Questions

- What is the difference between power and energy?
- What are examples of energy being used to do work?

- How is power derived from alternate energy sources?

## **ITEEA National Standards**

### **16. Energy and Power Technologies**

#### **2. The Core Concepts of Technology**

## **TSA Competitive Events**

### **Technology Bowl**

---

## **Task Number 40**

### **Identify units of measure for power.**

#### **Definition**

Identification should include units of measure, such as

- amps
- watts
- volts
- ohms
- Roentgen equivalent man (REM)
- gallons per minute (GPM)
- radiation absorbed dose [rad], British thermal units (BTUs)
- calories
- horsepower
- pounds per square inch (PSI)
- torque
- Fahrenheit
- pounds per hour (lbs/hr).

#### **Process/Skill Questions**

- What is measured in amps (i.e., amperes)?
- What does torque measure?
- What does Roentgen equivalent man (REM) measure?

## **ITEEA National Standards**

## 16. Energy and Power Technologies

### 2. The Core Concepts of Technology

#### TSA Competitive Events

##### Technology Bowl

---

## Task Number 41

Define *life cycle* as it relates to energy sources.

### Definition

Definition should include components such as

- extraction
- refinement
- transportation
- generation
- distribution/usage
- decommissioning/reclamation.

### Process/Skill Questions

- What is an energy *life cycle*?
- What energy sources do not follow the typical life cycle?
- What are the most challenging components of the energy life cycle?
- Which components of the energy life cycle produce the most jobs?

### ITEEA National Standards

## 16. Energy and Power Technologies

#### TSA Competitive Events

##### Technology Bowl

---

## **Task Number 42**

### **Describe the primary forms of energy and their uses.**

#### **Definition**

Description should include uses of

- thermal energy – internal energy of a system in thermodynamic equilibrium by virtue of its temperature, used for such things as home heating, transportation, cooking, water heating, industrial production, boilers, nuclear medicine, and x-rays
- mechanical energy – energy associated with the motion and position of an object, used for such things as transportation, power production, wind turbines, and steam turbines
- chemical energy – energy derived from chemical reactions (e.g., batteries, fuel, food), used for such things as transportation and electronics
- electrical energy – energy made available by the flow of electric charge through a conductor for residential, commercial, and industrial use
- radiant energy – energy transferred by electromagnetic radiation (e.g., light)
- nuclear energy – energy stored in the nuclei of atoms
- sound energy – produced by vibrations, when energy travels through a substance in the form of waves
- elastic energy – potential energy stored in a coiled spring
- gravitational energy – potential energy stored in objects higher than the ground.

#### **Process/Skill Questions**

- What applications of chemical energy exist?
- How might one determine the type of energy most effective for a given application?
- How is electricity a result of thermal, mechanical, or chemical generation?
- What type of energy powers batteries? Why is that the best choice?
- What types of energy are used in transportation?

#### **ITEEA National Standards**

##### **16. Energy and Power Technologies**

#### **TSA Competitive Events**

##### **Essays on Technology**

##### **Technology Bowl**



## **Task Number 43**

### **Identify sources of energy.**

#### **Definition**

Identification may include

- fossil fuels (e.g., coal, oil)
- gas
  - natural gas
  - renewable natural gas
  - hydrogen
  - propane
- solar (e.g., thermal, photovoltaic, and concentrating)
- nuclear (e.g., fission, fusion)
- hydroelectric (e.g., impoundment vs. run-of-river)
- wind (e.g., onshore, offshore)
- ocean energy (e.g., wave, tidal/current, ocean thermal energy conversion [OTEC])
- geothermal
- biomass (e.g., algae, hemp, crop and forestry debris)
- waste-to-energy
- other
  - elastic
  - magnetic
  - gravitational
  - emerging technologies.

#### **Process/Skill Questions**

- What energy sources are used in Virginia?
- What is the energy profile for Virginia?

#### **ITEEA National Standards**

##### **16. Energy and Power Technologies**

#### **TSA Competitive Events**

#### **Technology Bowl**

---

## **Task Number 44**

### **Evaluate energy sources that are nonrenewable, renewable, and inexhaustible.**

#### **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 environment, society, and the individual.

Teacher resource:

[National Energy Education Development \(NEED\)](#), The NEED Project

#### **Process/Skill Questions**

- What is the difference between a renewable and inexhaustible energy source?
- What is an example of a nonrenewable, renewable, and an inexhaustible energy source?
- Where do these energy sources thrive (geographically speaking)?

#### **ITEEA National Standards**

##### **13. Assess the Impact of Products and Systems**

#### **TSA Competitive Events**

##### **Essays on Technology**

---

## **Task Number 45**

### **Compare the footprints of various energy sources.**

#### **Definition**

Comparison should include

- physical footprint (i.e., acreage)
- carbon footprint
- capacity (as part of the grid)
- market share
- energy sources from specific geographic locations (may take into account physical location, infrastructure, population densities, environmental concerns).

Comparison should utilize maps.

Teacher resource:

[Independent Statistics and Analysis](#), U.S. Energy Information Administration

### **Process/Skill Questions**

- What energy sources are most prevalent in Virginia?
- What energy sources are best suited for densely populated areas? Sparsely populated areas?
- What is *capacity factor*?
- How does market share vary in different regions of Virginia?

### **ITEEA National Standards**

#### **16. Energy and Power Technologies**

#### **TSA Competitive Events**

#### **Essays on Technology**

#### **Technology Bowl**

## **Task Number 46**

### **Investigate career options within the energy sector.**

#### **Definition**

Investigation may include consideration of

- fields of study/expertise (e.g., engineering, law)
- educational/experience requirements (e.g., trade schools, college, military)
- certification requirements
- salary/compensation

- workforce demand
- trade organizations.

### **Process/Skill Questions**

- Which energy sectors produce the most jobs?
- Which component of the energy life cycle produces the most jobs?
- What area has the highest demand for workers?
- What are the advantages of a diverse workforce?
- What might the job outlook for this sector be in five years?

### **ITEEA National Standards**

#### **16. Energy and Power Technologies**

#### **TSA Competitive Events**

#### **Essays on Technology**

---

---

## **Understanding Extraction Techniques**

---

---

### **Task Number 47**

**Describe the difference between extraction and the harnessing of energy sources.**

#### **Definition**

Description should include

- definitions of *extraction* and *harnessing*
- forms of extraction and harnessing energy resources
- various energy sources
- methods for collecting energy resources
- differences in extraction and harnessing across geographical regions
- identifying misconceptions associated with various extraction and harnessing techniques.

## Process/Skill Questions

- What forms of energy require fuel?
- What forms of energy do not require fuel?
- How have new extraction techniques changed energy markets?

## ITEEA National Standards

### 16. Energy and Power Technologies

## TSA Competitive Events

### Technology Problem Solving

---

## Task Number 48

### Identify energy sources that are mined and the techniques used for extraction.

#### Definition

Identification should include

- sources
  - coal
  - uranium
  - thorium
  - rare earth metals (e.g., for solar panels, batteries)
- extraction techniques
  - surface mining
  - deep mining.

Identification may include a comparison between surface and deep mining.

## Process/Skill Questions

- What is the difference between surface mining and deep mining?
- What are the obstacles to the use of thorium in the United States?
- Where are rare earth metals mined?

## ITEEA National Standards

## 16. Energy and Power Technologies

### TSA Competitive Events

#### Technology Bowl

---

## Task Number 49

**Identify energy sources extracted using drilling and the techniques used for extraction.**

### Definition

Identification should include

- sources
  - oil
  - natural gas
  - propane
- extraction techniques
  - wells (vertical and horizontal)
  - hydraulic fracturing.

Identification may include a comparison between vertical and horizontal wells.

### Process/Skill Questions

- What are the benefits and challenges of offshore drilling?
- What is *hydraulic fracturing*?
- What was the focus of the film *Deep Water Horizon*?

### ITEEA National Standards

## 16. Energy and Power Technologies

### TSA Competitive Events

#### Technology Bowl

---

## **Task Number 50**

### **Identify energy sources that are harnessed.**

#### **Definition**

Identification should include

- wind
- solar
- hydroelectric power
- geothermal
- ocean energy (wave, tidal/current, ocean thermal energy conversion [OTEC])
- biomass (e.g., algae, hemp, crop and forestry debris)
- waste-to-energy.

Identification should include the concept that some energy sources (e.g., wind and solar) that are harnessed do not include a fuel.

#### **Process/Skill Questions**

- Which energy sources are most directly accessible to the end user?
- How are each of these energy sources related to the sun?
- What are the benefits and challenges of these harnessed energy sources?
- What emerging technologies are associated with these energy sources?

#### **ITEEA National Standards**

##### **16. Energy and Power Technologies**

#### **TSA Competitive Events**

##### **Biotechnology Design**

##### **Technology Bowl**

---

---

## **Understanding Refinement Techniques**

---

---

## **Task Number 51**

### **Define *refinement*.**

#### **Definition**

Definition should include the concept that energy fuels must go from a raw state to a usable state for various purposes (impurities and unwanted elements must be removed).

#### **Process/Skill Questions**

- Why are some components used in other production (e.g., plastics) removed from fuels?
- Why are unwanted impurities removed?
- How does refinement affect efficiency?

#### **ITEEA National Standards**

##### **16. Energy and Power Technologies**

#### **TSA Competitive Events**

##### **Technology Bowl**

---

## **Task Number 52**

### **Describe which energy sources require refinement.**

#### **Definition**

Description should include

- coal
- gas
- oil
- nuclear (e.g., fusion and fission)
- biofuels.

#### **Process/Skill Questions**

- Which energy sources require refinement?



- What are some marketable by-products of refinement processes?
- What is the difference between weapons-grade uranium and nuclear power plant uranium?

## **ITEEA National Standards**

### **16. Energy and Power Technologies**

---

## **Task Number 53**

### **Research refinement techniques.**

#### **Definition**

Research may include techniques for one or more of the following energy sources

- coal
- gas
- oil
- nuclear (enrichment)
- biofuels.

#### **Process/Skill Questions**

- Why is it important to enrich uranium?
- What is unique about the refinement of biofuels?
- What is the by-product of uranium enrichment?

## **ITEEA National Standards**

### **16. Energy and Power Technologies**

#### **TSA Competitive Events**

#### **Prepared Presentation**

---

---

# **Understanding Fuel Transport Logistics**

---

---

## **Task Number 54**

### **Trace the transport of oil and natural gas from extraction to energy production.**

#### **Definition**

Tracing should include oil, compressed natural gas (CNG), and/or liquefied natural gas (LNG) transported via

- pipelines
- trucking
- shipping (e.g., ocean transport)
- rail.

Tracing also includes an exploration of regulatory requirements.

Teacher resource:

[Regulations](#), U.S. Department of Transportation

#### **Process/Skill Questions**

- What are logistical concerns for renewable energy sources?
- What are the drawbacks and benefits of each mode of transport?

#### **ITEEA National Standards**

**16. Energy and Power Technologies**

**18. Transportation Technologies**

#### **TSA Competitive Events**

**Technology Bowl**

---

## **Task Number 55**

# **Trace the transport of solid fuel from extraction to energy production.**

## **Definition**

Tracing should include coal, enriched uranium, refined rare earth metals, thorium, and fuel assemblies transported via

- trucking
- rail
- shipping (e.g., ocean and barge transport).

Tracing also includes an exploration of regulatory requirements.

## **Process/Skill Questions**

- What are regulatory concerns in nuclear fuel transport?
- Which energy components undergo a manufacturing process before producing energy?

## **ITEEA National Standards**

### **18. Transportation Technologies**

### **TSA Competitive Events**

### **Technology Bowl**

---

## **Task Number 56**

### **Create a model of a fuel transportation method.**

#### **Definition**

Creation may include models that are

- topographical maps
- three-dimensional (3D)
- computer-aided design (CAD) drawings
- geographic information system (GIS) maps.

## Process/Skill Questions

- What does *topographical* mean?
- How prevalent is GIS mapping in the energy industry?
- How may regulation affect fuel transportation?

## ITEEA National Standards

### 11. Apply the Design Process

### 12. Use and Maintain Technological Products and Systems

## TSA Competitive Events

### Biotechnology Design

### Computer-Aided Design (CAD), Engineering

### Engineering Design

---

---

# Exploring Energy Generation

---

---

## Task Number 57

### Describe how energy sources are used to generate electricity.

#### Definition

Description may include a comparison of different energy sources used for electricity generation.

#### Process/Skill Questions

- What are methods of generating power?
- How have power-generation methods changed?
- Why are some power-generation methods more efficient than others?
- How is efficiency measured?

## ITEEA National Standards

### 16. Energy and Power Technologies

#### TSA Competitive Events

##### Technology Bowl

---

## Task Number 58

**Describe other uses of energy sources (aside from electricity).**

### Definition

Description should include

- uses of natural gas (CNG)
- industrial/manufacturing processes (e.g., coal is needed for steel production)
- desalinization
- transportation
- solar heating
- windmills.

### Process/Skill Questions

- What is *gasoline gallon equivalent*?
- How can solar energy be used for cooking?
- What is *desalinization*?
- What are the differences between passive and active solar?

## ITEEA National Standards

### 16. Energy and Power Technologies

---

## Task Number 59

**Model a method of energy generation.**

## Definition

Model may include

- diagram
- 3D
- CAD
- illustration.

## Process/Skill Questions

- What are the similarities between large-scale and small-scale energy generation?
- What are the benefits and challenges of using gears in a wind turbine?
- How does a solar panel work?

## ITEEA National Standards

### 16. Energy and Power Technologies

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

## TSA Competitive Events

### Biotechnology Design

### Computer-Aided Design (CAD), Engineering

### Engineering Design

---

---

# Exploring Transmission, Distribution, and Storage

---

---

## Task Number 60

Define the (electrical) *grid*.

## Definition

Definition should include

- the *grid*—transmission network
- difference between transmission and distribution
  - *transmission*—the process of delivering energy (115kV to 500 kV) from generation/production to substation
  - *distribution*—the process of delivering energy (120 V to 34.5 kV) from substation to the end user
- components of the transmission grid
- power station
  - step-up transformers
  - switchyard
  - transmission towers
  - transmission lines (overhead and underground)
  - transmission substations
  - regulators
- components of the distribution grid
  - distribution substations
  - step-down transformers
  - breakers/fuses
  - switches
  - distribution lines (overhead and underground)
  - utility poles
  - regulators
  - inverters.

Definition should explore the role of the [Federal Energy Regulation Commission \(FERC\)](#) in control of the grid.

## Process/Skill Questions

- What is the FERC? How does it regulate the grid?

## ITEEA National Standards

### 16. Energy and Power Technologies

## TSA Competitive Events

## Technology Bowl

---

## **Task Number 61**

**Explain the role of electrical transmission, distribution, and storage.**

### **Definition**

Explanation should include

- needs addressed by the grid
- evolution of the grid
- emerging technologies and future challenges.

### **Process/Skill Questions**

- What role may batteries play in the grid?

### **ITEEA National Standards**

#### **16. Energy and Power Technologies**

### **TSA Competitive Events**

#### **Principles of Technology (Virginia only)**

---

## **Task Number 62**

**Outline electricity's path from producer to consumer.**

### **Definition**

Outlining should include each component of the grid.

### **Process/Skill Questions**

- What roles do the various components play in the grid?
- How do the components of the grid work together?
- How is energy transmitted from generation to the end user?

### **ITEEA National Standards**



## **16. Energy and Power Technologies**

### **TSA Competitive Events**

#### **Principles of Technology (Virginia only)**

---

## **Task Number 63**

### **Illustrate the grid.**

#### **Definition**

Illustration should include

- connection among grid components, from generation to end user
- the technical attributes of each component
- mechanisms, tools, and equipment in each component of the grid
- the process of converting direct current (DC) to alternating current (AC) and when the process is used (i.e., from transmission to distribution).

Teacher resource:

[KidWind](#)

#### **Process/Skill Questions**

- How does protective equipment make the grid more efficient?
- How do the components of the grid work together?
- How could the grid be made more efficient?
- How could the grid be modernized?

#### **ITEEA National Standards**

### **16. Energy and Power Technologies**

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

### **TSA Competitive Events**

#### **Animatronics**

## Task Number 64

### Analyze grid modernization efforts.

#### Definition

Analysis should include

- grid reliability
- distributed energy resources (DER)
- smart grid
- micro-grids
- storage.

#### Process/Skill Questions

- What are concerns about grid infrastructure, cybersecurity, and national security?
- How is eco-terrorism a concern?
- How does grid modernization influence energy reliability and sustainability and environmental safety?

#### ITEEA National Standards

13. Assess the Impact of Products and Systems

16. Energy and Power Technologies

#### TSA Competitive Events

Principles of Technology (Virginia only)

---

## Task Number 65

### Differentiate transmission, distribution, and storage of gas and electricity.

## **Definition**

Differentiation should include

- uses of natural gas (aside from electricity generation)
- identification of grid components and natural gas system components
- comparison between components of the grid and components of the natural gas system.

## **Process/Skill Questions**

- What are the end uses of natural gas, beside electricity?
- What are byproducts of natural gas?

## **ITEEA National Standards**

### **16. Energy and Power Technologies**

---

## **Task Number 66**

### **Model components of a natural gas system.**

#### **Definition**

Model should include

- diagram
- 3D
- CAD
- illustration.

#### **Process/Skill Questions**

- What environmental or geographical factors influence extraction, pipelines, and site locations?
- What social, logistical, and economic factors influence site locations?

#### **ITEEA National Standards**

### **16. Energy and Power Technologies**

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

## **TSA Competitive Events**

**Biotechnology Design**

**Computer-Aided Design (CAD), Engineering**

**Engineering Design**

---

---

# **Exploring Environmental, Health, and Safety Aspects of Energy Production**

---

---

## **Task Number 67**

### **Identify decommissioning and reclamation.**

#### **Definition**

Identification should include

- definition of *decommissioning* and *reclamation*
- examples of decommissioning and reclamation efforts.

#### **Process/Skill Questions**

- What are benefits of using reclaimed areas?
- What are challenges involved in decommissioning and reclamation?
- What are safety concerns?

#### **ITEEA National Standards**

##### **16. Energy and Power Technologies**

##### **5. The Effects of Technology on the Environment**

---

## **Task Number 68**

### **Diagram the life cycle of energy sources.**

#### **Definition**

Diagram should include

- traditional
  - extraction
  - refinement
  - distribution
  - generation
  - usage
  - decommissioning/reclamation
- nontraditional
  - generation
  - usage
  - decommissioning/reclamation.

#### **Process/Skill Questions**

- What is an example of extraction?
- What are some examples of reclamation?

#### **ITEEA National Standards**

##### **16. Energy and Power Technologies**

---

## **Task Number 69**

### **Identify environmental, health, and safety aspects of the energy life cycle.**

#### **Definition**

Identification should include

- habitats
- soil quality
- water quality

- air quality
- worker safety and training
- public health and safety
- waste concerns
- concerns related to lack of access to energy.

## Process/Skill Questions

- What are positive and negative aspects of the energy life cycle?
- What is *energy poverty*?

## ITEEA National Standards

### 16. Energy and Power Technologies

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

#### 5. The Effects of Technology on the Environment

## TSA Competitive Events

### Essays on Technology

### Technology Bowl

## Task Number 70

### Explain the role of regulatory agencies.

#### Definition

Explanation may include but not be limited to

- localities
- permitting
- inspections
- state agencies and organizations
  - [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 \(DOLI\)](#)

- [Virginia Occupational Safety and Health \(VOSH\) Safety Compliance Division](#)
- [Virginia Department of Health \(VDH\)](#)
- federal agencies and organizations
  - [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 \(FWS\)](#)
  - [U.S. Forest Service \(FS\)](#)
  - [U.S. Department of Energy \(DOE\)](#)
  - [U.S. Department of Homeland Security \(DHS\)](#)
  - [U.S. Army Corps of Engineers \(DHS\)](#)
- international organizations
  - [North American Electric Reliability Corporation \(NERC\)](#)
  - [International Atomic Energy Agency \(IAEA\).](#)

## **Process/Skill Questions**

- How can regulatory issues affect all aspects of the energy life cycle?
- How do regulations affect the energy business and availability?
- Why are regulations important?
- How do agencies overlap?

## **ITEEA National Standards**

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

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

## **TSA Competitive Events**

## **Structural Design and Engineering**

## **Transportation Modeling**



# Exploring Energy Markets

---

---

## Task Number 71

### Define *energy markets*.

#### Definition

Definition should include the concept that energy markets are commodity markets that deal with the trade and supply of energy.

#### Process/Skill Questions

- What are factors that influence energy markets?
- What are the regions of the energy markets?

#### ITEEA National Standards

##### 16. Energy and Power Technologies

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

#### TSA Competitive Events

##### Biotechnology Design

##### Technology Bowl

---

## Task Number 72

### Identify factors that influence energy markets.

#### Definition

Identification may include



- incentives
- efficiency
- real-time pricing
- day-ahead pricing
- weather and natural disasters
- storage capacity
- capacity factor
- demand.

Teacher resources:

[Pennsylvania, Jersey, Maryland Power Pool \(PJM\)](#)

[APEX Clean Energy](#)

### **Process/Skill Questions**

- What is a *regional transmission organization (RTO)*?
- How does weather influence the energy markets?

### **ITEEA National Standards**

#### **16. Energy and Power Technologies**

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

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

## **Task Number 73**

### **Research an aspect of the energy market.**

#### **Definition**

Research may include

- fuel procurement
- fixed and variable costs
- energy brokers
- day trading
- consumer demand.

## Process/Skill Questions

- What careers are available?
- What are the laws influencing the energy market?
- How do the laws affect energy markets?

## ITEEA National Standards

### 16. Energy and Power Technologies

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

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

## TSA Competitive Events

### Extemporaneous Speech

### Prepared Presentation

---

# SOL Correlation by Task

39	Define <i>energy</i> .	English: 10.3, 11.3 History and Social Science: VUS.8, WHII.4, WHII.8 Science: PH.5, PH.6, PH.7, PH.11
40	Identify units of measure for power.	English: 10.5, 11.5
41	Define <i>life cycle</i> as it relates to energy sources.	English: 10.3, 11.3
42	Describe the primary forms of energy and their uses.	English: 10.5, 11.5 History and Social Science: VUS.8, WHII.4, WHII.8 Science: PH.7
43	Identify sources of energy.	English: 10.5, 11.5 History and Social Science: GOVT.12, VUS.14, WG.17, WHII.14

		Science: ES.6
44	Evaluate energy sources that are nonrenewable, renewable, and inexhaustible.	English: 10.3, 10.5, 11.3, 11.5 Science: ES.6
45	Compare the footprints of various energy sources.	English: 10.5, 11.5 History and Social Science: GOVT.12, VUS.14, WG.17, WHIL.14
46	Investigate career options within the energy sector.	English: 10.5, 11.5 History and Social Science: GOVT.12, VUS.14, WG.17, WHIL.14
47	Describe the difference between extraction and the harnessing of energy sources.	English: 10.3, 10.5, 11.3, 11.5 History and Social Science: GOVT.12, VUS.14, WG.17, WHIL.14
48	Identify energy sources that are mined and the techniques used for extraction.	English: 10.5, 11.5 History and Social Science: GOVT.12, VUS.14, WG.17, WHIL.14
49	Identify energy sources extracted using drilling and the techniques used for extraction.	English: 10.5, 11.5 History and Social Science: GOVT.12, VUS.14, WG.17, WHIL.14
50	Identify energy sources that are harnessed.	English: 10.5, 11.5 History and Social Science: GOVT.12, VUS.14, WG.17, WHIL.14
51	Define <i>refinement</i> .	English: 10.3, 11.3
52	Describe which energy sources require refinement.	English: 10.5, 11.5
53	Research refinement techniques.	English: 10.5, 10.8, 11.5, 11.8
54	Trace the transport of oil and natural gas from extraction to energy production.	English: 10.5, 11.5 History and Social Science: GOVT.12, VUS.14, WG.17, WHIL.14
55	Trace the transport of solid fuel from extraction to energy production.	English: 10.5, 11.5 History and Social Science: GOVT.12, VUS.14, WG.17, WHIL.14
56	Create a model of a fuel transportation method.	English: 10.1, 11.1 Mathematics: G.14, T.8, T.9, COM.15, COM.16, DM.1*, DM.2*, PS.8*
57	Describe how energy sources are used to generate electricity.	English: 10.5, 11.5

		History and Social Science: GOVT.12, VUS.14, WG.17, WHIL.14
58	Describe other uses of energy sources (aside from electricity).	English: 10.5, 11.5  History and Social Science: GOVT.12, VUS.14, WG.17, WHIL.14
59	Model a method of energy generation.	
60	Define the (electrical) <i>grid</i> .	English: 10.3, 11.3
61	Explain the role of electrical transmission, distribution, and storage.	English: 10.5, 11.5
62	Outline electricity's path from producer to consumer.	English: 10.6, 10.7, 11.6, 11.7
63	Illustrate the grid.	
64	Analyze grid modernization efforts.	English: 10.5, 11.5
65	Differentiate transmission, distribution, and storage of gas and electricity.	English: 10.5, 11.5
66	Model components of a natural gas system.	
67	Identify decommissioning and reclamation.	English: 10.5, 11.5
68	Diagram the life cycle of energy sources.	
69	Identify environmental, health, and safety aspects of the energy life cycle.	English: 10.5, 11.5  History and Social Science: GOVT.12, VUS.14, WG.17, WHIL.14
70	Explain the role of regulatory agencies.	English: 10.5, 10.8, 11.5, 11.8  History and Social Science: GOVT.7, GOVT.8, GOVT.9, GOVT.15
71	Define <i>energy markets</i> .	English: 10.3, 11.3  History and Social Science: GOVT.14, GOVT.15
72	Identify factors that influence energy markets.	English: 10.5, 11.5
73	Research an aspect of the energy market.	English: 10.8, 11.8

# Appendix: Credentials, Course Sequences, and Career Cluster Information

**Industry Credentials: Only apply to 36-week courses**

- Energy Industry Fundamentals Certificate Assessment

**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.*

- Engineered Energy Systems (EES8411/36 weeks)

<b>Career Cluster: Energy</b>	
<b>Pathway</b>	<b>Occupations</b>
<b>Energy Efficiency</b>	<b>Electrical Engineer</b> <b>Electrician</b> <b>Environmental Engineer</b> <b>Environmental Engineering Technician</b> <b>Environmental Science and Protection Technician</b> <b>Environmental Scientist</b> <b>HVAC and Refrigeration Mechanic or Installer</b>
<b>Fuels Production</b>	<b>Chemical Engineer</b> <b>Chemist</b> <b>Continuous Mining Machine Operator</b> <b>First-Line Supervisor of Transportation and Material-Moving Machine and Vehicle Operator</b> <b>Geological Technician</b> <b>Petroleum Engineer</b> <b>Petroleum Technician</b> <b>Service Unit Operator, Oil, Gas, and Mining</b> <b>Wellhead Pumper</b>
<b>Power Generation</b>	<b>Control and Valve Installer, Repairer</b> <b>Electrical Engineering Technician</b> <b>Electronics Engineer</b> <b>Electronics Engineering Technician</b> <b>Engineering Manager</b> <b>Health and Safety Engineer</b> <b>Mechanical Engineer</b> <b>Nuclear Engineer</b> <b>Nuclear Power Reactor Operator</b>

<b>Career Cluster: Energy</b>	
<b>Pathway</b>	<b>Occupations</b>
	<b>Nuclear Technician</b> <b>Solar Photovoltaic Installer</b>
<b>Transmission and Distribution</b>	<b>Electrical and Electronics Repairer, Powerhouse, Substation and Relay</b> <b>Electrical Power Line Installer/Repairer</b> <b>Electro-Mechanical Technician</b> <b>Gas Compressor and Gas Pumping Station Operator</b> <b>Pipefitter, Steamfitter</b> <b>Plumber</b> <b>Power Distributor, Dispatcher</b> <b>Wind Turbine Service Technician</b>

<b>Career Cluster: Science, Technology, Engineering and Mathematics</b>	
<b>Pathway</b>	<b>Occupations</b>
<b>Engineering and Technology</b>	<b>Chemical Engineer</b> <b>Computer Programmer</b> <b>Electrical Drafter</b> <b>Electrical Engineer</b> <b>Electrical Engineering Technician</b> <b>Electro-Mechanical Technician</b> <b>Electronics Engineering Technician</b> <b>Engineer</b> <b>Engineering Manager</b> <b>Engineering Technician</b> <b>Mechanical Drafter</b> <b>Mechanical Engineer</b> <b>Mechanical Engineering Technician</b> <b>Network and Computer Systems Administrator</b> <b>Network Systems and Data Communication Analyst</b> <b>Nuclear Engineer</b> <b>Petroleum Engineer</b> <b>Pipeline Drafter</b> <b>Power Systems Engineer</b> <b>Quality Engineer</b> <b>Quality Technician</b> <b>Statistician</b> <b>Systems Analyst</b>
<b>Science and Mathematics</b>	<b>Biologist</b> <b>Botanist</b> <b>Ecologist</b> <b>Environmental Scientist</b> <b>Geodetic Surveyor</b> <b>Occupational Health and Safety Specialist</b>

<b>Career Cluster: Transportation, Distribution and Logistics</b>	
<b>Pathway</b>	<b>Occupations</b>
<b>Facility and Mobile Equipment Maintenance</b>	<b>Electrical and Electronic Installer Electrical and Electronic Repairer</b>
<b>Health, Safety and Environmental Management</b>	<b>Health, Safety, and Environment Manager</b>
<b>Logistics Planning and Management Services</b>	<b>Logistics Manager</b>
<b>Transportation Operations</b>	<b>Transportation Manager</b>
<b>Transportation Systems/Infrastructure Planning, Management and Regulation</b>	<b>Civil Engineer Civil Engineering Technician</b>