Introduction to Alternative Energy
Annotated Instructor's Guide

Module 74101-11

Module Overview

This module introduces trainees to issues leading up to the development of alternative forms of energy and power generation. The four primary forms of alternative energy generation—nuclear, biomass, wind, and solar—are briefly presented as a prelude to further study in those areas. Coverage of the smart grid and the issues of integrating alternative energy into the national power supply are also included.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Power Industry Fundamentals*.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Understand the need for alternative energy and identify the various forms.
2. Describe the contributions of alternative energy sources to world supplies at present and their potential.
3. Describe the present US electrical grid and issues affecting alternative energy source tie-in, reliability, and economic impact.

Performance Tasks

This is a knowledge-based module; there are no performance tasks.

Materials and Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Alternative Energy PowerPoint® Presentation Slides (ISBN 978-0-13-266783-8)
Multimedia projector and screen
Computer
Appropriate personal protective equipment, including gloves and safety glasses
Materials for Project 2*:
- One copy per trainee of *Lighting in the Library – A Student Energy Audit*
- Tape measures

Materials and tools for Project 3*
(per hydroelectric generator constructed; tools can potentially be shared):
- Electric drill with ¼" drill bit
- Scissors
- Ruler
- 10 cm (3.5") nail or scratch awl
- Hot glue gun with glue sticks
- Utility knife
- Pencil sharpener
- Permanent marker
- Magnetic compass
- Wire cutters
- Glue
- Electrical tape
- Multimeter
- 4L rectangular-style plastic jug
- 10+ plastic spoons
- 1 large cork (3.5 cm to 5 cm)
- 100 m+ of enameled magnet wire, 24 gauge
- Foamcore or heavyweight cardboard, approx. 22 cm × 30 cm
- 6 mm wooden dowel rod, 20 cm in length
- 4 ceramic or rare earth magnets, 18 mm or larger
- 6 cm clear vinyl tubing, 0.250" inside diameter
- 4 brass paper fasteners

Materials and equipment for Project 4*
(per trainee or team):
- Computers with Internet access
- Graph paper or poster paper

Calculator
Module Examinations**

* Included at the back of this Annotated Instructor's Guide.

** Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with any appropriate PPE and know how to use it properly. This module includes optional activities that may require safety glasses and/or other PPE be provided. Please ensure trainees are familiar with and use the proper PPE as necessary.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

Your Role in the Green Environment, NCCER Module 70101-09. Prentice-Hall Education.
America's Energy Future: Technology and Transformation. Summary Edition. National Academies Press.
Electricity From Renewable Resources: Status, Prospects, and Impediments. National Academies Press.
US Department of Energy. www.energy.gov.
US DOE, Office of Energy Efficiency and Renewable Energy. www.eere.energy.gov.
US Energy Information Administration. www.eia.doe.gov.
National Renewable Energy Laboratory. www.nrel.gov.
North American Electric Reliability Corporation. www.nerc.com.
Center For Energy Workforce Development. www.cewd.org.
Database of State Incentives for Renewables and Efficiency. www.dsireusa.org.
Energy Careers website www.getintoenergy.com

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 25 hours are suggested to cover *Introduction to Alternative Energy*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

Topic	**Planned Time**
Session I. Introduction; Alternative Energy Overview	
A. Introduction	_____
B. Alternative Energy Overview	_____
1. National Position and Support	_____
C. Laboratory	_____
Have trainees begin *Project 1: Digging Deeper*, at the back of this Instructor's Guide.	
Session II. Alternative Energy Overview; Laboratory	
A. Alternative Energy Overview	_____
1. State Programs	_____
2. Energy Efficiency	_____
3. Obstacles to Alternative Energy Development	_____
B. Laboratory	_____
Have trainees complete Steps 1 through 9 of *Project 2: Lighting in the Library – A Student Energy Audit*.	
Session III. Laboratory	
A. Laboratory	_____
Have trainees complete the remainder of *Project 2: Lighting in the Library – A Student Energy Audit*.	

Session IV. Power Generation Essentials; Alternative Energy Sources

A. Power Generation Essentials _____
B. Alternative Energy Sources _____
   1. Nuclear Power _____
   2. Hydroelectric Power _____

Session V. Laboratory

A. Laboratory _____

   Have trainees complete *Project 3: Building a Hydroelectric Generating Unit*.

Session VI. Alternative Energy Sources; The Electrical Grid

A. Alternative Energy Sources _____
   1. Wind Power _____
   2. Solar Power _____
   3. Biomass _____
   4. Other Alternative Sources _____
B. The Electrical Grid _____
   1. Grid Risks and Concerns _____

Session VII. Laboratory

A. Laboratory _____

   Have trainees complete *Project 4: How Big Is Your Footprint?*

Session VIII. The Electrical Grid; Alternative Energy Career Opportunities

A. The Electrical Grid _____
   1. The Smart Grid _____
   2. Alternative Energy Integration _____
B. Alternative Energy Career Opportunities _____
   1. Powerline Workers _____
   2. Technicians _____
   3. Construction Trades _____
   4. Engineers _____
   5. Chemists and Material Scientists _____

Session IX. Laboratory

A. Laboratory _____

   Have trainees present their completed reports and/or PowerPoint® presentations from *Project 1: Digging Deeper*, to the class.

Session X. Review and Testing

A. Review _____
B. Module Examination _____
   1. Trainees must score 70 percent or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.

Biomass and Biofuels
Annotated Instructor's Guide

Module 74102-11

Module Overview

This module introduces the trainee to biomass and biofuels, including its sources and the processes for turning it into energy. It gives a brief history of the use of biomass, present attitudes and support for it, and the likely future of it.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Power Industry Fundamentals*; and *Alternative Energy*, Module 74101-11.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Define biomass, identify potential sources, and describe how it is used to generate energy.
2. List the advantages and disadvantages of biomass use for energy production.
3. Describe the past, present, and future of biomass for energy.
4. Define and identify biofuels, their sources, and how they are used to generate energy.

Performance Tasks

This is a knowledge-based module; there are no performance tasks.

Materials and Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Alternative Energy PowerPoint® Presentation Slides (ISBN 978-0-13-266783-8)
Multimedia projector and screen
Computer
Appropriate personal protective equipment, including gloves and safety glasses
Access to the Internet
Access to a large, well-ventilated area for building a fire
Suitable trash for sorting, enough for several 4½ lb. bags
Sufficient quantities of fuel for filling cans:
- Wood chips
- Sawdust
- Straw
- Stover (if available)
- Bagasse (if available)

Sufficient gasifier materials for each team, including:
- 1 gallon, 6.5" dia. × 7.75" h, clean, empty paint can with lid
- 1 clean and empty 38-oz tin can, 4" dia. × 6⅛" h or clean and empty 28-oz tin can, 4.1" dia. × 4.7" h
- 1 clean and empty 6-oz tin can, 2" dia. × 3⅜" h
- 1½" galvanized iron elbow
- 1½" galvanized street elbow fitting
- 1½" × 4" galvanized steel pipe nipple
- ¾" × ½" galvanized iron bushing

Multipurpose lighter
Bottle opener, churchkey type
Can opener, lever type
Hammer
Large nails or center punch for punching holes
Handouts*
Module Examinations**

* Located at the back of this Annotated Instructor's Guide.

** Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment, including protective gloves and safety glasses. Review safety guidelines for working with fire, heated cans, and burning feedstock for biomass and biofuels. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

Environmental Health and Safety online. www.ehso.com

US Environmental Protection Agency. www.epa.gov

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 22½ hours are suggested to cover *Biomass and Biofuels*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

Topic	**Planned Time**
Session I. Introduction; Biomass Sources and Uses, Part One	
A. Introduction	_____
B. Biomass Sources and Uses	_____
1. Biomass Sources	_____
Session II. Biomass Sources and Uses, Part Two	
A. Biomass Sources and Uses	_____
1. Biomass Sources	_____
2. Biomass Energy Crops	_____
3. Biomass Uses	_____
B. Laboratory	_____
Have trainees separate and identify items in a typical classroom trash can (Section 2.1.2 laboratory).	
Session III. Biomass Energy Production, Part One; Laboratory	
A. Biomass Energy Production	_____
1. Energy Flow and Trophic Levels	_____
2. Biofuels	_____
B. Laboratory	_____
Have trainees compare characteristics of different fuels used in spirit lamps (Section 3.2.1 laboratory).	
Session IV. Biomass Energy Production, Part Two	
A. Biomass Energy Production	_____
1. Biofuels	_____
2. Methods and Processes	_____
Session V. Biomass Energy Production, Part Three; Laboratory	
A. Biomass Energy Production	_____
1. Methods and Processes	_____
B. Laboratory	_____
Have trainees build simple gasifiers (Section 3.3.3 laboratory).	

Session VI. Biomass Energy Production, Part Four; Advantages and Disadvantages

A. Biomass Energy Production _____
   1. Methods and Processes _____
   2. Power Generation _____
B. Advantages and Disadvantages _____
   1. Renewable Material _____
   2. MSW _____
   3. Environmental Considerations _____

Session VII. Advantages and Disadvantages, Part Two; Past, Present, and Future of Biomass Energy, Part One

A. Advantages and Disadvantages _____
   1. Costs _____
   2. Land and Resources _____
B. Past, Present, and Future of Biomass Energy _____
   1. Past _____
   2. Present _____

Session VIII. Past, Present, and Future of Biomass Energy, Part Two; Laboratory

A. Past, Present, and Future of Biomass Energy _____
   1. Future _____
B. Laboratory _____

   Have trainees research biomass power plants (Section 3.4.0 laboratory).

Session IX. Review and Testing

A. Review _____
B. Module Examination _____
   1. Trainees must score 70% or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

Module Overview

This module introduces the trainee to the nuclear power industry, describes types of reactors and how they work, and explains some of the history and the future of nuclear power.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Power Industry Fundamentals*; and *Alternative Energy,* Modules 74101-11 and 74102-11.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Define and describe nuclear power and its sources.
2. Describe and explain nuclear power development and generation.
3. List the advantages and disadvantages of nuclear power.
4. Describe the past, present, and future of nuclear energy.

Performance Tasks

This is a knowledge-based module; there are no performance tasks.

Materials and Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Alternative Energy PowerPoint® Presentation Slides (ISBN 978-0-13-266783-8)
Multimedia projector and screen
Computer
Appropriate personal protective equipment
Sufficient Osun Technologies RF0010 Radiation Finders or equivalent
Optional Cloud Chamber experiment:
- Geiger counter
- Small transparent container with transparent lid
- Flat black spray paint
- Blotter paper
- Pure ethyl alcohol
- Radioactive source (available from chemistry supply house. **Warning:** *Take all precautions when handling this material*.)
- Masking tape
- Dry ice
- Styrofoam square
- Flashlight
- Gloves or tongs to handle the dry ice

Handouts*
Module Examinations**

* Located at the back of this module.
** Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with appropriate gloves or tongs and glasses for working with dry ice. Stress safety guidelines and precautions associated with working with radioactive materials. Emphasize the importance of proper housekeeping.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

US Energy Information Administration. www.eia.gov
Center for Energy Workforce Development. www.getintoenergy.com
US Department of Energy. www.energy.gov
US Department of Energy, Office of Nuclear Energy. www.ne.doe.gov
Institute of Nuclear Power Operations. www.inpo.info
Nuclear Energy Institute. www.nei.org
US Nuclear Regulatory Commission. www.nrc.gov
Coolclean Cooling Towers. www.coolclean.com.au
Duke Energy. www.duke-energy.com
Teacher lesson plans, grades 9–12. www.eia.doe.gov
Students and Teachers Corner. www.nrc.gov
Generation IV Nuclear Project. www.gen-4.org
Multiple resource links. www.entergy-nuclear.com

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 25 hours are suggested to cover *Introduction to Nuclear Power*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

Topic	**Planned Time**
Session I. Introduction; Nuclear Power and Its Sources, Part One	
A. Introduction	_____
B. Nuclear Power and Its Sources	_____
1. Uranium	_____
2. Mining	_____
Session II. Nuclear Power and Its Sources, Part Two	
A. Nuclear Power and Its Sources	_____
1. Milling	_____
2. Converting	_____
3. Enriching	_____
4. Fabricating	_____
5. Fission	_____
Session III. Nuclear Power Development and Generation, Part One	
A. Nuclear Power Development and Generation	_____
1. Major Components	_____

Session IV. Nuclear Power Development and Generation, Part Two

A. Nuclear Power Development and Generation _____
   1. Light Water Reactors _____
   2. Heavy Water Reactors _____
   3. Breeder Reactors _____

Session V. Advantages and Disadvantages of Nuclear Power, Part One

A. Advantages and Disadvantages of Nuclear Power _____
   1. Environmental Impact _____
   2. Cost _____
   3. Proven Technology _____

Session VI. Advantages and Disadvantages of Nuclear Power, Part Two

A. Advantages and Disadvantages of Nuclear Power _____
   1. Proven Technology _____

B. Laboratory – Testing Radiation _____

   Have trainees measure and record radiation levels of commonly found items.

Session VII. Advantages and Disadvantages of Nuclear Power, Part Three

A. Advantages and Disadvantages of Nuclear Power _____
   1. Permitting and Construction _____

Sessions VIII and IX. Past, Present, and Future of Nuclear Energy

A. Past, Present, and Future of Nuclear Energy _____
   1. Past _____
   2. Present _____
   3. Future _____

Session X. Review and Testing

A. Review _____

B. Module Examination _____
   1. Trainees must score 70% or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200 and submit the results to the Training Program Sponsor.

Solar Power
Annotated Instructor's Guide

Module 74104-11

Module Overview

This module introduces the trainee to solar power. It covers the advantages and disadvantages of this power source, along with its development and applications. It also explains the basic concepts of solar photovoltaic (PV) and solar thermal systems and components.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Power Industry Fundamentals*; and *Alternative Energy*, Modules 74101-11 through 74103-11.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. Define solar power, how it is harnessed, and how it is used to generate energy.
2. List the advantages and disadvantages of solar energy.
3. Describe the past, present, and future of solar energy.
4. Identify and describe solar applications.

Performance Tasks

This is a knowledge-based module; there are no performance tasks.

Materials and Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Alternative Energy PowerPoint® Presentation Slides (ISBN 978-0-13-266783-8)
Multimedia projector and screen
Computer
Appropriate personal protective equipment
Access to various installed PV systems
Digital DC meter
Sun path calculator
Compass
Calculator
Various types of solar panels and mounting system components
Inverter
Batteries
Charge controller
AC and DC disconnects
Materials for Project 1* (for each trainee or team): 1 large piece of cardboard, measuring tape, scissors, acrylic gesso paint, flat black acrylic paint, paint brush, thumbtacks, duct tape, thin string, plastic wrap, masking tape, thermometer, graph paper
Materials for Project 2* (for each trainee or team): *Collector*: 10-inch square piece of galvanized sheet metal (thinnest available), 20-inch square piece of cardboard, flat black spray paint, 10-inch square piece of insulation at least 3 inches thick, 3-foot length of soft copper tubing (⅜ to ½ inch in diameter), 16-inch square sheet of 3- or 4-mil clear plastic, knife or box cutter, cellophane or masking tape, tubing bender *Water Heater*: 1- or 2-pound coffee can with plastic lid, two 2-inch pieces of soft copper tubing (⅜ to ½ inch in diameter), thermometer, cardboard box sized slightly larger than coffee can, insulation material, 100- to 200-watt soldering iron and acid-flux solder
Materials for Project 3* (for each trainee or team): 14-inch sheet of aluminum foil, 11" × 14" piece of poster board, 1 unpainted wire coat hanger, cellophane or masking tape, 2 cardboard boxes, 2 nuts, 2 bolts
Handouts*
Module Examinations**

* Located at the back of this Annotated Instructor's Guide.

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Safety Considerations

Ensure that the trainees are equipped with appropriate personal protective equipment and know how to use it properly. Ensure that all trainees are briefed on appropriate field safety procedures, including fall protection, electrical hazards, sun exposure, and battery hazards. If the training center does not have various simple PV systems set up on site, this module will require that the trainees visit one or more job sites in order to view installed PV systems. Ensure that trainees are briefed on site safety policies prior to any site visits.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

National Electrical Code® (NFPA 70), Latest Edition. National Fire Protection Association (NFPA): Quincy, MA.

Photovoltaic Systems, Second Edition. James P. Dunlop. Orland Park, IL: American Technical Publishers.

Solar Water Heating, Second Edition. Benjamin Nusz: Gabriola Island, BC, Canada: New Society Publishers.

Uniform Solar Energy Code, Latest Edition. Ontario, CA: International Association of Plumbing and Mechanical Officials (IAPMO).

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 25 hours are suggested to cover *Solar Power*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

Topic	**Planned Time**
Session I. Introduction; Laboratory	
A. Introduction	_____
1. History of Solar Power	_____
2. Advantages and Disadvantages	_____
3. Career Opportunities	_____
B. Laboratory	_____
Have the trainees complete Project 1: Solar Air Heater (also available from www.energyquest.ca.gov).	
Sessions II through IV. Solar Thermal Applications; Laboratory	
A. Solar Thermal Applications	_____
1. Low-Temperature Applications	_____
2. Medium-Temperature Applications	_____
3. High-Temperature Applications	_____
B. Laboratory	_____
Have the trainees complete Project 2: Solar Water Heater and Project 3: Solar Hot Dog Cooker (also available from www.energyquest.ca.gov).	
Session V. Solar PV Applications	
A. Solar PV Applications	_____
1. Standalone Systems	_____
2. Grid-Connected Systems	_____
3. Grid-Interactive Systems	_____
4. Utility-Scale Solar Generating Systems	_____

Session VI. Power

A. Power _____

Session VII. PV System Components

A. PV System Components _____
   1. PV Panels _____
   2. Inverters _____
   3. Batteries _____
   4. Charge Controllers _____
   5. BOS Components _____

Session VIII. Collecting Solar Data

A. Collecting Solar Data _____

Session IX. Installation

A. Installation _____
   1. Roof-Mounted Installations _____
   2. Ground-Mounted Installations _____

Session X. US DOE Position; Emerging Technologies; Review and Testing

A. US DOE Position _____
B. Emerging Technologies _____
C. Module Review _____
D. Module Examination _____
   1. Trainees must score 70 percent or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.

Wind Power
Annotated Instructor's Guide

Module 74105-11

Module Overview

This module introduces trainees to the production of electrical power from wind energy. The development of wind energy over the years is presented, as well as the advantages and disadvantages of its use today. Trainees will be introduced to the scientific principles behind wind power and the mechanical systems that put those principles to work.

Prerequisites

Prior to training with this module, it is recommended that the trainee shall have successfully completed *Power Industry Fundamentals*; and *Alternative Energy*, Modules 74101-11 through 74104-11.

Objectives

Upon completion of this module, the trainee will be able to do the following:

1. List the advantages and disadvantages of wind energy.
2. Describe the past, present, and future of wind energy.
3. Describe wind power, how it is harnessed, and how it is used to generate energy.
4. Identify and describe wind energy applications.

Performance Tasks

This is a knowledge-based module; there are no performance tasks.

Materials and Equipment

Markers/chalk
Pencils and scratch paper
Whiteboard/chalkboard
Alternative Energy PowerPoint® Presentation Slides (ISBN 978-0-13-266783-8)
Multimedia projector and screen
Computer
Appropriate personal protective equipment
Materials for Project 1*, including:
- 3 oz. plastic cups (5 per assembly)
- Soda straws (2 per assembly)
- New pencils (1 per assembly)
- Push pins (1 per assembly)
- Single-hole paper punch
- Scissors
- Tape
- Permanent marker
- Three or four 4' × 4' × 1" Styrofoam panels

Worksheet and Materials for Project 2*
Project 3, *Word Problems: Economics* from the KidWind website (one copy per trainee)*
Module Examinations**

* Located at the back of this Annotated Instructor's Guide.
**Single-module AIG purchases include the printed exam and performance task sheet. If you have purchased the perfect-bound version of this title, download these materials from the IRC using your access code.

Safety Considerations

Ensure that the trainees are equipped with all appropriate PPE and know how to use it properly. This module includes optional activities that may require safety glasses and/or other PPE be provided. Please ensure trainees are familiar with and use the proper PPE as necessary.

Additional Resources

This module presents thorough resources for task training. The following resource material is suggested for further study.

American Wind Energy Association (AWEA). www.awea.org.
Introduction to Wind Principles. Thomas E. Kissell. Boston, MA: Prentice Hall.
US Department of Energy, Wind Powering America Program. www.windoweringamerica.gov.
Wind Power, Paul Gipe. White River Junction, VT: Chelsea Green Publishing Company.

Teaching Time for This Module

An outline for use in developing your lesson plan is presented below. Note that each Roman numeral in the outline equates to one session of instruction. Each session has a suggested time period of 2½ hours. This includes 10 minutes at the beginning of each session for administrative tasks and one 10-minute break during the session. Approximately 22½ hours are suggested to cover *Wind Power*. You will need to adjust the time required for hands-on activity and testing based on your class size and resources.

Topic	**Planned Time**
Session I. Introduction; Wind Power – Past, Present, and Future	
A. Introduction	_____
B. Wind Power – Past, Present, and Future	_____
1. Origin and History of Wind Power	_____
2. The Wind Industry Today	_____
C. Laboratory Have trainees select topics for reports per the laboratory associated with Section 2.0.0.	_____
Session II. Wind Power – Past, Present, and Future; A Study in Wind Energy	
A. Wind Power – Past, Present, and Future	_____
1. The Future of Wind Power	_____
2. Wind Power Career Opportunities	_____
B. A Study in Wind Energy	_____
1. The Power of the Wind	_____
Session III. A Study in Wind Energy	
A. A Study in Wind Energy	_____
1. More About Wind Velocity	_____
2. Wind Velocity and Height	_____
3. Wind Data Acquisition and Use	_____
Session IV. Laboratory; Intercepting Wind Energy; Wind Turbines	
A. Laboratory Have trainees construct anemometers for Project 1.	_____
B. Intercepting Wind Energy	_____

Session V. Wind Turbines

A. Wind Turbines _____
   1. Basic Designs _____
   2. HAWT Systems _____
      a. Blades _____
      b. Towers _____
      c. Nacelles _____

Session VI. Wind Turbines; Small Wind

A. Wind Turbines _____
   1. HAWT Systems _____
      a. Gearboxes _____
      b. Electric Power Components _____
      c. HAWT Yaw and Pitch _____
      d. Braking Systems _____
      e. Supervisory Control and Data Acquisition (SCADA) _____
B. Small Wind _____

Session VII. The Wind Farm; Laboratory

A. The Wind Farm _____
B. Laboratory _____

Have trainees complete Project 3, *Wind Farm Economics* word problems.

Session VIII. Laboratory

A. Laboratory _____

Have trainees present their topic reports and/or PowerPoint® presentations to the class, as described in the laboratory associated with Section 2.2.0.

Session IX. Review and Testing

A. Review _____
B. Module Examination _____
   1. Trainees must score 70 percent or higher to receive recognition from NCCER.
   2. Record the testing results on Training Report Form 200, and submit the results to the Training Program Sponsor.