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Northeast Wisconsin Technical College

10-480-101 056877 Renewable Energy & Sustainability

Course Outcome Summary

Course Information

Description 10-480-101 RENEWABLE ENERGY AND SUSTAINABILITY [...an](#) overview of various renewable energy technologies and sustainable design practices and their current applications. Emphasis will be placed on policies, renewable energy production, green products and jobs.

Total Credits 4

Total Hours 72

Course History

Last Revision Date 1/15/2020

Employability Skills

1. Communicate Effectively
2. Demonstrate Community and Global Accountability
3. Demonstrate Personal Accountability
4. Solve Problems Effectively
5. Think Critically and Creatively
6. Value Individual Differences and Abilities
7. Work Cooperatively and Professionally

Course Competencies

1. **Compare and contrast various definitions of renewable energy and sustainability.**

Assessment Strategies

by comparing and contrasting various definitions of renewable energy and sustainability.

Learning Objectives

- 1.a. Define renewable energy.
- 1.b. Analyze various sources of renewable energy.
- 1.c. Analyze the potential for renewable energy generation and conservation.
- 1.d. Define sustainability as it related to domestic and commercial applications.
- 1.e. Investigate various concepts of sustainability.

Criteria

Your performance will be successful when:

- 1.1. you provide a comprehensive definition of renewable energy.
- 1.2. you provide a list of at least five renewable energy sources.
- 1.3. you relate renewable energy generation and standards in the global economy.
- 1.4. you provide a comprehensive definition of sustainability.
- 1.5. you describe various concepts of sustainability.

2. Review scientific concepts of force, energy and power.

Assessment Strategies

by reviewing scientific concepts of force, energy and power.

Learning Objectives

- 2.a. Explain the first law of thermodynamics as it relates to energy
- 2.b. Summarize the forms of energy.
- 2.c. Define efficiency as it relates to the second law of thermodynamics

Criteria

Your performance will be successful when:

- 2.1. you define the first law of thermodynamics and discuss its relationship to energy conversion.
- 2.2. you define kinetic energy and are able to discuss its various forms.
- 2.3. you define gravitational energy and potential energy.
- 2.4. you define electrical energy and its properties.
- 2.5. you define nuclear energy and its properties.
- 2.6. you can discuss the relationship between the second law of thermodynamics and energy efficiency.

3. Summarize the correlation between fossil fuel use and climate change.

Assessment Strategies

by summarizing the correlation between fossil fuel use and climate change.

Learning Objectives

- 3.a. Identify the various pollutants that are emitted as a result of the consumption of fossil fuels.
- 3.b. Describe the causes and potential dangers of air pollution, acid rain, nuclear waste and the depletion of natural resources.
- 3.c. Analyze the greenhouse effect as it relates to emissions caused by fossil fuel combustion.
- 3.d. Explain how carbon dioxide emissions affect global climate.

Criteria

Your performance will be successful when:

- 3.1. you list the types and sources of pollutants that occur as a result of fossil fuel consumption.
- 3.2. you explain the causes and potential dangers of air pollution, acid rain, nuclear waste and the depletion of natural resources.
- 3.3. you summarize the causes and potential threats of the greenhouse effect.
- 3.4. you describe how carbon dioxide is emitted and the concerns with increased emissions.

4. Analyze current sources of renewable energy and current generation in the worldwide.

Assessment Strategies

by analyzing current sources of renewable energy and current generation in the world economy.

Learning Objectives

- 4.a. Analyze the ways in which solar energy can be directly converted to useful energy.
- 4.b. Analyze the ways in which solar energy can be indirectly converted to useful energy.
- 4.c. Describe two sources of renewable energy that do not depend on solar radiation.
- 4.d. Summarize the origins and magnitudes of the earth's renewable energy sources.

Criteria

Your performance will be successful when:

- 4.1. you describe how solar thermal energy and solar photovoltaics convert solar radiation to useful energy
- 4.2. you describe how hydropower, wind power, wave power and bioenergy are energy sources that indirectly result from solar radiation.
- 4.3. you summarize the two sources of renewable energy that do not depend on solar radiation.
- 4.4. you summarize the origins and magnitude of the various forms of renewable energy.

5. Examine governmental policy regarding energy conservation and renewable energies.

Assessment Strategies

by examining governmental policy regarding energy conservation and renewable energies.

Learning Objectives

- 5.a. Summarize United States policy regarding energy conservation and renewable energies.
- 5.b. List incentives for personal and business opportunities for renewable energy generation.
- 5.c. Summarize Global policy regarding energy conservation and renewable energies.
- 5.d. Describe the general attributes of the Kyoto Protocol and its implications on renewable energies

Criteria

Your performance will be successful when:

- 5.1. you describe the State of Wisconsin's renewable energy and energy conservation initiatives.
- 5.2. you describe the United States' renewable energy and energy conservation initiatives.
- 5.3. you describe Global renewable energy and energy conservation initiatives.
- 5.4. you summarize the history of renewable energy and energy conservation initiatives in the United States and Globally.

6. Assess the present state of technology and its implementation as well as the future potential of solar thermal energy.

Assessment Strategies

by assessing the present state of technology and its implementation as well as the future potential of solar thermal energy.

Learning Objectives

- 6.a. Discuss the history, applications and benefits of a solar water heater and other low temperature solar energy applications.
- 6.b. Characterize the nature and availability of solar radiation
- 6.c. Examine the history and present day applications of active solar heating including solar collectors.
- 6.d. Summarize the history and present day applications of passive solar heating including daylighting strategies.
- 6.e. Examine the future of solar thermal applications including the economic and environmental impacts.

Criteria

Your performance will be successful when:

- 6.1. you can describe how a rooftop solar water heater functions.
- 6.2. you are able to discuss the nature and availability of solar radiation.
- 6.3. you describe the benefits and system components of a solar water heating system
- 6.4. you explain the history and types of active solar heating systems including solar collectors.
- 6.5. you are able to describe the basic guidelines for passive solar heating systems including daylighting.
- 6.6. you are able to evaluate the cost and potential payback of solar thermal systems.
- 6.7. you can discuss the economics, potential and environmental impacts of solar thermal energy.

7. Assess the present state of technology and its implementation as well as the future potential of solar photovoltaics

Assessment Strategies

by assessing the present state of technology and its implementation as well as the future potential of solar photovoltaics.

Learning Objectives

- 7.a. summarize the history of photovoltaics and its basic principles
- 7.b. discuss the various types of PV systems and their construction.
- 7.c. Compare grid connected and battery storage PV systems.
- 7.d. Analyze the cost of PV systems and potential payback periods
- 7.e. Examine the environmental impacts, future prospects and resources required of solar photovoltaic systems

Criteria

Your performance will be successful when:

- 7.1. you provide a complete history of solar photovoltaics.
- 7.2. you are able to generate a payback schedule for a specific photovoltaic system installation.
- 7.3. you can list and describe the characteristics of materials used for PV technology.

- 7.4. you compare advantages and disadvantages of grid connected PV, battery storage systems and stand alone PV systems.
- 7.5. you discuss the environmental impact, resources required and future prospects of PV systems.

8. Assess the present state of technology and its implementation as well as the future potential of bioenergy generation.

Assessment Strategies

by assessing the present state of technology and its implementation as well as the future potential of bioenergy generation.

Learning Objectives

- 8.a. Define bioenergy by discussing its historical use and present state in the world energy economy.
- 8.b. Discuss the accepted criteria for defining a material as a fuel source
- 8.c. Compare the advantages and disadvantages of potential energy crop sources of bioenergy.
- 8.d. Compare the advantages and disadvantages of potential waste stream sources of bioenergy.
- 8.e. Describe the process of anaerobic digestion and its future potential as an energy source.
- 8.f. Summarize the environmental benefits and impacts of bioenergy regarding atmospheric emissions, land use and energy balance.
- 8.g. Acquire information about future prospects for bioenergy sources.

Criteria

Your performance will be successful when:

- 8.1. you summarize the past and present state of bioenergy.
- 8.2. you describe the components of the combustion process as it relates to defining a fuel.
- 8.3. you compare the average heat energy content of fuels
- 8.4. you identify energy crop types and compare their efficiency and annual gross yields.
- 8.5. you identify waste sources of bioenergy and discuss their potential for energy generation.
- 8.6. you describe the combustion process of solid biomass and municipal solid wastes.
- 8.7. you explain the process of anaerobic digestion and other options for production of gaseous fuels from biomass.
- 8.8. you summarize the economics and future prospects of bioenergy generation.

9. Assess the present state of technology and its implementation as well as the future potential of hydroelectricity.

Assessment Strategies

by assessing the present state of technology and its implementation as well as the future potential of hydroelectricity.

Learning Objectives

- 9.a. Quantify the historical role of hydroelectric power in the global energy market.
- 9.b. Explain the role of gravitational potential energy in hydroelectric power generation.
- 9.c. Describe the history of hydroelectric generation including the water wheel, mills, and turbines.
- 9.d. Summarize the types of hydroelectric plants in operation today.
- 9.e. Illustrate the properties of a turbine and the characteristics of modern turbines that increase efficiency
- 9.f. Provide examples of small scale hydroelectricity.
- 9.g. Describe the economics, environmental considerations and social effects of hydroelectric generation.
- 9.h. Examine the future prospects of large and small scale hydroelectric generation.

Criteria

Your performance will be successful when:

- 9.1. you summarize the history of hydroelectric generation.
- 9.2. you define gravitational potential energy and relate it to hydroelectricity.
- 9.3. you explain the details of how water wheels, mills and turbines operate to generate electricity.
- 9.4. you identify and describe the types of hydroelectric power plants in operation today.
- 9.5. you describe how turbine design affects efficiency.
- 9.6. you analyze the economics of hydroelectricity and its share of the current and future marketplace of renewable energies.
- 9.7. you summarize the benefits of small scale hydroelectric operations
- 9.8. you examine the future prospects of hydroelectric generation in the world energy market.

10. Assess the present state of technology and its implementation as well as the future potential of tidal power systems.

Assessment Strategies

by assessing the present state of technology and its implementation as well as the future potential of tidal power systems.

Learning Objectives

- 10.a. Compare and contrast hydro power and tidal energy.
- 10.b. Summarize the history of tidal power.
- 10.c. Analyze the basic physics behind tidal currents.
- 10.d. Identify the various types of systems used and proposed within the tidal power industry.
- 10.e. Analyze the environmental concerns and economic factors involved with wide scale tidal power generation
- 10.f. Discuss the tidal energy potential in the global renewable energy industries.

Criteria

Your performance will be successful when:

- 10.1. you define tidal power and contrast its properties with hydro power.
- 10.2. you summarize the history of tidal power.
- 10.3. you describe how tidal currents and tidal flow relate to the sun and moon and tidal power systems.
- 10.4. you describe the characteristics of tidal power generation systems.
- 10.5. you identify the placement of turbines in tidal power systems and relate their placement to they type of tidal power system and its location.
- 10.6. you summarize the environmental factors that encourage or limit the spread of tidal power generating systems.
- 10.7. you list the potential for tidal power energy generation
- 10.8. you discuss the economic factors that limit tidal power generation systems.

11. Assess the present state of technology and its implementation as well as the future potential of wind energy.

Assessment Strategies

by assessing the present state of technology and its implementation as well as the future potential of wind energy.

Learning Objectives

- 11.a. Explain the atmospheric processes that give rise to wind energy.
- 11.b. Describe wind as a kinetic form of energy.
- 11.c. Summarize a history of wind energy.
- 11.d. Characterize the types of wind turbines and their potential uses.
- 11.e. Explain how properties of aerodynamics affects the generation of wind energy.
- 11.f. Describe how the properties of the wind turbines rotor blades affect the amount of energy generated.
- 11.g. Summarize the factors that contribute to how much energy a wind turbine can produce.
- 11.h. Understand a number of techniques that can be employed to give an approximate estimate of a sites wind speed characteristics.
- 11.i. Distinguish between the negative and positive environmental impacts of development of wind energy generation.
- 11.j. Develop a strategy to provide a preliminary cost analysis of wind energy given a particular site.
- 11.k. Summarize the potential for wind energy and its distribution in the global energy market.

Criteria

Your performance will be successful when:

- 11.1. you describe the processes that give rise to wind energy.
- 11.2. you define atmospheric wind terms including isobars, jet streams, and barometric pressures.
- 11.3. you can identify traditional examples of windmills and wind energy converter devices.
- 11.4. you describe wind turbine types including horizontal axis wind turbines and vertical axis wind turbines.
- 11.5. you define drag force and lift force in the context of aerodynamics and wind energy generation.
- 11.6. you identify how a rotor blades configuration affects the wind forces and velocities achieved by a turbine system.
- 11.7. you explain how the energy a wind turbine produces is dependent on its wind speed power curve and the wind speed frequency distribution at the site.
- 11.8. you are able to read wind speed maps and atlases to approximate the wind speed characteristics of a site.
- 11.9. you describe the environmental benefits of electricity generation by wind energy.
- 11.10. you describe the perceived negative impacts of electricity generation by wind energy.
- 11.11. you research planning and zoning ordinances that pertain to siting of wind turbines.
- 11.12. you analyze a basic cost calculation for a electricity generating wind system.
- 11.13. you summarize wind energy development worldwide and its potential.
- 11.14. you describe how offshore wind energy provides potential for future energy generation.

12. Assess the present state of technology and its implementation as well as the future potential of geothermal energy.

Assessment Strategies

by assessing the present state of technology and its implementation as well as the future of geothermal energy.

Learning Objectives

- 12.a. Identify the source of geothermal heat, its maximum and average temperatures.
- 12.b. Summarize the history of the use of geothermal heat.
- 12.c. Explain properties of physics that relate to geothermal resources.
- 12.d. Describe the types of geothermal power plants by comparing and contrasting their construction and efficiency.
- 12.e. Evaluate the environmental implications of geothermal energy generation.
- 12.f. Evaluate the economics and world potential of geothermal energy sources.

Criteria

Your performance will be successful when:

- 12.1. you describe the sources of geothermal heat and characteristics of the earth's composition.
- 12.2. you list the major historical milestones in the use of geothermal heat as an energy source.
- 12.3. you list and define the three important characteristics of geothermal resources.
- 12.4. you graphically depict the earth composition including all geothermal resources.
- 12.5. you classify the types of power plants for which dry steam is used as a geothermal energy source.
- 12.6. you explain how a ground source heat pump is used in single source domestic installation.
- 12.7. you analyze a simple geothermal application for its economic viability
- 12.8. you summarize the future world potential of geothermal energy.
- 12.9. you depict the environmental and economic concerns of geothermal energy.

13. Assess the present state of technology and its implementation as well as the future potential of alternative fuel vehicles.

Assessment Strategies

by assessing the present state of technology and its implementation as well as the future potential of alternative fuel vehicles.

Learning Objectives

- 13.a. Summarize the history of transportation and fuel consumption.
- 13.b. Evaluate the environmental impacts of dependence on fossil fuels for transportation.
- 13.c. Describe opportunities for alternative transportation types.
- 13.d. Compare options for alternative fuel vehicles for personal use.
- 13.e. Research the possibilities for future technology in the transportation industry.
- 13.f. Examine the potential of hydrogen as a future fuel source.
- 13.g. Discuss the potential for fuel cells in the transportation industry.
- 13.h. Examine the future of alternative fuel sources in the transportation industry.

Criteria

Your performance will be successful when:

- 13.1. you provide a summary of the history of transportation and use of fossil fuels.
- 13.2. you describe environmental problems associated with use of fossil fuels and transportation.
- 13.3. you analyze various options for alternative fuels for use in the transportation industry.
- 13.4. you summarize the 6 types of personal alternative fuel vehicles.
- 13.5. you describe the potential for hydrogen as a fuel source.
- 13.6. you explain how improvements in battery and energy storage technology will affect the automotive industry.
- 13.7. you describe how a fuel cell works.
- 13.8. you explain the environmental implications and potential for biodiesel as a fuel source
- 13.9. you summarize the use of methanol and ethanol in the transportation industry.
- 13.10. you examine the future of the transportation industry.

14. Explain the economics of combining energy conservation and renewable energy projects.

Assessment Strategies

by explaining the economics of combining energy conservation and renewable energy projects.

Learning Objectives

- 14.a. Discuss the benefits of reducing energy waste
- 14.b. Compare the electricity cost for various technologies of comparable products.

- 14.c. Examine the potential energy savings when taking a whole project approach to building, transportation and manufacturing.
- 14.d. Summarize the potential for savings in residential and commercial business by incorporation of energy efficiency practices.
- 14.e. Evaluate the potential for personal savings by incorporating energy efficiency.
- 14.f. Gather techniques for evaluating cost effectiveness of various energy efficient practices.
- 14.g. Discuss the implications of the reduction of energy consumption through energy efficiency on renewable energy technologies.

Criteria

Your performance will be successful when:

- 14.1. you describe the benefits of reducing energy waste.
- 14.2. you compare the electrical cost for comparable light bulbs of varying technologies.
- 14.3. you examine a commercial building for opportunities for energy efficiency.
- 14.4. you explain the implications of reducing energy use through energy efficiency as it relates to renewable energy sources.
- 14.5. you describe how a combination of energy efficiency and renewable energy technology is cost effective.

15. **Articulate the processes that consumers use for selection of "green" power and products.**

Assessment Strategies

by articulating the processes that consumers use for selection of "green" power and products.

Learning Objectives

- 15.a. Describe the motivations that lead consumers to select renewable energy technologies or implement sustainable practices.
- 15.b. Develop strategies to locate reliable sources of "green" products, companies and technologies
- 15.c. Examine model economic feasibility studies for renewable energy power generation sources.
- 15.d. Examine model standards for sustainable products.
- 15.e. Correlate tendencies in consumer purchasing with current events.

Criteria

Your performance will be successful when:

- 15.1. you summarize the motivations that lead consumers to invest in renewable energy technologies.
- 15.2. you create a library of resources to reliable "green" products, companies and technologies.
- 15.3. you develop resources to determine economic feasibility of renewable energy generation technologies.
- 15.4. you compare the model standards for sustainable products.
- 15.5. you link the status of consumer purchasing of sustainable products and renewable technologies to current events.
- 15.6. you construct a "roadmap" to guide consumers in their purchases of sustainable products and renewable technologies.

16. **Explore the types of job opportunities available in the renewable energy industry and investigate the skills required for these jobs.**

Assessment Strategies

by exploring the types of job opportunities available in the renewable energies industry and investigating the skills required for these jobs.

Learning Objectives

- 16.a. Assess what qualifies a job to be considered a renewable energy "green collar" job.
- 16.b. Acquaint self with the processes involved and industries affected by developing renewable energy technologies and sustainable products.
- 16.c. Evaluate the history of sustainable job growth in the United States and the Global Marketplace.
- 16.d. Identify current trends in job growth for renewable energy technologies.
- 16.e. Summarize the skills required for renewable energy "green collar" jobs.

Criteria

Your performance will be successful when:

- 16.1. you define "green collar" job.
- 16.2. you explain the supply chain for renewable energy technologies and products.
- 16.3. you formulate a holistic approach to "green" jobs and products.
- 16.4. you create a resource tool for finding jobs in renewable energy and sustainable practices.
- 16.5. you research a job in the renewable energy industries.

- 16.6. you develop a plan to acquire skills needed for a job in the renewable energy industries.
- 16.7. you identify trends in job growth for various renewable energy jobs.

Course Learning Plans and Performance Assessment Tasks

Type	Title	Source	Status
PAT	(No Title)	Course	Active
LP	(No Title)	Course	Active