

Certificate Course on Renewable Energy and the Environment

Course Syllabus

Duration: 16 Weeks (48 Hrs)

Course Description:

There is a growing sense of national and global urgency regarding carbon and climate change with particular emphasis on our energy system. Unfortunately, the answers are not simple. In this course, students explore our wide range of traditional and renewable energy sources and how these options impact our environment and society. Students are also exposed to the complex and compelling ethical issues raised by global, national and local changes in how we produce and use energy.

This course informs and engages students to be thoughtful, rather than passive, consumers of energy. Students gain the knowledge necessary to be articulate in career, community, and personal arenas regarding renewable energy resources. In addition, students develop the ability to evaluate and respond to present and future technological changes that impact their energy use in the workplace, at home, and in the community.

Participants Learning Outcomes:

Having successfully completed this course, participants can:

- Identify and describe present energy use, trends, and impacts.
- Describe the diverse renewable energy technologies that are available to individuals, businesses, and communities.
- Understand how differing societal perspectives impact individual and community choices regarding renewable energy technologies.
- Analyze the potential challenges and opportunities with various renewable energies.
- Understand the environmental, technical, policy, and economic implications of each of the renewable energy opportunities.
- Develop the ability to make informed personal, career, and public decisions regarding energy use for today's global world.

Course Topics:

Unit 1, Energy Overview: Lesson 1-4 (2 weeks)

An introduction and overview of energy and the role of both fossil fuels and renewable energy options in society and the environment.

Key concepts include:

- The carbon cycle - where carbon comes from (sources) and where does it go (sinks). The role of carbon in our atmosphere and ecosystem. Trends in atmospheric carbon.
- Life Cycle Assessment – an overview of the accounting system used to determine the relative contributions of carbon emissions from products and services. Several examples are provided with a focus direct and indirect carbon emissions with purchased products, food choices, and transportation, as viewed in terms of a personal carbon footprint.

- Climate change and weather - exploring the current science of climate change. What is the difference between natural climate cycles and current climate trends?
- Discussion of terms and units such as kinetic, potential, chemical and electrical energy, BTU, energy density, watts, kilowatts, and kilowatt hours.

Unit 2, Fossil Fuels: Lessons 5-11 (7 weeks)

A detailed look at our current fossil fuel based energy system with a review of technologies, trends, policies, and environmental implications for petroleum, natural gas, and coal.

Key concepts include:

- Reserves/supply, exploration, extraction, refining, and distribution, and environmental impacts, social implications of petroleum, natural gas and coal.
- Environmental impacts with topics such as pipeline vs rail transportation, oil spills, fracking, and CO₂ emissions.
- Transportation efficiency and conservation including fuel economy, efficiency measures, CAFE standards, alternative vehicles, economics implications, etc.
- Home energy efficiency and conservation concepts including heat loss and insulation in buildings, phantom power, lighting efficiency, appliance efficiencies, and home energy audits. (EISA, Energy Star, etc)
- Industrial and commercial energy use, conservation, and efficiency covering areas of heating, lighting, compressed air, motors, and manufacturing processes. Discussion includes relevant policies, programs, and other economic incentives. (NextGen, ISO 50001, Benchmarking)

Unit 3 Part 1, Biomass to Liquid Fuels: Lessons 12-17

An overview of biomass technologies and their current and future uses in society and a discussion of related policies, environmental concerns, and economic issues.

Key concepts include:

- Challenges of integrating renewable fuels into our current transportation system
- Concepts of first generation, second generation, advanced biofuels and biomass refineries.
- Logistics of the biomass to fuel supply chain, net energy balance of these systems and how these systems impact land use and the environment.
- Biological and chemical conversion of biomass to ethanol, biodiesel, and other fuels
- Progress on algae for fuel along with other designated biomass crops.
- Renewable Fuel Standard and other related policies.

Unit 3 Part 2, Biomass/Waste to Energy: Lessons 18-20

Biomass to energy conversion with a focus on waste products. With each of these technologies we include an overview of the technology, environmental controversies, economics, and policy drivers.

- Municipal waste to energy systems technologies. (WTE facilities)
- Anaerobic digestion technology to convert organic waste such as farm, food and wastewater to produce biogas.
- Wood waste and designated woody biomass crops and the conversion to combined heat and power.

Unit 4, Renewables: Lessons 21-27

This unit provides an in-depth study of the most popular renewable energy technologies and trends in the industry. With each of these energy sources we include an overview of the technology, economics, environmental implications of their use and expansion and related policies.

- Hydroelectricity: Hydroelectric dams and wave energy.
- Wind energy from both land and water based systems.
- Solar energy including solar thermal, solar photovoltaic, and concentrated solar power
- Nuclear energy: The technology, challenges, and the importance of this low carbon (yet not renewable) energy source in our energy system.
- Deep geothermal for electricity and heating.
- Ground source heat pumps for heating and cooling.
- Fuel cells – a brief description of operation and challenges.

Unit 5, Policy and Community Engagement: Lessons 28 and 29.

The final unit focuses on understanding the policy implications and political climate that impacts the development of renewable energy sources.

Key concepts include:

- Policy options, market forces and economic drivers that effect energy in the US. With particular attention to the Minnesota Renewable Portfolio Standard, Next Gen Act, EISA, CPP
- Personal responsibility, life-long learning, and involvement through community-based energy organizations.