



8292

SUSTAINABLE ENERGY:
WIND SYSTEMS (12B)

40S/40E/40M

A Sustainable Energy Course

8292: SUSTAINABLE ENERGY: WIND SYSTEMS (12B) 40S/40E/40M

Course Description

This course focuses on the use of wind energy for generating electricity. It explores both utility-scale wind farms and small wind systems (< 100 kW). Students will plan and contribute to the installation of a small wind turbine.

Topics include the following:

- baseline wind resource assessments
- geographic information system (GIS) data sets/maps for wind farm siting
- wind turbine product selection
- wind turbine installation
- safety practices and procedures

Goal 1: Describe and apply appropriate **health and safety practices** as they relate to the sustainable energy industry.

GLO 1.1: Demonstrate adherence to **safety practices and procedures** for **facilities, processes, tools, and equipment** used in the sustainable energy industry.

- SLO 12B.1.1.1: Demonstrate adherence to safety practices and procedures for facilities, processes, tools, and equipment used in the sustainable energy industry.
- SLO 12B.1.1.2: Describe health and safety requirements.
- SLO 12B.1.1.3: Describe personal protective equipment (PPE) and procedures.
- SLO 12B.1.1.4: Describe electrical safety practices and procedures.
- SLO 12B.1.1.5: Describe fire safety practices and procedures.
- SLO 12B.1.1.6: Describe ergonomic considerations related to the sustainable energy industry.
- SLO 12B.1.1.7: Describe hazard recognition and control practices.
- SLO 12B.1.1.8: Describe the hazards of confined space entry.
- SLO 12B.1.1.9: Describe safety requirements as they apply to the Workplace Hazardous Materials Information System (WHMIS).
- SLO 12B.1.1.10: Describe the identification and control of specified hazards.

SLO 12B.1.1.11: Demonstrate safe work practices related to the sustainable energy industry.

SLO 12B.1.1.12: Describe safety guidelines related to the sustainable energy industry.

Goal 2: Demonstrate the safe and appropriate **operation, handling, cleaning, maintenance, and storage** of **equipment, tools, materials, products, and consumable items**.

GLO 2.1: Demonstrate the safe and appropriate **operation and handling** of equipment, tools, materials, products, and consumable items.

SLO 12B.2.1.1: Demonstrate the safe and appropriate operation and handling of equipment, tools, materials, products, and consumable items used in wind energy systems.

GLO 2.2: Demonstrate the safe and appropriate **cleaning, maintenance, and storage** of equipment, tools, materials, products, and consumable items.

SLO 12B.2.2.1: Demonstrate the safe and appropriate cleaning, maintenance, and storage of equipment, tools, materials, products, and consumable items used in wind energy systems.

Goal 3: Demonstrate an understanding of **demand-side management (DSM)** as it applies to sustainable energy.

GLO 3.1: Demonstrate an understanding of **DSM** as it applies to sustainable energy.

SLO 12B.3.1.1: Demonstrate an awareness of designs and processes that maximize the efficiency of wind energy systems.

SLO 12B.3.1.2: Demonstrate the ability to conduct a cost-benefit analysis of wind energy systems.

Goal 4: Demonstrate the knowledge and skills required to **promote and plan sustainable energy systems**.

GLO 4.1: Demonstrate the knowledge and skills required to **promote** sustainable energy systems.

SLO 12B.4.1.1: Describe existing strategies, both in the private and public sectors (e.g., Manitoba Growth, Enterprise and Trade, Manitoba Hydro, Manitoba Sustainable Energy Association, EnergyManitoba), that promote wind energy systems in Manitoba.

GLO 4.2: Demonstrate the knowledge and skills required to **plan** sustainable energy systems.

- SLO 12B.4.2.1: Perform an energy audit for a building proposed as a site for the installation of a small wind energy system.
- SLO 12B.4.2.2: Collect and analyze relevant baseline data (e.g., wind speed, direction) that will determine the efficiency of a small wind energy system.
- SLO 12B.4.2.3: Size a wind energy system according to a baseline data analysis (e.g., required total watt-hours/day, peak instantaneous power use, duty cycle, peak load versus base load).
- SLO 12B.4.2.4: Determine an appropriate location (e.g., tower or roof mount) for a wind turbine, taking into account bylaw considerations.
- SLO 12B.4.2.5: Select an appropriate wind turbine for a specific location (e.g., horizontal or vertical axis, cut-in speed, rated power).
- SLO 12B.4.2.6: Determine an appropriate battery bank set-up for a wind energy system.

Goal 5: Demonstrate the knowledge and skills required to **install or convert sustainable energy systems**.

GLO 5.1: Demonstrate the knowledge and skills required to **perform the installation or conversion** of sustainable energy systems.

- SLO 12B.5.1.1: Participate in the installation or conversion of a small wind energy system.

Goal 6: Demonstrate the knowledge and skills required to **maintain sustainable energy systems**.

GLO 6.1: Demonstrate the knowledge and skills required to **perform preventive maintenance** of sustainable energy systems.

- SLO 12B.6.1.1: Monitor a wind energy system to determine whether it is operating to its designed specifications.

GLO 6.2: Demonstrate the knowledge and skills required to **diagnose malfunctions** in sustainable energy systems.

- SLO 12B.6.2.1: Diagnose both external malfunctions (e.g., wildlife damage) and internal malfunctions (e.g., wiring problems, loose connections, blown fuses, tripped breakers) in wind energy systems.
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GLO 6.3: Demonstrate the knowledge and skills required to **repair** sustainable energy systems.

SLO 12B.6.3.1: Read and demonstrate an understanding of product warranties.

SLO 12B.6.3.2: Repair wind energy systems.

SLO 12B.6.3.3: Replace/repair fuses, broken wires, and loose connections.

Goal 7: Describe and apply transferable **cross-curricular knowledge and skills** as they relate to sustainable energy.

GLO 7.1: Demonstrate **information and communication technology** skills required in the sustainable energy industry.

SLO 12B.7.1.1: Demonstrate how geographic information systems (GIS) can be used to determine locations for wind farms.

GLO 7.2: **Read, interpret, and communicate information** related to the sustainable energy industry.

SLO 12B.7.2.1: Read, interpret, and communicate information related to wind energy systems.

SLO 12B.7.2.2: Read, interpret, and communicate information from electrical schematics.

GLO 7.3: Demonstrate knowledge of **mathematical** concepts and skills related to the sustainable energy industry.

SLO 12B.7.3.1: Demonstrate knowledge of mathematics skills related to wind energy systems.

SLO 12B.7.3.2: Convert between imperial and metric systems of measurement.

SLO 12B.7.3.3: Demonstrate the use of fractions, decimals, ratios, and percentages.

SLO 12B.7.3.4: Apply mathematical formulas to electrical calculations.

SLO 12B.7.3.5: Demonstrate knowledge of load-duration and demand-duration curves.

SLO 12B.7.3.6: Demonstrate an understanding of the Weibull probability density function.

SLO 12B.7.3.7: Demonstrate an understanding of the wind energy absorption rate.

SLO 12B.7.3.8: Demonstrate an understanding of the wind farm capacity factor.

GLO 7.4: Demonstrate knowledge of **science** as it relates to the sustainable energy industry.

- SLO 12B.7.4.1: Demonstrate knowledge of science as it relates to sustainable wind energy systems.
- SLO 12B.7.4.2: Apply scientific knowledge and equations to electrical Ohm's law formulas.
- SLO 12B.7.4.3: Define terminology associated with electrical fundamentals.
- SLO 12B.7.4.4: Describe current and electron flow in direct current (DC) and alternating current (AC) circuits.
- SLO 12B.7.4.5: Describe the relationships between voltage, current, resistance, and power.
- SLO 12B.7.4.6: Calculate voltage, current, and resistance in series, parallel, and combination circuits.
- SLO 12B.7.4.7: Identify, and describe the characteristics of, series, parallel, and series-parallel electrical circuits.
- SLO 12B.7.4.8: Demonstrate measuring voltage, resistance, current, and power.

Goal 8: Demonstrate an understanding of the **ethical and legal standards** that pertain to the sustainable energy industry.

GLO 8.1: Demonstrate an awareness of the **ethical and legal expectations** of the sustainable energy industry.

- SLO 12B.8.1.1: Demonstrate an understanding of the need to adhere to local authority requirements (e.g., permit, insurance, emission regulations) related to sustainable energy.
 - SLO 12B.8.1.2: Demonstrate an understanding of the importance of accurate performance reporting for wind energy systems.
 - SLO 12B.8.1.3: Demonstrate an awareness of the certification requirements from a recognized certifying body for a small wind system installer.
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Goal 9: Practise **employability skills** required in the sustainable energy industry.

GLO 9.1: Demonstrate **employability skills**.

- SLO 12B.9.1.1: Demonstrate problem-solving skills.
- SLO 12B.9.1.2: Demonstrate critical thinking skills.
- SLO 12B.9.1.3: Demonstrate regular attendance and punctuality.
- SLO 12B.9.1.4: Demonstrate accountability by taking responsibility for own actions.
- SLO 12B.9.1.5: Demonstrate adaptability, initiative, and effort.
- SLO 12B.9.1.6: Demonstrate the ability to accept feedback and to follow direction.
- SLO 12B.9.1.7: Demonstrate teamwork skills.
- SLO 12B.9.1.8: Demonstrate the ability to stay on task and to make effective use of time in class and shop environments.
- SLO 12B.9.1.9: Demonstrate the ability to communicate respectfully and effectively with co-workers and customers.

Goal 10: Demonstrate an awareness of **sustainability** as it pertains to the sustainable energy industry.

GLO 10.1: Describe the impact of **sustainability** on the **health and well-being** of sustainable energy industry workers, their customers, and those who are affected by their products and services.

- SLO 12B.10.1.1: Discuss the benefits of wind energy systems to human health and well-being.
- SLO 12B.10.1.2: Discuss how wind energy systems can negatively affect humans (e.g., wind turbine syndrome).

GLO 10.2: Describe the sustainable energy industry's **sustainability practices and their impact on the environment**.

- SLO 12B.10.2.1: Describe sustainability practices related to wind energy systems and their impact on the environment.

GLO 10.3: Describe the **relationship between the economy and sustainability practices** within the sustainable energy industry.

- SLO 12B.10.3.1: Discuss the effect of wind energy systems on the local and national economies.
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Goal 11: Demonstrate an understanding of **career options** in sustainable energy.

GLO 11.1: Describe **apprenticeship, post-secondary education, and employment opportunities** related to sustainable energy.

SLO 12B.11.1.1: Describe apprenticeship, post-secondary education, and employment opportunities related to wind energy systems.

Goal 12: Demonstrate an understanding of the **evolution** of sustainable energy, including its **technological progression** and **emerging trends**.

GLO 12.1: Demonstrate an understanding of the **evolution** of sustainable energy, including its **technological progression** and **emerging trends**.

SLO 12B.12.1.1: Demonstrate an understanding of the evolution of wind energy systems, including their technological progression and emerging trends.
