



8279

SUSTAINABLE ENERGY:
SOLAR SYSTEMS (12A)

40S/40E/40M

A Sustainable Energy Course

8279: SUSTAINABLE ENERGY: SOLAR SYSTEMS (12A) 40S/40E/40M

Course Description

This course focuses on solar energy technologies used to heat buildings and generate electricity. Students will become familiar with major solar energy installation sites in Manitoba (e.g., Manitoba Hydro Place—solar chimney, Manitoba Housing Authority—solar wall, Red River College—solar trough). Building on the solar energy basics explored in the Grades 9 to 11 sustainable energy courses, students will plan and contribute to the installation of a solar system (either solar photovoltaic or solar thermal).

Topics include the following:

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

- SLO 12A.1.1.10: Describe the identification and control of specified hazards.
- SLO 12A.1.1.11: Demonstrate safe work practices related to the sustainable energy industry.
- SLO 12A.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 12A.2.1.1: Demonstrate the safe and appropriate operation and handling of equipment, tools, materials, products, and consumable items used in solar energy systems.
-

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

- SLO 12A.2.2.1: Demonstrate the safe and appropriate cleaning, maintenance, and storage of equipment, tools, materials, products, and consumable items used in solar 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 12A.3.1.1: Demonstrate an awareness of designs and processes that maximize the efficiency of solar energy systems.
- SLO 12A.3.1.2: Demonstrate the ability to conduct a cost-benefit analysis of solar 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 12A.4.1.1: Describe existing strategies, both in the private and public sectors (e.g., Manitoba Growth, Enterprise and Trade, Manitoba Sustainable Energy Association, EnergyManitoba), that promote solar energy systems in Manitoba.

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

SLO 12A.4.2.1: Perform an energy audit for a building proposed as a site for the installation of a solar (photovoltaic [PV] or heat) energy system.

SLO 12A.4.2.2: Evaluate solar resources of a proposed solar energy installation site.

SLO 12A.4.2.3: Collect and analyze relevant baseline data (e.g., sunlight hours, shading concerns, temperature, precipitation) that will determine the efficiency of a solar energy system.

SLO 12A.4.2.4: Size a solar energy system according to a baseline data analysis (e.g., required total watt-hours/day, peak instantaneous power use, peak heat use, duty cycle, peak load versus base load).

SLO 12A.4.2.5: Determine an appropriate location (e.g., rooftop, ground) for PV panel mounts.

SLO 12A.4.2.6: Perform a roof inspection for PV panel mounts.

SLO 12A.4.2.7: Determine an appropriate battery size and battery bank set-up for a PV 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 12A.5.1.1: Participate in the installation or conversion of a solar energy system (either PV or heat).

SLO 12A.5.1.2: Frame and mount PV panels.

SLO 12A.5.1.3: Interpret a PV system schematic.

SLO 12A.5.1.4: Demonstrate an understanding of the various components (e.g., panels, inverter, charger controller, battery charger) of a PV 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 12A.6.1.1: Perform preventive maintenance of sustainable energy systems.
 - SLO 12A.6.1.2: Monitor a solar energy system to determine whether it is operating to its designed specifications.
 - SLO 12A.6.1.3: Perform a visual inspection of PV panels to ensure they are not covered (e.g., by debris, snow).
-

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

- SLO 12A.6.2.1: Diagnose both external malfunctions (e.g., shading, debris, wildlife damage) and internal malfunctions (e.g., wiring problems, loose connections, blown fuses, tripped breakers) in solar PV systems.
 - SLO 12A.6.2.2: Monitor and collect data on solar thermal energy system performance (e.g., temperature, pressure, voltage, amperage, resistance).
-

GLO 6.3: Demonstrate the knowledge and skills required to **repair** sustainable energy systems.

- SLO 12A.6.3.1: Read and demonstrate an understanding of product warranties.
 - SLO 12A.6.3.2: Repair solar energy systems.
 - SLO 12A.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 12A.7.1.1: Demonstrate how geographic information systems (GIS) can be used to determine locations for solar panel installations.
-

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

- SLO 12A.72.1: Read, interpret, and communicate information related to solar energy systems.
 - SLO 12A.72.2: 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 12A.73.1: Demonstrate knowledge of mathematics skills related to solar PV systems.
 - SLO 12A.73.2: Convert between imperial and metric systems of measurement.
 - SLO 12A.73.3: Demonstrate the use of fractions, decimals, ratios, and percentages.
 - SLO 12A.73.4: Apply mathematical formulas to electrical calculations.
 - SLO 12A.73.5: Demonstrate knowledge of load-duration and demand-duration curves.
 - SLO 12A.73.6: Demonstrate an understanding of declination and Cooper's equation.
 - SLO 12A.73.7: Demonstrate an understanding of how to calculate extraterrestrial solar radiation and the clearness index.
-

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

- SLO 12A.74.1: Demonstrate knowledge of science as it relates to sustainable solar energy systems.
 - SLO 12A.74.2: Apply scientific knowledge and equations to electrical Ohm's law formulas.
 - SLO 12A.74.3: Define terminology associated with electrical fundamentals.
 - SLO 12A.74.4: Describe current and electron flow in direct current (DC) and alternating current (AC) circuits.
 - SLO 12A.74.5: Describe the relationships between voltage, current, resistance, and power.
 - SLO 12A.74.6: Calculate voltage, current, and resistance in series, parallel, and combination circuits.
 - SLO 12A.74.7: Identify, and describe the characteristics of, series, parallel, and series-parallel electrical circuits.
 - SLO 12A.74.8: 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 12A.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 12A.8.1.2: Demonstrate an understanding of the importance of accurate performance reporting for solar energy systems.
- SLO 12A.8.1.3: Demonstrate an awareness of the certification requirements from a recognized certifying body for a solar PV system installer.

Goal 9: Practise **employability skills** required in the sustainable energy industry.

GLO 9.1: Demonstrate **employability skills**.

- SLO 12A.9.1.1: Demonstrate problem-solving skills.
 - SLO 12A.9.1.2: Demonstrate critical thinking skills.
 - SLO 12A.9.1.3: Demonstrate regular attendance and punctuality.
 - SLO 12A.9.1.4: Demonstrate accountability by taking responsibility for own actions.
 - SLO 12A.9.1.5: Demonstrate adaptability, initiative, and effort.
 - SLO 12A.9.1.6: Demonstrate the ability to accept feedback and to follow direction.
 - SLO 12A.9.1.7: Demonstrate teamwork skills.
 - SLO 12A.9.1.8: Demonstrate the ability to stay on task and to make effective use of time in class and shop environments.
 - SLO 12A.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 12A.10.1.1: Discuss the benefits of solar energy systems to human health and well-being.

SLO 12A.10.1.2: Discuss how solar energy systems can negatively affect humans (e.g., aesthetic concerns).

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

SLO 12A.10.2.1: Describe sustainability practices related to PV 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 12A.10.3.1: Discuss the effect of solar energy systems on the local and national economies.

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 12A.11.1.1: Describe apprenticeship, post-secondary education, and employment opportunities related to PV 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 12A.12.1.1: Demonstrate an understanding of the evolution of solar energy systems, including their technological progression and emerging trends.
