Gridworks 5-day solar PV design and installation Course syllabus

The objectives of this 5 day PV design and installation course are to:

- Provide an introduction to renewable energy
- Describe various PV systems and their components
- Explain operation of modules and electrical characteristics
- Go through a site assessment including shade analysis
- Describe common installation methods on various surfaces
- Explain the theory of both grid-connected and off-grid systems
- Size and design multiple grid-connected PV systems
- Size and design multiple off-grid PV systems
- Utilize the Canadian Electrical Code to install systems safely
- Commission, troubleshoot, and perform maintenance on a PV system
- Properly utilize the OH&S Act, Code, and Regulation during installations
- Design and install a 1.5kW string inverter system
- Design and install a 1.5kW micro inverter system

Unit 1 – Introduction to Renewable Energy

- Overview of the PV industry past and present including history of PV
- Common and required terminology in both industry and CE Code (Canadian Electrical Code)
- Climate change and it's mitigation through policy world-wide
- Different types of financial incentives and policies from around the world
- Environmental impacts
- Energy efficiency and reduced consumption
- Why energy efficiency is important when it comes to a renewable energy like PV
- A comparison of non-renewables and renewables
- Other forms of renewables (solar hot water, wind, geothermal, etc.)
- Different careers available in the industry and how to attain them

Unit 2 – PV Systems and Electrical Components

- Examine the differences between DC current and AC current
- Examine basic components for electrical and PV systems including racking, RSDs, and building entrance methods
- Certification of equipment
- Discuss the components required for different types of PV systems (ex. grid-connected and off-grid battery based systems)
- Discuss grid connected and off grid differences and economics of each
- We will look at how a grid-connected PV system works, looks and behaves and discuss how a grid-connected system works with different types of regulations and incentives (ex. FIT's and Net-Metering)
- Explain the basics of a micro inverter vs string inverter system

Unit 3 – PV Modules and Electrical Theory

- Provide an in-depth understanding of how a PV module is constructed.
- Discuss the processes a module goes through for testing
- Explain STC (Standard Test Conditions) and labeling
- Describe how a PV cell/module produces electricity from sunlight
- Discuss the different types and materials used in the construction of PV cells (ex. Mono-crystalline and polycrystalline cells)
- Discuss the specific terminology required for the design of PV systems
- Discuss series/parallel circuits and how they relate to not only PV modules/arrays and the design but to the safe installation of an entire PV system
- Discuss how temperature and irradiance fluctuations can have a significant effect on PV cells, modules, arrays and the design of PV systems (there will be labs for testing modules at this point)
- Show I-V (current-voltage) curve characteristics of modules, arrays, and PV system designs
- Explain MPPT (Maximum Power Point Tracking) and it's uses
- Go through several exercises for the design of grid-connected PV systems and the basic math and formulas used

Unit 4 – Site Analysis and Mounting Solutions

- Discuss site analysis, planning, and implementation
- Use the Solar Pathfinder and Solmetric Suneye via demonstration labs to determine site shading
- Discuss the different instruments and tools required for solar site analysis
- Discuss the need to understand the following factors and how they apply to PV systems and yearly energy production:
    - Azimuth (orientation)
    - Magnetic declination
    - Tilt angle
    - Shading, debris, other losses
    - Roof type (material and condition)
    - Roof structure
- Explain solar resource data from various sources
- Discuss the different mounting methods, costs associated, pros and cons with each type, and why you would choose one mounting method over another

Unit 5 – Grid-Connected PV Systems

- Discuss system sizing for a client's needs, desires, and/or budget
- Address energy efficiency and why it's important for people who are considering a grid-connected PV system
- Sizing a system requires addressing a client's habits when consuming (electrical) energy and the property's ability or inability to accommodate a PV system
- Explain losses and how some are calculated
- Examine the formulas used to calculate appropriate performance and derating factors, solar insolation, temperature co-efficient parameters, and code specific rules then apply these to a PV system design
- Explain how to do proper load analysis on various electrical appliances using a watt meter
- Discuss how to determine the correct size of a grid-connected PV system for a client using a yearly kWh consumption derived from the client's electricity bills
- Discuss how to calculate the amount of space needed for a PV array and how to properly lay it out
- Explain how to determine whether there is a need for any upgrades to the structure, electrical system, and/or property
- Examine different types of grid-dependent inverters (string, central, and micro inverters), their unique qualities and performance values, how and why to choose the proper one for your system as well as installation techniques
- Discuss how all of this will determine the system size, the number of PV modules, wiring configuration, and type of inverter

Unit 6 – Off Grid PV Systems

- Discuss equipment and components used in off-grid PV installations
- Examine different system designs and configurations
- Perform sizing calculations for PV array and battery bank sizes
- Explain proper installation methods for PV arrays, battery banks, and additional equipment
- Discuss proper maintenance regimes and their importance in battery based systems

Unit 7 – Canadian Electrical Code Requirements and Documentation

- Examine how to properly bond and ground a PV system and why it is so important
- Examine different bonding and grounding equipment specific to the PV industry
- How to properly determine the type, size, and ratings of wiring/cabling, over-current protection (fusing and circuit breakers), and BOS (Balance of System) components (ex. Disconnects, Junction boxes, combiner boxes etc.)
- Examine specific Canadian Electrical Code nomenclature
- How to determine voltage drop and why it is important
- Examine wire gauge and ampacities, types of conductors, size and colour coding of conductors, and insulation ratings
- Examine PV wire and PV specific connectors
- Examine different wire and cable protection methods (conduits and raceways)
- Perform calculations based on the above course material
- Describe the Microgeneration Regulation application process

Unit 8 – Installation, Commissioning, Troubleshooting, Maintenance, and Safety

- Examine the specifics when it comes to installation and building integration (mechanically and electrically) of grid-connected PV systems
- We will examine different methods of installing PV systems mechanically to homes and buildings
- Pay attention to the building envelope and ensure it is completely sealed during installation
- We will examine safe and effective ways to integrate PV systems electrically to homes and buildings and how to deal with “Islanding and Anti-Islanding” issues for buildings with back-up generators
- We will examine proper ways to commission, troubleshoot, and maintain PV systems
- We will examine safety issues and hazards both specific and non-specific to the PV industry
- Discuss OH&S Requirements on site for PV installations

2 Day Hands-On Installation

- Design and install both a microinverter and string inverter system on a full scale, fully shingled roof
- Complete OH&S documentation as required in the field
- Perform multiple sizing and layout examples
- Complete a post install commissioning and testing
- Troubleshoot common issues

**Please Note: As per the Province or Alberta’s Electrician Trade Regulation 274/2000, anyone who is not a Certified Electrician or Registered Electrical Apprentice will have to sign an "Acknowledgment and Release Waiver" stating that this training will not qualify you to design or install solar photovoltaic (PV) systems, and you will not be a certified solar PV installer as a result of completing the course. Further, you must understand and acknowledge that the installation, alteration, repair, inspection, verification, commissioning, maintenance, and operation of electrical systems, including solar PV systems, must be performed by a certified Electrician.