4 DAY ADVANCED GRID-CONNECTED SOLAR PV DESIGN AND INSTALLATION COURSE OVERVIEW/SYLLABUS

Objectives:

The objective of this 4-day PV design and installation course is to provide insight into the PV industry, design training for grid-connected PV systems, the Canadian Electrical Code and how it applies to PV, theory, safety.

Unit 1 Introduction to Renewable Energy

A thorough overview of the PV industry past and present. An overlook at the history of PV. Discuss common terminology in both industry and examine CE Code (Canadian electrical Code) required terminology. We will examine types of PV systems and their differences physically, electrically, and economically (ex. Grid-connected Vs. off-grid).

We will discuss the different careers available in the industry and how to attain them. We will discuss the need for renewables, climate change and its mitigation through policy world-wide, the environmental impacts of non-renewables vs. renewables.

We will touch on other forms of renewables (solar hot water, wind, geothermal etc.). We will discuss why energy efficiency is very important when it comes to marrying renewable energy like solar PV. We will discuss different types of financial incentives and policy from around the world, Canada and Alberta.

We will provide a road map for you to travel upon as you decide how you want to enter the solar PV market.

We will discuss why it will become incredibly important for you as a new solar electrical contractor to familiarize yourself with EVSE installation safe and best practices for your solar clients. as well as backup battery systems.

Unit 2 PV System's and Electrical Components

We will examine all the components of PV systems and the electrical components associated with the electrical and mechanical integration of PV systems. The importance of valid Certification for PV equipment and all electrical components. We will Look at and discuss the components required for different types of PV systems (ex. grid-connected and

off-grid battery based systems or the different types of inverter based grid-connected systems).

We will examine the differences between DC current and AC current and why it's important for you understand how to work with both when designing and installing PV equipment and systems.
We will look at how a grid-connected PV system works, how it operates, looks and behaves and discuss how a grid-connected system marries different types of regulations/incentives (ex. FIT's, Net-Metering, Net-Billing, rebates etc.).

We will showcase all of this with all of our up-to-date hands-on solar equipment in our Training Centre. We will show you example of all the major brands of solar equipment that you can easily purchase here in Alberta.

Unit 3 Modules, Series and Parallel Circuits, Multimeter labs

We will show and provide you with an in-depth understanding of how a PV module is constructed and its physicality and why it looks the way it does. We will discuss the processes a module goes through for testing-STC (Standard Test Conditions) and labeling and why that is so important to you in your new career.

We will describe how a PV cell / module produces electricity from sunlight and how electrons travel within a PV cell / module / or array. We will discuss the different types and materials used in the construction of PV cells (ex. Mono-crystalline and polycrystalline cells) and PV modules.

We will discuss the specific terminology required for the design of PV systems and why it's important and where to use them. We will discuss DC and AC series and parallel circuits and how they relate to PV modules. We will discuss PV arrays as a whole and the design and safe installation of entire PV systems.

We will discuss how temperature and irradiance (light) fluctuations can have a significant effect on PV cells, modules, arrays as well as the design of PV systems (there will be labs for testing modules at this point). We will show I-V (current-voltage) curve characteristics of modules, arrays and PV system design.

Unit 4 Solar Site Analysis, Mounting Solutions, Interpret Design documents and coordinating with AHJ's and preparing documents.

We will discuss site analysis, planning and implementation using the Solar Pathfinder and Solmetric Suneye via demonstration videos and labs. Discuss the different instruments and tools required for solar site analysis. Discuss the need to understand azimuth (orientation), tilt angle, shading and debris, magnetic declination, roof type (material)/condition and roof

structures and how it all applies to PV systems, PV system design, and yearly energy production of PV systems.

the CE Code, permitting and inspection and what to expect when coordinating permitting and asking for We will speak about AHJ's (authority having jurisdiction) and the role they play along with inspection of completed PV systems.

We show you the typical documents required for permitting, grid-interconnection and rebates that are required for local jurisdictions plus what to expect when dealing with AHJ requirements for PV systems in Alberta.

Onsite review, interpretation of design documents and site preparations are crucially important and we will discuss why. We will discuss the different mounting methods, costs associated, pros and cons with each type, and why you would choose one mounting method over another. We will show you several different ways you can attach a PV system to a roof for residential or commercial based systems.

We will go through several exercises for the design of grid-connected PV systems using math and formulas and design a complete system on paper in the next chapter. During this chapter we will discuss and show you several cloud based solar PV design software options and give you a demonstration by designing a complete system online.

Unit 5 Grid-Connected PV System Sizing, Off-Grid system sizing and Components

We will discuss PV system sizing for a client's needs or desire or budget by addressing energy efficiency and why it's important for people who are considering a grid-connected PV system. We will do this by addressing a client's habits when consuming (electrical) energy and by assessing a client's property and it's ability or inability to accommodate a PV system. We will show you how to correctly use and interpret that data that you have collected for a properties site assessment.

We will examine how to apply appropriate performance and de-ration factors based on specific types of installations, solar insolation data, seasonal temperature coefficients, and CE Code specific regulations. We will introduce you to the math and formulas used to determine these.
We will cover how to do proper load analysis on various electrical appliances using a watt meter or calculations for off grid PV systems.
We will 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 and we will discuss how to properly site a grid-connected PV system, the amount of space needed, and whether there is a need for any upgrades to the structure, the buildings electrical infrastructure, and/or property.

We will examine different types of grid-dependent inverters (string inverter, string inverter with optimizers, central inverter and micro-inverters) and their unique qualities and differences in performance, dollar value and why some are chosen overt the other.

We will discuss how to choose the proper grid-connected system for a building and why it's important, as well installation techniques and best practices. We will discuss how all of this will determine the system size, (the number of PV modules) and wiring configuration and type of inverter.
We will show the how to consider and determine DC watts and AC Watts for a PV system and why that is important when it comes to manufacturer DC to AC ratios.

We will examine off-grid (stand-alone) PV systems, their design and installation of charge controller and batteries (lead acid, lithium, etc.) and code requirements.

Unit 6: Grounding and Bonding, Wiring, Over-current Protection, Electrical Configuration. All will be discussed according to Canadian Electrical Code.

This chapter we will take a deep dive into the Canadian Electrical Code Part 1 and all the most important or contentious rules that solar contractors come across and how we work with inspection authorities to deal with them effectively and collaboratively.

As an example, will examine Grounding and bonding and the differences of the two when it comes to PV systems. How to properly bond and ground a PV system and why it is so important. We will look at different bonding and grounding material and bonding equipment specific to the PV industry.

We will tie all the previous units into how to properly determine the type, size and insulation ratings of wiring/cabling, over-current protection (fusing and circuit breakers), and BOS (Balance of System) components (ex. Disconnects, Junction boxes, combiner boxes etc.) and why it is so important when working with both DC and AC circuits. We will examine specific Canadian Electrical Code nomenclature. We will look at how to determine voltage drop and why it is important. Wire gauge and their ampacity and how they changed, types of conductors, size and colour coding of conductors and what it means. We will look at PV wire and PV specific connectors. We will look at different wire and cable protection methods (conduits and raceways). We will go through example of each.

We will look at and give examples of rapid shutdown requirements plus how to use the CE Code to determine if and how to you can avoid installing rapid shutdown equipment.

We will look a conductor or busbar ratings and why this is so important for you during your site assessments and subsequent PV system design.

Plus, much more…

Unit 7: Installation and Building Integration, Commissioning, Troubleshooting and Maintenance, and SAFETY.

We will examine the specifics when it comes to installation and building integration (mechanically and electrically) of grid-connected PV systems. We will examine different ways to attach PV systems mechanically to homes and buildings.

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 PV systems, trouble shoot and maintain PV systems, decommissioning PV systems for maintenance and repair.

We will examine extensively safety issues and hazards specific and non-specific to the PV industry and specific regulations and enforcements there-of and the duties of employers and employees.

Unit 8: A bonus EV & EV Infrastructure course.

We will examine the EV industry in depth. We will look at the different types of EV's available, EV charging, EV range, EV misconceptions and misinformation etc.
We will look at EV infrastructure and how it is designed and installed and wired. We will look at the CE Code requirements for EV infrastructure. All of this much more.

1 Day of Hands-On Installation Training.

We take all that is learned for the first 3 days of in class instruction and apply it to this hands-on section.
Students get the experience of installing 3 real-world grid-connected solar PV systems. The instructor will give the students, who will work as a crew, specific scenarios for design. They will design the system and they will then determine how to lay it out oil the roof, install each component in order, and wire it properly and test. The instructor will guide where necessary.

1 - String inverter system
1- String inverter system with optimizers
1- Micro-inverter system

** Please Note: Anyone who is not a Certified Electrician or Registered Electrical Apprentice will need 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 because of completing the Course. Further, I 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.