

PHOTON Academy 5-day Workshop: Installing and Designing PV Systems

This 40-hour comprehensive training workshop will teach participants how solar photovoltaic systems work, how they are designed, how to predict the output of a system, and how systems are installed. The program will cover the fundamentals of PV, such as how voltage, current, power and energy interrelate, and also fundamental knowledge about the economics and expected payback period. This program is designed for those who intend to pursue a professional career in Solar PV design and installation.

Syllabus & Curriculum

Day 1

Solar PV Introduction

- Renewable energy trend (global and local)
- Solar PV opportunities
- PV markets & applications

1 Safety Basics

- PV specific safety hazards & the Local Electric Code
- OSHA (Occupational Safety & Health Administration)
- PV electrical shock, electrocution and arc flash
- Ladder safety and angles
- Fall protection

2 Electrical Basics

- Electrical circuit components
- Electrical test equipment
- Utility systems, generation, transmission, distribution & electrical service
- Using a digital multimeter to test voltage, current and resistance
- Measuring Voc, Isc and voltage and current under a load
- Using a power meter to make an IV curve

3 Solar Energy Fundamentals

- Making a sun path diagram
- Reading sun path diagrams
- Magnetic vs. true azimuth
- PV shading principles
- Shade analysis tools (Solmetric, Pathfinder, CAD & common sense)
- Shading ratios, 9am-3pm solar window & inter-row dist.
- Irradiance & irradiation measuring devices

4 PV Modules

- Plotting Voc, Isc, Vmp, Imp and Pmp on the I-V curve
- Testing current, voltage, power and energy
- Making IV curves
- Measuring Irradiance and temperature & the IV curve
- Testing load on I-V curve without MPPT
- PV & battery charging
- Similar and dissimilar PV experiments. Module mismatch v. matching modules in series & parallel on I-V curves.
- STC, NOCT, PVUSA, CEC and PTC
- Touching 99.99999 pure refined silicon.
- Examining crystalline and thin film PV module construction
- Testing PV efficiency (commissioning a module)
- Testing PV as a limited current & power source
- Testing bypass diodes
- Understanding and documenting labeling PV standards, CE, IEC & UL

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Day 2

5 Installing System Components

- Turning on PV, inverters, chargers, storage & sources
- Testing anti-islanding
- Installing BOS
- Programming power conditioning
- Installing PV system components for different PV system types
- Small off-grid PV system installation
- Inexpensive phone charging direct coupled systems

6 PV System Materials

- Choosing your own PV system
- Students will try their skills at choosing PV, Inverters, Racking, etc.
- Finding materials on the internet
- Finding the correct inverters for the local grid.
- Making a materials list
- Instructor will help and critique systems.
- Lab: Shading Analysis with Solmetric SunEye
- Lab: Irradiance Meter & IV Curve Trace

7 PV System Electrical Installation

- Applying the Local Electric Code
- Line drawing exercises
- Performing PV series & parallel connections for different applications
- Choosing and using conductors, ampacity, conductor sizing & OCPD requirements
- PV & BOS installation parameters
- Settings for charging batteries with correct current, voltage & rates
- Installing labeling
- Installing grounding systems
- Voltage drop & voltage rise testing
- The process of installing a PV system according to code
- Philippine Electric Code. Looking for code violations

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Day 3

8 System Mechanical Installation

- Installing Roof, Ground, Pole, Trackers, BIPV
- Compare different types of PV integration
- Installing for PV temperature and wind variables
- Installing BIPV (building-integrated photovoltaic) applications
- Installing materials for a harsh outdoor environment
- Installing roofing & PV
- Estimating mechanical loads
- Mechanical installation/components
- Mechanical installation for thermal, orientation & electrical performance
- Installing to manufacturers' instructions & Local Electric Code

9 Performance Analysis, Maintenance, Commissioning & Troubleshooting

- Performance problems
- Performance monitoring & parameters
- Expected versus actual performance
- Maintenance
- Operation & Management (O&M) safety
- Most common system failures
- Maintenance planning to manufacturers' instructions
- Dx & treatment of unhealthy PV systems

Solar PV NetMetering

- NetMetering rules & guide
- DU Net-Metering application and guide
- Grid connection standards and guide

Hands on PV Installation: Flat Roof Exercise

- Racks, PV, Fasteners, Hardware
- UniRac SolarMount Rails
- IronRidge Rails
- Tilt-up racking system
- PV Module Installation with mid & end clamps
- Grounding with WEEBS, Lugs, WEEB Lugs, Bonding Rails
- PV Source Circuits to Combiner Box
- Inverter Interconnection & Power to Grid
- Testing AC & DC Voltage & Current with Digital Multi-meter
- Breakdown

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Day 4

Fastening PV to roofing systems

- Composition Asphalt Flashing
- Tile Roofs (Flat Tile & Spanish Tile)
- Shake Roofs
- Penetrations
- Hardware
- Galvanic Corrosion with Dissimilar Metals
- Finding Rafters
- Hangar Bolts/Pull Out Strength Tests
- Blocking
- Rafter Spans

Hands on roofing & PV

- Composition Asphalt, Flat Tile & Barrel Tile Roofs
- Methods for Finding Rafters
- Removing Roofing Nails to Make Room for Flashing
- Drilling Holes
- Installing Hangar Bolts
- Waterproofing Gaskets
- Caulking Tips
- ProSolar Racking
- IronRidge Racking
- UniRac ClickSys Racking
- Grounding & Bonding
- Rail Splicing
- Inverter Connection

Hands on PV on Sloped Roofs with Microinverters and AC modules

- Microinverter and AC module Installation
- Microinverter and AC module Grounding
- Microinverter and AC module Monitoring

10 Breakdown of Sloped Roofs

- Wiring at Panelboard/Inverter Wall & in Classroom
- 120% Rule
- Supply Side Connection
- Breaker sizing
- DC conductor sizing
- Grounding

Solar PV Parts OEM/Supply

- Parts and supply options
- Standard compliance

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Day 5

Hands on Ground Mount PV Exercise

- ProSolar GroundTrac System
- Installation According to ProSolar Manufacturers Instructions
- 250 Watt PV Modules
- Measuring Distances
- Hooking up the System to Grounded & Transformer less Inverters
- Discussion of Combine Fuse Calculations
- Discussion of Conductor Sizing for PV Source Circuits & Output Circuits
- Breakdown of Ground Mount
- Color coding and labeling of conductors

Discussion at Panelboard/Inverter Wall:

- Transformerless versus Transformer Based Inverters
- Differences in Fuse Requirements
- Differences in DC Disconnect Requirements
- Grounded Conductor Requirements
- NEC 2011 Maintenance Disconnect Exception

Other Considerations

- Local rules (LGU, NBCP, PEC, Distribution Code, etc.)
- Standard practices

11 Advanced Topics

- Exam preparation
- NABCEP Practice Exams
- Discussion: Mapping your future
- Further study, licensing & certifications

Final Examination & Award Presentation

**Upcoming workshop dates & venues and the registration form are on our website:
PHOTON Academy Workshops - Solar PV Boot Camps**