

Integrating Hands on Labs into PV Curricula



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AltE U. Presenter



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- **AltE U**
 - ISPQ Accredited Training Program
 - Classroom and Lab facilities in Columbus, OH and Hudson, MA



Why have hands on labs?



- Provides a break to the monotony of classroom teaching
- Provides tactile learning for those that learn best through doing things
- Enables students to get their hands on real world equipment
- Enables students to work in a safe and closely monitored environment
- Allows the ability isolate key parts of a PV system in a controlled environment

Break up the monotony



- The majority of our students at AltE U are adults
- PV system design is highly technical
- Without breaks, the students tend to get “glossed” over



Break up the monotony



- Labs and system walkthroughs provide needed breaks in the classroom teaching
 - This can be in the form of a hands on lab or maybe just a walk through of a code compliant system
 - ✦ There is value in showing both energized and de-energized systems



Tactile learning



- Everyone has different preferences for learning
 - Visual
 - Auditory
 - Tactile
- Combining lecture and presentation materials with hands on aspects we help to satisfy all three learning styles



Tactile learning



- Especially important when teaching students with minimal experience with electricity and/or construction
- Always remember to follow “best practices” and use appropriate tools and personal protective equipment



Real world equipment



- Use equipment that is currently available on the market
- Also try to use a variety of different manufacturers
 - Fake or “dummy” equipment is often available
 - Fake batteries are very helpful to show proper battery wiring
- PV equipment is often unique

Series / Parallel Wiring Lab



Real world equipment



- Always make sure that labs are designed, constructed and installed in a code compliant fashion
- Always use listed equipment when available
- If any parts of a lab are not code-compliant make sure to disclose that to the students



Safe and closely monitored



- Whenever possible we try to make sure we are working with de-energized systems unless we need to show current flow
 - PV module wiring labs are done indoors
 - Fake batteries are used
 - Eliminate any possible sources of current unless needed



Safe and closely monitored



- In order to keep lab groups manageable we always use multiple instructors and call in extra instructors when needed for labs
- We like to limit our labs to a 6:1 student to teacher ratio



Isolate key parts of the system



- Labs enable the instructor to isolate key parts of a PV system in order to reinforce the learning objectives being taught in the class



Series / Parallel wiring lab:
Reinforce PV Source circuit theory

Isolate key parts of the system



- **Grid Tied Inverter Wiring lab**
 - Focuses on PV Output circuit and Inverter Input and Output circuits



AltE U. Hands On Labs



- Site analysis
- Module Testing
- Series & Parallel wiring – PV Modules
- Series & Parallel wiring – batteries
- Off-grid system walk-through
- Grid tied system walk-through
- Module mounting – flush roof, pole, ballast
- Grid tied inverter wiring w/ DC & AC Disconnects
- Roof Penetration lab

Thanks!



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