
groSolar
What the World Needs. NOW.
groSolar Presents
gro Your Solar Business
An Insider's Guide To Success
Webinar starts at 9AM Pacific (12 Noon Eastern)
Jeff Spies
SOLARSPIES
Solar Training & Consulting
www.solarspies.net
groSolar.com
800.374.4494

Webinar Instructions

groSolar
What the World Needs, NOW!

- **Audio options**
  - Telephone - Refer to your email for phone number
  - Computer - Listen via computer speakers or headset
  - Move closer to wireless router or use a wired internet connection
- **Q & A**
  - Audio - Click "Raise your hand" button and the host will un-mute your phone when ready for questions
  - Chat - Type your question into chat window and host will read question to presenter
  - Questions addressed based upon time availability
- **Download entire presentation complete with presenter notes at www.groSolar.com/training**

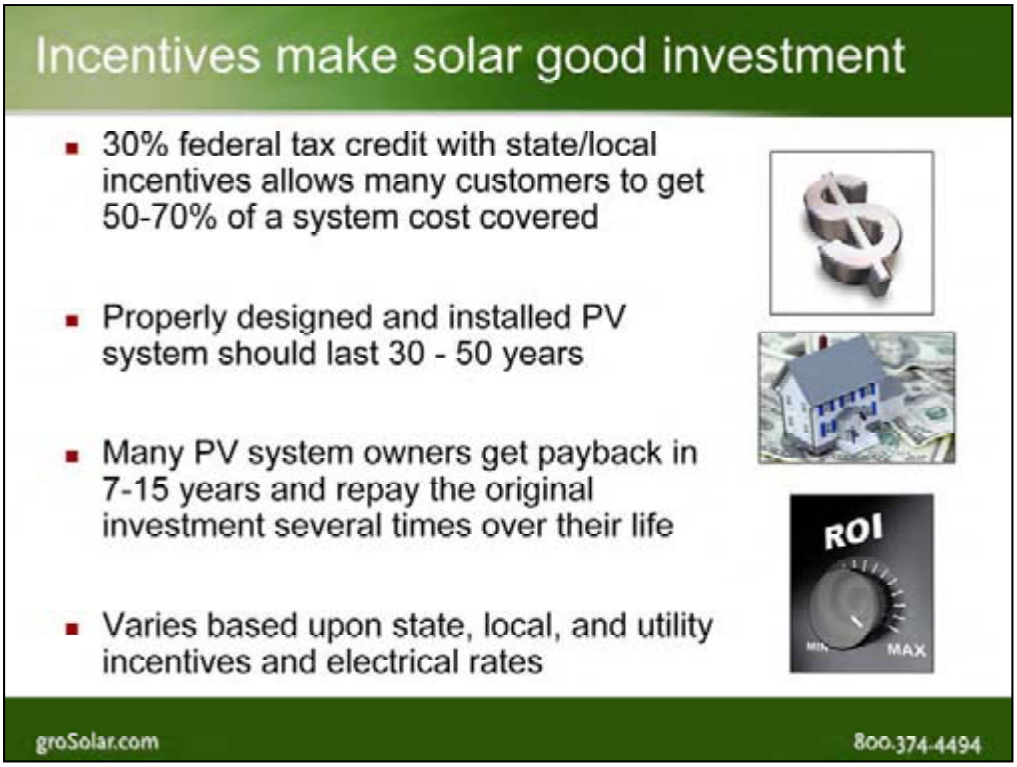
Presentation Outline

groSolar
What the World Needs. NOW.

1. History of Residential Solar
2. How to become a Dealer
3. Renewable energy options
4. Industry players
5. Solar markets
6. PV configurations
7. Product groups
   - Modules, racking, inverters, etc...
8. Key factors to building a successful solar business
9. NABCEP certification
10. Training
11. Site analysis & system design
12. The 4 key partners
13. Incentives & financing
14. Dealer cost & profitability
15. Effective sales & marketing
16. Publications & textbooks
17. Code resources
18. Organizations and websites
19. Industry events
20. International sales

- **Pre-Solar Experience**
  - Degree in Mechanical Engineering from Michigan State University
  - 20 years experience in sales & marketing of electrical and mechanical motion control systems for industrial automation applications
  - Extensive technical product training experience throughout North America and overseas
- **AEE Solar Director of Training 2007 - 2010**
  - Organized the 1st, 2nd, & 3rd annual AEE Solar Dealer Conferences - Largest supplier based solar training events in North America
  - Solar training webpage ranked #1 “Solar Training” link on Google for 2 years
  - Featured speaker at major industry tradeshows and conferences
    - SPI, Intersolar, ASES, Northwest Solar Expo, NECA, IREC, MREF
- **NABCEP Secretary** - North American Board of Certified Energy Practitioners
  - NABCEP is the Solar Industry Certification Agency
- **President of SolarSpies**
  - Training program development for groSolar and Solar Energy International


groSolar Training Program
Go beyond the 101
Featuring SOLARSPIES Training
gro-Workshops
1 & 2 day training events each month in a location near you
gro-Webinars
gro your solar business
PV Modules
Solar Selling
Marketing & PR
Stepping up to Commercial PV
Inspectors – Avoid red tagging
Solar Policy – Licensing, Certification, Incentives, etc..
SEI PV Design & Installation Training
PV101 Beginner Photovoltaics
PV202 Advanced Grid Tie
Lab week - hands on installation training
SEI Technical PV Sales Training
PV206 - Technical PV sales and business training
Register at www.solarenergy.org
groSolar.com
800.374.4494

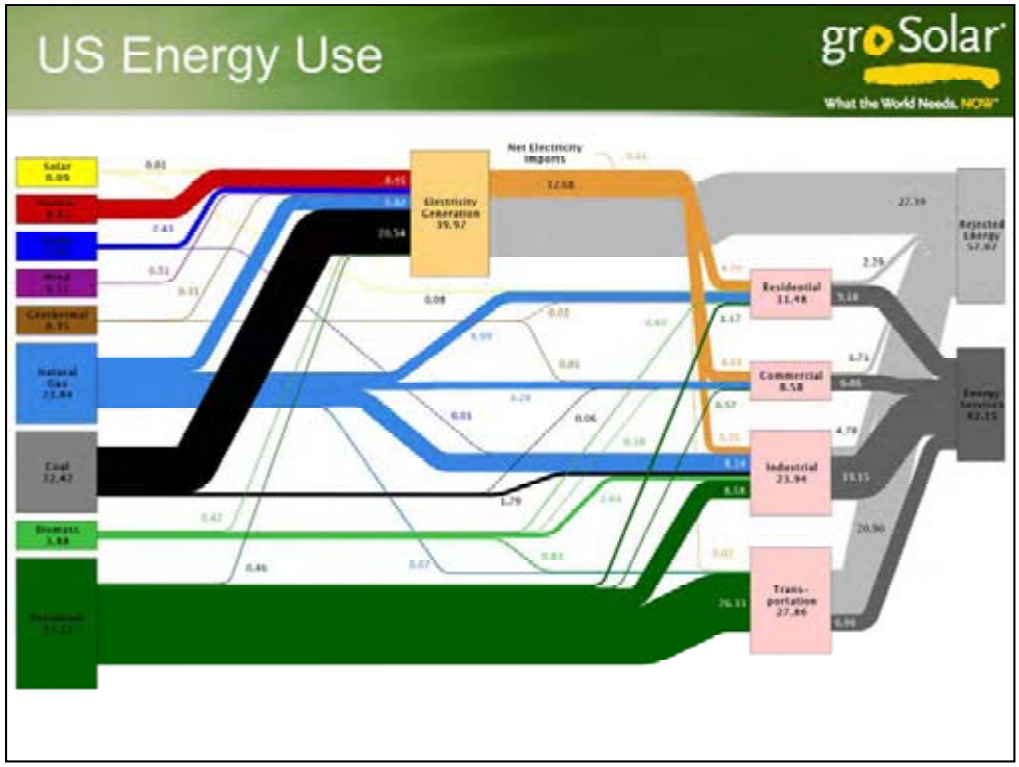


•30 percent Federal solar tax credit

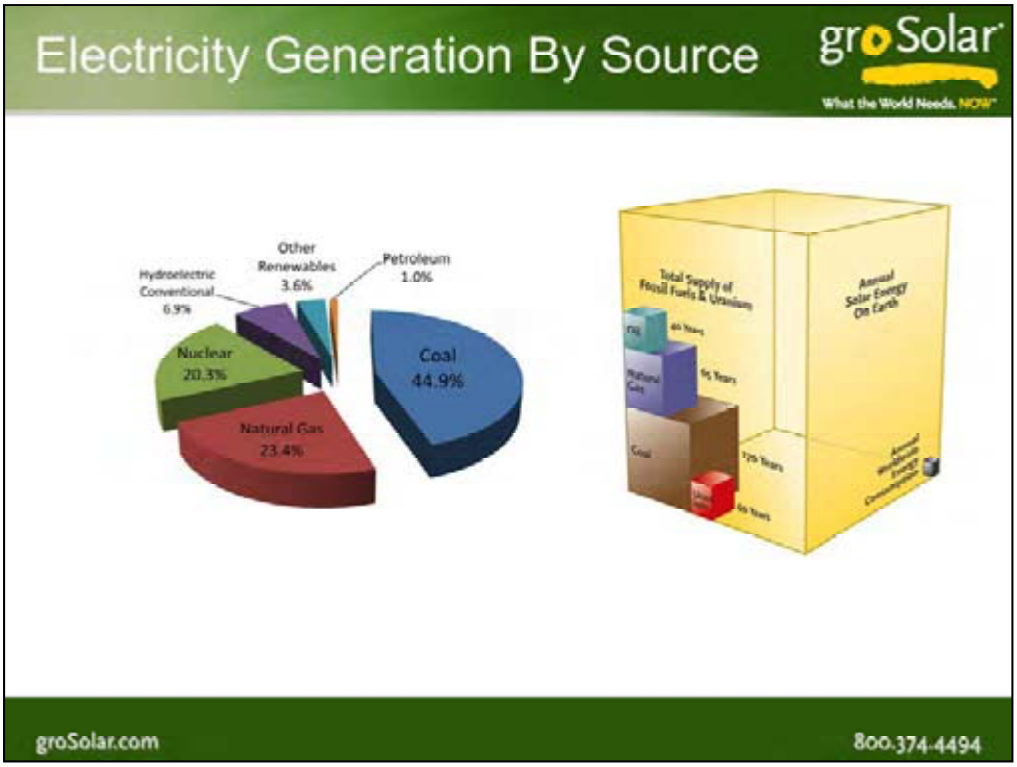
- •extended & expanded in 2009
- •Applies through 2016 for both residential and commercial solar installations
- •$2,000 cap for residential systems was eliminated and the tax credit was also extended to off-grid system owners!
- •Coupled with state and local incentives, many solar customers in the US can get 50-70% of a system cost covered by incentives

•PV system should last 30 - 50 years

- •Inverter replacement every 15 years
- •Many PV system payback in 7-15 years
- •Most PV systems repay the original investment 2-4 times over their life
- •Payback time varies based upon state, local, and utility incentives and electrical rates
- •Areas with inexpensive electricity and no state/local incentives may have payback as long as 20-30 years



•I can stare at this chart for hours – so much good information!



•It is truly amazing that the sun can deliver the amount of energy every year

•The above chart shows that we have only a few decades of oil, gas, and uranium. Even coal is targeted at 170 years.

•The future is bright for solar.

History of Residential Solar

groSolar
What the World Needs. NOW.

Arco 33 watt solar module hit the residential market in 1981

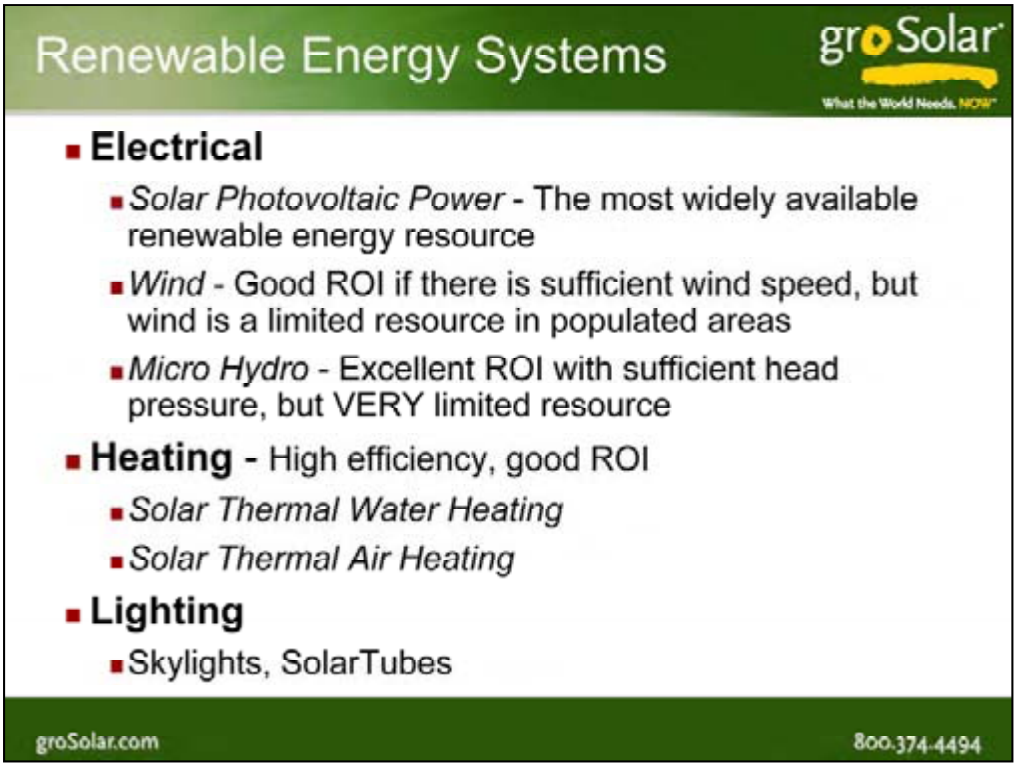
- "Back to the Land" solar pioneers laid the foundation for the entire solar PV industry
  - The Grateful Dead, VW Beetles, wildfire, and PV modules
- Humboldt County boasts the largest base of offgrid solar communities in the US
- Inexpensive, reliable electricity drove the market in the early days, and it still does today

•Proper business status is necessary to become a dealer

- •appropriate licenses state and local
- •contractor, resale tax, business

•Dealers should complete Beginning and Advanced PV training courses with Solar Energy International prior to applying for dealer status

- •Those that forgo training have a high failure rate in the industry



Electrical Systems

- •Solar Photovoltaic Power
  - •Solar PV is the most widely available renewable energy resource
- •Wind
  - •Good return on investment (ROI) when there is adequate average wind speed
  - •Limited resource in populated areas of the US
- •Micro Hydro
  - •Excellent ROI if you have sufficient head pressure
  - •Very limited resource - requires water flow over large vertical drop

Heating

- •Solar Thermal Water heating, air heating
  - •High efficiency & good ROI

Lighting

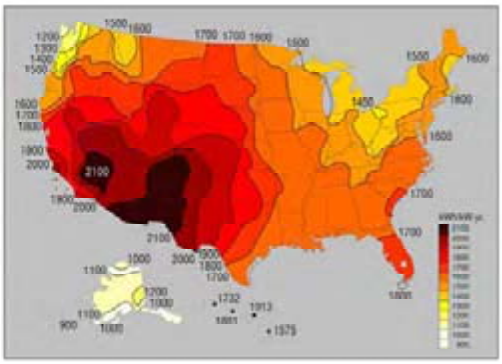
- •Skylights, SolarTubes
- •Light a dark room during the day with natural light

Solar Photovoltaic Power - PV

gro Solar
What the World Needs. NOW!

- No moving parts
- Long system life
- Low maintenance
- Solar resource much more widespread than wind or micro-hydro
- Annualized average sun hours:
  - Phoenix – 6.5
  - Portland – 4.0
  - Seattle – 3.8
  - Anchorage – 3.1
  - Germany – 3.0

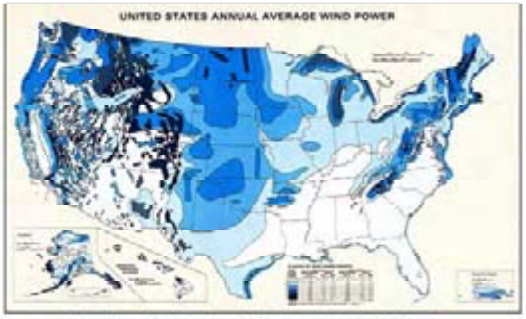
Germany is #1 PV market in the world



Wind Energy

groSolar
What the World Needs. NOW.

- "Small Wind" is best suited to darkest shaded areas
- Less than 5% of people live where it is windy enough



http://rredc.nrel.gov/wind/pubs/atlas/maps/chap2/2-01m.html

- Tall towers are desirable (50 to 100 ft tall)
- Wind is very important as backup in off-grid systems
- Wind speed assessment (12 months) is recommended
  - Southwest Windpower and 3Tier have helpful siting software

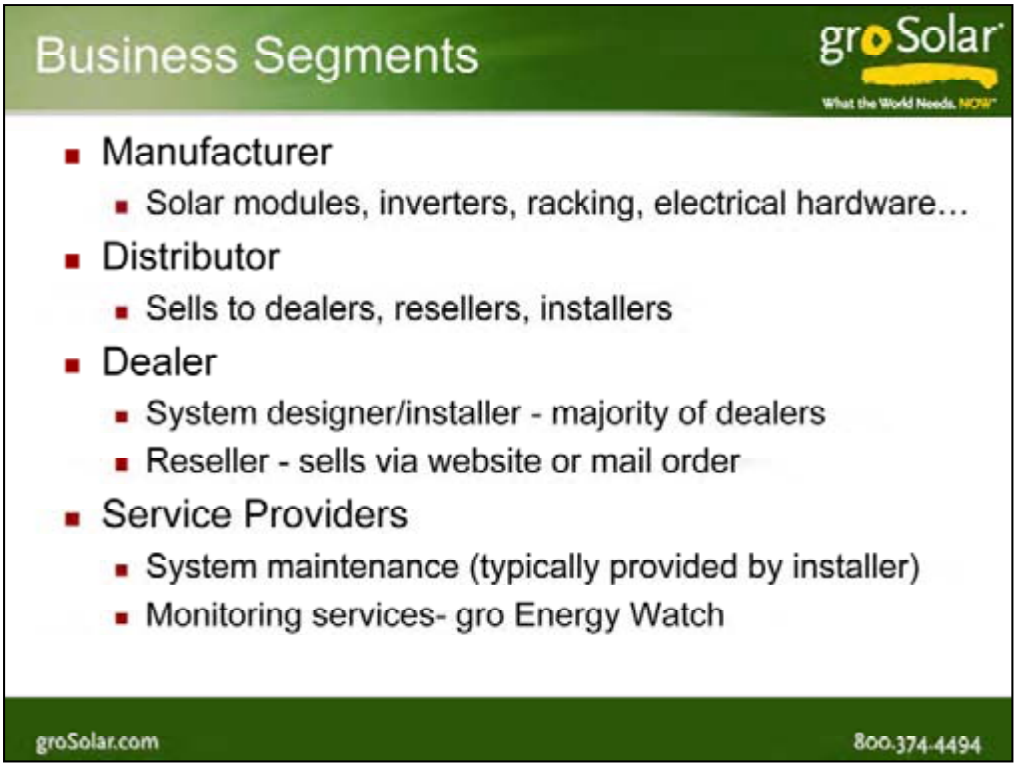
•Residential and commercial wind generators fall into the category of **"Small Wind"**

•Only a small percentage of the population has a sufficient wind resource to make small wind as cost effective as solar

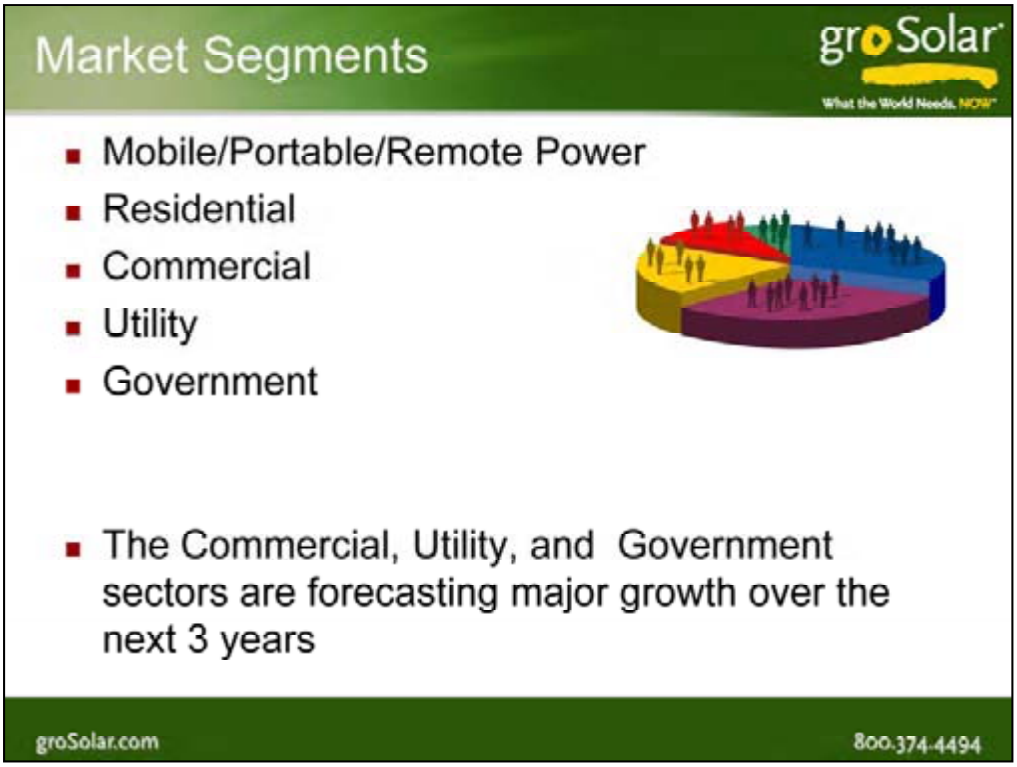
•The areas with sufficient wind are shaded in the darkest blue on the above map.

•You might notice that very few people live in these areas (most people don't like ot live near windy areas)

•Wind cannot be used in most urban or suburban settings making it mainly a rural technology



•Monitoring services include Deck, Draker Labs, Fat Spaniels offering 3rd party monitoring for production based incentive programs – common for larger commercial installations

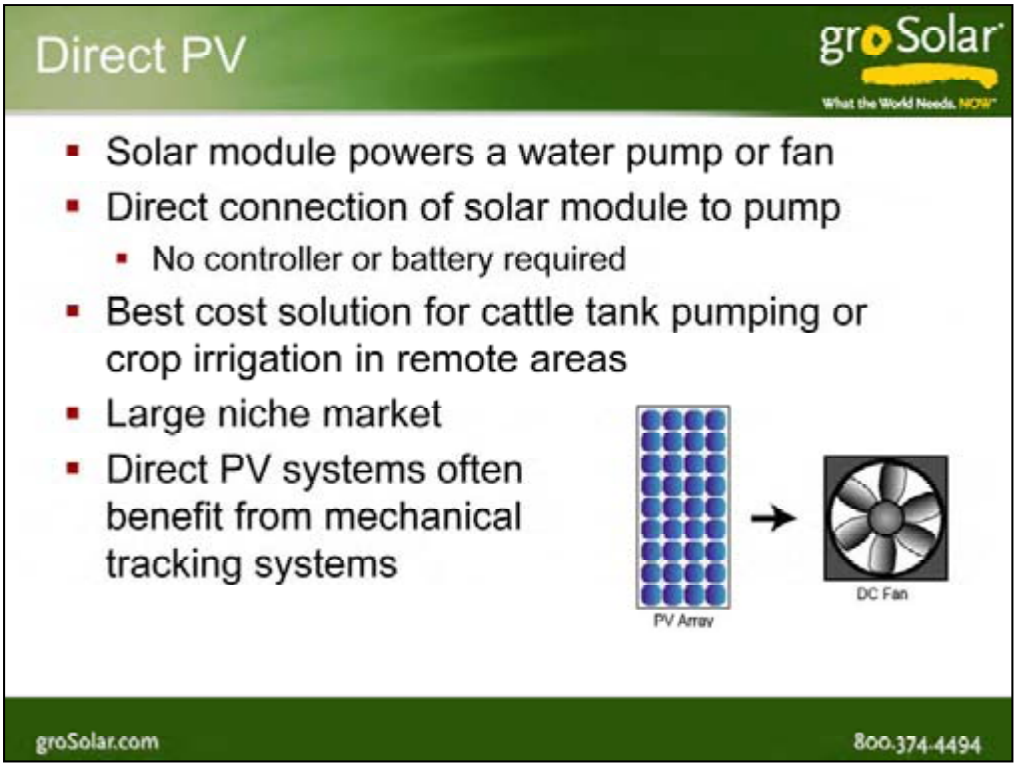


- **Mobile/Portable/Remote Power**
  - RVs, Traffic controls, Telecom power systems
- **Residential**
  - Represents majority of solar PV installations
  - Federal tax credit provides full 30% credit with no cap
- **Commercial**
  - Strong activity in 2006 - 2008, declined in 2009 with credit crunch
  - Forecast for major growth in 2010 - 2012 as credit eases
  - Higher power rates allow faster ROI
- **Utility**
  - Specialized large scale installations designed by Solar Engineering firms sourcing direct from manufacturers
  - Forecast for major growth in 2010 - 2012
  - credit eases
- **Government**
  - GSA certified to bid projects
  - Forecast for major growth in 2010 - 2012 due to ARRA
  - Bidding and scheduling complex

PV Configurations

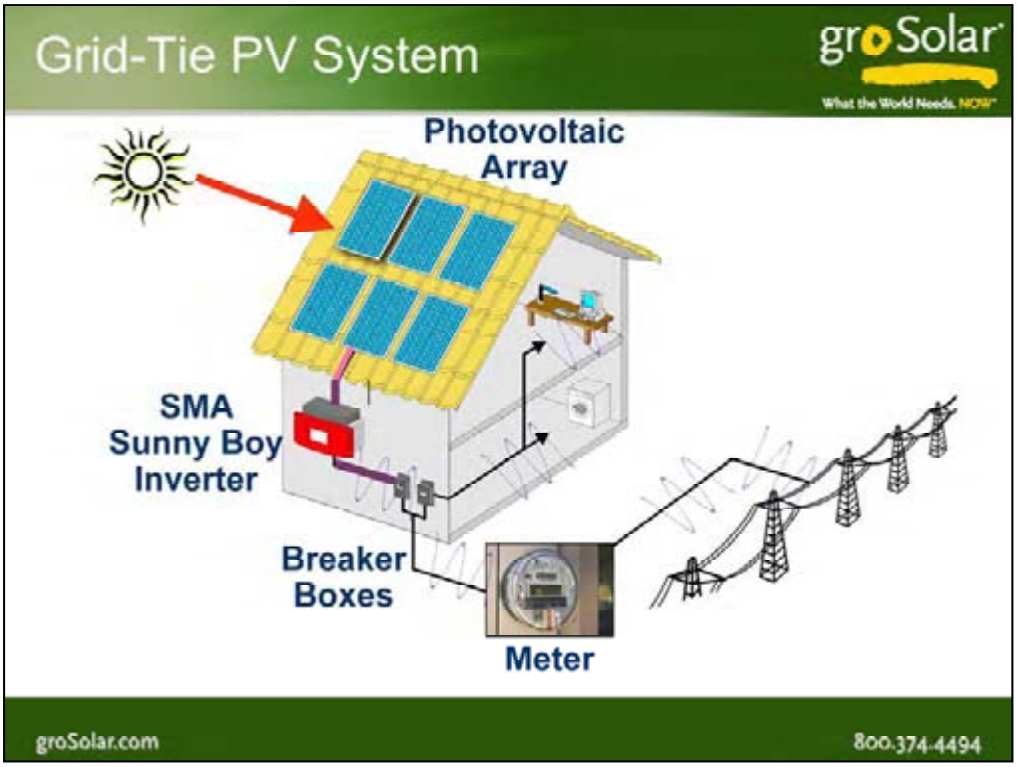
groSolar
What the World Needs, NOW

- Direct PV
  - Simple systems for water pumping and fans
- Grid-tie
  - 90% of installations are grid-tie (no batteries)
- Grid-tie with battery backup
  - Provides power when grid goes down
  - Silent, RELIABLE, power in times of grid outage
- Off-grid
  - Best choice in remote areas
  - Less expensive than connecting to grid if installation is more than ¼ mile from grid



•Trackers don't make cost sense for the vast majority of applications, but direct PV water pumping systems are an exception

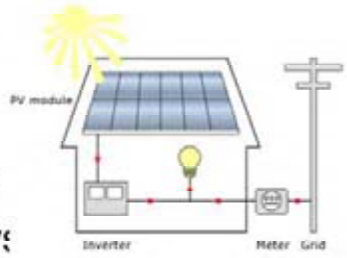
•By using a mechanical tracker, you can pump water for more hours in a day allowing the use of a smaller pump. Smaller pumps and wells are more cost effective.


Grid-Tie PV System
groSolar
What the World Needs, NOW!
Photovoltaic Array
SMA Sunny Boy Inverter
Breaker Boxes
Meter
groSolar.com
800.374.4494

Grid-Tie

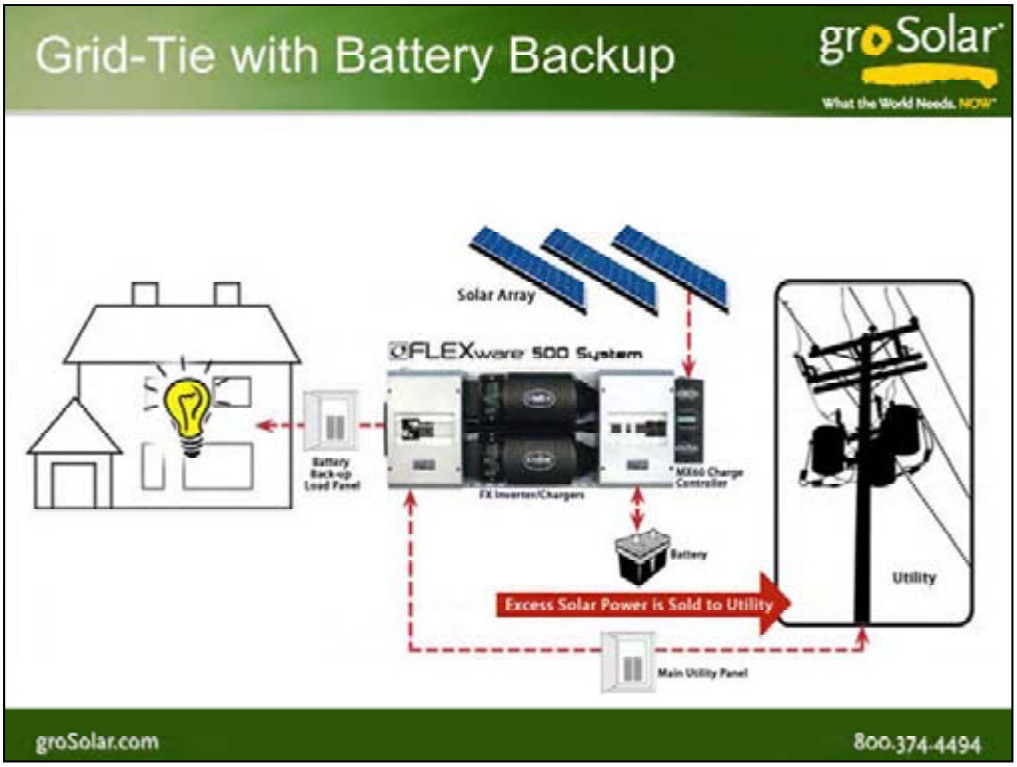
groSolar
What the World Needs. NOW.

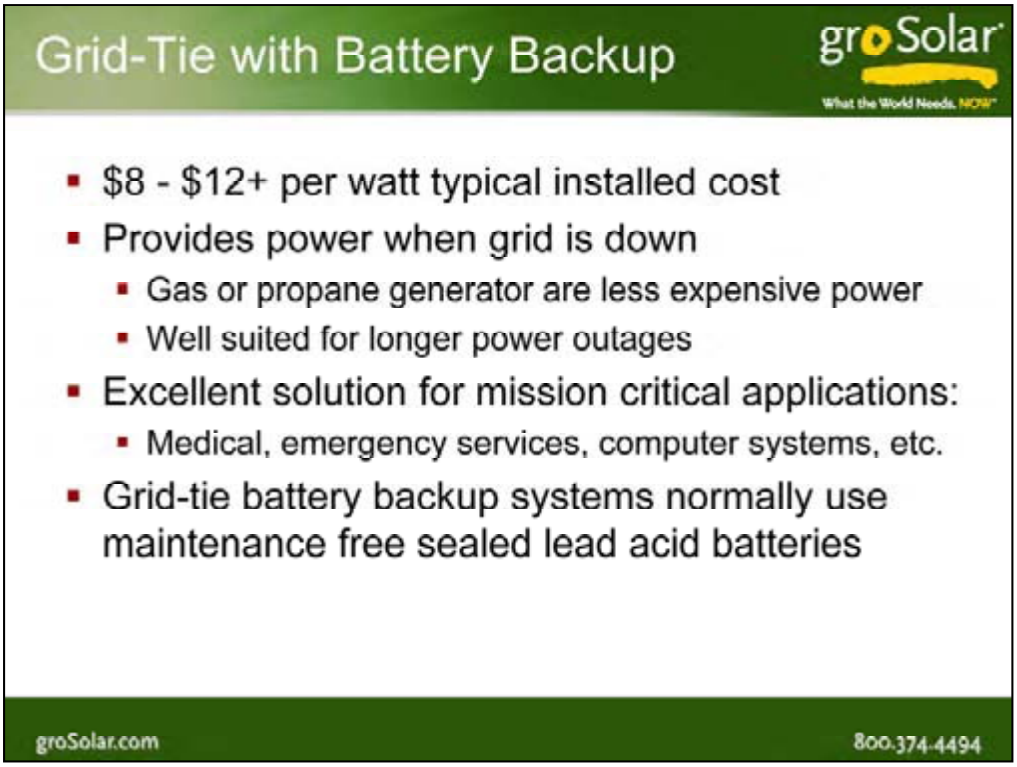
- Typical installed cost
  - Residential $4.50 - $7.50/watt
  - Commercial $4.00 - $5.50/watt
- Grid tie modules
  - 200 - 250 Watts output in full sun
- Typical California residential sy
  - 3000-5000 watts = 15 - 25 modules
- Grid-tie represents 90% of solar PV market
- Simple system: modules, racking, & inverter
- ***Will not produce power when grid is down***



groSolar.com 800.374.4494

- Will *not* produce power when grid is down
  - Due to system safety considerations
  - Also not practical to have grid-tie running when grid is down due to frequent brownouts when clouds pass by


Grid-Tie with Battery Backup
groSolar
What the World Needs. NOW.
Solar Array
FLEXware 500 System
Battery Back-up Load Panel
FX Inverter/Chargers
MX60 Charge Controller
Battery
Utility
Excess Solar Power is Sold to Utility
Main Utility Panel
groSolar.com
800.374.4494



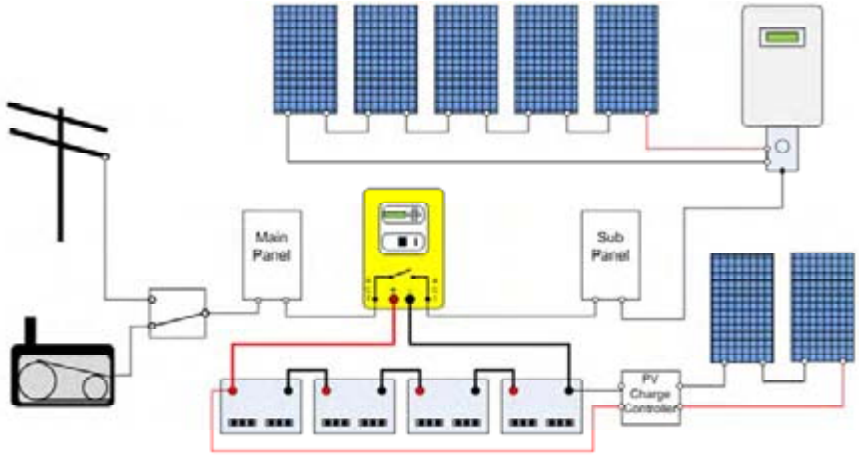
- Well suited for longer power outages - e.g., hurricane zones, icing on power lines

Grid Tie With Battery Backup

groSolar
What the World Needs. NOW.

SMA

On-Grid AC and DC Coupled With AC Generator



groSolar.com

800.374.4494

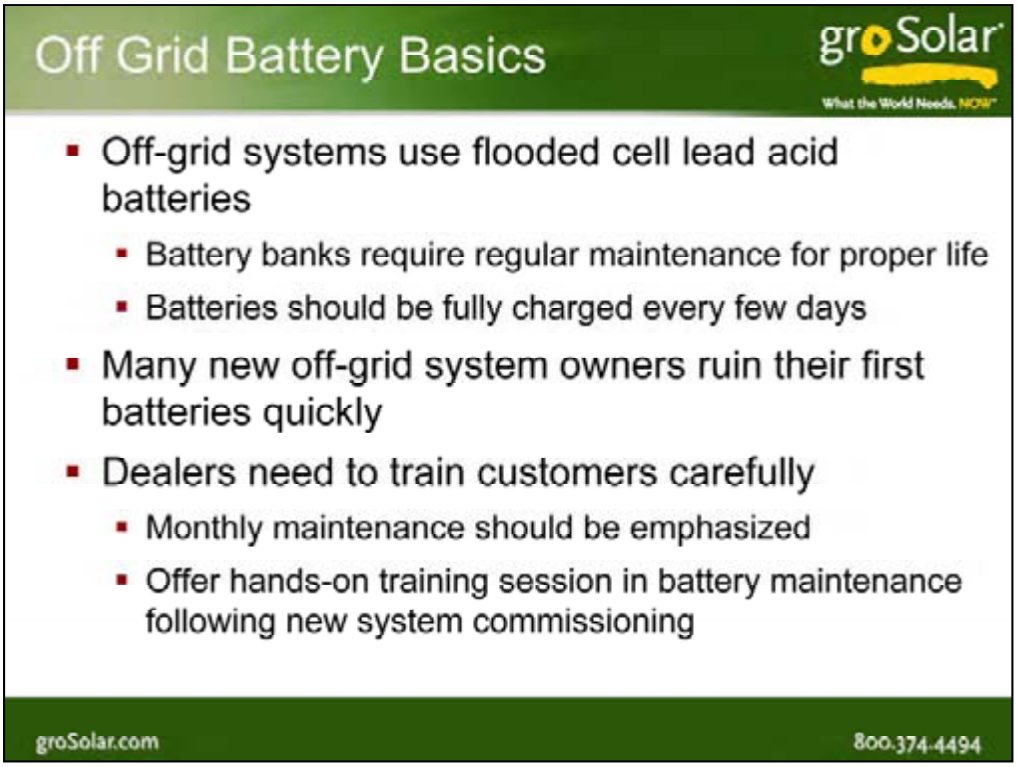
Off-Grid

groSolar
What the World Needs. NOW.

- $9 - $14 per watt typical installed cost
  - Best cost solution more than ¼ mile from power lines
- Much more complex to design and install than grid tie
  - Load analysis is critical for proper off grid design
  - Off-grid owners tailor power usage to available renewable energy
- Most offgrid systems have multiple energy inputs
  - Solar array, wind generator, micro hydro generator, gas/propane generator

groSolar.com 800.374.4494

- It is best to live with an off grid system to do a good job designing an off-grid system
- Off-grid owners typically do not run dishwasher, laundry machine, vacuum during extended periods of cloudy weather

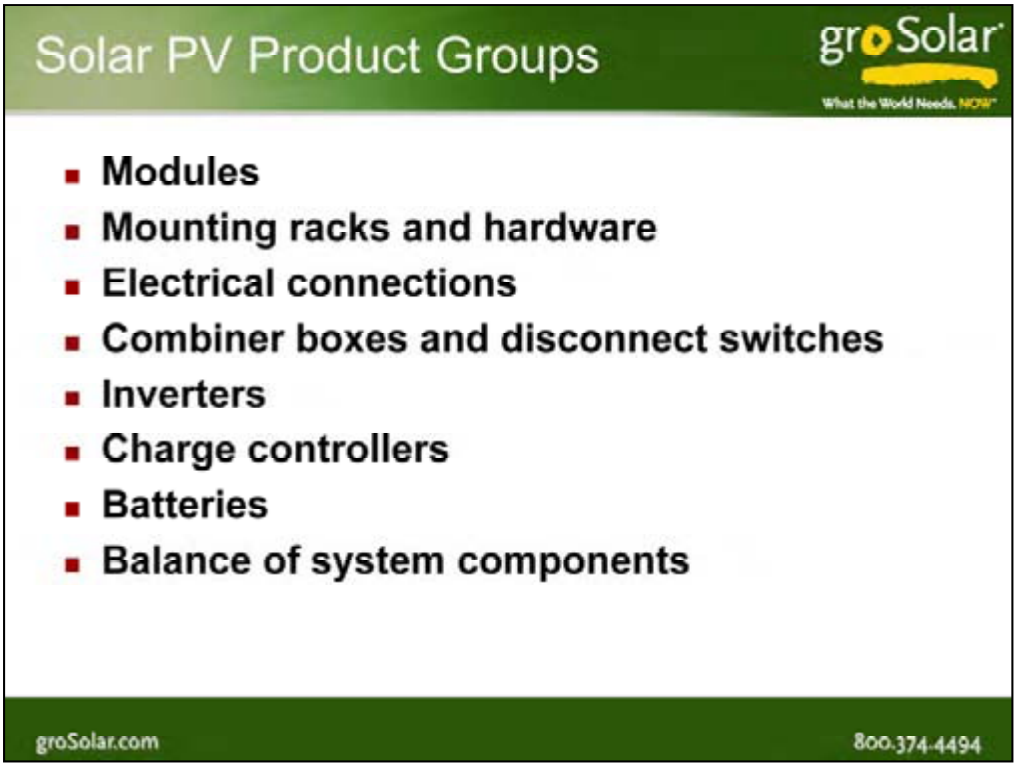


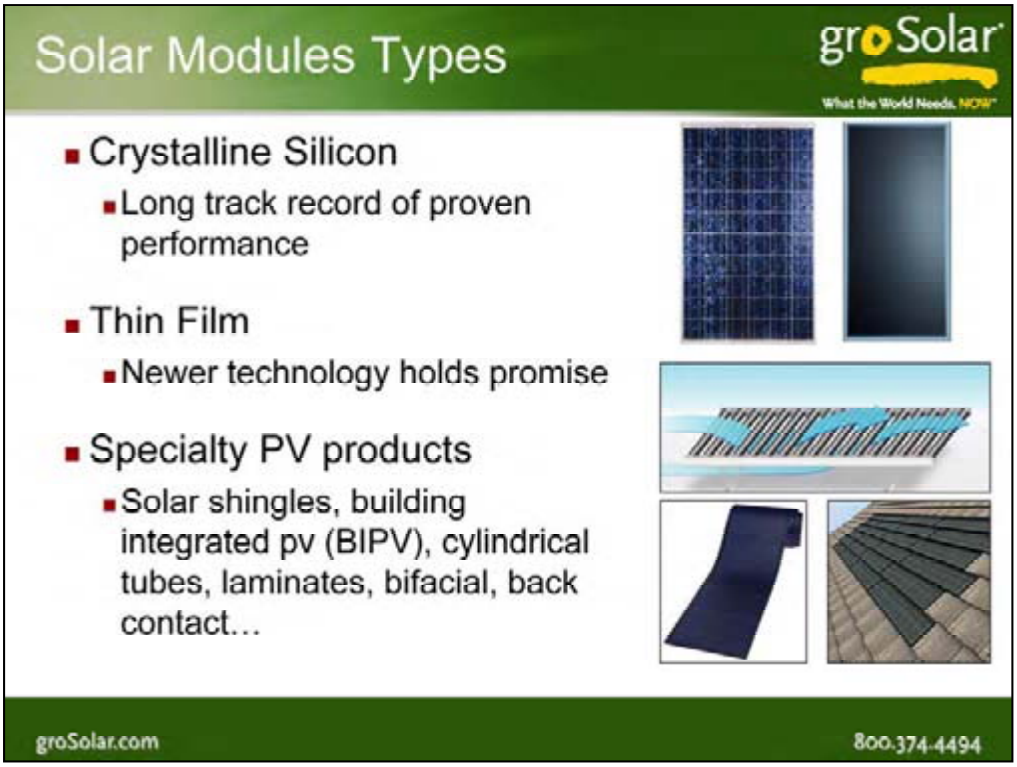
- Dealers often sell less expensive batteries for first time off-grid system owners
- Owners upgrade to better batteries after they ruin the first set

Installation Cost Summary

groSolar
What the World Needs. NOW.

- Grid-tie
  - $4.50-7.50/watt typical installed cost - residential
  - $4.00-5.50/watt typical installed cost – commercial
- Grid-tie with battery backup
  - $8-12/watt typical installed cost
- Off-grid
  - $9-14/watt typical installed cost


Solar PV Product Groups
groSolar
What the World Needs, NOW
Modules
Mounting racks and hardware
Electrical connections
Combiner boxes and disconnect switches
Inverters
Charge controllers
Batteries
Balance of system components
groSolar.com
800.374.4494



Crystalline silicon: mono & poly

Highest efficiency 13-19%

Long track record of proven performance

Thin film: CIGS, CdTe, amorphous silicon

Lower efficiency 5-9% CdTe, A-Si

Medium efficiency 8-13% CIGS

Struggling to keep pace with lower crystalline silicon pricing

Specialty PV products

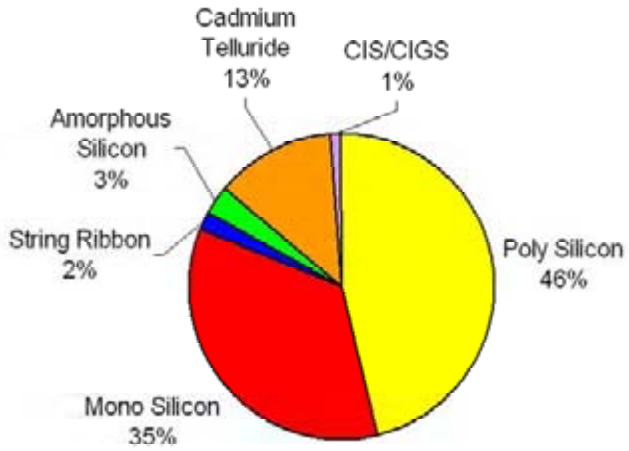
Solar shingles, building integrated pv (BIPV), cylindrical tubes, laminates, bifacial, back contact,

Higher pricing 50 - 100% more expensive than crystalline silicon

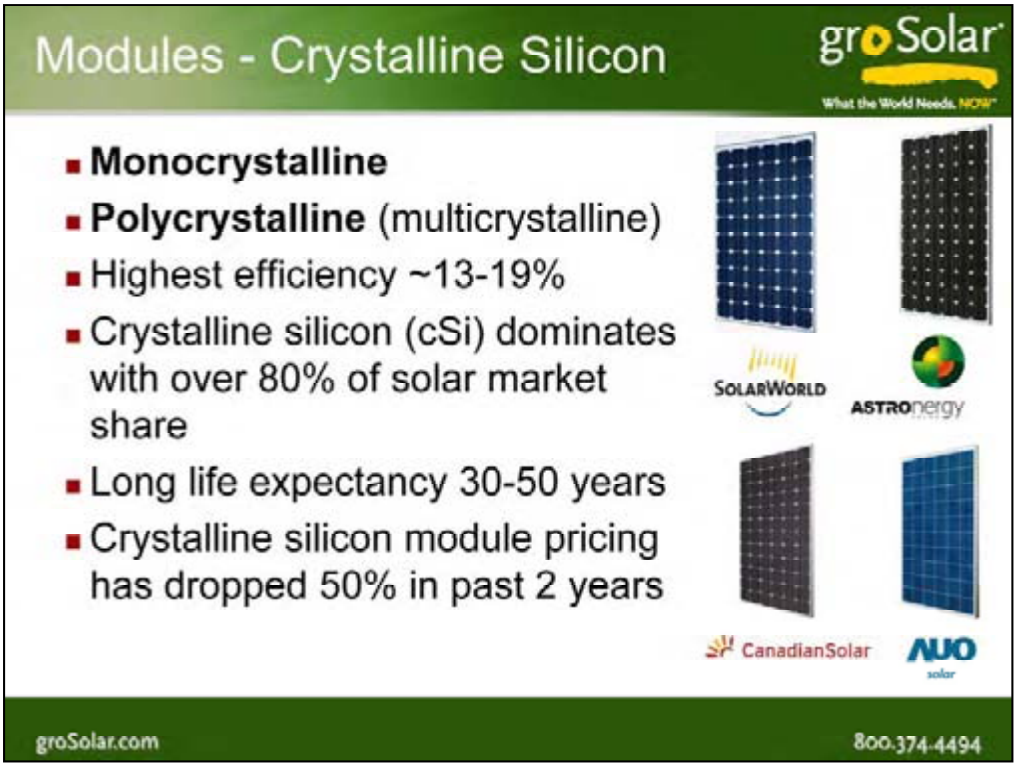
Many new pv technologies are not yet ready for prime time

2009 Market Share

groSolar
What the World Needs. NOW.



groSolar.com 800.374.4494

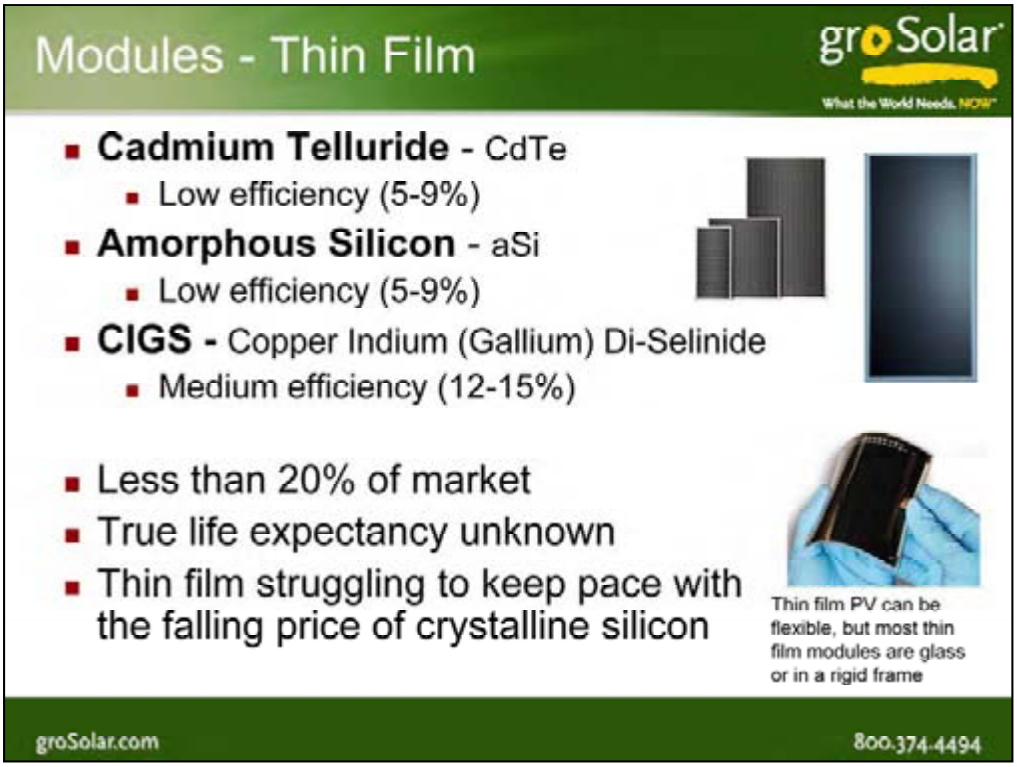


2 types of crystalline silicon modules

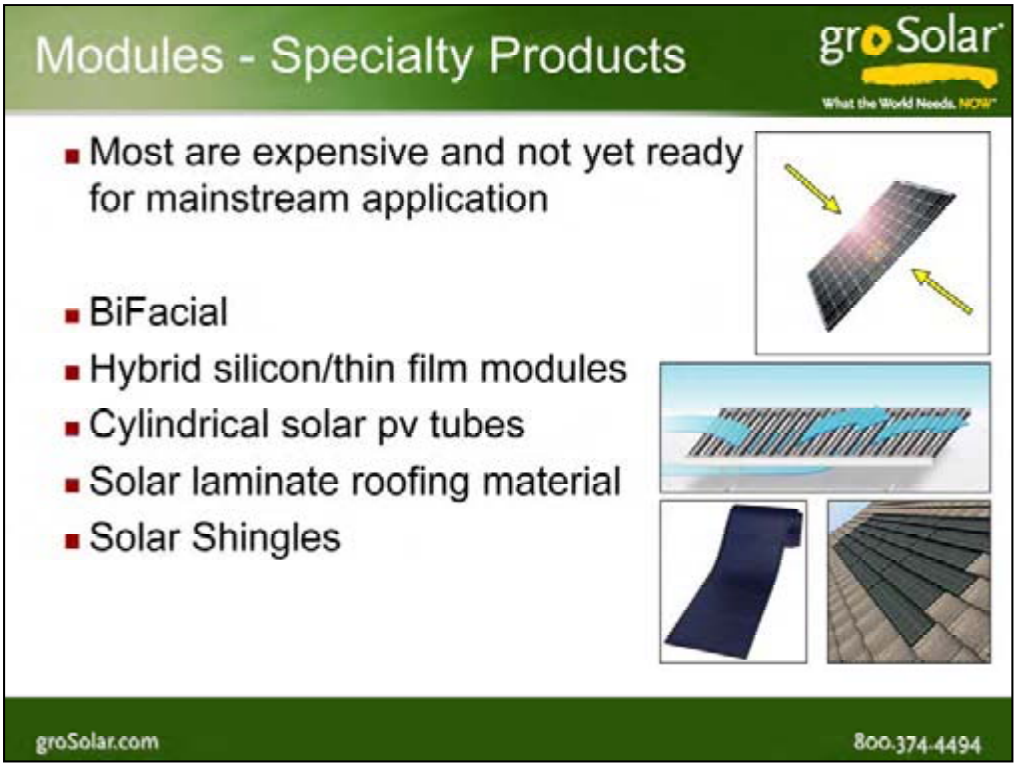
- **Monocrystalline**
  - SolarWorld, Sunpower, Sanyo
  - Highest efficiency
  - Less power loss in high temps
  - Back contact modules from Sunpower result in high efficiency, but positive grounding is required
- **Polycrystalline (multicrystalline)**
  - Yingli, Canadian Solar, Sharp, Suntech, Kyocera
  - Evergreen string ribbon – variation on polycrystalline

Long life expectancy

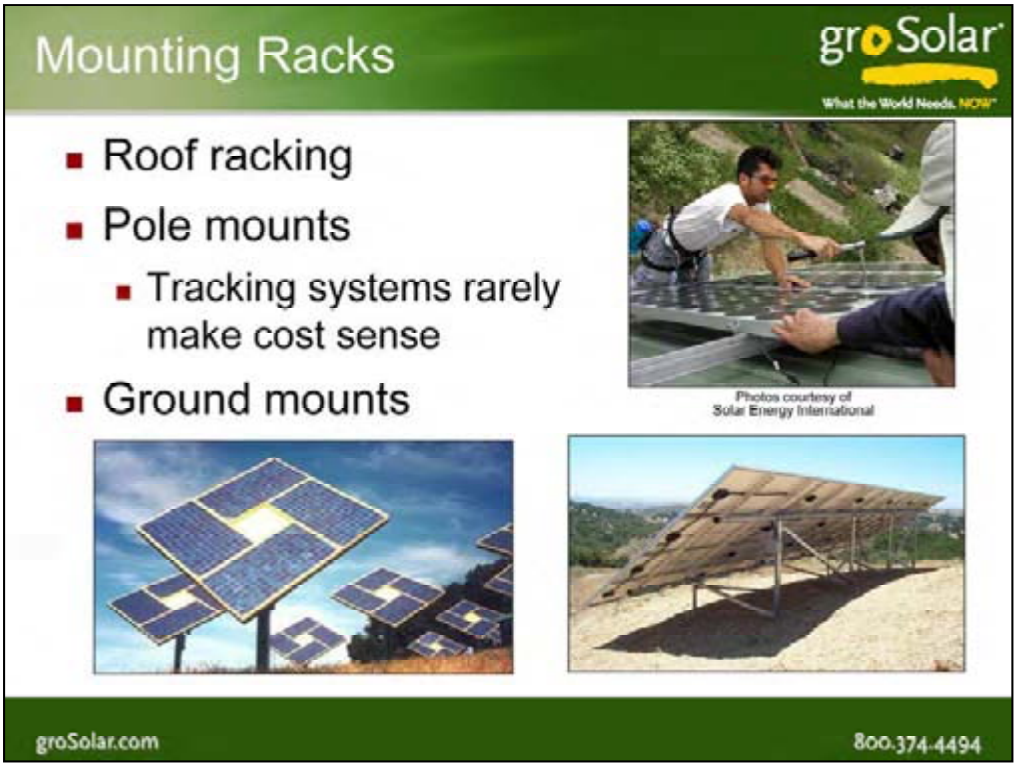
- 30-50 years for quality modules that are properly designed and installed



- **3 types of thin film modules**
  - **Cadmium Telluride** (CdTe)
    - First Solar
  - **Amorphous Silicon**
    - Unisolar
  - **CIGS** - Copper Indium Gallium Di-Selinide
    - Stion, Miasole, Solyndra, Global Solar, Nano Solar
- **Lower efficiency (5-9%) CdTe**
  - Array must be twice the size to give same power output compared to crystalline silicon array
  - is only cost effective for large utility scale
- **Medium Efficiency (8-13%) CIGS and A-Si**
  - Expensive compared with cSi
- **True life expectancy not yet known**
- **Less than 20% of market**
- **Thin film pricing struggling to keep pace with the falling price of crystalline silicon**
  - Thin film does have good potential to lower installed costs in the long term, but currently the installed price is considered high when compared to crystalline silicon



- **BiFacial**
  - Sanyo puts cells on front and rear of module to harvest reflected light
- **Hybrid silicon/thin film modules**
  - Sanyo HIT modules use CIGS material in between monocrystalline silicon cells for higher efficiency
- **Cylindrical solar pv tubes**
  - Solyndra CIGS modules designed for flat roof
  - Higher efficiency than most CIGS module
  - 30-40% more expensive than crystalline silicon
- **Solar laminate roofing material**
  - More expensive than crystalline silicon
  - Ventilation problems are common
- **Solar Shingles**
  - Poor ventilation, runs hot, shorter life, less power
  - 40-80% more expensive than crystalline
  - silicon



- **Roof racking**
  - Most practical and cost effective method for installing solar arrays in urban/suburban areas
- **Pole mounts**
  - Static mounts common in rural areas
  - Avoid shading problems or drilling holes in roof
  - Tracking systems rarely make cost sense
- **Ground mounts**
  - Best in areas with little/no weed growth
  - Should be behind a fence!

PV Wire will withstand harsh conditions (heat) and has superior abrasion resistant insulation

UL has stated that when making PV module interconnection, only the wire types specified in the National Electrical Code (NEC) can be utilized if the modules are to be sold in the USA

2008 version of the NEC article 690.31 (B) states PV wire is required to be sunlight resistant and rated for wet locations at a temperature rating of 90C or more

In the past, USE-2 copper wire has been used in PV applications; however PV wire is quickly becoming the standard for solar module interconnections. PV Wire is superior for multiple reasons over its predecessor USE-2

PV Wire:

•rated at 600V, 1KV or 2KV voltage levels

•can be used in both grounded and ungrounded PV arrays

•thicker insulation/jacket giving it more abrasion and mechanical protection

•can be found in 16 AWG and 18 AWG while USE-2 smallest available size is 14 AWG

•must comply with most stringent sunlight (UV) resistance and be flexible at the extreme lower temperatures

•must undergo 720 hour climate test with -40C cold chamber conditioning - over

- **Tin-plated copper grounding lugs**
  - industry standard method to ground aluminum frame and mounting rack
  - Installation complex requiring several washers, abrasive cloth, anti-oxidizing paste, and torque wrench
  - Copper grounding wire is required (expensive)
- **WEEB grounding clips**
  - Simplify grounding & reduces installation time/cost
  - Documentation http://www.we-llc.com/index.html
  - Check with local inspector for approval before design
- **ZEP Solar mounting system**
  - integrates rugged grounding system into mounting rack for cost effective grounding – currently only available on Canadian Solar modules
  - Design/layout software at http://www.zepulator.com

Combiner Boxes & Disconnects

groSolar
What the World Needs. NOW.

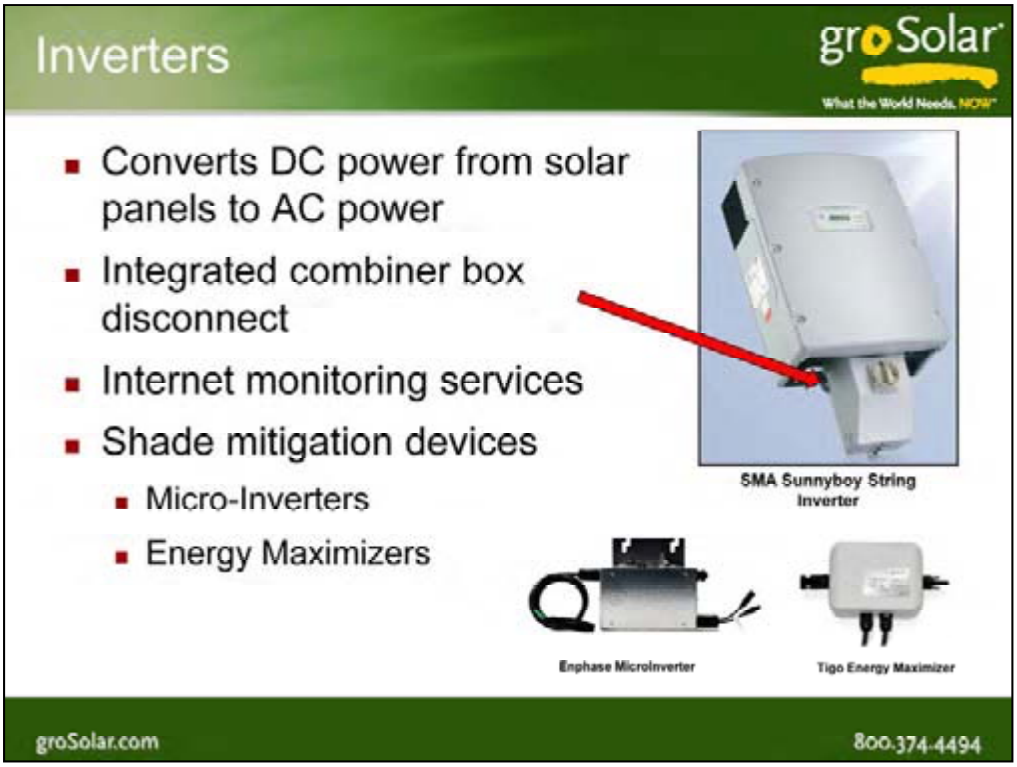
- **Combiner box**
  - Enables wiring of multiple strings of modules into single inverter
  - Often incorporates fusing

- **Disconnect = Switch**
  - Disconnect DC power between array and inverter
  - Disconnect AC power between grid and inverter

groSolar.com 800.374.4494

•Newer inverters offer integrated disconnect switches

•Check with local utility or inspector to determine if integrated disconnects are allowable



•Converts DC power from solar panels to AC power for home use or selling power back to public utility

•Integrated combiner box disconnect

- •Space and cost saving option

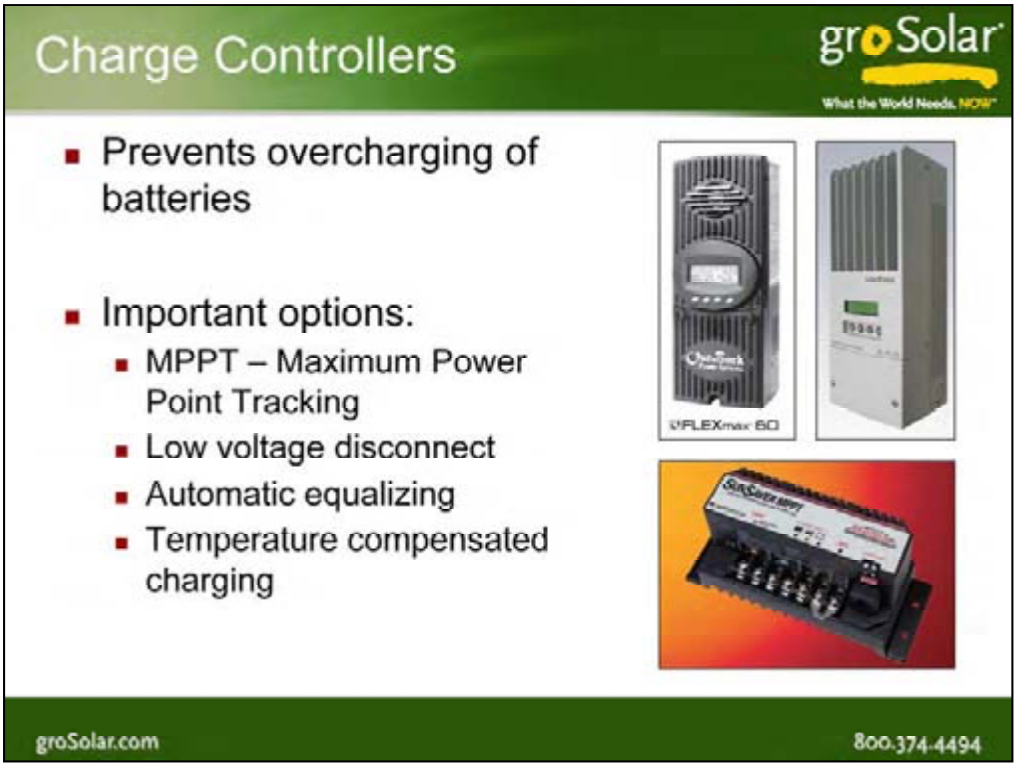
•Internet monitoring services

- •View system productivity via web
- •Excellent sales feature
- •Convenient troubleshooting tool
- •Email alert if system productivity declines

•Shade mitigation devices

- **•Micro-Inverters** mount on back of every module and offer shade mitigation, module level monitoring, and improved system safety

- **•Energy Maximizers** (DC-DC converters) work with string inverters to offer shade mitigation, module level monitoring, and improved system safety



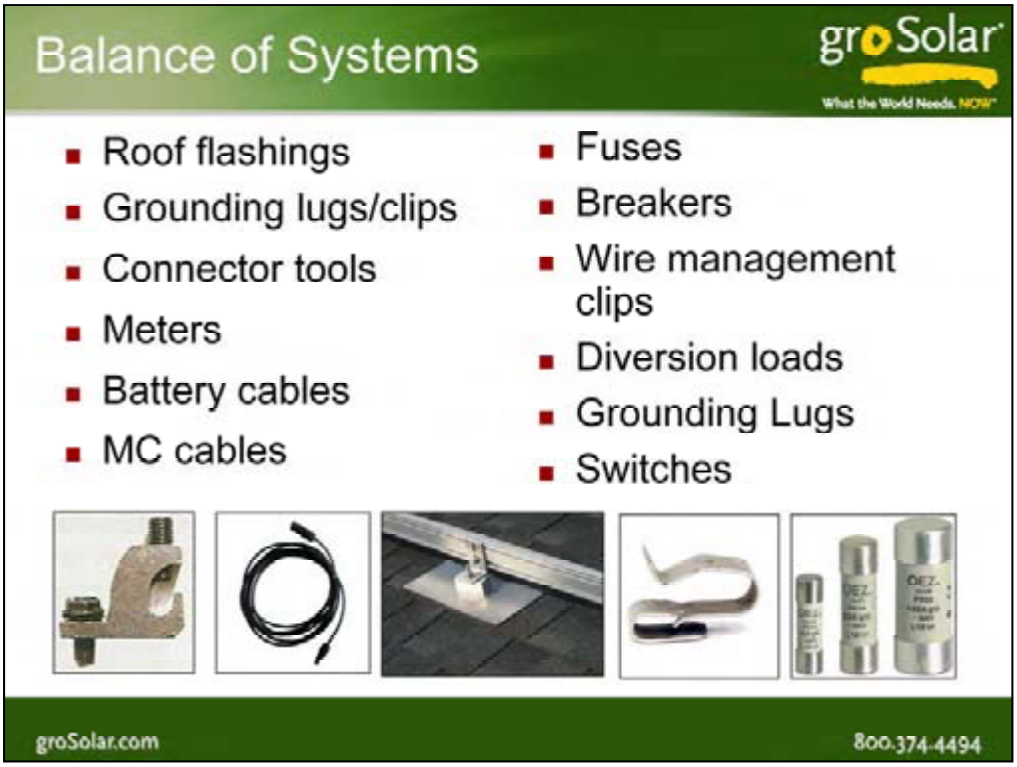
•**MPPT – Maximum Power Point Tracking** optimizes power from solar array power

•**Low voltage disconnect** – prevents battery damage when batteries discharged

•**Automatic equalizing** renews lead acid plate life

•**Temperature compensated charging**

- **Off-grid** systems use **flooded cell** lead acid batteries
  - Require monthly maintenance
  - Can last 10-15 years with proper care, but 6-8 years life is common
  - Best cost over battery life
  - Should be fully charged every 3-4 days
- **Grid-tie battery backup** systems use **sealed** lead acid batteries
  - Maintenance-free
  - Can last 5-7 years if regularly returned to full state of charge, but life expectancy shorter (3-4 years) if left discharged for more than 4 days
  - Approximately 2 times the price of flooded cell over battery life



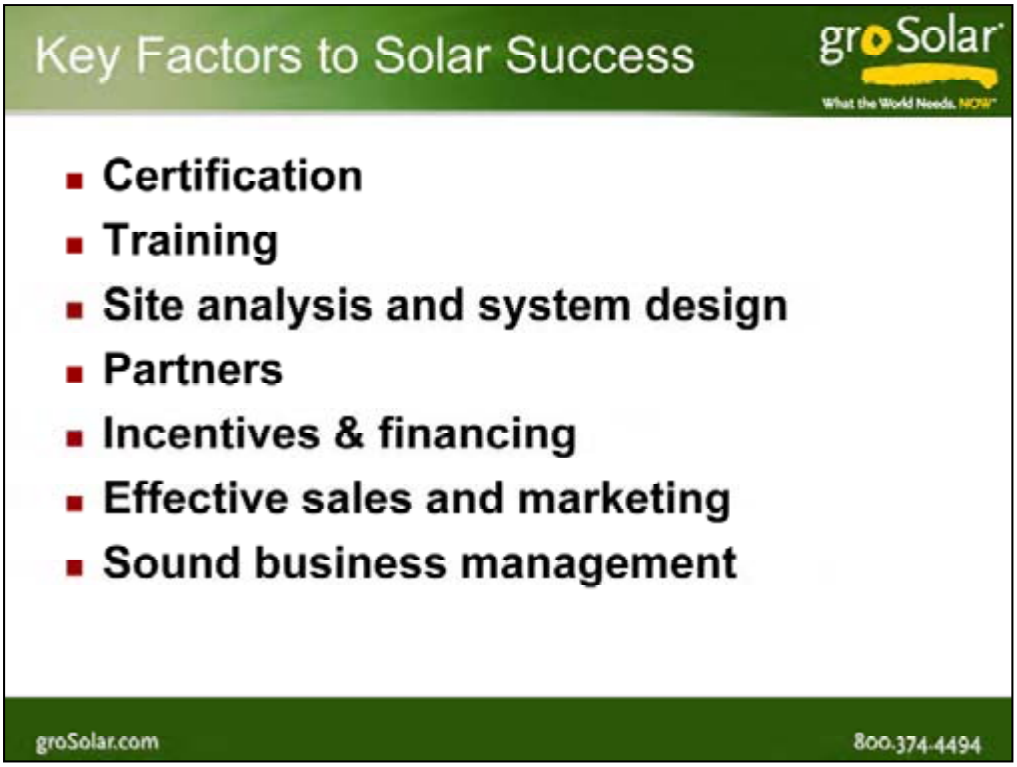
These seemingly insignificant items can make or break an installation

Really cool cable ties from Hellermann Tyton

-

Question and Answer Time

groSolar
What the World Needs. NOW.

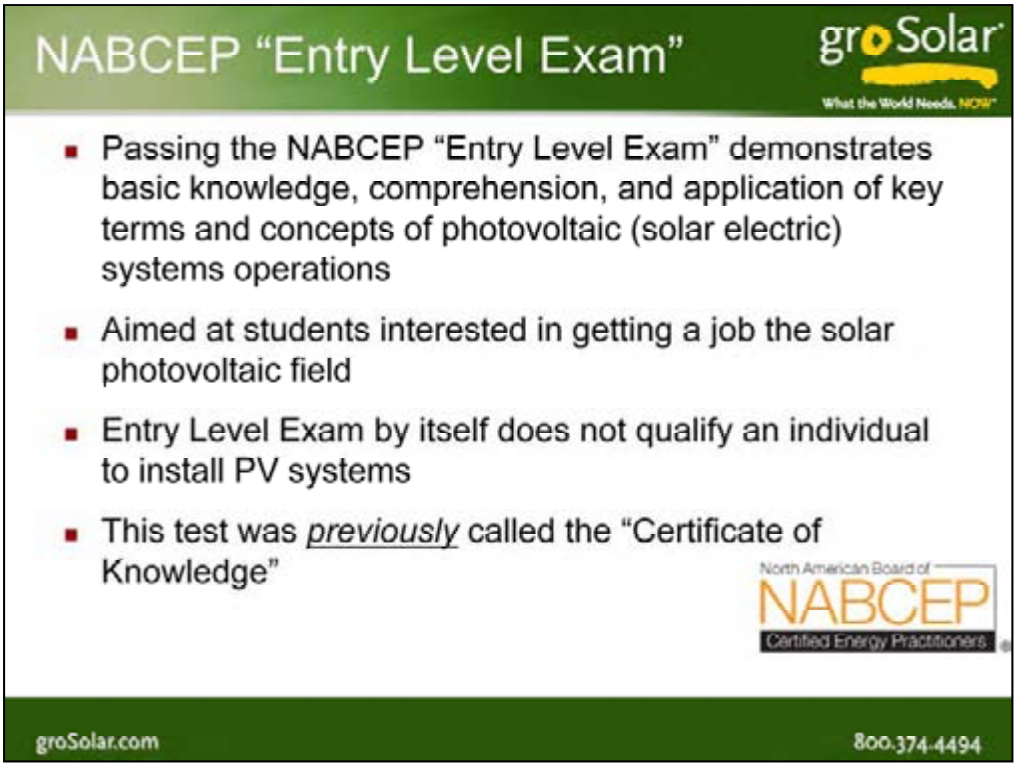


- **Training and Certification**
  - Beginning **AND** Advanced PV training strongly advised.
  - NABCEP certification
- **Site analysis and system design**
  - Power production estimates
- **Partners**
  - Supplier – Distributors or Manufacturers
  - Electrical contractor
  - Roofing contractor
  - Local inspectors
- **Incentives & financing**
- **Effective sales and marketing**
- **Sound business management**
  - This is a contractor business. Those that understand contracting have a major advantage.

•North American Board of Certified Energy Practitioners (NABCEP) is "the" solar PV certification agency in North America

•NABCEP administers **4 different solar tests**

- **•PV Entry Level Exam** (previously called "certificate of knowledge" exam)
  - **•Passing this test provides no certification**
  - •Allows job seekers to demonstrate entry level knowledge to employer
- **•PV Installer Certification Test**
  - •Test very challenging
  - •NABCEP certified PV installers have earned a mark of distinction as knowledgeable professionals
  - •Passing this test demonstrates strong knowledge of PV design/installation
  - •Applicants must complete education AND job experience prerequisites to qualify to take the Certification test, refer to www.**nabcep**.org for details
- **•Solar Thermal Installer Certification Test**
- **•Technical PV Sales Certification Test -** debuts in Jan 2011



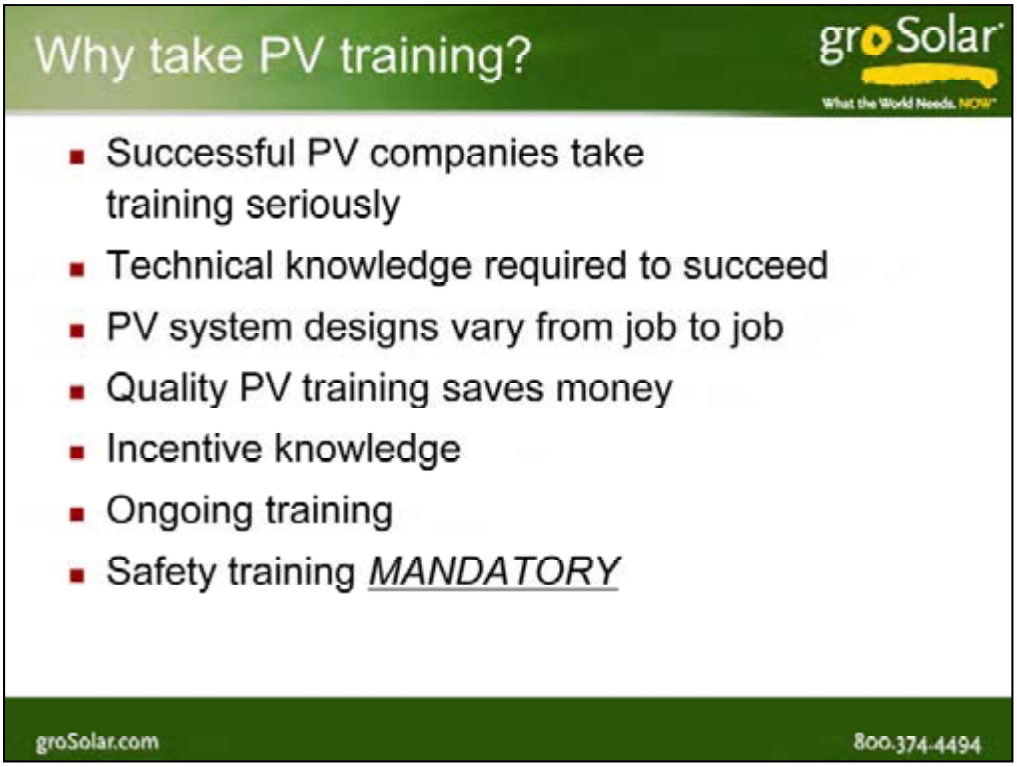
•Passing the NABCEP "Entry Level Exam" demonstrates basic knowledge, comprehension, and application of key terms and concepts of photovoltaic (solar electric) systems operations

•The NABCEP "Entry Level Exam" is **aimed at students interested in getting a job** the solar photovoltaic field

•The NABCEP Entry Level Exam by itself does not qualify an individual to install PV systems but it does prepare them for employment in the field

•This test was *previously* called the "Certificate of Knowledge"

- **IMPORTANT NOTE 1:** Passing this test **DOES NOT MAKE YOU CERTIFIED**
- **IMPORTANT NOTE 2:** There is **NO SUCH THING as "NABCEP entry level certification"** despite what many training organizations claim.



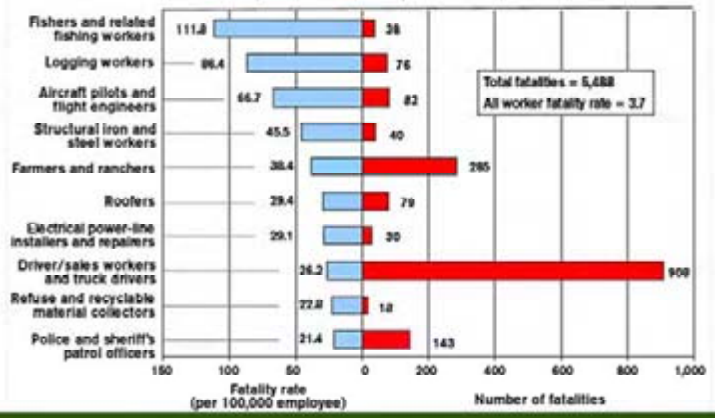
- **Successful PV companies take training seriously**
  - Solar PV design/installation is a contractor business and requires technical competency to succeed
  - Those that forgo training have high failure rate
- **Technical knowledge - one of the keys to success**
  - PV system design, Installation techniques, roofing considerations, electrical code considerations
- **PV system designs vary from job to job**
  - Pre engineered kits may help ease the solar design process for newcomers to the industry, but this strategy is not a viable business model over the long term
  - PV installation business is overwhelmingly is retrofit oriented. It is very uncommon to find 2 identical installations. Systems must be designed **AFTER** careful site evaluation
- **Quality PV training saves money**
  - Those that forgo training pay more within the first 1-2 jobs due to cost overruns, system redesign due to failed inspections, shortened system life, and poor system productivity
- **Incentive knowledge**
  - Critical to solar dealer profitability
- **Ongoing training**
  - Ongoing training required due to constant stream of new products, electrical and building code updates, and evolving incentive programs

Safety Considerations

groSolar
What the World Needs. NOW.

- Roofing is the **6th most fatal job** in the US
- Electrical power-line installers/repairers is 7th

US Dept of Labor fatality statistics from 2007



Training Matrix

groSolar
What the World Needs, NOW!

NABCEP Entry Level Training

	Intro Training	Business Training	IREC ISPQ Beginner PV	Incentive training	IREC ISPQ Advanced PV	Manufacturer product training	NEC code training	Safety training	Installation training
System Designers	x	x	x	x	x	x	x	x	x
Installers	x		x		optional	x	x	x	x
Electricians	x		x		optional	x	x	x	x
Business Managers	x	x	x	x				x	
Sales Reps	x	x	x	x		optional			
Admin staff	x	optional		x					
Solar Brokers	x	x	x	x	optional	x	x	optional	x
Site Assessors	x	x	x	optional	optional	optional	x	optional	optional

- **Intro to Solar PV**
  - Webinars
  - 1, 2, & 3 day training workshops (solar conferences)
    - These classes serve as an introduction, not sufficient for formal design/installation training
  - NABCEP Entry Level training courses are a good introduction to PV
    - http://www.nabcep.org/wp-content/uploads/2009/01/approved-providers05122009.pdf
- **Formal PV design and installation training**
  - Solar Energy International offers the best PV training in the industry
  - I strongly advise completing Beginner PV, Advanced PV, **and** Battery System training **before** designing or installing your first PV system
    - Tuition for most 5 day workshops is $800 - $1200
    - All students **should** complete Beginner PV before taking Advanced or Battery classes
- **Product specific training**
  - Inverter, racking, grounding, etc…
  - Offered at workshops, trade shows, and dealer conferences
  - Best when taken AFTER formal PV training
- **Hands-on system installation training**
  - Lab Week training with SEI in Paonia, CO
  - Install system on your house
- **NEC code training (Bill Brooks or John Wiles)**
  - Annual code refresher course advised for all dealers
- **Safety training – OSHA certified safety course**
  - Contact your workman's comp insurance carrier for recommended courses
- **Business Training**
  - 1 - 3 day training workshops available from Solar Energy International
  - Andy Black Ongrid training is great way to learn PV economics www.ongrid.net
  - SEI Tech PV Sales (PV 206) training course starts in November
- **Incentive training**
  - 40 - 50% of PV staff is dedicated to managing incentive programs and administration aspects of business
  - ASES and SEIA (CANSIA in Canada) chapter meetings
  - Local utilities and state energy offices have training resources and meetings
  - www.dsireusa.org is best online resource.

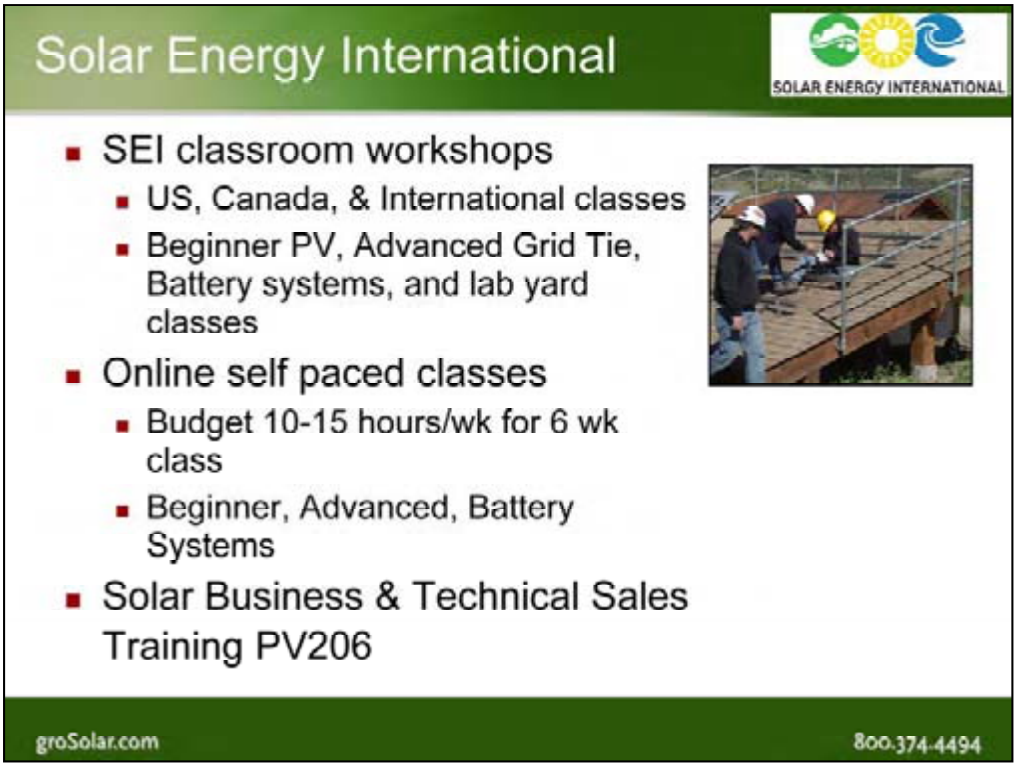
•The Interstate Renewable Energy Council (IREC) accredits PV training programs through the Institute for Sustainable Power Quality (ISPQ)

- •SEI's training programs are ISPQ accredited
- •http://irecusa.org/index.php?id=91

•Solar Energy International (SEI) is "THE" premier renewable energy training institute

- •www.solarenergy.org
- •Non-profit solar training organization headquartered in Carbondale, CO
- •SEI has the longest track record, best industry reputation, best curriculum, best instructors, and the most extensive course offering
- •SEI **ISPQ Certified Instructors:** Kyle Bolger, Rebekah Hren, Khanti Munro, Jason (Jay) Pozner, E. H. Roy, Jeff Tobe, Laura Walters
- •SEI **ISPQ Certified Master Trainers:** David Del Vecchio, Ed Eaton, Phillip Friedman, Kelly Larson, Jay Peltz, Justine Sanchez, Kristopher Sutton, Carol Weis, Johnny Weiss , Lena Wilensky

•The majority of NABCEP certified PV installers have trained at SEI



- SEI classroom training workshops
  - IREC ISPQ accredited PV training
  - Beginner Grid-Tie PV, Advanced Grid-Tie, Battery Systems, Solar Thermal, Wind, Micro-Hydro, Water Pumping, Sustainable Building, etc...
  - Workshops offered throughout North America
    - Canadian electric code training in Ontario Canada
  - Most classes have 2 instructors per class
  - Class size limited to 30 students (70 students for online classes)
  - More face time with a seasoned solar professional

- **NEW -** Solar Business & Technical Sales Training PV206
  - **Now open for registration**
  - Prepare for the new NABCEP Technical PV Sales Certification
  - http://www.solarenergy.org/workshop/solar-business-and-technical-sales

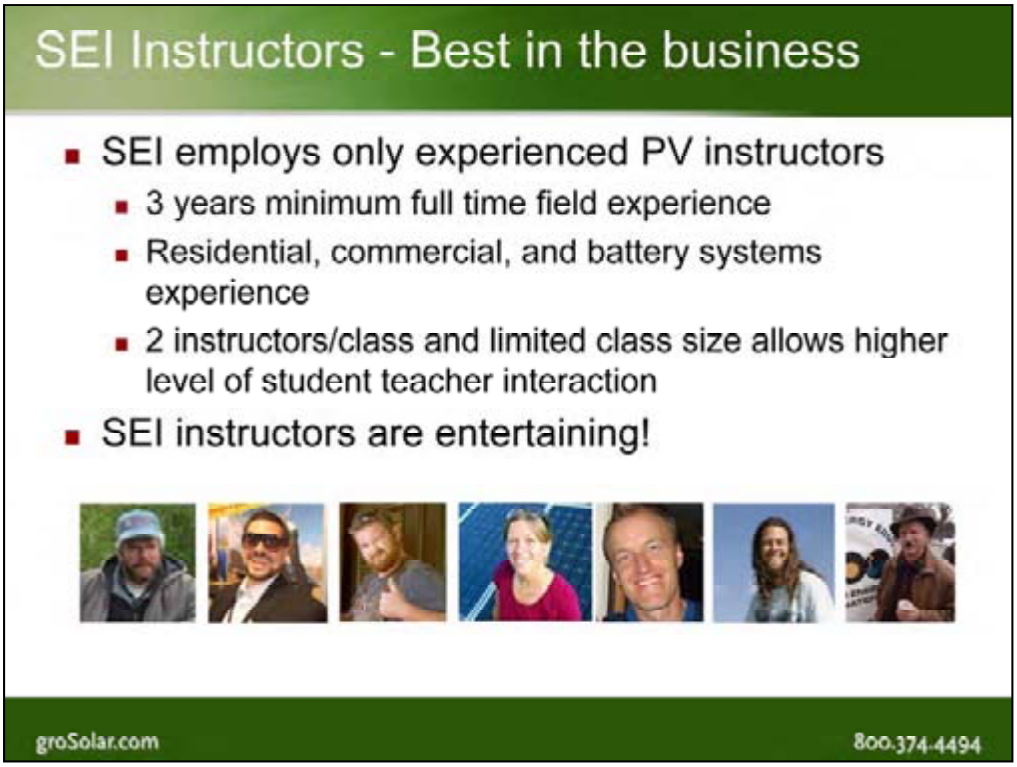
•10 different renewable energy systems Solar PV, Solar thermal, water pumping, micro-hydro, wind, etc…

•Students uninstall, study the system design, and reinstall under the close watch of an instructor

SEI PV206 - Solar Business & Technical Sales Training Class

SOLAR ENERGY INTERNATIONAL

- Helps prepare sales *professionals* for the NABCEP Technical PV Sales Certification
  - Training for all elements of the NABCEP Job Task Analysis
  - Recommend taking SEI PV101 and PV202 along with PV206 to be properly prepared
- Also includes training on solar business structure, marketing, PR, & site safety considerations
- Register at http://www.solarenergy.org/workshop/solar-business-and-technical-sales

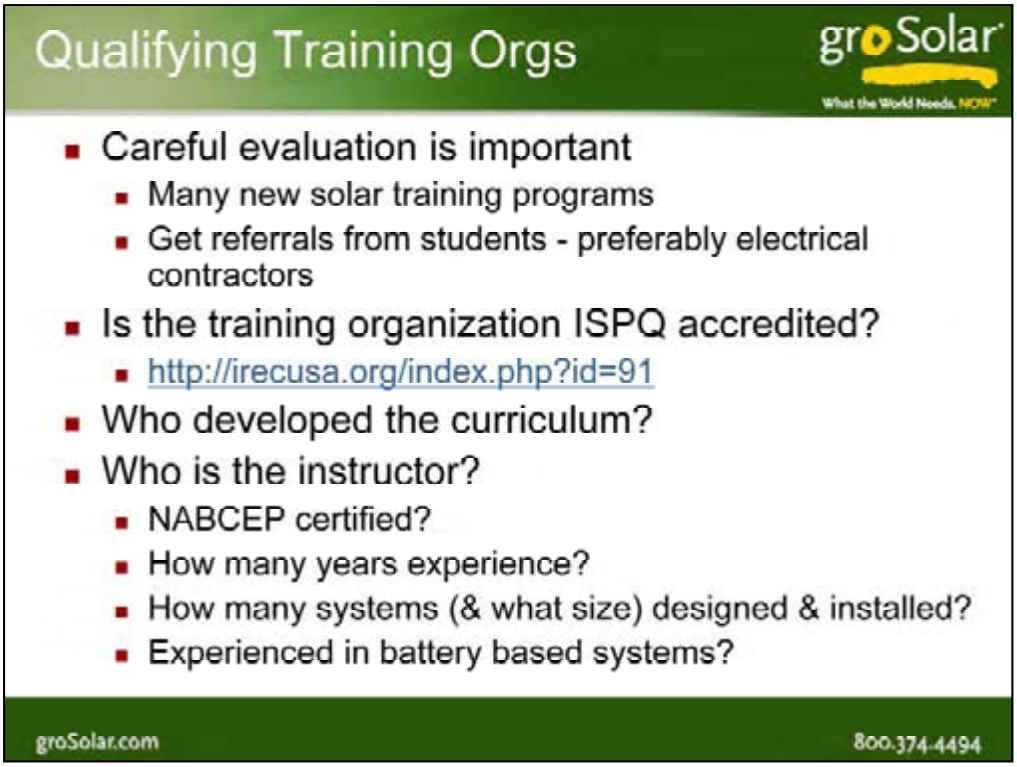


•**SEI employs only experienced PV instructors**
- •SEI instructors have a **minimum** of 3 years full time PV experience
- •SEI instructors are excellent educators with years of technical teaching experience
- •All have owned or worked for successful solar businesses

•**SEI Technical PV Instructors are experienced with:**
- •a wide variety of solar products and applications
- •designing and installing residential and commercial installations
- •grid-tie and battery based systems
- •retrofitting PV systems to a variety of roof surfaces
- •drilling thousands of holes in roofs that should never leak
- •permitting and inspectors in a wide range of work environments

•**SEI Instructors are entertaining!**

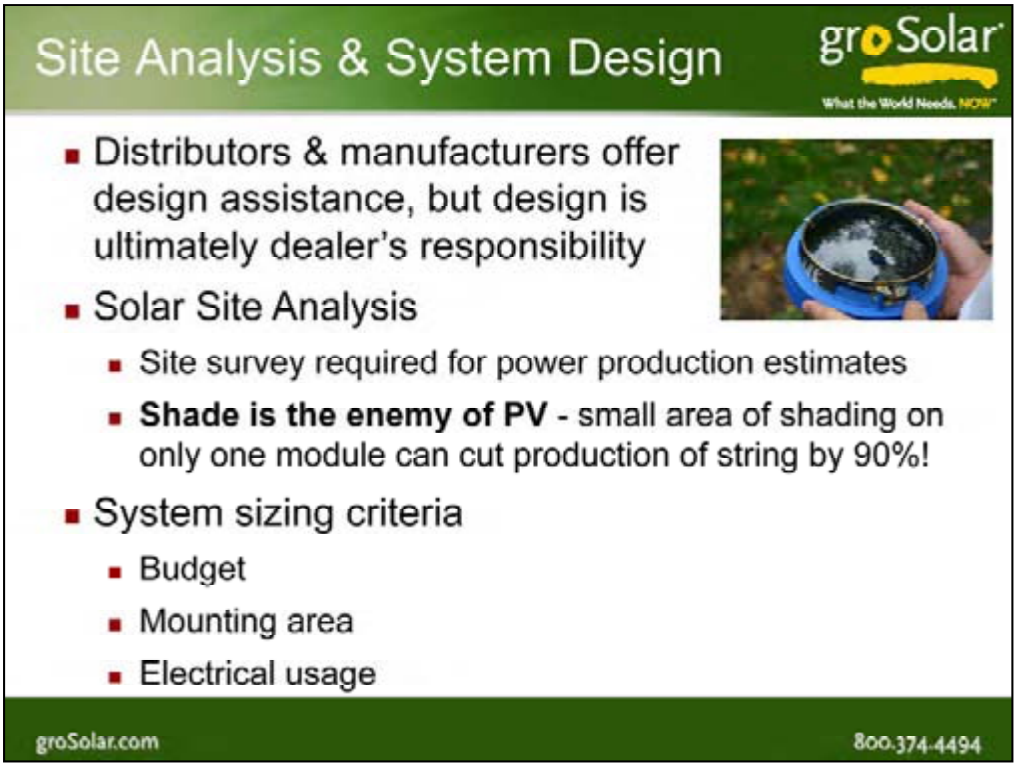
•SEI instructors possess the wisdom developed through years of working in this dynamic and challenging field. They are able to educate students at a higher level than most newer solar training organizations because they possess that special blend of PV system knowledge, experience, high level communication skills, and they are entertaining enough to hold your attention during the dry discussions on code compliance, wire sizing, and the finer points of inspector debating tactics



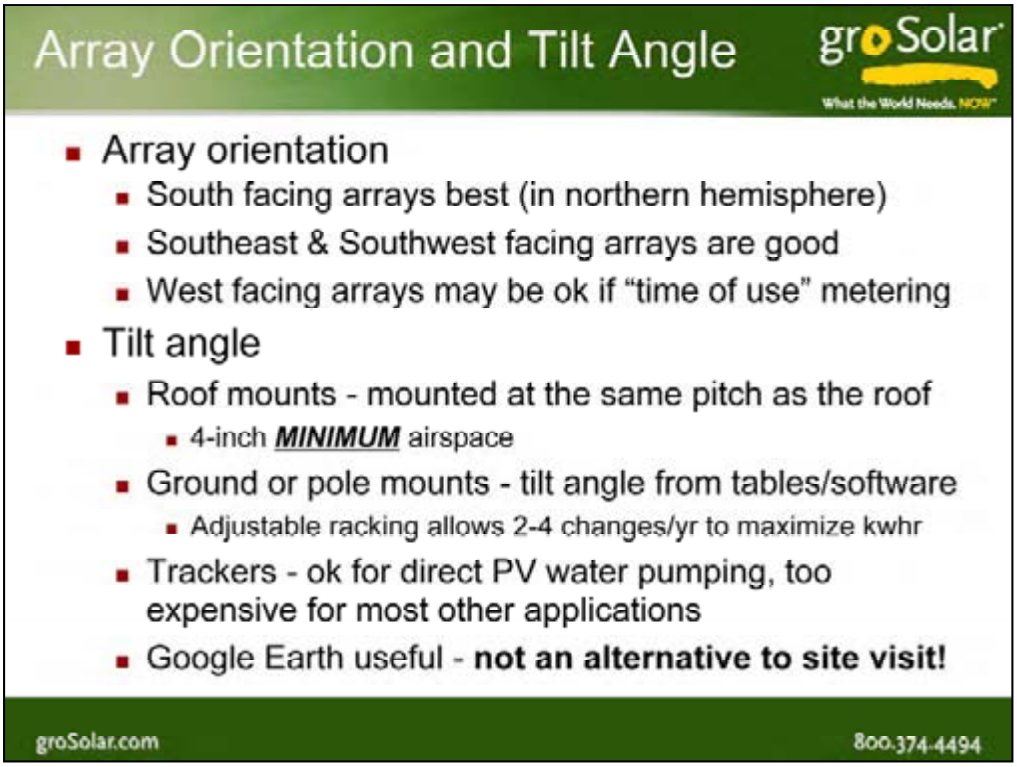
•NABCEP-certified PV installers are among the best instructors in the industry, however, being NABCEP certified does not necessarily mean they are a good educator

•How many years did the instructor work as a system designer/installer? 3-4 years minimum experience as **full time** designer/installer is desirable

•The best PV instructors have worn the tool belt on the job for years, navigated slippery roofs in cold months, crawled through the insulation in the hot attics in the summer, and lived with the legacy (good and bad) of the systems they have designed and installed for years



- **Site analysis and system design**
  - Should be conducted by a properly trained PV designer
  - Distributors and manufacturers offer design assistance, but design is ultimately the responsibility of the dealer
  - This is why beginning **and** advanced PV training are very important
- **Solar Site Analysis**
  - Proper site analysis required for power production estimates
  - Best to have no shade anywhere on array from 9 AM to 3 PM
  - **Shade is the enemy of PV** - small area of shading on only one module can cut production of an entire string by 90%!
    - Enphase Micro-Inverter & Tigo Energy Maximizer mitigate the effects of shade
- **System sizing criteria**
  - Budget is primary limiting factor for system size
  - Available mounting area is secondary limiting factor for most systems
  - Usage - Offset entire annual usage, or offset highest bracket for fast ROI on tiered rate users



- **Array orientation**
  - South facing arrays best, southeast & southwest facing arrays are good, and west facing arrays may be acceptable if using "time of use" metering
- **Tilt angle**
  - **Roof mounts -** in urban/suburban areas, solar arrays are normally mounted at the same pitch as the roof with a 4-inch ***MINIMUM*** airspace under array for convective cooling
  - **Ground or pole mounts -** Determine optimum tilt angle from design books or web tools for best year-round production
  - **Adjustable racking** - allows varying tilt to maximize summer vs. winter production, common in off grid systems, rare in grid tie applications
  - **Trackers -** common with direct PV water pumping systems, but generally not advisable in grid tie or urban areas because they are not cost practical
- **Site assessment**
  - **Google Earth** helpful in pre-screening site for shade obstacles and siting
  - Google Earth is NOT a suitable alternative to a site visit and shade assessment
  - Customer email digital photos of south, east, and western sides of house

Question and Answer Time

groSolar
What the World Needs. NOW.

Customer Proposals

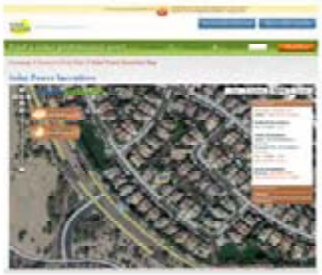
groSolar
What the World Needs, NOW

- **Power production estimate** & **incentive review** are basis for customer proposals
- List Return-On-Investment (ROI), payback time, and out-of-pocket cost
- Helpful web tools
  - FindSolar.com
  - Go Solar California
  - California Solar Initiative Calculator
  - PV Watts
- Proposal Generation Tool
  - www.ongrid.net
  - www.cleanpowerfinance.com

FindSolar.com

groSolar
What the World Needs. NOW.

- Free service of the American Solar Energy Society (ASES)
- Helpful estimator tool for homeowners and dealers
- Fast easy way to understand solar economics



- Provides "ballpark" estimates of incentives, power production, payback time, carbon savings
- Provides dealer listing services for local zip code areas

FindSolar.com

gro Solar
What the World Needs. NOW!

- Enter address/utility info to view:
  - Satellite Image of House
  - Incentives
  - System Size Information
  - ROI & system payback time
  - Emissions Information

Incentives	System Size		Savings		Emissions
Maricopa County, AZ Utility: Salt River Project **Federal Incentives** Tax Credit: 30% **State Incentives** Sales Tax Exemption: Exempt Property Tax Exemption: Exempt Tax Credit: 25% ($1,000.00 max) **Local Incentives** Rebate: $2.70/W DC ($13,500.00 max) (Salt	Solar Radiance:	6.32 kWh/sq.	Avg. Monthly Savings:	$100.00	The yearly electricity you use causes the release of 40,960 pounds of carbon dioxide (which promotes global warming). Driving 45,385 miles in an average car emits an equal amount. To offset the yearly emissions, it would require planting 102 trees a year.
	Avg. Monthly Usage:	2,276 kWh	25 Year Savings:	$49,975.09	
	System Size:	7.462 kW	25 Year ROI:	191.99%	
	Roof Size:	746 sq ft	Break Even:	15.96 years	
	Estimated Cost:	$52,231.64			
	Post Incentive Cost:	$26,112.15			

Go Solar California

groSolar
What the World Needs. NOW.

http://gosolarcalifornia.ca.gov/

- California Energy Commission (CEC) website lists eligible PV modules and inverters
- "CEC approved" module and inverter lists are used by many other state and local incentive programs
- California solar dealers must apply with CEC to offer incentives

CSI Incentive Calculator

groSolar
What the World Needs. NOW.

http://csi-epbb.com

- Lists appropriate incentive for CA installs
- Provides power production estimates for specified system
- Displays total incentive rate and amount that would be available from the CSI program

PV Watts

groSolar
What the World Needs. NOW.

http://www.nrel.gov/rredc/pvwatts/

- Free power production estimator from NREL
- Calculates PV system kw-hr production

Key Partners

groSolar
What the World Needs. NOW.

4 partners required to complete a successful PV system install:

1. **Supplier**
   - Manufacturer
   - Distributor
2. **Electrical contractor**
3. **Roofing contractor**
4. **Local inspector**

•Can be less expensive if purchasing at MegaWatt level

•Dealer must carefully assess all components in the system so they work well with other parts of system

•**Large solar distributors:** AEE Solar, Conergy, DC Power, groSolar, Solar Depot, Sunwize

•**Electrical distributors** (Platt, Wesco, CED) expanding into solar distribution

- •Limited product offering, limited tech support

•**Distributor stock** modules, controls, and components for grid tie, off grid, remote power, & battery backup including modules, inverters, racking, batteries, wind turbines, monitoring, and much more

•**One stop shopping** - eliminates complex web of vendor relationships, multiple purchase orders, and invoices for every job

"gro" your solar business with groSolar

What the World Needs. NOW.

SolarWorld · SMA · UNIRAC · CanadianSolar · Fronius · ZepSolar · Astronergy · enphase energy · panelclaw · AUO solar · PVPowered · Quick Mount PV

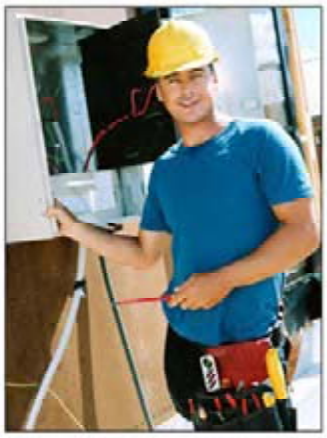
- Largest 100% U.S. owned distributor in the solar industry
- Quality products you can trust
- SOLARSPIES Training
- Excellent customer service - we call our customers back!

groSolar.com 800.374.4494

Partner #2 – Electrical Contractor

groSolar
What the World Needs. NOW.

- Electrical contractors often have the **best credentials** for becoming solar installers
- States/municipalities/utilities typically require licensed electrician to do wiring
- Electrical contractors must study Article 690 of the National Electric Code (NEC)
- Electrical contractors should receive PV training



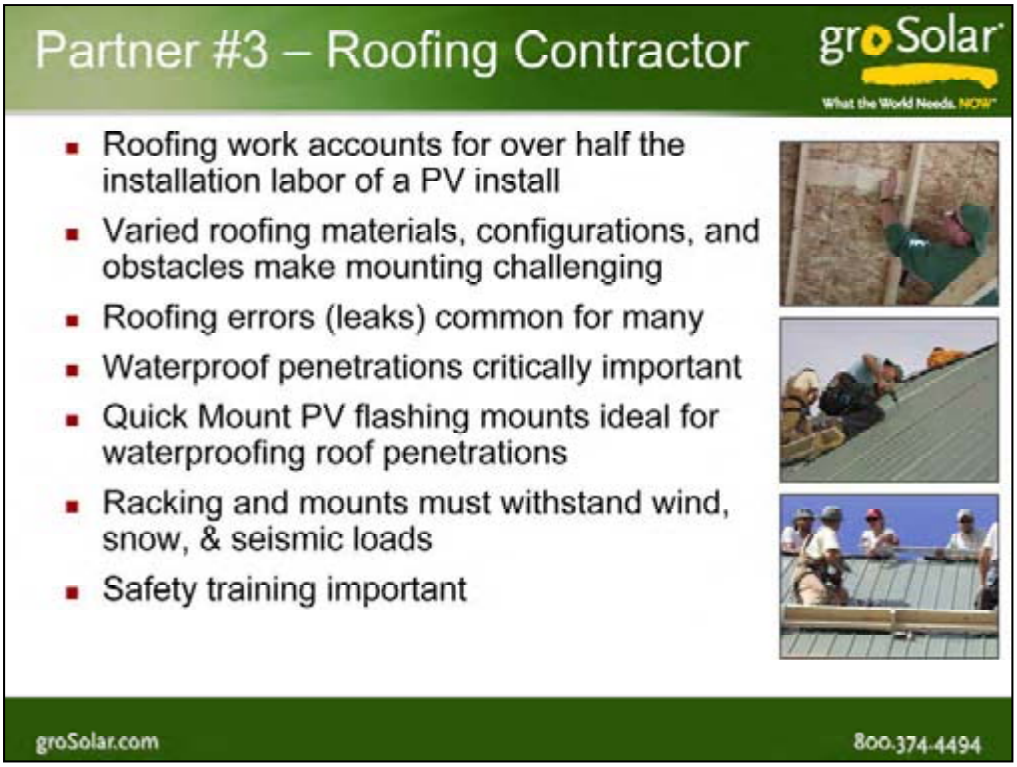
groSolar.com 800.374.4494

•**NEC Article 690** defines electrical code for PV

•**NEC Codebook** updated every 3 years – 2011 edition coming soon

•**Electrical contractors should receive PV training**

- •High-voltage DC power requires special training
- •PV power requires specialized training
- •Small patch of shade can knock out over 90% of system power



•**Roofing experience is highly beneficial** due to varied roofing materials, configurations, obstacles, etc…

•**Roofing errors (leaks) leading cause of service calls – 80% of construction litigation stems from water intrusion.**

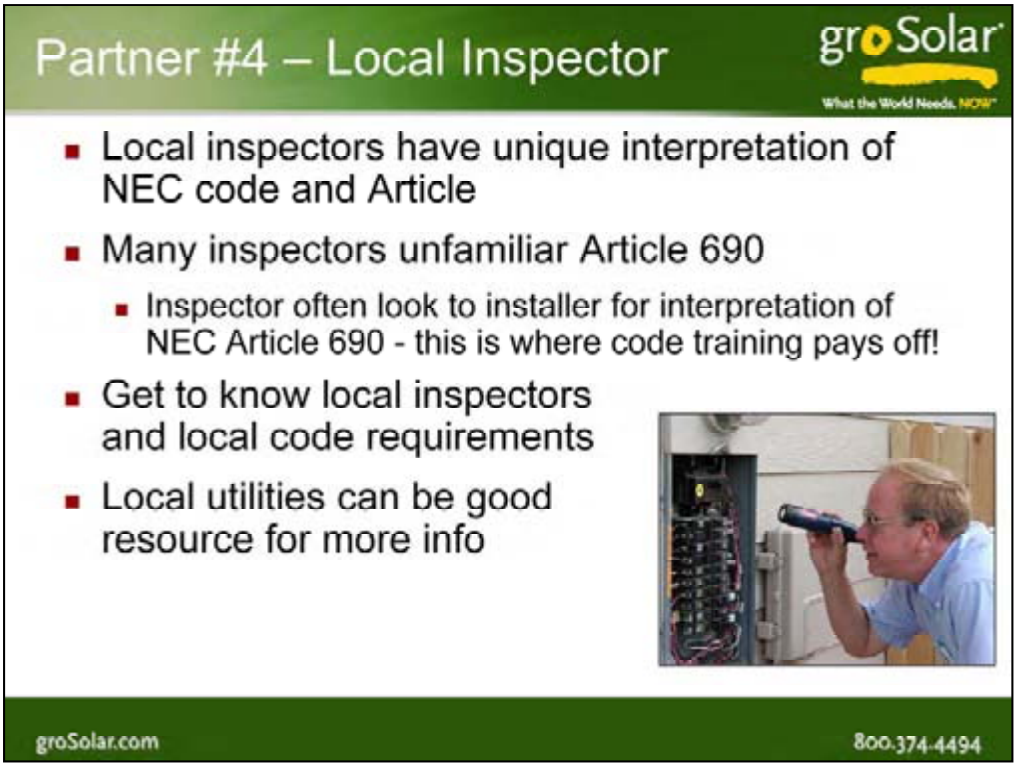
- •Waterproof roof penetrations critically important
- •Quick Mount PV flashing mounts ideal for roof penetrations
- •Quick Mounts are fast, easy, and won't void roof warranty

•**Racking and mounts must be engineered to handle:**

- •Wind - uplift loads challenging in hurricane zones
- •Snow load
- •Unirac web software eases design process

•**Safety training important**

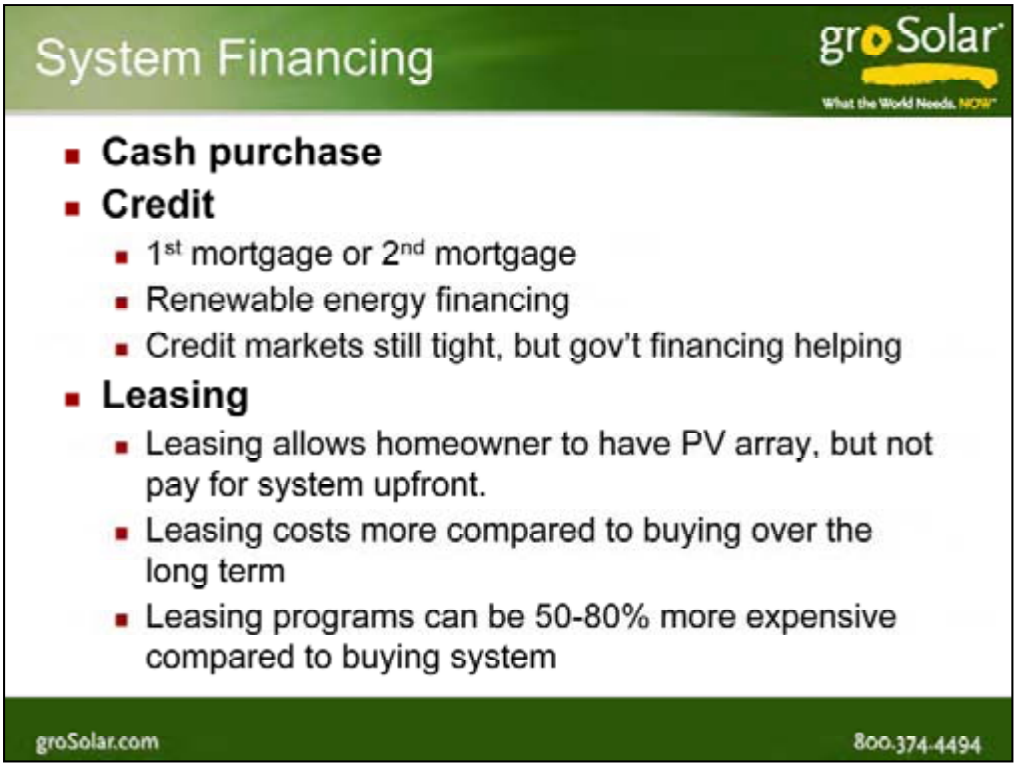
- •Osha requires use of safety harness



•Local inspectors may not follow NEC article 690

•New code may not be adopted for several years by some inspectors

•Every solar dealer should take annual code refresher course from John Wiles or Bill Brooks



- **Cash purchase**
- **Credit**
  - Rolled into 1st mortgage
  - 2nd mortgage
  - Renewable energy financing
    - Often a simpler financing option compared to mortgage
    - Can function as a bridge loan
  - Credit markets still tight, but government financing helping to boost the market for commercial installations
- **Leasing**
  - Leasing allows homeowner to have PV array, but not pay for system upfront.
  - Leasing costs more compare to buying over the long term
    - Many leasing programs are 50-80% more expensive compared to buying system
  - Great podcast on solar financing
    - http://www.renewableenergyworld.com/rea/news/podcast/2010/11/how-solar-as-a-service-began#readercomments

•Examples of different state programs

•California

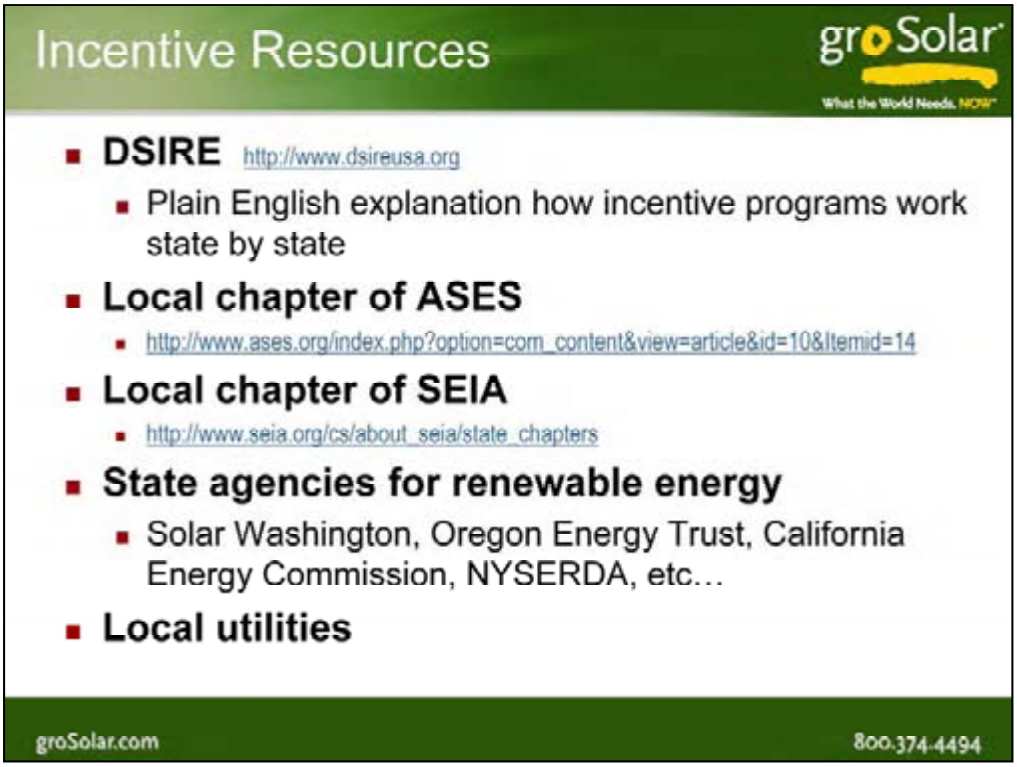
- •Up-front incentive or performance-based incentive
- •Installer must be registered with California Energy Commission to get incentives

•Oregon :

- •Installer must be registered with Oregon Energy Trust to offer incentives

•Arizona

- •Utilities offer incentives to meet state mandated Renewable Portfolio Standards (RPS)
- •Program funding is dynamic with frequent program changes



•**DSIRE** http://www.dsireusa.org

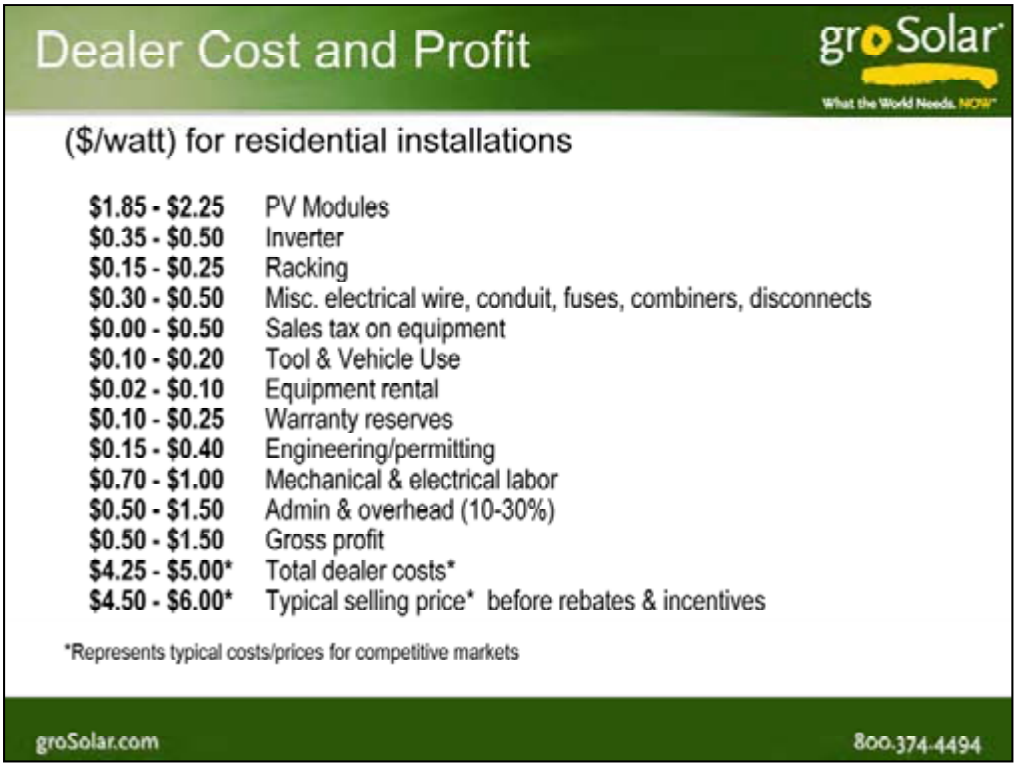
- •Database of State Incentives for Renewables & Efficiency
- •Lists in plain English how incentive programs work state by state

•**Local chapter of ASES**

- •American Solar Energy Society
- •http://www.ases.org/index.php?option=com_content&view=article&id=10&Itemid=14

•**Local chapter of SEIA**

- •Solar Energy Industry Association
- • http://www.seia.org/cs/about_seia/state_chapters



•***Total dealer cost is not simply a sum of the itemized costs**, but are a realistic range of actual costs incurred.

- •While some jobs will use the lower price range modules, racking, and inverters, they may have higher engineering/permitting costs, conversely some projects may have no sales tax, but may have higher hardware costs.
- •It is rare that a job hits all the lowest costs points for each category

•**Installation time for 4 kW system is approximately** 60 man hours (1-2 days at the site) and includes all labor (installation, site assessment, permitting, and admin).

- **Website is CRITICALLY important**
  - Most prospective customers will look at your website
  - A professionally developed and managed website is the best ROI in marketing
  - Presentation on building an effective solar website: www.strategicword.com/webreport
- **Home Shows and Outdoor Events**
  - Professional appearing demos and displays get you leads
  - Professional booth staffing gets you credibility
  - Invest in decent popup booths/banners, modules, racking, inverter, literature
- **Solar makes news**
  - Contact local newspapers, radio or TV stations for free publicity
  - Invite local media to a jobsite (with your customer's permission)
- **Speak at meetings**
  - Offer solar educational workshops to homeowners at meetings of the Rotary, chamber of commerce, environmental groups, builders groups, libraries, church groups, real estate groups

- **Word of mouth advertising is key**
  - Good word of mouth guarantees you customers
  - Bad word of mouth puts you out of business
  - Do not over-promise system performance
- **Advertise licenses and certifications**
  - List your official NABCEP certification logo and electrical contractor licenses
- **Advertising avenues for new dealers to find customers**
  - FindSolar.com
  - Home Power contractor guide
  - Solar Today contractor guide
  - ASES and SEIA chapter directories
  - Yellow Pages, newspapers, fliers, TV, and radio can be effective if done properly

•Energy consulting

- •A fundamental pre-requisite to PV quotation
- •Excellent public relations, establishes your credibility
- •Conservation more cost-effective than watts from a PV array
- •Every $1 spent in energy savings saves $3-$5 in the PV system
- •Allows smaller dealers to compete with large installers

•Excellent ROI can be achieved with small array (1-3 KW) on a power hungry home/business if the utility has tiered electric rates (common in CA and the Northeast)

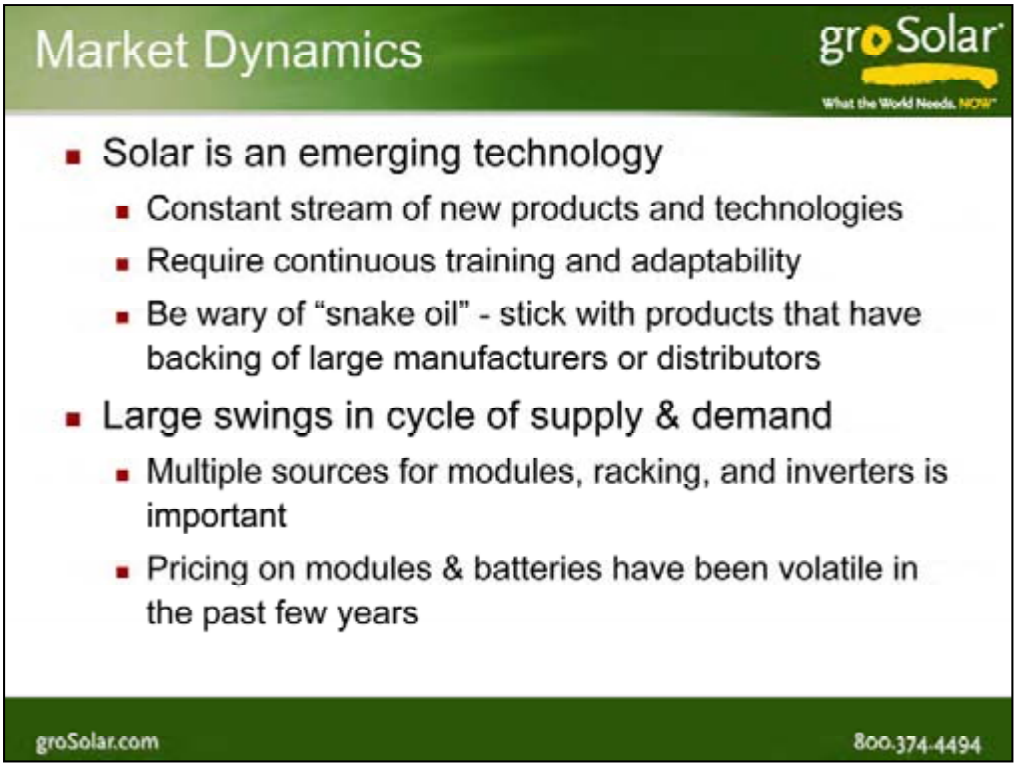
- •Some systems able to achieve ROI in under 5 years

•**Solar brokers**

•Brokers perform site evaluation, design the PV system design, and manage the sale

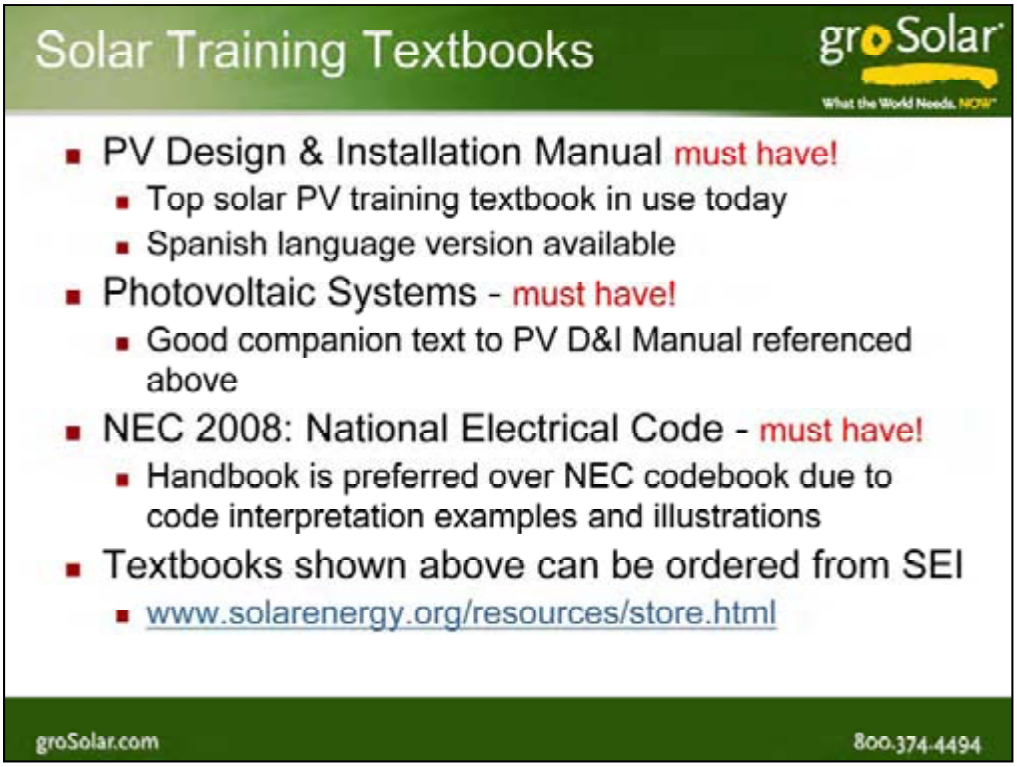
•Partner with local installation companies to complete the install

•Installer and Brokers should complete PV training



- **Service after the sale**
  - Budget for service in initial estimate
  - Grid-tie rarely require repairs until inverter replacement ~ 15 years
  - Off-grid installers budget 3-4 service calls for new installations

- **Home Power - must have!**
  - www.homepower.com
  - Excellent resource for residential & small scale commercial
  - Off-grid roots, but expanding grid-tie focus
- **SolarPro - must have!**
  - www.solarprofessional.com
  - Produced by the publisher of Home Power
  - Targeted to Solar designers, installers, resellers, and industry insiders.
- **Solar Today - must have!**
  - www.solartoday.org
  - Publication of the American Solar Energy Society
- **Solar Industry**
  - www.solarindustrymag.com
  - Industry focus
- **Photon International**
  - www.photon-magazine.com
  - Excellent industry journal; in-depth market and product news
  - European focus - $350/yr subscription fee



- **Photovoltaics Design and Installation Manual - must have!**
  - Published by Solar Energy International – 2007
  - Top solar PV training textbook in use today
  - Spanish language version available
- **Photovoltaic Systems - must have!**
  - Published by the National Joint Apprenticeship & Training Committee for the Electrical Industry - American Technical Publishers, 2007
  - Good companion text to PV D&I Manual referenced above
- **NEC 2008: National Electrical Code NFPA 70 - must have!**
  - Published by NFPA - National Fire Protection Association
  - National Electric Codebook or Handbook (Handbook is preferred due to code interpretation examples and illustrations)
- **Textbooks shown above can be ordered from SEI**
  - www.solarenergy.org/resources/store.html

Electrical Code Resources

groSolar
What the World Needs. NOW.

- National Electric Code NEC
  - The electrician' bible
  - Article 690 governs PV wiring and grounding
- Bill Brooks or John Wiles training classes
  - http://www.nmsu.edu/~tdi/Photovoltaics/Codes-Stds/C-S-Resources.html?agree=agree
  - http://www.solarabcs.org/index.php?option=com_events&Itemid=71
  - Google their names with "NEC training"
- NECA/IBEW/NJATC offers electrician training
- Local inspectors and local utilities
  - Contact info at http://www.dsireusa.org
- NABCEP study guide http://www.nabcep.org

Organizations

- Solar Educational Organizations
  - Solar Energy International (SEI) www.solarenergy.org
  - Solar Living Institute (SLI) www.solarliving.org
  - Midwest Renewable Energy Assoc. (MREA) www.the-mrea.org
  - Florida Solar Energy Center (FSEC) www.fsec.ucf.edu
- Solar Energy Industry Association (SEIA) www.seia.org
  - Industry lobby to congress - federal/state incentives
  - State chapters hold monthly meetings
    http://www.seia.org/cs/about_seia/state_chapters
- American Solar Energy Society (ASES) www.ases.org
  - State chapters hold monthly meetings
    http://www.ases.org/index.php?option=com_content&view=article&id=10&Itemid=14#arizona

Helpful Websites

groSolar
What the World Needs, NOW!

- RE Wrenches Forum - Great tech info!
  - http://lists.re-wrenches.org/pipermail/re-wrenches-re-wrenches.org
- PV Fire Safety
  - http://www.otherpower.com/firefighter_safety.shtml

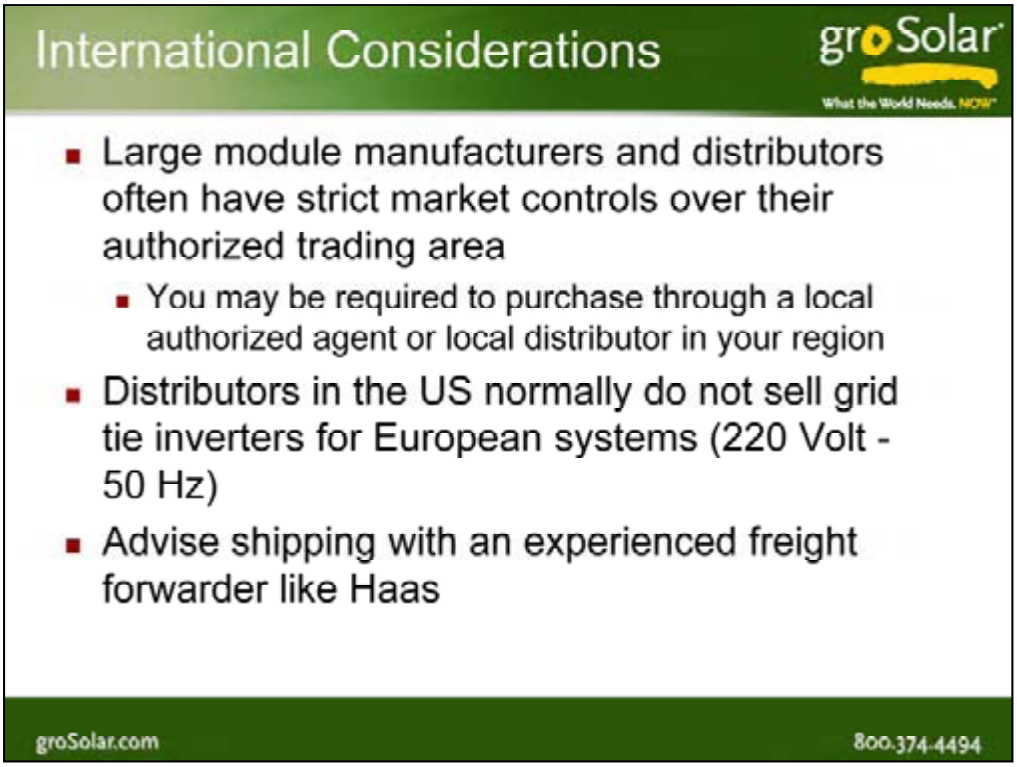
- www.consumerenergycenter.org
- www.nrel.gov
- www.renewableenergyworld.com
- www.solarbuzz.com
- www.solarindustrymag.com

2011 Major Industry Events

groSolar
What the World Needs. NOW.

- **Feb 22-24** **Electric West** - Long Beach, CA
  - http://www.electricshow.com
- **April 3-5** **PV America** - Philadelphia, PA
  - http://www.pvamericaexpo.com groSolar Booth
- **Apr 29 - May 1** **Northwest Solar Expo** - Portland, OR
  - http://www.nwsolarexpo.com
- **May 19-21** **Solar 2011** - Raleigh, NC
  - http://www.nationalsolarconference.org/
- **June 17-19** **Midwest RE Fair** - Custer, WI
  - http://www.the-mrea.org Lotsa Fun!
- **July 12-14** **Intersolar** - San Francisco, CA
  - http://www.intersolar.us
- **Oct 18-20** **Solar Power International** - Dallas, TX
  - http://www.solarpowerinternational.com/ Biggest solar show in North America
- **Oct 23-25** **NECA** - San Diego, CA
  - http://www.necaconvention.org

groSolar.com 800.374.4494



•Large module manufacturers and distributors often have strict market controls over their authorized trading area

- •You may be required to purchase through a local authorized agent or local distributor in your region

•Distributors in the US normally do not sell grid tie inverters for European systems (220 Volt - 50 Hz)

•Advise shipping with an experienced freight forwarder like Haas

- •If you choose the least expensive forwarder, you may get a company that has no experience with batteries, modules, and other PV items that require specific handling
- •If you use your own freight forwarder, you will need to secure the proper shipping documents
- •Getting an accurate freight quote can take between 2 to 10 working days (or more) depending on location and the level of freight service at their destination

Politics of Renewable Energy

groSolar
What the World Needs. NOW.

- She likes the clean energy
- He likes the energy independence
- They are both right (correct)

Question and Answer Time

groSolar
What the World Needs. NOW.

- Download a PDF copy of this presentation (complete with presenter notes) from
- www.groSolar.com/training

  or
- www.SolarSpies.net

HooRay

PV Modules Now In Stock!

groSolar
What the World Needs. NOW.

- Large inventory of modules at distribution centers in Vermont, Maryland, and California
- Contact your groSolar sales manager today to get pricing on our in-stock modules
- Download a pdf copy of this presentation (complete with presenter notes) from:
  - www.groSolar.com/training **or**
  - www.SolarSpies.net

SolarWorld · SMA · UNIRAC · AUO solar · Fronius · panelclaw · ASTROenergy · enphase ENERGY · ZepSolar · CanadianSolar · PVPowered · Quick Mount PV