

OCCUPATIONAL PROFILES FOR THE SOLAR INDUSTRY

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Since 2004, the Interstate Renewable Energy Council (IREC) has been compiling information on occupational descriptions and titles for the solar industry focusing primarily on photovoltaics (PV) or solar electricity. As the solar industry continues to set record growth, we are also seeing corresponding changes in the occupational profiles associated with a maturing industry.

Not that long ago, a solar installer handled many facets of the job – it was not unusual that “one guy did it all.” But today, there is differentiation in job categories as markets grow; systems are moving from small residential ones to larger, commercial projects requiring a variety of contractors and crews; work is governed by state licensing laws; and consumers are looking for quality assurance through third-party credentialing programs.

According to a July 2008 IREC Report, over 80,000 solar installations were completed in 2007. The average size of a grid-connected PV residential installation has grown steadily from 2.2 kW to over 4.7 kW from 1998 to 2008. The size of a non-residential system has also been growing in recent years with an average of 67 kW_{DC} in 2007.¹

Job Trends

The November 2001 Renewable Energy Policy Project (REPP) report, *The Work that Goes into Renewable Energy*, found that wind and solar electricity production offer 40% more jobs than coal.² On an energy capacity basis, PV employs the most workers among the renewables that were examined, followed by wind and biomass co-firing. The leading activity is module assembly. Systems integration is the second and installation is the third leading activity.³

The Renewable and Appropriate Energy Laboratory at University of California, Berkeley, released the report *Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?* (April 2004).⁴ The authors looked at 13 independent

reports and studies that analyzed the economic and employment impacts of the clean energy industry in the United States and Europe. They concluded that across a broad range of scenarios, the renewable energy sector generates more jobs than the fossil fuel-based energy sector per unit of energy delivered (i.e., per average megawatt). They found that the employment rate in fossil fuel-related industries has been declining.

Worldwatch Institute's July 2008 report, *Jobs in Renewable Energy Expanding* by Michael Renner states that "Renewables tend to be a more labor-intensive energy source than the still-dominant fossil fuels, which rely heavily on expensive pieces of production equipment.⁵ A transition toward renewables thus promises job gains." Renner goes on to state "The leaders in renewables technologies can expect considerable job gains in the near future in manufacturing solar panels and wind turbines for both domestic and export markets. Jobs in installing, operating, and maintaining renewable energy systems tend to be more local in nature and could thus benefit a broad range of countries." Renner's report states that "currently about 2.3 million people worldwide work either directly in renewables or indirectly in supplier industries."

In Roger Bezdek's report for the American Solar Energy Association, *Renewable Energy and Energy Efficiency: Economic Drivers for the 21st Century* (November 2007), the renewable energy and energy efficiency industries created a total of 8.5 million jobs in 2006; 450,000 jobs in renewable energy and 8 million in energy efficiency throughout the United States.⁶

For a more complete listing of reports on job trends and labor forecasts for the renewable energy industries, please visit www.irecusa.org.

An Overview of Solar Industries & Occupations

A variety of upstream companies, including large companies, and downstream players, many of whom deal directly with consumers, comprise the solar energy industry value chain.

Direct/Primary

- **Solar Cell and Module Manufacturers**
- **Photovoltaic Equipment Manufactures**
- **Balance of Systems (BOS) Manufacturers and Supplies**

- **System Integrators & Packagers**
- **Distributors**

- **Installers, Service & Repair Technicians (Operations & Maintenance)**

- **Sales Representatives/Marketers/Estimators**
- **Site Surveyors/Assessors**

- **Researchers & Scientists**
- **Engineers/Designers**
- **Trainers/Educators**

Indirect Occupations

- **Architects**
- **Builders**
- **Trade & Skilled Workers** – roofers, electrical and metal workers, HVAC installers, plumbers
- **Commodity Suppliers** – glass industry, electronic device manufacturers, plastics and polymer industries, equipment suppliers, wire and cable makers, and steel, aluminum, and other metal industries.
- **Electric Power Utility Workers**
- **Finance**
- **Policy & Program Managers**

Drilling Down to the Details – Sub Classifications

In April 2005, the California Solar Energy Industries Association released the ***Solar Occupations*** Survey Report.⁷ The report distinguishes between two groups of workers – Solar Panel Installers and Photovoltaic Specialists.

According to the report, tasks performed by *Solar Panel Installers* usually include the following: Moving, handling, packing, unpacking, and preparation of the tools, equipment, supplies, and materials necessary to construct a solar thermal or photovoltaic system; Use and operation of all hand and power tools and equipment necessary to facilitate an erection, construction, or assembly of solar panel support structures; Attachment, mounting, and sealing of system components; Cutting, bending, welding, soldering, placing, and fastening of pipes, conduits, and fittings; Pushing, pulling, and routing of module connectors.

Tasks performed by *Photovoltaic Specialists* usually include the following: Moving, handling, packing, unpacking, and preparation of the tools, equipment, supplies, and materials necessary to compose a photovoltaic system; Use and operation of all hand and power tools and equipment necessary to facilitate an erection, construction, or assembly of solar panel support structures; Attachment, mounting, and sealing of system

components; Cutting, bending, welding, soldering, placing, and fastening of pipes, conduits, and fittings; Pushing, pulling, and fastening of wires; Photovoltaic system design and component selection; Termination, testing, and commissioning of all components of a photovoltaic system; Operation, maintenance, diagnostic evaluation, and repair of photovoltaic systems.

In December 2007, the *Solar Technicians Occupational Environmental Scan for California Community Colleges* report further differentiated among solar jobs.⁸ This report groups solar technician jobs into the following main clusters.

Solar Energy Engineer/ Designers are primarily responsible for generating system designs and supporting documentation for PV and solar hot water systems. This includes production of plans for building permit applications and construction, specification of components, design of systems, and mechanical and electrical points of connection. The position works with a multi-disciplined team to design and produce construction plans for photovoltaic or solar thermal projects.

A Solar Energy System Installer is responsible for the installation of solar electric, hot water and pool heating systems. Installers are required to perform some of the following tasks: electrical wiring, rooftop panel mounting, carpentry and handyman tasks, system troubleshooting, customer interaction, and miscellaneous labor work.

A Solar Energy Foreman leads installation teams on residential and commercial PV/thermal systems. Working as an installer, with some additional office planning time, the foreman is responsible for installation, commissioning, troubleshooting and repair as well as managing the job site, reviewing and finalizing system design, managing equipment and materials, and writing safety plans. Both Installers and Foremen can be specialists either in solar electric or solar thermal equipment. The main professional advancement for all three groups is to move to a Solar Installation Manager position.⁹

Solar Installation Operation Managers provide project management for the installations, the oversight of installation services, and the training of the project management team. The Manager also provides guidance and contributes to the development of the supply chain strategy and system design activities.

Some comments on these job classifications...

Jerry Ventre, retired from the Florida Solar Energy Center and now a consultant with IREC, says that the “Biggest delineation in [PV] job specialization is directly tied to system size and associated contracting arrangements. Large system may involve an A&E firm, or a general or electrical contractor as lead, with roofing and construction contracted out. Tasks like installing support structures for large arrays, making roof attachments, installing glazing support frames for building-integrated PV would usually be done by contractors that have much broader construction experience, for which PV is an easy extension.”

Jim Dunlop, formerly with the Florida Solar Energy Center and now with the National Joint Apprenticeship Training Committee, cautions that “In the case of PV installations, these are clearly electrical power systems, and nearly all aspects are governed by the North American Electrical Safety System. That is, the standards are promulgated by IEEE, products are listed and certified by UL, and installation and safety requirements are covered by the National Electrical Code (NEC) and OSHA and enforced by the local AHJ [Authority Having Jurisdiction] through the electrical plans review, permitting and inspection/approval process. The NEC has a lot to do with tying all this together, which is adopted as law by most states and local jurisdictions, and impacts contracting rules and regulations as well as a guide for inspections and code compliance.”¹⁰

States have different licensing requirements which usually fall under a General Contractor (or equivalent) License, Electrical Contractor License for PV or Plumbing License for Solar Thermal, Solar Contractor license or sublicense or other licensing requirements. While the North American Board of Certified Energy Practitioners (NABCEP) is clear that their certification is not a substitute for licensure or any other credential or certification which may be required by state or local laws or regulations and that their professional credentials are voluntary, some state rebate funds and projects are requiring NABCEP certification or in a few cases are offering a tiered incentive program with greater incentives for NABCEP certificants. Berkeley Lab and the Clean Energy States Alliance’s October 2006 report titled *Designing PV Incentive Programs to Promote Performance: A Review of Current Practice*¹¹ has a good list of PV Installer Requirements on page 12. Also visit the Database of State Incentives for Renewables and Efficiency (DSIRE) at www.dsireusa.org for a listing of contractor licensing requirements by state.

In a July 21, 2008 email, Jim Dunlop refers to the US Department of Labor’s (DOL) classifications in their Occupational Outlook Handbook. Jim says that “While [DOL] does not presently have a specific “solar” category listed, they do mention solar under HAVAR and I think PV is implicitly covered under electrical given the scope of work.” Jim also writes “... that DOL does not attempt to classify occupations based on a specific product or technology, but in a broader general context based on competencies involved.”¹²

Job Analysis for Solar Installers

The task (or job) analysis is a formal process for determining what people do, under what working conditions they do it, what they must know to do it, and the skills they must have to do it. Usually a technical committee of subject matter experts is convened to develop the task analysis.¹³

One of the best sources that defines a general set of knowledge, skills and abilities typically required of solar electric installers is the North American Board of Certified Energy Practitioners’ Task or Job Analysis.¹⁴

NABCEP-Certified Solar PV installers are required to specify, configure, install, inspect and maintain a solar electric system that meets the performance and reliability needs of customers, incorporates quality craftsmanship, and complies with all applicable safety codes and standards.

For the purposes of developing training curricula, assessment mechanisms and certification criteria, specific tasks are classified as either cognitive or psychomotor skills.

The NABCEP PV Task Analysis covers 8 major areas:

1. Working Safely with PV Systems
2. Conducting a Site Assessment
3. Selecting a System Design
4. Adapting the Mechanical Design
5. Adapting the Electrical Design
6. Installing Subsystems and Components at the Site
7. Performing a System Checkout and Inspection
8. Maintaining and Troubleshooting a System

The July 2003 report prepared for the Massachusetts Technology Collaborative titled *Needs Assessment for Training and Certification within the Photovoltaic Industry*,¹⁵ further discusses training needs for photovoltaic installers. The report states, “The type of training that is unique to the solar industry extends beyond the normal craft of building trades ... [and includes] considerations of system design and execution for performance. The following is a partial list of training needs from the report which are unique to photovoltaic installers:

- Training in site assessment as it pertains to system performance (assessing the effects of shading obstructions, tilt and azimuth angles, etc.)
- Training in photovoltaic cell and module characteristics as they apply to the design and performance of integrated systems
- Training in calculating system characteristics, such as wire sizes, to minimize power losses and maximize energy production
- Training in applicable wiring methods and technologies
- Training in mounting techniques and technologies
- Training in PV system maintenance, diagnostic and troubleshooting techniques
- Training in customer education practices.”

In addition to the tasks listed above, training should also include fundamental electrical skills, understanding of the electrical grid, and understanding of roof applications and ceilings.

NABCEP also has approved a Task Analysis for solar thermal that defines a general set of knowledge, skills and abilities typically required of practitioners who install and maintain solar hot water or pool heating systems.¹⁶

The NABCEP Solar Thermal Task Analysis covers 12 major areas:

1. Working safely with solar hot water and pool heating systems
2. Identifying systems and their components
3. Adapting a system design
4. Conducting a site assessment
5. Installing solar collectors
6. Installing water heater and storage tanks
7. Installing piping, pipe insulation and connecting system piping
8. Installing mechanical/plumbing equipment and other components
9. Installing electrical control systems
10. Installing operation and identification tags and labels
11. Performing a system checkout
12. Maintaining and troubleshooting a solar thermal system

This task list assumes the installation contractor starts with an approved solar system design package, complete with major components, manufacturer installation manual, system schematics, and assembly and troubleshooting instructions. While the solar installation contractor may not design the system, in many cases they must be knowledgeable about many aspects of systems design, and may be required to adapt certain designs to fit a particular application or customer need.

Job Descriptions

Here are sample skills and experience requirements from some recently posted jobs.

Source: Renewable Energy World - www.renewableenergyworld.com

• **Entry Level Solar Electric Installer**

Desired Qualifications:

- Strong work ethic, self motivation, organization and a can-do attitude
- Experience in mechanical installations, general construction and ladder work
- Basic understanding/experience with electrical wiring of AC and DC systems PREFERRED
- 1-2 years of construction background is PREFERRED
- Experience with all types of hand-held and power tools
- Experience with small machinery (trenchers, bobcats, forklifts) PREFERRED
- Experience working with all types of building materials - various roof types, stucco, wood, concrete, Uni-strut, roofing etc PREFERRED
- Team player who listens, learns, and actively communicates · Visual thinker good at problem solving and implementing ideas · Knowledge of the RE marketplace, technology and industry ·
- Desire to learn and master all aspects of installing solar PV systems
- H.S. Diploma, two-year degree in technology/industrial arts PREFERRED

Position Responsibilities will include but are not be limited to:

Perform project installations including:
Pulling inventory for specific projects
On site design implementation – working off of plans and schematics
Layout of solar modules / array
Mechanical/structural mounting of racking, modules and electrical equipment
Assembly of mounting hardware
AC and DC Electrical wiring of systems
Attic work in homes and businesses to verify structural attachment
System commissioning / start-up
Site clean-up
Job Documentation – photos
Drive the company truck to and from the job site as required
Maintain minimum inventory levels on the work truck
Pre-assemble job components in the warehouse
Maintain a clean warehouse, truck and work site
Perform tool maintenance as required
Perform truck maintenance
Attend mandatory training sessions on new products, methodology and safety
Perform system service as required
Distribute brochures/talk/sell solar as required to interested

• **Experienced Solar PV Installer**

Applicants must be able to show they meet the following qualifications:

- Minimum 18 months experience installing commercial or residential solar electric systems
- Either hold a NABCEP certificate or be working towards certification
- Disciplined, self-motivated work style
- Desire to stay on the leading edge of the RE industry
- Experience with electrical wiring in residential or commercial applications
- Experience in mechanical installations, general construction and ladder work
- Working knowledge of the NEC Code and AC and DC electrical systems
- Working knowledge of Universal Building Codes
- General understanding of common building materials and techniques (i.e. lumber, roofing materials, etc.)
- Previous foreman or team leader experience
- Good communication and customer service skills and experience
- Experience providing safety tailgate meetings
- Experience with all types of hand-held and power tools, as well as small machinery (trenchers and bobcats)
- Experience mounting to all types of building materials — various roof types, stucco, wood, concrete, Uni-strut, etc.
- Proficiency on a PC computer (MS Word, Excel) a PLUS
- Experience with solar thermal systems a plus.
- Previously employed by a well known contractor a PLUS

• **Experienced Solar PV Project Manager**

Desired Qualifications:

- Experience installing or project managing solar PV construction projects
- Strong understanding of grid-tied PV system design
- Previous project management or foreman experience
- Strong leadership skills – ability to organize, utilize and motivate team members quickly to respond to changes in the construction schedule

- Ability to read, understand, and edit electrical and structural plans
- Good at problem solving and implementing site-specific design modifications
- Strong understanding of electrical wiring, theory and the trade – bending pipe, sizing conduit, sizing wire, working with power distribution centers, calculating voltage drop
- Strong understanding of the NEC Code and the ability to reference the code as required
- Knowledge of Universal Building Codes and building materials and techniques (i.e. lumber, roofing materials, etc.)
- Experience supervising and managing subcontractors in other trades
- Experience working with city/county permitting offices and inspectors
- Proficiency on a PC computer in MS Office (Emphasis on Excel, Outlook)
- Positive ‘can-do’ attitude
- Ability to work long hours as required in order for the installation crews to work to optimal efficiently on a daily basis
- H.S. Diploma required (4-year college degree preferred)

Position Responsibilities will include but not be limited to:

- Maintain complicated schedules, develop project timelines, and manage people and materials to complete jobs on schedule
- Independently manage performance and productivity of installation teams
- Set and obtain installation goals
- Mentor staff of solar technicians as required
- Coordinate the construction of multiple projects simultaneously
- Attend weekly Project Management and Design Meetings
- Coordinate and schedule building inspections

• **Marketing Coordinator**

Tasks

Handle and respond to customer inquiries, distribute leads
 Responsible for implementation, administration and maintenance of CRM system (SuperUser)
 Administrate the market intelligence database
 Organize, participate and administrate trade exhibitions and seminars
 Planning and execution of all sales arrangements
 Manage marketing materials, collateral. Ordering and distribution.
 Manage give aways, coop fund, sales competitions.
 General administrative tasks related to sales and marketing
 Coordinate all sales and marketing activities and initiatives with HQ
 Coordinate all sales and marketing activities in US
 Cooperate with international marketing HQ

Qualifications

Marketing Masters or Bachelor degree
 3-5 years work experience
 International work or educational experience
 Fluent English, both written and verbal. Spanish a great advantage
 Service minded. Strong work capacity. Customer focused.
 Ambitious, high energy, proactive and independent. Team player. Result oriented. Positive attitude, enthusiastic.

• **Inside Sales Representative**

Responsibilities

- Coordinate initial reply from all incoming new international sales leads
- Assign proper sales representative to all new leads
- Prepare proposals and quotations to customers

- Perform sales and marketing support duties as needed
- Work with Business Manager to ensure proper sales process flows properly
- Serve as the internal ISO auditor
- Track and prepare daily, weekly, monthly and quarterly sales and revenue reports
- Act as sales lead coordinator for all trade shows

Qualifications

- Technical Degree (Associates minimum) with sales experience
- Ability to perform limited travel
- High proficiency in MS Office suite, and SalesForce.com
- Ability to communicate clearly and represent Spire professionally
- Strong team participation skills

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Endnotes

¹ *U.S. Solar Market Trends 2007*, July 2008, Larry Sherwood, Interstate Renewable Energy Council. www.irecusa.org

² <http://www.repp.org/repp/index.html>

³ Another REPP report is *Solar PV Development: Location of Economic Activity*. January 2005. http://www.repp.org/Solar_PV_Dev.htm

⁴ <http://rael.berkeley.edu/files/2004/Kammen-Renewable-Jobs-2004.pdf>

⁵ <http://www.worldwatch.org/node/5821>

⁶ <http://www.ases.org/images/stories/ASES-JobsReport-Final.pdf>

⁷ Consultant: Jim Cassio, Workforce Information Group, Inc., Folsom, CA

⁸ Prepared By: Evgeniya Lindstrom, Southern California Centers of Excellence Hub San Bernardino Community College District, San Bernardino, CA.

http://www.coeccc.net/products_industry_scans.asp. There are additional scans and reports at this site for the solar industry as well as for wind.

⁹ The Solar Energy Foreman, as defined by the Southern California Centers of Excellence Hub's report, is more closely aligned with the requirements for a NABCEP-Certified Solar Installer.

¹⁰ January 4, 2008 email correspondence between Jim Dunlop and Jane Weissman

¹¹ http://www.cleanenergystates.org/library/Reports/LBNL-61643_Designing_PV-Incentive_Programs.pdf

¹² Links to classifications in DOL's Occupational Outlook Handbook:

- Electricians: <http://www.bls.gov/oco/ocos206.htm>
- HVACR Mechanics and Installers: <http://www.bls.gov/oco/ocos192.htm>
- Engineering Technicians: <http://www.bls.gov/oco/ocos112.htm>
- Installation, Maintenance and Repair Occupations: <http://www.bls.gov/oco/oco1008.htm#other>
- Electrical and Electronics Installers and Repairers: <http://www.bls.gov/oco/ocos184.htm>
- Construction Trades and Related Workers: <http://www.bls.gov/oco/oco1009.htm>

¹³ Performance-Based Certification: How to Design a Valid, Defensible, and Cost Effective Program. Judith Hale, November 1999.

¹⁴ <http://www.nabcep.org/pvtaskanalysis.cfm>

¹⁵ This report was prepared by Center for Industrial Competitiveness, University of Massachusetts, Lowell, William Mass, James Bing, William Rothwell.

¹⁶ <http://www.nabcep.org/solarthermalta.cfm>