Financing the Next Generation of Solar Workers

An Exploration of Workforce Training Program Sustainability in the Context of Reduced Public Funding

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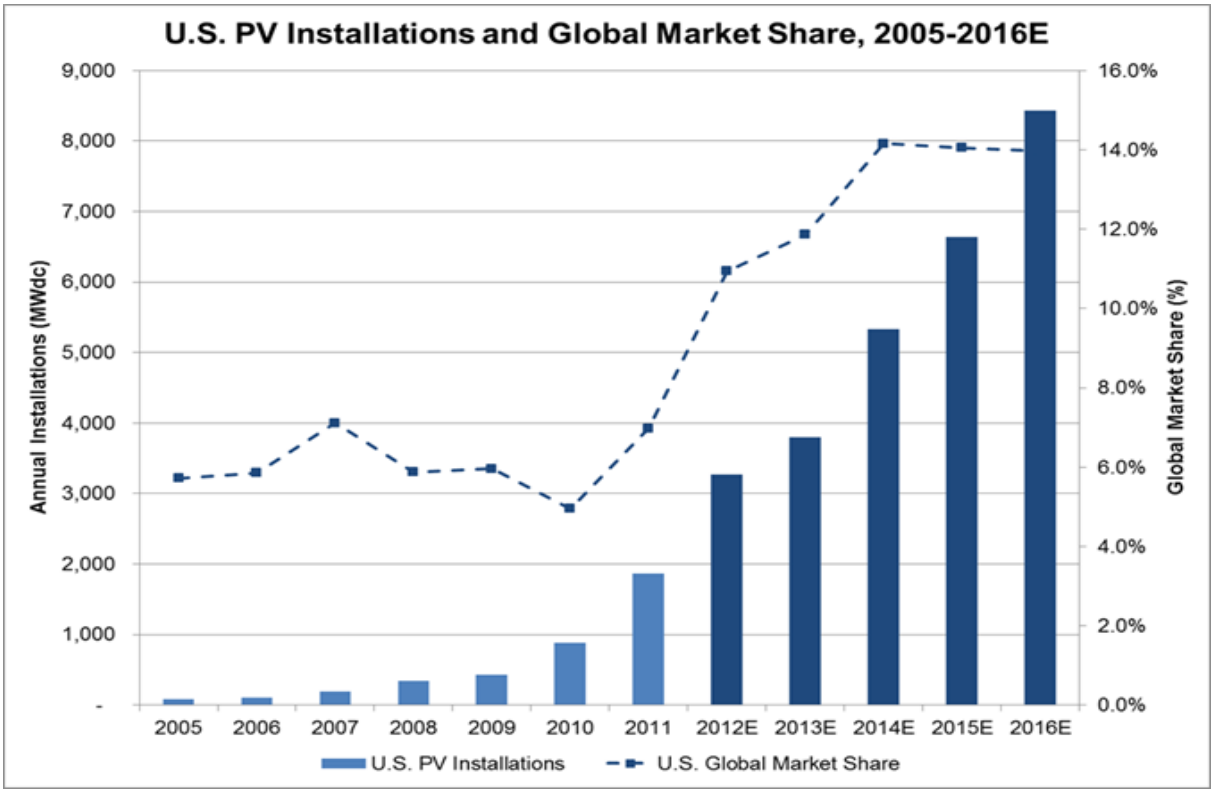
Executive Summary

The U.S. solar energy industry has experienced dramatic growth over the past five years. A 77% compound annual growth rate in solar installations brought total installed capacity up to nearly four gigawatts (GW) by the end of 2011, with ten states accounting for 87% of the nation's total solar capacity.[1] The growth of solar energy, an emerging clean energy technology, has provided over 100,000 jobs across the country. Over the twelve months preceding August 2011, a time in which millions of people remained out of work and overall national employment grew only 0.7%, employment in the solar industry demonstrated a 6.8% annual growth rate.[2] To support this recent growth in solar employment, a number of workforce development organizations, certification programs, credentialing programs and workforce best practices have emerged in recent years.

Figure ES1: U.S. PV Installations and Global Market Share, 2005-2016E
Source: SEIA/GTM SMI Q1 2012



With many analysts predicting the U.S. solar market to be the largest in the world by 2014 and capturing about 14% of the global market share by 2016, the solar industry has a reason to be optimistic. Furthermore, the National Renewable Energy Laboratory (NREL) predicts that the solar industry stands on the precipice of a significant tipping point. NREL projects that by 2015, much of the U.S. will attain "break-even" points[3] for residential photovoltaic (PV) systems at price points that are less than or equal

[1] Solar Energy Industries Association/ GTM Research. 2012. *U.S. Solar Market Insight: 2011 Year-in-Review*. Executive Summary available at http://seia.org/cs/research/

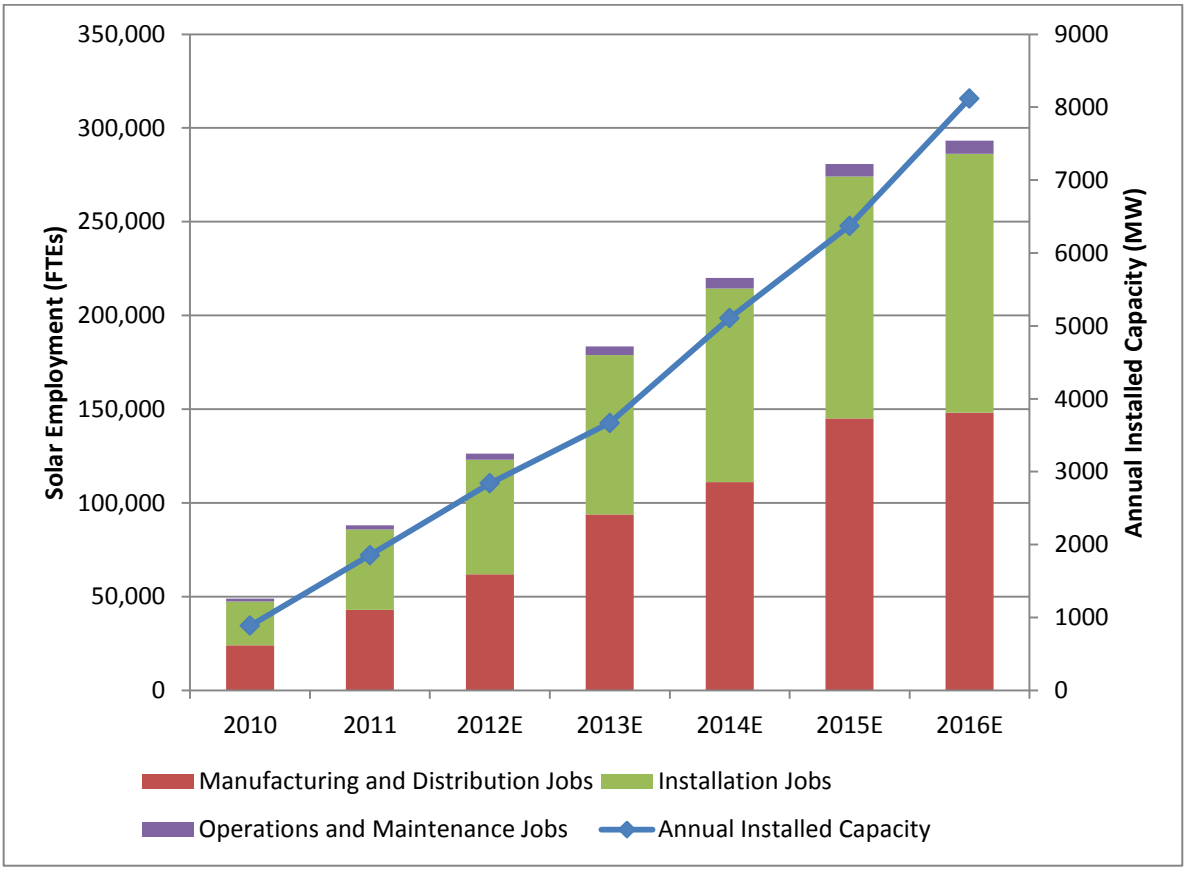
[2] The Solar Foundation. 2011. *National Solar Jobs Census 2011.* Available at http://www.thesolarfoundation.org/sites/thesolarfoundation.org/files/TSF_JobsCensus2011_Final_Compressed.pdf

[3] A "break-even" cost or point is defined as the point at which the net costs of PV systems are equal to the net benefits of system

to projected future installed costs.[4] NREL also projects by 2015, 75% of the U.S. solar market will attain "break-even" points less than or equal to the estimated installed cost of residential solar; thus, it is accepted that the industry will accelerate at growth rates never before witnessed in this country.

Additionally, according to the U.S. Department of Energy's *SunShot Vision Study*, continued cost reductions and steady increases in installed solar capacity will lead the solar industry to employ over 340,000 workers by 2030.[5] Applying the methods used in this concept paper to the latest installation growth projections suggests the industry may support even more American jobs (see Figure ES2 and the Appendix). These sources indicate that we need to plan for and fund much higher levels of workforce development (on a sustainable basis) than we have in the past.

Figure ES2: Solar Industry Projections: Installations and Employment *(2009-2016)*
Source: The Solar Foundation, SEIA/GTM SMI Q1 2012, SunShot Vision Study



Despite the fact that jobs and skills training for the solar industry are necessary to meet this precipitous rise in demand (and for quality workmanship to become standard), funding availability for workforce training programs has not been commensurate with industry and job growth. According to The Solar Foundation, cumulative public investment in workforce development was roughly $70 million nationally over the last three years. Even though solar companies are not generally recipients of public workforce

ownership.

[4] National Renewable Energy Laboratory. 2009. *Break-Even Cost for Residential Photovoltaics in the United States: Key Drivers and Sensitivities.* Technical Report NREL/TP-6A2-46909.

[5] U.S. Department of Energy. February 2012. *SunShot Vision Study*. Accessed June 27, 2012 at http://www1.eere.energy.gov/solar/sunshot/vision_study.html

dollars, with nearly 6,000 solar companies in existence, this would amount to a mere $4,000 per company in public training funds per year. Many larger companies, however, are able to invest their own dollars in training. In these cases, the total amount (public and private) of training funding for these companies will of course be higher.

Although solar jobs numbers are a product of several factors in addition to demand (such as labor intensities and labor efficiencies), if installed capacity projections over the next several years are correct, hundreds of thousands of additional solar workers will be needed to supply this increased demand. It is therefore time for the solar industry to ask some fundamental questions:

- **Who will train all these new workers and where will the money come from?**
- **How can we create a better match between private capital and human capital?**

This concept paper attempts to answer these questions. However, as this is uncharted territory and significant gaps exist in data availability at this time (given the ongoing maturation process for the industry), our conclusions are predicated on a number of assumptions. The goal here is to present an exploratory vision for sustainable, long-term solar workforce training funding via public/private and private funding models that leverage existing workforce development program infrastructure, share results from existing solar labor/market research, and incorporate lessons learned from proof-of-concept work to date that not only facilitates a transition from public to private workforce training dollars, but also maximizes the efficiency with which these funds are allocated to workforce training providers.

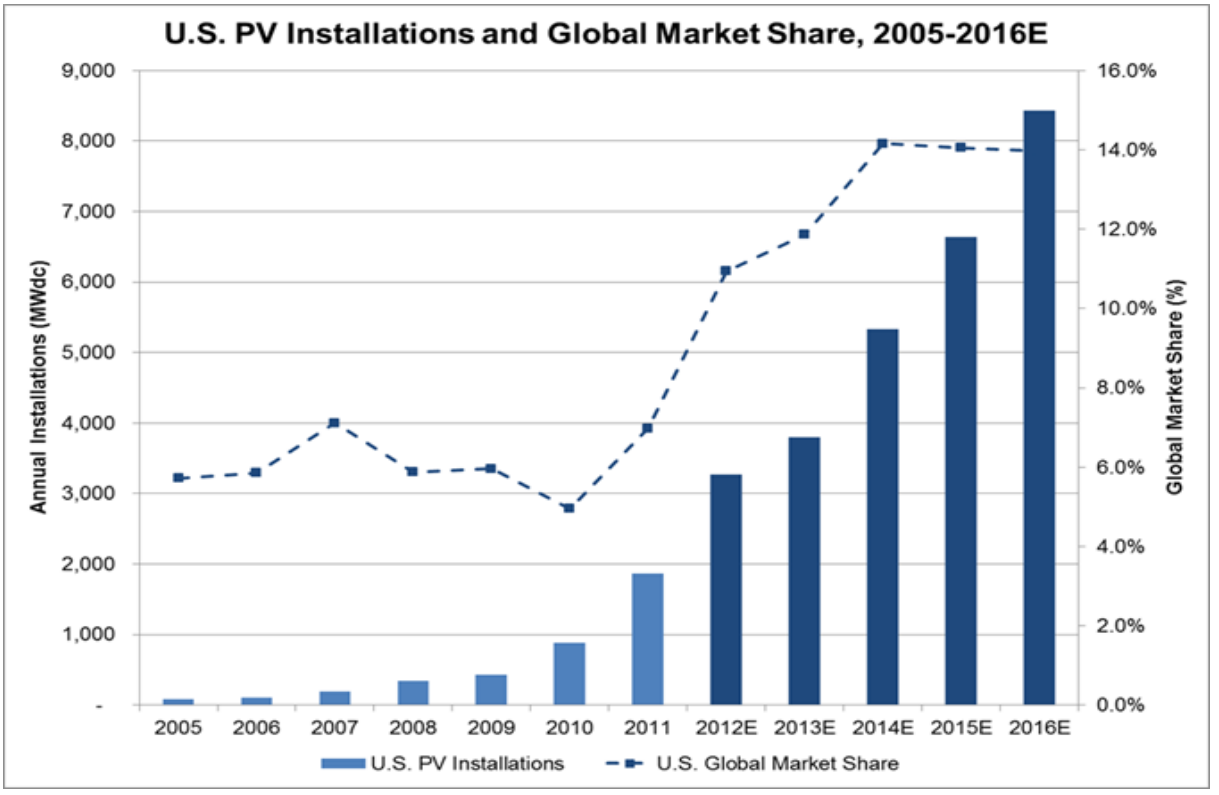
We acknowledge any workforce development organization should be and always will be free to pursue any business model, funding mechanism, or other sources of funding they may choose. However, we conjecture that an industry/private capital-funded, opt-in model that organizations could access on a pre-qualified basis *may* provide a powerful framework for connecting private and human capital – providing millions of dollars to the hundreds of thousands of people who will deliver clean, local, solar energy across the nation.

Problem Orientation

The U.S. solar industry's growth has been fueled by several factors, including an eagerness on the part of U.S. citizens to have access to clean renewable power generation sources, manufacturing cost reductions, technological advancements, a surge in private investment, and a number of federal, state, and local policies that support the development of solar markets.

This growth has increased installed capacity to nearly 4GW – enough to power nearly 700,000 American homes.[6] Analysts predict that this unprecedented growth will continue over the next several years, allowing the U.S. to become a world leader in solar energy generation (see Figure 1 below). One result of this growth will be job opportunities for nearly 300,000 Americans by 2016 (as illustrated in Figure 3), including construction workers, electricians, designers, engineers, financiers, developers and anyone supporting the domestic installation of solar.

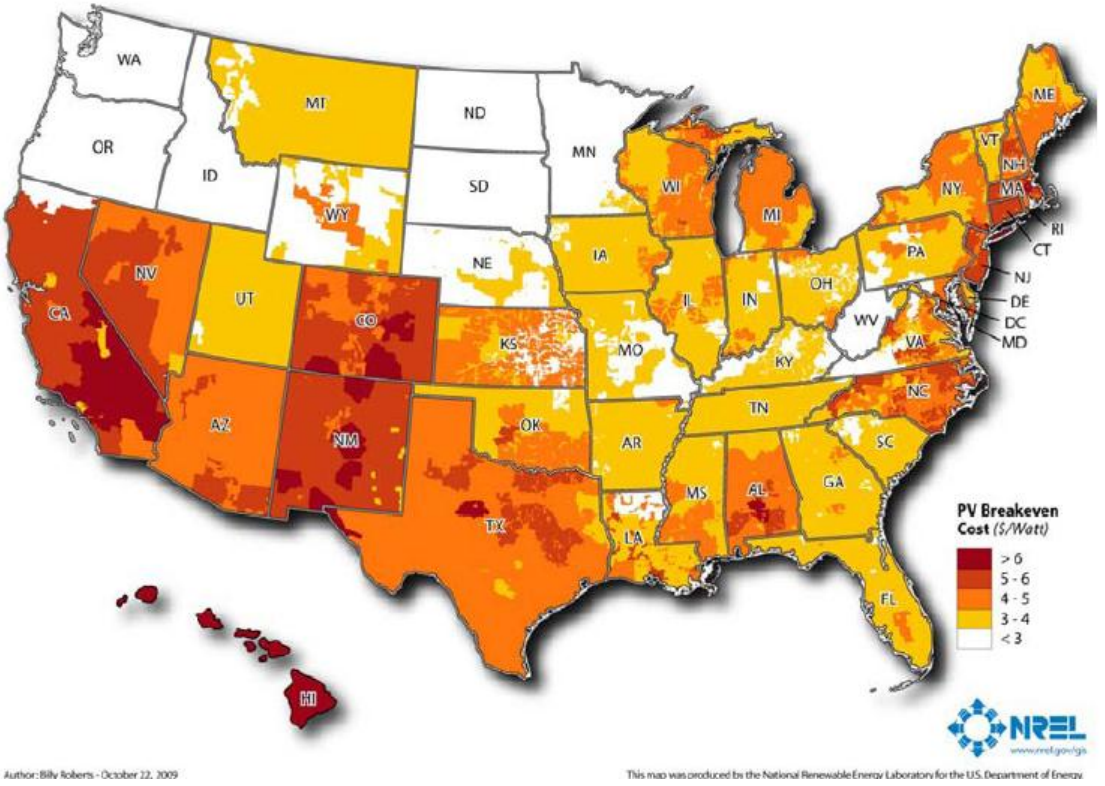
Figure 1: U.S. PV Installations and Global Market Share, 2005-2016E
Source: SEIA/GTM SMI Q1 2012



[6] Solar Energy Industries Association/ GTM Research. 2012. *U.S. Solar Market Insight: 2011 Year-in-Review*. Executive Summary available at http://seia.org/cs/research/

Expected continued decreases in the costs of solar energy system ownership will steadily drive the solar industry to a tipping point past which installations (and therefore solar employment) will grow at unprecedented rates. The National Renewable Energy Laboratory (NREL) projects that by 2015, much of the United States will attain "break-even" points[7] for residential photovoltaic (PV) systems at price points that are less than or equal to projected future installed costs.[8] The Solar Energy Industries Association (SEIA) and GTM Research reported an average installed cost of $5.89/Wp for residential solar energy systems in the first quarter of 2012.[9] Since the beginning of 2010, average residential system prices have decreased an average of 3% each quarter. Should the industry maintain this rate of price reduction, average residential system prices will drop to about $4.50 by 2015. When considered in the context of NREL's forecast that 75% of the U.S. solar market will attain "break-even" point beyond the $4/Wp price barrier by this time, indications are that the industry will accelerate at growth rates never before witnessed in this country. Given this, it is clear that we need to plan for and fund much higher levels of workforce development (and on a sustainable basis) than we have to date.

Figure 2: PV Break-Even Cost ($/Wp) in 2015 with Base Rate Structure
Source: NREL



[7] A "break-even" cost or point is defined as the point at which the net costs of PV systems are equal to the net benefits of system ownership.
[8] National Renewable Energy Laboratory. 2009. *Break-Even Cost for Residential Photovoltaics in the United States: Key Drivers and Sensitivities.* Technical Report NREL/TP-6A2-46909.
[9] Solar Energy Industries Association/ GTM Research. 2012. *U.S. Solar Market Insight: Q1 2012*. Executive Summary available at http://www.slideshare.net/SEIA/us-solar-market-insight-report-q1-2012

Figure 3: Solar Industry Projections: Installations and Employment *(2009-2016)*
Source: The Solar Foundation, SEIA/GTM SMI Q1 2012, SunShot Vision Study

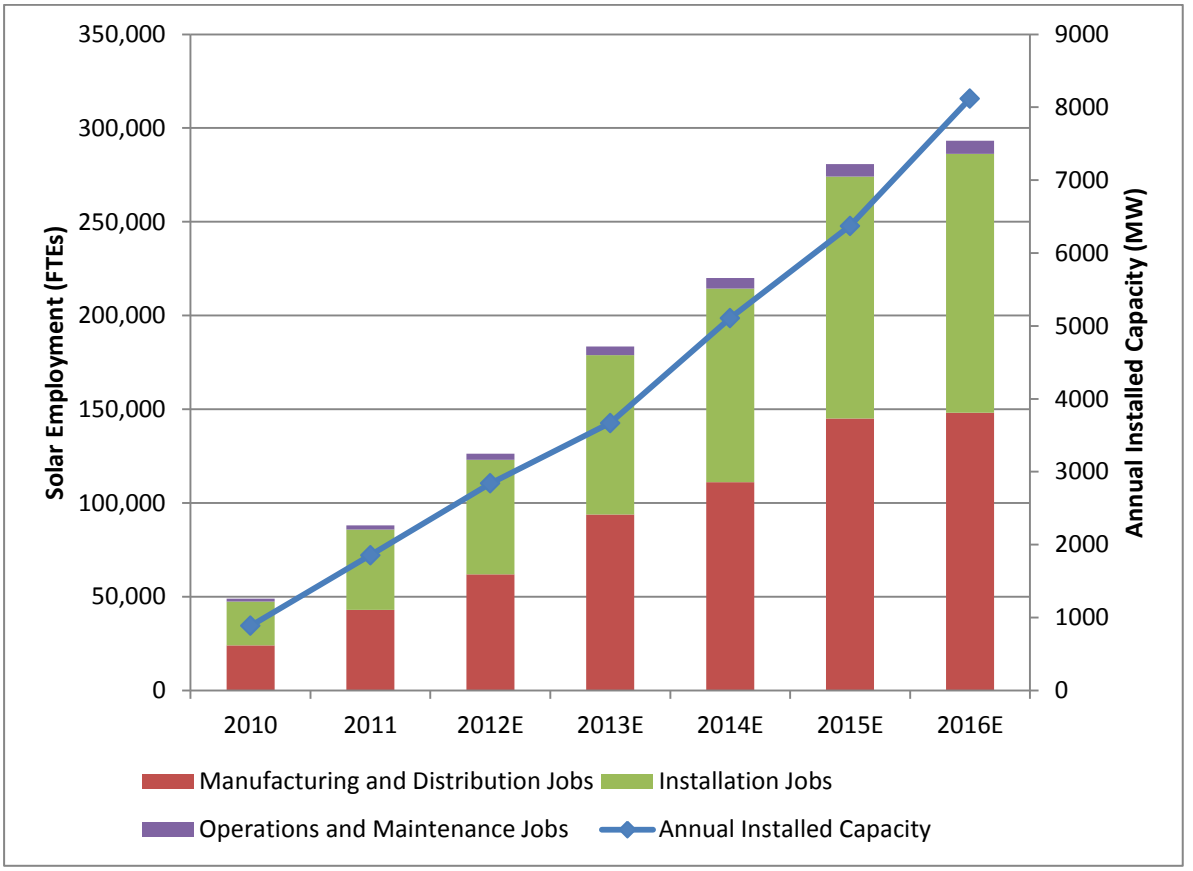


Figure 3 demonstrates that the majority of the jobs are in the installation and manufacturing and distribution subsectors. These jobs range from highly technical (electrician, engineer, system designer, process control technicians, etc.) to non-technical (sales, distribution, payroll, administration, finance, legal). According to research conducted by SWIC, 36% of jobs postings in Q1 2012 were related to sales, 16% for engineering, and 29% of the job postings are considered "back-office" jobs (those that support the more technical solar positions).

Keen observers will note that the solar employment figures cited above for 2010 and 2011 are substantially lower than the numbers reported in The Solar Foundation's National Solar Jobs Census (NSJC). This discrepancy is the result of methodological differences between the NSJC and the SunShot Vision Study, which developed the methods used to build the model illustrated in Figure 3. The NSJC, still widely regarded as the authoritative measure of employment in the solar industry, considers a "solar worker" as one who spends at least 50% of their time supporting solar-related activities, while the SunShot Vision Study counts full-time equivalents (FTEs). According to the NSJC, the U.S. solar industry employed 93,000 solar workers in 2010 and over 100,000 in 2011.[10,11] See the Appendix for information on employment estimation methods.

[10] The Solar Foundation. 2010. National Solar Jobs Census 2010. Available at http://www.thesolarfoundation.org/sites/thesolarfoundation.org/files/Final%20TSF%20National%20Solar%20Jobs%20Census%202010%20Web%20Version.pdf
[11] The Solar Foundation. 2011. National Solar Jobs Census 2011. Available at http://www.thesolarfoundation.org/sites/thesolarfoundation.org/files/TSF_JobsCensus2011_Final_Compressed.pdf

According to the Interstate Renewable Energy Council's (IREC) Solar Career Map (developed for the U.S. Department of Energy), only three of 26 occupations are considered entry-level (entry-level in this case is defined as a job that can be obtained with only a high school diploma or a job that requires very little, if any, experience).[12] This suggests that the majority of the positions in the solar industry either require a great deal of experience or education either in the form of a B.S/B.A, A.S./A.A.S., trade or apprentice work, or through solar-specific workshops, classes and certificate programs.[13]. Even those with some transferrable skills but in dire need of work, (such as unemployed construction workers[14]), are finding that they may need additional training in order to work with high-voltage solar systems. This additional training is not only important, but is oftentimes required to ensure solar installations are safe and of the highest quality.

Behind the scenes, upwards of $70 million in federal, state, and local workforce development funding has been allocated between 2009 and 2012 to support programs that offer solar workforce training.[15] Total U.S. Department of Energy (DOE) and U.S. Department of Labor (DOL) solar workforce training money topped $60 million over this three year period.[16] However, the majority of this funding has already been, or will shortly be, exhausted. This funding gap suggests industry growth may not be sustainable as long as their programs remain dependent on diminishing federal, state, or local public funds.

Despite DOE-funded programs like the Solar Instructor Training Network (SITN), a program that is nationally administered by IREC to train solar instructors, funding gaps remain in permanently improving the career training and placement infrastructure. Meanwhile, local workforce development organizations have historically faced difficulties raising the necessary non-public funds to permanently improve internal processes to take advantage of new and perhaps more sustainable business models.

Current Workforce Development Landscape

There are three major types of solar workforce training and education that are currently being delivered in the U.S.:

- Pre-Employment Training (i.e. entry-level);
- Advanced In-Service Training; and,
- Continuing Education

Additionally, there is a considerable amount of effort put into "Train the Trainer" activities.

Pre-Employment or Employment Advancement

This type of training is also referred to as entry-level training and is generally based on a set of Learning Objectives. Learning Objectives are established by credentialing (and other) organizations to articulate the specific types of knowledge a person entering a specific industry should possess. For the photovoltaic

[12] Details available at http://www1.eere.energy.gov/solar/careermap/

[13] Note: Certificates (those based on assessment and not attendance) can and will have a major impact on training/education offerings. The issuance of certificates is growing among all industries and will continue to be an appealing time/cost manageable approach to training and education See IREC's website for a list of certification organizations: http://www.irecusa.org/irec-programs/workforce-development/certification-organizations/

[14] According to the Bureau of Labor Statistics, the unemployment rate for the construction sector was 14.2% in May 2012. See http://www.bls.gov/iag/tgs/iag23.htm for more.

[15] Note: these are The Solar Foundation's own internal estimates. In the absence of a comprehensive database that separates solar from other clean energy workforce funding, we can only rely on estimates.

[16] Note: Other programs that were identified during our preliminary research are listed in the Appendix

or PV industry, entry-level programs attempt to ensure that the student learns the "fundamental principles of the history, application, design, installation, operation and maintenance of PV systems".[17]

Entry-level programs attract a wide variety of students. While many are seeking new employment in the PV industry, others are already employed either within the industry or in ancillary industries. For example, a person working for a solar company in a warehouse or at a reception desk who wishes to advance his or her career could seek out entry-level training to demonstrate to their employer that they have attained a broader understanding of the company's business and are therefore good candidates for advancement. Similarly, a banker or insurance agent, who routinely sees applications that pertain to PV, might seek out entry-level training so that he or she can better understand the information these often complex documents contain.

There are hundreds of organizations that offer entry-level training for the PV industry. They range from colleges and universities to vocational trainers and advocacy-oriented organizations. Many of them use the North American Board of Certified Energy Practitioners (NABCEP) Entry-Level Learning Objectives and register with NABCEP as Registered Entry-Level Exam Providers. Over the past four years, over 10,000 students have taken courses that culminated with the NABCEP PV Entry-Level Exam.

Many entry-level students take advantage of workforce development programs to fund this aspect of their education. Although anecdotal, many solar workforce experts have observed that the number of students enrolling in entry-level programs appears to be directly proportionate to the amount of federal, state, and other funding available for these programs.

Although no data yet exists to support this, if workforce development and job training funding were not available over the next several years, many solar workforce development experts believe that the majority of the organizations offering this type of training would close or drastically reduce their program offerings. In fact, several organizations have already closed their doors or scaled back on their offerings due to funding shortfalls.

Delivery models for entry-level training vary, but may include web-based programs, semester long classroom programs (which may or may not include a hands-on component or other labs), and intensive "boot-camp" style programs that occur over a short period and usually include hands-on and lab components. Additionally, there are some more intensive workforce development models that incorporate remedial education into the training process. These programs typically are much longer, as they use PV education as an opportunity to teach basic language, math, science and communication skills. Each model has its strengths and weaknesses; however, the wide range of availability offers students a high likelihood that a program will suit their needs and learning styles.

Advanced In-Service Training

These training programs are based on specific Job Task Analyses[18] that describe in detail the work that a particular worker or group of workers will perform. Examples include training programs for installers, sales professionals, and maintenance personnel. Typically, training programs of this sort are offered to individuals who already work in the field and are interested in career advancement.

[17] Taken from the NABCEP PV Entry Level Learning Objectives – http://www.nabcep.org/entry-level-program-2/learning-objectives

[18] Job Task Analyses (JTA) are detailed descriptions of a given job and the set of knowledge, skills, and abilities required of those filling the positions. For more on solar JTAs, visit the NABCEP website www.nabcep.org

For example, advanced installer training may be sought by an entry-level worker on an installation crew seeking to obtain the knowledge of system design, project management, codes and standards, commissioning, etc. required of those filling positions of greater responsibility.

Similarly, a different worker (who perhaps graduated from the same entry-level program as the individual described above) might have obtained a job in the sales and marketing division of a PV company. This individual might seek advanced training in system siting, financial analysis, performance estimation, and other skills germane to advancement in a technical sales career.

There are far fewer organizations delivering this type of training. The major reasons for this include:

- There are fewer potential students seeking this level of training, because most available funding is geared toward finding employment rather than advancing within a career track once employment is attained;
- The requirements for labs and specific hands-on training increases the capital costs to organizations that would like to offer this type of training, making for a more challenging business case for those developing educational programs, and;
- Instructor requirements are more rigorous at this level because quality programs require instructors who have considerable training and industry experience.

This level of training is somewhat less sensitive to fluctuations in outside funding, though the development of new programs at publicly-funded colleges or vocational schools is generally completely dependent on state and federal funding.

The vast majority of funding for this type of training comes from four sources:

1. Educational providers making business-case driven investments into programs (this private funding stream will remain solid, provided that programs remain profitable);
2. Vocational programs such as publicly-funded apprenticeship training initiatives that offer advanced PV training as part of attaining a trade qualification (as in the electrical trades);
3. Students self-funding their professional development; and
4. Employers, who are a source of funding for students seeking this sort of training, albeit to a lesser extent than other sources. Employers can support training by subsidizing career development activities to further their staff growth objectives.

Continuing Education

Continuing education courses are used as a means for on-going professional development and as part of a requirement to stay up-to-date with new equipment, installation or sales tools, and codes and standards. There typically is not a specific Job Task Analysis or set of Learning Objectives set forth for these programs, but they do generally attempt to conform to the continuing education requirements of major certification programs or trade qualifications.

This is one area where the solar industry contributes to the majority of the education that is delivered, In fact, most of this education is delivered through vendor seminars or at manufacturer owned and operated education facilities. Additionally, most industry-oriented conferences feature continuing education days as part of the conference tracks (often with full day sessions occurring before or after the conference). The availability of continuing education is largely dependent on the health of the marketplace. It is commonly viewed by manufacturers as a promotional or marketing activity and will be curtailed if revenues or profits decline.

Some aspects of continuing education are dependent on public funding. While manufacturers and other product vendors are often more than happy to cover the delivery costs for their specific products, they may not be as enthusiastic to fund training that covers codes, standards and safety practices. In many cases, industry or professional organizations subsidize this type of critical training.

"Train the Trainer"

This part of the educational landscape of the PV industry is entirely aimed at increasing workforce development opportunities by cultivating a wide pool of skilled trainers. National "Train the Trainer" efforts are focused on training existing teachers and college instructors how to teach PV entry-level programs so that students are better prepared to become successful professionals in a credible solar industry. The DOE has invested heavily in these efforts through the Solar Instructor Training Network (SITN), which is administered by IREC and centered on nine regional resource and training providers.[19]

Unfortunately, "Train the Trainer" programs may have contributed to two problems: an oversupply of entry-level programs (due to the available public funding) and a proliferation of poorly taught students. To illustrate, once public funding is obtained, colleges and universities will send staff to become solar trainers with the intention that they will eventually launch entry-level programs. The problem is that many of these trainers do not have enough familiarity with the subject to be effect instructors, and is an issue the SITN is working hard to reverse.

At the moment, "Train the Trainer" programs are entirely dependent on government funding and will likely disappear in its absence.

Funding: Today and Tomorrow

According to experts in solar workforce development, there is an oversupply of entry-level and "Train the Trainer" programs, however, this situation may self-correct as the availability of workforce funding abates.[20] While on the surface it would appear that this represents a perfect example of market forces working properly (i.e., oversupply leading to a market contraction), but this is not the case.

The specific and intended training of **entry-level** workers for the PV industry on a broad scale is a relatively new phenomenon. For most of the past two decades, a very small number of mission driven[21] organizations have offered entry-level education as part of their comprehensive training programs. Access to this education was primarily limited to those who were prepared to travel and use their own funds to learn about PV installation, design and troubleshooting. However, over the past few years, the PV market has experienced explosive growth and the demand for workers with entry-level knowledge has grown accordingly.

The training market has responded to increased access to funds via the Recovery Act and other

[19] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Solar Energy Technologies Program. *Solar Instructor Training Network*. Accessed June 26, 2012 at http://www1.eere.energy.gov/solar/instructor_training_network.html

[20] Data provided by NABCEP shows that while the number of entry-level exams administered peaked in 2009-2010 and has since fallen, the number of registered training providers has shown a net increase. In addition, there is a high turnover rate among registered providers – many providers allow their registered status to lapse due to lack of candidate interest and/or loss of funding, but are quickly replaced by new entrants to the solar workforce training market. This net growth in providers, though steady decline in exams, suggest an oversupply of entry-level training providers.

[21] Mission driven organizations exist for the purpose of supporting and furthering a specific industry or field of endeavor. They tend to be operated by passionate advocates of the specific technologies and draw students with similar passions and interests.

workforce development funds, as indicated by the large number of programs that have been launched over the past several years. The first flush of potential workers has gone through the system and many have found jobs. Many others have not found employment, fostering considerable suspicion of the actual quantity of so-called "green jobs" among both students and educators. More frequently, program administrators are demanding to know how many jobs will result from training programs before they expend organizational resources on PV training programs.

Thus, it is increasingly clear that in the next few years the availability of entry-level training programs will contract as will the student body. The most significant driver of this contraction will be the reduction in funding support. Many programs faced with a "sink or swim" situation will, unfortunately, end up on the "sink" side of the equation.

It would be imprudent to consider this contraction an acceptable outcome. As the PV market continues to grow, and if programs are allowed to disappear in the near term, there will be a dearth of workers with the necessary skills and education in the long run. Reviving funding for students and educators is likely to be a slow process during which the industry will suffer, as poorly qualified entrants raise installation costs and drive the quality of sales and installations down.

While some contraction is natural and acceptable, it is not a viable option to simply allow the entry-level PV training landscape to revert to a handful of mission-driven organizations. It is imperative that some sort of long-term funding mechanism be developed to support students and their educators to ensure the availability of training when it is needed most.

Advanced training for installers, sales people, designers, etc. is closely linked to career advancement and, as such, it is not unreasonable to expect that companies and those receiving the training will pay the majority of the costs of these programs going forward. Government support for training becomes a critical issue when the workers are needed by emerging industries. Companies that are struggling to bring new technologies to market do not have the financial resources to invest in workforce development; however, their very success depends on trained personnel. In this context, it is an appropriate role of government to provide workforce development incubation services by way of funding training programs. In the same way that it is considered appropriate for government to support research, particularly in the commercialization stage. It is equally as appropriate for the government to support workforce development activities that spur companies' abilities to commercialize new technologies. Those workers (and the businesses that may hire them) do not have the financial reserves or resources to develop training programs and deliver them without public sector support. Once industries reach a reasonable level of maturity, students (and those hiring them) may be expected to carry the financial burden of paying for training. Most certainly creative financing options for those wishing to advance their career advancement are needed and, thus, must become part of how training is funded in the future.

Continuing education is self-funded by students and industry and will largely stay that way. The critical aspects of continuing education that require external or public support are courses that offer non-commercial technical training (codes and standards, safety etc.). The need for support is most acute during industry downturn periods when both practitioners and their employers cannot afford the cost of continuing education.

At present **"Train the Trainer"** funding is entirely dependent on government programs that are most likely going to disappear. A slight reduction in the number of these programs will likely not pose a

significant impediment to the industry because of the number of trainers that have already been trained. Furthermore, it is reasonable to expect that many non-trainers, who have advanced in their careers, will eventually be drawn to teaching. This most certainly has shown to be very effective in other, more mature industries.

Scenarios and Program Efficacy

The impact of reduced public funding on a given training program's ability to produce a skilled and qualified workforce is summarized in the table below. Values between 1 and 10 are assigned to each program according to how well this program meets the criteria listed under three different public funding levels – at 0%, 50%, and 100% of current funding levels. These values are then translated into a weighted score, based on the importance a particular criterion has on overall program success. These weighted scores are listed in italics alongside the raw values. The focus of the matrix below is the relative differences between weighted scores and not on the absolute value of these scores. Given this, a "weighted range" row captures the difference between weighted program efficacy scores in the high and low funding scenarios. A dramatic change in score between funding scenarios (i.e., a large weighted range – indicated in red below) indicates that program efficacy is highly sensitive to changes in funding, making this program a good candidate to target in the private funding scenarios discussed in the following sections.

In the lattice on the following page, entry-level and "Train the Trainer" programs are seen to be particularly sensitive to changes in funding. Community colleges, for example, are able to adequately prepare trainees enrolled in the programs they offer at present levels of funding (with raw scores of 7+ in each category), but their effectiveness drops considerably in the absence of these funds (as indicated by scores of 1 or 2 for each criterion). This change is captured in the "weighted range" category at the bottom of the column. With a large weighted range of 6.2, a value calculated as the difference between the weighted score in the 100% funding scenario (8.1) and the weighted score in the 0% funding scenario (1.9), community colleges are shown to be highly sensitive to reductions in external funding.

Because entry-level and "Train the Trainer" programs presumed to be at risk when state and federal funding runs out, we envision that these programs will be the focus of the private funding mechanisms proposed later in this paper. As noted earlier, there is currently an overabundance of entry level programs. This, however, should not lead one to conclude that these programs can do without funding. Because of the high sensitivity of entry level program efficacy to funding availability, dramatic reductions in funds will lead to a significant contraction of entry level programs, resulting in a shortfall of these programs (rather than the present overabundance). Organizing the capital and other resources necessary to revive these programs to meet future workforce demand will require great time and effort, leading to a period during which the solar industry will suffer from a lack of skilled and qualified workers.

Missing Elements

As the PV industry continues to grow and becomes more specialized, a larger number of career pathways will emerge. Over the next four or five years, careers such as PV Designer, Energy Storage Specialist, PV Maintenance Specialist and PV Data Specialist will emerge. There are currently no clear training programs or resources for many of these newer career pathways. This is an area where the combined support of government funding and industry participation is critical. The credentials and training to support the aforementioned jobs will not be developed without funding for program development and startup phases.

Table 1: Training Program Efficacy - Sensitivity to Reductions in Public Funding
Source: The Solar Foundation/ SolarTech/ NABCEP

			Type of Training							
			Pre-Employment/ Employment				*Advanced*	*Continuing Education*		*Train the Trainer*
		Public Funding Scenario*	Community College	Public University	Vocational Trainer	Mission Driven Org.	In-Service Training	Vendor	Manufacturer	Public Supported
Evaluative Criteria	Response to local demand for jobs *(Weight = 30%)*	**0%**	2 *(0.6)*	1 *(0.3)*	2 *(0.6)*	2 *(0.6)*	5 *(1.5)*	7 *(2.1)*	7 *(2.1)*	1 *(0.3)*
		50%	4 *(1.2)*	3 *(0.9)*	4 *(1.2)*	4 *(1.2)*	7 *(2.1)*	8 *(2.4)*	8 *(2.4)*	2 *(0.6)*
		100%	8 *(2.4)*	7 *(2.1)*	8 *(2.4)*	8 *(2.4)*	8 *(2.4)*	9 *(2.7)*	9 *(2.7)*	7 *(2.1)*
	Prepares students for new jobs *(Weight = 40%)*	**0%**	2 *(0.8)*	2 *(0.8)*	2 *(0.8)*	3 *(1.2)*	7 *(2.8)*	5 *(2.0)*	5 *(2.0)*	1 *(0.4)*
		50%	5 *(2.0)*	5 *(2.0)*	5 *(2.0)*	6 *(2.4)*	8 *(3.2)*	6 *(2.4)*	6 *(2.4)*	2 *(0.8)*
		100%	9 *(3.6)*	9 *(3.6)*	9 *(3.6)*	9 *(3.6)*	9 *(3.6)*	7 *(2.8)*	7 *(2.8)*	8 *(3.2)*
	Training Affordability (Weight = 10%)	**0%**	2 *(0.2)*	2 *(0.2)*	2 *(0.2)*	3 *(0.3)*	5 *(0.5)*	7 *(0.7)*	7 *(0.7)*	1 *(0.1)*
		50%	4 *(0.4)*	4 *(0.4)*	4 *(0.4)*	5 *(0.5)*	7 *(0.7)*	8 *(0.8)*	8 *(0.8)*	2 *(0.2)*
		100%	7 *(0.7)*	7 *(0.7)*	7 *(0.7)*	7 *(0.7)*	8 *(0.8)*	9 *(0.9)*	9 *(0.9)*	7 *(0.7)*
	Allows for creative training delivery *(Weight = 10%)*	**0%**	2 *(0.2)*	2 *(0.2)*	2 *(0.2)*	2 *(0.2)*	6 *(0.6)*	7 *(0.7)*	7 *(0.7)*	1 *(0.1)*
		50%	5 *(0.5)*	5 *(0.5)*	5 *(0.5)*	5 *(0.5)*	7 *(0.7)*	8 *(0.8)*	8 *(0.8)*	2 *(0.2)*
		100%	7 *(0.7)*	7 *(0.7)*	8 *(0.8)*	8 *(0.8)*	8 *(0.8)*	9 *(0.9)*	9 *(0.9)*	7 *(0.7)*
	Connects students to employers *(Weight = 5%)*	**0%**	1 *(0.05)*	1 *(0.05)*	2 *(0.1)*	2 *(0.1)*	1 *(0.05)*	1 *(0.05)*	1 *(0.05)*	1 *(0.05)*
		50%	4 *(0.2)*	4 *(0.2)*	5 *(0.25)*	5 *(0.25)*	1 *(0.05)*	1 *(0.05)*	1 *(0.05)*	2 *(0.1)*
		100%	7 *(0.35)*	7 *(0.35)*	8 *(0.4)*	8 *(0.4)*	1 *(0.05)*	1 *(0.05)*	1 *(0.05)*	5 *(0.25)*
	Adaptable to address future career paths *(Weight = 5%)*	**0%**	1 *(0.05)*	1 *(0.05)*	2 *(0.1)*	2 *(0.1)*	7 *(0.35)*	7 *(0.35)*	7 *(0.35)*	1 *(0.05)*
		50%	4 *(0.2)*	4 *(0.2)*	5 *(0.25)*	5 *(0.25)*	8 *(0.4)*	8 *(0.4)*	8 *(0.4)*	2 *(0.1)*
		100%	7 *(0.35)*	7 *(0.35)*	9 *(0.45)*	9 *(0.45)*	9 *(0.45)*	9 *(0.45)*	9 *(0.45)*	6 *(0.3)*
	TOTALS	**0%**	10 *(1.9)*	9 *(1.6)*	12 *(2.0)*	14 *(2.5)*	31 *(5.8)*	34 *(5.9)*	34 *(5.9)*	6 *(1.0)*
		50%	26 *(4.5)*	25 *(4.2)*	28 *(4.6)*	30 *(5.1)*	38 *(7.15)*	39 *(6.85)*	39 *(6.85)*	12 *(2.0)*
		100%	45 *(8.1)*	44 *(7.8)*	49 *(8.35)*	49 *(8.35)*	43 *(8.1)*	50 *(7.8)*	50 *(7.8)*	40 *(7.25)*
	Weighted Range		**6.2**	**6.2**	**6.35**	**5.85**	**2.3**	**1.9**	**1.9**	**6.25**

(1 = Doesn't Meet Criterion; 4 = Somewhat Meets Criterion; 7 = Mostly Meets Criterion; 10 = Completely Meets Criterion)
**Percent of Current Public Funding Level*

Summary

All levels of practitioner training within the industry are critical and, to one degree or another, face looming reductions in funding support. A new model that better focuses limited government funding on critical occupational pathways will need to be developed. Consultation between government and industry will be essential to ensure that the funds that are available are directed to the areas of most need.

Additionally, industry must be prepared to invest a greater amount of money into the emergence of a qualified workforce. Some sort of mechanism that funnels a very small percentage of the money generated by the PV industry into workforce development, career development and continuing education may become a necessity.

Solar Workforce Training Funding: Past and Present

By the end of 2011, cumulative installed solar capacity in the United States reached 3,950 megawatts (MW), with nearly half this capacity (1,855 MW) installed in that year.[22] The distribution of this capacity among the states is highly skewed. Some states have recognized the economic and environmental value of a robust solar market, and have established policies and incentives to foster the growth of these markets, while other states continue to lag far behind. The top ten states in terms of installed solar capacity account for 87% of solar capacity in the nation (see Table 2 on the following page).

Adopting policies and incentives that spur investment in solar energy systems are necessary, though not in themselves sufficient, elements of promoting a strong solar market. Evidence shows that a qualified, trained, and certified workforce performs installations that result in fewer problems at the time of inspection and, as such, have a direct impact on lowering costs for project developers, consumers, and inspection authorities.[23] Recognizing this, state agencies, legislatures, and executives have made state funds available for solar workforce training.

It is reasonable to assume that a state's allocation of solar workforce funding is or at least should be proportionate to the size of the solar market in that state. As such, we use the figures in Table A1 in the Appendix and what we know of the share of domestic installed solar capacity in these ten states (i.e., that they account for 87% of installed capacity in the nation) to estimate that total **state** funding in the U.S. for solar workforce training was in the neighborhood of $6.5 million between 2009 and 2012.

Additionally, the U.S. government has been a considerable source of solar workforce training funding, especially through loans, grants, and contracts made under the American Recovery and Reinvestment Act of 2009. These funds were made available to workforce training providers primarily through programs administered by the U.S. Department of Energy (DOE) and U.S. Department of Labor (DOL). Together, these **federal** investments totaled approximately $60 million over 2009-2012.

Our estimates of solar workforce training funds originating from the federal government and the governments of the top ten states by solar capacity are provided in the table in Appendix A. It is important to note that figures in this table ***do not*** represent a comprehensive accounting of state and federal training funds. Because of the diverse number and nature of grant recipients, and because no central clearinghouse exists for this information, such a tabulation would be a monumental undertaking that is well outside the scope of this paper. Figures are listed merely to provide a general sense of the past and current allocations that might be needed for future workforce growth and program continuance, and to illustrate that the majority of this funding is derived from federal programs that have already, or are soon to be, expired.

[22] Solar Energy Industries Association/ GTM Research. 2012. *U.S. Solar Market Insight: 2011 Year-in-Review*. Executive Summary available at http://seia.org/cs/research/

[23] See McRae, M, Nemore, C., Gonzales, P, and Ferranti, A.. 2008. *PV Workforce Development and the Market for Customer-Sited PV*, in which the authors found "NABCEP-certified installers had fewer problems during the installation inspection review…NABCEP-certified installers had 0.17 problems on average, compared with 0.47 problems for installers lacking certification". Accessed June 29, 2012 at http://www.dps.ny.gov/07M0548/workgroups/WGVII_SOLAR_2008_Paper_0231_PV_Workforce_Development.pdf

Table 2: Top Ten States by Cumulative Installed Solar Capacity[24] and Solar Workforce Funding Needs[25]
Source: The Solar Foundation, SEIA/GTM Research

State	*Cumulative Capacity (MW)*	*Funding Needs Based on Market Share*
California	1,513.4	$25,480,000
New Jersey	601.7	$10,130,000
Arizona	383.2	$6,450,000
Colorado	198.6	$3,340,000
New Mexico	160.9	$2,710,000
Pennsylvania	141.9	$2,390,000
Nevada	141.0	$2,370,000
New York	114.4	$1,930,000
North Carolina	97.2	$1,640,000
Florida	87.1	$1,470,000
Rest of Nation	510.60	$8,590,000
Total	***3,950***	***$66,500,000***

Above, Table 2 attempts to illustrate the significant training funding needs of each of the top ten solar states. The total solar training funding needs for the nation is estimated at $66.5 million over 2009-2012. Due to the significant uncertainty associated with these funding figures, it bears repeating that these numbers should be understood as providing a very rough estimate of total funding for solar training. A comprehensive census of federal, state, and local support for solar workforce training is an excellent area for further research, and would provide a much more accurate picture of state and national training needs. This total is apportioned among the top ten solar states according to the ratio of each state's cumulative installed capacity to the total capacity in the nation. It is immediately apparent that many states have significant training needs, and that those states with the strongest solar markets stand to lose the most once publicly sourced training funds have been exhausted.

New Funding Structures

Although a variety of creative funding mechanisms may come to mind, we have identified three known structures from other industries or across other aspects of the solar industry that have not yet been broadly implemented for funding solar workforce development. Validating the concepts presented here are beyond the scope of this paper. It is however worth noting that the next appropriate step would be to engage a broad spectrum of industry stakeholders to vet the concepts and determine which have the highest degree of support. These concepts are not meant to be prescriptive; rather, our intention in proposing them is to motivate a discussion on how the solar industry and other stakeholders might bridge the impending workforce funding gap. Additionally, we recognize that our concepts may not work for everyone and that any workforce development organization is free to pursue any business model, funding mechanism, or other sources of funding they choose.

Concept #1 – Public/Private Partnership

A classic public/private partnership structure could overcome these anticipated funding shortages by providing streamlined and integrated tools to support all stages of solar career training and placement programs (program design, technical support, financing, software/hardware solutions,

[24] *Ibid*
[25] As estimated by The Solar Foundation. See Appendix for details.

training/certification, and program administration). A properly structured partnership would help to maximize the efficiency with which existing state and federal funds are allocated, eventually shifting local workforce development organizations and companies from their reliance on publicly-funded programs toward a modern, privately-funded system.

In this scenario, local Workforce Development Organizations (WDOs) or Workforce Investment Boards (WIBs) will establish a working line of capital or loans (perhaps through bonds or a relationship with foundation, credit union or bank) for solar companies to support solar workforce development with their region. This scenario will primarily benefit those entry-level workers most, but, in some cases, may benefit advanced in-service training workers or those pursuing continuing education.

The amount of funding available will be determined by quarterly regional labor market forecasting models that predict forward funding requirements and allocate capital (instructors, equipment, classrooms, funds, etc.) within these regions in exchange for industry commitment to hiring graduates of a pre-defined and certified curriculum. Funds would not be allocated or disbursed until these industry 'matching placement' commitments are in place, subject to some reasonable level of variability in local market conditions.

All companies that opt into the placement program would pay a small transaction fee to help offset the costs of the new e-commerce platform that contains an automated and standardized training and job placement process.

Concept #2 – Revolving Loan Funds

With the support of local WIBs or WDOs, companies seeking to boost the numbers of local, trained, and well-qualified solar workers would voluntarily enter into a contract designed to collect nominal fees or assessments from industry participants and leverage the money to support workforce training programs meeting rigorous, pre-defined criteria. The purpose of the revolving loan fund is to create a pool of capital to support the development of human capital.[26] As such, this fund could be used for grants to organizations that develop services for the workforce.

The funding stream leveraged by the contract would be comprised of assessments collected from industry participants on a per-watt basis of solar photovoltaic equipment (or on a per square-foot basis for solar water heating systems) placed in service to support installer training. For example, a workforce training revolving loan fund could initially be capitalized via a $0.0075/watt DC assessment on each solar PV installation and a $0.10/square foot of installed solar water heating systems during the industry entity's first year of participation. Thus, a PV system that is 3-5kW (which is average for the US residential market) would capitalize the revolving loan fund for as little as this $22.50-$37.50 per installation (a cost increase of about 1/10 of a percent). Rates for solar water heating systems will add less than $10 to the cost of installation.

With 3,300 megawatts (MW) of domestic PV installations projected for 2012,[27] and 2,624 thousand square feet (tsf) of solar water heating capacity projected for the same year,[28] full industry participation in this type of program would result in a revolving loan fund capitalized at over $25 million.

[26] The nuclear industry has been doing this for quite some time. In the absence of federal and other public sector support, the nuclear industry pools together their funds in order to provide tuition scholarships for students entering nuclear workforce programs. For more information, see the American Nuclear Society's webpage at http://www.new.ans.org/honors/scholarships/

[27] Goossens, E. June 13, 2012. U.S. Solar Grew 85 Percent in First Quarter, SEIA says. *Bloomberg.* Accessed June 26, 2012 at http://www.bloomberg.com/news/2012-06-13/u-s-solar-grew-85-percent-in-first-quarter-seia-says.html

Once fully or partially capitalized, the fund could be used to issue workforce training loans to program participants in good standing (i.e., those who have faithfully remitted their per-watt assessments and have repaid any outstanding workforce training loans originating from the revolving loan fund). Such criteria would encourage a level training playing field across all companies large and small and all regions regardless of previous workforce efforts. Additionally, the issuance of loans to several entities in good standing increases investment diversity while minimizing risk.

Local WIBs or WDOs with first-hand knowledge of local workforce training needs are likely best poised to administer these types of agreements and could serve as the fiscal agent acting on behalf of the revolving fund asset manager. Because good standing requirements help to minimize risk, loans from the revolving loan fund could be provided with a low 0.25% cost of capital fee. This fee will help hedge against any remaining risk, while helping mitigate the impact inflation has on the fund.

In addition to the mandatory per-watt fee, program participants (that opt-in) ideally would be required to adopt the appropriate industry training, safety, and quality standards and certifications. Including such a requirement would lead to higher quality projects installed by certified professionals according to the highest industry standards, resulting in lower project risk and lower total cost of ownership for solar customers. Finally, annual quality and performance reviews would ensure appropriate levels of consistency are maintained and that the revolving fund is not depleted, while guarding investors, industry, workforce programs, and prospective workers against significant risk.

This scenario will potentially benefit all levels of solar workers, from entry-level workers to advanced in-service training and continuing education workers.

Concept #3 – Crowd sourcing

Crowd sourcing or online-to-offline *(O_2O)* commerce refers to a number of innovative business models that allow consumers to arrange real-world exchanges or relationships via an online forum. Under such systems, consumers and providers of goods and services advertise their respective wants or offers through a designated web portal and negotiate the terms governing the relationship or transaction. Once an agreement is made, the goods or services in question are exchanged offline.

Examples of *O_2O* commerce abound. Perhaps the most well-known illustration of *O_2O* is the group discount website, "Groupon" (www.groupon.com). Under this system, the Groupon staff negotiates discounts with local providers of goods and services. These deals, often offering significant discounts, are advertised on, and purchased through, the Groupon website. To ensure businesses receive an adequate amount of new business in exchange for the discounts being offered, the deals only go into effect once a set number of discount vouchers have been purchased. Deals obtained through Groupon's online platform are redeemed offline for real-world goods and services.

Another illustration of the *O_2O* model that is growing in popularity is Airbnb (www.airbnb.com), a website that connects property owners with available short-term space to travelers seeking accommodation in their area. Hosts list the details of the space they are offering, including availability and price points, on the Airbnb website. Travelers can browse these listings and select those that best meet their needs. Airbnb serves as a third party that collects and remits online payments. Once the transaction is completed online, host and guest are ready to complete their business offline.

[28] Solar Energy Industries Association/ GTM Research. 2011. *U.S. Solar Market Insight: 2010 Year-in-Review*. Executive Summary available at http://seia.org/cs/research/SolarInsight/Archives

The imminent constraints on workforce training funds anticipated under "business as usual" public funding models present a unique opportunity for *O_2O* commerce to play an important role in the next generation of workforce training fund mechanisms. Arranging training sessions through an online platform provides an innovative means of efficiently allocating solar workforce training funds, assigning scarce resources to areas with the greatest demand. Under this concept, training sessions will be proposed in markets across the nation, but classes will only be scheduled once a certain enrollment threshold has been met. Once scheduled, funds collected from enrollees at the time of registration will be matched with industry funds, the sum of which will rapidly flow to schools and instructors.

This scenario will potentially benefit all levels of solar workers, from entry-level workers to advanced in-service training and continuing education workers. Additionally, this concept may solve the problem of entry-level and "Train the Trainer" oversupply while focusing on regions where there is the greatest demand. Finally, in its purest sense, crowd-funded business models represent the fastest method for responding directly to market needs driven by engaged community participation. SolarMosaic has already demonstrated this model for financing solar projects and recently been rewarded for their results with $2 million in DOE SunShot funding.[29] There is a clear opportunity to apply the same concept to an underlying solar industry need - supporting workforce development through crowdsourcing in high growth markets based on particularly unique local market needs.

In application, we envision that an online exchange would be set up whereby local market participants would "offer space, services, and resources" (via the cloud) that are aligned with current market needs. For example, industry operations or human resource staff would submit weekly skills or job needs based on a menu of pre-defined and regularly updated job categories. These submissions would drive the local supply/demand requirements for WIBS, trainers, classroom facilities, and funding. WIBS would then access the data and issue a "call for training or services" to registered pre-qualified providers. Trainers, facilities providers, and others would respond virtually indicating availability of time, space, materials on certain dates. The program administrators would then issue notices to participating individuals standing by for training programs. These individuals would register at some nominal fee to secure space and provide a down payment on capital that would be raised virtually, and then matched by other investors. People could also 'fund' training projects in exchange for ancillary services, etc. This is an illustrative example only, but serves as an analog for how other sectors are leveraging virtual communities to fund a wide variety of projects.

Analysis

On a scale of 1-10 (with 1 representing the "least" and 10 represent the "most"), Table 2 on the following page contains a matrix that summarizes how each model compares with the other. Of the five criteria listed in the below table, it appears that the most important indicator of the success of a funding structure is industry participation, followed by viable long-term sustainability and ease of funding. While a lack of technical simplicity can essentially curb a program, the funding structures can be designed so as to avoid or circumvent many potential technical challenges. Furthermore, since being replicable is of great interest for achieving economies of scale, again, it is our hope that the programs will be designed with universality in mind.

[29] Gifford, J. June 14, 2012. Solar Mosaic picks up US$2 million from DOE. *PV Magazine*. Accessed June 29, 2012 at http://www.pv-magazine.com/news/details/beitrag/solar-mosaic-picks-up-us2-million-from-doe_100007353/#axzz1zC0ZoEB8

Based on the scores below, the revolving fund concept received the highest score in three out of the five categories and scored highest overall, with the public/private partnership receiving the highest score in two categories. That is not so say that the crowd sourcing idea is infeasible, but rather that it is perhaps more innovative than the others and therefore more difficult to implement. In fact, no one program is perfect. While the public/private partnership concept will likely garner widespread solar industry participation, it might be difficult for the WIBs or WDOs to come up with long-term bond funding or other lines of credit to be issued toward solar workforce development. Additionally, solar industry participants might resist having to provide a work placement match or pay a small fee. Similarly, with the revolving fund concept, while it is extremely viable over the long-term, it might prove difficult to get solar industry installers to "buy into" the idea of paying a fee per watt or square foot of solar installed. Finally, while crowd sourcing presents another viable long-term funding mechanism, it is almost exclusively online, utilizing a platform that has not yet been developed, let alone perfected. The industry cost-match component of this model may also pose an obstacle to successful implementation.

Table 3: Comparison of Three Funding Concepts
Source: The Solar Foundation/SolarTech/NABCEP

	Key Element and Relative Weighting %					
Model	**Technical Simplicity (7.5%)**	**Industry Participation (35%)**	**Ease of Funding (30%)**	**Long-Term Viability (20%)**	**Replicable (7.5%)**	**Total Weighted Score**
Public/Private Partnership	5	10	2	4	6	**5.7**
Revolving Fund	3	5	7	10	8	**6.7**
Crowd sourcing	2	5	4	9	7	**5.4**
Highest Score	Public/Private Partnership	Public/Private Partnership	Revolving Fund	Revolving Fund	Revolving Fund	**Revolving Fund**

Implementation Pathway

Business As Usual - Unfortunately, without the continued support of public funding, many training organizations/providers (currently in operation at community colleges and universities or in the non-profit sector) will not be able to maintain their solar training offerings, or at the very least will be required to dramatically scale back the scope of these programs. In fact, over the last several years, the industry has witnessed a number of organizations such as *Boots on the Roof* and *Troop Transition, Inc.* either close their doors or "drop out" of providing entry-level training. While some surviving training

organizations currently suffer from low enrollment rates, the majority are experiencing widespread interest from people with varying levels of experience and education. Although there is a role for the public sector to play in assisting programs in emerging sectors like solar to "get off the ground," the solar industry may be already operating in a mature enough market to bear some of the responsibility for capitalizing resources for solar training. Conversely, if some responsibility is not taken, we believe there is little possibility for the U.S. to continue its impressive domestic installation boom, which will negatively impact solar companies' profit margins and their ability to expand. Furthermore, stalled solar industry growth resulting from a lack of qualified installers, electricians, designers, engineers, and technicians would be a forceful blow to a fragile economy plagued by chronically high unemployment rates. As such, "business as usual" is not an option.

A New Way Forward – Establishing a financing mechanism to support the next generation of solar workers will not occur overnight. Because there are merits and weaknesses associated with each concept presented in the preceding pages, and because of the number and diversity of stakeholders involved, we believe that the next reasonable step is to convene focus groups, composed of both representatives from the workforce development community and solar industry stakeholders, to learn which of the three concepts presented herein is most feasible or if an entirely new concept arises through the discussion. In addition to such focus groups, surveys should be sent out to a broader range of stakeholders. Soliciting this feedback from such a broad and diverse group of stakeholders, thoughtfully addressing these comments, and incorporating this feedback into whatever model is ultimately adopted will be essential to ensuring widespread participation that will lead to improved stakeholder buy-in and a greater degree of program success.[30] Such participation by industry and other stakeholders will allow each of the concepts presented in this paper to be judged not only in terms of their individual merits and shortcomings, but will provide additional perspective on how to increase funding, or to reduce funding requirements. The idea of integrating training into existing trade and other programs, for example, is likely to arise during these discussions as a means of reducing funding requirements and leveraging existing training infrastructure. Still, other stakeholders will recognize that sustainable solar training programs are required not only for those directly employed by the solar industry, but also for those professionals who regularly interact with the solar industry – code officials, real estate brokers and appraisers, builders, insurance agents, architects, etc.

A Stepwise Approach - Once a concept has been targeted for implementation, a comprehensive plan will be drafted. The plan will likely include an integrated strategy that achieves reductions in hiring time, transaction cost savings, and widespread industry participation. During the pilot stage, tasks will consist of program development followed by testing/validation, marketing/business development, and scaling the platform in test communities.

Any one of the three private funding models discussed previously could maximize its marketing and training successes by adopting a suite of web-based tools and applications. Program information, enrollment instructions (for both students and businesses), and links to tools and resources might be housed in a web portal application optimized for viewing on tablets, smartphones, and/or similar platforms. This ease of access may enable any one of the three funding programs to grow exponentially at internet scale via search engine optimization, Google AdWords, social media, crowd sourcing of partner marketing, rewards program development, and strategic online partnerships to improve traffic 'pull' effects.

[30] Note: All consequent steps will be considered "Phase II" activities, as they are not currently part of the scope of this effort.

The Opportunity - If a funding model can be chosen and developed quickly, it may be rolled out on a trial basis over the next two years in any number of the 100 early adopter local/regional markets targeted by the DOE-funded Solar 3.0 program. Additionally, rapid program selection and design will present opportunities to integrate the chosen funding model into the DOE's SunShot Solar Outreach Partnership, or to run the pilot program in any of the DOE's Rooftop Solar Challenge awardee regions.

Getting to Scale - With proper design, the back-end of this online platform may scale through multiple channel partnerships with the Solar Energy Industries Association, National Association of Workforce Boards, International Economic Development Council, U.S. Department of Energy, U.S. Department of Labor, Institute for Building Technology and Safety, Labor Unions currently active in (or seeking to expand into) solar installation work, International Association of Electrical Inspectors, National Association of Home Builders, ICLEI – Local Governments for Sustainability, the International City/County Management Association, the Interstate Renewable Energy Council, among others. Engaging these organizations will raise the level of awareness about the issue and potentially help to expand industry and local workforce participation.

The management team will consist of industry pioneers in solar workforce development, solar market process improvement, private equity finance, government relations, and entrepreneurial management across multiple platforms, providing the foundational knowledge necessary to ensure program sustainability. At the very least, representatives from Interstate Renewable Energy Council, North American Board of Certified Energy Practioners, SolarTech, The Solar Foundation, and others may serve in an advisory capacity during program selection, development, and implementation.

Conclusion & Recommendations

The solar industry will face two significant shortfalls in the near future - a sharp decrease in funding for workforce development, leading to a shortage of solar workers to supply the ever-increasing demand for solar installations in the U.S. Thus, now is the time to begin evaluating and planning how the industry will overcome these deficits.

In the absence of federal, state, or local public funds, it will be essential that private funding mechanisms begin to emerge. This concept paper identified three possible ideas for bridging the workforce funding gap. Although the revolving loan fund scored the highest in our preliminary analysis, it is of critical importance that these ideas be thoroughly evaluated by the industry and other stakeholders - without the participation of these stakeholders, the success and sustainability of any of the programs proposed herein cannot be ensured.

A successful commercial deployment of any one of the three concepts will be driven by both market adoption and technology innovation. Those involved in the program may benefit in the following ways:

- The solar industry gains a more transparent and efficient workforce pathway that enables it to adequately meet domestic installation demand and get Americans back to work, with higher response rates to market needs than traditional funding methods;
- Local workforce development organizations are more efficient and provide training at a lower cost, which, in turn, enables them to develop more programs for more students. They also better understand where workforce training programs are needed geographically and which positions are in greatest demand, and;

- Investors receive a low risk return by providing critical process infrastructure to sustain double digit annual U.S. renewable energy industry growth.

It is our hope that the transition to a funding mechanism that leverages private funds will occur over the next three years through the use of both private and public funding. It is also hoped that significant funding may be raised in order to achieve full commercial deployment and licensing or syndication of these innovative workforce solutions across all fifty states.

Appendix

Table A1: Solar Training Funding from Federal Government and Top Solar States

Source: The Solar Foundation

Level	***Federal***						***State***	***Totals***
Agency	U.S. Department of Labor				U.S. Department of Energy		*Various*	
Program	State Energy Sector Partnership[31]	Energy Training Partnership[32]	Pathways Out of Poverty[33]	Green Capacity Building[34]	State Energy Program[35]	Solar Instructor Training Network[36]	*Various*	
AZ	$215,000	$968,485	$500,116	$13,141			$2,000,000[37]	$3,696,742
AR		$188,860						$188,860
CA	$786,222		$1,177,000	$148,107	$1,253,388	$3,499,828	$500,000[38]	$7,364,545
CO	$713,767	$431,120		$13,122				$1,158,009
DC				$12,386				$12,386
FL		$431,098	$397,192	$13,141		$2,800,000	$184,482[39]	$3,825,913
GA			$292,779	$13,141				$305,920
HI	$258,000			$100,000				$358,000
IL	$258,000			$18,593				$276,593
IN		$776,497						$776,497
IA	$257,871							$257,871
KS		$968,485						$968,485
ME						$2,886,782		$2,886,782
MD	$758,906							$758,906
MA	$513,734			$35,298				$549,032
MI	$762,419	$564,872						$1,327,291
MN		$338,753						$338,753
MS				$10,256	$24,500			$34,756
MO	$474,000		$586,646					$1,060,646
MT				$11,514				$11,514
NJ	$258,000						$300,000[40]	$558,000
NM	$479,999	$968,485			$500,000		$250,000[41]	$2,198,484
NY		$776,497	$619,422			$8,297,595	$2,450,000[42,43]	$12,143,514
NC	$782,923		$140,467		$420,000	$3,008,826		$4,352,216
OH	$3,156,000		$359,649	$13,141				$3,528,790
OK		$968,485						$968,485
OR				$11,962				$11,962
PA		$776,497				$3,500,000		$4,276,497
TN		$188,860						$188,860
TX		$968,485	$768,703		$431,300	$3,566,058		$5,734,546
UT				$12,643		$3,110,140		$3,122,783
WA	$782,546							$782,546
WI				$12,926		$3,307,709		$3,320,635
Program	$10,457,387	$9,315,479	$4,481,974	$439,371	$2,629,188	$33,976,938	--	--
Agency	$25,254,211				$36,606,126		--	--
TOTAL	**$61,660,337**						**$5,684,482**	**$67,344,819**

[31] State Energy Sector Partnership Awardees: http://www.doleta.gov/pdf/SESP_Summaries.pdf
[32] Energy Training Partnership Awardees: http://www.doleta.gov/pdf/ETP_SGA_Award_Summaries_120409.pdf
[33] Pathways Out of Poverty Awardees: http://www.doleta.gov/pdf/Pathways_Poverty_grants.pdf
[34] Green Capacity Building Awardees: http://www.doleta.gov/pdf/GreenJobs.pdf
[35] State Energy Program Awardees: http://www1.eere.energy.gov/wip/project_map/
[36] Solar Instructor Training Network Awardees: http://www.irecusa.org/2009/10/doe-announces-grants-for-solar-america-cities-special-projects-and-solar-installer-training/
[37] Solar Training Incentives for First Solar:
[38] California Solar Training Partnership: http://www.energy.ca.gov/releases/2009_releases/2009-10-29_green_jobs.html
[39] Mustang Vacuum System Award: http://www.manateeedc.com/News/PDF/Mustang%20training%20grant%202010%20FINAL.pdf
[40] Lincoln Park Coast Cultural District Green Job Training Program: http://lpccd.org/sustainability/green-jobs-training/
[41] Job Training Incentive Program: http://www.nmlegis.gov/Sessions/09%20Regular/bills/senate/SB0318.pdf
[42] Green Jobs, Green New York: http://www.labor.ny.gov/workforcenypartners/annualreport/WIAAnnualReport10.pdf
[43] NYSERDA Clean Energy Workforce Initiative: http://www.nyserda.ny.gov//About/Newsroom/2008-Announcements/2008-02-25-Clean-Energy-Workforce-and-Wind-energy-Research-Center-to-be-Established.aspx

The table on the preceding page reflects The Solar Foundation's estimates for federal and selected state funds supporting the **solar-only** components of the training programs offered by awardees. As stated previously, this table *does not* represent a comprehensive accounting of funds for solar training. Because of the diverse number and nature of grant recipients, and because no central clearinghouse exists for this information, such a tabulation would be a monumental undertaking that is well outside the scope of this concept paper. Figures are listed merely to provide a general sense of the past and present funding environment for solar workforce training to the end of estimating funding needs into the future, and to illustrate that the majority of this funding is derived from federal programs that have already, or are soon to be, expired.

A Note on Solar Workforce Funding Amounts

Due to the shallow scope of this exploratory paper, along with the immense difficulty of tracking down comprehensive federal and state workforce training funds specific to the solar industry, funding amounts listed in this paper should be understood as providing only rough estimates at best. Providing accurate figures would require collecting award information on the entire universe of federal and state grantees over the time period covered in this paper. Furthermore, the information resources that do exist typically don't disaggregate funding amounts by industry (i.e., into training funds for solar, wind, energy efficiency and other industries).

As such, funding levels had to be estimated based on the information that could be collected in the time allotted. There are undoubtedly funding programs that were missed during the data collection phase. Furthermore, the funding figures reported herein are subject to significant uncertainties. Figures for solar workforce funding, from both state and federal sources, were determined according to a three step process:

1. Solar workforce figures, along with employment numbers for the other renewable and clean energy industries, were collected through the Energy Fact Check website (http://www.energyfactcheck.org/category/jobs/). Figures for the various industries are recreated below.

Industry	Employment	Source
Wind	75,000	American Wind Energy Association
Solar	100,000	The Solar Foundation
Biofuels	400,000	Renewable Fuels Association
Hydropower	200,000	Navigant Consulting
Geothermal	25,000	TechNewsWorld
Clean and Efficient Vehicles	155,000	NRDC/NWF/UAW
Biomass	15,000	Biomass Power Association
Green Building/ Energy Efficiency	661,000	McGraw Hill

Source: http://www.energyfactcheck.org/category/jobs/

2. Program descriptions were used to identify the industries covered by each workforce training grant. We then determined a ratio of the number of **solar** jobs to the number of jobs in all industries covered by a given grant.

3. This ratio was then multiplied by the funding level for the entire grant, thereby providing a very rough estimate for the portion of these funds going to **solar** workforce training.

A Note on Installation and Employment Projections

Installation projections used in this concept paper represent the latest capacity projections provided by the Solar Energy Industries Association and GTM Research in their *Solar Market Insight: 2011 Year-in-Review*.[44] In this report, the authors cite forecasts for annual solar capacity additions under three different scenarios, recreated in the table below. Our paper uses the figures from the "base case" scenario.

Table A2: Annual Installed Solar Capacity Projections (MW) *(2010-2016)*
Source: SEIA/GTM SMI 2011 Year-in-Review

	2010	2011	2012 (est.)	2013 (est.)	2014 (est.)	2015 (est.)	2016 (est.)
Downside	887	1,855	2,267	2,930	4,085	5,094	6,476
Base Case	887	1,855	2,840	3,668	5,108	6,371	8,118
Upside	887	1,855	3,535	4,581	6,412	7,995	10,163

These installation projections were then used to estimate solar industry employment through 2016. Employment was estimated through a process nearly identical to that used in the U.S. Department of Energy's *SunShot Vision Study*.[45] Authors of the *Vision Study* used the employment figures cited in The Solar Foundation's *National Solar Jobs Census 2010* to derive employment multipliers based on the installed solar capacity from that year. We use the same multipliers in our projections. Job numbers are reported here in full-time equivalents (FTEs).

The *Vision Study* estimates that, as solar energy equipment prices continue to fall and as labor productivity increases, fewer employees will be required per megawatt of equipment production or system installation. Productivity, captured in the "Jobs Index" metric in the SunShot projections, will increase by a factor of five for PV, and by a factor of three for CSP, by 2030. However, the *Vision Study's* authors offer no guidance on what this productivity curve might look like (i.e., exponential vs. linear), making it difficult to assess productivity gains for each year between now and 2030. For simplicity, it is assumed that the solar industry realizes productivity gains in a linear fashion.

The tables on the following page contain the data used to develop Figure ES2 and Figure 3 in the body of the paper.

[44] Solar Energy Industries Association/ GTM Research. 2012. *U.S. Solar Market Insight: 2011 Year-in-Review*. Executive Summary available at http://seia.org/cs/research/
[45] U.S. Department of Energy. February 2012. *SunShot Vision Study*. Accessed June 27, 2012 at http://www1.eere.energy.gov/solar/sunshot/vision_study.html

Table A3: PV Job Projections *(2010-2016)*

Source: The Solar Foundation/DOE SunShot Vision Study/ SEIA/GTM SMI 2011 Year-in-Review

	2010	2011	2012	2013	2014	2015	2016
Jobs Index	1	0.92	0.85	0.78	0.72	0.66	0.61
Annual Installed Capacity (MW)	887	1855	2840	3668	5108	6371	8118
Cumulative Installed Capacity (MW)	2095	3950	6790	10458	15566	21937	30055
Manufacturing and Distribution Jobs/MW	25	23	21.16	19.47	17.91	16.48	15.16
Installation Jobs/MW	25	23	21.16	19.47	17.91	16.48	15.16
O&M Jobs/MW	0.50	0.46	0.39	0.30	0.22	0.14	0.09
TOTAL M&D	22175	42665	60094	71406	91483	104975	123060
TOTAL Installation	22175	42665	60094	71406	91483	104975	123060
TOTAL O&M	1048	1817	2644	3171	3381	3140	2609
TOTAL PV (FTE)	45398	87147	122833	145982	186,348	213091	248728

Table A4: CSP Job Projections *(2010-2016)*

Source: The Solar Foundation/DOE SunShot Vision Study/ SEIA/GTM SMI 2011 Year-in-Review

	2010	2011	2012	2013	2014	2015	2016
Jobs Index	1	0.95	0.89	0.85	0.80	0.76	0.72
Annual Installed Capacity (MW)	78	12	81	1063	983	2117	1397
Cumulative Installed Capacity (MW)	515	527	608	1671	2654	4771	6168
Manufacturing and Distribution Jobs/MW	25	23.65	22.37	21.16	20.02	18.94	17.92
Installation Jobs/MW	15	14.19	13.42	12.70	12.01	11.36	10.75
O&M Jobs/MW	1	0.95	0.89	0.85	0.80	0.76	0.72
TOTAL M&D	1939	284	1812	22498	19681	40097	25031
TOTAL Installation	1164	170	1087	13499	11809	24058	15019
TOTAL O&M	515	499	544	1415	2126	3615	4421
TOTAL CSP (FTE)	3618	953	3444	37412	33616	67771	44471

Table A5: Total Solar Job (Full Time Equivalent) Projections *(2010-2016)*

Source: The Solar Foundation/DOE SunShot Vision Study/ SEIA/GTM SMI 2011 Year-in-Review

	2010	2011	2012	2013	2014	2015	2016
PV	45398	87147	122833	145982	186348	213091	248728
CSP	3618	953	3444	37412	33616	67771	44471
Total Solar Jobs (FTE)	49016	88100	126276	183394	219964	280861	293199