



# National Solar Jobs Census **2015**



JANUARY 2016

# Acknowledgements

The Solar Foundation® (TSF) is a national 501(c)(3) nonprofit organization whose mission is to increase understanding of solar energy through strategic research and education that transforms markets. In 2010, TSF conducted its first *National Solar Jobs Census* report, establishing the first comprehensive solar jobs baseline and verifying that the solar industry is having a positive impact on the U.S. economy. Using the same rigorous, peer-reviewed methodology, TSF has conducted an annual *Census* in each of the last six years to track changes and analyze trends.

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# Table of Contents

<b>5</b>	Executive Summary
<b>9</b>	Overview
<b>19</b>	Installation
<b>25</b>	Manufacturing
<b>32</b>	Sales and Distribution
<b>37</b>	Project Development
<b>41</b>	Other
<b>46</b>	Workforce Development
<b>53</b>	Solar Policy
<b>58</b>	Conclusions & Recommendations
<b>62</b>	Methodology

# Executive Summary

The Solar Foundation's *National Solar Jobs Census 2015* is the sixth annual edition of current employment, trends, and projected growth in the U.S. solar industry. Given this industry's rapid transformation, The Solar Foundation has conducted annual employer surveys of the domestic solar labor force and perspectives on job growth and future opportunities. Data for *Census 2015* is derived from a statistically valid sampling and survey that went to nearly 400,000 establishments throughout the nation, in sectors ranging from manufacturing, to construction and engineering, to sales. The results from the *Census* are based on rigorous survey efforts over the course of October and November 2015 that include 287,962 telephone calls and over 44,220 emails to known and potential energy establishments across the United States, resulting in data from 19,000 firms and a total of 2,350 full completions from U.S. solar establishments.

This year's *Census* found that the solar industry continues to outpace most other sectors of the economy, **adding workers<sup>1</sup> at a rate nearly 12 times faster than the overall economy and accounting for 1.2% of all jobs created in the U.S. over the past year.** The Solar Foundation's long-term research shows that **solar industry employment has grown by 123% since 2010, resulting in over 115,000 new domestic living-wage jobs.**

**As of November 2015, the solar industry employs nearly 209,000 solar workers, representing a growth rate of 20.2% since November 2014.** Meanwhile, U.S. businesses as a whole added just over 2.4 million jobs at an annual growth rate of 1.74%.<sup>2</sup> Over the next 12 months, surveyed employers expect to see total employment in the solar industry increase by 14.7% - which is 13 times faster than the overall economy is expected to grow<sup>3</sup> - to approximately 240,000<sup>4</sup> solar workers.

This report includes up-to-date information on the solar industry - quantifying employment growth since last year's study and since the publication of *Census 2010*. These research findings also provide information on the potential for further growth and factors that are likely to impact the industry over the coming years.

In addition to the above statistics, the following were observed as of November 2015:

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<sup>1</sup> In this survey, solar employees are defined as a worker that spends at least 50% of their time on solar-related work. However, we have consistently found that 90% or more of these workers spend 100% of their time on solar-related work.

<sup>2</sup> BLS, Current Employment Statistics for November 1, 2014 to October 31, 2015, updated January 8, 2016.

<sup>3</sup> JobsEQ 20153Q; Projected growth is 1.1%

<sup>4</sup> The survey took place prior to the extension of the federal solar investment tax credit (ITC) beyond 2016. The extension is expected to reduce pressure to complete projects in 2016. This will likely result in lower solar employment growth in 2016 but higher solar employment in 2017 resulting in greater stability in solar employment. Prior to this policy change, major job losses had been expected for 2017.

- **2015 was the third consecutive year in which solar employment grew by approximately 20%.** At 20.2%, the 2015 growth fell just short last year's *Census* projected growth of 20.9%. By contrast, growth in 2013 and 2014 exceeded the *Census's* prior year's projected growth.
- **Over one out of every 83 new jobs created in the U.S. over the 12-month period was created by the solar industry** – representing nearly 1.2% of all new jobs.
- **Solar is a major source of new U.S. jobs.** Of the 35,000 solar workers added since November 2014, 83% were newly created positions with the remaining comprised of existing positions that have added solar responsibilities (17%).
- **Employees of installation companies accounted for 22,900 or 65% of the new jobs added in 2015.** The U.S. solar installation sector employs 77% more people than the domestic coal mining industry. Since 2014, solar installation has created more jobs than oil and gas pipeline construction and crude petroleum and natural gas extraction combined.<sup>5</sup>
- **Of the nearly 209,000 solar workers in the United States, approximately 90% are 100% dedicated to solar activities.** The “all-solar” percentage of workers is effectively unchanged since 2013.
- **Demand-side sectors (installation, sales and distribution, and project development) make up about 80% of overall solar industry employment;** installation firms account for the largest share of the workforce at 57%. Manufacturing comprises the second largest share at almost 15% of U.S. solar jobs.
- **All sectors - with the exception of solar manufacturing - grew over the past year.** Manufacturing jobs are expected to recover from the 2,200 job decline in 2015, growing by 3,800 jobs in 2016. These expectations are supported by industry construction activity.
- **Approximately 63% of the nearly 209,000 jobs are in the residential market segment, while 15% are in commercial and 22% were in utility-scale project development.** Utility-scale development is less labor intensive than residential so there are fewer utility-scale jobs despite the greater amount of utility MW installed.
- **About one in five employers report that it is “very difficult” to find qualified employees.** Except for manufacturing, all of the “very difficult to hire” percentages increased from 2014. Installation increased from 19.4% to 26.0%, sales and

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<sup>5</sup> JobsEQ 20153Q

distribution increased from 20.0% to 23.4%, and utility-scale project development nearly doubled in difficulty from 12.5% to 24.5%.

- **Wages paid to solar workers remain competitive with similar industries and provide many living-wage opportunities.** Solar installers pay a median wage of \$21 per hour, a 5% increase over the \$20 per hour wage in 2014. Manufacturers pay assemblers a median of \$18 per hour. Sales representatives and solar designers earn the highest medians of \$28.85 and \$26.92 per hour respectively. All of these are above the national median wage of \$17.04 per hour (BLS, May 2014, wage data is not yet available for 2015).
- **Women represent a greater proportion of the solar workforce than in previous years.** Women account for 49,775 solar workers – 24% of the total; this is up from over 37,500 or 22% in 2014. A lower proportion of certain racial and ethnic minorities are working in the solar industry than in 2014. The workforce is comprised of approximately 5% African American, 9% Asian/Pacific Islander, 11% Latino/Hispanic, and 8% veterans. Despite some of the percent declines from 2014, there was little loss in employed workers of diverse backgrounds.
- **Experience is the most important hiring requirement for all sectors.** Two-thirds of employers require experience compared with 35% requiring a bachelor's degree or higher, and 10% requiring an associate's degree but not a B.A. Nonetheless, the solar industry provides an opportunity for workers in low-wage jobs who pursue some training in solar-specific technologies to move into sustainable wage careers in as little as 12 months.
- **Policies and incentives remain important.** Among policies and incentives, the 2015 *Census* found that 78% of solar firms noted that the federal ITC considerably or somewhat increased business prospects followed by 57% for state-level renewable portfolio standards (RPS) and energy efficiency resource standards (EERS); and 56% of businesses that expect the EPA Clean Power Plan to considerably or somewhat increase business prospects.

*National Solar Jobs Census 2015* continues to demonstrate that the U.S. solar industry is having a positive and growing impact on the national economy, supporting jobs across every state in the nation.

As with the previous *Census* studies, this report includes information about all types of companies engaged in the analysis, research and development, production, sales, installation, and use of all solar technologies – ranging from solar photovoltaics (PV), to concentrating solar power (CSP), to solar water heating systems for the residential, commercial, industrial, and utility market segments.

The findings presented herein are based on rigorous survey efforts that include nearly 288,000 telephone calls and over 44,000 emails to known and potential solar

establishments across the United States, resulting in a maximum margin of error for employment-related questions of  $\pm 1.99\%$  at a 95% confidence interval. Unlike economic impact models that generate employment estimates based on economic data or jobs-per-megawatt (or jobs-per-dollar) assumptions, the *National Solar Jobs Census* series provides statistically valid and current data gathered from actual employers.

### ***About The Solar Foundation®***

The Solar Foundation® (TSF) is an independent 501(c)(3) nonprofit organization whose mission is to increase understanding of solar energy through strategic research and education that transforms markets. TSF is considered the premier research organization on the solar labor workforce, employer trends, and the economic impacts of solar. It has provided expert advice to leading organizations such as the National Academies, the Inter-American Development Bank, the U.S. Department of Energy, and others during a time of dynamic industry growth and policy and economic uncertainty.

While TSF recognizes that solar energy is a key part of our energy future, it is committed to excellence in its aim to help people fairly and objectively gauge the value and importance of solar technologies.

### ***About BW Research Partnership***

BW Research is widely regarded as the national leader in labor market research for emerging industries and clean energy technologies. In addition to the *Census* series, BW Research has conducted rigorous solar installation and wind industry labor market analysis for the National Renewable Energy Laboratory, wind energy and energy retrofit studies for the Natural Resources Defense Council, a series of comprehensive clean energy workforce studies for the Commonwealth of Massachusetts, Illinois, Vermont, Florida, Pennsylvania, Iowa, and California and numerous skills and gap analyses for community colleges, workforce investment boards, state agencies, and nonprofit organizations.

BW Research provides high-quality data and keen insight into economic and workforce issues related to renewable energy, energy efficiency, transportation, recycling, water, waste and wastewater management, and other environmental fields. The principals of the firm are committed to providing research and analysis for data-driven decision-making.



# Overview

The *National Solar Jobs Census 2015* is The Solar Foundation's sixth annual review of the size and scope of employment in the U.S. solar industry, and represents the most significant and rigorous analysis of solar labor market trends to date. This year's *Census* includes data gathered between October and November 2015 from more than 19,000 U.S. businesses, with full survey completions from 2,350 solar establishments, allowing for an overall margin of error for employment numbers of  $\pm 1.99\%$  at a 95% confidence interval, which is significantly lower than similar studies.

**The solar industry continues to support robust job growth, creating 35,052 new jobs in 2015, a growth rate of approximately twelve times greater than that of the overall economy.** U.S. businesses added just over 2.4 million jobs over 2015, a growth rate of 1.74%<sup>6</sup> - the solar industry grew by 20%, accounting for 1.2% of all new jobs.<sup>7</sup>

**As of November 2015, the solar industry supports 208,859 jobs at 28,593 locations<sup>8</sup>, an increase in employment of 20% over the past 12 months and 123% since The Solar Foundation began its *Census* series in September 2010.** This growth has been driven primarily by the massive increase in solar energy installations over the same time frame. In fact, a quarter of all existing U.S. solar energy capacity was installed in 2015 - 7,430 megawatts (MW) - eight times the 929 MW installed in 2010 when the *Census* was first published.<sup>9</sup> Now with over 27 gigawatts (GW) of total capacity, solar energy is expected to comprise 1% of total US electricity generation by the end of 2015.<sup>10</sup>

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<sup>6</sup> BLS, Current Employment Statistics for November 1, 2014 to October 31, 2015, updated January 8, 2016.

<sup>7</sup> Based on total solar job growth of 35,052 multiplied by the 83% newly created positions divided by 2.4 million jobs created across the total U.S. workforce.

<sup>8</sup> When including all establishments that are involved in solar work, including those that employ solar workers that spend less than half their time on solar-related activities, the total number of firms is 63,077.

<sup>9</sup> SEIA/GTM Solar Market Insight Q3 2015

<sup>10</sup> SEIA/GTM Solar Market Insight Q3 2015

*Census* respondents expect similar capacity growth in 2016 in the U.S., mirroring global trends. Cumulative capacity of global installed solar grew from 40 GW in 2010 to an estimated 177 GW by the end of 2014.<sup>11</sup> It is projected to grow by 30% to 230 GW by the end of 2015.<sup>12</sup>

The vast majority of these jobs are focused on solar photovoltaic (PV) electric generation for the residential market. Ninety-three percent of solar workers are focused on solar PV electric generation; about 5% support renewable heating and cooling, such as solar thermal, and another 2% work on projects related to concentrating solar power (CSP). Approximately 63% of the 208,859 jobs were in the residential market segment, while 15% were in commercial and 22% were in utility-scale development. Utility-scale development is less labor-intensive than residential so there are fewer utility-scale jobs despite the greater amount of MWs installed by such firms.

Furthermore, the 2015 *Census* found that demand-side sectors (installation, sales and distribution, and project development) make up almost 80% of overall solar industry employment, with installation firms accounting for 57% of the workforce and manufacturing comprising almost 15% of U.S. solar jobs.<sup>13</sup> Interestingly, more than half (53%) of all solar employment is reported to be in administrative, management, professional, or sales positions across all types of solar companies in the United States, and just under one-third (31%) are non-management installation or repair workers.

*Census* data include occupations critical to meeting domestic installation demand. These include most of the direct jobs and many of the indirect jobs in the solar industry except some indirect jobs in the component and materials supply chain. Those jobs, combined with induced impacts of the industry, support an additional 610,650 jobs, bringing the total employment impact for the U.S. solar industry to 818,309 jobs.<sup>14</sup>

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<sup>11</sup> REN 21 Global Status Report 2015

<sup>12</sup> GTM Research, *Global PV Demand Outlook 2015-2020: Exploring Risk in Downstream Solar Markets*, June 2015.

<sup>13</sup> There remains significant overlap across many of these sectors; however, the industry is becoming more specialized and each year there is less reported overlap, especially among larger employers.

<sup>14</sup> This calculation is based on the U.S. Bureau of Economic Analysis RIMS II model for the specific NAICS clusters that employ solar workers. The calculation is largely comprised of induced impacts, with a small amount of indirect employment for those segments of the value chain that are not included in the survey, such as raw materials.

Table 1: Solar Employment by Sector

Sector	2015 Employment	% Total Employment	% Growth 2014-2015	% Growth 2010-2015
Installation	119,931	57.4%	23.6%	173.0%
Manufacturing	30,282	14.5%	-6.8%	21.5%
Sales & Distribution	24,377	11.7%	20.8%	107.6%
Project Development	22,452	10.8%	48.6%	181.1% <sup>15</sup>
All Others	11,816	5.7%	31.5%	-8.5%
Total <sup>16</sup>	208,859		20.2%	123.4%

**Solar firms added over 35,000 jobs since *Census 2014*, at an annual growth rate of 20.2%.<sup>17</sup>** Installers were responsible for 22,900 of these new jobs (65% of the total). However, all sectors - with the exception of manufacturing - grew over the past year. Eight in ten (83%) positions were new hires for newly created positions, with the remainder (17%) coming from existing employees that added solar responsibilities.

Table 2: Solar Energy Sector Employment, 2010-2016 (Projected)

Sector	2010	2011	2012	2013	2014	2015	2016 (Projected)
Installation	43,934	52,503	57,177	69,658	97,031	119,931	139,813
Manufacturing	24,916	24,064	29,742	29,851	32,490	30,282	34,123
Sales & Distribution	11,744	17,722	16,005	19,771	20,185	24,377	27,352
Project Development	n/a	n/a	7,988	12,169	15,112	22,452	26,074
All Others	12,908	5,948	8,105	11,248	8,989	11,816	12,263
Total	93,502	100,237	119,017	142,697	173,807	208,859	239,625

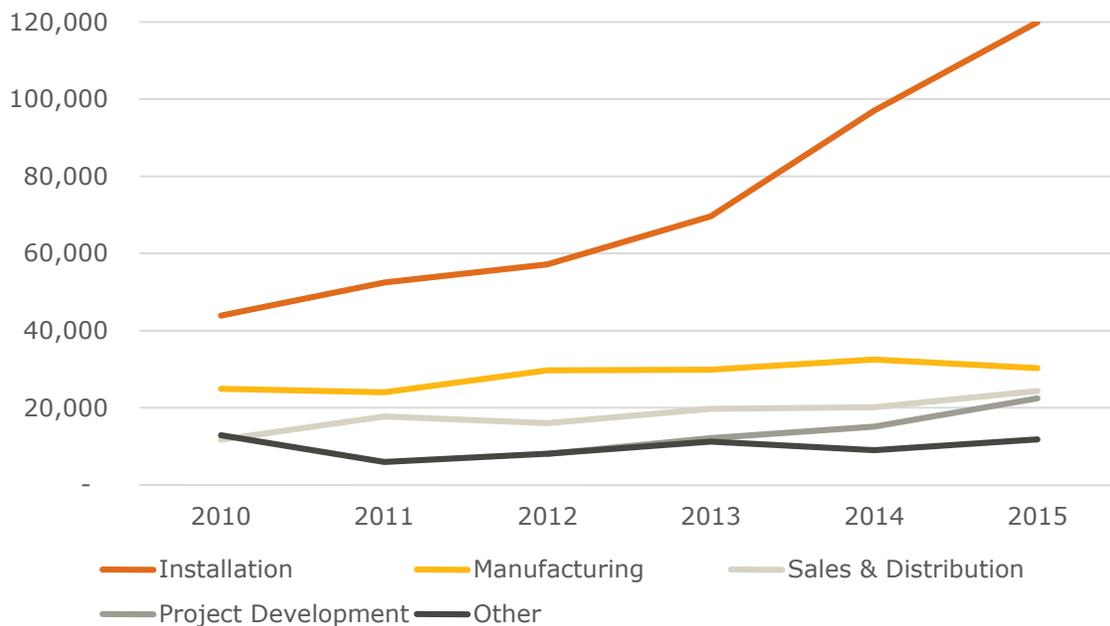
<sup>15</sup> Based on growth from 2012, the first year the *Census* broke out Project Development.

<sup>16</sup> Due to traditional rounding, separate categories do not sum to total.

<sup>17</sup> The 2015 *Census* covers the 12-month period between November 2014 and October 2015.

Thanks to its phenomenal growth, the installation sector is already larger than well-established sectors of fossil fuel generation. For example, the U.S. solar installation sector employs 77% more than the domestic coal mining industry.<sup>18</sup> Since 2014, solar installation has created significantly more jobs than both oil/gas pipeline construction and crude petroleum/natural gas extraction combined.<sup>19</sup> Since 2010, the oil /gas pipeline construction and crude petroleum/natural gas extraction industries respectively grew by 8% and 4%.<sup>20</sup>

Figure 1: Solar Employment Growth by Sector, 2010-2015<sup>21</sup>



**The U.S. solar industry expects total employment in the solar industry to increase to 239,625, an annual growth rate of 14.7% by the end of 2016.** This growth projection is almost 13 times faster than the projected 1.1% U.S. employment growth rate over the next 12 months. It is also nearly 11 times faster than the projected growth rates for the mining, quarrying, and oil and gas extraction industry over the same period.<sup>22</sup>

This survey based projection appears, at first glance, much more conservative than projected industry construction activity. The Solar Energy Industries Association (SEIA) and GTM Research expect new installations to grow 80% from 7.4 GW<sub>dc</sub> 2015 to 13.5 GW<sub>dc</sub>

<sup>18</sup> The coal mining industry employs 67,929 workers according to JobsEQ 2015Q3.

<sup>19</sup> Oil/gas pipeline construction and crude petroleum/natural gas extraction respectively created 152 and 725 new jobs in 2015.

<sup>20</sup> *Id.*

<sup>21</sup> Growth for the Project Development sector is set to 2012, the first year the category was used.

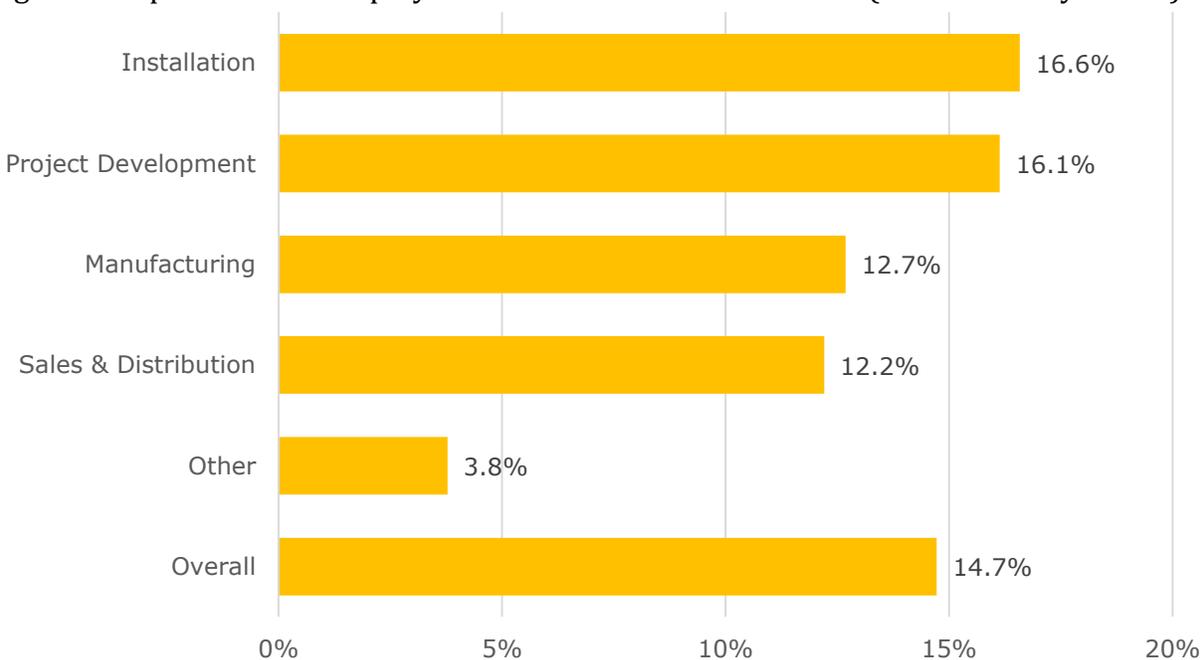
<sup>22</sup> JobsEQ 20153Q; NAICS 21, Mining, Quarrying, and Oil and Gas Extraction, is projected to grow by 1.4% over the next year with a total growth demand of 11,377 jobs.

in 2016.<sup>23</sup> Most (9.3 GW) of the capacity growth will be from utility-scale project development.

Two factors will likely lessen the capacity growth impact on employment. First, utility-scale project development is more efficient than other sectors so the sector tends to hire fewer employees per MW of installed capacity. Second, in ramping up for this high level of 2016 growth, many firms likely began hiring in the latter half of 2015 and therefore, are counted in the 2015 *Census* survey. In fact, *Census 2015* showed that utility-scale project development experienced the highest percentage growth (49%) of any of the sectors from 2014 to 2015 - growing from 15,112 to 22,452 employees (installation had the most total employee growth).

In 2016, solar installation and project development firms expect the fastest percentage growth at 16.6% and 16.1% respectively. Installation will add almost 20,000 jobs, while manufacturers expect to nearly double recent losses over the coming year.

Figure 2: Expected Solar Employment Growth from 2015 – 2016 (Overall and by Sector)

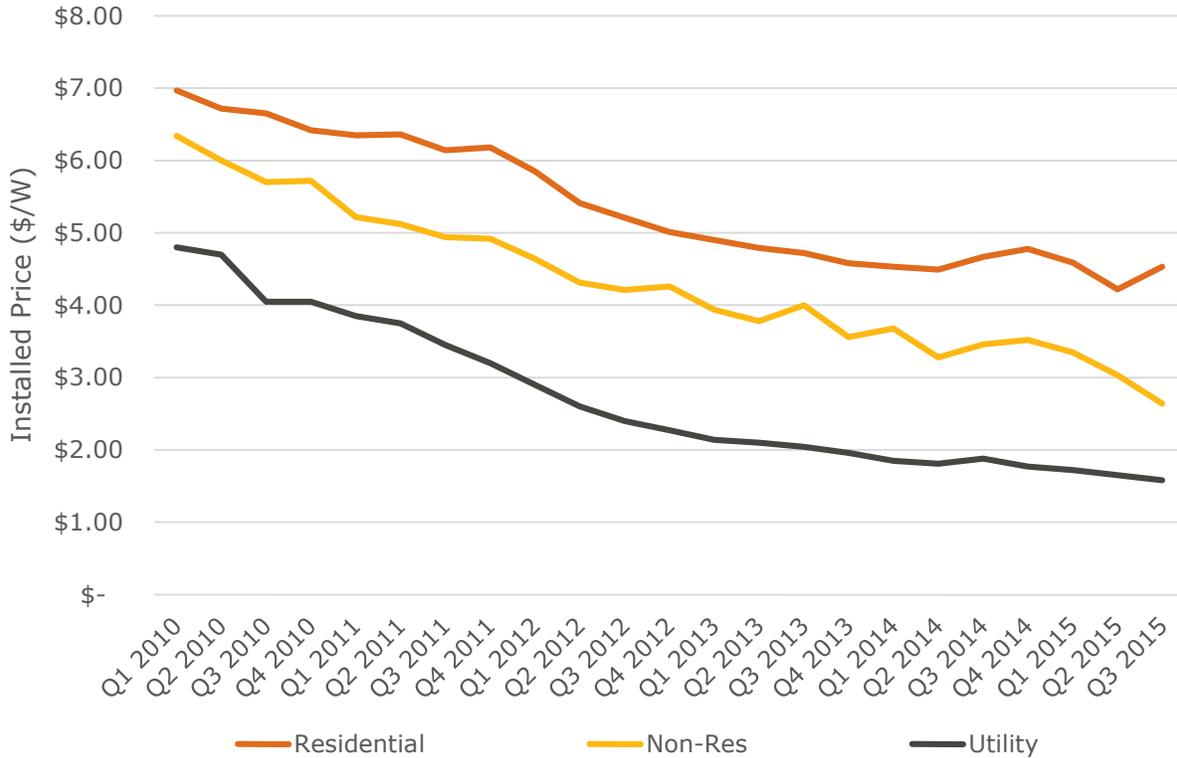


**Growth in annual installed capacity continues to be primarily driven by the falling installed costs of solar energy.** As shown in Figure 3 below, capacity-weighted average installed costs have declined by nearly 35% for residential installations, 58%

<sup>23</sup> At the time the survey was in the field, the industry had expected to see 15.4 GWdc of new installations in 2016 and a drop to 5.5 GWdc in 2017. However, the extension of the ITC is expected to smooth deployment by allowing some construction activity to carry-over into 2017. Now 13.5 GWdc is expected in 2016 and 10.4 GWdc is expected in 2017.

for non-residential systems, and 67% for utility-scale projects since the beginning of 2010.<sup>24</sup> Utility-scale development is at cost parity with new fossil fuel generators in some locations.<sup>25</sup>

Figure 3. Reported Capacity-Weighted Average Installed Costs, 2010-2015<sup>26</sup>



About half of solar firms tend to be “pure play” solar firms; they only sell solar products and services. The majority of installation firms (59%) and half of manufacturing firms derive all of their revenue from solar activities. However, there is a greater proportion of diversified firms in the manufacturing sector. Approximately a quarter of them generate less than 25% of their revenue from solar-related work. While diversification lowers financial risk, the more products a manufacturing firm produces, the more variety of staff skills are needed to remain competitive. Thus, the more a firm diversifies, the more difficult it is to source these skills.

<sup>24</sup> SEIA/GTM Solar Market Insight report series, 2010-2015

<sup>25</sup> Lazard Levelized Cost of Energy Analysis - Version 9.0. LCOE is based on the levelized cost of energy, on a \$/MWh basis, that would provide an after tax IRR to equity holders equal to an assumed cost of equity capital. For crystalline utility-scale solar PV projects, a 6-year average percentage decrease of 83% was observed in the unsubsidized levelized cost of energy (LCOE), with the latest averages ranging from \$0.058 - \$0.070/kWh making it competitive with natural gas at \$.068 - \$.101/kWh.

<sup>26</sup> SEIA/GTM, Solar Market Insight report series, 2010-2015

Table 3. Solar Revenue by Value Chain, 2015<sup>27</sup>

	All of it (100%)	Half to most of it (50% to 99%)	A quarter to almost half of it (25% to 49%)	Less than a quarter (1% to 24%)
Installation	59.0%	22.1%	7.2%	11.7%
Manufacturing	49.7%	16.0%	8.3%	26.0%
Sales & Distribution	52.9%	27.6%	7.8%	11.7%
Project Development	54.6%	23.1%	7.8%	14.5%
All Others	42.2%	24.3%	10.1%	23.4%

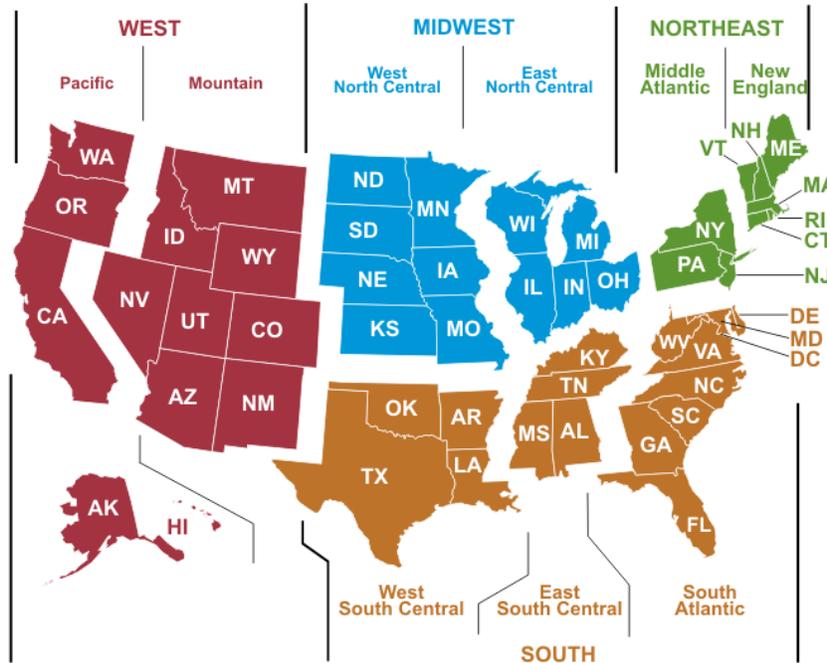
Most (99%) firms work with photovoltaic systems. By contrast, twenty-five percent of firms conduct work in renewable heating and cooling and 6% of firms work with concentrating solar power.

Table 4. Installed Technology by Census Division<sup>28</sup>

	Overall	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mntn	Pacific
Photovoltaic solar	<b>98.8%</b>	100.0%	98.9%	96.4%	96.8%	98.7%	100.0%	100.0%	96.4%	100.0%
Concentrating solar	<b>6.4%</b>	7.2%	3.3%	5.4%	3.2%	6.7%	5.9%	19.2%	12.0%	6.8%
Renewable heating & cooling (incl. solar thermal)	<b>24.9%</b>	39.2%	12.9%	32.3%	13.6%	33.9%	22.7%	18.9%	15.6%	22.5%

<sup>27</sup> Values displayed are with “DK/NA” responses factored out.

<sup>28</sup> Does not sum to 100% as many companies work across multiple technologies.



Source: U.S. Energy Information Administration

**Eight in ten solar installation firms (81%) report that their customers are located primarily within the state.** Project development and sales & distribution also predominately serve in-state customers with 75% and 65% of their customers respectively. In contrast, most (74%) of manufacturing customers are primarily outside the facility’s state including 10% with customers that are primarily international.

Table 5. Primary Customer Location by Value Chain, 2015<sup>29</sup>

	In-state	In a bordering state but out of state	In the United States, but outside of a bordering state	Outside of the United States
Installation	81.5%	6.1%	11.5%	0.9%
Manufacturing	26.3%	5.0%	58.7%	10.1%
Sales & Distribution	64.7%	3.7%	29.8%	1.8%
Project Development	74.9%	6.4%	17.4%	1.3%
All Others	54.5%	4.8%	38.1%	2.6%

<sup>29</sup> Values displayed are with “DK/NA” responses factored out.

Three sectors -- installation, project development, and other -- primarily source about 43% from in-state vendors with most of their remaining purchases in other states. Only about 5% of firms report that their primary vendors are overseas. **In contrast, 18% of manufacturers report that their primary vendors are overseas and only 20% report that they are within their state.**

Table 6. Primary Vendor Location by Value Chain, 2015<sup>30</sup>

	In-state	In a bordering state but out of state	In the United States, but outside of a bordering state	Outside of the United States
Installation	43.3%	9.5%	41.9%	5.3%
Manufacturing	20.7%	7.9%	53.0%	18.3%
Sales & Distribution	34.0%	8.7%	47.5%	9.8%
Project Development	43.4%	8.7%	43.3%	4.6%
All Others	43.8%	6.3%	45.1%	4.8%

**More women are working in solar, but other demographics lag.** Women represent a greater proportion of the solar workforce than in previous years, though a lower proportion of certain racial and ethnic minorities (as a whole) are working in the solar industry than in 2014. The declines in veteran and Latino proportions can be partially explained by state trends. There were declines in some very diverse, veteran-friendly states such as Arizona; 15% of Arizona’s solar workers in 2014 were veterans. Moreover, there was significant hiring in places like New York and Massachusetts, which tend to be less ethnically diverse and have a much lower rate of hiring veterans (6.7% and 4.5% respectively) than more southern states where veterans make up a larger percentage of the population.

Diversity within the workplace is important to overall economic growth and recent studies show that it also yields benefits to firms. For example, in a comprehensive study that examined both inherent and acquired diversity (2-D diversity), researchers found that “employees of firms with 2-D diversity are 45% likelier to report a growth in market share over the previous year and 70% likelier to report that the firm captured a new market.”<sup>31</sup>

<sup>30</sup> Values displayed are with “DK/NA” responses factored out.

<sup>31</sup> Harvard Business Review, *How Diversity Can Drive Innovation*, December, 2013

While the solar industry still has work to do to become as diverse as the overall U.S. population, it is still more diverse than other sectors of the economy, such as coal mining.<sup>32</sup>

Changes will take time, but many major companies within the solar industry, such as SunEdison and Solar City, have already adopted programs to recruit a more diverse staff. Additionally, the U.S. Department of Energy *Solar Ready Vets* program is underway to prepare veterans to enter the solar workforce.

Table 7: Solar Worker Demographic Breakdown, 2013-2015

	2013	2014	2015	2015 Total
Women	18.7%	21.6%	23.9%	49,556
Veterans	9.2%	9.7%	8.1%	16,835
Union	n/a	6.2%	5.5%	11,498
African American	5.9%	6.0%	5.2%	10,741
Asian/Pacific Island	6.7%	7.0%	8.7%	17,980
Latino/Hispanic	15.6%	16.3%	11.3%	23,494

<sup>32</sup> Bureau of Labor Statistics: <http://www.bls.gov/cps/cpsaat18.htm>



# Installation

The installation sector represents the end of the solar value chain and is the largest sector of the U.S. solar industry. Nearly two-thirds of new solar jobs in 2015 were created by the installation sector. Composed of companies that primarily install photovoltaic, solar water heating, and other, much smaller, solar energy technologies such as solar space heating and cooling, the installation sector's growth is primarily driven by declining costs and the existence of policies that support solar deployment.

The installation sector is still primarily composed of small firms – more than half of all installers have 10 or fewer employees – yet since the first *National Solar Jobs Census* was conducted in 2010, the number of large installation firms, defined as having more than 100 employees, has more than doubled to almost 10%. This section includes the key findings from the data gathered from more than 850 U.S. solar installation firms.

Solar installers employ a wide range of workers, though the majority are connected to the building trades, particularly electricians, construction laborers, and plumbers. They work on smaller residential systems as well as large commercial and utility-scale systems.<sup>33</sup>

## Big News in Installation:

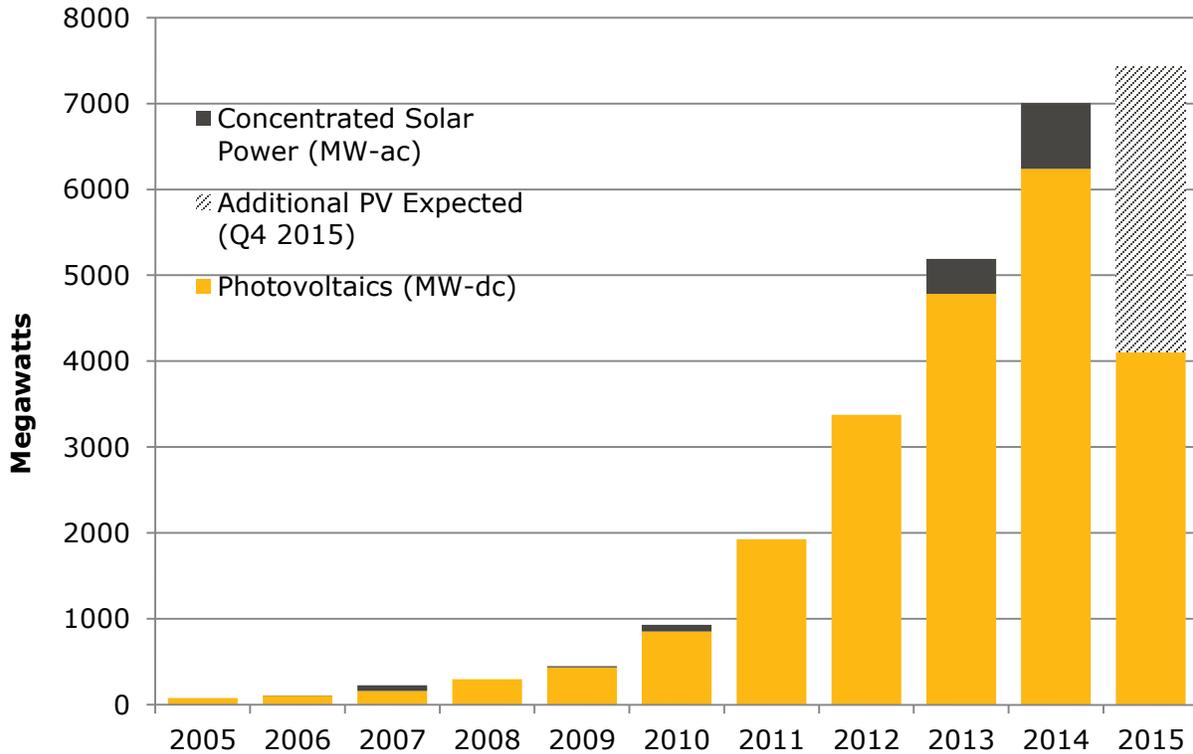
- **Due to decreasing costs, leading market research suggests that 2015 was a banner year for solar installations across the U.S.** Over 7,400 MW are expected

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<sup>33</sup> Most utility-scale installation jobs are tracked in the project development section of this report. Project development includes employment that works only on (or predominantly on) large scale systems such as those owned or operated by utilities. However, installers who work on different types of installations are included here.

to have been installed in 2015, enough to power over 1.2 million U.S. homes. If achieved, the U.S. will have 27.4 GW of cumulative installed capacity, an increase of 37% over the 20 GW installed through the end of 2014.<sup>34</sup>

Figure 4. Annual Solar Power Capacity Installations, 2005-2015<sup>35</sup>



- Installation growth was particularly strong in a number of states**, including California, North Carolina, Massachusetts, Nevada, Arizona, New York, New Jersey, Maryland, and Hawaii. While perennial market leader California will likely experience a decline in the growth of new installations compared to 2014, many states such as Georgia, Hawaii, Maryland, New York, North Carolina, Texas, and Utah are expected to experience growth in excess of 50%. North Carolina is expected to join California in installing over a gigawatt in one year. Driven by utility-scale development to meet an expiring state tax credit, North Carolina is expected to install 1,043 MW in 2015, nearly three times the 349 MW installed in 2014.<sup>36</sup> More on how installation growth has affected job growth within states will be released by The Solar Foundation in February (2016) at [www.SolarStates.org](http://www.SolarStates.org).

<sup>34</sup> SEIA Solar Market Insight Q3 2015

<sup>35</sup> SEIA and GTM Research, “Solar Market Insight” report series

<sup>36</sup> SEIA Solar Market Insight Q3 2015



- **Companies have been expanding installation capacity.** In December, SolarCity announced it was on track to install more than one gigawatt by the end of 2015.<sup>37</sup> In July, SunEdison unveiled a \$2.2 billion plan to acquire major residential installation firm, Vivint Solar. The deal, while subsequently restructured, provides Vivint with the resources to expand its installation activities.<sup>38</sup> One of the largest deals in Property Assessed Clean Energy (PACE) financing took place in September when PACE Equity announced it had raised \$200 million to expand its commercial building energy retrofit activities across seven states.<sup>39</sup> Sunrun, a leading residential solar company, raised more than \$250 million with its August IPO.<sup>40</sup>

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<sup>37</sup> See: "SolarCity Talks Cost Reduction at Analyst Day, Company Mission at Town Hall", from Greentech Media at: <http://www.greentechmedia.com/articles/read/SolarCity-Talks-Cost-Reduction-at-Analyst-Day-and-Mission-at-Town-Hall>

<sup>38</sup> See: "Revised Vivint Solar-SunEdison Deal Is a Positive for Both Companies", from Seeking Alpha at: <http://seekingalpha.com/article/3751986-revised-vivint-solar-sunedison-deal-is-a-positive-for-both-companies>

<sup>39</sup> See: "PACE Equity Offers \$200 Million and Expanded Resources in 7 States to Develop & Fund Commercial Real Estate Projects Nationwide", from PACE Equity at: <http://pace-equity.com/press-release-pace-equity-offers-200-million-and-expanded-resources-in-7-states/>

<sup>40</sup> See "Sunrun Hits Its Target Price, Raises \$251 Million in Solar Installer IPO", from Greentech Media at: <http://www.greentechmedia.com/articles/read/Sunrun-Hits-Its-Target-Price-Raises-251-Million-in-Solar-Installer-IPO>



## Tim Gulden

Owner of a small Solar PV Co.

Company: Winona Renewable Energy, LLC

Location: Winona, MN

Years at Occupation: 6

Tim was a Senior Electronic Engineering Design Technician at Watlow Controls in Winona, MN for 10 years. He specialized in root cause analysis and implemented design changes to prevent field reoccurrence. In 2009, he started Winona Renewable Energy, LLC and has been running his small PV business “from one end to the other,” including: sales, design, parts procurement, installations, warranty support, etc.

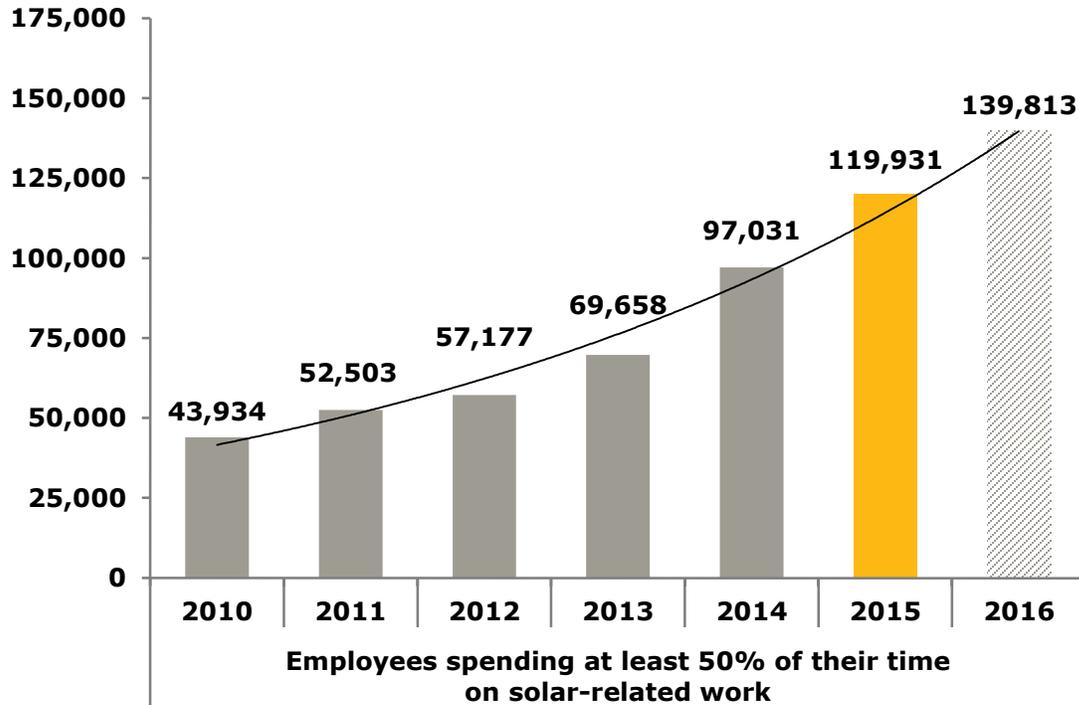
Working with clients and helping them achieve their energy independence goals energizes Tim and gives him great satisfaction. “I have always loved the idea of generating electricity from sunlight, and solar PV is one huge semiconductor,” he said.

One of his best experiences working in solar is the excitement of being chosen to install two small community solar gardens for two local electric cooperatives. He also appreciates the role he is playing in continually helping people reduce fossil fuel use.

Tim encourages prospective solar employees to become NABCEP (North American Board of Certified Energy Practitioners) certified and have a strong passion to keep learning. Tim is a NABCEP –PV Installation Professional.

**Installation companies now employ 119,931 workers, growing by almost 24% or 22,900 jobs since November 2014 and 173% since 2010.** Installation jobs now account for 57% of total industry employment. More Americans work at solar installation companies than work at petroleum refineries in the United States.<sup>41</sup> **The installation sector anticipates adding the most workers in 2016 as well,** reaching nearly 140,000 jobs by year’s end with an expected employment growth rate of 16.6% or 20,000 jobs.

Figure 5. Solar Installation Employment Growth, 2010-2016 (Projected)



Residential installation generates the greatest number of jobs per kW installed while utility-scale development generates fewer such jobs, deploying labor more efficiently on a kW basis. Nonetheless, utility-scale firms hired about 50 installers per firm in the last 12 months, over eight times the rate of such hiring in 2014.

<sup>41</sup> EMSI Class of Worker Employment, 2014.3

Table 8. Installation Market Segments, 2015

	Median Labor Hours for 5kW Residential PV	% Total Revenue Attributed to Solar	Average Solar Workers Hired per Firm in Last 12 Months
Overall	32	48.2%	8.85
Residential	40	67.4%	6.32
Commercial	36	63.0%	12.06
Utility-Scale	25	41.2%	50.91

Installation companies employ fewer women but more Latinos or Hispanics than their counterparts in other solar sectors. **Nonetheless, installation companies employ a higher percentage of women than the construction industry, the coal industry, and the oil and gas extraction industries.** Almost 9% of solar installation employees are veterans of the U.S. Armed Forces compared to 7% veterans in the national workforce.

Table 9. 2015 Installation Sector Demographic Breakdown<sup>42</sup>

	2015 Solar Employment	% of Solar Installation Employment	% of Total U.S. Workforce	% of Construction Industry Employment	% Oil and Gas Extraction Industry Employment	% of Coal Industry Employment
Women	25,305	21.1%	46.9%	8.9%	17.9%	7.40%
African American	5,877	4.9%	11.4%	5.9%	5.8%	6.30%
Asian or Pacific Islander	8,395	7.0%	6.1%	1.8%	2.1%	2.1%
Latino or Hispanic	16,191	13.50%	16.1%	27.3%	12.8%	5.8%
Veterans of the US Armed Forces	10,674	8.9%	7.0%	n/a	n/a	n/a
Belong to a union	8,515	7.1%	n/a	n/a	n/a	n/a
55 and over	19,669	16.4%	22.1%	n/a	n/a	n/a

<sup>42</sup> Source: 2014 annual U.S. BLS estimates available at: <http://www.bls.gov/cps/cpsaat18.htm>, <http://www.bls.gov/cps/demographics.htm#age>

# Manufacturing

Solar manufacturers produce a variety of products and components for domestic and international markets. This section includes the key findings from the data gathered from more than 250 solar manufacturers.

Manufacturing is critical to the U.S. economy. Overall, it provides well-paying jobs<sup>43</sup> that support other manufacturers (suppliers) and service sector jobs. Growth in domestic manufacturing supports professions such as lawyers and accountants and industries such as transportation and logistics. Many manufactured goods are exported, providing income to the national economy. Similarly, from a local perspective, goods exported to other regions and states, inject dollars into the local economy.

Manufacturing provides the foundation of an innovative, high technology economy. Approximately 70% of U.S. research & development fulfills manufacturing needs.<sup>44</sup> When technologies shift overseas, their R&D capacity often shifts as well. For example, the shift of semiconductor manufacturers to Asia resulted in a relative decline of U.S. thin-film-deposition knowledge – knowledge needed in the manufacture of photovoltaic cells. A loss like this can weaken U.S. competitiveness in solar cell development.<sup>45</sup>

While only half of manufacturing firms derive all of their revenue from solar activities, solar manufacturing remains critical to the overall solar value chain. Solar energy systems are comprised of hundreds of components such as ingots, cells, racking, modules, inverter cases, and even the equipment used to manufacture solar components. Some solar manufacturers are vertically integrated, while others specialize in one or two aspects of the value chain.

## Big News in Domestic Manufacturing:

- **The U.S./China trade dispute continues.** In 2012, German-owned and Oregon based manufacturer SolarWorld successfully petitioned the Commerce Department to apply tariffs on solar cells from China. Subsequently, Chinese firms shifted some production to Taiwan, so SolarWorld filed another case which included Taiwan, which was ruled in SolarWorld's favor in June 2014.

In January 2015, The U.S. International Trade Commission (ITC) proposed to reduce duties on solar products imported from China and Taiwan.<sup>46</sup> These tariffs have been controversial even among U.S. firms. While the duties are intended to protect U.S. manufacturers, many U.S. installers and distributors maintain that the duties have

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<sup>43</sup> Full-time manufacturing workers make 12% more on average than the full-time workforce as a whole. Economics & Statistics Administration, US Dept. of Commerce, *The Pay Premium for Manufacturing Workers as Measured by Federal Statistics*, Oct. 2, 2015

<sup>44</sup> The Information Technology & Innovation Foundation (ITIF), *The Case for a National Manufacturing Strategy*, April 2011

<sup>45</sup> IBID, ITIF

<sup>46</sup> GTM Research, *A Setback for SolarWorld and a Trade Case Win for Chinese Solar Manufacturers*, Jan. 5, 2015

curtailed job growth. They maintain that the tariffs inflate prices which reduces demand for installations.

- **Asia, specifically China, has led the PV module manufacturing market since 2009.** In 2014, Asia produced 87% of worldwide PV modules including 64% from China. In contrast, the U.S. only manufactured 2% of global supply. Even Europe outperformed the U.S., providing 8% of global supply or about four times that of the U.S. in 2014.<sup>47</sup>
- **Global PV module demand is expected to increase substantially over the next five years from 40 GW in 2014 to 135 GW by 2020.** Manufacturing capacity is rapidly growing to meet this demand. Announced manufacturing facility expansion has targeted countries outside of China and Taiwan, two countries subject to U.S. tariffs. Through 3Q 2015, announced manufacturing capacity growth has targeted India at 32%; followed by Thailand, 18%; Malaysia, 16%; and the U.S. and Brazil, each at 9%.<sup>48</sup>

Bloomberg Business reports that the top manufacturers are “on a building binge.” They are projected to add nearly 7 GW to their capacity in 2015. The largest U.S. manufacturer, First Solar, was not among the expanding firms, reporting that it expects to stay at 3 GW of capacity through 2017 although it could quickly ramp up to meet demand growth.<sup>49</sup>

- **The United States was ranked fifth in the GTM Research Global PV Manufacturing Attractiveness Index.** The index ranked countries’ PV manufacturing attractiveness based on four weighted factors: business environment – 10%, access to demand – 40%, PV manufacturing support – 15%, and all-in costs – 35%. GTM Research noted that the U.S. “provides significant access to demand tied to strong domestic demand, as well as access to markets globally, attractive support for PV manufacturing, and an excellent business environment.”<sup>50</sup> China ranked first followed by Singapore, Taiwan, Malaysia, U.S., and India.
- **Domestic module production increased 28% from Q3 2014 to Q3 2015.** Due to a glut in U.S. PV module supply at the beginning of this decade, module production fell in 2012. With more of a balance between supply and demand, production has recovered since then as shown in Figure 6.

Domestic production of PV components was mixed year over year. Polysilicon production at the three U.S. polysilicon plants decreased 35% from Q3 2014 to Q3 2015. Wafer production at the one U.S. plant increased from six to seven MW,

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<sup>47</sup> REN 21 Global Status Report 2015

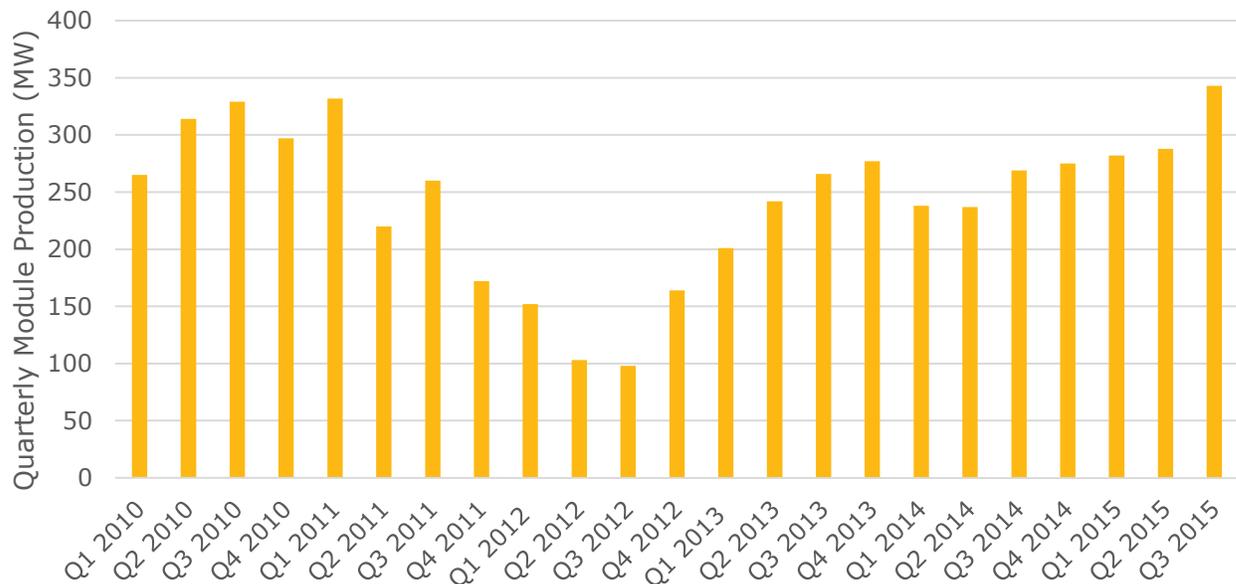
<sup>48</sup> GTM Research, Global PV Manufacturing Attractiveness Index 2015

<sup>49</sup> Bloomberg Business, *Solar Goes on a Building Boom Despite Memories of Past Bust*, 12/17/15

<sup>50</sup> GTM Research, Global PV Manufacturing Attractiveness Index 2015

crystalline silicon cell production increased 64% from Q3 2014 to Q3 2015, and inverter production increased 49% from Q3 2014 to Q3 2015.<sup>51</sup>

Figure 6. U.S. Domestic Solar Module Production, 2010-2015<sup>52</sup>



**Although there were manufacturer employment losses in 2015, announcements point to possible growth in 2016.** Silicon Valley-based Qbotix announced in September that it will cease operations despite restructuring and winning several awards and rounds of venture capital in previous years.<sup>53</sup> A somewhat similar story occurred with the U.S. arm of France’s leading semiconductor manufacturer, Soitec, when it announced that it was suspending its efforts to commercialize concentrating photovoltaic (CPV) technology. The company had installed approximately 75 MW of CPV projects.<sup>54</sup> More established firms, such as polysilicon manufacturer Wacker Chemie also faced a difficult year.<sup>55</sup> Nevertheless, other companies announced domestic manufacturing expansions. SolarCity reported progress on the expansion of its Buffalo, NY-based PV manufacturing facility.<sup>56</sup>

<sup>51</sup> SEIA Solar Market Insight Q3 2014

<sup>52</sup> SEIA and GTM Research, “Solar Market Insight” report series

<sup>53</sup> See: “RIP QBotix: Robotic Solar Tracking Fails to Reach the Market”, from Greentech Media at: <http://www.greentechmedia.com/articles/read/QBotix-Robotic-Solar-Tracking-Fails-to-Reach-the-Market>

<sup>54</sup> See “Soitec divests its solar system business to refocus on its core semiconductor activities”, from Soitec at: <http://www.soitec.com/en/investors/financial-press-releases/article-1722/>

<sup>55</sup> See “Wacker Polysilicon reports small Q3 sales increase, reduced special income”, from PV-Magazine at: [http://www.pv-magazine.com/news/details/beitrag/wacker-polysilicon-reports-small-q3-sales-increase--reduced-special-income\\_100021801/#axzz3ui7dHYrq](http://www.pv-magazine.com/news/details/beitrag/wacker-polysilicon-reports-small-q3-sales-increase--reduced-special-income_100021801/#axzz3ui7dHYrq)

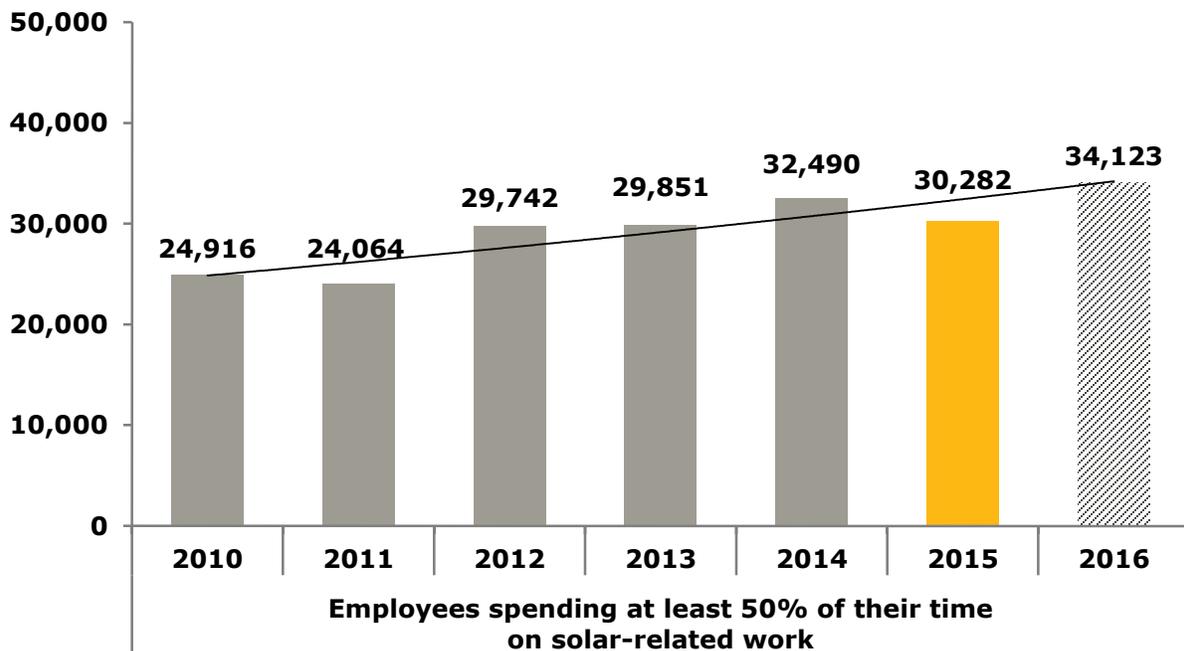
<sup>56</sup> See “Is SolarCity’s New PV Module the ‘World’s Most Efficient Rooftop Solar Panel?’”, from Greentech Media at: <http://www.greentechmedia.com/articles/read/Is-SolarCitys-New-PV-Module-the-Worlds-Most-Efficient-Rooftop-Solar-Pane>

**Manufacturers currently employ 30,282 solar workers, a decline of 6.8% or 2,208 jobs since November 2014, but still greater than November 2013.** The decline represents a decrease in the number of manufacturing employees spending at least 50% of their time in solar activity. However, the decrease was likely offset by an increase in the number of firms and thus employees that report doing solar work but don't meet the 50% threshold. These "new" firms may only focus part of their efforts on solar components.

Furthermore, as discussed above, there were plant downsizings, closures, new facilities and consolidations. Losses seen in polysilicon manufacturing likely offset gains in less labor intensive inverter manufacturing. The consolidations allowed companies to prune lower skilled workers and gain efficiencies in automation that required higher skilled workers. Our *Census* data bears that out. Median solar assembly worker wages increased by 30% from \$15 to \$18 per hour. Surveyed establishments also hired more educated workers in 2015: 35% required a bachelor's degree and 10% an associate's degree, up from 21% and 6% respectively in 2014.

Overall, manufacturers expect to recoup their losses over the coming year, expecting to add nearly 4,000 jobs at a 12.7% employment growth rate. Meanwhile, the nation's manufacturing industry (overall) is expected to decline by 1% over the next year.<sup>57</sup>

Figure 7: Solar Manufacturing Employment Growth, 2010-2016 (Projected)



<sup>57</sup> JobsEQ 2015Q3 - 2016Q3 Projected



## Dennis Lilikes

Warehouse Operations Managers

Company: Kyocera Solar Inc.

Location: Scottsdale, AZ

Years at Occupation: 27

As Warehouse Operations Manager in Scottsdale, AZ, Dennis oversees receiving and dispersal of materials entering or leaving the warehouses, monthly inventory, daily shipping reports, and logistics requirements. He also coordinates shipments with Kyocera's 3PL warehouses. While serving in the U.S. Army, Arizona National Guard, and Army Reserve, Dennis learned and developed many of the skills he uses in his role at Kyocera.

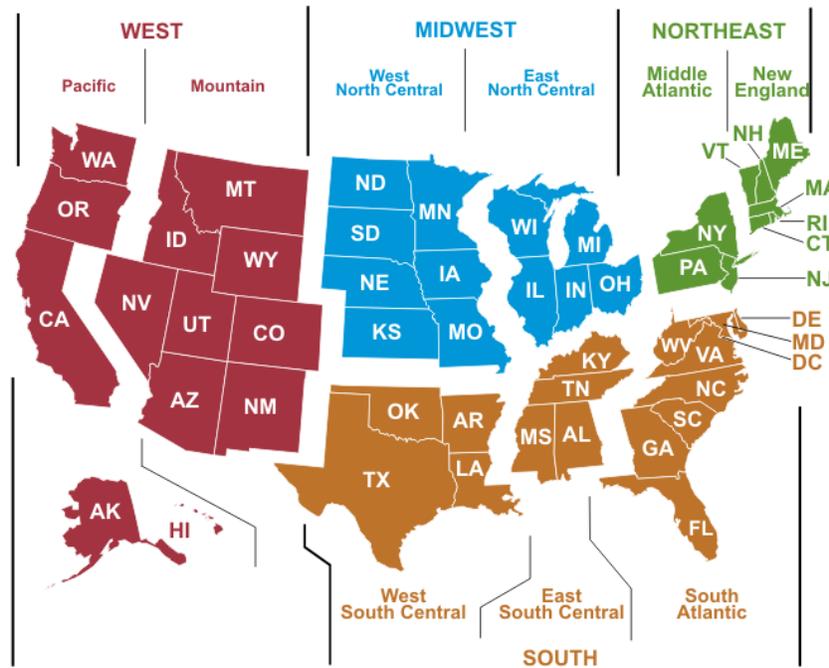
Logistics, receiving, and shipping are only part of the job. "You need to work with your internal and external customers to understand and recognize the different requirements as needed per customer," Dennis said. At the end of each and every day, Dennis and his team ensure quality for all shipments that are shipped and invoiced.

Previously, Dennis worked for Photocomm Inc./Golden Genesis, which was acquired by Kyocera. He said that he was attracted to his new employer's philosophy and the company's commitment to fair management and operation.

Dennis recommends that solar jobseekers utilize their personal and professional networks as much as possible. "If you need help, reach out to the experts for it," he said. He also suggests prospective applicants interested in working in warehouse management and related positions learn and understand logistics.

While serving in the U.S. Army, Dennis received training and certifications in logistics, heavy equipment, and carpentry. Dennis served in U.S. Army for 6 years; served 10 years in the Arizona National Guard, and 9 years in the U.S. Army Reserve.

Manufacturers of photovoltaic systems account for most (96%) reported activity nationally. Renewable heating and cooling activity was reported by 19% of manufacturers and concentrating solar power only reported by 23% of firms as shown in Table 10 below. Renewable heating and cooling activity was present in all parts of the country but the Mid-Atlantic.



Source: U.S. Energy Information Administration

Table 10. Manufactured Products by Census Division, 2015<sup>58</sup>

	Overall	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific
Photovoltaic solar	<b>96.3%</b>	94.1%	100.0%	95.7%	87.5%	96.0%	n/a	80.0%	96.0%	100.0%
Concentrated solar	<b>23.3%</b>	23.5%	16.7%	13.0%	50.0%	20.0%	n/a	40.0%	28.0%	23.0%
Renewable heating and cooling (incl. solar thermal)	<b>18.6%</b>	19.0%	0.0%	16.7%	30.8%	31.7%	n/a	23.1%	15.2%	16.2%

<sup>58</sup> Multiple responses permitted, percentages do not sum to 100%.



**Solar manufacturing establishments employ more women compared to installation, project development, and sales.** The sector also has the highest percentage of Asian or Pacific Islander employees at 16%.

Table 11: 2015 Manufacturing Demographic Breakdown<sup>59</sup>

	2015 Solar Employment	% of Solar Manufacturing Employment	% of Total U.S. Workforce	% of U.S. Manufacturing Industry
Women	8,635	28.5%	46.9%	29.3%
African American	2,942	9.7%	11.4%	9.7%
Asian or Pacific Islander	4,895	16.2%	6.1%	6.6%
Latino or Hispanic	3,415	11.3%	16.1%	15.8%
Veterans of the United States Armed Forces	2,874	9.5%	7.0%	n/a
Belong to a union	108	0.4%	n/a	n/a
55 and over	7,272	24.0%	22.1%	n/a

<sup>59</sup> Source: 2014 annual estimates from <http://www.bls.gov/cps/cpsaat18.htm>, <http://www.bls.gov/cps/demographics.htm#age>

# Sales and Distribution

The solar sales and distribution sector is made up primarily of wholesale and retail trade establishments. They are engaged in selling (but not installing) solar and other ancillary services to customers and/or warehousing and distributing U.S. and foreign made solar goods to installers. This report delineates companies by the activities at each business location to gather the most accurate employment information. Thus, much of the data for this section includes data from sales offices and distribution warehouses from companies across other segments of the value chain. This section includes the key findings from the data gathered from more than 350 U.S. solar sales and distribution firms.

As the industry matures and companies grow, much of this work is carried out in-house. In contrast, developing U.S. markets are likely to be more reliant on distributors – since firms in such markets may not be sufficiently large to justify the investment in direct sales.

## Big News in Sales and Distribution:

- Third-party-owned (TPO) installations remain a popular form of residential sales but, **with declining installation costs, more and more residents are choosing to retain ownership either through a cash purchase or loan.** Most TPO providers are offering a loan product to address such demand. Major solar states such as CA, CO, and NY experienced significant declines in TPO installations from 3<sup>rd</sup> quarter 2014 to 3<sup>rd</sup> quarter 2015. For example, residential TPO installations in California declined from 68% of new installations in Q3 2014 to 53% in Q3 2015.<sup>60</sup>
- **Community solar is experiencing rapid growth.** GTM Research predicts that the community solar market will experience a sevenfold increase over the next two years. By 2020 they forecast a half-gigawatt annual market.<sup>61</sup> Traditional residential solar installers, like Vermont’s SunCommon, are promoting community solar to households that lack the physical attributes that would enable them to site solar on their rooftop.
- **In March, the New York State Public Service Commission (PSC) issued an order to begin transforming utilities into “distributed system platform managers.”** In its first order in the state’s Reforming the Energy Vision (REV), the PSC directed the utilities to integrate rather than compete with distributed energy generation. Moreover, the utilities are discouraged from owning distributed systems, but instead directed to support private investment and ownership.<sup>62</sup>

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<sup>60</sup> SEIA/GTM Solar Market Insight Q3 2015

<sup>61</sup> GTM Research, *U.S. Community Solar Market Outlook 2015-2020*, June 2015

<sup>62</sup> Advanced Energy Economy, *New York Issues Order in Reforming the Energy Vision Proceeding, Turning Utilities into Distributed System Platform Managers*, March 6, 2015



- **Customer acquisition platforms and national distributors see growing investment.** At the end of 2015, the industry saw one of the largest ever investments in a customer acquisition firm when Sungevity raised \$650 million from Apollo Global Management to expand Sungevity’s services. Private equity firm Apollo Global Management joins other major investors who see increasingly sophisticated solar sales operations as a growing investment opportunity. Meanwhile, the largest solar distributor in the country, Soligent, sold off its commercial solar development business to focus on expanding its equipment distribution network.<sup>63</sup>

**Solar firms primarily engaged in sales currently employ 24,377 solar workers, an increase of 20.8% or 4,192 since 2014.** This is considerably higher than the nation’s overall retail (2%) and wholesale trade (1%) employment growth from 2014 to 2015.<sup>64</sup> Employers and expect to increase employment by 12%, or an additional 3,000 jobs by November 2016.

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<sup>63</sup> See “Rohnert Park solar company Soligent sells unit” from The Press Democrat at: <http://www.pressdemocrat.com/business/4081738-181/rohnert-park-solar-company-soligent>

<sup>64</sup> JobsEQ 2014Q3 – 2015Q3



## Gabriella Brune

Marketing Specialist and  
Administrative Assistant

Company: TruNorth Solar LLC

Location: Minneapolis, MN

Years at Occupation: 10 Months

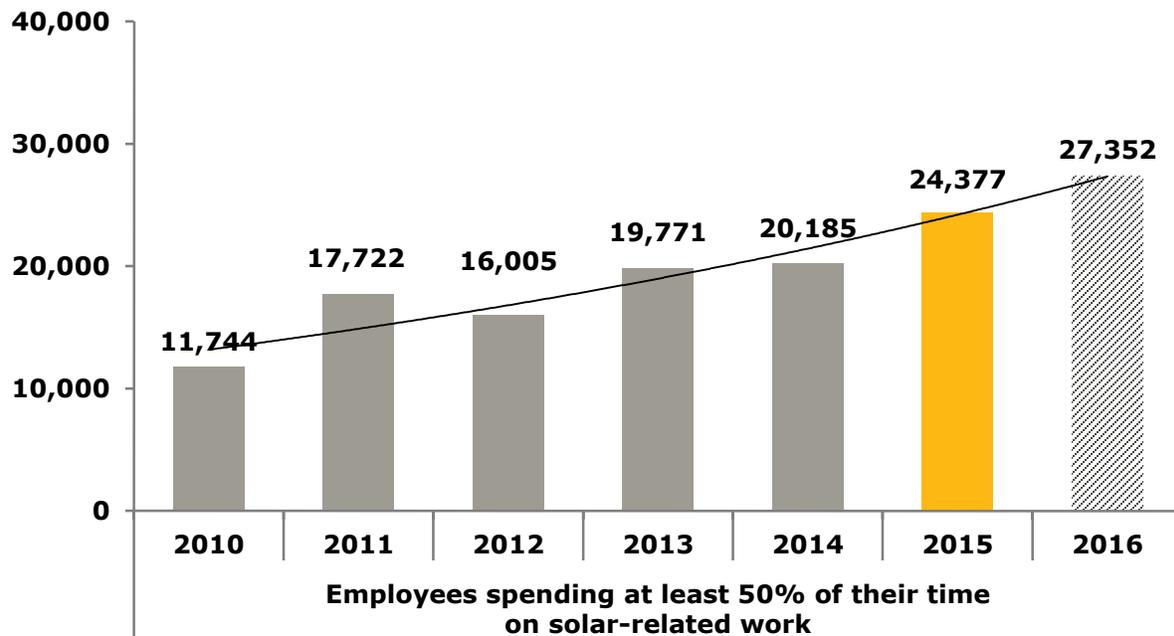
During the summer of 2014, Gabriella participated in the Summer of Solutions Minneapolis program, and worked with Cooperative Energy Futures on their preliminary Community Solar Garden. The following spring, as part of her Environmental Studies degree program at the College of St. Benedict, Gabriella interviewed one of the managers at TruNorth Solar for her thesis on Community Solar. She went on to intern for that company and today works as the company's Marketing Specialist and Administrative Assistant.

Gabriella says that she likes having many diverse responsibilities. In addition to supporting sales efforts and lead generation, Gabriella manages the company's web site, posts on social media pages, writes blogs, and she assists with administrative work, human resources, and office management.

Born and raised in Anchorage, Alaska, Gabriella said that she has always had a passion for the outdoors and renewable energy. "I wanted to work in the solar energy industry; it was my ideal job."

Gabriella encourages solar jobseekers to take classes on solar and get involved in their local solar advocacy organizations, like MNSEIA (Minnesota Solar Energy Industry Association) or CERT (Clean Energy Resource Team). "Those two things will differentiate them from other people who are trying to get work in the solar industry," she said.

Figure 8: Sales and Distribution Employment Growth from 2010 to 2016 (Projected)



Sales and distribution firms are less diverse than other sectors of the solar industry. Though women represent almost a quarter (24%) of the workforce, African Americans, Latinos, and Asians together represent less than 14% of all solar sales and distribution employees.

Table 12: 2015 Sales and Distribution Demographic Breakdown<sup>65</sup>

	2015 Solar Employment	% of Solar Sales & Distribution Employment	% of Total U.S. Workforce	% U.S. Wholesale Trade Industry
Women	5,740	23.5%	46.9%	30.2%
African American	566	2.3%	11.4%	8.6%
Asian or Pacific Islander	1,904	7.8%	6.1%	4.8%
Latino or Hispanic	803	3.3%	16.1%	15.8%
Veterans of the United States Armed Forces	1,014	4.2%	7.0%	n/a
Belong to a union	159	0.7%	n/a	n/a
55 and over	5,045	20.7%	22.1%	n/a

<sup>65</sup> Source: 2014 annual estimates from <http://www.bls.gov/cps/cpsaat18.htm>, <http://www.bls.gov/cps/demographics.htm#age>



## Marvin Talbert

Head of Marketing

Company: SolarWorld Americas

Location: Hillsboro, OR

Years at Occupation: 6

With experience in both managing factories and in building automation and electrical engineering, Marvin was attracted to the opportunity to work in solar as a chance to re-invest in the US and US manufacturing. In 2010, he was hired as head of modeling, to build SolarWorld's Oregon module manufacturing facility. Eight months later, the empty 110,000 sq. ft. warehouse was a fully automated solar module factory, churning out 4,000 modules per day.

Marvin managed tool qualification, tool installation, technology transfer, personnel, and the overall build-out of the facility. In 2015, Marvin was promoted to Head of Marketing and Brand Management and now oversees marketing and brand management decisions for SolarWorld Americas, including global alignment on strategies with Germany, product meetings, and he leads tours of the module factory that he helped build.

"I have had many careers and working in renewable energy is by far the best," Marvin said. "I love going home every day knowing that I left the world a better place."

A memorable day Marvin shared occurred recently. "The day the ITC extension was announced was one of the best days I can remember in the last six years," he said, calling it a huge deal for the industry as a whole. "It felt like a long awaited exhale after a long time spent holding our breaths in anticipation," he said.

Marvin is a certified Six Sigma Black Belt, Lean Manufacturing Certified, he has a B.S. degree in electrical engineering from North Carolina A&T State University, and continues his education through programs including: AMA Critical Listening Skills, Karrass Effective Negotiation, 30-hour OSHA Health and Safety, Set Up Reduction Courses, and more.

Marvin's advice to solar jobseekers: "Anyone who is interested in working in solar, should feel empowered. Regardless of your experience or skill level, there are countless roles you can delve into within the solar industry: from factory line work, to policy advocacy, to sales and marketing, to installation, all the way to complex business management. This industry has enormous career opportunities for all professions. If you have a passion for solar and/or renewable energy, there is a career waiting for you in this industry."

# Project Development

The project development sector includes utilities and companies that work on the largest, utility-scale solar projects. Predominantly using photovoltaic (PV) or concentrating solar power (CSP), these firms construct and sell bulk power to utilities or directly to consumers as a utility. This section includes the key findings from the data gathered from more than 280 U.S. solar project development companies and utilities.

Project developers and utilities require a wider range of in-house and outsourced workers and contractors, including civil engineers, land surveyors, and power plant operators. Permitting, finance, and land acquisition is more complex, requiring more and often higher paid administrative and professional workers as well. Employers in the sector tend to be larger and highly efficient with specialized labor for each component of the project.

## Big News in Project Development

- **In March, 2015, California became the first state with more than 5% of its annual electricity generation from utility-scale solar power.** California's utility-scale (1 MW or larger) solar plants generated a record 9.9 million megawatt hours (MWh) of electricity in 2014, an increase of 6.1 million MWh from 2013. California has promoted solar power through a series of state policies, including a recently enhanced renewable portfolio standard (RPS) that requires electricity providers to obtain 50% of the power they sell from eligible renewable sources by 2030. In 2014, the state obtained 22% of its electricity from non-hydropower renewables including wind, solar, and biomass.<sup>66</sup>
- **By the end of 2016, the U.S. is expected to install a record-high 9.3 GW of utility-scale solar PV capacity,** approximately 165% more than the projected 4.3 GW installed in 2015. These projections support almost 6 GW in projects in the pipeline.<sup>67</sup> This pipeline was primarily driven by utility companies' desire to complete their projects before the anticipated 2016 expiration of the 30% Federal Investment Tax Credit (ITC). While the 5-year ITC extension (signed into law by President Obama in December 2015) may delay some of this 2016 growth, much of it is still likely since many of these long lead-time projects are already underway.

Other factors are also stimulating growth: declining solar costs, declining coal generation, and the need to meet utility RPS compliance timelines. Even with higher rates, solar power rates are less volatile than those of fossil fuels and often sought by utilities and other firms to round out an otherwise volatile cost energy portfolio.<sup>68</sup>

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<sup>66</sup> U.S. Energy Information Association, *Electronic Power Monthly*, March 24, 2015

<sup>67</sup> SEIA Solar Market Insight revised Q3 2015

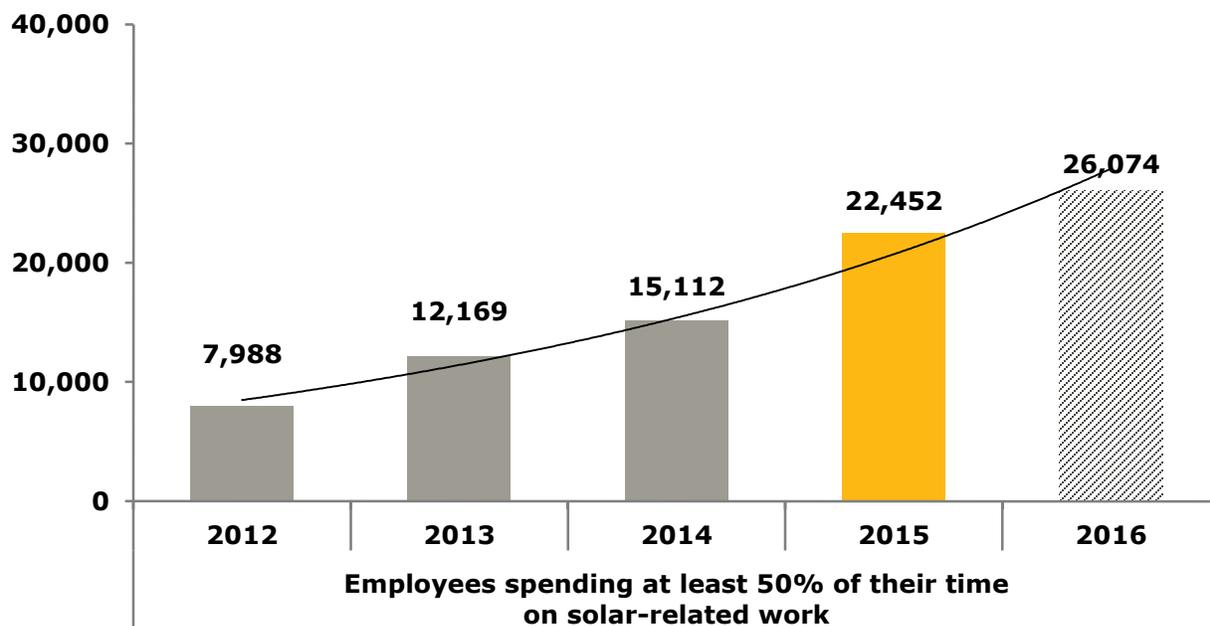
<sup>68</sup> SEIA Solar Market Insight Q3 2015

- Corporations become major source of demand for large-scale solar.**  
 In February, Apple, Inc. announced a twenty-five-year power purchase agreement to offtake production from First Solar's 130 MW California Flats Solar Project in Monterey County. Similar announcements were made throughout the year. In Virginia, Dominion Energy Inc. acquired an 80 MW solar project from developer Community Energy Inc. to sell the electricity to Amazon for one of the company's power-hungry data centers. Google announced that it had invested in 842 MW of renewable energy capacity including a solar plant in Chile. Google intends to support 100% of its operations with renewable energy by 2025.<sup>69</sup>

**The project development sector is the fastest growing solar sector, gaining more than 7,300 jobs to 22,452 solar workers, a growth rate of 48.6% since 2014.**

Project developers expect to grow by 16% over the coming 12 months, adding approximately 3,600 more solar jobs. While this lower 2016 projected employment growth seems to contradict the more aggressive projected 2016 capacity growth, it is likely that much of the Q3 and Q4 2015 employment growth was in anticipation of 2016 capacity growth.

Figure 9: Project Developer Employment Growth from 2012 to 2016 (Projected)<sup>70</sup>



<sup>69</sup> Fortune, *Google's Latest Renewable Energy Investment Is Its Biggest Ever*, Dec. 3, 2015

<sup>70</sup> 2012 was the first year that project developers were counted as a separate category.



## Rozie Amenity

Project Coordinator

Company: Sun Edison

Location: Denver, CO

Years at Occupation: 5 months

While preparing to leave the Army, where she served as a Signal Soldier on high-capacity line-of-sight radios, Rozie went through the 8-week course in Project Management and the U.S. Department of Energy's "Solar Ready Vets Program," a 6-week rigorous program run by Solar Energy International. In addition to lectures, lab work, and hands-on work, the course covers the basics of electricity, how solar works, and provides training on rooftop solar systems. Rozie received a certificate from NABCEP (North American Board Certified Energy Practitioners).

Towards the end of the Solar Ready Vets Program, Rozie recalls, the Department of Energy arranged for six large solar companies to come in for interviews. "I sat in hours of interviews with recruiters from these companies," Rozie said. "I got lucky and got this job!"

Today, Rozie coordinates accounts payable requisitions, invoices, and document management. She also coordinates meetings, payment schedules, and requisitions. Most of her time is spent in an office environment. "I like to get involved with the people who are out there building our projects," Rozie said. "Whenever I get a chance I go out into the field to see the projects that we are working on, and I get involved."

Rozie says that every day is a learning opportunity and that the people make a big difference. "Everyone is very intelligent. Some have been working in solar for a very long time and have a lot to share," she said.

Her advice for jobseekers: "I encourage anyone who is interested to pursue it!" Contact an organization like SEI (Solar Energy International). They work with people who are new to the industry, who have never worked with electricity, and they help them get up to speed to make a smooth transition. "It's truly amazing!" Rozie said.

**Project developers have a relatively large proportion of women and Latinos.** Women represent a quarter of the project development workforce and Latinos comprise nearly 13%. Sixteen percent of project developers are aged 55 and over.

Table 13: 2015 Project Developer Solar Worker Demographic Breakdown<sup>71</sup>

	2015 Solar Employment	% of Solar Project Development Employment	% of Total U.S. Workforce	% of Construction Industry Employment
Women	5,582	24.9%	46.9%	8.9%
African American	1,069	4.8%	11.4%	5.9%
Asian or Pacific Islander	1,577	7.0%	6.1%	1.8%
Latino or Hispanic	2,898	12.9%	16.1%	27.3%
Veterans of the United States Armed Forces	1,877	8.4%	7.0%	n/a
Belong to a union	1,567	7.0%	n/a	n/a
55 and over	3,675	16.4%	22.1%	n/a

<sup>71</sup> Source: 2014 annual estimates from <http://www.bls.gov/cps/cpsaat18.htm>, <http://www.bls.gov/cps/demographics.htm#age>

# Other

Research and development firms, finance and legal firms, nonprofits, government agencies, solar training providers, and academic research centers play a small but important role in the U.S. solar industry. This section includes the key findings from the data gathered from more than 570 such organizations.

## Big News in the Other Sector

- **Early stage business/project funding continues.** With an aim to “significantly reduce the costs for solar energy systems across a variety of technologies”, the U.S. Department of Energy provided nearly \$23 million for 23 such projects across the country.<sup>72</sup> Many of these projects are early-stage businesses working in finance, project engineering, or solar technology development. More advanced firms are attracting private sector investments to do similar soft-cost reduction work. Solar software start-up, Sighthen, received \$3.5 million of venture funding from Obvious Ventures to expand its solar asset management platform.<sup>73</sup>
- **PACE projects have grown by tenfold since 2013 (from \$60m to \$600m in value).**<sup>74</sup> Residential PACE is now five times the size of commercial PACE. The residential market for Property Assessed Clean Energy (PACE) is taking off given greater certainty in mortgage underwriting. Federal agencies such as FHA, which guarantee mortgage loans, have agreed to mortgage industry desires to only approve loans when PACE financing is subordinate to the original loan. However, the agencies have agreed to allow the transfer of the property with the PACE financing intact. Previously, homeowners had to pay off the PACE financing when they sold their property. These clarifications allow lenders to efficiently package and resell the loans as a standard product.<sup>75</sup>
- **It has been a roller coaster year for solar energy stocks as evidenced by the Guggenheim Solar ETF.**<sup>76</sup> The ETF started 2015 at about \$34 per share, rose to \$49 per share in May and then dropped by almost half by the end of September. With the announced extension of the ITC, share prices, by year-end, had risen to just below the 2015 starting price. The May to September decline was attributable to a number of factors including the overall decline in the U.S. stock market, declining oil

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<sup>72</sup> See “Sunshot Technology to Market “Incubator 10, Solarmat 3, Sunpath 2”” from DOE at:

<http://energy.gov/eere/sunshot/sunshot-technology-market-incubator-10-solarmat-3-sunpath-2>

<sup>73</sup> See “End-to-End Solar Software Startup Wins \$3.5M from Obvious Ventures” from Greentech Media at:

<http://www.greentechmedia.com/articles/read/End-to-End-Solar-Software-Startup-Wins-3.5M-From-Obvious-Ventures>

<sup>74</sup> Advanced Energy Economy, *White House Announcement Clears Up PACE*, Sept. 1, 2015

<sup>75</sup> Advanced Energy Economy, *White House Announcement Clears Up PACE*, Sept. 1, 2015

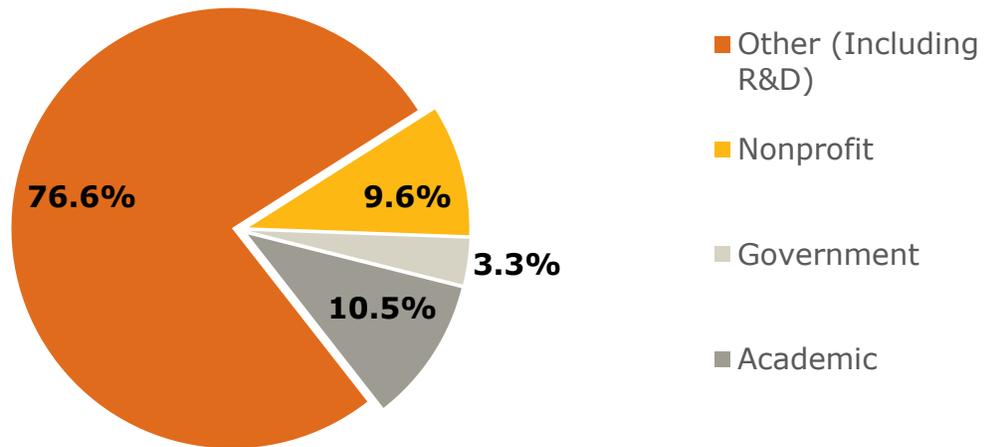
<sup>76</sup> The Guggenheim ETF represents a broad array of solar stocks; it tracks the MAC Global Solar Energy Index.

prices, concerns about the performance of YieldCos, and weakness in the Chinese economy.<sup>77</sup>

- **YieldCo stocks fell over investor concerns about YieldCo growth prospects as oil prices declined.** With cheaper oil, renewable energy is viewed by some as a less attractive alternative. Since peaking in April, the Indxx Global YieldCo Index has lost nearly 40 percent.<sup>78</sup> There are also concerns about the YieldCo business model in which many firms provide dividend growth by issuing stock to support that growth. Once share prices fall, the ability to raise low cost capital does so as well.<sup>79</sup>
- **Major renewable energy investments were announced.** In June, 2015 Bill Gates announced that he planned to double his renewable energy investments to \$2 billion over the next five years focusing on transformative technology, such as solar.

**About 5.7% of the solar workforce, or 11,816 workers, are engaged in other solar activities such as nonprofit advocacy, academic research, government oversight, research and development, finance, architecture, consulting, law and the media.**

Figure 10: Percentage Breakdown of “Other” Employment



<sup>77</sup> MAC Solar Index, *Solar Sector Update*, Oct. 13, 2015

<sup>78</sup> U.S. News and World Report Money, *Yieldcos Offer a Bright Spot for Solar Investors in 2016*, Matt Whittaker, Dec. 14, 2015

<sup>79</sup> GTM Research, *What YieldCo Managers Are Saying About the Market Meltdown*, Tom Konrad, November 27, 2015



## Dayton Brown

Solar Designer

Company: SunCommon

Location: Waterbury, VT

Years at Occupation: 4

Dayton works on the final designs for SunCommon's community solar arrays (CSAs). Determining the electrical specifications, the equipment and wire sizing, and estimating energy production, his work is a combination of office and fieldwork. He helps teams survey sites for new CSAs, and he helps with the final stakes for the design. Staking out a project is important because it allows the property owner to see how the array space will look.

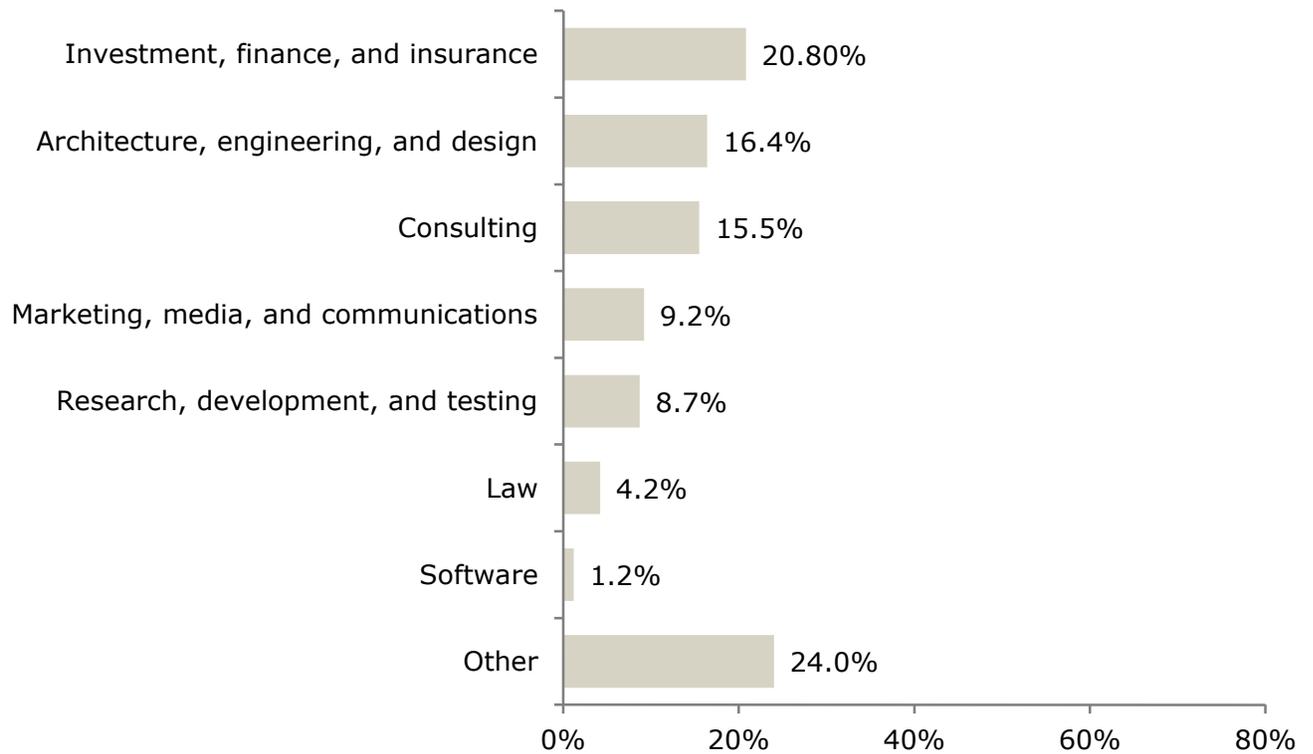
When asked what he likes best about his job, Dayton said, "The people; these are the best people here. It's mission-driven. It's not about money or some of the other reasons why people work. Everyone's motivated to do something different than a typical job. You can make a difference, help people go solar, and help change our future."

Recalling an exceptional time at work, Dayton mentioned a day last winter (2014-15) when he and some team members were outside during a snowstorm, laying out stakes in 3 feet of snow. "It was right in the middle of winter when people aren't really thinking of solar, but so many people are gung-ho about it and are there to support us even in the cold," he said. "That was a memorable time."

Dayton graduated from Vermont Technical College with a dual Bachelor's degree in Architectural Engineering and Sustainable Design. He studied structural, plumbing, electrical systems, and HVAC systems for buildings. In addition, Dayton credits his experience in the Vermont Air National Guard and the training he receives help to ensure his success in solar. He holds OSHA certification and PV entry and will be taking the PV Installers exam in the spring 2016.

His advice to jobseekers is to visit the company and ask them what they are all about. One of the best things that prospective employees can do is to learn about the opportunities and not limit themselves. "Try to figure out your strengths and weaknesses and how you can fit in," Dayton said. "Take courses, and get involved because there are lots of different options."

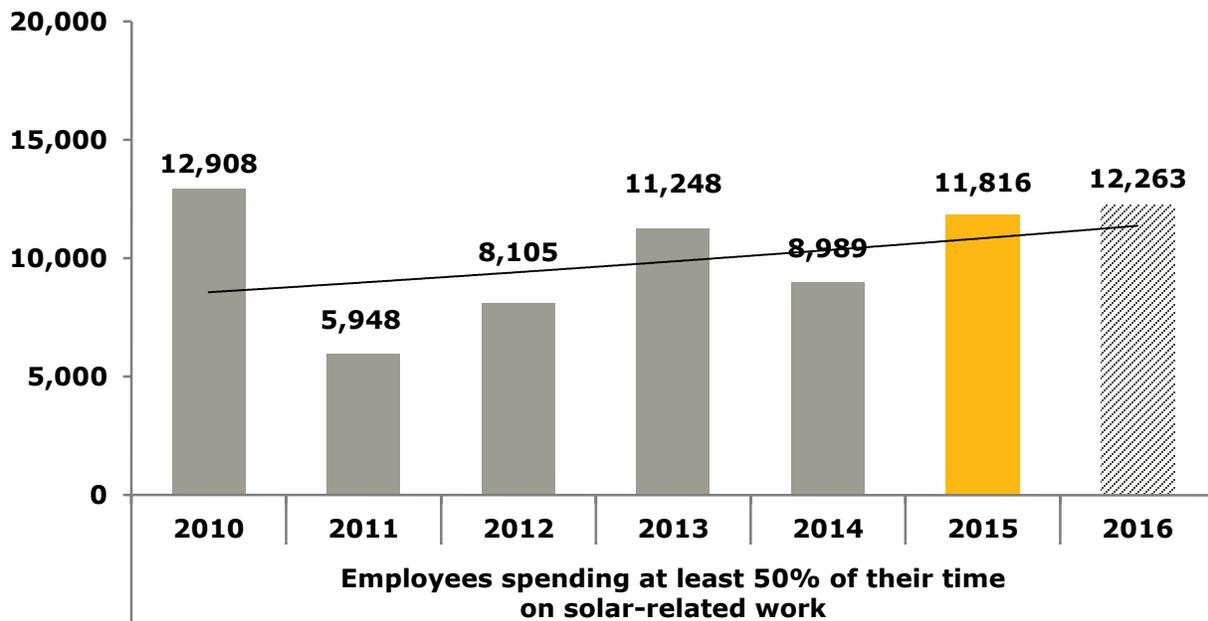
Figure 11. Percentage Breakdown of “Other (Including R&D)” Establishments<sup>80</sup>



**The “Other” sector grew by 32% in 2015, adding just over 2,800 jobs.** This sector is expected to grow 3.8% by November 2016.

<sup>80</sup> These values represent a rough estimate based on responses and NAICS codes.

Figure 12: “Other” Employment Growth, 2010-2016 (Projected)



**This sector has the highest proportion of female employees – where women account for almost 40% of solar workers.** Workers 55 and over account for a quarter of the workforce. Solar workers are less racially and ethnically diverse in this sector than in other solar sectors.

Table 14: 2014 “Other” Demographic Breakdown

	2015 Solar Employment	% of “Other” Solar Employment	% of Total U.S. Workforce
Women	4,595	38.9%	46.9%
African American	368	3.1%	11.4%
Asian or Pacific Islander	1,298	11.0%	6.1%
Latino or Hispanic	381	3.2%	16.1%
Veterans of the United States Armed Forces	490	4.1%	7.0%
Belong to a union	1,199	10.1%	n/a
55 and over	2,957	25.0%	22.1%

# Workforce Development

The solar industry has added tens of thousands of jobs over the past five years in a variety of occupational categories including engineering, sales, production, and, most abundantly, the construction trades. This growth has occurred during a time of slow economic recovery in the United States as other industries have struggled to add jobs. With historically high unemployment rates – particularly in the trades – following the economic recession, solar employers had little difficulty finding qualified applicants with abundant related experience in their fields.

Electricians, which are particularly valuable to solar installation firms, were hard hit. Between 2007 and 2010, almost 19% of electricians (about 136,000) across the United States lost their jobs. The occupation has seen a 3% growth since 2010, creating nearly 75,000 jobs.<sup>81</sup>

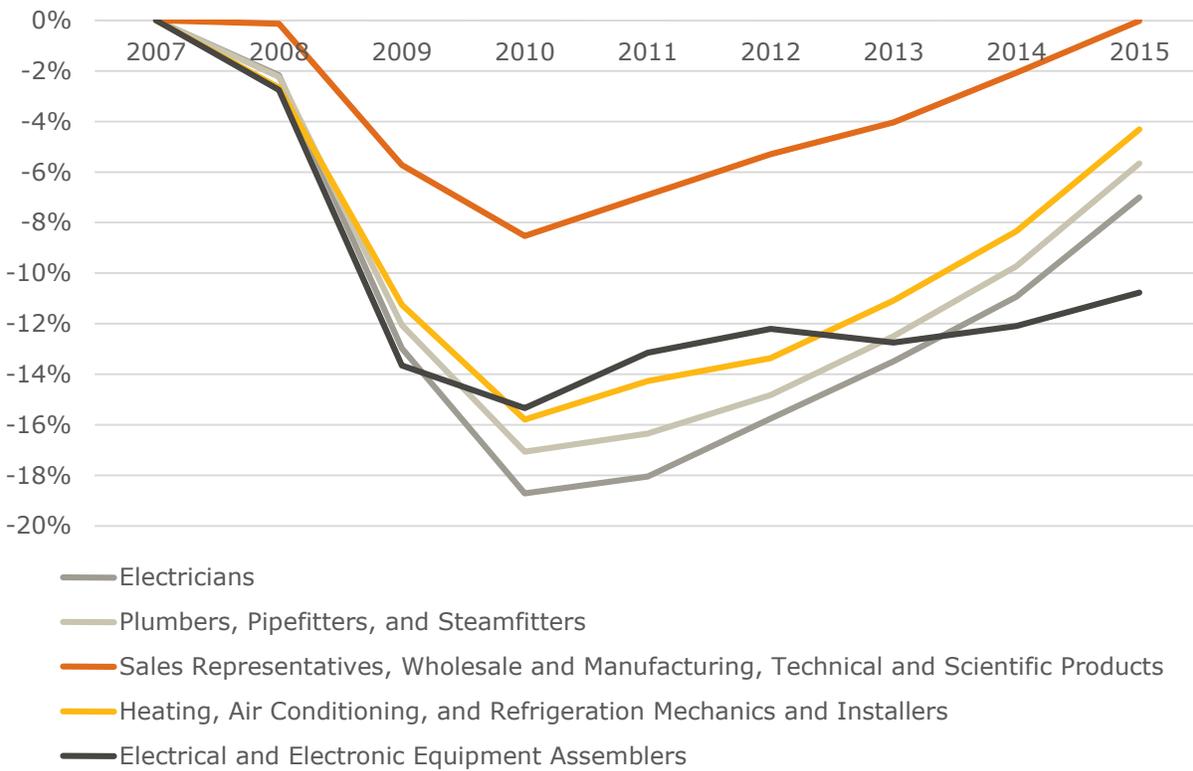
These statistics illustrate the key role that the solar industry has played in providing employment for many of the hardest hit occupations and a road to recovery for thousands who were out of work. At the same time, the surplus of experienced workers made for a very competitive solar labor market for some job seekers. **Inexperienced trainees, for example, have faced very long odds when competing against applicants with licensure, experience, and a solid track record in related industries.**

The tide is turning and much of the slack of the construction-trade and broader solar labor market is being quickly absorbed. **As this trend accelerates, there will be fewer experienced candidates available, and employers will be more likely to turn to education and training (both on-the-job and with outside training providers) to meet their needs for a skilled workforce.** Two key metrics for understanding the supply and demand of the workforce are employers' reported difficulties in finding qualified workers and the wages paid to employees in different industry sectors, both of which are reviewed in detail in this section.

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<sup>81</sup> JobsEQ 2010Q3-2015Q3

Figure 13. Cumulative Change in Occupational Employment, 2007-2015<sup>82</sup>



<sup>82</sup> Source: EMSI 2014 and JobsEQ 2015Q3. JobsEQ 2014Q3-2015Q3 growth rate applied to EMSI 2014 employment totals.



## Tara Kelly

Deputy Director of Community  
Development

Company: Sullivan Solar Power

Location: San Diego, CA

Years at Occupation: 4.5

A passion for sustainability, a good work ethic, and eagerness to learn more helped Tara land her job at Sullivan Solar Power. While at San Diego State University, she chaired the environmental board for the student government. Many of her duties in that role were similar to those she performs today as Deputy Director of Community Development.

Tara's position includes public relations, marketing, community outreach, education, event planning, policy work, customer service and sharing her company's vision: to change the way this world generates electricity. She truly enjoys the variety, which can mean hosting a press conference, participating on a statewide solar policy call, meeting with a customer, and planning an upcoming event – all during the same day.

Another thing she likes about her job is contributing to changing the way her community generates electricity. "I grew up in Santa Cruz, California and was always environmentally conscious," Tara said. "I wanted to work for a company whose values were similar to mine, and I wanted to make a difference."

One memorable day Tara shared was June 30<sup>th</sup>, 2014. That was when the San Diego County Board of Supervisors named "*Sullivan Solar Power Day*" in all of San Diego. The entire board recognized the company's work over the past 10 years. "It was an honor receiving that recognition," Tara said.

If jobseekers are hard workers and are passionate about making a difference, Tara suggests that solar could be a perfect fit. There are so many different fields in the solar industry – engineering, accounting, marketing, IT, installing, etc. "There is a place for anyone interested in joining the solar energy revolution," she said.

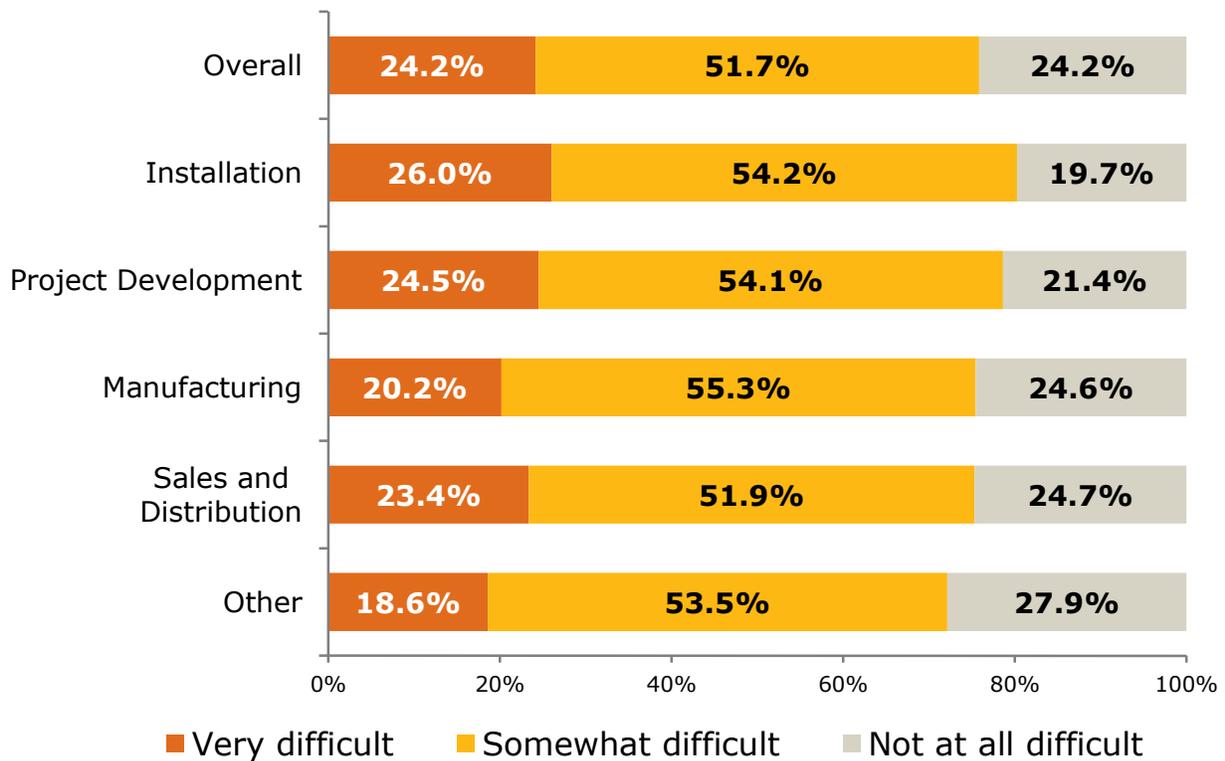
Tara Kelly is a NABCEP Certified Technical Sales Professional™.

## Hiring Difficulty

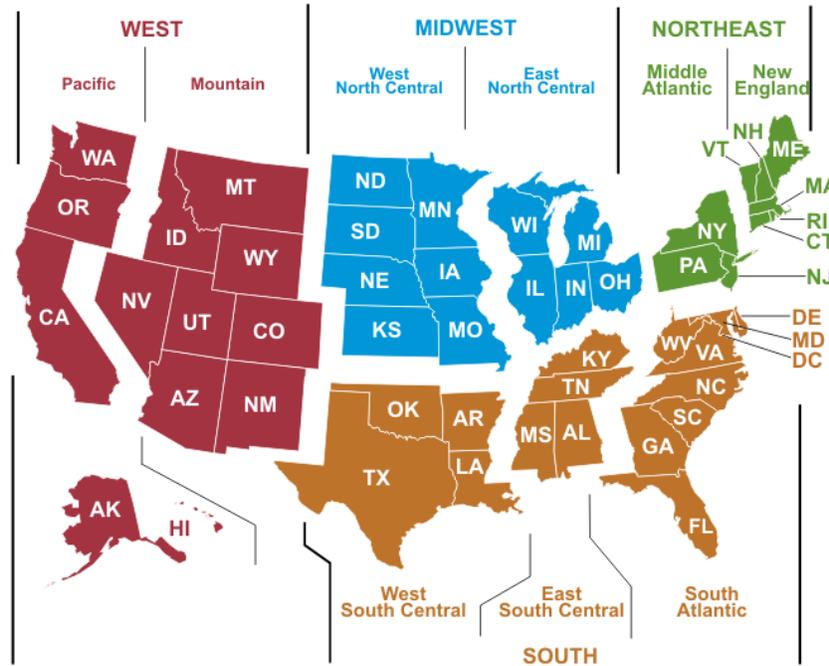
One of the most important metrics for understanding potential gaps and surpluses in the labor market is employers' reported difficulty in hiring. Overall, solar employers report increasing difficulty in finding qualified workers as compared to previous *Census* reports, though it is not yet to a critical level. **Nearly one in four solar employers report that they have no difficulty finding the employees they need, but about one in five report that it is very difficult to find qualified employees.**

Except for manufacturing, all of the "very difficult to hire" percentages increased from 2014. Installation increased from 19.4% to 26.0%, sales and distribution increased from 20.0% to 23.4%, and project development nearly doubled from 12.5% to 24.5%.

Figure 14. Hiring Difficulty over the Last 12 Months



Hiring difficulties are very fairly consistent across regions. Thirty-two percent of Mid-Atlantic establishments reported that hiring was very difficult followed by 28% for the West South Central U.S. In other regions 19% - 26% of respondents reported hiring difficulty.



Source: U.S. Energy Information Administration

Table 15. Hiring Difficulty by Census Division, 2015<sup>83</sup>

	Overall	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mtn	Pacific
Very difficult	<b>24.2%</b>	25.0%	32.0%	26.3%	23.6%	23.1%	19.4%	27.9%	20.2%	23.3%
Somewhat difficult	<b>51.7%</b>	51.9%	57.7%	50.8%	44.4%	52.3%	58.1%	41.0%	51.8%	52.7%
Not at all difficult	<b>24.2%</b>	23.1%	10.3%	22.9%	31.9%	24.6%	22.6%	31.1%	28.0%	24.0%

<sup>83</sup> Percentages displayed with “DK/NA” factored out.

## Wages

**Changes in wages paid offer insight into labor supply and demand as wages rise in response to the scarcity of talent.** The median wage for installers is \$21.00 per hour an increase of 5% over the 2014 median of \$20.00 per hour. Sales representatives and solar designers earn the highest medians of \$28.85 and \$26.92 per hour respectively. Assembly workers are the lowest paid with a median of \$18.00 per hour but the median increased 20% from \$15.00 per hour in 2014. Given that the 2015 decline in manufacturing employment did not coincide with a decline in output, there were likely improvements in automation and efficiency requiring fewer but higher skilled workers.

Overall, median wages from these four solar occupations are higher than the national median hourly wage of \$17.09. From a sector standpoint, utility-scale project development pays the highest wages. The median wage for installers at utility-scale firms is approximately 20% higher than at firms working on commercial or residential scale projects.

Table 16. Median Hourly Wage, 2014-2015

Occupation	Median Hourly Wage (2014)	Median Hourly Wage (2015)
<b>National Median Hourly Wage<sup>84</sup></b>	\$	17.09
Installer	\$ 20.00	\$ 21.00
Sales Representative	\$ 28.85	\$ 28.85
Solar Designer	\$ 26.00	\$ 26.92
Assembly Worker	\$ 15.00	\$ 18.00

**Based on employees hired over the last twelve months, experience is the most important hiring requirement for all sectors with 67% requiring experience compared to 35% requiring a bachelor's degree or higher and 10% requiring an associate's degree but not a B.A.** The degree requirements increased from 2014 when bachelor and associate degrees were only required by 21% and 6% of new hires respectively. Sales also considers education important with 58% requiring a bachelor degree or higher. Installation is least concerned with education.

For manufacturing, over six in ten new hires (65%) filled positions that required previous work experience. This represents an increase from 2014, where 60% of new hires required experience. Thirty-seven percent of newly-filled positions in this sector required a bachelor's degree or more and nine percent required an associate's degree or certification.

<sup>84</sup> Bureau of Labor Statistics, Occupational Employment Statistics, May 2014. Wage data is not yet available for 2015.

For project development, educational requirements declined dramatically from 2014 when 70% required a bachelor's and 13% required an associate's degree or certification. The stark decline can be addressed by the type of employees they reported hiring, with a large majority reported to be non-managerial installation and repair workers (as opposed to professional and management positions, which are more likely to require a college degree).

Table 17. New Hire Experience and Education Requirements<sup>85</sup>

Sector	% with Experience in 2015	% with Experience in 2014	% with Bachelor's Degree or Higher	% Associate's Degree or credential but not B.A.
Overall	67.0%	67.3%	34.9%	9.7%
Manufacturing	65.0%	59.9%	36.8%	8.9%
Installation	62.2%	68.4%	16.3%	6.4%
Sales	65.1%	45.5%	58.4%	20.0%
Project Development	80.4%	85.5%	9.0%	4.0%
Other	79.1%	78.1%	83.1%	10.9%

**The solar industry provides an opportunity for workers in low wage jobs, who pursue some training in solar-specific technologies, to move into sustainable wage careers in as little as 12 months.** For example, in Maryland, The Solar Foundation found that the construction trades provide a good source of feeder occupations (laborers, roofers, electricians, etc.) for installation work. Apprentice and entry level construction trades can advance to higher wage solar installer positions making between \$20 and \$22 per hour.<sup>86</sup> As noted in the *Census 2014*, which documents data derived from Monster Government Solutions and Payscale, a solar panel installer making \$33,200 to start can in five years make \$41,300 as a solar panel installer, \$45,200 as a construction foreman, or \$67,900 as a construction manager.

<sup>85</sup> Taken as a proportion of new hires over the last 12 months.

<sup>86</sup> The Solar Foundation, *Maryland Solar Jobs, Observations and Analysis of Underserved Populations*, Oct., 2015

# Solar Policy

Employment is directly tied to policy. In addition to well-known national incentives such as the federal investment tax credit (ITC), there are many state and local policies that impact growth. Firms are also willing to invest more when they can plan with some degree of certainty. Thus, a more predictable policy environment is favored over one that is less so. The purpose of this section is to discuss key policies and how respondents viewed them.

## Big News in Solar Policy

- **In December 2015, Congress approved a five-year extension to the solar energy investment tax credit which was due to expire in December of 2016.** The bill continues to provide 30% credits for commercial and residential projects started and completed from 2017 to 2019, a 26% credit in 2020, and a 22% credit in 2021. A 10% credit remains effective for commercial projects after 2021. Unlike the ITC expiring in 2016, the extended ITC annual deadlines include properties that are under construction; they don't have to be completed and tied to the grid.
- **Paris Summit on Climate Change Boosts Renewable Energy.** To limit the increase in global temperatures to a 1.5 degrees C (2.7 F), 195 countries agreed to limit greenhouse gas emissions. Although the GHG reduction targets will be set by the individual countries, many such as the U.S., European Union, China, India, and Brazil have set aggressive targets to limit GHG emissions. Article 6 of the agreement promotes carbon markets and encourages governments to form carbon markets across international boundaries. Many regional initiatives are underway and a global carbon market is being planned. China is planning to open a market in 2017 and many U.S. states are considering carbon markets to comply with the Clean Power Plan.<sup>87</sup>
- **In August 2015, the U.S. Environmental Protection Agency (EPA) finalized national limits on carbon pollution from existing power plants.** The Clean Power Plan requires the power sector to cut carbon pollution by 32% from 2005 levels by 2030. The rule sets carbon pollution emission performance rates for coal and gas-fired power plants, although states can customize their own plans to meet their specific goals. The compliance period begins in 2022; increasing gradually until the 2030 final goal. While considered by many to be a landmark rule, it is very controversial. In fact, 24 states have filed lawsuits against the EPA. If the rule survives the legal challenges, it will provide a very strong incentive for renewable energy growth, including solar.

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<sup>87</sup> Forbes, *Why 2016 Will Be Solar's Year Again*, Jan. 1, 2016

- **Most states continue to support net-metering though many are exploring fees and improved rate design.** In December 2015, the California Public Utilities Commission (CPUC) recommended keeping the basic features of net metering after 2017 and Mississippi allowed for net metering for the first time. Now 46 states have net metering.<sup>88</sup> As net metering rate caps expire, utilities are proposing fees and other changes in their favor. In Q3 2015, utilities proposed 26 increases in residential fixed customer charges in 18 states.<sup>89</sup> Even California's proposed extension would require an interconnection fee and a small per kilowatt-hour consumption fee. As a bell weather solar state, California often sets a precedence for other states.<sup>90</sup>
- **Nevada eliminates retail rate net-metering; Major installers leave the state.** The Nevada PUC voted to decrease excess solar generation reimbursement for both existing and future households to the wholesale rate. The reduction was to phase in over a four-year period starting January 1, 2016 although at the time of this report publication the date was being reconsidered. The state will also increase the fixed service charges.<sup>91</sup> In a January 6, 2016 press release, SolarCity reported that as a result of the regulatory change they will eliminate 550 Nevada jobs.

**Policies and incentives remain important.** Among policies and incentives, the 2015 Census found that 78% of solar firms noted that the federal ITC considerably or somewhat increased business prospects followed by 57% for state-level renewable portfolio standards (RPS) and energy efficiency resource standards (EERS); and 56% of businesses that expect the EPA Clean Power Plan to considerably or somewhat increase business prospects.

Three-fourths of respondents were aware of the ITC and of these, 58% noted that the ITC considerably increased business prospects. Almost half (49.4%) of the manufacturing sector expressed these sentiments with more than half of respondents in the remaining sectors (including 61.3% of installers) reporting that the ITC considerably increased business prospects.

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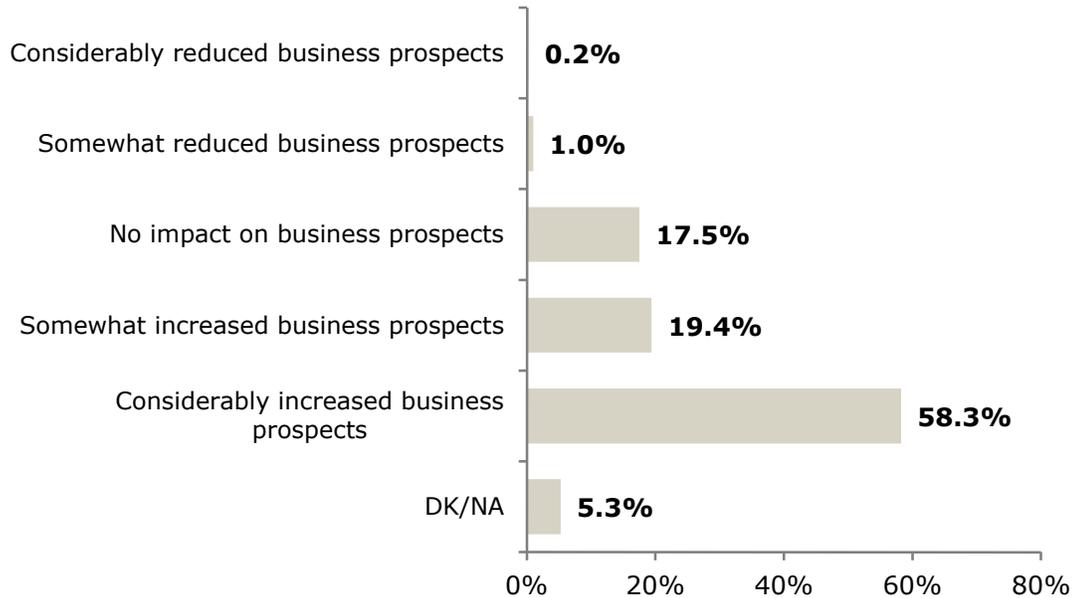
<sup>88</sup> CleanTechnica, *Modified Net Metering to Take Place in Mississippi*, December 12, 2015

<sup>89</sup> *The 50 States of Solar*, Q3 2015 NC Clean Energy Technology Center and Meister Consultants Group

<sup>90</sup> PV Magazine, *BREAKING: California regulators propose to keep solar net metering, with modifications*, Dec. 15, 2015

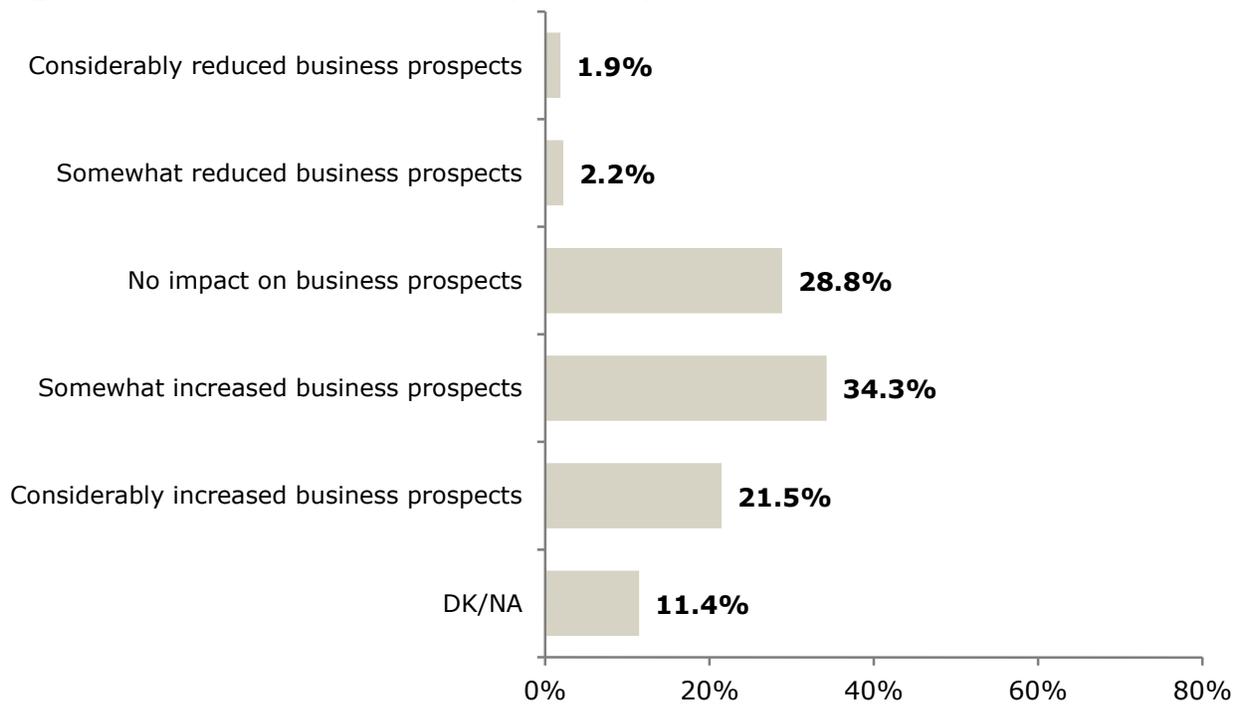
<sup>91</sup> GTM Research, *Nevada Regulators Eliminate Retail Rate Net Metering for New and Existing Solar Customers*, Dec. 23, 2015

Figure 15. Investment Tax Credit Impact on Business



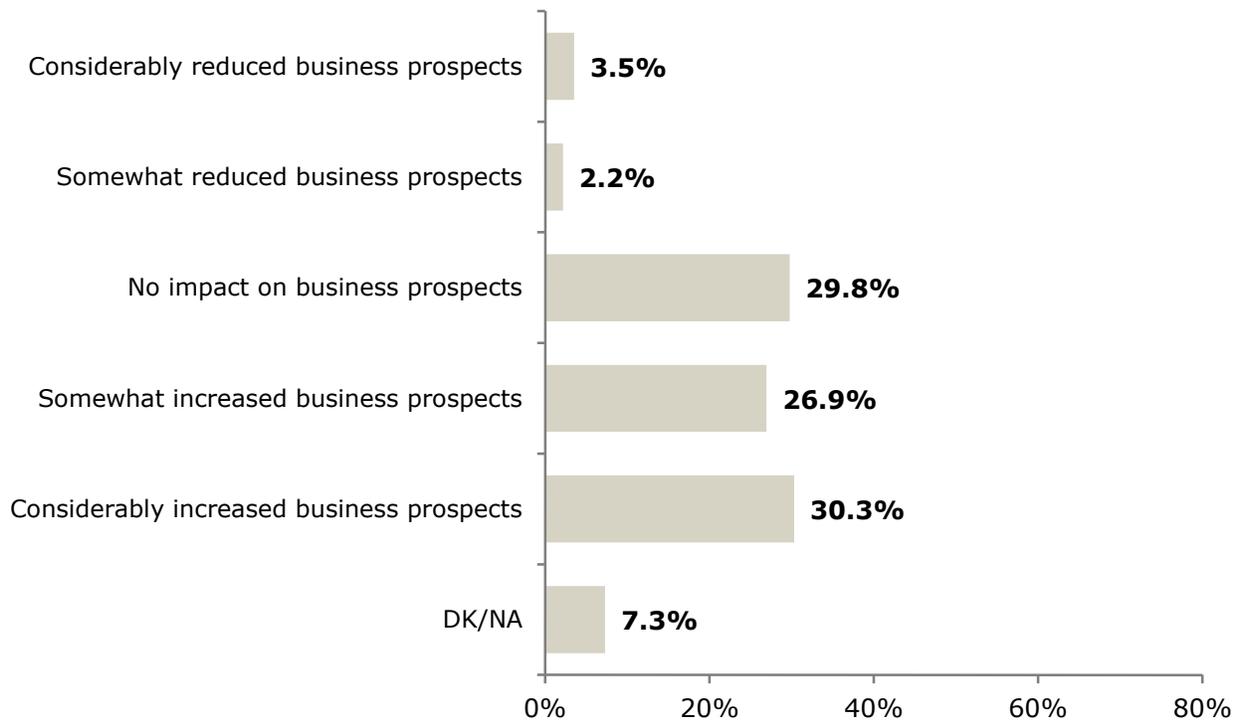
Over half of solar firm respondents were aware of the Clean Power Plan and 21.5% of those respondents reported that the plan considerably increased business prospects. The project development sector viewed the plan the most favorable with 28.1% saying that it considerably increased business prospects.

Figure 16. EPA's Clean Power Plan *Expected* Impact on Business



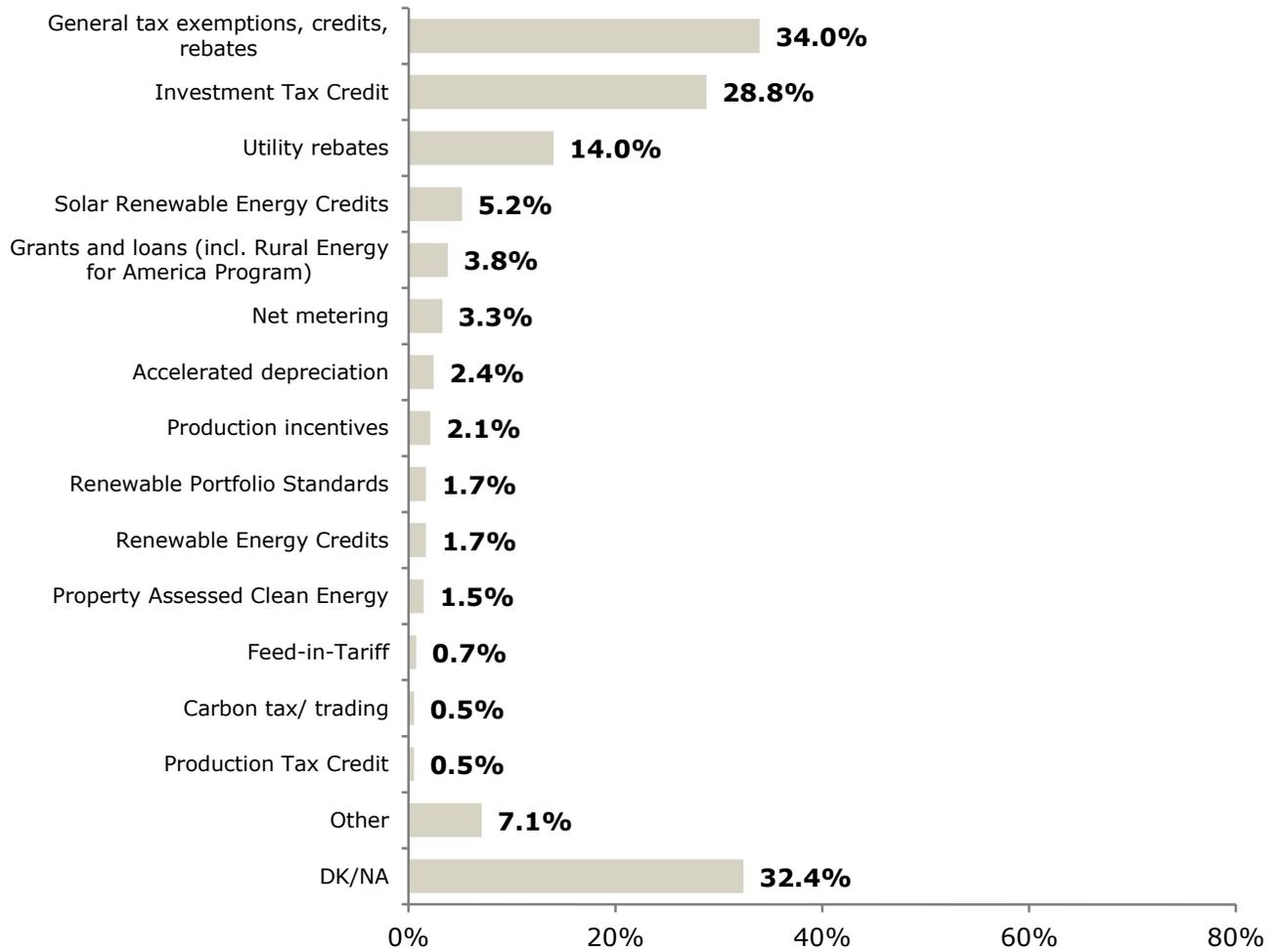
Just over 30% said that RPS and EERS policies considerably increased business prospects. For project development, 40% reported that RPS and EERS considerably increased business prospects with 25 – 30 % of the remaining three sectors reporting similar such sentiments.

Figure 17. Renewable Portfolio Standard or Energy Efficiency Resource Standard Impact on Business



For rebates and incentives that reduce customer costs, 34% of respondents reported that general tax exemptions, credits, and rebates reduced such costs. Another 28.8% reported the ITC reduced costs and 14% identified utility rebates as decreasing costs. Among the sectors, only 10.5% of manufacturing reported cost reductions from utility rebates.

Figure 18. Rebates or Incentives that Reduce Customer Costs



# Conclusions & Recommendations

The U.S. solar industry continues on its well-documented positive growth trajectory, posting 20% employment growth from October 2014 to November 2015, and 123% job growth since September 2010. Except for manufacturing, firms across the entire value chain of solar goods and services experienced employment gains in 2015. All sectors have experienced significant gains since 2010 most notably a 173% growth in the installation sector.

The industry ramped up employment toward the end of 2015 in anticipation of a doubling of new installations due to market conditions including the anticipated 2016 ITC expiration. Although a majority of this growth is expected to derive from the less labor intensive, utility-scale project development sector, respondents still expect a 15% growth in 2016 employment, well above the projected 1.1% national employment growth rate.

Trends and policies have aligned to generate a major opportunity for stronger growth. They include the:

- Declining cost of solar power;
- Extension of the federal Investment Tax Credit (ITC) until 2021;
- Clean Power Plan caused reductions in power plant fossil fuels;
- State renewable portfolio standards;
- Other state and local incentives, and;
- Global momentum from the Paris Summit (COP 21) on Climate Change.

Yet there remain barriers that could disrupt or slow growth:

- Continued decline in fossil fuel prices, especially natural gas;
- Legal challenges that derail the Clean Power Plan;
- Changes in state net metering laws that discourage distributive power generation, and;
- Worker skill shortages.

Taken together, the opportunities outweigh the barriers. While states may overturn the Clean Power Plan, there is still considerable momentum at the local, state, and national levels to develop renewable energy. The dramatic 2015 drop in oil and gas prices appears to have little or no effect on solar power development. A continued decline in natural gas prices would, given policy goals, likely accelerate the use of natural gas over coal rather than solar power. Furthermore, solar costs are also expected to continue to decline. Utility-scale solar is already at cost parity with fossil fuels in some markets. Changes to net

metering pose a significant risk. As more and more households develop solar rooftop power, utilities will push for more fees and cuts to retail pricing.

Prior to the Great Recession, labor skill shortages were prevalent throughout the trades. Although the slow recovery has mitigated a return to skill shortages, solar firms are reporting growing difficulty in hiring. Except for manufacturing, all of the “very difficult to hire” percentages increased from 2014. Installation increased from 19.4% to 26.0%, sales and distribution increased from 20.0% to 23.4%, and project development nearly doubled from 12.5% to 24.5%.

These increases were typically accompanied by increased wages. For example, the median wage of installers increased 5% and the median wage of assembly workers increased 20% per hour from 2014 to 2015. An increase in demand for qualified workers relative to supply compels employers to offer higher wages in order to attract talent. Moreover, as demand for construction employment increases, electricians, roofers, and workers in other trades related to solar will find work in their respective industries, decreasing the solar labor pool and driving up wages for solar workers. While welcome news for solar workers, rising wages could also drive up labor installation costs, which constitute the single largest category of solar soft costs.

In hiring, the solar industry emphasized previous related experience; two-thirds of new hires in 2015 had experience. The industry placed less emphasis on education but much more so compared to 2014. In 2014 only 21% of new workers held a bachelor’s degree or higher and less than 6% held an associate’s degree or credential. In 2015, 35% had a bachelor’s degree or higher and 10% had an associate’s degree but not a B.A. Much of the increase in educational requirements can be attributed to greater demand in the utility-scale project development sector which generally hires more skilled, higher wage workers. Such demand is expected to not only grow in 2016 but also, with the ITC extension, beyond 2016.

One obvious way to limit the impact of rising wages is by increasing the supply of qualified workers through education, training, and apprenticeship. Given the stark differences among employers in their reporting regarding the use of on-the-job training, third-party training, and credentials, it is becoming clearer that the solar industry is one that is searching for a consistent framework for training and evaluating talent. This may become a problem quickly as the growth of the industry accelerates.

Based on these conclusions, we make the following recommendations for ensuring continued strong solar job growth:

**Promote stability in state and federal policy.** The U.S. solar industry continues to demonstrate its strength across most of the value chain. There is a very strong link between solar adoption and job creation although this link may change as labor efficiencies improve. As has been the case with every domestic energy industry in our nation’s history, the solar industry continues to benefit from policies and incentives that accelerate growth and help bring the industry to scale, particularly those policies with the multiyear certainty needed to leverage project financing.

The 2015 *Census* found that many firms reported benefits from a favorable policy landscape. They reported the most benefits from the federal ITC; state-level renewable portfolio standards (RPS) and energy efficiency resource standards (EERS); other tax exemptions, credits, and rebates; and anticipated benefits from the Clean Power Plan. Given the reported importance of such policies to the deployment of solar technology, the incentives will continue to have a strong, positive impact on job creation and competitiveness.

Although a question on the difficulty of obtaining financing was not part of the 2015 *Census*, the 2014 *Census* reported that 19% to 27% of sectors experienced significant difficulty in obtaining financing. These difficulties are likely a reflection of the limited financing options available to solar companies forcing them to accept higher cost financing. The solar industry is also subject to investor disinterest in the energy industry given declining oil and gas prices. For installation and project development firms, an increased ability to leverage promising financing arrangements such as Master Limited Partnerships, Solar Real Estate Investment Trusts, YieldCos, and securitization of solar assets may help alleviate this problem.

While access to capital is important for solar companies, it is also key for consumers. Increasing the number and availability of solar financing options for home and business owners will help further drive solar adoption leading to increased solar employment. Though the solar industry has continually proven its ability to develop and offer innovative financing solutions, there remain many market gaps.

Lower-income households face a number of inherent barriers to going solar. These barriers include being less likely to own their roof, having limited access to affordable financing, being more likely to live in buildings with deferred maintenance, and being unable to realize the financial benefits of fuel-free electricity because their utility bills are partially or fully subsidized. Finding ways to serve the low-income markets is essential for the solar industry to continue to expand.

Many households in the U.S. are aging, and less likely to remain in their homes for the number of years that may be required for full-payback of their systems. Programs that allow loans to follow the home rather than the owner (such as property assessed clean energy, or PACE) could unlock this untapped potential.

**Continue to develop bridge programs for veterans.** Veterans of the U.S. Armed Forces continue to represent a larger proportion of the solar workforce as compared to the overall economy. This strong representation may be driven in part by a high degree of skill transferability between military occupations and solar jobs, which has been supported by interviews with select solar employers conducted for the 2014 report *Veterans in Solar: Securing America's Energy Future*, co-authored by The Solar Foundation and the Truman National Security Project. Despite this potential skills overlap, some groups of veterans – especially those in the 18 to 24 age group – continue to grapple with high unemployment. A deeper understanding of the skills developed in military occupations – especially non-technical workplace skills that are in high demand in the solar industry – can help these

former service members transition into jobs in the solar industry. Workforce training providers are aware of this opportunity but need greater support to further develop the solar industry as a strong employer of military veterans.

In addition, workforce training providers and solar employers should become more familiar with the Post-9/11 GI Bill and the education and training opportunities it provides. Online portals such as the “Veteran’s Employment Center” (<https://www.ebenefits.va.gov/ebenefits/jobs>), provided by the Department of Veterans Affairs and the Department of Defense, as well as “America’s Job Centers” run by the Department of Labor (<http://www.servicelocator.org/onestopcenters.asp>), can help employers identify and connect with veterans seeking employment. Finally, The Solar Foundation encourages industry to participate in the White House’s Joining Forces initiative and/or the Department of Energy Solar Ready Vets Program and publically commit to hiring increasing numbers of veterans.

**Support worker evaluation efforts and the development of comprehensive assessment tools.** As the supply and demand balance for qualified workers continues to shift, the industry will have a growing need for workers able to meet their technical, educational, and soft skill requirements. As documented in this report, solar employers most frequently focus on a candidate’s experience when determining whether they would make a good fit. An overreliance on experience can cause companies to overlook otherwise qualified – though inexperienced – candidates, and may cause them to face even greater difficulty in recruiting talent in the face of contracting pools of experienced workers. The development of a comprehensive set of assessment tools that evaluate all aspects of a candidate’s suitability for employment (not just technical skills) can be of great value in overcoming or avoiding these issues.

**Support early stage R&D, finance, and commercialization.** Due in part to continued declines in the price of traditional solar goods, investment in early-stage finance and research and development is down. Technical innovation is critical for the long-term competitiveness of the industry, yet both public and private dollars to support it are significantly lower. Given the low returns on R&D investments expected in the private sector, the gap in research funding from private sources will likely persist, suggesting an increased need for public sector support of early stage research and commercialization on new and more efficient solar technologies and applications.

Support The Solar Foundation and other groups that publish publically accessible primary research on practices, impacts, and benefits of solar power, one of the important energy resources for our future.

# Methodology

The *National Solar Jobs Census* methodology is the most closely aligned with the Bureau of Labor Statistics' methodology for its Quarterly Census of Employment and Wages (QCEW) and Current Employment Statistics (CES). Like BLS, this study uses survey questionnaires and employer-reported data, though ours are administered by phone and web, as opposed to mail.

Also like BLS, we develop a hierarchy of various categories that represent solar value chain activities (within their broader NAICS framework), develop representative sample frames, and use statistical analysis and extrapolation in a very similar manner to BLS. We also constrain our universe of establishments by relying on the most recent data from the BLS or the state departments of labor, depending on which is collected most recently. We believe that the categories that we have developed could be readily adopted by BLS should it choose to begin to quantify solar employment in its QCEW and CES series.

The results from the *Census* are based on rigorous survey efforts that include 287,962 telephone calls and over 44,220 emails to known and potential energy establishments across the United States, resulting in a total of 2,350 full completions for solar establishments in the U.S. Unlike economic impact models that generate employment estimates based on economic data or jobs-per-megawatt (or jobs-per-dollar) assumptions, the *National Solar Jobs Census* series provides statistically valid and current data gathered from actual employers.

The survey was administered to a *known* universe of energy employers that includes 68,494 establishments and is derived from The Solar Foundation's *National Solar Database* as well as other public and private sources. Of these establishments, 2,118 identified as solar and completed full or substantially completed surveys.

The survey was also administered to a stratified, clustered, random sampling from various industries that are potentially energy-related (*unknown universe*) that include a total of approximately 314,000 establishments nationwide. After an extensive cleaning and de-duplication process, a sampling plan was developed that gathered information on the level of solar activity (including none) from 12,765 establishments. Of these, 327 establishments qualified as solar establishments and completed full surveys. The sampling rigor in the known and unknown universes provides a margin of error for establishment counts at +/- 0.85% and employment at +/- 1.99% at a 95% confidence interval.

The following three-phased methodology describes the survey process used to gather employer information from both self-identified and known solar employers, those establishments that are connected to solar industry associations and can be found on solar employer databases, and unknown solar employers that are found in industry classifications that are more likely to have solar employers. This methodology describes the process that was followed for all of the solar employer surveys except for those completed by utilities in earlier editions of the *Census*.

**Phase 1:** Develop, classify and analyze a database of self-identified or known solar employers. ☒

The first phase created a comprehensive database of all known or self-identified solar employers across the country. This database was developed by SEIA and its partners. The comprehensive database was developed from all of the partners' contact information of employers. Duplicates were identified and removed following a stringent evaluation of firm phone numbers, locations, and firm names.

The database of employers did not include variables that consistently identified which sector (manufacturing, installation, sales and distribution, project development, and other) each employer was involved in, the size of the employer, or whether the employer had a single location or represented multiple locations.

**Phase 2:** Survey of self-identified or known solar employers.

The second phase of the survey research was a census, using online and telephone surveys of all solar employers from the database developed in phase one. Employers were asked which sector they were involved in (installation, manufacturing, wholesale trade, research & development and other) and based on their response they were forwarded to the appropriate survey instrument. All employers in the database with email information were sent multiple online invitations and for those that did not complete an online survey, they were called up to three times. The employers without email information were called up to six times and asked to participate in the survey by completing a brief phone survey. These results represent the solar employer community that is connected to regional and national solar trade associations.

It is important to note that surveys were completed for each employment location and not necessarily for each firm. So if a solar employer was asked to participate in a survey, s/he would be asked about the employment profile of a given location and not of the entire firm.

**Phase 3:** A random sampling of employers in industry classifications that are most likely to have unknown energy employers.

The final phase of the survey research was a sampling of employers in specific industries within wholesale trade, manufacturing, professional services, and the construction (installation) industries. The survey was completed over the phone and the sample was stratified by industry, region, and firm size (4 or fewer employees, 5 to 49 employees, or 50 or more employees). These results represent the solar employers that make up the wholesale trade, manufacturing, and construction industry employers within the industry classifications noted below.

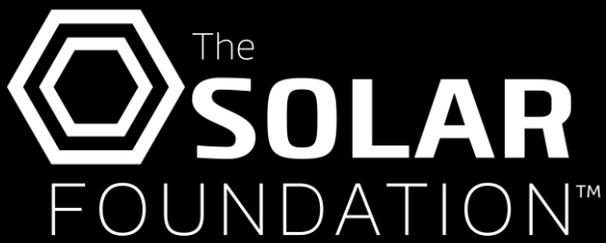
It is important to note that known employment was allocated based on NAICS code of responding establishments and removed from the unknown QCEW totals prior to generating employment estimates in the unknown. As a result, the potential for double counting establishments or employment is nonexistent.

Finally, the indirect and induced job figures were gathered using averaged figures from Bureau of Economic Analysis RIMS II input output model. The industries selected for installation were electrical contractors and power and communication line construction; for manufacturers, semiconductor equipment manufacturing and other electronic and electrical assembly; for sales and distribution, wholesale trade of electronic appliances and wholesale trade of heating and hot water apparatus; and for project development, heavy civil construction and engineering and power and communication line construction.

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For questions about this report or to explore options for an in-depth solar jobs study for your state/region, please contact Andrea Luecke at The Solar Foundation, [aluecke@solarfound.org](mailto:aluecke@solarfound.org).



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