Acknowledgements:

The Solar Foundation™ wishes to thank all of the employers that participated in the survey. Your responses were critical in providing us with accurate and timely information. The Solar Foundation™ would also like to acknowledge Cornell University’s School of Industrial Labor Relations for providing advanced technical assistance and methodological review, the Solar Energy Industries Association® (SEIA) for use of their expansive National Solar Database and the in-kind research support, and GTM Research and SEIA for providing free copies of the SEIA/GTM Solar Market Insight Report: 2011 Year-in-Review to many of the employers that participated in the survey. Finally, The Solar Foundation™ would like to thank the following institutions for their financial assistance in bringing this project to fruition:

Interstate Renewable Energy Council, Inc.
First Solar, Inc.
SolarCity, Inc.
Sungevity, Inc.
Sierra Club, Inc.
BlueGreen Alliance Foundation
The Stella Group, Ltd.
Sunnovations, Inc.
Helios USA, Inc.
Optony, Inc.
CohnReznick Group LLP
The ShugarMagic Foundation

For questions or comments about this report, please contact either:

Andrea Luecke, Executive Director
The Solar Foundation™
505 9th Street, NW - Suite 800
Washington, DC  20004
202-469-3750
info@solarfound.org
TheSolarFoundation.org

or

Philip Jordan, Principal and Vice-President
BW Research Partnership
50 Mill Pond Dr.
Wrentham, MA 02093
508-384-2471
pjordan@bwresearch.com
bwresearch.com
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Cover Photo Courtesy of DOE/NREL
1. Executive Summary

The National Solar Jobs Census 2012 is the third annual update of current employment and projected growth in the United States solar industry. Census 2012 includes new data from a statistically valid sampling of over 1,000 employers throughout the nation. The rapid pace of change in this industry has warranted annual updates that examine the size and scope of the solar labor force and employers’ perspectives on job growth and opportunities.

The Solar Foundation™, an independent 501(c)(3) nonprofit, non-lobbying organization focused on solar research and education, recognized these informational gaps and collaborated with BW Research Partnership, Cornell University, and others to construct an accurate picture of domestic solar employment and bring this issue to the forefront of renewable energy policy and workforce development discourse. The outcome of this partnership, the National Solar Jobs Census report series, represents an unprecedented effort in understanding the solar industry’s labor market conditions and potential for growth.

Since The Solar Foundation™ first started tracking solar jobs, it has found that—despite persistent policy uncertainty—the industry has experienced steady job growth. Our research shows that solar industry employment has grown 27% since we first started tracking solar jobs in 2010. Leading this growth are businesses in the installation subsector, in which solar employment has grown by nearly one-third over the three-year period covered by the Census series, and the sales and distribution subsector, which employs 36% more workers today than it did in 2010. With leading market analyses predicting continued growth in annual installed solar capacity, we are confident that the national solar workforce will continue to follow a similar growth trajectory.
U.S. solar companies continue their trend of hiring faster than the overall economy, and remain optimistic about future growth. In fact, as of September 2012, the solar industry has grown to 119,016 solar workers—defined as those workers who spend at least 50% of their time supporting solar-related activities. This is up over 13% from the 2011 revised figures. Over the next 12 months, nearly 45% of solar firms expect to add jobs, while fewer than 4% expect to cut workers, yielding a 17% growth in employment. This finding is especially relevant given that the overall employment in the entire U.S. economy is projected to grow by only 1.5% over the next 12 months.¹

By comparing the job growth expectations from our multi-year research effort and from existing secondary sources, we can draw several important conclusions.

As of September 2012:

• There are 119,016 solar workers in the United States, up from a revised 105,145 in 2011. This represents an overall growth rate of 13.2% since August 2011, which is nearly six times higher than the national average employment growth rate of 2.3% over the same period. This comparison indicates that since the release of Census 2011, one in 230 new jobs were created in the solar industry.

• Eighty-six percent of the nearly 14,000 new solar workers added since August 2011 represent new jobs, rather than existing positions that have added solar responsibilities.

• Installers added the most solar workers over the past year, more than offsetting declines in manufacturing. While this subsector is dominated by small firms, employment is growing most dramatically at larger firms, suggesting consolidation and maturation of the installation subsector.

• Solar employment is expected to grow by 17.2% over the next 12 months, representing the addition of approximately 20,000 new solar workers. Forty-four percent of all solar firms expect to add solar employees during this period.

• Employers from all of the solar industry subsectors examined in this study expect significant employment growth over the next 12 months, with nearly all of them projecting percentage job growth in the double-digits.

¹ EMSI Complete Employment 2012.3
• Nearly half of installation firms expect to add solar workers in the next year, adding a total of nearly 12,000 jobs (a 21% growth rate year-over-year).

• Approximately 90% of those who meet our definition of a “solar worker” (those workers who spend at least 50% of their time supporting solar-related activities) actually spent 100% of their time working on solar.

• Over half of all firms (across all subsectors) generate 100% of their revenues exclusively from solar.

• Employers are increasingly less likely to span multiple subsectors, suggesting that firms are beginning to specialize.

These findings continue to illustrate that the solar industry is a strong and growing cluster that is responsible for thousands of jobs across every state in the nation. The unprecedented growth observed in this industry is providing much needed job creation, despite an historic economic downturn and slowly recovering labor demand. The optimism of solar employers in the midst of these conditions suggests that job growth will continue for years to come.

This report includes accurate, up-to-date information on the solar industry, quantifying employment growth and trends since Census 2011. The research findings documented herein also provide stakeholders with fresh information on the potential for further growth and the factors that are likely to impact the industry over the coming year. As in years past, this report includes information about all types of companies engaged in the production, sale, installation, and use of all solar technologies - ranging from photovoltaics (PV) to concentrating solar power (CSP) to solar water heating systems for the residential, commercial, and utility market segments.
About The Solar Foundation™

The Solar Foundation™ is a national 501(c)(3) nonprofit working to demonstrate the global benefits of solar energy through research and education. Founded in 1977 and based in Washington, DC, The Solar Foundation™ strives to increase the widespread adoption of solar energy and transform the marketplace through its objective and highly credible research efforts and active participation in a number of diverse educational and outreach initiatives.

The Solar Foundation™ is committed to excellence and its aim is to be on the front lines - catalyzing solar markets and helping people recognize the value of solar as a clean, renewable energy source that promotes greater use of domestic energy resources. The Solar Foundation™ believes that solar energy is a key part of our energy future and is unique even among other renewable energies as a source of wealth creation for individuals, communities, homeowners, and entrepreneurs in all 50 states and across the world.

Since undertaking its inaugural National Solar Jobs Census, The Solar Foundation™ has diversified the lenses through which it studies the solar labor market and expanded its role in supporting solar workforce development. The Solar Foundation’s growing team of solar subject matter experts has worked with the Interstate Renewable Energy Council (IREC) to support the U.S. Department of Energy’s Solar Instructor Training Network, and is on the Accreditation Committee for the new IREC-ANSI standard that evaluates and accredits certificate-awarding training programs in renewable energy and energy efficiency. The Solar Foundation™ is also currently working with the BlueGreen Alliance Foundation to assess job skills, training, and opportunities tied to the development of utility-scale solar farms. Finally, a partnership with SolarTech and the North American Board of Certified Energy Practitioners during the first half of 2012 culminated in the publication of a report that both examines the future state of solar workforce development funding and proposes three funding mechanisms that could help the industry overcome anticipated funding shortfalls.

About BW Research Partnership

BW Research is widely regarded as the national leader in labor market analysis 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, a series of comprehensive clean energy workforce studies for the Commonwealth of Massachusetts, and numerous skills and gap analyses for community colleges, workforce investment boards, state agencies, and nonprofit organizations.

BW Research Partnership, Inc. was created out of a belief that the highest quality research products and consulting services to corporations, government agencies, educational institutions, and non-profit agencies are a result of: 1) a research process that is focused on providing the
most reliable results using the most effective methodologies; 2) creating a partnership of professionals, not employees, who have a vested interest in the quality of our products and services; and 3) a commitment to research that builds communities, supports workers and consumers, and provides a clear direction for decision makers.

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 decisionmaking.
2. Introduction

The U.S. solar industry continues to be a bright spot in the economic recovery. The industry has experienced rapid growth over the last half-decade, with domestic photovoltaic (PV) installed capacity increasing at a 77% compound annual growth rate between 2006 and 2011. The major drivers behind this growth—precipitous declines in component prices and installed system costs, the accelerated propagation of pro-solar state policies nationwide, positive federal consumer incentives, increased consumer awareness, and a burgeoning cultural shift that increasingly favors renewable and clean energy technologies—continue to push cumulative installed capacity to unprecedented levels with no signs of slowing. SEIA and GTM Research estimate that 3,200 MW of new PV capacity will be added in the U.S. by the end of 2012. This figure represents 71% growth in annual installed capacity over 2011.

Figure 1: Annual U.S. Solar Capacity Additions

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The results of this year’s Census confirm that one of the major factors contributing to this growth is the continued decline in the price of solar products. Over the last three years, component prices have dropped dramatically, with a 44% decline in 2011 alone (Figure 2). This decline in PV module prices is mirrored by a similar decrease in total average installed system costs, estimated to have declined by one-third over the same period. These dramatic price declines have impacted the solar industry in different ways across the value chain, but have clearly led to more installed solar capacity and more competitive power pricing.

Figure 2: Photovoltaic Module Prices, 2009-2011

The United States is expected to top 300 gigawatts (GW) of PV and nearly 30 GW of concentrating solar power (CSP) by 2030. Such staggering growth will have a dramatic impact on total solar employment. Taking labor efficiencies into account (as fewer workers are required to perform the same tasks as an industry matures and becomes more automated), the solar workforce under this “SunShot Scenario” is expected to nearly triple in size, employing over 340,000 workers by 2030.

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4 Id.
5 Id.
As tantalizing as such long-run hypotheticals may be, the focus of this report is on current trends and short-term growth, which has not been without setbacks. The same price declines that have helped to fuel a solar installation boom have led to steep declines in employment among solar manufacturers. Generally speaking, employers throughout the value chain reported several major obstacles to growth, including general economic conditions, lack of consumer incentives, and low consumer awareness, among others (Figure 3). While these results are not wildly different from those documented in Census 2011, employers report slightly less concern with general economic conditions – and place much more emphasis on consumer incentives and awareness – than in years past.

**Figure 3: Barriers to Growth**

![Bar chart showing barriers to growth](image)

Year-over-year changes to employer sentiment were more evident when respondents were asked to identify the positive factors related to their growth between August 2011- September 2012 (Figure 4). As seen below, the aforementioned drop in component prices was the most important factor fueling a firm’s growth, followed by the development of state renewable portfolio standards, federal tax incentives, and increased consumer awareness. Though broad economic and market conditions are largely out of the hands of a single individual, and only a select few individuals are able to dedicate copious amounts of time to lobbying state and federal governments for solar-friendly policies and incentives, any motivated and informed solar advocate can have a direct impact on raising consumer awareness.
This report includes accurate, up-to-date information on the various subsectors comprising the solar industry and quantifies employment growth and trends since Census 2011. The research findings also provide stakeholders with fresh information on the potential for further growth and the factors that are likely to impact the industry over the coming year. As in years past, this report includes information about all types of companies engaged in the production, sale, installation, and use of all solar technologies, ranging from PV to CSP to solar water heating systems across the residential, commercial, and utility market segments.

Unlike economic impact models that generate employment estimates based on economic data (such as company revenue) 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 primary data contained in this report are drawn from a mixed-method survey administered directly to employers. Information was collected in September 2012 in two stages: (1) through a survey of so-called “known universe” firms, which were primarily drawn from SEIA's National Solar Database, and; (2) via a random sampling of businesses within various construction, sales and distribution, and manufacturing industries.

This mixed approach allows us to accurately update previous years’ efforts and draw broad conclusions about the solar industry with a high degree of confidence. Although our margin of error is +/- 1.5%, the figures included in this report are conservative estimates, meaning that there may well be more solar workers than reported herein. It is also important to mention that there are limits to the survey approach. Because the research findings are based on survey
responses, the employment growth figures cited in the following sections represent employers’ best estimates of how many jobs they will add over the coming year. As seen in the 2010 and 2011 Census reports, actual growth may vary. Also, as often occurs with labor market studies, information gathered for Census 2012 allowed us to better estimate employment in the last year, leading us to revise our 2011 estimates and increase overall 2011 solar workforce figures by nearly 5,000 jobs.

It is of further importance to note that the figures provided in this report are estimates based on surveys administered only to employers in manufacturing, sales and distribution, project development, and installation, as well as those who perform “other” related activities. The data do not capture all jobs in the government, academic, workforce development, or nonprofit sectors, nor do they include many of the research and development firms, finance and accounting establishments, law offices, or other ancillary employers that do solar work. Although some companies from this latter group of firms are included in SEIA’s National Solar Database, accounting, legal, finance, and other ancillary firms spend only a very small portion of their time on solar activities. Thus, full inclusion would lead to inflated employment counts. As a result, those companies that are included are reported as part of the “other” category.

The National Solar Jobs Census 2012 was conducted by The Solar Foundation™ and BW Research Partnership. Cornell University provided technical assistance in reviewing and validating the entire process, from data collection through results analysis.
3. Labor Market Analysis: Overview of the Industry

Overall, the primary data—or information gathered by our survey of solar employers—indicate that there are currently nearly 15,000 solar establishments\(^7\) employing 119,016 solar workers in the United States. These figures represent an overall reduction in the number of establishments (by more than 2,000 firms), but an employment growth rate of 13.2% over the past year.

The Census 2012 effort includes significant new information, leading to required revisions of the 2011 employment estimates. While the overall employment estimate is revised upward by 4.8% to 105,145, individual subsector changes are more dramatic. Employment in manufacturing was significantly higher than previously estimated, and installation and sales and distribution employed fewer workers than reported in 2011. Please see Section 5.2 for an explanation of the revised calculations.

A decline in establishments, coupled with increased employment, suggests consolidation and maturation of the industry. Solar employment is growing nearly six times faster than the national average employment growth rate of 2.3%,\(^8\) and many sectors across the various conventional energy generation industries either grew more slowly or experienced employment declines.\(^9\) For example, over the last year, the fossil fuel electric generation sector lost nearly 4,000 workers (representing a 3.77% decline in employment), and jobs in coal mining fell by 850 (a 0.83% decline).\(^10\) Solar employment, on the other hand, is likely to continue its impressive growth, with the number of solar workers in the U.S. increasing by more than 17% in the next 12 months, representing the addition of approximately 20,000 new solar workers (Figure 5).

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\(^7\) The establishment figures provided in this Census refer to employment locations. Many companies report having several employment locations, all of which are captured in this report.


\(^9\) EMSI Complete Employment 2012.3

\(^10\) Id.
As further evidence of solar employer optimism, 44.2% of surveyed firms expect to add solar employees over the next 12 months, while only 3.6% expect to cut solar workers over the period. These findings show an industry that is clearly growing at a significantly faster pace than the economy as a whole, which is expected to experience employment growth of only 1.5% from 2012 to 2013.

Employers were asked several preliminary questions to ensure that the sample included only firms that work in solar. The survey respondents were asked to select the appropriate subsector to which their firm belongs, choosing from installation, manufacturing, sales and distribution, project development, or - for those that did not fit neatly into a category - “other,” such as research and development firms and other firms that provide ancillary support to the solar industry (e.g., financial or legal services). Many firms reported that their work spanned

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11 This compares with 2011, when 45.3% of employers expected to add solar workers and 2.6% expected declines.

12 EMSI Complete Employment 2012.3
several subsectors; however, the number of such responses appears to be decreasing over time, suggesting that firms are beginning to specialize.

Figure 6: Percentage of Respondents, by Subsector

- Installer: 48.0% (8,813 Establishments)
- Manufacturing / Assembling: 25.0% (1,262 Establishments)
- Sales / Trade: 13.4% (3,050 Establishments)
- Developer / Utility (Known Only): 6.7% (414 Establishments)
- Other (Including R&D): 6.8% (1,454 Establishments)

Photo Courtesy of DOE/NREL
### Table 1: Data by Subsector—Number of Solar Workers

<table>
<thead>
<tr>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation</td>
<td>48,656</td>
<td>57,177</td>
<td>17.5%</td>
<td>68,931</td>
<td>21%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>37,941</td>
<td>29,742</td>
<td>(21.6%)</td>
<td>32,313</td>
<td>9%</td>
</tr>
<tr>
<td>Sales and Distribution</td>
<td>13,000</td>
<td>16,005</td>
<td>23.1%</td>
<td>19,549</td>
<td>22%</td>
</tr>
<tr>
<td>Project Development</td>
<td>--</td>
<td>7,988</td>
<td>--</td>
<td>9,098</td>
<td>14%</td>
</tr>
<tr>
<td>Other</td>
<td>5,548</td>
<td>8,105</td>
<td>46.1%</td>
<td>9,551</td>
<td>18%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>105,145</strong></td>
<td><strong>119,016</strong></td>
<td><strong>13.2%</strong></td>
<td><strong>139,442</strong></td>
<td><strong>17%</strong></td>
</tr>
</tbody>
</table>

In previous years, some questioned whether defining solar workers as those that spend at least 50% of their time on solar activities was a reasonable metric for calculating industry jobs. Some further suggested that the metric was potentially inflating employment figures. In order to understand this better, Census 2012 included additional questions to address these concerns. The additional research suggests that approximately 90% of solar workers, or approximately 105,000 out of 119,000 total workers, spend 100% of their time on solar activities. This finding suggests that the solar worker definition is a reasonable proxy for full time equivalency. Further discussion on this topic can be found in Section 5.3.

Overall, the solar industry is still heavily focused on PV, though solar water heating is making noteworthy gains as well. Figure 7 illustrates the breakdown of firms across the value chain by technology. Due to many firms working with more than one technology, the sum is greater than 100%.
Figure 7: Solar Establishments by Technology Area

- **Photovoltaic**
  - 13,079 Establishments (87.2%)
- **Water heating, which includes pool heating**
  - 5,385 Establishments (35.9%)
- **Concentrating solar power**
  - 1,560 Establishments (10.4%)
- **Other**
  - 1,725 Establishments (11.5%)
- **DK/NA**
  - 300 Establishments (2.0%)

Photo Courtesy of SunEdison
Solar firms were also asked to report the portion of their revenues that are attributed to solar related activities. Over half of all firms surveyed receive 100% and over three-quarters receive at least 50% of their revenues from solar goods and services (Figure 8).

**Figure 8: Solar Revenues**

![Bar chart showing the distribution of solar revenues as a percentage of total revenues.](image)

In order to understand the supply and demand of potential new jobs in this growing industry better, employers were asked several questions about the new workers they hired over the past year. First, they were asked whether increases in reported employment were driven by new hires or by repurposing existing employees. Survey results show that nearly 90% of the increase in solar employment can be attributed to new hires, as seen in Figure 9.

**Figure 9: New Positions at Solar Firms**

![Pie chart showing the distribution of new positions created and existing employees given added solar responsibilities.](image)
Next, employers were asked questions about the backgrounds and profiles of their new solar workers. Employers reported that their new solar workers are generally not entry-level. The majority require at least some work experience related to the position, and a surprisingly large number require a college degree or certificate (Figure 10).

**Figure 10: New Hire Profile**

- Required previous work experience related to the position: 50.6%
- Required a bachelor’s degree or beyond: 40.7%
- Required an associate’s degree or certificate from an accredited college, but not a bachelor’s degree: 17.6%
- Required membership in a union: 2.0%

Photo Courtesy of BrightSource
The new solar positions for 2012 are well distributed across a range of skill-sets. The largest category of new solar workers includes technical or production-related positions, followed by management, administrative, and sales jobs (Figure 11).

**Figure 11: New Positions by Occupational Category**

As has been seen in the previous Census studies and other clean energy reports, solar firms do not rely heavily on traditional methods of recruitment. Instead, solar firms strongly prefer word of mouth and referrals to fill vacant positions. Other leading means of recruitment reported by respondents were online job postings and seeking out talent through educational institutions (Figure 12).

**Figure 12: Employer Preferences: Recruitment**

Employers report having some trouble finding qualified applicants to fill their positions, with about one-in-three reporting no difficulty at all and about 10% reporting great difficulty (Figure 13).

Figure 13: Difficulty Hiring

![Figure 13: Difficulty Hiring](image)

Photo Courtesy of BrightSource
Lack of technical experience is most often to blame for these difficulties, followed by deficiencies in communication, problem solving and analytical skills, and education (Figure 14). These results are not surprising given reports of a continued lack of professionals with sufficient training in various regions across the U.S., particularly in the face of reduced public funding for workforce development.\textsuperscript{14}

**Figure 14: Applicants’ Deficiencies**

- Not enough applicants with required technical experience: 20.6%
- Applicants had deficiencies with communications, problem solving, or analytical abilities: 14.9%
- Not enough applicants with required education: 14.2%
- Lack of networking or other opportunities to meet prospective applicants: 13.0%
- Competition from other companies: 11.2%
- Applicants demonstrated poor work ethic: 11.2%
- Too many resumes: 11.2%
- Other: 3.7%


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Photo Courtesy of SolarCity
3.1 Installation

The 2012 research effort collected responses from hundreds of installation firms to update the employment figures for the current year. Based on the responses, Census 2012 finds that there are 8,818 establishments deriving at least some of their revenue from installation services and related goods, though the bulk of these - over 6,500 - are quite small, employing only 2 or 3 solar workers.

Installation companies in the U.S. employ 57,177 solar workers, making the installation subsector the largest single segment of the solar industry. Installers added the most new solar workers over the past year, more than offsetting declines in manufacturing (see Section 3.2). While the installation subsector is dominated by small firms, employment is growing most dramatically at known, larger firms, suggesting consolidation and maturation of the subsector.

Solar installation firms expect to add 11,754 solar workers over the next 12 months, representing a 21% employment growth rate, with 44% of employers expecting to add solar workers over this period (Figure 15).

Figure 15: 12-Month Hiring Expectations—Installation Firms
Figure 16: 2010, 2011, 2012 and 2013 Expected Solar Workers—Installation

A majority of installation firms reported that they receive all or most of their revenue from solar projects, as opposed to solar only accounting for a portion of total revenue. This phenomenon marks a first for the Census (as fewer than 50% of firms participating in previous Census studies indicated they obtained all of their revenue from solar) and provides further evidence of consolidation in the installation sector (Figure 17). As of September 2012, 51% of installation firms receive 100% of their revenues from solar installations, up significantly from 39% the previous year. Eight in 10 receive a majority of their revenues from solar, up from fewer than six in 10 in 2011.
As shown in Figure 18 below, many establishments install more than one type of system. Ninety-one percent of firms install PV systems while just under half install solar hot water systems.
Because of the number of establishments working with multiple technologies, it is still not possible to provide reliable estimates of the numbers of employees working with each specific solar technology. Also, establishment percentages provided in Figure 18 include overlap (i.e., establishments working with multiple technologies are counted in each technology group), so the sum of the percentages will exceed 100%.

U.S. installation companies are also working on systems of varying sizes. As would be expected, the majority of installation firms are working on smaller systems—mainly residential systems and commercial installations up to 50 kilowatts (Figure 19). As all categories show increases over 2011 figures, the only significant change from last year is that more firms are working across a broader range of system sizes.

**Figure 19: Percentage of Establishments Working on Systems, by Size—Installation**

The research findings illustrate a potential trend toward specialization. Firms are either hiring in-house specialists or contracting out portions of their solar work—including administrative responsibilities, on-site installation work, and other duties related to the installation process—rather than relying on cross-functional employees to conduct these multiple and varied tasks. As a result, there appears to be greater efficiency in the installation process, with more highly-refined and specific occupational areas and fewer workers who are expected to conduct multiple installation activities (such as assessment, customer service, and roof-top installation). This is verified by findings showing that, while the average solar system size increased over the last 12 months, the average amount of labor hours for a system installation did not.
3.2 Manufacturing

Solar manufacturing has had a challenging year. Solar product price declines (see Figure 2), while great news for consumers and other entities that purchase or install these systems, have reduced margins for manufacturers and sales and distribution firms, resulting in several high-profile bankruptcies. Census 2012 demonstrates that solar manufacturing experienced employment declines since 2011. However, manufacturers are optimistic for 2013 and there are examples of successful manufacturing firms that have grown since 2011.

This Census finds 1,262 solar manufacturing establishments in the United States, employing 29,742 solar workers.\textsuperscript{15} Forty-one percent of firms produce finished products only, 31% solely manufacture components, and 27% of these establishments produce both finished products and components (Figure 20).

Figure 20: Solar Manufacturing—Percentage of Establishments Type of Goods

The establishments that were surveyed manufacture a variety of products at domestic facilities, and the majority of them manufacture PV systems or supply components for PV manufacturers (Figure 21). This 75% figure is up significantly from 2011, when only 59% reported the same. Although speculative, there are two potential reasons for the increase in PV manufacturing (as opposed to CSP or solar water heating). The first is that PV has grown more quickly than the other technologies from a deployment standpoint. Second, U.S. manufacturers

\textsuperscript{15} Establishments identified as manufacturers in Census 2011 declined by 21%.
provide many supplies and subcomponents to foreign PV manufacturing firms, so global growth in PV manufacturing benefits these manufacturers.

**Figure 21: Percentage of Establishments by Product—Manufacturing**

<table>
<thead>
<tr>
<th>Product Description</th>
<th>Percentage</th>
<th>Establishments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photovoltaic</td>
<td>74.7%</td>
<td>943</td>
</tr>
<tr>
<td>Water heating, which includes pool heating</td>
<td>19.9%</td>
<td>251</td>
</tr>
<tr>
<td>Concentrating solar power</td>
<td>14.5%</td>
<td>183</td>
</tr>
<tr>
<td>Other</td>
<td>11.4%</td>
<td>144</td>
</tr>
<tr>
<td>DK/NA</td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

Firms that manufacture system components make a variety of items, with these production activities covering a number of different technologies. Although it can be assumed that some manufacturers did better than others, we are not able to break out the data in such a way that allows us to identify which manufacturers were particularly susceptible to competition and falling prices, and which manufacturers remained strong or even grew. Complete breakdowns of the percentage of manufacturers that produce specific components for PV, CSP, and solar water heating technologies are provided in Figures 22-24.
Figure 22: Percentage of Establishments by Component—PV

<table>
<thead>
<tr>
<th>Component</th>
<th>Yes</th>
<th>No</th>
<th>DK/NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inverters</td>
<td>29.6%</td>
<td>68.5%</td>
<td></td>
</tr>
<tr>
<td>Racking</td>
<td>28.7%</td>
<td>69.4%</td>
<td></td>
</tr>
<tr>
<td>Modules</td>
<td>28.7%</td>
<td>68.5%</td>
<td></td>
</tr>
<tr>
<td>Laminates</td>
<td>14.8%</td>
<td>83.3%</td>
<td></td>
</tr>
<tr>
<td>Cells</td>
<td>13.9%</td>
<td>85.2%</td>
<td></td>
</tr>
<tr>
<td>Glass</td>
<td>11.1%</td>
<td>88.0%</td>
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</tr>
<tr>
<td>Material feedstocks</td>
<td>9%</td>
<td>86.1%</td>
<td></td>
</tr>
<tr>
<td>Wafers</td>
<td></td>
<td>91.7%</td>
<td></td>
</tr>
<tr>
<td>Ingots</td>
<td></td>
<td>91.7%</td>
<td></td>
</tr>
</tbody>
</table>

Figure 23: Percentage of Establishments by Component—Concentrating Solar Power (CSP)

<table>
<thead>
<tr>
<th>Component</th>
<th>Yes</th>
<th>No</th>
<th>DK/NA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frames or racking</td>
<td>54.5%</td>
<td>27.3%</td>
<td>18.2%</td>
</tr>
<tr>
<td>Trackers</td>
<td>36.4%</td>
<td>27.3%</td>
<td>36.4%</td>
</tr>
<tr>
<td>Reflectors, mirrors, or glass</td>
<td>36.4%</td>
<td>36.4%</td>
<td>27.3%</td>
</tr>
<tr>
<td>Piping</td>
<td>27.3%</td>
<td>45.5%</td>
<td>27.3%</td>
</tr>
<tr>
<td>Receivers</td>
<td>27%</td>
<td>45.5%</td>
<td>27.3%</td>
</tr>
<tr>
<td>Insulation</td>
<td>18.2%</td>
<td>54.5%</td>
<td>27.3%</td>
</tr>
<tr>
<td>Heat transfer fluids</td>
<td>18.2%</td>
<td>63.6%</td>
<td>18.2%</td>
</tr>
</tbody>
</table>
As has been reported in previous years, it is likely that more establishments produce components for solar products than those reported in Figures 20-22, but those uncounted establishments may not know their final products’ destination. Nearly 60% of the manufacturing firms surveyed produce solar products exclusively (Figure 23). This continues a trend from 2010 and 2011 in which manufacturers are receiving more revenue from solar than in each previous year.\(^\text{16}\) This increased focus on the solar portion of a firm’s manufacturing activities is a positive sign, indicating that company executives and managers continue to view solar as a sound path to increased prosperity. However, there are a number of firms that have chosen to continue to diversify their production activities. While the reasons behind this choice differ across firms, it is possible that some companies are reluctant to specialize in solar manufacturing because of the perceived risk in doing so.

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\(^\text{16}\) In 2010, 40.1% of manufacturers reported that all of their revenue came from solar goods. This number grew to 48.4% in 2011 and 59% in 2012.
Solar manufacturers employ 29,742 solar workers and expect to grow over the coming year (albeit by a much smaller margin than other industry segments). The revised figures for 2011 show a steep decline in manufacturing between 2011 and 2012, after solid growth between 2010 and 2011.
Solar manufacturing companies anticipate adding 2,571 solar workers over the next 12 months, an 8.6% employment growth rate (Figure 26), with nearly half expecting to add solar workers over the coming 12 months (Figure 27). This compares with an expected nationwide 2.7% decline in overall manufacturing employment from 2012-2013.\textsuperscript{17}

\textsuperscript{17} EMSI Complete Employment, 2012.3
Figure 27: 12 Month Hiring Expectations—Manufacturing Firms

- More: 46.2%
- Same number: 39.1%
- Less: 4.7%
- DK/NA: 10.1%

Workers assemble solar modules at Suntech’s module facility in Goodyear, Arizona. The modules produced from Suntech’s U.S. facility are compliant with the Buy American Act provisions of the American Recovery and Reinvestment Act (ARRA). Photo courtesy of Suntech.
3.3 Sales and Distribution

Employers in the solar sales and distribution subsector sell all types of systems, from residential solar pool heaters to commercial-scale PV systems. They also sell components, raw materials, and other critical items to finished product manufacturers, assemblers, and project developers. The firms sell directly to consumers and also to other businesses and can be found in every state in the nation.

The majority of sales and distribution companies provide PV systems and solar water heaters (Figure 28). Compared to 2011, slightly more firms are selling or distributing PV and significantly fewer offer solar water heating products.

Figure 28: Percentage of Establishments by Product Sales—Sales and Distribution

As with other subsectors, sales and distribution firms report receiving a greater proportion of their revenues from solar projects, as compared with previous years (Figure 29). A majority (52%) attribute 100% of their revenues to solar goods, which is up from only 31% in 2011.
Solar sales and distribution continues to grow. However, the revised 2011 figures show that the growth between 2010 and 2011 was significantly slower than originally forecast, adding 1,255 jobs as opposed to 5,977 (as reported in Census 2011). The current research indicates that there are 3,050 solar sales and distribution establishments in the United States employing 16,005 solar workers (Figure 30).
Figure 30: 2010, 2011, 2012 and Expected 2013 Solar Workers—Sales and Distribution
Nearly half of solar sales and distribution firms surveyed expect to add jobs, resulting in the projected addition of 3,500 new jobs by September 2013. Fewer than 4% of these firms expect to cut solar workers (Figure 31).

**Figure 31: 12 Month Hiring Expectations—Sales and Distribution**

![Pie chart showing hiring expectations: More 49.1%, Same number 37.6%, Less 3.6%, DK/NA 9.7%]

Photo Courtesy of DOE/NREL
3.4 Project Developers

This year, the Census includes specific information about project developers, which, in years past, were distributed throughout other categories (most often in installation or other). This company classification encompasses firms that plan, construct, and maintain large utility-scale solar projects.

As would be expected, the overwhelming majority of developers work with PV, though 10% also report working with CSP and 18% in water heating (Figure 32).

**Figure 32: Percentage of Establishments by Technology—Project Development**

- **Photovoltaic**: 393 Establishments (94.8%)
- **Water heating**: 18.2% (75 Establishments)
- **Concentrating solar power**: 10.4% (43 Establishments)
- **Other**: 2.6% (11 Establishments)

Project developers are slightly more “solar focused” than workers in other subsectors, with a full two-thirds of them reporting that all of their revenue is derived from solar projects. Nevertheless, many are still engaged in other types of non-solar projects, as illustrated in Figure 33.
As Census 2012 is the first edition of our report series with specific information on project developers, we can draw no conclusions regarding growth over the previous year. Our inaugural estimate suggests that there are 414 project development establishments employing 7,998 solar workers.
Developers expect strong growth over the coming year, with 61% of these firms expecting to add solar workers, increasing the total for this category by 1,110 jobs in 2013. Just over 6% of these firms anticipate eliminating solar jobs over the next 12 months (Figure 34).

Figure 34: 12 Month Hiring Expectations—Project Developers

Photo Courtesy of DOE/NREL
3.5 Other

As in previous years, a significant number of the solar establishments participating in this study did not identify with any of the specific subsectors already described in this report.¹⁸ These firms, which have been grouped into an “other” category, include those engaged in research and development, finance and accounting, legal work, or other ancillary services that support the solar industry.

Though none of these additional solar subsectors was large enough from an employment perspective to warrant its own category, the firms classified as “other” collectively employ more than 8,100 workers, which is 46% larger than the revised 2011 estimate. While certainly some of this increase is attributable to year-over-year employment growth, some is a function of an improved employer database.¹⁹

The “other” firms have indicated that they anticipate strong growth over the coming 12 months – adding nearly 1,450 new jobs at an employment growth rate of 17.8%. Forty-two percent of survey respondents in this category expect to add solar workers by September 2013 (Figure 35).

Figure 35: 12-Month Growth—Other

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¹⁸ Nor were they specifically targeted.

¹⁹ Because the “other” category is not targeted in the unknown universe, and therefore is generated solely within the known universe, increased representation in the database significantly impacts this segment of the industry.
Establishments in this category reported working predominantly with photovoltaic panels. Year-over-year, fewer firms indicate involvement with solar water heating technologies. In fact, 28.1% of “other” firms were connected with solar water heating in 2012, compared with 43.3% in 2011. As with the other subsectors, our survey found that many firms work with more than one technology (Figure 36).

Figure 36: Percentage of Establishments by Technology—Other

<table>
<thead>
<tr>
<th>Technology</th>
<th>Establishments</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photovoltaic</td>
<td>1,264</td>
<td>86.9%</td>
</tr>
<tr>
<td>Water heating, which includes pool heating</td>
<td>409</td>
<td>28.1%</td>
</tr>
<tr>
<td>Concentrating solar power</td>
<td>295</td>
<td>20.3%</td>
</tr>
<tr>
<td>Other</td>
<td>199</td>
<td>13.7%</td>
</tr>
<tr>
<td>DK/NA</td>
<td>76</td>
<td>5.2%</td>
</tr>
</tbody>
</table>
Though more than 40% of the employers in this category described their firm as being a 100% solar-related business, this category has the highest percentage of establishments (31%) that obtain less than half their revenue from solar work (Figure 37).

Figure 37: Percentage of Revenue Related to Solar Products—Other

- All of it (100%)
- Most but not all (50% to 99%)
- Less than half (1% to 49%)
- DK/NA

Photo Courtesy of SolarCity
4. Conclusions and Recommendations

The U.S. solar industry is a fast-growing and dynamic sector, providing high-quality employment opportunities for nearly 120,000 workers at nearly 15,000 locations in all 50 states. The solar energy workforce grew an impressive 13.2% over the last year—nearly six times the overall national employment growth rate, and has grown 27% since 2010. This compares to only 3.2% national employment growth over that same period (August 2010 - September 2012). Growth in the solar industry is expected to continue, with employers reporting growth estimates of 17% over the next 12 months.

Viewing job growth in the solar industry vis-à-vis employment trends in some of the conventional energy industries highlights just how notable solar’s growth over the past year has been. For example, companies involved in fossil fuel electric generation shed 3.77% of their workforce between 2011 and 2012 (3,857 jobs), while the coal mining labor force contracted by 0.83% (a rate representing the loss of 851 workers). Solar’s growth rate has even surpassed that of some energy industries that experienced job gains over the last year. The bulk power transmission and electric power distribution sectors both added workers (415 and 11,196 jobs, respectively) though at a lower growth rate than solar (compare solar’s 13.2% employment growth rate between 2011 and 2012 with bulk power’s 1.71% rate and electric power distribution’s 5.13% rate).

The major key to solar’s continued success as a job creator is the sharply falling price of solar products. In the second quarter of 2012, the average selling price for crystalline silicon PV modules was 44% less than in the same quarter in the previous year. Between the second quarter of 2011 and and the second quarter of 2012, the average installed cost of solar fell by 33%. Assuming consistent and effective policy support and a continued concerted effort across the public, private, and non-profit sectors to reduce the non-hardware costs of solar, it is not unreasonable to expect that installed costs will eventually fall as low as $1/W – the level at which electricity generated from solar in the U.S. will be cost competitive with wholesale electricity derived from conventional sources. Progress toward this goal will continue to drive growth in both installed solar capacity and new solar employment.

Such price declines, however, impact different industry subsectors in different ways. Some domestic manufacturers have found it difficult to keep up with the dramatically falling cost of solar components, leading some to scale back their operations or exit solar altogether. Although it has not generally been a great year for U.S. solar manufacturers, our analysis does not suggest that all solar manufacturers have experienced employment declines or expect to in the future.

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20 EMSI Complete Employment 2012.3

21 Id.
Although our data does not provide conclusive insights into growth patterns by type of manufacturer, it appears that while cell and module manufacturers may not be faring so well against the global competition, other manufacturers (producing inverters, backsheets, racking, and metal paste) seem to be having more success from an employment perspective. Achieving economies of scale appears to be an ingredient of manufacturing success (something that is currently more difficult in the U.S. than in other countries due to present levels of domestic product demand), but attaining this goal may not be an option for every firm. More research is needed to truly understand which types of manufacturers have the best chance of surviving an era of razor-thin profit margins and global competition.

While solar manufacturers may be suffering now, they remain optimistic that global demand for solar will continue to provide business opportunities for them in the future. If there are positive signs of long-term domestic demand, capital expenditures in U.S. solar manufacturing may be justified. This is why demand-side policies are so critical. They not only make it more affordable for homeowners and business owners to choose a low-carbon energy alternative, but they also encourage manufacturing economies of scale which allow production to run at a higher rate (thereby delivering production cost savings). A lack of economies of scale appear to be why U.S. solar manufacturing has fallen behind, but we do not believe it is too late for these firms to catch up or even become global leaders.

Over the past few decades, the solar industry has grown from a niche market to a mainstream energy source. When polled, nine out of ten voters in the U.S. agreed it is important for the U.S. to develop and use solar power and approximately 70% said the federal government should do more than it currently is doing to promote solar.\textsuperscript{22} Solar has also become big business. In just five years, the industry grew nearly six times in value, with total solar installations in the U.S. estimated to be worth $8.4 billion in 2011.\textsuperscript{23} Worldwide, solar accounted for over $30 billion worth of investment the second quarter of 2012 alone, which represents an increase of nearly 20% over the previous quarter.\textsuperscript{24} With even greater growth projected for the foreseeable future, the industry stands as a notable bright spot on the nation’s economic and employment landscape. By working together to support the continued growth of solar energy, policymakers, workforce training providers, and solar companies have an excellent opportunity to boost the struggling economy and reduce fossil fuel dependence while creating good jobs for skilled workers. To this end, there are a few key actions, supported by our data, that policymakers,

\begin{itemize}
\item \textsuperscript{22} SEIA/Hart Research, “America Votes Solar – National Solar Survey 2012”. Available at \url{www.seia.org/research-resources/americas-votes-solar-national-solar-survey-2012}
\item \textsuperscript{23} SEIA, “Solar Industry Data”. Available at \url{www.seia.org/research-resources/solar-industry-data}
\item \textsuperscript{24} Bloomberg New Energy Finance, “China stars as quarterly clean energy investment numbers rebound 24% over Q1”, 2012. Available at \url{www.newenergyfinance.com/PressReleases/view/234}
\end{itemize}
workforce training providers, and solar employers can take to foster further solar industry employment growth.

**Recommendations for Policymakers:**

*Recommendation #1: Implement strong, transparent, and stable demand-side policies*

The U.S. solar industry continues to demonstrate its strength across most of the value chain. As a result, increases in solar installations led to employment growth across the board—not only in installation but in research and development, sales, and other related occupations. Although this may change as labor efficiencies improve, currently there is a very strong link between solar adoption and job creation. 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. In Census 2012, employers cited federal tax incentives for solar investment as one of the top three drivers of industry and employment growth. Given the importance of such policies to the industry, it is not unreasonable to expect that demand-side incentives will continue to have a strong, positive impact on job creation and competitiveness.

*Recommendation #2: Support solar company economic development needs*

The *National Solar Jobs Census* series continues to demonstrate that employers pay attention to incentives and regulations when planning for the future. Although external factors play a large role in attracting businesses, economic development incentives that encourage local investment (particularly at the state and local level), signal to employers that the area is “open for business.” However, such incentives will have less impact if they are only short-term in nature. Attracting economic growth and new investment requires a long-term commitment to incentives and policies that attract and drive development.

*Recommendation #3: Invest in solar workforce development where it is needed*

While solar energy creates jobs across a wide variety of occupations and technologies, the majority of these jobs are for highly-skilled and highly-trained workers. Although some entry-level jobs exist, solar jobs should not be considered quick “pathways out of poverty,” and expectations in creating job opportunities for lower-skilled workers must be managed. As our data show, just over 50% of solar jobs require workers with previous experience, and at least one in five require some form of post-secondary education. Given this, programs that stand to make the greatest impact on solar workforce development are: 1) those that provide high-skilled workers with new or updated skills or experience; and 2) comprehensive entry-level programs (typically offered through technical high schools, community-based organizations, and
community colleges) that prepare lower-skilled workers to move into more highly-skilled occupations.

Recommendations for Workforce Training Providers

Recommendation #1: Know the market

In order to be effective, workforce training providers must have a solid understanding of the labor force they seek to serve. This includes recognizing the gap between the skills that trainees already possess, and those they need to be marketable to employers. It also requires understanding the available opportunities for advancement and how these pathways should be navigated. Of equal importance to cultivating a quality labor pool is understanding local labor demand. Connecting with local employers, understanding their labor needs, and providing training according to these needs are vital components of a successful workforce training program.

Recommendation #2: Train for highest growth occupations, consider the future, and integrate solar into existing trade and professional programs

In order to serve the needs of the solar industry and aid as many job seekers as possible, training programs should offer skill development opportunities across the full range of occupations. However, training providers should also be knowledgeable about high-growth occupations and prepare trainees for them. New solar positions added in 2012 required a diverse range of skill sets. The largest category of new jobs was composed of production and technical positions, followed by management, administrative, and sales jobs.

Furthermore, designing and implementing a successful workforce training program requires not only understanding which jobs are currently available or which are growing the fastest, but how industry demand for labor is expected to evolve over the near- and mid-term. Increased capital investment in state-of-the-art manufacturing facilities and in new equipment across all sectors frequently results in increased process automation. Savvy training providers will understand this trend toward automation and how it is manifested in the local labor market, and design coursework that is appropriate for the solar workers of tomorrow.

Finally, program designers should look for ways to integrate solar curricula into more traditional or mainstream coursework. By cultivating a workforce with a set of solar skills that enhance a more broadly applicable set of core trade (e.g., roofing or electrical) or professional (e.g., legal or finance) skills, rather than creating solar-only workers, training providers will help ensure that program graduates are diverse enough to be successful, despite fluctuations in demand for some of their skills. For example, a roofer trained in solar can remain gainfully
employed during a lull in the housing market by focusing on solar, while able to transition back to his or her primary skill set when demand picks back up.

**Recommendation #3: Invest in high-quality standards**

Quality solar workforce training, backed by credentials involving defensible, balanced, and transparent assessments according to well-developed sets of criteria, requirements, and standards, is the key to ensuring not only safety and quality in the solar industry, but the industry’s long-term success. Many solar occupations work with high-voltage equipment and do fairly dangerous work. Without high-quality training, the solar industry’s reputation for safety and quality may suffer. By incorporating industry-leading accreditation standards into workforce development efforts, training program providers can be assured that their students will gain the skills and training that they, along with the solar industry at large, require to succeed.

**Recommendations for Employers**

**Recommendation #1: Spend resources on raising consumer awareness**

One of the major barriers to growth documented in Census 2012 is the lack of consumer awareness about solar products and services. In order to help consumers make informed decisions and to offer them better turnkey solutions, employers need to know the market and be able to communicate solar’s value proposition effectively to their clients. It may not be enough to provide a spec sheet or a cost quote. Consumers these days demand easy-to-read graphic representations of how the product is going to improve their lives. Knowing more about what incentives exist and becoming more communications savvy will help solar firms develop services that increase their chances of making a sale, which in turn may allow them to expand their workforce.

**Recommendation #2: Support high-quality training**

A connection exists between growth in installed solar capacity and increased employer demand for labor. Less clear is how the solar workforce of tomorrow will obtain the skills, education, and training it will need, or how it will grow to the scale employers will inevitably require. The workforce training programs that have supported the solar industry thus far have primarily been sustained through public funding. These funds, however, have been largely exhausted, and new monies are unlikely to be forthcoming. Moving forward, it will be very likely up to the private sector to pay for workforce training. A revolving loan fund capitalized through industry contributions provides a possible mechanism for supporting solar workforce development into the future. This funding mechanism is introduced in *Financing the Next Generation of Solar Workers*, produced by The Solar Foundation™ in partnership with SolarTech
and the North American Board of Certified Energy Practitioners. Discussions for how employers can play a role will be forthcoming.

**Recommendation #3: Support advocacy and education organizations**

By virtue of not being associated with any one company, federal, state, and local solar advocacy and education organizations (usually nonprofit) are able to provide policymakers and the general public with more objective information on the benefits of solar energy and the number of jobs the industry creates. Raising awareness of these important attributes will help the industry to be more effective in promoting new incentives and other favorable policies. By providing third-party insight into market trends and serving as an impartial messenger of the industry’s successes, these entities provide significant benefits to all solar companies and the individuals these firms employ—boosting the struggling economy, facilitating a transition to a clean energy future, and creating good jobs for American workers.
5. Appendices

5.1 Data Sources

EMSI Data Sources and Calculations

Industry Data

In order to capture a complete picture of industry employment, EMSI basically combines covered employment data from Quarterly Census of Employment and Wages (QCEW) produced by the Department of Labor with total employment data in Regional Economic Information System (REIS) published by the Bureau of Economic Analysis (BEA), augmented with County Business Patterns (CBP) and Nonemployer Statistics (NES) published by the U.S. Census Bureau. Projections are based on the latest available EMSI industry data, 15-year past local trends in each industry, growth rates in statewide and (where available) sub-state area industry projections published by individual state agencies, and (in part) growth rates in national projections from the Bureau of Labor Statistics.

State Data Sources

This report uses state data from the following agencies: Alabama Department of Industrial Relations; Alaska Department of Labor and Workforce Development; Arizona Department of Commerce, Research Administration; Arkansas Department of Workforce Services; California Labor Market Information Department; Colorado Department of Labor and Employment; Connecticut did not provide us with a data source; Delaware Office of Occupational and Labor Market Information, Delaware Wages 2004; District of Columbia did not provide us with a data source; Florida Agency for Workforce Innovation; Georgia Department of Labor, Workforce Information and Analysis, Occupational Information Services Unit; Hawaii Department of Labor and Industrial Relations, Research and Statistics Office; Idaho Department of Labor; Illinois Department of Employment Security, Employment Projections; Indiana Department of Workforce Development; Iowa Workforce Development; Kansas Department of Labor, Labor Market Information Services, Kansas Wage Survey; Kentucky Office of Employment and Training; Louisiana Department of Labor; Maine did not provide us with a data source; Maryland Department of Labor, Licensing and Regulation, Office of Labor Market Analysis and Information; Massachusetts did not provide us with a data source; Michigan Department of Labor and Economic Growth, Bureau of Labor Market Information and Strategic Initiatives; Minnesota Department of Employment and Economic Development; Mississippi Department of Employment Security; Missouri Department of Economic Development; Montana Department of Labor and Industry, Research and Analysis Bureau; Nebraska Workforce Development; Nevada Department of Employment, Training and Rehabilitation, Information Development and Processing Division, Research and Analysis Bureau; New Hampshire Department of Employment Security; New Jersey Department of Labor and Workforce Development; New Mexico Department of Labor, Bureau of Economic Research and Analysis; New York Department of Labor, Division of Research and Statistics; North Carolina Employment Security Commission, Labor Market Information Division; North Dakota Job Service, Labor Market Information Center; Ohio Department of Job and Family
Services, Labor Market Information Division; Oklahoma Employment Security Commission; Oregon Employment Department, Oregon Labor Market Information System; Pennsylvania Department of Labor and Industry, Center for Workforce Information and Analysis; Rhode Island did not provide us with a data source; South Carolina Employment Security Commission, Labor Market Information Department; South Dakota Department of Labor, Labor Market Information Division; Tennessee Department of Labor and Workforce Development, Research and Statistics Division; Texas Workforce Commission; Utah Department of Workforce Services; Vermont did not provide us with a data source; Virginia Employment Commission, Economic Information Services; Washington State Employment Security Department, Labor Market and Economic Analysis Branch; West Virginia Bureau of Employment Programs, Research Information & Analysis Division; Wisconsin Department of Workforce Development, Bureau of Workforce Information; Wyoming Department of Employment, Research and Planning.

This report uses data release EMSI Complete Employment 2012.3
5.2 Data Limitations and Methodology

The following three-phased methodology describes the survey process used to gather employer information from both self-identified or known solar employers, those firms 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.

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 and 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 subsector (manufacturing, installation, sales and distribution, project development, ...) 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 five 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.

Margin of error: Survey of self-identified or known solar employers.

The overall margin of error for the known universe of the solar employer survey, at the 95 percent level of confidence, is between +/- 1.67 percent and +/- 2.78 percent (depending on the distribution of each question) for questions answered by all 1,004 employers from the universe of 5,146 solar employment locations estimated in the known universe. This also represents a response rate of 20 percent from the database of known solar employers, which includes
employers in manufacturing, installation, wholesale trade, research & development, and other related solar industries.

It is important to note that questions asked of smaller sub-groups of respondents will have a margin of error greater than +/- 2.78 percent, with the exact margin of error dependent on the number of respondents within each sub-group as well as the distribution of responses.

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

The final phase of the survey research was a sampling of employers in specific industries within wholesale trade, manufacturing, 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 less employees or 5 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 the percentage of overlap between the known and unknown universe of solar employers was calculated based on a thorough search of the known firm database to the unknown universe file or firms that indicated they had already completed a similar survey. The resulting calculation of overlapping firms was taken out of the total estimate of firms in the unknown universe of solar employers.

Wholesale trade: Provides the cleanest opportunity to interview firms that were not in the known universe list because there are two NAICS (North American Industry Classification System) codes that are very specific to solar distributors/ wholesalers:

42372031 – Solar energy system supplier, and parts wholesaler;

42372032 - Solar energy equipment wholesaler.

According to InfoUSA, there are 1,752 firms that indicated one of these two wholesale trade designations as their primary industry classification. All firms that identified one of these two NAICS codes as their primary were called and asked whether they were in the solar industry and if they would participate in the survey.

Manufacturing: Industry classifications for manufacturing related to solar were not as specifically identified with solar work. Three NAICS codes were identified with the highest expected concentration of firms that manufacture solar products and components. These NAICS codes were:

333611 – Turbine and turbine generator set unit manufacturing;

334413 – Semiconductor and related device manufacturing;

334414 – Manufacturing of Heating Equipment;
According to InfoUSA, there are 3,473 firms that indicated one of these three manufacturing designations as their primary industry classification. All firms that were identified in one of these three NAICS codes as their primary industry classification were called and asked whether they were in the solar industry and if they would participate in the survey.

Construction: Industry classifications for the construction industry related to solar were not specifically identified with solar work. Five NAICS codes were identified with the highest expected concentration of firms that provide solar installation services. These NAICS codes were:

236118 Residential remodelers;
238160 Roofing contractors;
238210 Electrical contractors;
238220 Plumbing & HVAC contractors;
238990 All other specialty trade contractors.

According to InfoUSA, there are 332,005 firms that indicated one of these five construction designations as their primary industry classification. A total of 10,000 firms stratified by employer size and region within the country were called and asked whether they were in the solar industry and if they would participate in the survey.

Margin of Error: Survey of unknown solar employers in specific industries.

The overall margin of error for the unknown or random universe of solar employer in wholesale trade, manufacturing, and the construction industry, at the 95 percent level of confidence, is between +/- 1.5 percent and +/- 2.3 percent (depending on the distribution of each question) for questions answered by all employers that completed a survey or passed a screener question from the universe of all potential solar employment locations estimated of unknown employers in sales and distribution, manufacturing and construction.

Full survey completions were achieved from a total of 1,067 establishments in the known and unknown. An additional 693 responses from the unknown universe were used to calculate incidence rates. The overall margin of error, in consideration of all full survey completions and partial completions from the random sample is +/- 1.5% at a 95% confidence interval.

Revised 2011 Estimates

The 2012 research suggested a significant change to the calculations of the 2011 employment estimates. As is the case with most labor market studies, estimates are derived by employment totals in a sample that is representative of the universe of firms. In a sector that is emerging, such as the solar industry, this estimate is based significantly on the distribution of firm in the known universe. As a result, overall figures will change little by improvements to the database of known
firms, however, the distribution of those firms can change dramatically when a more accurate database is used. This is because in an emerging industry without sufficient known database detail, researchers must assume that the distribution of responses reflects the distribution of the industry, which may not be accurate.

For Census 2012, BW Research used a newly developed, highly accurate National Solar Database, provided by SEIA. This database was verified through previous contact with SEIA staff, and included many metrics not previously available. This new distribution, coupled with information on churn since 2011, allowed BW Research to provide revised estimates. These revised estimates for 2011 suggest that there were significantly more manufacturers and fewer installers and sales and distribution establishments than previously reported. Because the average manufacturer is larger than the average installer, this change increased the 2011 overall employment estimate by 4.8%. It also reduced the installation and sales and distribution employment estimates and increased the manufacturing employment estimate.
5.3 Frequently Asked Questions

1. Why doesn’t the Census include state jobs data?

   The National Solar Jobs Census 2012 does not include state jobs numbers because there are limits to how well state numbers can be extrapolated from national data. Obtaining sound state numbers would require individual and costly sampling plans for each state in question. This, in turn, would significantly increase the funding and labor demands of conducting the Census. Until the financial support needed to conduct such a comprehensive study materializes, the focus of the Census will remain on producing the best possible national numbers.

   We do, however, recognize the current and growing need for state numbers, and have attempted to provide at least a glimpse of the state picture in this and previous versions of the Census. Our inaugural Census 2010 contained raw data broken down by state, with rough employment estimates provided for the top ten solar states. The 2011 Census included updated state numbers generated by a more detailed process, but these numbers were still subject to significant uncertainties. For this year’s Census 2012, we explore the state picture in a wholly different way, providing figures on solar establishments in each state, broken down by industry subsector, to provide readers with a general idea as to what the corresponding employment picture may look like.

   Pending funding, we plan to conduct a few state jobs studies in early 2013. States, companies, researchers, foundations, and other parties interested in helping to bring highly credible state-level employment reports into fruition should contact The Solar Foundation.

2. How is a “solar job” or “solar worker” defined? Are these direct, indirect or induced jobs?

   The Census currently counts jobs across four industry subsectors (installation, manufacturing, sales & distribution, and project development) and an "other" category that includes some of the jobs in research and development, finance and accounting, legal work, or other ancillary services that support the solar industry. Although the Census is considered the most comprehensive study on solar jobs employment in the U.S., it, unfortunately, does not capture every job. In fact, the Census excludes solar jobs in academic institutions, government or nonprofit entities, workforce development, and many solar jobs at research and accounting firms and legal offices.

   A "solar worker" is defined as a worker who spends at least 50% of his or her time supporting solar-related activities. This definition reflects the difficulties in counting “full-time equivalencies” or FTEs, but uses 50% as a reasonable proxy for employment. Although the Bureau of Labor Statistics and others consider our methodology to be the emerging standard for tracking jobs they do not yet track, critics of our methodology claim a 50% definition causes jobs to be over counted. However, Census 2012 research finds that approximately 90% of those who meet our definition of a solar worker in 2012 actually spend 100% of their time supporting solar-related activities. Because the Census covers subsectors directly related to new installed solar
capacity and the subsectors that support these efforts, jobs figures are best thought of as covering direct jobs.

3. Why doesn’t the Census break out the industry by technology?

Because so many establishments work across multiple technologies (PV, CSP, and solar water heating), it is impossible to provide reliable estimates of the number of employees working with a single technology. We do, however, provide figures on the number and relative percentage of solar establishments by technology. However, these figures reflect this technology overlap and are therefore not useful for ascribing employment to a single technology. BW Research estimates that 85% of installation firms and 80% of manufacturing establishments work exclusively with PV (and approximately 84% overall).

4. What methodology is used for the Census?

In each of its three reports, the National Solar Jobs Census series applied the following three-phase methodology.

Phase I involved the development, classification, and analysis of a national database of self-identified solar employers. The Solar Foundation and BW Research Partnership worked with national solar industry associations and other industry partners to develop this database from our partners’ existing lists of employer contact information.

Phase II was the Census phase, in which we conducted web-based and telephone surveys of the employers in our database. Employers were asked to identify which industry subsector label (installation, manufacturing, sales and distribution, project development, and “other”) best described their business and how many solar workers they employed, as well as a number of other questions.

Phase III focused on random sampling of employers in industry classifications that are most likely to have unknown solar employers. These employers were surveyed by telephone to determine if they employed solar workers, along with how many and in which subsector. Final figures for this “unknown universe” were adjusted for overlap with known employers. Finally, raw data from both the known and unknown universe were used to extrapolate final national numbers. The focus of Census 2011 and 2012 was on conducting additional sampling in both the known and unknown universes. Additional data were collected for the known universe and new rounds of random sampling of the unknown universe were conducted on a national basis to determine growth and contraction of solar establishments over the previous year.

5. How does the Census methodology compare with other jobs studies?

The methods employed in the National Solar Jobs Census differ significantly from those used to produce other jobs studies. The fundamental methodological difference between the Census and the Bureau of Labor Statistics (BLS) report on Green Goods and Services is that organization’s over-reliance on industry or occupational codes to identify solar employers.
Currently, unique code identifiers do not exist for the full spectrum of clean energy jobs in the U.S., making it difficult for BLS to fully quantify workers in these industries. BLS allocates these workers by revenue. This allocation is problematic because revenues for green goods often have significantly different labor intensities, and the assumption that revenue allocations are the same as labor allocations is inherently flawed.

Though similar to the Census in some ways, we view the Brookings Institution's *Sizing the Green Economy* report as applying a less comprehensive methodology than our own. While both studies used databases of known solar employers as the basis for their analysis, the Census goes one step further, conducting random sampling of the unknown universe (businesses likely to have unknown or unclassified solar workers). In addition, Brookings relies on overall employment estimates from Dun and Bradstreet, which are imprecise. In the case of the Brookings solar numbers, we believe they underestimated solar jobs by 300-400%.

6. How has the Census been used?

The topline figure from the 2011 Census (that the U.S. solar industry employs over 100,000 solar workers) has been extensively cited by lawmakers, the solar industry, the U.S. Department of Energy and the national labs, the National Academies, and the media. Census 2010 won the Interstate Renewable Energy Council's (IREC) Innovation Award and both Census 2010 and 2011 have been the subject of hundreds of media citations and dozens of in-depth articles from high-profile media outlets including CNN, Forbes, Bloomberg, NPR, the LA Times, the NY Times, and US News and World Report.

7. What is the minimum education necessary to enter the solar job field?

While there exist entry-level positions for individuals interested in entering certain solar job fields, there is not always an immediate pathway into these jobs. Of the employers who participated in the 2012 Census, 51% indicated that they look for previous experience in the solar workers they hire. In addition, 18% noted they require an associate’s degree and 40% seek workers with a bachelor’s degree. For those looking to begin a career in the solar industry, a great place to start is with the U.S. Department of Energy’s Solar Career Map, developed by IREC.

8. What is the prognosis for the solar workforce in 2013? What do the data from the *National Solar Jobs Census* tell us about where the solar industry is headed?

Over the next 12 months, nearly half (44%) of solar employers expect to add new jobs, while fewer than 4% anticipate losing workers. Census 2012 estimates that overall solar employment will increase by 17% during this period. The installation and sales and distribution subsectors will lead this growth (with 21% and 22% projected growth rates, respectively), followed by “other” jobs (18% growth), project development (14%), and manufacturing (9%). Although employers are often overly optimistic in their growth estimates, the solar industry has consistently grown over the last several years. In fact, since we first started tracking solar jobs in 2010, the industry has created jobs at a 27% clip, while the overall economy created jobs at a much slower rate of 3.2%. Another indicator of where the industry is headed can be found with
revenues. Census 2012 shows that all subsectors derive a larger percentage of their overall revenues from solar than in previous years. This demonstrates that companies find solar to be an increasingly sound investment.

9. How does the Census calculate growth figures?

Growth figures and projections are based on our definition of a “solar worker” (see Question 2). These numbers increase or decrease based on changes in the number of solar companies, changes in new positions at these firms, and existing workers starting/ceasing to perform tasks that support solar. For example, a roofing company may employ ten workers, two of whom are “solar workers”. In the following year, solar-related work increases, but demand for general roofing work falls. As a result, the company still employs ten workers, but now four of them work on solar. While total employment has stayed flat, two workers have been repurposed to support solar, giving the company two new “solar workers” for that year.

10. What are the primary drivers of growth for solar businesses?

According to our survey results, the most oft-cited reason for continued growth has been the steady decline in component prices, with nearly one-in-three (31%) of respondents selecting this as their response. Other leading drivers of growth were: the passage of state legislation mandating the development of renewable portfolio standards or allowing third-party ownership (17%); federal tax incentives (16%), and; greater consumer awareness of solar products and services (13%).

11. How are project developers categorized?

A new feature of Census 2012 is the inclusion of project developers as its own company classification. This category includes firms that “plan, construct, and maintain large utility-scale solar projects”. Though these workers were counted in previous versions of the Census, they were subsumed within the installation or “other” categories. Therefore, the inclusion of this new category does not represent a count of previously uncounted jobs, but merely the reclassification of solar workers counted in previous versions of the Census.

Although state employment estimates were included in both Census 2010 and Census 2011, we decided not to include them this year because providing accurate and reliable state solar jobs numbers requires developing costly sampling plans for each state. This is not to say that our previous estimates were incorrect, rather they were not precise enough to be used with the same level of certainty as our national employment numbers.

Even though it is beyond the scope of Census 2012, highly credible state numbers would be of immense use for demonstrating the employment value of state solar industries, providing solar advocates with information that could help reshape state energy policy discussions. Our team is ready and willing to undertake such studies, but requires the financial means to do so. Government agencies, state solar advocates, solar businesses, or other stakeholders interested in highly credible state-level employment reports should contact The Solar Foundation™.

Despite the continued absence of reliable state jobs numbers, Census 2012 makes an attempt to provide some idea of what the state employment picture looks like. The following pages contain tables and charts that break down the number and relative percentages of solar establishments active in each industry subsector by state and region. These figures are derived from the most current version of SEIA's National Solar Database, the most comprehensive list of the “known universe” of solar employers in the United States. Greater accuracy in the database of known solar companies enables us to better estimate solar employment.

The data in the following pages are broken down by the industry subsector classifications used in Census 2012 (installation, manufacturing, sales and distribution, project development, other). States are grouped together into the four geographic regions (West, Midwest, South, and East) and nine divisions developed by the U.S. Census Bureau. Each table lists the states by region and provides information on the number of businesses in each state active in each industry subsector (# column), as well as the percentage of the total state solar industry each subsector represents (% column). For example, according to the National Solar Database, Alaska has only one active solar installation firm and a total of nine solar establishments, meaning that installation makes up approximately 11% (1 ÷ 9) of the solar industry in that state. Charts on each page graphically represent the make-up of the solar industry in each of the nine divisions.

While these figures and groupings can serve as a rough proxy for solar employment on subnational levels, differences in regional economies and state dynamics may cause firms to vary in average size from state to state. Therefore, employment levels may not track exactly with establishment totals.

Given the strong national trend for increased solar capacity, it is no surprise that many states have seen an increase in the number of solar establishments operating within their borders.

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25 Companies interested in being listed in the National Solar Database should contact SEIA's research department: seia.org/research-resources/national-solar-database.
As mentioned above, financial constraints limited the scope of the research performed for this Census. Despite this, compelling information can still be drawn from the available state data.

Census 2010 found that the average solar installation firm employs eight solar workers, the average manufacturing firm employs 24 solar workers, and the average sales and distribution firm employs four solar workers. While the number of establishments in a state is not indicative of total employment (and the National Solar Database does not capture all solar employers), some trends are worth noting.

<table>
<thead>
<tr>
<th>Top Ten States: Installed PV Capacity</th>
<th>Top Ten States: Number of Solar Establishments</th>
</tr>
</thead>
<tbody>
<tr>
<td>California</td>
<td>California</td>
</tr>
<tr>
<td>New Jersey</td>
<td>New Jersey</td>
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<td>Colorado</td>
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<tr>
<td>Texas</td>
<td>Massachusetts</td>
</tr>
<tr>
<td>Nevada</td>
<td>Ohio</td>
</tr>
</tbody>
</table>

Note that the states that are shaded above are not found in both columns.

The installation subsector is the leading solar employer across most of the country. Most notable among these is California, whose installation establishments comprise nearly 15% of all solar establishments in the National Solar Database. Strong state solar markets, however, are not required for many states to benefit from solar installation demand. While three of the top ten states (in terms of installed PV capacity) are located in the Northeast, others in this region have much smaller solar markets in terms of installed capacity. It is likely, however, that the growth in installed capacity is benefiting installation firms in neighboring states. Leaders in the number of solar establishments in the installation subsector are: CA, NJ, PA, FL, NY.

In Midwestern states, like Ohio and Michigan, the manufacturing subsector is the most robust area of solar employment. Many of these states have long been strong manufacturing bases, making it easier for employers to find the skilled labor they need to manufacture solar components. In addition, many of these states have well-funded state universities that work with industry to perform advanced research and development. Leaders in the number of solar establishments in the manufacturing subsector are: CA, OH, PA, TX, MI,

Several states that are not generally known to have a very robust market (such as South Dakota and Alaska), interestingly, have many more sales and distribution firms than other types of firms along the value chain. Although speculative, this could be due to a misclassification of the
company in the National Solar Database\textsuperscript{26} or the existence of quite a bit of overlap across subsectors. Leaders in the number of solar establishments in the sales and distribution subsector are: CA, FL, AZ, TX, NJ.

States known for having an abundant solar resource (such as Nevada) tend to attract more project developers and installers than manufacturers. Leaders in the number of solar establishments in the project development subsector are: CA, NJ, TX, NY, CO.

States with urban areas that are home to financial or legal service firms, such as New York and the District of Columbia, are represented strongly in the “other” category. Leaders in the number of solar establishments in the “other” subsector are: CA, NY, AZ, TX, PA.

\textsuperscript{26} The 2012 survey data suggest that there are significant discrepancies between firms’ self-identification and their classifications in the NSD, making comparisons between the two sources difficult.
### Solar Establishments by State

<table>
<thead>
<tr>
<th>State/Region</th>
<th>Installation</th>
<th>Manufacturing</th>
<th>Sales and Distribution</th>
<th>Project Development</th>
<th>Other</th>
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Source: NSD/SEIA/TSF
### Solar Establishments by State

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Source: NSD/SEIA/TSF
## Solar Establishments by State

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Source: NSD/SEIA/TSF
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<td>74</td>
<td>22%</td>
<td>17</td>
</tr>
<tr>
<td><strong>New England</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecticut</td>
<td>25</td>
<td>36%</td>
<td>26</td>
<td>37%</td>
<td>4</td>
</tr>
<tr>
<td>Maine</td>
<td>24</td>
<td>67%</td>
<td>4</td>
<td>11%</td>
<td>6</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>96</td>
<td>47%</td>
<td>54</td>
<td>26%</td>
<td>13</td>
</tr>
<tr>
<td>New Hampshire</td>
<td>11</td>
<td>26%</td>
<td>19</td>
<td>45%</td>
<td>8</td>
</tr>
<tr>
<td>Rhode Island</td>
<td>8</td>
<td>42%</td>
<td>6</td>
<td>32%</td>
<td>2</td>
</tr>
<tr>
<td>Vermont</td>
<td>19</td>
<td>56%</td>
<td>8</td>
<td>24%</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: NSD/SEIA/TSF
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