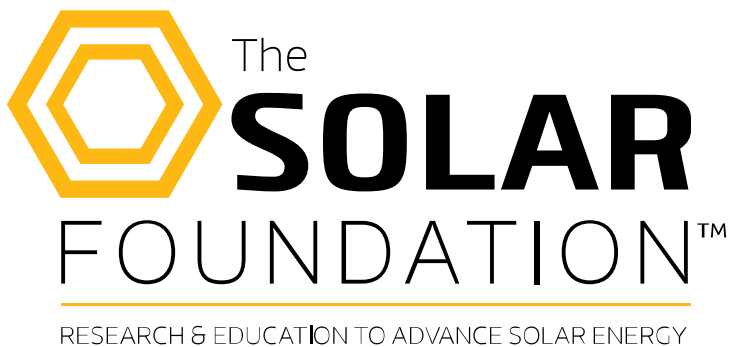


2015

STATE SOLAR JOBS CENSUS

COMPENDIUM



ABOUT THE SOLAR FOUNDATION®

Considered the premier research organization on the solar workforce, employer trends, and the economic impacts of solar, TSF has provided expert advice to leading organizations such as the National Academies, the Inter-American Development Bank, the U.S. Department of Energy, and others during a time of dynamic industry growth and policy and economic uncertainty.

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

ABOUT BW RESEARCH PARTNERSHIP

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



ACKNOWLEDGEMENTS

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

This *Census Compendium* is an offshoot from TSF's *National Solar Jobs Census 2015* effort. TSF would like to acknowledge and thank its research partners. Without their foresight and leadership, this report would not have been possible. Research partners include: the George Washington University Solar Institute for providing assistance and support in reviewing and validating report results and analysis; the Solar Energy Industries Association (SEIA) for use of its National Solar Database and peer review; GTM Research/SEIA for providing survey respondents with the U.S. Solar Market

Insight: 2014 YIR report, and; the following universities for their contributions to the their state *Census* reports: Florida Solar Energy Center at the University of Central Florida, North Carolina Clean Energy Technology Center at North Carolina State University, Energy Policy Innovation Council at Arizona State University, and Michigan State University.

Sponsors of this year's *Census* effort include: Energy Foundation, William and Flora Hewlett Foundation, Tilia Fund, George Washington University Solar Institute, State of Minnesota Department of Commerce, State of New Mexico Energy Minerals and Natural Resources Department, Utah Governor's Office of Energy Development, SEIA, Recurrent, SolarCity, First Solar, Sol Systems, E.ON, Trina, sPower, Standard Solar, CALSEIA, All Earth Renewables, and groSolar.

We also want to thank all the solar employers that participated in the survey. Your responses were critical in providing us with accurate and timely data.

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INTRODUCTION & OVERVIEW

The Solar Foundation's *State Solar Jobs Census 2015* provides current employment, trends, and projected growth in the solar industry. This year's *State Census* is comprised of individual reports for 14 states, an interactive district-level map at www.SolarStates.org, and this *Compendium*, which includes summaries of all states and regions based on the nine U.S. Census Divisions.

This work follows the January 2016 release of the *National Solar Jobs Census 2015*. The *National Census* found that as of November 2015, the U.S. solar industry employs nearly 209,000 solar workers, representing a growth rate of 20.2%

since November 2014, and 123% since The Solar Foundation first started tracking solar workers in 2010. In 2015, the solar industry added workers¹ at a rate nearly 12 times faster than the overall economy, accounting for 1.2% of all jobs created in the U.S. Over the next 12 months, employers expect to see total employment in the solar industry increase by 14.7% – which is 13 times faster than the U.S. workforce as a whole is expected to grow² – to approximately 240,000 solar workers.³ Nationally, solar power currently produces approximately 1% of U.S. electricity generation, but that too is expected to increase in coming years.⁴

Factors that Differentiate Solar Power Among States

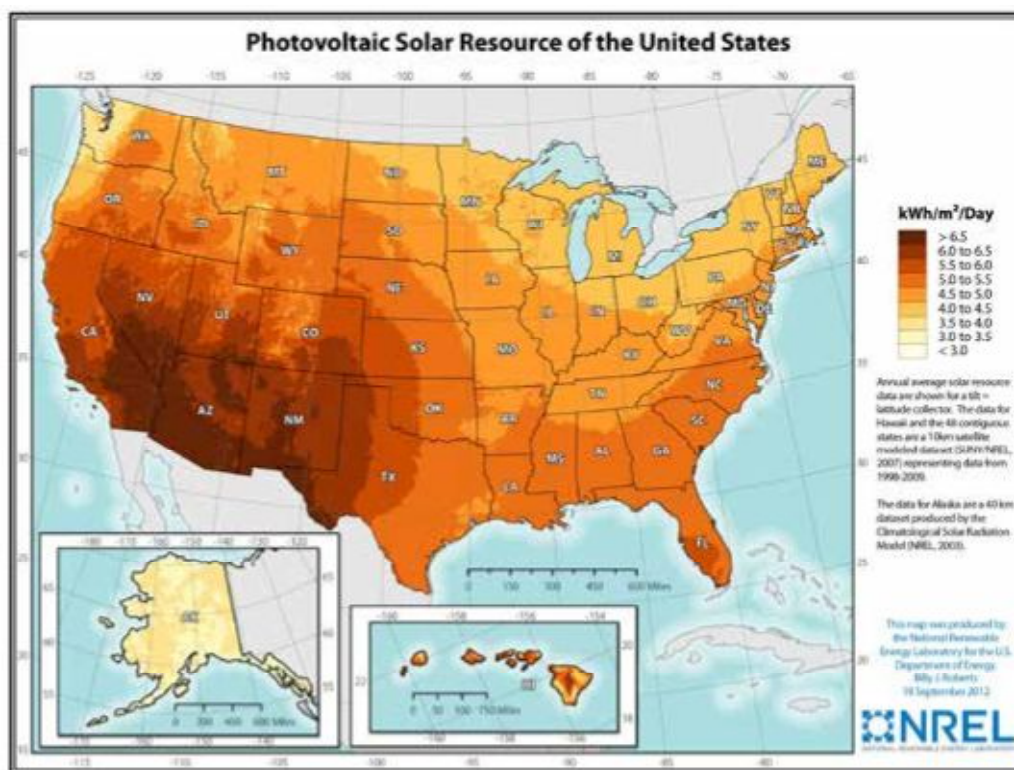
This section addresses key factors that help to differentiate solar power employment and development among the states. Such factors include:

- Customer demand
- Solar radiation/resource
- Grid access
- Installation costs
- Energy prices
- Local and state policies

More populated states generate greater residential, commercial, and industrial demand for electricity, including solar power. While California, the nation's most populated state, leads the country in solar power, the next four most populated states – Texas, Florida, New York, and Illinois – do not rank in the top five for installed solar capacity, and only New York joins California as a top five state for total solar jobs.

Some states receive far greater solar radiation in a given year than others, as seen in the National Renewable Energy Laboratory map below. The sunny, dry Southwest has the greatest natu-

ral solar resource, generating on average more electricity from photovoltaic cells per square meter than in other part of the country. Not surprisingly, the four states with the best solar resource – Arizona, California, Nevada, and New Mexico – rank in the top ten for solar jobs per capita. Nonetheless, regions that receive less solar radiation can also generate ample power. Germany's solar resource is less than that of any U.S. state except Alaska, yet Germany boasts 40 GW of installed solar capacity, more than all U.S. states combined.⁵ Closer to home, even a system in Portland, Maine can produce over 90% of the



solar electricity, on an annual basis, as a comparable system operating in Miami, Florida.⁶

Solar power systems typically require access to the grid. Large, utility-scale solar generation, for example, must have access to the electric grid to sell bulk power to consumers. While it may be preferable to locate utility-scale solar projects in remote areas, such areas often lack transmission lines that allow access to the grid. This disconnect can limit the potential for high radiation regions with ample open space to support more populated regions. However, the growth of distributed solar power could decrease the need for additional bulk power generation and related transmission lines.⁷

The general decline in installation costs has been essential to solar market growth. Since 2010, U.S. average installed costs have declined 35% for residential, 58% for nonresidential, and 67% for utility-scale installations.⁸ However, among the states, there is a considerable amount of variability in these costs. A 15-state study of smaller (<15 kW) PV systems found that installation costs ranged considerably among

states.⁹ Factors that influenced installation costs include (1) potential electric bill savings, (2) government incentives, (3) number of installers in the local market, (4) installer experience, (5) installation size, (6) installation ownership (customer of third party), (7) construction type (new construction or retrofits), (8) PV materials (thin film or crystalline silicon), and (9) source of materials.

Installation costs typically range from \$2.00 to \$4.00 per watt, with residential systems costing more, and varying more, on average than non-residential and utility-scale systems.¹⁰

The economic benefit of solar power tends to be greater in states with higher average electricity prices. Mainland U.S. electricity prices range from a high of 16.73 cents per kWh in New England, to a low of 8.48 cents per kWh in the West South Central Division of the U.S. Some of the highest prices for electricity can be found in populous states such as California, New York, and New Jersey, while prices are highest in Hawaii, at 26.81 cents per kWh. As of September, average electricity prices for 2015 were 10.51

Average Price of Electricity to Customers by State, Year-to-Date, Through Sept. 2015[#]

Division & States	Price (cents per kWh)	State Rank: Highest to Lowest Price	Division & States	Price (cents per kWh)	State Rank: Highest to Lowest Price
Division 1	16.73		North Carolina	9.41	31
Connecticut	17.99	2	South Carolina	9.58	28
Maine	13.08	11	Virginia	9.39	32
Massachusetts	17.11	5	West Virginia	8.06	46
New Hampshire	16.17	6	Division 6	9.13	
Rhode Island	17.20	4	Alabama	9.52	29
Vermont	14.33	9	Kentucky	8.02	47
Division 2	13.22		Mississippi	9.65	27
New Jersey	14.14	10	Tennessee	9.36	33
New York	15.54	8	Division 7	8.48	
Pennsylvania	10.42	19	Arkansas	8.22	44
Division 3	9.87		Louisiana	7.71	50
Illinois	9.30	35	Oklahoma	7.94	49
Indiana	8.82	39	Texas	8.77	41
Michigan	10.89	16	Division 8	9.65	
Ohio	9.91	21	Arizona	10.64	18
Wisconsin	11.01	15	Colorado	9.86	23
Division 4	9.43		Idaho	8.18	45
Iowa	8.72	43	Montana	8.99	37
Kansas	10.11	20	Nevada	9.74	26
Minnesota	9.75	24	New Mexico	9.89	22
Missouri	9.44	30	Utah	8.74	42
Nebraska	9.20	36	Wyoming	7.97	48
North Dakota	8.94	38	Division 9 (cont.)	12.95	
South Dakota	9.35	34	California	15.63	7
Division 5	10.06		Oregon	8.80	40
Delaware	11.21	14	Washington	7.32	51
District of Columbia	12.01	13	Division 9 (non-cont.)	23.34	
Florida	10.71	17	Alaska	17.96	3
Georgia	9.75	24	Hawaii	26.81	1
Maryland	12.11	12	US AVERAGE	10.51	

cents per kWh nationwide. Due to the increased economic benefits of solar in states with traditionally expensive electricity, nearly all of the high-rate states have seen significant solar development in recent years.

State and local policies and incentives can differentiate solar development among states. Chief among these are net metering and interconnection. A majority of states offer net metering, which allows owners of residential and commercial solar energy systems to sell excess power back to the utility. For most states, customers can sell the excess power back to the utility at the retail electricity rate. For other states, such as Hawaii and Nevada, excess power is credited at a lower wholesale rate, decreasing investment return on solar installations in those areas. States may also have aggregate system caps, meaning that utilities will only purchase a fixed amount of distributed power in a given year. Finally, there may be interconnection charges or fees for hooking distributed power up to the grid. Almost half (22) of all states received an “A” or “B” grade for net metering and interconnection as shown in the table on the next page.

There are numerous state incentives, such as rebates and tax credits, that encourage solar development. Such incentives are often influenced by broader goals for renewable portfolio standards (RPS) – in which case states commit to derive a specific percent of their power generation from renewable energy sources by a specified year. RPS designated renewable energy sources typically include hydro-electric, wind, solar (PV & thermal), biomass, and geothermal. States typically designate 15% to 30% of their electricity generation from renewable sources by a year in the relatively near future. Some states such as California, New York, Maine, and New Hampshire have set aggressive RPS goals that will help to drive solar development in those states for years to come.

There are policy developments related to technological changes that can differentiate solar

power among states. Demand response tools, such as “automated load control, smart grid and smart metering, real-time pricing, and time-of-use tariffs,” can provide flexibility for intermittent power sources, such as solar, to more efficiently meet demand.¹¹ Efficient battery storage could further leverage these demand response tools. Additionally, the growing use of electric vehicles will increase demand for electricity. States that are quick to accommodate electric vehicles will experience a correlated growth in electricity demand, which may serve as an additional driver for increased solar development.



Top Scoring States (A & B grades)				
	Policy Grades ¹²		Renewable Portfolio Standards (RPS) ¹³	
State	Net Metering	Interconnection	RPS Target	RPS Target Deadline
CA	A	A	50%	2030
CO	A	B	30%	2020
CT	A	B	23%	2020
DC	A	B	20%	2020
DE	A	B	25%	2026
IA	B	B	105 MW	N/A
IL	B	A	25%	2023
IN	B	B	10%	2025
MA	A	A	15%	2020
MD	A	B	20%	2022
ME	B	B	40%	2017
NH	A	B	24.8%	2025
NJ	A	B	20.38%	2021
NM	B	A	20%	2020
NY	A	B	50%	2030
OH	A	A	12.5%	2026
OR	A	A	25%	2025
PA	A	B	18%	2021
RI	B	B	14.5%	2019
UT	A	A	20%	2025
VT	A	B	75%	2032
WA	B	B	15%	2020

State Solar Employment

California leads the nation with over 75,000 solar jobs. It has five times the number of solar jobs as the second highest state of Massachusetts (15,095). California is expected to continue to lead the nation in solar jobs with a forecasted 19% growth in 2016. The third largest state by solar jobs, Nevada, has the most jobs per capita, followed by Massachusetts. However, given recent policy changes in Nevada, the state's solar workforce is no longer expected to grow in 2016 at the 18% rate projected. Nationally, solar jobs are expected to grow 14.7% in 2016.

California leads the nation in installation jobs, followed by Massachusetts and Nevada (though, as noted, this may no longer be true). The proportion of Nevada, New York, Tennessee, and Maryland's installation jobs is well above the national average of 57.4%. Of the top ten states for total installation jobs, Nevada has by far the greatest proportion of such positions, with installation firms employing nearly 95% of its solar workers. Thus, Nevada's solar economy is highly dependent on the residential rooftop solar business, where most installation jobs are typically found.

California leads the nation in solar manufacturing jobs, followed by Arizona and Massachusetts. Arizona and Oregon manufacturing firms employ over a third of their states' solar workers, which is well in excess of the national average of 14.5%.

California leads the nation in project development jobs, followed by Massachusetts and Florida. Massachusetts, Florida, and Louisiana employ a significantly greater proportion of project development workers than the national average of 10.8%. Notably, Nebraska project development firms employ an impressive 61.4% of the state's solar workers. While a high proportion of project development jobs may imply that utilities and large firms are actively pursuing solar power, it could also indicate a missed opportunity to develop more residential and small commercial rooftop solar.

Top 10 States in Installation Jobs

State	Installation	% of Solar Jobs
CA	40,597	53.7%
MA	8,741	57.9%
NV	8,285	94.5%
NY	5,829	70.7%
TX	4,547	64.7%
NJ	4,303	60.9%
FL	3,217	49.0%
TN	3,047	80.2%
MD	3,025	70.9%
CO	2,958	59.2%
National Average		57.4%

Top 10 States in Manufacturing Jobs

State	Manufacturing	% of Solar Jobs
CA	11,183	14.8%
AZ	2,400	34.7%
MA	2,098	13.9%
TX	1,424	20.3%
OR	1,149	38.3%
NC	1,144	19.2%
OH	834	17.3%
IL	822	23.6%
NY	800	9.7%
GA	751	23.6%
National Average		14.5%

Top 10 States in Solar Jobs					
State	2015 Jobs	National Rank	Jobs Per Capita Rank	2016 Projected Growth	Cumulative Q3 2015 Installed Capacity Rank
California	75,598	1	5	18.9%	1
Massachusetts	15,095	2	2	8.6%	6
Nevada	8,764	3	1	18.5%	5
New York	8,250	4	21	11.6%	7
New Jersey	7,071	5	12	10.3%	3
Texas	7,030	6	34	12.7%	10
Arizona	6,922	7	7	8.4%	2
Florida	6,560	8	28	7.8%	13
North Carolina	5,950	9	15	10.2%	4
Colorado	4,998	10	8	10.3%	9

Methodology

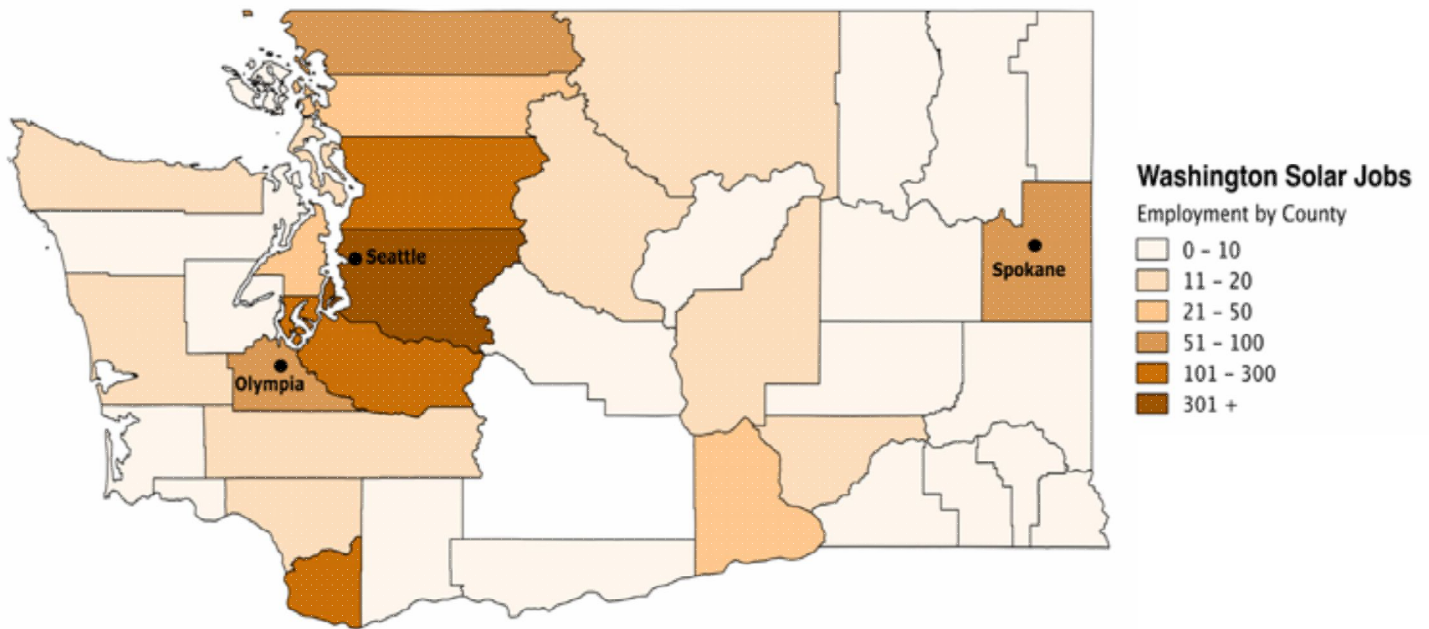
The *State Solar Jobs Census 2015* demonstrates that the U.S. solar industry is having a positive and growing impact on the national economy, supporting jobs across every state in the nation. As with the previous *Census* studies, this report series includes information about all types of companies engaged in the analysis, research and development, production, sales, installation, and use of all solar technologies – ranging from solar photovoltaics (PV), to concentrating solar power (CSP), to solar water heating systems for the residential, commercial, industrial, and utility market segments.

The findings presented herein are based on rigorous survey efforts that include nearly 288,000 telephone calls and over 44,000 emails to known and potential solar establishments across the United States, resulting in a maximum margin of error for state employment of $\pm 5\%$ at a 95% confidence interval. Unlike economic impact models that generate employment estimates based on economic data or jobs-per megawatt (or jobs-per-dollar) assumptions, the *Solar Jobs Census* series provides statistically valid and current data, gathered from actual employers.

In contrast, The Solar Foundation's 2014 state estimates of solar employment (for all states except CA, AZ, NY, TX, MD, and GA) were produced using a carefully developed dual methodology – one for installation and construction jobs and another for non-installation jobs (covering industry sectors such as manufacturing, sales & distribution, project development, and “other” occupations that support the solar industry). Method one used labor intensity multipliers developed internally and cross-checked with leading studies on the subject, while method two was based not only on a direct count of solar workers, but also the average number of jobs per solar establishment and total number of establishments in the state.

This year's full methodology can be found in the Appendix of the *National Solar Jobs Census 2015* report: www.TSfcensus.org.

State-specific *Census* reports were completed for 14 states including: Arizona, California, Colorado, Florida, Massachusetts, Michigan, Minnesota, New Jersey, New Mexico, New York, North Carolina, Texas, Utah, and Vermont. These reports can be found at www.TSfcensus.org or on The Solar Foundation's new interactive www.SolarStates.org microsite.



WASHINGTON

Total Solar Jobs, 2015

2,262

Projected Solar
Jobs Growth, 2016

349
(15.4%)

Solar Jobs
Rank

#21

Solar Jobs
Per Capita Rank

#29

Cumulative Installed
Capacity thru Q3 2015 (MW)

54.2

Total Solar
Companies**

136

Washington

One of few states that saw minor contraction in solar jobs in 2015, Washington now has 2,262 solar workers, which is slightly lower than the previous year. An estimated 15.5 megawatts (MW) of new solar photovoltaic (PV) capacity were installed in 2015 through Q3, about 10% more than the previous year, which brings Washington's total to 54.2 MW cumulative installed solar PV capacity.⁵⁵⁴

Under Initiative 937, the Energy Independence Act, electric utilities that serve more than 25,000 customers must obtain 15% of their electricity from new renewable resources by 2020 and must undertake cost-effective energy conservation measures. Distributed generation in Washington receives a two times credit multiplier under the state's RPS requirements.⁵⁵⁵ Washington has received a grade of "B" from Freeing the Grid for its net metering policy, which apply

Sector	WA Solar Jobs	% WA Solar Jobs	% U.S. Solar Jobs
Installation	1,429	63.2%	57.4%
Manufacturing	274	12.1%	14.5%
Sales & Distribution	37	1.6%	11.7%
Project Development	297	13.1%	10.8%
Other	225	9.9%	5.7%

Demographic	% WA Solar Jobs	% WA Overall Jobs†	% U.S. Solar Jobs
Women	26.5%	46.7%	23.8%
African-American	2.5%	3.3%	5.1%
Asian or Pacific Islander	4.3%	8.1%	8.6%
Latino or Hispanic	3.6%	10.8%	11.3%
Older Workers (55+)	16.0%	22.6%	18.6%
Union Members	6.8%	-	5.5%
Veterans of the U.S. Armed Forces	6.0%	9.3%	8.1%

to all utilities and credit net excess generation at the retail rate. Its comparatively low cap on aggregate capacity (0.5% of peak demand from a base year) keeps it from receiving the highest grade.⁵⁵⁶ Washington is also one of the few states to have taken steps at the state-level to address solar "soft costs" (e.g., local administrative or business process costs) – through allowing local jurisdictions to exempt solar energy systems from certain requirements of the state building code. This effectively allows jurisdictions to establish expedited permitting processes for qualifying residential solar energy systems.⁵⁵⁷

Last summer, Governor Jay Inslee directed the state's Department of Ecology to more strictly enforce an emissions target set in 2008, imposing a binding cap on carbon emissions under the authority of the state's Clean Air Act.⁵⁵⁸

The state's installed capacity in 2016 is expected to significantly exceed the previous year's total. As such, employers are projecting that Washington's solar workforce to grow approximately 15% in 2016.