

FIGURES:

From: Vero, Eranda <evero@pa.gov>
Sent: Tuesday, September 8, 2020 11:21 AM
To: Spunaugle, Shirley A <sspunaugle@pa.gov>
Subject: FW: PECO DSP V - P-2020-3019290 - Public input hearing on Tuesday 6/9/2020

Hi Shirley,
At the Public Input Hearing (PIH) in the above-captioned matter, Ron Celentano's (PASEIA) exhibits 3, 4 and 5 were not admitted into the record. By Order dated July 2, 2020, Celentano's Exhibits 3 and 5 were admitted into the PIH record. Exhibit 4 was not admitted. Can you please attach to the public input hearing transcript along with the other exhibits?
Thank you

Eranda Vero
Administrative Law Judge

From: Vero, Eranda
Sent: Friday, June 12, 2020 1:20 PM
To: Jennifer Young <jyoung@strehlowcourtreporting.com>
Subject: PECO DSP V - P-2020-3019290 - Public input hearing on Tuesday 6/9/2020

Hello Jennifer***

This is the written statement and exhibits submitted by Mr. Ron Celentano. Only Exhibits 1 and 2 were admitted into the record. I have still not ruled on the admissibility of exhibits 3, 4 and 5.

Thank you and sorry for calling you Julie. I have no idea where that name came from. I do not know any Julies.

Eranda Vero

Brown, Audley

From: McNeal, Pamela
Sent: Friday, June 5, 2020 9:45 AM
To: Vero, Eranda
Subject: FW: [External] Written Testimony of PASEIA for P-2020-3019290 - Only Exhibits #2, #3 & #5 of 5 Exhibits
Attachments: Exhibit 2_PA Solar Capacity.pdf; Exhibit 5_SolarJobsCensus2019.pdf; Exhibit 3_E2-Clean-Jobs-America-2020.pdf

From: Ron Celentano <celentanor@aol.com>
Sent: Thursday, June 4, 2020 4:41 PM
To: McNeal, Pamela <pmcneal@pa.gov>; ken.kulak@morganlewis.com; brooke.mcglinn@morganlewis.com; catherine.vasudevan@morganlewis.com; anthony.gay@exeloncorp.com; jack.garfinkle@exeloncorp.com; craig.williams@exeloncorp.com; dmcdougall@earthjustice.org; rbarker@earthjustice.org; lwelde@cleanair.org; joe_minott@cleanair.org; abeatty@paoca.org; devrard@paoca.org; Asmus, Daniel <dasmus@pa.gov>; Fure, Erin <efure@pa.gov>; Kanaskie, Richard <RKANASKIE@pa.gov>; emarxpulp@palegalaid.net; jsweetpulp@palegalaid.net; rpereirapulp@palegalaid.net; pulp@palegalaid.net; rballenger@clsphila.org; jpickens@clsphila.org; jprice@clsphila.org; kscott@clsphila.org; cmincavage@mcneeslaw.com; abakare@mcneeslaw.com; jthompson@mcneeslaw.com; jlushis@norris-law.com; jlaskey@norris-law.com; becky.merola@calpinesolutions.com; gpeterson@phillipslytle.com; kblake@phillipslytle.com; tpuchner@phillipslytle.com; kmoury@eckertseamans.com; dodell@eckertseamans.com
Subject: [External] Written Testimony of PASEIA for P-2020-3019290 - Only Exhibits #2, #3 & #5 of 5 Exhibits

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Please find attached only Exhibits #2, #3 and #5, for written testimony to accompany oral testimony that will be submitted by PASEIA at the public hearing on June 9.

Thanks

=====
Ron Celentano
Celentano Energy Services

7821 Flourtown Ave.
Wyndmoor, PA 19038

215-836-9958 (O)
215-740-0439 (C)

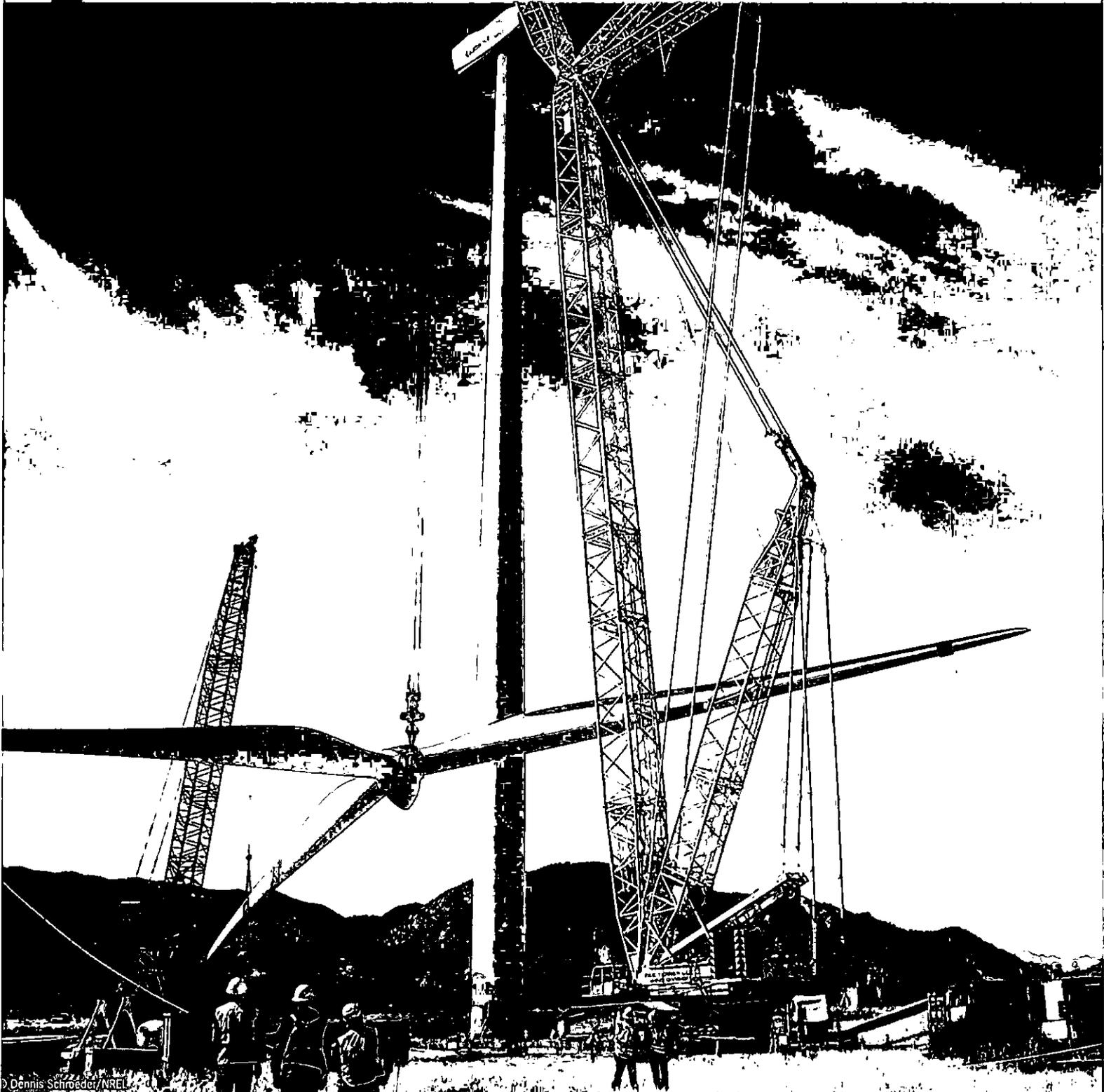


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CLEAN JOBS AMERICA 2020

REPOWERING AMERICA'S ECONOMY IN THE WAKE OF COVID-19



CLEAN JOBS AMERICA 2020¹

REPOWERING AMERICA'S ECONOMY IN THE WAKE OF COVID-19

As lawmakers and policymakers seek to get America back to work after the COVID-19 health and economic crisis, every job matters, from airline employees and hospitality workers to retail clerks and restaurateurs. We also cannot forget the employment sector that has become one of the biggest, fastest-growing and most beneficial for both our economy and our environment.

The clean energy sector

E2's 2020 Clean Jobs America report details the sheer size of this important employment sector, the troubles it is currently facing due to COVID-19 and how focusing recovery policies on clean energy can get America's economy humming again—quickly and for the long run.

Before the COVID-19 crisis, nearly 3.4 million Americans worked in clean energy—solar, wind, energy efficiency, clean vehicles, and more, according to this new analysis. For perspective, that's more people than worked as school teachers or farmers or real estate brokers in our country, and three times as many as worked in fossil fuels.²

Who are these workers? They are technicians and tradespeople who pull on their gloves, lace up their boots and squeeze into attics and boiler rooms to better insulate our buildings and improve our heating, air conditioning and ventilation systems.

They are electricians who design and install LED lighting systems; scurry across hot rooftops to install solar panels; climb into the sky to work on wind turbines and upgrade our electricity grid to make it safer, more reliable and ready for renewable energy.

They are factory workers who build Energy Star appliances and building supplies; high-efficiency HVAC systems; hybrid and electric vehicles and the parts that go in them.

And right now, they are hurting.

COVID-19 hammered the clean energy sector. According to our estimates, more than 106,000 workers are in clean energy-related companies lost their jobs in just the first few weeks after the pandemic began.³ See details in the sidebar on the next page and read some of their stories in the pages that follow.

As federal and state lawmakers look toward economic recovery, this report shows how clean energy is a major part of the economy of every state, employing workers in inner cities as well as rural areas, regardless of geography, politics or natural resources. Small businesses—the backbones of America's economy—employ nearly two out of three clean energy workers. And clean energy companies hire a greater percentage of veterans than the national average.

Most importantly at this time, Clean Jobs America shows why it's imperative for lawmakers to focus on clean energy in economic stimulus packages and other policies aimed at restarting our economy and keep in mind the benefits that will come with a cleaner, more resilient economy in the future.

This is an industry that simply cannot be ignored. As history shows, it is a proven catalyst for quick job growth in the aftermath of economic meltdown.

After the Great Recession, no part of the 2009 American Recovery and Reinvestment Act (ARRA) was more successful than the \$90 billion in federal investments in clean energy. In the years following ARRA, nearly 1 million clean energy jobs were created. Hundreds of new made-in-America businesses—game-changing companies such as Tesla which employed 45,000 workers before the crisis—got their start with ARRA-era Department of Energy loans that were repaid in full. More than 100,000 wind, solar and other clean energy projects were started, bringing new investments and job opportunities to states across the country.⁴

Recovery Act investments also led to the weatherization of more than 1 million homes, expanding energy efficiency work across the country and quickly getting electricians, HVAC technicians and other construction workers—as well as manufacturers of building supplies and Energy Star appliances—back to work. And along the way, consumers and businesses saved billions of dollars, our environment benefitted and our nation became more energy secure.

The right clean energy stimulus policies can once again get this big and game-changing part of America's workforce back on the job. In doing so, we can quickly repower our economy—and in ways that make it cleaner, more resilient and better positioned for continued growth.

THE CURRENT SITUATION

Clean Energy Unemployment Claims Skyrocket in COVID-19 Aftermath

More than 106,000 clean energy workers lost their jobs in the month of March alone, wiping out all the job gains in renewable energy, energy efficiency, clean vehicles and other clean energy sectors in 2019, according to an analysis of unemployment data by BW Research for E2.

The March layoffs were just the first indication of how badly the clean energy industry has been hit by the COVID-19 and economic crises. Much bigger job cuts are expected in the months ahead—making it imperative that Congress and state lawmakers seek ways to get the industry back on its feet, especially since clean energy has a proven history of helping pull the country out of economic crises.

What had been one the nation's fastest-growing jobs sectors at the start of the year by March was experiencing significant job losses every week.

The job losses are across a wide variety of occupations, and in every state. Energy efficiency workers are losing their jobs after being shut out of homes and buildings to prevent the spread of the coronavirus. Solar and wind turbine companies are laying off workers as they're unable to access panels and parts stranded in shut-down factories and as financing disappears. Factory workers are being let go as assembly lines for Energy Star appliances and electric and hybrid vehicles are ground to a halt.

The clean energy economy has previously weathered choppy seas, but this storm is wholly different.

Unemployment Claims by Clean Energy Workers, March 2020³

Industry	Unemployment Claims
Energy Efficiency	69,800
Renewable Energy	16,500
Clean Vehicles	12,300
Grid & Storage	4,300
Clean Fuels	3,400
Total	106,400

States With Most Clean Energy Job Losses, March 2020³

State	Unemployment Claims	Share of Clean Energy Workforce
US TOTAL	106,472	3.10%
California	19,949	3.60%
North Carolina	6,800	5.90%
Pennsylvania	6,068	6.20%
Massachusetts	5,611	4.40%
Michigan	5,446	4.10%
New York	4,789	2.90%
Ohio	4,719	4.10%
Texas	4,246	1.70%
Washington	3,940	4.40%
Illinois	3,326	2.60%
Florida	2,673	1.60%
Indiana	2,592	2.90%

State	Unemployment Claims	Share of Clean Energy Workforce
Minnesota	2,415	3.70%
New Jersey	2,345	4.10%
Virginia	2,044	2.10%
Wisconsin	2,031	2.60%
Maryland	1,954	2.30%
Kentucky	1,505	3.80%
Tennessee	1,492	1.70%
Louisiana	1,463	4.60%
Missouri	1,462	2.50%
Georgia	1,332	1.50%
Oregon	1,324	2.20%
Colorado	1,080	1.60%
Iowa	1,066	2.90%

Reaction from the Frontlines

Despite how far the clean energy sector has come over the last five years, the economic impact of the COVID-19 crisis is quickly devastating businesses, workers, and project from coast to coast.

As lawmakers look to reinvigorate our economy and get America back to work, E2 surveyed its 8,000 members and supporters nationwide about how they're being impacted, and how public policy could help.

This is the new reality their operations and workers are facing. In their own words:



MARK HALL

Founder, Revalue.io
California

"We had 5 residential retrofit projects that were supposed to begin ... but cannot due to the shutdown, as well as 1 warehouse project. Much of our work is in workforce development, as we train high school, college and other adults in energy efficiency technology. We now have to alter our training plans and reduce our outreach and business development."



MICHAEL RUCKER

CEO, Scout Clean Energy
Colorado

"As I talk to banks ... they are in a panic situation that I haven't seen since 2008."



EMILY RICE

COO, The Energy Group
Iowa

"Projects are getting delayed because we don't have access to buildings. This is impacting cashflow and we are potentially going to face layoffs. We are working to avoid that, and it will depend on the duration of this disruption."



GREG SMITH

Founder, Energy Optimizers
Ohio

"We have terminated the employment of approximately 25 percent of our personnel. We have had over \$10 million of projects halt moving forward, impacting the jobs of at least 150 people."



LLOYD KASS

VP of Policy and Business
Development, Lime Energy
New Jersey

"We are devastated by the coronavirus. Nothing we do is considered 'critical service' so installing energy efficiency and solar panels in California is completely shut down. We can't go into apartment units to do energy audits or efficiency upgrades in NYC. We are facing substantial furloughs for staff and pay cuts for the ones who aren't furloughed."

CLEAN ENERGY JOBS OVERVIEW

One of the many benefits of focusing federal and state economic recovery efforts on clean energy is the fact that doing so can preserve and create new jobs in every state: in rural and urban areas, and across a wide variety of occupations.

At the start of 2020, clean energy employment increased for the fifth straight year since this annual report was first released—growing beyond 3.3 million workers nationwide.

While California remained the nation's undisputed leader in clean energy jobs through 2019, states as diverse in size and structure as Texas and Massachusetts also are in the top ten for clean energy jobs. Florida, North Carolina and Georgia continued to lead the South, while Michigan, Illinois and Ohio led the Midwest. On a per capita basis of statewide total employment, the Northeast claimed the top five spots with Vermont, Rhode Island, Massachusetts, Maryland, and Delaware employing the largest share of clean energy jobs per capita in the country.

As expected, America's large metro areas—led by New York City, Los Angeles, San Francisco, and Chicago—outpaced the country in total clean energy employment, with metros Denver, Houston, and Philadelphia among the top 20 and Kansas City, Milwaukee, and Raleigh among the top 40. However, small and mid-sized metros dominated when clean energy jobs were analyzed per capita. California's San Luis Obispo-Paso Robles and Michigan's

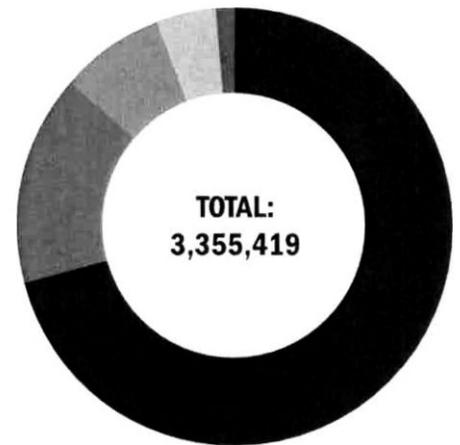
Holland-Grand Haven metro areas led the country with clean energy accounting for over eight percent of their overall employment in 2019. Other metros among the Top 25 per capita included Provo (Utah), Elizabethtown (Ky.) Fort Wayne (Ind.), Wilmington (N.C.), and Boulder (Colo.), while San Francisco and San Diego were the only metros to place among the top 25 in both total and per capita clean energy employment.

Clean energy also proved to be critical to rural economies in 2019: North Carolina leads the country for clean energy jobs in rural areas with nearly 29,000 workers, followed by Michigan and Texas.

Overall, clean energy jobs across the country grew by slightly more than two percent in 2019, slower than its nearly four percent growth in 2018. Jobs in renewable energy grew more than three percent, led in part by a rebound in solar jobs. Clean energy storage and grid modernization jobs increased four percent—faster than any other sector—while clean vehicle employment declined by about two percent after a 17 percent jump in 2018. Energy efficiency remains the single biggest sector of the clean energy economy, growing over two percent in 2019 and adding the most net new jobs (54,000) across the entire energy sector.

As a result of the industry's consistent growth, clean energy accounted for more than 40 percent of America's entire energy workforce and over 2.25 percent of the nation's overall employment at the end of 2019.

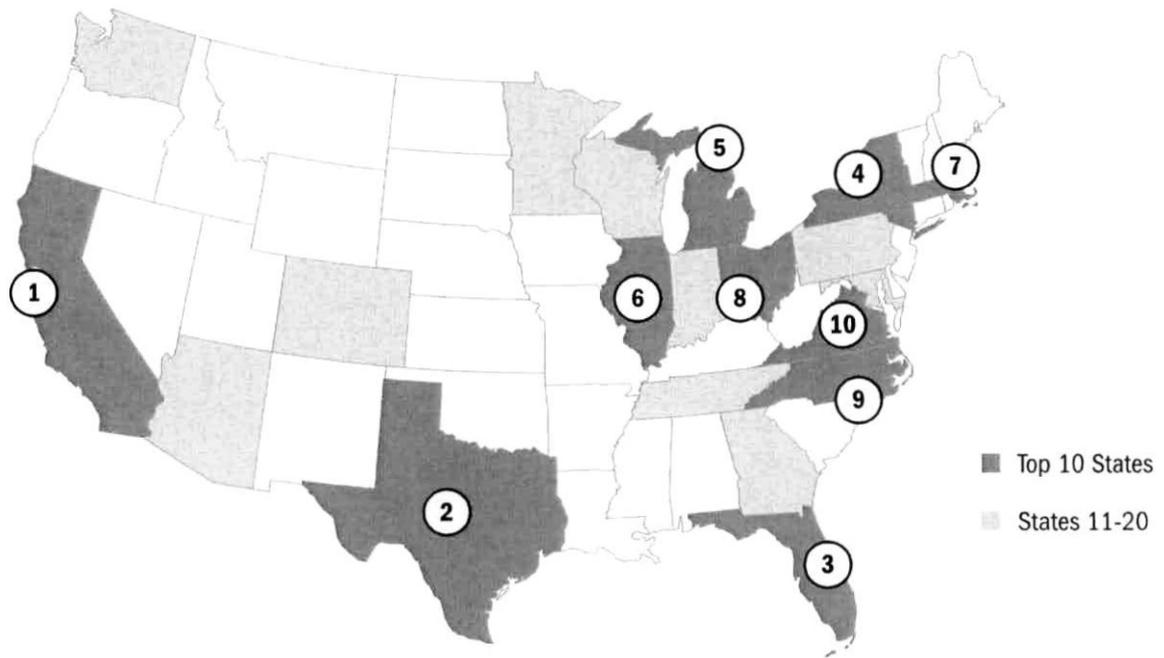
NATIONAL CLEAN ENERGY EMPLOYMENT Q4 2019



- Energy Efficiency: 2,378,893
- Renewable Energy: 522,811
- Clean Vehicles: 266,368
- Grid & Storage: 147,644
- Fuels: 39,704

STATEWIDE CLEAN ENERGY EMPLOYMENT Q4 2019

42 states and the District of Columbia employed more clean energy than fossil fuel workers in 2019.



Rank	STATE	TOTAL*	Renewables	Grid & Storage	Energy Efficiency	Clean Fuels	Clean Vehicles
1	California	536,919	142,957	24,021	323,529	5,785	40,627
2	Texas	241,289	39,303	13,204	169,398	2,073	17,309
3	Florida	166,032	24,987	5,499	123,560	2,897	9,090
4	New York	159,337	18,049	4,290	126,739	1,680	8,579
5	Michigan	125,365	11,447	3,896	85,323	625	24,073
6	Illinois	125,364	17,707	5,077	91,024	1,468	10,088
7	Massachusetts	122,477	21,963	7,050	88,231	569	4,664
8	Ohio	114,388	10,607	3,135	83,165	1,353	16,129
9	North Carolina	112,720	12,349	3,727	88,001	1,538	7,105
10	Virginia	97,305	9,047	2,520	80,181	312	5,245
11	Pennsylvania	93,861	9,744	3,698	71,443	1,436	7,541
12	Indiana	86,892	10,975	3,107	55,663	779	16,369
13	Washington	85,035	11,189	3,628	64,930	1,936	3,351
14	Maryland	84,549	8,203	2,001	71,337	170	2,839
15	Georgia	83,806	8,751	4,241	62,924	467	7,423
16	Tennessee	79,626	5,763	8,778	53,916	1,198	9,971
17	Wisconsin	76,685	5,958	2,175	63,569	368	4,615
18	Colorado	62,420	17,924	3,072	36,092	2,120	3,212
19	Arizona	62,106	11,629	2,273	44,782	345	3,077
20	Minnesota	61,805	7,920	2,899	47,114	681	3,191

* Total includes renewable energy, energy efficiency, clean vehicles, battery storage, advanced biofuels, low-impact hydro and other sectors.

STATEWIDE CLEAN ENERGY EMPLOYMENT Q4 2019 *continued*

Rank	STATE	TOTAL*	Renewables	Grid & Storage	Energy Efficiency	Clean Fuels	Clean Vehicles
21	New Jersey	57,139	12,569	1,913	37,982	396	4,278
22	Oregon	56,617	7,540	2,873	42,935	776	2,493
23	Missouri	56,486	5,316	1,950	42,537	921	5,762
24	South Carolina	46,527	7,336	2,052	30,794	652	5,693
25	Utah	44,005	8,118	1,079	32,483	109	2,215
26	Alabama	43,828	3,839	1,927	31,546	223	6,294
27	Connecticut	42,455	3,492	761	36,000	337	1,865
28	Kentucky	38,266	2,277	1,380	26,221	289	8,097
29	Nevada	33,788	11,265	9,098	11,988	138	1,299
30	Iowa	32,057	5,796	1,434	21,165	879	2,783
31	Louisiana	31,109	4,352	1,614	23,261	237	1,645
32	Kansas	24,909	3,874	1,059	17,848	288	1,840
33	Oklahoma	22,765	3,199	1,587	15,046	909	2,024
34	Mississippi	20,985	1,508	833	15,668	512	2,464
35	Arkansas	20,377	1,694	806	15,492	565	1,820
36	Nebraska	19,440	3,138	508	13,949	211	1,633
37	Vermont	16,635	2,439	1,024	11,032	688	1,451
38	New Hampshire	16,571	3,377	311	11,913	143	827
39	Rhode Island	16,429	2,066	681	13,028	322	331
40	District of Col.	15,383	1,821	313	12,982	17	251
41	Delaware	13,943	725	233	12,543	76	366
42	Hawaii	13,927	4,830	549	6,083	2,072	394
43	Idaho	13,181	1,763	1,076	9,035	275	1,032
44	Maine	12,798	2,512	472	8,879	213	721
45	New Mexico	12,365	4,614	762	6,099	113	777
46	South Dakota	11,458	2,327	445	7,628	194	863
47	Montana	10,376	464	418	8,838	51	605
48	West Virginia	10,078	1,171	859	7,144	30	873
49	North Dakota	9,192	2,244	566	5,581	154	647
50	Wyoming	8,721	332	445	7,568	79	297
51	Alaska	5,628	342	322	4,701	34	228

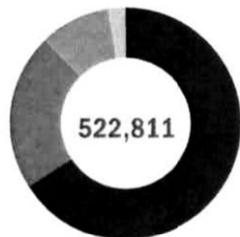
* Total includes renewable energy, energy efficiency, clean vehicles, battery storage, advanced biofuels, low-impact hydro and other sectors.

INDUSTRY BREAKDOWN: Q4 2019 EMPLOYMENT



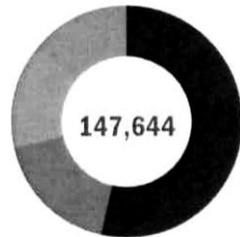
ENERGY EFFICIENCY:

- ENERGY STAR and Efficient Lighting: 552,435
- Traditional HVAC: 598,375
- High-Efficiency HVAC and Renewable Heating & Cooling: 566,290
- Advanced Materials: 366,608
- Other: 295,185



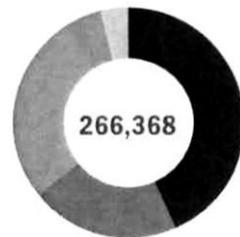
RENEWABLE ENERGY:

- Solar: 345,393
- Wind: 114,774
- Geothermal: 8,794
- Bioenergy/CHP: 41,546
- Low-Impact Hydro: 12,304



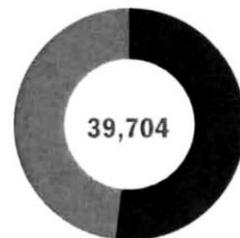
GRID & STORAGE:

- Clean Storage: 76,699
- Smart Grid: 25,631
- Micro-Grid: 22,192
- Other Grid Modernization: 20,122



CLEAN VEHICLES:

- Hybrid Electric Vehicles: 113,449
- Plug-In Hybrid Vehicles: 51,619
- Electric Vehicles: 77,667
- Natural Gas Vehicles: 12,878
- Hydrogen & Fuel Cell: 10,755



FUELS:

- Other Ethanol/Non-Woody Biomass: 20,694
- Other Biofuels: 19,009

CLEAN ENERGY VS FOSSIL FUELS

3 to 1

Clean energy jobs (3.36 million) outnumbered total fossil fuel employment (1.19 million) by more than 3 to 1 in 2019

2.5 times more

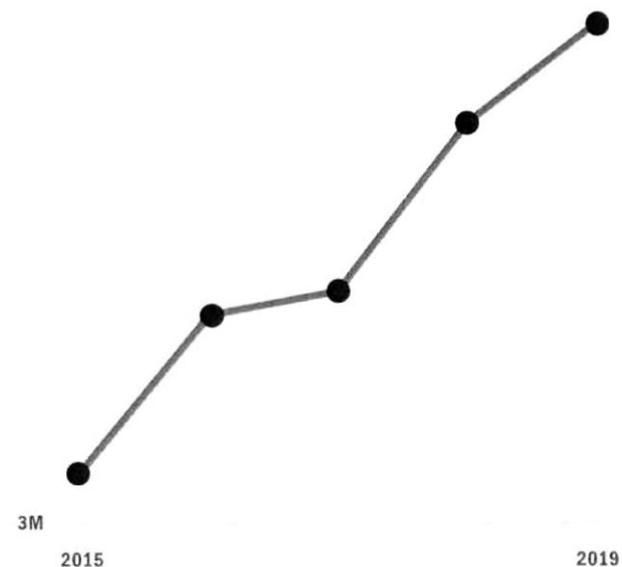
Renewable generation employed nearly 2.5X more workers than fossil fuel electric power generation

42

States and the District of Columbia employ more clean energy workers than fossil fuel workers

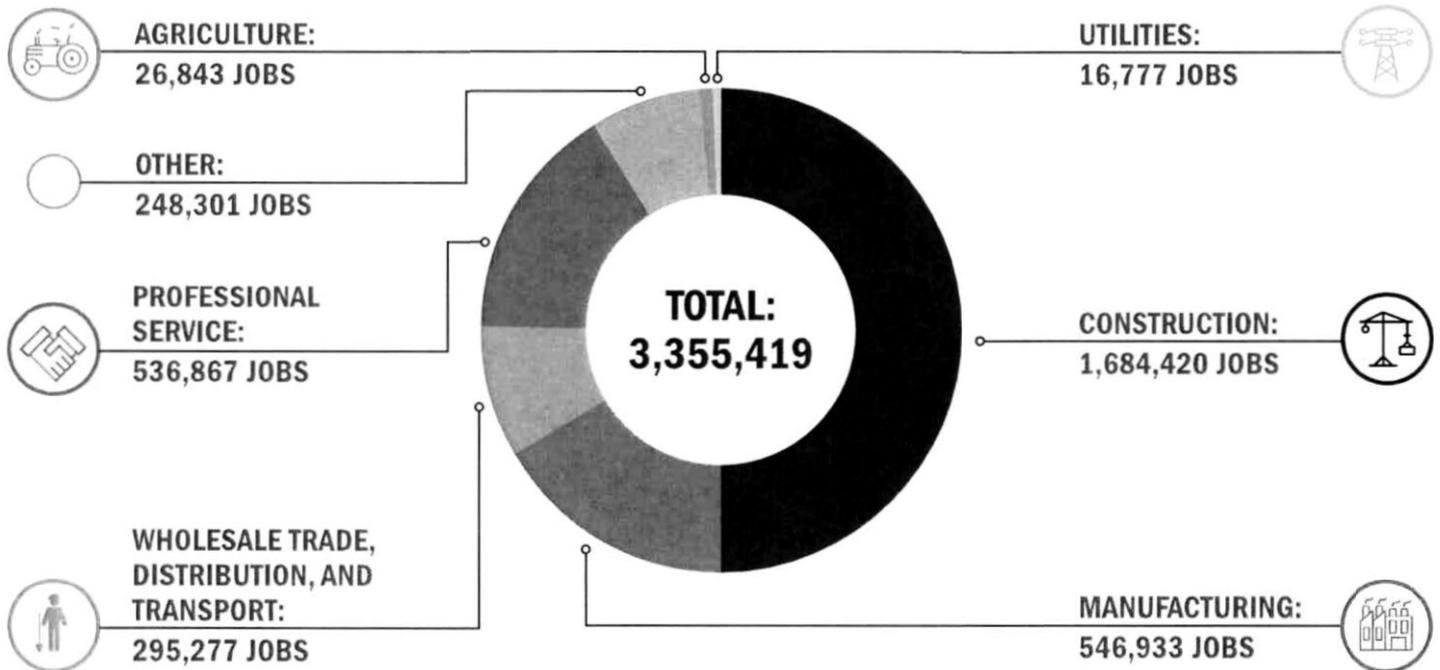
Five-Year Trend 2015–Q4 2019 Employment Growth

3.5M



CLEAN JOBS: ACROSS THE SUPPLY CHAIN

While construction and manufacturing accounted for the most clean energy jobs in the U.S. economic value chain in 2019, more than 1.1 million other clean energy workers are employed across agriculture, trade, distribution and transportation, professional services and more. Those jobs alone employed as many workers as the entire fossil fuel sector in 2019.



CLEAN ENERGY: AT THE HEART OF AMERICA'S CONSTRUCTION NEEDS

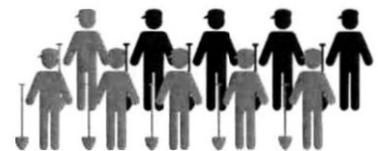
1.7 million workers in the U.S. are employed in construction work across the clean energy sector—installing new renewable energy systems, making buildings and schools more energy efficient, repairing the electric grid, and more.



ONE IN FIVE CONSTRUCTION WORKERS ARE EMPLOYED IN CLEAN ENERGY

43%

43 PERCENT OF SOLAR AND WIND ENERGY JOBS ARE IN CONSTRUCTION



NEARLY SIX IN TEN ENERGY EFFICIENCY EMPLOYEES WORK IN CONSTRUCTION

THE CASE FOR A CLEAN ENERGY-DRIVEN RECOVERY

POWERING AMERICA'S RECOVERY

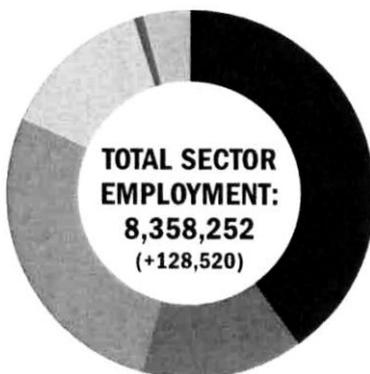
As America looks to recover from the COVID-19 pandemic in 2020 and beyond, no other part of the energy sector can deliver the economic benefits—as quickly or as significantly as clean energy.

Across the entire U.S. energy sector, clean energy jobs now represent about 40 percent of the workforce. Clean energy accounted for more than half (55 percent) of the sector's net employment growth in 2019. Not only does clean energy employ about three times the number of workers as the entire U.S. fossil fuel industry, the number of clean energy jobs added last year was nearly five times greater than fossil fuel jobs added.

Clean Energy: In the Overall Energy Economy

Energy Sector Employment Q4 2019

- Clean Energy Employment: 3,355,419 (+70,819)
- Fossil Fuel Employment: 1,190,183 (+15,440)
- Motor Vehicle Employment: 2,290,124 (+26,363)
- Trad. Transmission & Distribution Employment: 1,114,575 (+12,946)
- Nuclear Energy Employment: 70,323 (-1,823)
- Other Employment: 337,629 (+4,775)



A Closer Look: 2019 Job Growth Breakdown

Employment increased across every sector of the U.S. clean energy sector except clean vehicles, which saw record double-digit growth in 2018.

While the clean vehicle industry's employment decrease was felt in most states, at least two-thirds of all 50 states and the District of Columbia saw growth in every other sector—including all 51 in energy efficiency and 44 in renewable energy.

Small Businesses at Risk

2.2 million clean energy workers—nearly two-thirds of the entire workforce—are employed by businesses with fewer than 19 employees.

Small firms, more dependent on consistent business and access to finance, are some of the most at-risk companies in the U.S. economy due to the impact COVID-19 has had on regular commerce.

- 1-4 employees: 32.9%
- 5-19 employees: 31.5%
- 20-99 employees: 25.0%
- 100-499 employees: 8.1%
- 500+ employees: 2.5%



What is a clean energy worker?

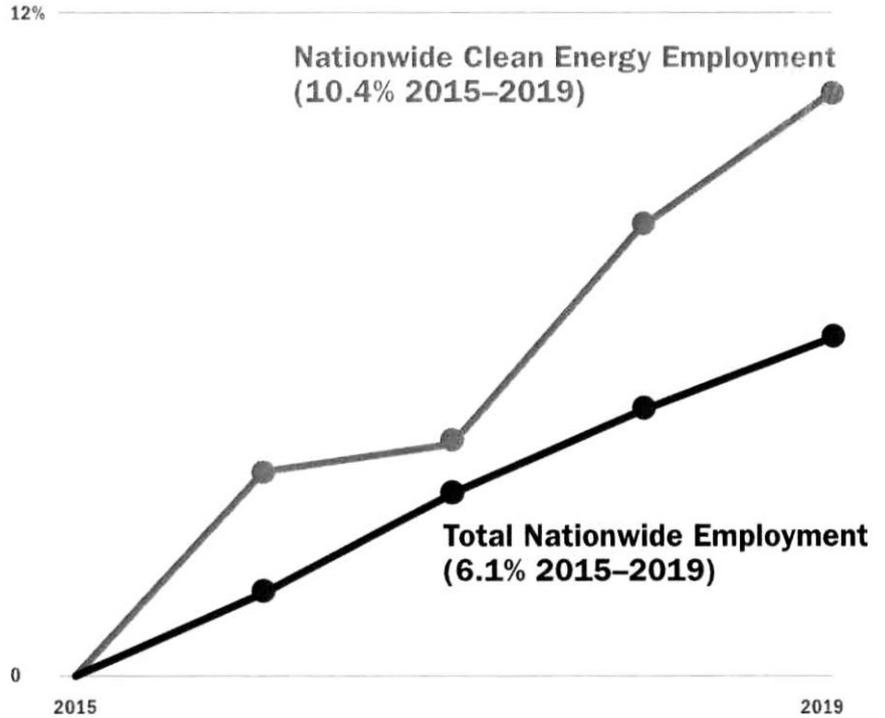
Along with size and geographic diversity, the clean energy sector spans a wide swath of the economy—meaning millions of Americans across an array of occupations and with different skillsets are being affected.

- // Energy efficiency companies employ electricians, roofers, plumbers, welders, and technicians who work in mechanical trades.
- // Solar, wind and geothermal companies employ high-tech engineers as well as hard-hatted construction workers.
- // Manufacturers in the clean energy and clean vehicles space put people to work producing everything from Low-E energy efficient windows and LED lighting to the latest energy-sipping dishwashers, clothes dryers and electric and hybrid vehicles.
- // Salespeople, marketers, energy auditors, field technicians, inspectors, line workers, mechanics, and service tech are a part of nearly every sector of the clean economy.

CLEAN ENERGY: IN THE US ECONOMY

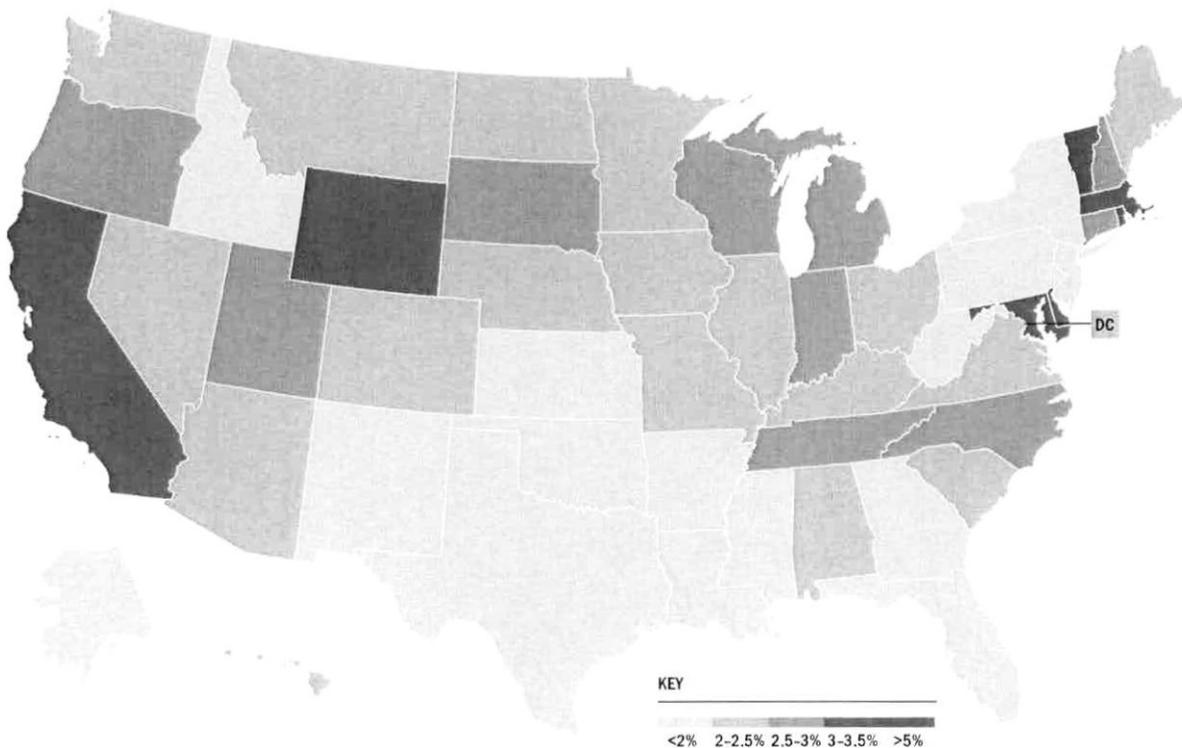
Clean energy is uniquely capable of leading America's recovery post-COVID-19. Not only has the sector proven capable of delivering results during a time of economic depression, it has the room needed to quickly expand and absorb hundreds of thousands of new job seekers, Americans who need employment in order for the economy to fully recover.

In 2019, clean energy employed a record 2.25 percent of U.S. workers nationwide, including more than 3 percent of workers in seven states. Clean energy's share of U.S. total employment was expected to increase even further in 2020. The industry has kept well ahead of total U.S. employment growth over the last five years, adding jobs 70 percent faster than the overall economy from 2015–2019.



Clean Energy Jobs: Share of Statewide Employment Q4 2019

Nationally, clean energy companies employed 2.25% of all workers in the U.S. in 2019.



GETTING AMERICA BACK TO WORK: WITH POLICIES THAT WORK

Given the extent of the economic shutdown, getting America back to work—and in ways that create a stronger, cleaner economy in the future—requires bold ideas, big initiatives and commonsense policies at both the state and federal levels.

Clean Energy Infrastructure Jobs Are Key

Big infrastructure projects have always helped America recover from economic calamity—whether it was the Pacific Railroad Act that helped get America back to work after the Civil War or the highway and public works programs that helped bring the United States out of the Great Depression. Making sure clean energy infrastructure projects are a major part of any economic recovery policies is essential to restarting our economy.

Fixing our power grid is one place to start. Estimates show that America needs to invest \$30 billion to \$90 billion⁵ to upgrade our transmission lines over the next decade in order to properly handle new renewable energy generation and repair

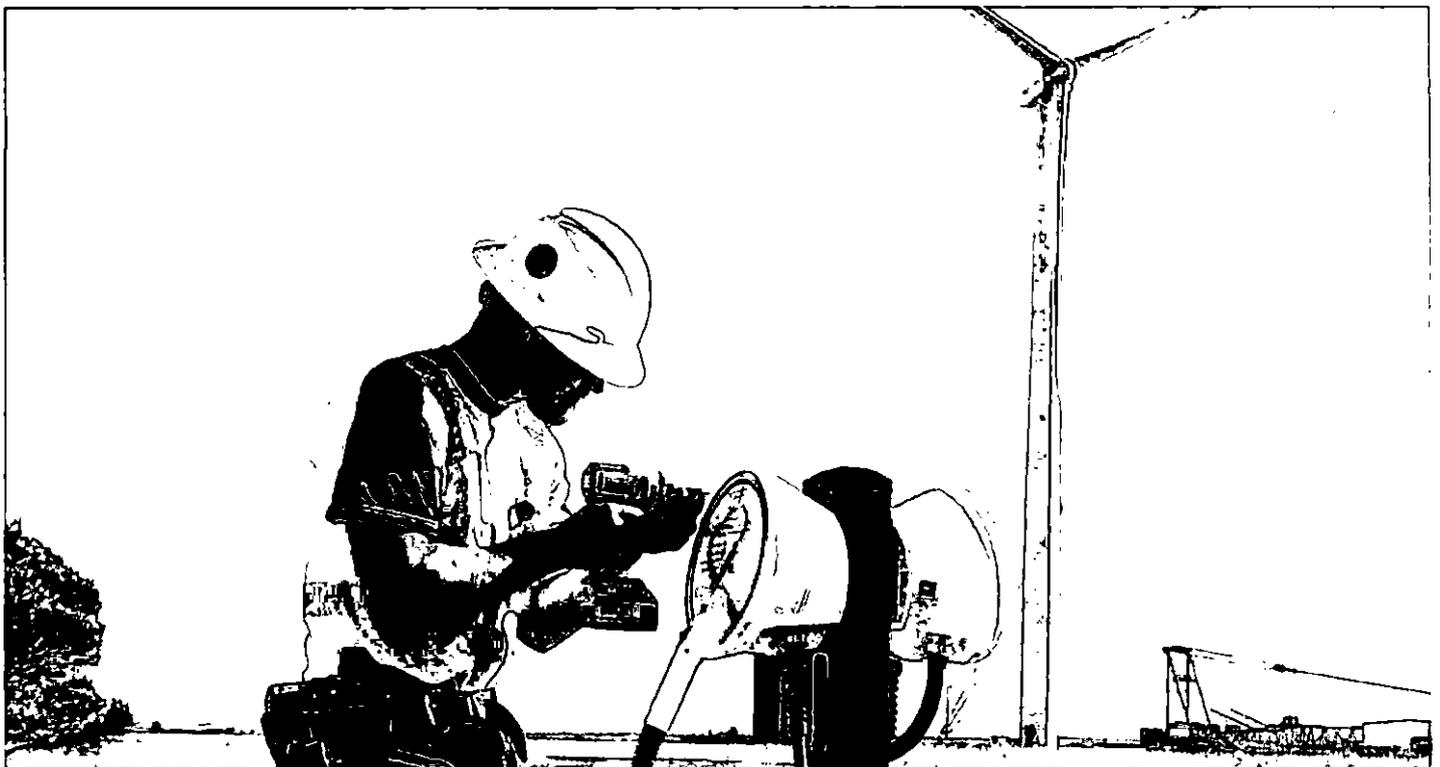
aging equipment to prevent costly disasters like wildfires. Doing so could get many of the nearly 148,000 Americans who work in grid and energy storage businesses back to work, and create tens of thousands of new jobs as well.

Building a national electric vehicle charging network also could help get the more than 160,000 American who work in electric and electric-hybrid vehicles back to work, in addition to creating tens of thousands more construction jobs across the country.

Meanwhile, an estimated 70 million American homes and businesses rely on natural gas, oil or propane for heating, cooking, and warming up bath water.

Additionally, commercial buildings account for about 40 percent of all energy consumed in the United States and over one-third of the country's carbon dioxide emissions.

A nationwide program to electrify our buildings could help put some of the nearly 2.4 million energy efficiency workers in America back to work and create tens of thousands of new jobs too. One place to start: The nation's 98,000 public schools, most of which will remain closed for students and staff for months because of COVID-19. Tens of thousands of other government-owned buildings at the more than 800 U.S. military bases also are badly in need of energy upgrades and electrification.



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SPECIFIC CONGRESSIONAL ACTIONS THAT CAN GET AMERICA BACK TO WORK REBUILDING A CLEAN ECONOMY

TREASURY DEPARTMENT

- // Reinstating the Section 1603 program to deliver payments directly to clean energy developers and suppliers now, rather than make them wait to claim these credits in tax filings. And expand the program to cover energy storage and energy efficiency projects.⁶
- // Extend federal clean energy incentive deadlines to account for COVID-19 related delays and to secure the projects and jobs relying on their funding— including “Safe Harbor” and “in construction” deadlines.

INTERNAL REVENUE DEPARTMENT

Extend, expand and reform clean energy incentives, through the following bills:

- // H.R. 2096/S. 1142, “The Energy Storage Tax Incentive and Deployment Act of 2019”
- // H.R. 3961/S. 2289, “The Renewable Energy Extension Act”
- // H.R. 4887/S. 1988, “The Offshore Wind Power Act”, and S. 1957/H.R. 3473, “The Incentivizing Offshore Wind Power Act”
- // H.R. 2256/S. 1094, “The Driving America Forward Act”
- // Extend the Production Tax Credit (PTC) for wind as included in the House Ways and Means Committee’s GREEN Act proposal
- // H.R. 4506/S. 2588, “Home Energy Savings Act”; H.R.4646/S. 2595, “New Home Energy Efficiency Act”.

DEPARTMENT OF ENERGY

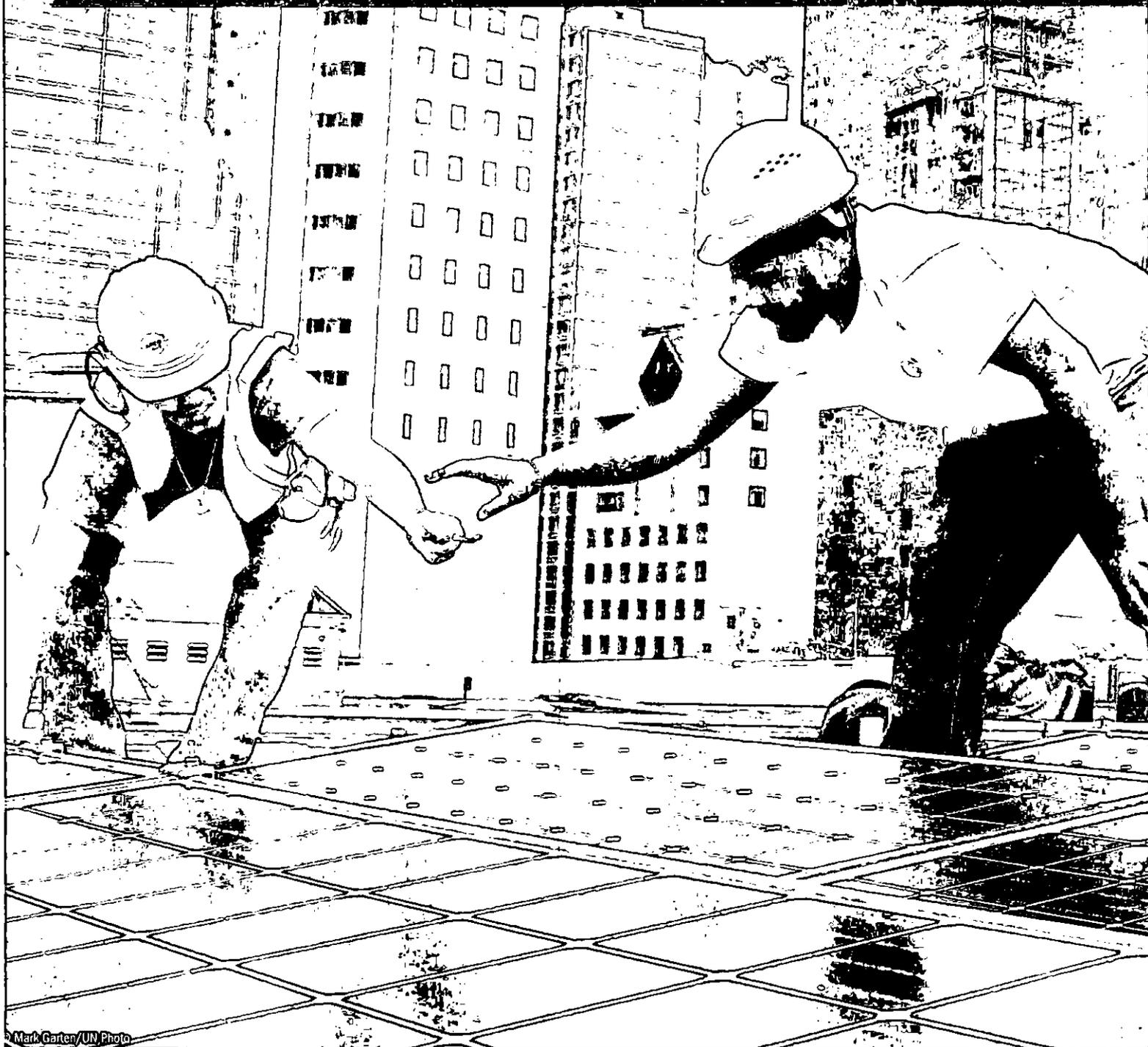
Increase funding for:

- // The Federal Loan Guarantee Program and the Advanced Research Projects Agency-Energy (ARPA-E), to immediately spur innovation and new opportunities as the economy recovers.
- // The Weatherization Assistance Program, which provides funding for cost-saving energy efficiency upgrades for low-income households. The program has supported more than 8,000 jobs and provides weatherization services to 35,000 homes every year.
- // Clean energy demonstration programs, including for large-scale energy storage, advanced renewable energy technologies, clean transportation solutions, clean industrial projects, and clean hydrogen and other zero-carbon fuels.
- // Advanced construction of net-zero-carbon building retrofits for low-income homes.
- // Clean energy job training to help those isolated due to COVID now and to reduce unemployment and help displaced workers find new careers in clean energy during recovery. This should include increasing funding for DOE clean energy job training as well as funding community colleges and other certified institutions or organizations to create and grow clean energy training programs.
- // Resurrect the Energy Efficiency and Conservation Block Grant program for states that can be used to immediately launch job-intensive renewable energy projects and energy efficiency programs for K-12 schools and municipal buildings.

DEPARTMENT OF TRANSPORTATION

- // Invest in clean cars and clean vehicle infrastructure through legislation such as the Clean Corridors Act of 2019 and the EV Freedom Act to immediately create jobs, expand the nation’s electric vehicle charging and clean fuel networks
- // Support a nationwide vehicle trade-in program to get cleaner, more efficient and cost-effective cars in production and to consumers.

American cities across the country were hubs for growing clean energy jobs and businesses in 2019 while rural districts and small communities increasingly made their mark.

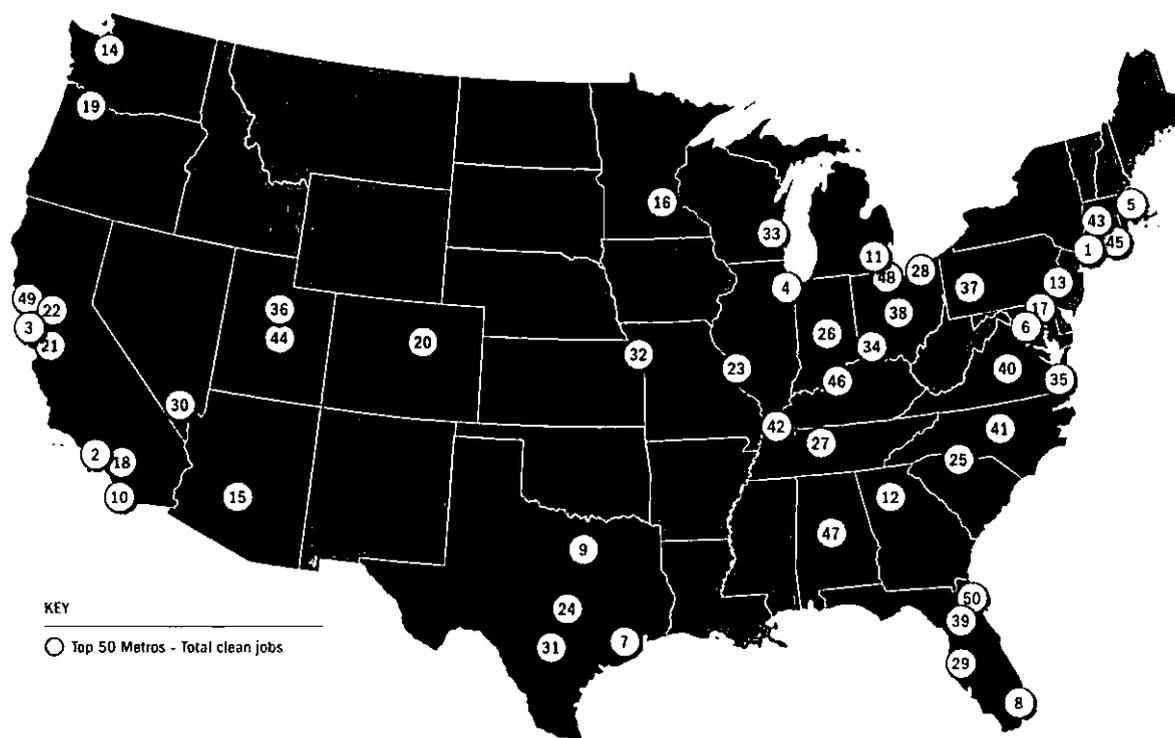


AMERICA'S CLEAN JOB ENGINES IN 2019

35 states and the District of Columbia were home to a Top 50 metropolitan statistical areas (MSAs) for clean energy jobs in 2019, and 15 states had at least two or more metros represented.

In total, the Top 50 metro areas accounted for 1.9 million of the nation's nearly 3.4 million clean jobs at the start of 2020.

Clean Jobs Cities: Top 50 Metros By Total Clean Energy Employment Q4 2019



Rank	Metro	Clean Energy Jobs*
1	New York City, NY-NJ-PA	152,267
2	Los Angeles, CA	146,394
3	San Francisco-Oakland, CA	122,813
4	Chicago, IL-IN-WI	102,850
5	Boston, MA-NH	95,966
6	Washington, DC-VA-MD-WV	88,991
7	Houston, TX	64,924
8	Miami, FL	60,963
9	Dallas-Fort Worth, TX	58,554
10	San Diego, CA	58,094
11	Detroit, MI	55,466
12	Atlanta, GA	55,085
13	Philadelphia, PA-NJ-DE-MD	49,510
14	Seattle, WA	48,345
15	Phoenix, AZ	47,462
16	Minneapolis-St. Paul, MN-WI	42,021
17	Baltimore, MD	38,860

Rank	Metro	Clean Energy Jobs*
18	Riverside-San Bernardino, CA	38,440
19	Portland, OR-WA	35,683
20	Denver, CO	34,823
21	San Jose, CA	32,643
22	Sacramento, CA	32,208
23	St. Louis, MO-IL	27,057
24	Austin, TX	26,297
25	Charlotte, NC-SC	25,001
26	Indianapolis, IN	24,822
27	Nashville, TN	24,168
28	Cleveland, OH	22,399
29	Tampa-St. Petersburg, FL	22,071
30	Las Vegas, NV	22,042
31	San Antonio, TX	21,307
32	Kansas City, MO-KS	20,835
33	Milwaukee, WI	20,505
34	Cincinnati, OH-KY-IN	20,389

Rank	Metro	Clean Energy Jobs*
35	Virginia Beach, VA-NC	18,412
36	Salt Lake City, UT	18,135
37	Pittsburgh, PA	18,116
38	Columbus, OH	16,890
39	Orlando, FL	16,870
40	Richmond, VA	16,424
41	Raleigh-Cary, NC	16,126
42	Memphis, TN-AR-MS	14,921
43	Hartford, CT	14,869
44	Provo, UT	14,842
45	Bridgeport, CT	14,323
46	Louisville, KY-IN	14,186
47	Birmingham, AL	13,298
48	Toledo, OH	12,823
49	Santa Rosa, CA	11,301
50	Jacksonville, FL	11,116

* Total includes renewable energy, energy efficiency, clean vehicles, battery storage, advanced biofuels, low-impact hydro and other sectors.

BEYOND THE BIG CITIES

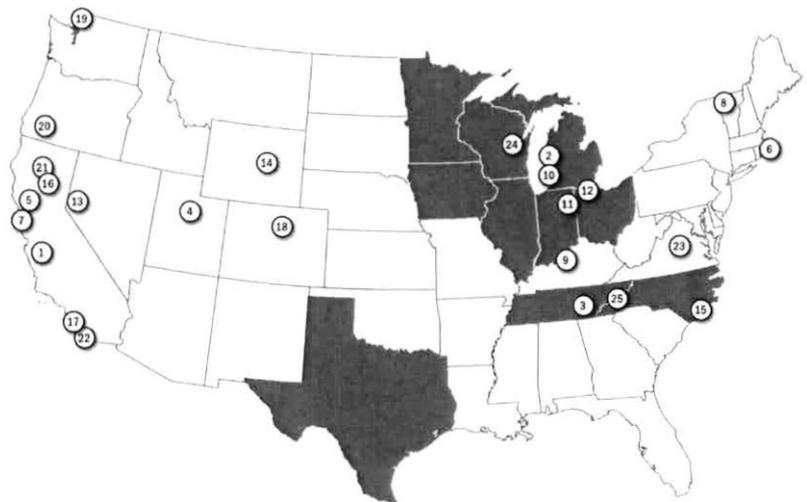
While the largest metros are home to most clean energy jobs, many smaller and mid-sized metro areas are seeing clean energy businesses make an even greater impact per capita. Among the metro areas with the largest share of clean energy jobs in their total workforce, 22 of the top 25 have populations under 500,000.

Clean Jobs Cities: Metros with Largest Share of Clean Energy Workers as Share of Total Workforce⁷ Q4 2019

Rank	Metro	Clean Energy Jobs	Share of Total Employment
1	San Luis Obispo-Paso Robles, CA	11,050	8.8%
2	Holland-Grand Haven, MI	3,538	8.6%
3	Cleveland, TN	3,071	6.4%
4	Provo, UT	14,842	5.4%
5	Santa Rosa, CA	11,301	5.2%
6	Barnstable Town, MA	4,953	4.9%
7	San Francisco-Oakland, CA	122,813	4.9%
8	Burlington, VT	5,609	4.3%
9	Elizabethtown, KY	2,541	4.3%
10	Niles-Benton Harbor, MI	2,685	4.2%
11	Fort Wayne, IN	8,625	4.0%
12	Toledo, OH	12,823	4.0%
13	Reno-Sparks, NV	9,807	4.0%
14	Casper, WY	1,571	3.9%
15	Wilmington, NC	5,121	3.9%
16	Chico, CA	3,325	3.8%
17	Santa Barbara, CA	8,094	3.8%
18	Boulder, CO	7,372	3.8%
19	Bellingham, WA	3,638	3.8%
20	Medford, OR	3,387	3.7%
21	Redding, CA	2,532	3.6%
22	San Diego, CA	58,094	3.6%
23	Charlottesville, VA	4,307	3.6%
24	Oshkosh-Neenah, WI	3,403	3.5%
25	Asheville, NC	7,177	3.5%

America's rural communities are also reaping the rewards, accounting for more than 430,000 jobs in 2019 led by Midwestern and Southern states.

City & Country: Top states for rural clean energy jobs; top metros by share of total workforce



KEY

- Top States - Rural clean jobs
- Top 25 Metros - Clean jobs per capita

Clean Jobs Rural America: Top 10 States for Rural Clean Energy Jobs* Q4 2019

Rank	State	Rural Clean Energy Jobs
1	North Carolina	28,894
2	Michigan	24,954
3	Texas	23,904
4	Wisconsin	19,513
5	Ohio	17,513
6	Indiana	16,009
7	Tennessee	14,725
8	Iowa	14,244
9	Minnesota	13,845
10	Illinois	13,502

*Rural clean energy jobs are calculated based on the Bureau of Labor Statistics' (BLS) nonmetropolitan area for every state, which is any area not designated as a metropolitan area by BLS.⁸

Methodology

The analysis expands on data from the 2020 U.S. Energy and Employment Report (USEER) produced by the Energy Futures Initiative (EFI) in partnership with the National Association of State Energy Officials (NASEO), using data collected and analyzed by the BW Research Partnership. The USEER analyzes data from the U.S. Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW) to track employment across many energy production, transmission, and distribution subsectors. In addition, the 2020 USEER relies on a unique supplemental survey of 30,000 business representatives across the United States. Created and conducted by BW Research and approved by the Office of Management and Budget and U.S. Department of Energy (DOE), this survey is used to identify energy-related employment within key subsectors of the broader industries as classified by the BLS and to assign them into their component energy and energy efficiency sectors.

E2 is a partner on the USEER, which was first released by the Department of Energy in 2016. The 2020 USEER was released on March 23, 2020 and is available at www.usenergyjobs.org.

An FAQ is also [available here](#) to answer any questions.



About E2

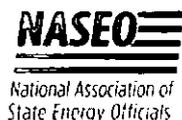
E2 (Environmental Entrepreneurs) is a national, nonpartisan group of business leaders, investors, and professionals from every sector of the economy who advocate for smart policies that are good for the economy and good for the environment. E2 members have founded or funded more than 2,500 companies, created more than 600,000 jobs, and manage more than \$100 billion in venture and private equity capital.

E2 releases more than a dozen clean energy employment reports annually—including Clean Jobs America—with state-specific reports covering more than 20 states every year. Clean energy jobs have grown every year since the first national report was released in 2016.

For additional insight into E2's Clean Jobs America 2020 or our other annual Clean Jobs America reports, visit e2.org/reports.

THANKS TO SUPPORT FROM:

E2 wishes to express its appreciation to the **National Association of State Energy Officials** (NASEO), the **Energy Futures Initiative** (EFI) and **BW Research Partnership** ("BWRP") who made this report possible by producing the USEER and its underlying data.



ENDNOTES

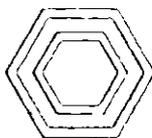
- 1 Unless otherwise stated, all data is from the 2020 U.S. Energy and Employment Report (USEER), March 2020, NASEO and EFI. All employment findings in USEER is based on survey and data analysis collected from Q4 2019 prior to any onset of the COVID-19 crisis. See Pages 201-206 for methodology questions, available at www.usenergyjobs.org.
- 2 <https://www.bls.gov/oes/tables.htm>.
- 3 BW Research Partnership: Clean Energy Employment Initial Impacts from the COVID-19 Economic Crisis from, March 2020, available at www.e2.org/reports/clean-jobs-covid-economic-crisis-march-2020.
- 4 <https://obamawhitehouse.archives.gov/the-press-office/2016/02/25/fact-sheet-recovery-act-made-largest-single-investment-clean-energy>.
- 5 https://wiresgroup.com/wp-content/uploads/2019/03/Electrification_BrattleReport_WIRES_FINAL_03062019.pdf.
- 6 <https://home.treasury.gov/policy-issues/financial-markets-financial-institutions-and-fiscal-service/1603-program-payments-for>.
- 7 Economic Modeling Specialists, Intl. (EMSI) 2019.
- 8 <https://www.ers.usda.gov/topics/rural-economy-population/rural-classifications/what-is-rural>.

E-15

10TH ANNUAL

NATIONAL SOLAR JOBS CENSUS 2019

FEBRUARY 2020



The

SOLAR

FOUNDATION™

for a bright future

ABOUT



The Solar Foundation

The Solar Foundation® is a national 501(c)(3) nonprofit organization whose mission is to accelerate adoption of the world's most abundant energy source. Through its leadership, research, and capacity building, The Solar Foundation creates transformative solutions to achieve a prosperous future in which solar and solar-compatible technologies are integrated into all aspects of our lives. In 2010, The Solar Foundation conducted its inaugural *National Solar Jobs Census*, 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, The Solar Foundation has conducted an annual *Census* in each of the past 10 years to analyze trends and track changes over time.

About BW Research Partnership

BW Research Partnership is a full-service, economic and workforce research consulting firm with offices in Carlsbad, California, and Wrentham, Massachusetts. It is the nation's leading provider of accurate, comprehensive clean energy research studies, including the *National Solar Jobs Census*, wind industry analyses for the National Renewable Energy Laboratory and the Natural Resources Defense Council, and state level clean energy reports for Massachusetts, New York, Illinois, Vermont, Iowa, and Florida, among others.

ACKNOWLEDGEMENTS

We extend our gratitude to all The Solar Foundation's organizational and individual sponsors. Without their support, the tenth annual *National Solar Jobs Census* would not have been possible.

The Solar Foundation and BW Research Partnership would also like to thank all the solar employers who participated in the survey. Your responses were critical in providing us with accurate and timely data.

Thanks to the Energy Futures Initiative and the National Association of State Energy Officials for their assistance providing solar + storage employment data. A report from these organizations, forthcoming in 2020, will include jobs numbers across other energy industries as well as the solar employment data from this *National Solar Jobs Census*.

Unless otherwise indicated, all solar jobs data for 2010-2018 derive from The Solar Foundation's *National Solar Jobs Census* report series, available at SolarJobsCensus.org.

Special thanks to our institutional sponsors, including Energy Foundation, Tilia Fund, McKnight Foundation, the California Energy Commission, D.C. Department of Energy & Environment, and Virginia Department of Mines, Minerals, and Energy.

Thanks to The Solar Foundation's individual members for their support, including Silver Members Jonathan Abe, Daniel Dus, Mark Joyce, William Hopkins, Chikoma Kazunga, Nicholas Lutsey, James Mendelsohn, and Rhoda Springer, along with all others who provided generous donations to The Solar Foundation.

Additional thanks to our Bronze and Member level organizational sponsors. For a complete list of supporters, visit SolarJobsCensus.org.

The lead author on this report is Ed Gilliland, Senior Director at The Solar Foundation. Additional authors include Mary Van Leuven, Dave Golembeski, and Avery Palmer. The Solar Foundation thanks Susan DeVico and Sam Boykin for their assistance with communications and outreach, and Top Shelf Design for designing the report layout. Report reviewers were Justin Baca, Shawn Rumery, Rachel Goldstein, Ryan Young, and Mitchell Schirch.

For technical questions about the report, please contact:

Ed Gilliland

The Solar Foundation, Senior Director
egilliland@solarfound.org, 202-866-0918

For press and media inquiries, please contact:

Avery Palmer

The Solar Foundation, Communications Director
apalmer@solarfound.org, 202-866-0908

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TESTIMONIALS

"There's no doubt about it: The solar industry is a major employer and an increasingly important part of our economy. It would benefit lawmakers to remember the hundreds of thousands of Americans who now work in solar in every state in our country as they consider policies that can keep these good-paying jobs growing for a long time to come."

– Bob Keefe, Executive Director, E2 (Environmental Entrepreneurs)

"The outlook for solar in America has never been brighter. The 2020s are beginning with record installations, stellar job totals, and strong workforce diversification. Q CELLS could not be prouder to be a leading U.S. solar manufacturer during these exciting times."

– Scott Moskowitz, Q CELLS, Director of Market Intelligence and Public Affairs

"With solar development continuing to gain momentum, as more utilities and businesses commit to clean energy goals, rural and urban communities across the nation are realizing the economic development potential of including solar into their clean energy mix. As a result, recruiting, training and retaining a robust skilled workforce has been a growing priority for us and others in our industry. Thanks to the efforts

by our team to refine and expand our workforce development programs, we're introducing new workers to promising careers in solar construction. It's an exciting time in solar!" – **Scott Canada, Senior Vice President of McCarthy Building Companies Solar Energy and Storage Group**

"It's exciting to see employment in the solar industry continue to grow, which we see as part of a long term secular shift to renewable energy. We are humbled to support the growth of this market by making solar easier and cheaper to design and sell." – **Samuel Adeyemo, Co-founder of Aurora Solar Inc.**

"Nautilus Solar is excited to contribute to America's solar jobs expansion with community solar projects under development and construction across the country. In Maryland, we are making a difference in LMI communities with the addition of nine community solar projects that will make affordable solar accessible to low-to-moderate income households. We're proud that these projects are contributing to Maryland's overall growth in solar jobs and support job training programs that benefit local communities." – **Laura Stern, Co-CEO, Nautilus Solar Energy**

"The solar industry is an American success story, and NEXTracker is proud to contribute to American solar jobs growth as the world's leading solar tracking company. As the new decade begins, we look forward to building the pipeline of new solar projects that will help revitalize local economies and put even more people to work." – **Bruce Ledesma, President, NEXTracker**

"As innovation enables the mainstreaming of solar, we're met with a progressively diverse customer base that needs to be matched by an equally diverse workforce. This drives us to hire forward-thinking contributors with a range of skills and experiences to deliver even more intelligent solar, storage and energy services to businesses and homeowners nationwide." – **Tom Werner, SunPower CEO and Chairman of the Board**

"U.S. Bank does all of its tax investing through its subsidiary, U.S. Bancorp Community Development Corporation. As the name would suggest, our group is heavily focused not just on the return to shareholders but the economic and social returns to the communities we serve. That is why we find jobs impact data to be so compelling and we are grateful to play a small but meaningful role in what has been an amazing economic success story all across the country." – **Dan Siegel, Senior Vice President, U.S. Bank**

"As one of the leading providers of renewable energy, RWE has ambitious plans for continuous investment in solar energy. Our expertise, skill, and experience allows us to proudly contribute to the exciting opportunities that lie ahead in this fast-growing business." – **Silvia Ortin, COO Onshore Wind and Solar PV Americas, RWE Renewables**

"With a diverse workforce, Sunnova strives to find the best and brightest team members to provide excellent service to its customers, solve the technology and service challenges of an evolving industry, and support long-term growth and profitability as a leader in the residential solar energy space. We look forward to contributing to future solar job growth." – **William J. (John) Berger, Chief Executive Officer, Sunnova Energy International Inc.**

"As we continue to build toward our Solar + Decade goals, we need to remain focused on increasing diversity within the solar industry. The solar industry has jobs and growth potential for everyone, and through united recruitment and training efforts, we'll continue to provide more opportunities for more Americans." – **George Hershman, President of Swinerton Renewable Energy and Board Chair of the Solar Energy Industries Association (SEIA)**

"At Southern Current, we're excited to contribute to job growth in the U.S. solar industry, including within the growing regional market in the Southeastern United States. With women making up only 26% of the solar workforce, the latest Solar Jobs Census data is a reminder that the industry needs to double its efforts to recruit women and promote them to leadership roles." – **Steffanie Dohn, Director of Government Relations, Southern Current**



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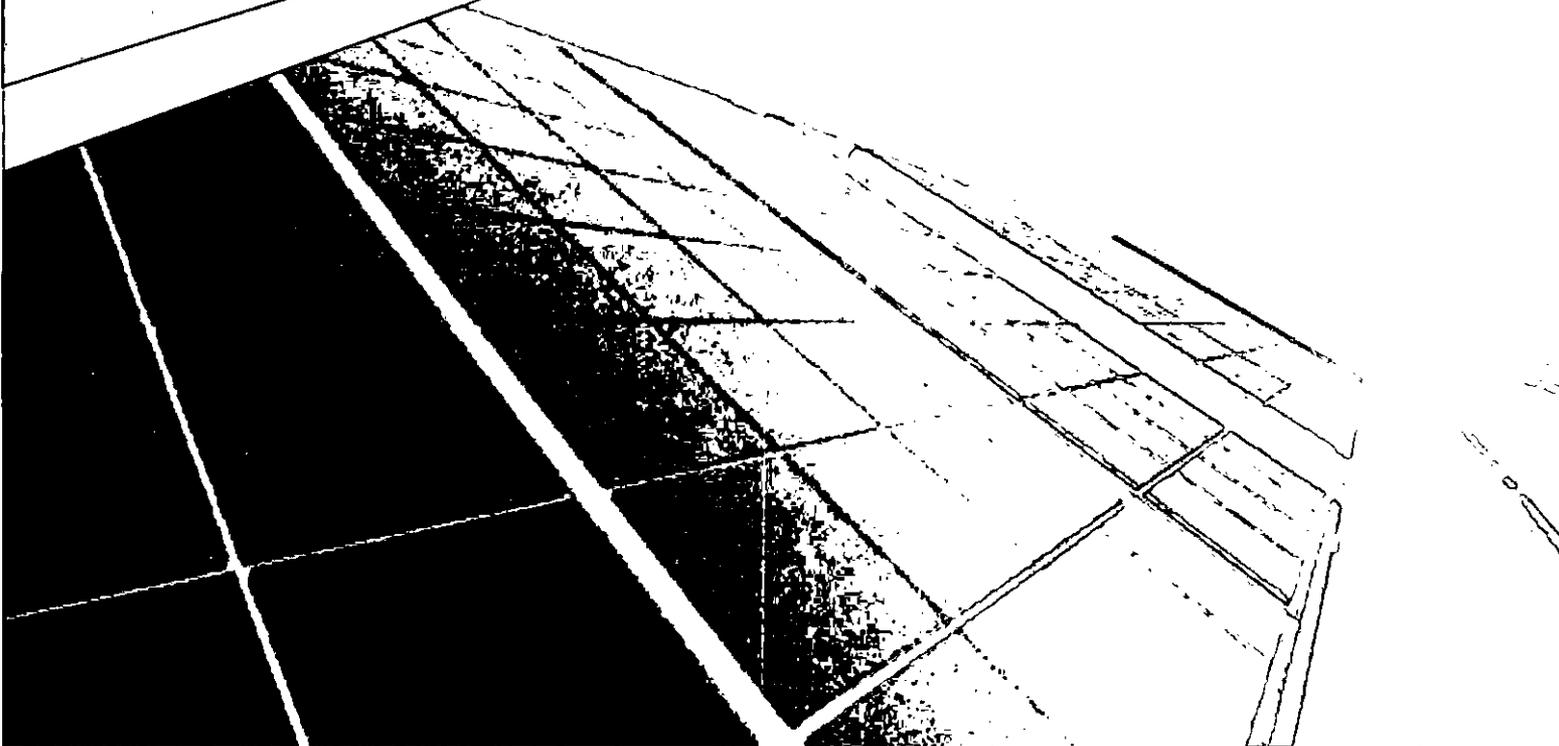
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EXECUTIVE SUMMARY



10th Annual National Solar Jobs Census

The Solar Foundation's *National Solar Jobs Census 2019* is the tenth annual report on current employment and workforce trends in the U.S. solar industry, nationwide and state by state. Based on a rigorous survey of U.S. companies, this report represents the most comprehensive analysis of solar labor market trends in the United States.

As of November 2019, the solar industry employs nearly 250,000 solar workers, representing a growth of 2.3%, or 5,643 jobs, since 2018. This growth contrasts with job losses in 2017 and 2018 but continues the seven years of well-documented growth from 2010 to 2016. Annual data from the *National Solar Jobs Census* has found that since 2010, solar employment has grown 167%, from just over 93,000 to 249,983 jobs in all 50 states, the District of Columbia, and Puerto Rico.

The most important reason for the growth in solar jobs from 2018 to 2019 was a significant increase in the capacity of solar installations over the previous year. This industry expansion can be attributed to several factors, including:

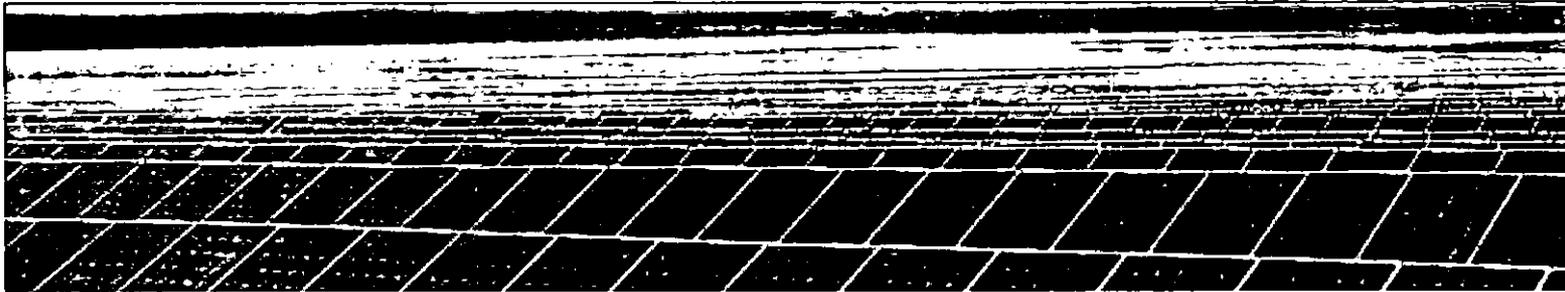
- ◇ **Declining solar costs.** As solar installation costs continue to decline, more projects provide favorable returns on investment, even in states with lower electricity rates.
- ◇ **The phaseout of the federal investment tax credit.** Since 2019 was the last year the full 30% investment tax credit was available, there was a rush to install solar, especially in the residential solar market segment which has a shorter development cycle.
- ◇ **Waning concerns about the impacts of Section 201 tariffs.** The February 2018 tariffs on solar cells and modules depressed 2018 solar jobs. By 2019, the impact had been largely mitigated by lower global prices on these components.

SOLAR JOB TRENDS IN 2019

This report includes up-to-date information on solar jobs by state, industry sector, and within demographic groups, as well as employer predictions on future job growth. Other major findings on the U.S. solar workforce, as of November 2019, are as follows:

- ◇ **31 states saw solar job growth in 2019, including many states with emerging solar markets.** States that experienced significant gains in employment included Florida (+1,843 jobs), Georgia (+1,102), Utah (+1,062), New York (+1,011), and Texas (+649).

The most important reason for the growth in solar jobs from 2018 to 2019 was a significant increase in the capacity of solar installations over the previous year.

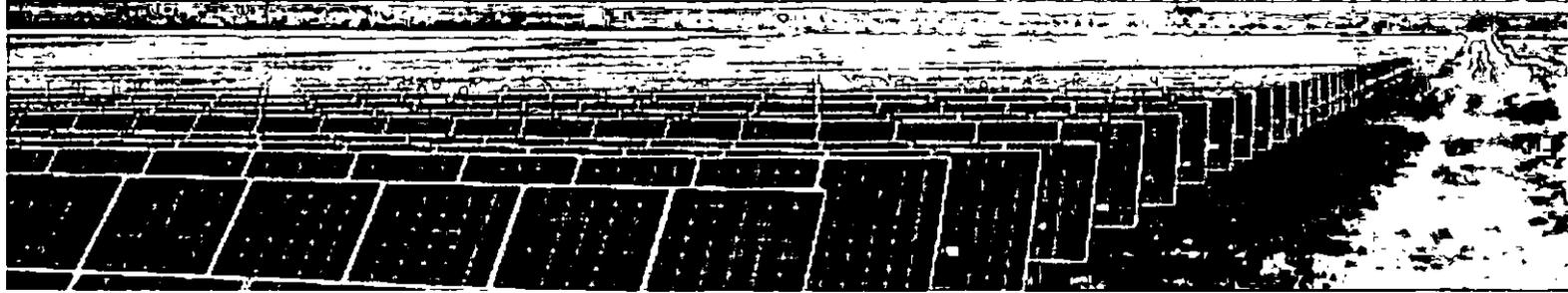


The states that experienced the largest job reductions between 2018 and 2019 include California (-2,583 jobs), Tennessee (-496), Michigan (-293), Minnesota (-267), and Washington (-264). California, home to about 40% of U.S. solar capacity, still has by far the most solar jobs nationwide.

- ◇ Solar installation companies reported that about 16,000 jobs, or 10% of the total at installation companies, focused on battery storage. Separately, within firms where battery storage is the primary focus, there were 14,638 jobs directly linked to solar.*
- ◇ As solar energy has taken hold in the United States, the job market has expanded rapidly over the past decade. In the five-year period between 2014 and 2019, solar employment increased 44% overall, adding 76,000 jobs, which is about five times faster than job growth in the overall U.S. economy. Since 2010, solar employment has grown 167%, from just over 93,000 to nearly 250,000 jobs.
- ◇ Solar represents about 2.6% of overall U.S. electricity generation, yet it employs almost twice as many workers as the coal industry. In the energy sector, only the oil/petroleum and natural gas industries have more employment than solar.[†]
- ◇ Demand-side sectors (comprised of the installation and project development sector, and the wholesale trade and distribution sector) make up 77% of overall solar industry employment, while manufacturing represents 14% of the total. Operations and maintenance comprise just under 5%, and the “other” sector, which includes engineering, legal, and financing firms, represents just under 5%.
- ◇ About 162,000 solar jobs, or 65% of the total, are in the installation and project development sector. Of these, 56% are focused on the residential market segment, 25% focus on non-residential, and 19% are utility-scale.
- ◇ Respondents to the *Solar Jobs Census* survey predicted that total U.S. solar industry employment would reach about 269,500 jobs by the end of 2020, a 7.8% increase year over year.

* The 14,638 solar related workers at battery storage companies are not included in the solar jobs total, but will be listed in the forthcoming U.S. Energy and Employment Report (USEER), to be published by the Energy Futures Initiative and the National Association of State Energy Officials.

† Based on a comparison with 2018 data for other energy industries, the latest year of complete data available. See National Association of State Energy Officials and Energy Futures Initiative, *The 2018 U.S. Energy and Employment Report*, May 2018, <https://www.usenergyjobs.org/>.



THE U.S. SOLAR WORKFORCE

- ◇ In 2019, women represented 26% of the solar workforce, Latino or Hispanic workers represented 17%, Asian workers comprised 9%, and black or African American workers comprised 8%. The percentage of solar workers who are veterans was 8%. These figures are similar to what the *National Solar Jobs Census* reported for 2018.
- ◇ Twenty-six percent of solar establishments overall and 33% of installation companies reported that it was “very difficult” to find qualified candidates to fill open positions, the same reported difficulty hiring as 2018.
- ◇ Solar establishments required experience for 45% of their new hires, lower than the 60% of establishments that required experience in 2018. The proportion of new hires requiring bachelor’s degrees (28%) was higher than the 21% reported in 2018.
- ◇ Solar industry wages remain competitive with similar industries and above the national median wage (\$18.58) for all occupations.¹ The median reported wage for non-electrician photovoltaic (PV) installers is \$16.00 for entry-level workers and \$23.00 for mid-level workers. The median reported wage for electrician PV installers is \$20.00 for entry-level workers and \$28.00 for mid-level workers.

*Between 2014 and 2019,
solar jobs grew five times faster
than the overall economy.*

KEY FINDINGS

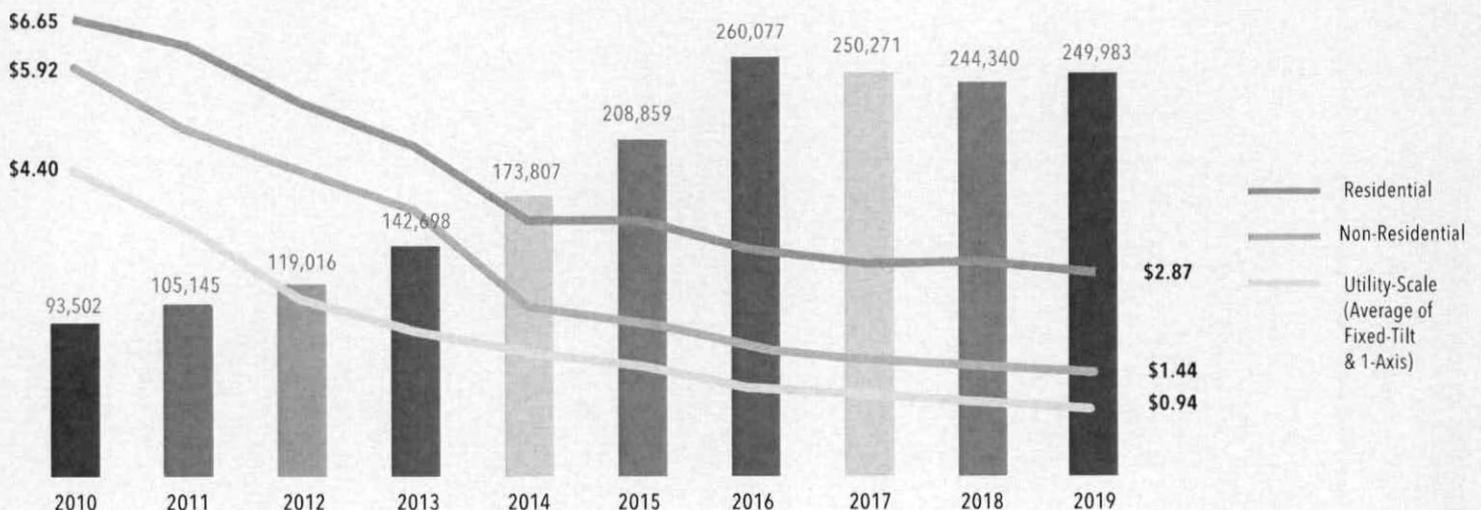
The *National Solar Jobs Census 2019* is The Solar Foundation's tenth annual review of employment in the U.S. solar energy industry, nationwide and state by state. It represents the most comprehensive and rigorous analysis of solar labor market trends in the United States. This report provides original data on the solar industry's role as a job creator and economic engine over the past decade, along with detailed information on the U.S. solar workforce.

The *National Solar Jobs Census 2019* includes data gathered between October and November 2019 from known and potential solar energy establishments or locations.* The combined survey effort included approximately 66,900 phone calls and over 47,000 emails. Information was gathered from 2,766 establishments, of which 1,859 completed or substantially completed the survey. This level of sampling rigor provides a margin of error of +/- 2.27% for the national jobs data.†

For its top-line numbers, the *National Solar Jobs Census* applies a rigorous test in counting solar jobs across

Figure 1

INSTALLED SOLAR PV COSTS BY SEGMENT COMPARED TO SOLAR EMPLOYMENT GROWTH, 2010-2019



Note: Puerto Rico was not included in the solar jobs count prior to 2018.

Sources: The Solar Foundation, National Solar Jobs Census; Wood Mackenzie, Limited, and the Solar Energy Industries Association, U.S. Solar Market Insight.

* An establishment or location is where work is performed, such as a small firm with one office or a branch office of a larger firm.

† For more information on the National Solar Jobs Census methodology, see Appendix C, p 52.



the United States. Since 2010, The Solar Foundation has defined a solar job as one held by a worker spending at least 50% of his or her time on solar-related work. Census findings have consistently shown that roughly 90% of these workers (91.4% in 2019) spend 100% of their time on solar-related work.

As of November 2019, the solar industry supports 249,983 jobs at 28,422 locations in all 50 states, the District of Columbia, and Puerto Rico. This represents an increase of 2.3%, or 5,643 more jobs, since the 2018 *Solar Jobs Census*.^{*} This growth is a rebound from the decline in solar jobs over the previous two years, following seven years of steady job growth from 2010 to 2016. Since 2010, the solar industry has grown dramatically in both jobs and added capacity as installation costs have plummeted (Figure 1). Solar employment grew by 167% from 2010 to 2019, adding 156,481 jobs. The 13 GW in installations expected in 2019 is almost 14 times the 849 MW installed in 2010.²

In 2019, there were an additional 94,549 workers who spent less than half their time on solar-related work, for a total of 344,532 workers who spent all or part of their time on solar. This represents a 2.7% increase from 2018, and a 14.8% increase from 2015.[†]

The increase in solar jobs during 2019 corresponds with a growth in solar installations over the previous year. The most recent *U.S. Solar Market Insight*[®] report found the United States added about 7.1 GW of new installed solar capacity through Q3 2019, 10% above the total for the same period in 2018. This growth reflects an increase in both residential rooftop installations and utility-scale development.

Several factors supported this growth. First, the federal solar investment tax credit (ITC) was scheduled to drop from 30% to 26% on January 1, 2020. Particularly for residential solar, that meant there was a rush to install panels before the end of the year, generating more jobs. For utility-scale projects, which have a longer development cycle, there was also a rush to get projects started to qualify for the full tax credit. These projects may not be completed until 2020 or later, which will likely drive additional job growth in future years.³

In 2018, one of the key factors behind the decline in solar jobs was the impact of the Section 201 tariffs imposed on solar modules and cells in February of that year. Starting in early 2017 when the trade petition was pending, developers opted to delay many utility-scale projects due to industry uncertainty, supply shortages, and increasing module prices. Ultimately, the delays resulted in less installed capacity than previously expected in 2018 and a corresponding loss in jobs.⁴

^{*} The National Solar Jobs Census began collecting jobs data for Puerto Rico in the 2018 report. The National Solar Jobs Census 2018 reported 242,343 solar jobs in all 50 states and the District of Columbia, and 244,340 jobs with Puerto Rico included.

[†] This solar jobs data, along with jobs totals for other energy industries, will be listed in the forthcoming *U.S. Energy and Employment Report (USEER)*, to be published by the Energy Futures Initiative and the National Association of State Energy Officials.

Once the tariffs were established, however, the industry was able to factor the impacts into their business plans and the pipeline of projects began to build up again, though at a slower rate than had been expected prior to initiation of the trade dispute. Policy changes in China also reduced demand for solar panels, decreasing global prices and mitigating the impact of the tariffs. With less uncertainty over the tariffs and the rush to begin construction to capture the full 30% ITC, the utility-scale solar market was much more active in 2019, requiring additional solar workers to begin or complete these projects.

Third, declining costs and prices continue to drive demand. The cost of solar energy continued to decline in 2019, making solar a competitive choice for residential consumers, corporate purchasers, and utilities across the country, even in traditionally underperforming markets where electricity prices are low. Without subsidies, utility-scale solar is now cost competitive with new fossil fuel generators in many locations, and even competitive with many existing fossil fuel power plants.⁵

Today, there is an urgent need to accelerate solar energy development to meet goals for climate change mitigation, energy cost savings, resilience, and economic development. While the job growth in 2019 is good news, the solar industry still faces headwinds such as

the phaseout of the federal ITC, continuing uncertainty around tariffs, and state and local policies and practices that delay or discourage solar development. Solar energy has the potential to expand even more dramatically in the new decade, but this will require policy support at the federal and state levels. A comprehensive strategy to support renewable energy growth and address climate change is vital to our future.*

SOLAR JOBS BY STATE

In 2019, solar jobs grew in 31 states, led by Florida, Georgia, Utah, and New York (Table 1). Other states with emerging solar markets such as Texas, Illinois, and Virginia experienced major job gains, while the state with the most established market, California, lost jobs. Florida, the top state for solar job growth, saw expanded installations for both residential and utility-scale solar. Utilities such as Florida Power & Light and Tampa Bay Electric Company are aggressively building utility-scale projects.⁶ For the residential sector, the new availability of solar leasing in Florida has allowed installers to offer an attractive financing option already available to consumers in other large solar markets.⁷

The Southeastern United States is one of the bright spots in this year's *Census*, with strong job growth driven by utility-scale expansion as well as new manufacturing jobs (see Spotlight, p 42). A net total of more than 3,700 jobs was added across the region, with eight of 13 Southeastern states experiencing job growth. Outside of that region, Texas is gearing up for its solar markets to expand even more in the next few years, especially in utility-scale development. Despite the state's low electricity rates, over a quarter of the U.S. corporate renewable energy deals in 2019 were for Texas projects, of which 80% were for solar.⁸

California remains by far the nation's largest solar jobs market, with 74,255 jobs in 2019 and about 40% of cumulative U.S. solar capacity.¹ While solar jobs declined in the state by 3.4% (a loss of 2,583 jobs), this was well below the 13.6% and 11.1% declines in 2017 and 2018, respectively. This is one indication that California's residential market is rebounding. Following the catastrophic fires in both 2018 and 2019, more households are looking to solar PV systems combined with storage to maintain electricity when utility companies cut power for safety reasons (see box, p 28).

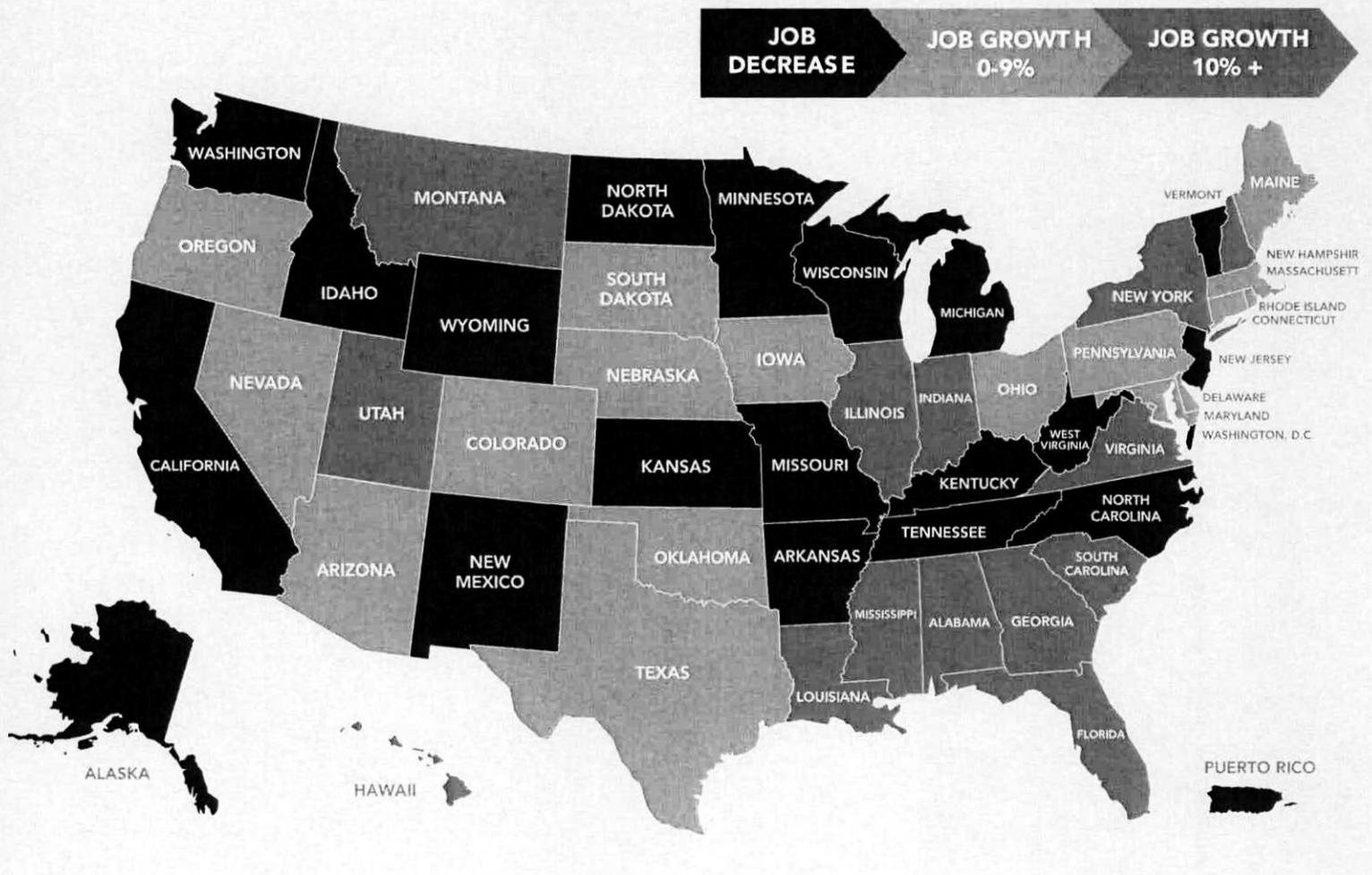
Table 1
TOP 10 STATES WITH SOLAR JOBS GROWTH

STATE	2018 Jobs	2019 Jobs	% Increase in Jobs 2018-2019	Jobs Added 2018-2019
Florida	10,358	12,202	17.8%	1,843
Georgia	3,696	4,798	29.8%	1,102
Utah	6,045	7,107	17.6%	1,062
New York	9,729	10,740	10.4%	1,011
Texas	9,612	10,261	6.7%	649
Illinois	4,879	5,513	13.0%	634
Virginia	3,890	4,489	15.4%	599
Indiana	3,114	3,600	15.6%	486
Louisiana	2,950	3,352	13.6%	402
Hawaii	2,120	2,484	17.2%	364

* The Solar Energy Industries Association has set a goal for solar to reach 20% of U.S. electricity generation by 2030, which would require an annual growth rate of 18% and an average installation of 39 GW each year. See Solar Energy Industries Association, "The Solar+ Decade 2020-2030: Leading the Energy Transition," September 2019, https://www.seia.org/sites/default/files/2019-09/SEIA_Solar%2B_Decade_Roadmap_FINAL.pdf.

† Although California lost jobs in 2017, 2018, and 2019, it grew by a staggering 24,500 jobs in 2016, representing almost half of the 51,000 new solar jobs added nationwide in 2016.

SOLAR JOBS BY STATE



State policies also support California residential solar growth. Beginning in 2020, most new single-family homes will be required to include solar (see *Census In-Depth*, p 40). Despite the strengthening of residential demand, job growth has been limited because installers have reduced sales staff for door-to-door canvassing. Also, the nonresidential segment was stymied by interconnection delays and policy uncertainty, resulting in the net loss in solar jobs.⁹

Massachusetts, another state with an established solar market, experienced a 1.9% gain after losing jobs in the two previous years. However, policy uncertainty is still curtailing nonresidential development in Massachusetts.¹⁰ In Midwestern states, the picture was more mixed in 2019. Strong job growth in Illinois reflects the industry's rapid expansion after the passage of the Future Energy Jobs Act. However, jobs were down in Minnesota, where growth in past years had been driven

by the state's landmark community solar program, which has since seen signs of slower growth.¹¹ Michigan and Missouri also lost jobs, while there was a modest increase in Ohio and neighboring Pennsylvania.

Puerto Rico had 1,949 solar jobs in 2019, a 2.4% decline from 2018. Since the 2017 hurricanes, there has been increased interest in solar and battery storage to bolster the island's sustainability and resilience. The need for grid reliability was only reinforced after a series of earthquakes hit the island in late 2019 and 2020.*

A table listing solar jobs in all 50 states, the District of Columbia, and Puerto Rico, along with the gains or losses from 2018, can be found in Appendix A (p 46). In March 2020, The Solar Foundation will release more detailed state jobs data, as well as local data for counties, metropolitan areas, and federal and state congressional districts.

* The Solar Foundation has launched a new program, the Puerto Rican Solar Business Accelerator, to foster the expansion of Puerto Rico's solar industry and workforce. More information can be found at <https://www.thesolarfoundation.org/puerto-rico/>.



McCarthy Building Companies

*McCarthy's
Training Within
Industries:
Proven
Strategies
for Building a
National Solar
Workforce*

With a utility-scale project pipeline that's larger than ever before, solar companies are faced with the prospect of hiring and training hundreds of workers in very short periods of time. McCarthy Building Companies, a top construction firm that has built over 2.7 GW of solar in the past decade, is taking on this challenge using a framework that dates back to World War II.

Known as Training Within Industries (TWI), McCarthy views this as a tried-and-true approach that is already helping the company meet its training and recruitment goals. First created in the 1940s by the U.S. Department of War, TWI is designed to train inexperienced workers for moderately complex tasks. For McCarthy, it provides an effective way to bring new hires on board with no experience in solar, while improving the quality, timeliness, and efficiency of each project. "It's a way to formalize the process and provide an organized training experience for new hires, helping workers learn foundational skills that are transferable to new projects," says Scott Canada, Senior Vice President and Business Leader of the Renewable Energy & Storage Group.

So far, McCarthy has used TWI at select projects with encouraging results, and plans to roll it out across its entire solar portfolio in 2020. McCarthy expects this approach will help meet the demands of today's fast-paced solar markets. "We'll have nine to 10 months to build a solar project and we need a few hundred people to be trained very quickly," Canada says. "If we're going to be successful, we need to be more effective at quickly bringing people into this industry and growing their capability."

OPTIMIZING RECRUITMENT AND TRAINING

A successful training program begins with recruitment. For entry-level hires, McCarthy looks for qualities like mechanical aptitude, work ethic, the ability to do outdoor work, and a regard for teamwork and safety. McCarthy prides itself on hiring a large majority of employees from the local communities



*Training Within Industries
is designed to train inexperienced workers
for moderately complex tasks.*

where solar is being built, and experience in solar can be helpful but isn't required. To make the hiring more effective, McCarthy has started to formally train its team leaders on best practices for conducting interviews. "Making that interview step more effective has been key in making the local hire process go well," Canada says.

Another important part of the TWI process is "training the trainers." At the beginning of a project, managers work with foremen and superintendents to establish a set of procedures for training new hires. Once the entry-level employees are on board, training follows a specific, guided process. A supervisor shows an employee how to do a task three separate times. Then, the employee has to demonstrate at least three times that they are able to do the task.

From there, supervisors monitor an employee's progress and check in frequently to make sure the work is going well. For each major task, they give employees a grade between 1 (beginner level) and 5 (capable of teaching the task to others). These grades provide a structured way for employees to advance on the job and get promotions, Canada says. "It allows us to transfer people between job tasks and easily transfer them to the next project."

While this approach might almost seem like common sense, it marks a departure from the more informal training methods still used on many construction projects. It's more rigorous and time-intensive than simply

McCarthy Building Companies

*McCarthy's
Training Within
Industries:
**Proven
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for Building a
National Solar
Workforce*

watching a supervisor do a job and then saying "okay, I got this," Canada says. Moreover, the construction industry has traditionally relied on apprenticeships that teach workers a trade over a period of years. This may not be an option for solar projects where workers are needed immediately.

Adopting the TWI method has required a considerable culture shift among project teams. "You're trying to change a bunch of habits that have been established over hundreds of years in the construction industry," Canada says. However, it has already led to measurable improvements. McCarthy found it reduced training time on most projects by 25%, reduced labor hours by over 25%, and reduced the learning curve from three weeks to one week. Improved training has also resulted in fewer quality control issues and led to more efficient performance.

TWI IN ACTION: HAZLEHURST, GEORGIA

One recent project where McCarthy put TWI into practice was Hazlehurst III, a 55 MWdc solar installation in central Georgia, developed, owned, and operated by Silicon Ranch Corporation, one of the nation's largest independent solar power producers and the U.S. solar platform for Shell. This project offered a meaningful economic opportunity for a region that has struggled with high unemployment, exacerbated when the nearby Husqvarna outdoor equipment manufacturer closed in 2019 and about 1,200 employees lost their jobs.

The Hazlehurst project required nearly 300 local workers. Most of the new hires did not have a background in solar or even construction, and included people with experience in retail, restaurants, or warehouses. Using the TWI method, McCarthy trained employees to perform the tasks on-site, with the goal to make them effective within a day and fully productive in about a week.

"We'll start out with very small parts and pieces, and once they get comfortable with that we go on to expand their knowledge base," says McCarthy Project Director Matt McMullan. "We're not focused on training a person who's only capable of fastening a bolt or putting on one part of a tracker, but we want well-rounded individuals that can be flexible and can be used as necessary across multiple parts of the installation."



Silicon Ranch has found TWI to be an effective way to recruit a quality workforce and provide economic benefits for the community.

"As the long-term owner and operator of our entire portfolio, Silicon Ranch is deeply committed to being a good citizen in the communities we serve and to investing in the well-being of our fellow citizens," says Silicon Ranch CEO and Co-Founder Reagan Farr. "We seek to use local service providers and hire from the local labor pool as much as possible, and we are proud to partner with McCarthy to execute this vision. We're excited to bring the experience of locals trained through McCarthy's Training Within Industry platform to bear on multiple solar construction projects as our portfolio continues to grow, and to see the platform benefit communities across the country."

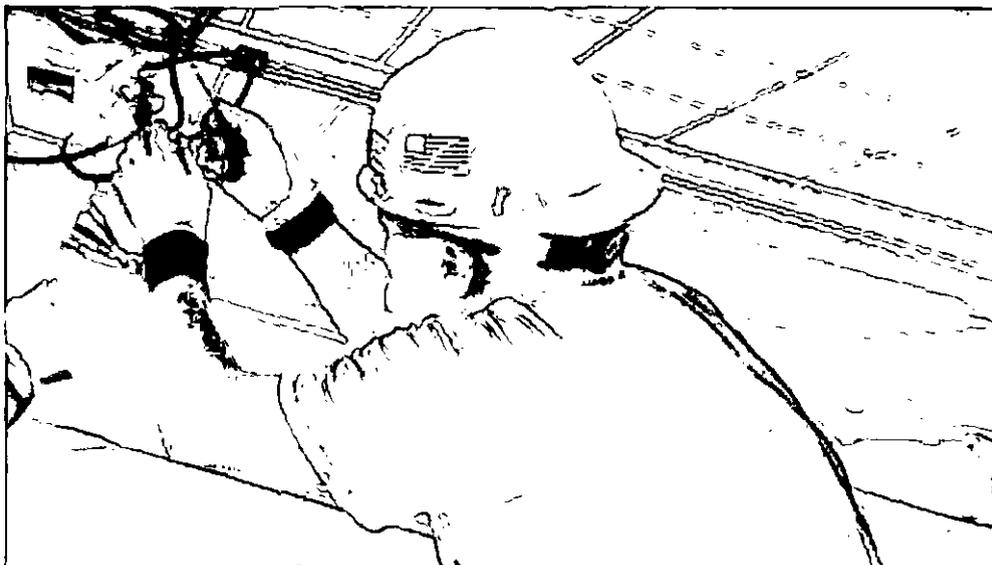
EMPOWERING COMMUNITIES AND STRENGTHENING THE WORKFORCE

McCarthy will be using the TWI method in solar projects totaling 850 MW that are planned for 2020. One of these is the Assembly Solar Plant in Michigan, developed by Ranger Power. This 228 MWdc project will be the largest solar plant in the state, requiring over 200 craft workers and 100 general laborers to complete.

Local leaders are enthusiastic about the project's impact on the community, and in particular the impact on jobs. "Overall it's a huge win for our economy," says Justin Horvath, President and CEO of the Shiawassee Economic Development Partnership. "This project will bring in new dollars to support local businesses and property taxes to support essential government services, and it's providing well-paying jobs to hundreds of people in Shiawassee County."

For McCarthy, the benefits of the TWI approach extend beyond the impact on the community and the company's bottom line. They've also found it helps improve relationships between managers, foremen, and employees.

"It definitely shows our craft workforce that we care a lot about them, and it's driving them to be more engaged in their job and feel better about their work," Canada says. "It's about viewing the workforce as an equal partner, and making sure they get a lot out of the work as they help us become a successful business."



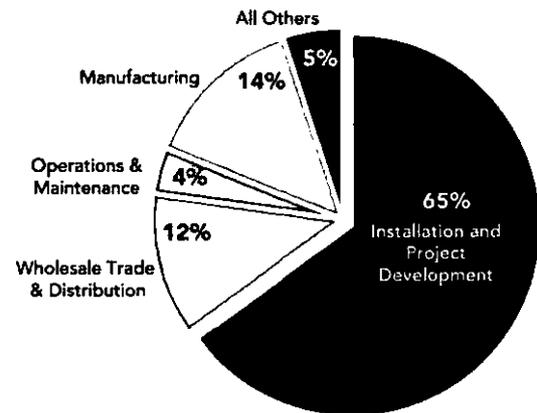
SOLAR JOBS BY SECTOR

The *National Solar Jobs Census* also reports on jobs by industry sectors: installation (including project development), wholesale trade and distribution, manufacturing, operations and maintenance (O&M), and the “other” category.* In 2019, demand-side sectors (installation and project development combined with wholesale trade and distribution) made up almost 77% of overall solar industry employment (Figure 2). In contrast, the manufacturing sector comprises only 14% of U.S. solar jobs, and O&M and the “other” sectors each comprise just under 5%.

The installation and project development sector was responsible for most of the job gains between 2018 and 2019. This sector grew by about 7,000 jobs to a total of 162,126, representing 4.5% growth (Table 3). Meanwhile, the manufacturing sector grew by just under

Figure 2

SOLAR EMPLOYMENT BY SECTOR



700 jobs, while the wholesale trade and distribution sector grew just over 550 jobs and the “other” category lost 1,000 jobs.†

* The jobs per industry sector are calculated based on the type of solar establishment, rather than an individual employee’s work activities. For example, a sales representative at a solar installation establishment would be classified within the installation sector.

† The main types of firms included in the “other” category include research & development and related services, consulting, engineering, finance, legal, and other professional and support services. Until 2018, the “other” category also included O&M. “Other” jobs have likely declined due to survey participants’ increased awareness of the Solar Jobs Census and the categories they could choose from, allowing them to more accurately delineate their work to a specific sector category.

D.C.’S NATION-LEADING RENEWABLES MANDATE TO SPUR SOLAR GROWTH

In March 2019, a new mandate went into effect requiring Washington, D.C. to achieve 100% renewable energy by 2032, one of the most ambitious clean energy targets nationwide.¹² The law includes a solar carveout which requires 10% of the District’s electricity to be produced from local solar generation by 2041. The rest of the power can be purchased through renewable energy credits (RECs).

This 100% clean energy target is a growing trend across America as cities, counties, and states seek to transition to a clean energy economy. As of November 2019, more than 200 cities and counties, 11 states, Puerto Rico, and D.C. have set a 100% commitment to clean energy, together representing one in every three Americans.¹³

The District Department of Energy and Environment (DOEE) is implementing the mandate through its Solar for All program, which provides the benefits of locally generated solar energy to low- and moderate- income households. This program mandates that the District reduce the electricity bills by 50% for 100,000 low-income households by 2032, through either the installation of rooftop solar or participation in a community solar project.¹⁴ In the Spring of 2019, DOEE announced plans to install over 7 MW of local solar capacity in partnership with the DC Sustainable Energy Utility, the current administrator of the Solar for All program.¹⁵

Thanks to these supportive policies, the District expects to see a 53% increase in local solar capacity year over year, both for residential and non-residential installations.¹⁶ This will have an impact on solar jobs not only in D.C., but also in neighboring Maryland and Virginia, where some of the installation companies may be located. In 2019, while the District lost 40 jobs year over year, Maryland and Virginia both gained jobs at the rate of 8% and 15%, respectively. Overall, these three jurisdictions gained approximately 900 solar jobs.

TEXAS PRIMED FOR LARGE-SCALE SOLAR MARKET GROWTH

A new 100 MW project in Texas developed by **RWE Renewables** adds to the company's burgeoning portfolio of U.S. solar projects, with about 10 GW of renewable energy in the development pipeline. RWE is an international developer of wind, solar, and battery storage facilities with a combined capacity of more than 9 GW. The company's West of the Pecos project, completed in January, utilizes nearly 350,000 solar modules and spans over 700 acres in Reeves County, Texas.¹⁷ It enabled approximately 200 jobs during construction.

Today, there are over 3.4 GW of installed solar capacity in Texas, a growth of 2.3 GW from only four years ago.¹⁸ Over the next five years, Texas is poised to be the top state for large-scale solar development with about 14 GW coming online.¹⁹ Texas is particularly conducive to utility-scale solar due to the significant land available, a strong solar resource (especially in west Texas), and the compatibility of the state's wind and solar generation, allowing efficient use of existing transmission infrastructure.²⁰ These attributes along with several market factors are leading the state to large-scale solar market dominance.

One of the biggest market factors is the state's energy-only ERCOT market, which has proven to be exceedingly attractive for solar developers that are able to take advantage of peak Texas energy prices.²¹ Electricity demand growth, corporate renewable energy goals, and the phaseout of the investment tax credit will also be key drivers spurring the massive expansion of large-scale solar in Texas.²²

The *Solar Jobs Census* further breaks down the installation and project development sector into market segments: residential, non-residential, and utility-scale (Table 2). Although utility-scale represents the largest segment for installed capacity, it has considerably fewer jobs than the other two segments. The utility-scale sector has higher labor productivity and greater economies of scale, due to the relatively low transaction costs per unit of capacity deployed.*

Table 2 **INSTALLATION AND PROJECT DEVELOPMENT JOBS BY SEGMENT**

	Employment	%
Residential	90,953	56.1%
Non-residential	39,721	24.5%
Community Solar	11,025	6.8%
Other Non-residential	28,696	17.7%
Utility-scale	31,452	19.4%
Total	162,126	

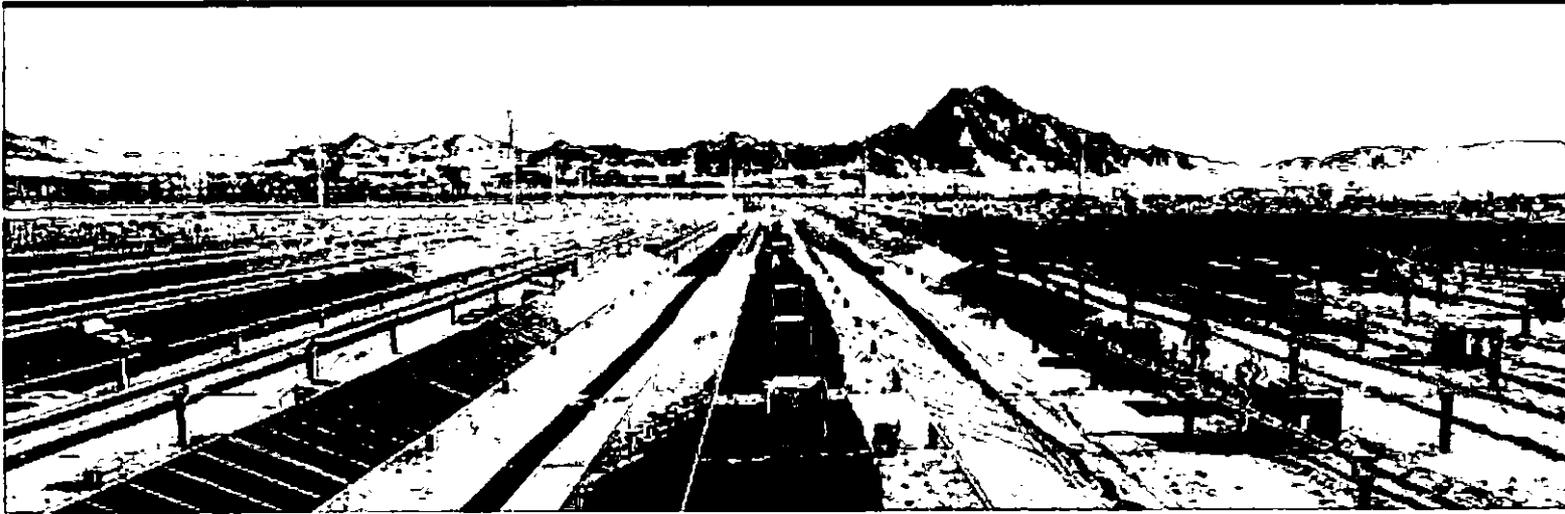
Table 3

SOLAR EMPLOYMENT BY SECTOR

Sector	2018 Employment	2019 Employment	Change in Employment 2018-2019	% Total Employment	% Growth 2018 - 2019	% Growth 2010 - 2019
Installation and Project Development	155,157	162,126	6,969	64.9%	4.5%	269%
Wholesale Trade and Distribution	29,243	29,798	555	11.9%	1.9%	154%
Operations & Maintenance	11,164	11,583	419	4.6%	3.8%	n/a
Manufacturing	33,726	34,423	697	13.8%	2.1%	38%
All Others	13,053	12,053	-1,000	4.8%	-7.7%	-7%
Overall	244,340	249,983	5,643		2.3%	167%

Note: There was no sector-level data available for Puerto Rico prior to 2019, but Puerto Rico is included in overall 2018 and 2019 employment.

* Our 2018 analysis found the residential sector created 38.7 jobs per MW installed, compared to 21.9 jobs for the non-residential sector and 3.3 jobs for utility-scale. See *The Solar Foundation, National Solar Jobs Census 2018, February 2019, <http://www.solarjobsensus.org>*.



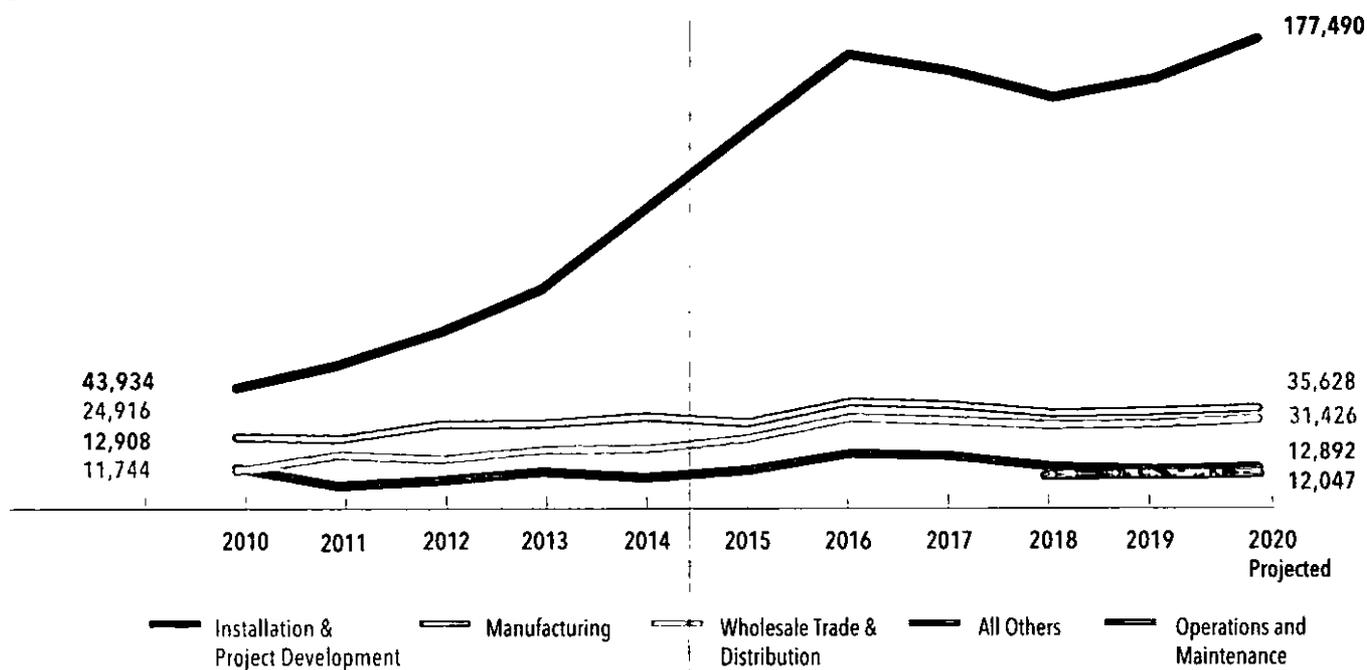
Solar installers were also asked to identify jobs in their organizations that primarily work on battery storage. Establishments reported that about 16,000 installation jobs focus on storage, or 10% of the total in the installation sector. Separately, within firms where battery storage is the primary focus, there were 14,638 jobs directly linked to solar. This second group of energy storage jobs is not included in the solar jobs total for this report. Instead, they will be listed as part of the energy storage category in the forthcoming *U.S. Energy and Employment Report*, published by the Energy Futures Initiative and the National Association of State Energy Officials.

LONG-TERM TRENDS FOR SOLAR JOBS

As solar energy has taken hold in the United States, the job market has expanded rapidly over the past decade. While the solar job losses in 2017 and 2018 reflected short-term policy and market challenges, overall trends have been positive. Since 2010, solar employment has grown 167%, from just over 93,000 to nearly 250,000 jobs in all 50 states. The most significant growth has taken place in the installation and project development sector, which has grown 269%, or 3.7 times the number of jobs in 2010. Wholesale trade and distribution, the second fastest growing sector, grew by 154%, and manufacturing jobs grew by 38% (Table 3, Figure 3).*

Figure 3

SOLAR EMPLOYMENT GROWTH BY SECTOR, 2010-2019



* The "other" sector lost 7% of jobs. As noted, however, this sector no longer includes O&M as of 2018, so the low growth doesn't accurately reflect the long-term trend for this sector. For comparison, the "other" sector grew by 34% between 2010 and 2017.

COMMUNITY SOLAR BROADENING REACH TO LMI MARKET

Community solar projects geared toward low-and-moderate income (LMI) communities are becoming more prevalent across the country. Since 2011, 15 states and the District of Columbia have implemented programs that encourage these LMI projects.²³ Across these states, the program design, structure, and incentives differ greatly.

Maryland is one state that is seeking to make LMI community solar more successful by addressing common issues with the design of such programs.²⁴ The state community solar program, established in 2017, includes a 60 MW carve-out requiring at least 50 percent LMI participation.²⁵ While carve-outs ensure a minimum level of LMI participation, they can also raise customer acquisition costs due to turnover and the increased financial risk to project developers.²⁶ Maryland's program addresses financial risk by providing grants to local subscriber organizations that purchase the project's capacity and offer the power at a discount to LMI residents.²⁷

Nautilus Solar, a national solar acquisition, development, and asset management company, is currently developing nine projects serving LMI communities in Maryland, which will serve approximately 1400 LMI households by Q1 2021. The first of these projects is a 1.8 MW community solar project in White Marsh, Maryland, expected to be energized in 2020.²⁸ Over 50 percent of the energy generated will be provided to approximately 220 LMI households in the area. Nautilus partnered with Power52, a Maryland-based nonprofit, on three of their projects. Power52 assisted with customer acquisition, offering the power to LMI households at an energy cost savings. The projects are also being constructed by members of the Power52 Energy Institute's 11-week solar training program for individuals in disadvantaged communities.²⁹

Other states including Illinois, Oregon, and Massachusetts have also launched innovative programs to reach LMI customers. As more of these state programs mature, they will provide valuable case studies on how to optimize program design, incentives, financing options, and outreach strategies.

Table 4

SOLAR ENERGY SECTOR EMPLOYMENT, 2010-2020

SECTOR	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020 (Projected)
Installation and Project Development	43,934	48,656	65,165	81,827	112,143	142,383	171,533	165,174	155,157	162,126	177,490
Wholesale Trade and Distribution	11,744	13,000	16,005	19,771	20,185	24,377	32,147	30,912	29,243	29,798	31,426
Operations and Maintenance	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	11,164	11,583	12,047
Manufacturing	24,916	37,941	29,742	29,851	32,490	30,282	38,121	36,885	33,726	34,423	35,628
All Others	12,908	5,548	8,105	11,248	8,989	11,816	18,274	17,300	13,053	12,053	12,892
Overall	93,502	105,145	119,017	142,697	173,807	208,859	260,077	250,271	244,340	249,983	269,482

*Note: There was no sector-level data available for Puerto Rico prior to 2019, but Puerto Rico is included in overall 2018 and 2019 employment.