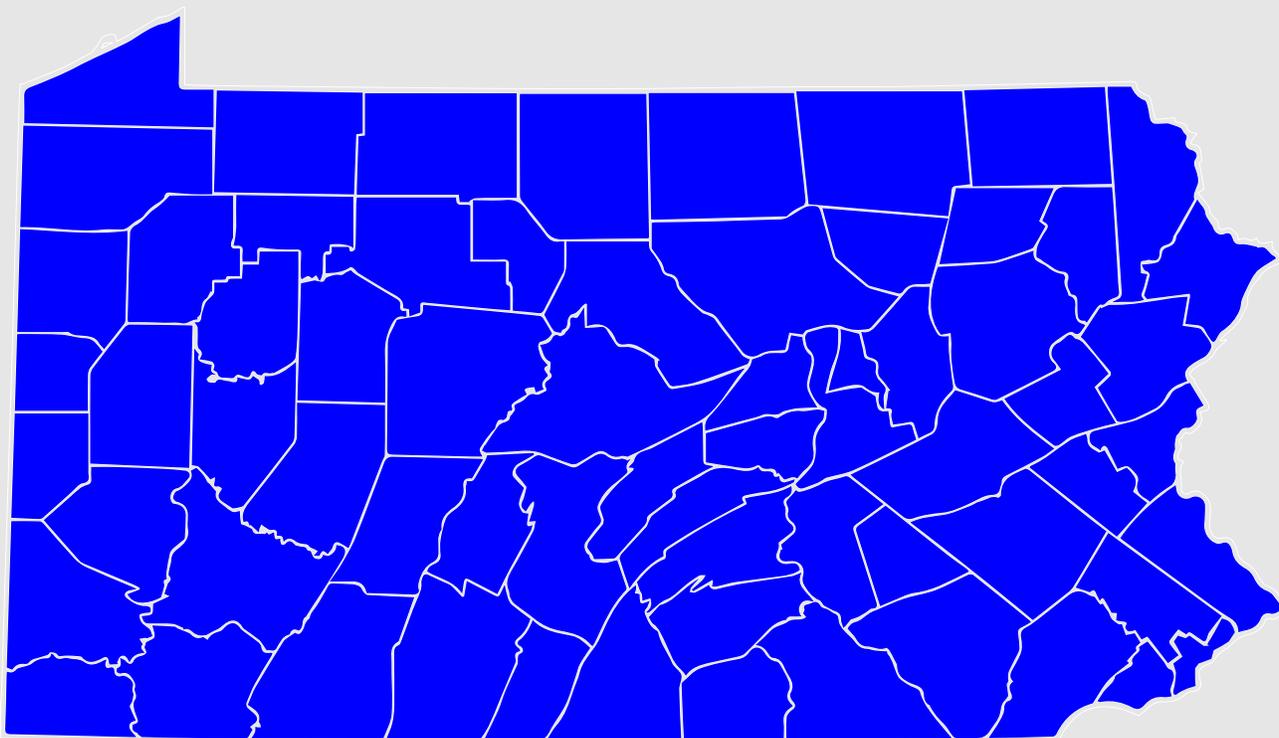


Clean Jobs Pennsylvania



Presented by

Presented by
Environmental Entrepreneurs (E2)
Keystone Energy Efficiency Alliance

July 2016

About the Partners

Environmental Entrepreneurs (E2) is a national, nonpartisan group of business leaders, investors and others who promote smart environmental policies that drive economic growth. E2 members, active in nearly every state in the country, have built or financed more than 1,700 companies that have created more than 570,000 jobs, and manage more than \$100 billion in venture and private equity capital. E2 is an affiliate of the Natural Resources Defense Council (NRDC).

The Keystone Energy Efficiency Alliance (KEEA) is a non-profit, tax-exempt 501(c)(6) corporation dedicated to promoting the energy efficiency and renewable energy industries in Pennsylvania. In 2006, KEEA was founded in response to the pending expiration of utility rate caps in Pennsylvania and the state's lack of energy efficiency policies. With over 50 business members as well as nonprofit and government partners, KEEA advocates on behalf of clean energy on the local, state, and federal levels. By representing the interests of the clean energy industry in Pennsylvania, KEEA is growing the market for energy efficiency and helping the Keystone State secure a prosperous, sustainable tomorrow.

About the Research and Analysis Partners

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 Census, wind industry analyses for the National Renewable Energy Laboratory and the Natural Resources Defense Council, and state-level clean energy reports for Massachusetts, Illinois, Vermont, Iowa, and Florida, among others.

The Economic Advancement Research Institute (EARI) is a nonprofit research organization focused on economic mobility and regional competitiveness. EARI is primarily focused on studying the impact of policies and systems on economic growth and prosperity across all income levels. EARI has conducted numerous labor market analyses that address key economic sectors with high probability to provide opportunities to underrepresented and disadvantaged populations.

Introduction

To better understand how clean energy is creating jobs in the Keystone State and to examine what policies are needed now to support future job growth, Clean Jobs Pennsylvania analyzes the size and scope of the state's clean energy economy.

Relying on databases and survey data from Pennsylvania employers, this comprehensive report found that the clean energy sector in Pennsylvania in 2015 employed more than 66,000 workers at 5,900 businesses and establishments.

This represents about 1 percent of total state employment. It also represents a 15 percent increase over the number of clean energy jobs in the state in 2014, nearly doubling the predicted growth rate E2 identified in our previous Clean Jobs Pennsylvania report.

Clean energy businesses across the state say they anticipate growth to continue. More than half of the businesses surveyed expect to add jobs in the upcoming year, with only 3 percent expecting to cut jobs.

Who are the people who fill these Pennsylvania clean energy jobs? They're scientists and researchers who make solar panels cheaper and more efficient. They're factory workers who manufacture energy-efficient appliances, wind turbine blades, and solar components. And they're engineers, construction workers, and administrative staff who develop and install clean energy products and services.

To ensure Pennsylvania's clean energy economy continues to create jobs and expand the state's economy, Governor Wolf and the General Assembly can and should strengthen the state's clean energy policies. One way to do this is to update Act 129, Pennsylvania's energy efficiency statute (enacted in 2008), and the state's Alternative Energy Portfolio Standard, or AEPS (enacted in 2004 and last amended in 2007). Another way to expand the state's clean energy economy is to implement the Clean Power Plan, the historic federal plan to cut climate-warming carbon pollution from power plants in a way that maximizes the use of energy efficiency and clean, renewable energy.

Taking these and other steps can help Pennsylvania become a national leader in clean energy job creation.

Overall Clean Energy Jobs

Quick Facts

The clean energy industry—which in this report includes energy efficiency, renewable energy, alternative transportation and greenhouse gas (GHG) management and accounting—is a source of good jobs for tens of thousands of Pennsylvanians.

In 2015, Pennsylvania’s clean energy industry supported 66,021 workers at 5,900 businesses and establishments. About 80 percent of Pennsylvania’s clean energy workforce is employed in energy efficiency industries, with renewable energy, clean fuels, and alternative transportation also supporting significant numbers of workers.

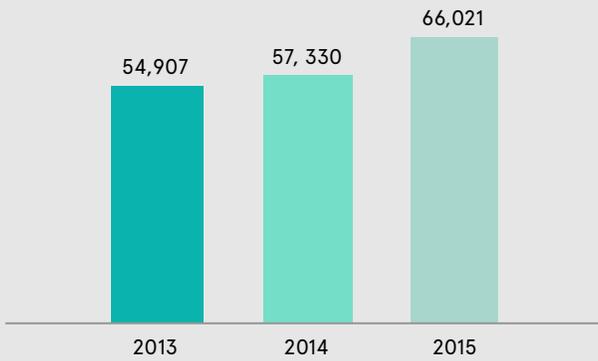
Energy efficiency industries led the clean energy sector in job growth last year, increasing from 37,000 jobs to 53,000 jobs. These gains in energy efficiency employment helped boost the overall number of clean energy jobs in Pennsylvania by more than 8,700 workers between 2014-2015, despite job declines in clean fuels and other areas.

Renewable energy jobs increased slightly to more than 8,800 jobs, reflecting growth in the wind, solar, and low-impact hydro-electric industries. The bioenergy industry shed about 2,000 jobs, which mirrors a national slowdown trend in the technology.

Companies in the state are bullish on the industry’s future. More than half project hiring more employees in 2016.

66,021

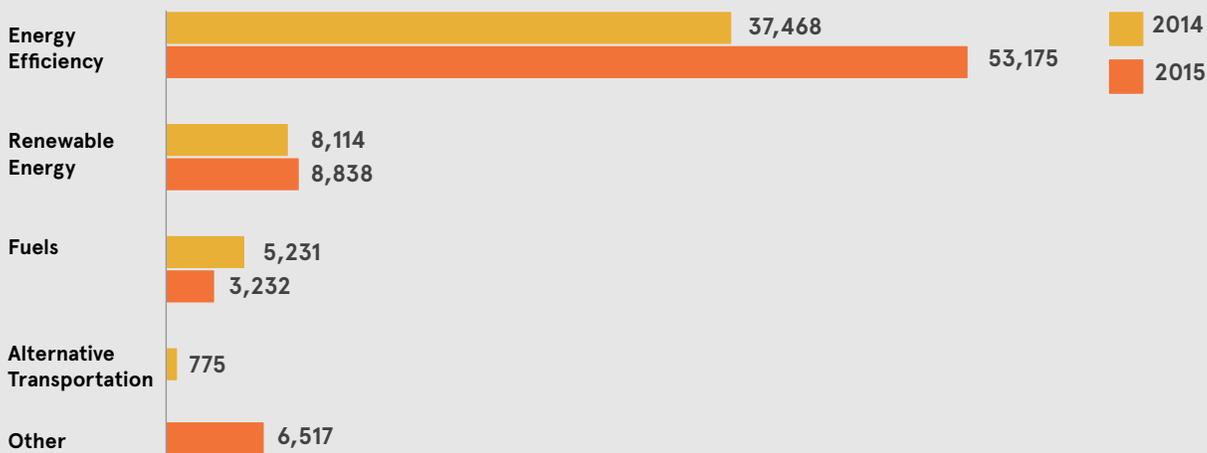
clean energy workers in
Pennsylvania



PA Clean Energy Jobs Trends by Year



Clean Energy Technology Jobs Breakdown¹



Clean Energy Technology Jobs Breakdown by Year

¹ The 2014 Clean Industry Report, which formed the basis for the first Clean Jobs Pennsylvania, reported Clean Fuels together with Renewable Energy Generation and Alternative Transportation under Other. This year's report breaks out both the fuel sector and alternative transport.

Clean Energy Jobs In Every County

Clean energy jobs can be found in every county, congressional district, and state legislative district in Pennsylvania, from the Laurel Highlands to the Lehigh Valley. They are rural jobs and urban jobs, blue-collar and white-collar.

Unsurprisingly, the top three clean energy job counties in Pennsylvania are the state’s most populous: Allegheny County (7,617 jobs), Philadelphia County (5,471) and Montgomery County (5,458). Philadelphia County has about 3.5 clean energy jobs for every 1,000 residents; Allegheny County just over 6, Montgomery County almost 7.

Looking at metropolitan areas, Philadelphia-Camden-Wilmington has 22,081 clean energy jobs, while Pittsburgh has 13,171. Allentown-Bethlehem-Easton, Scranton—Wilkes-Barre and Harrisburg-Carlisle each have more than 3,000 clean energy jobs.

Combined, Pennsylvania’s rural areas (i.e., areas that are not part of a Metropolitan Statistical Area, or MSA) have nearly 10,000 clean energy jobs.

<i>County</i>	<i>Employment</i>	<i>County</i>	<i>Employment</i>	<i>County</i>	<i>Employment</i>	<i>County</i>	<i>Employment</i>
Adams	418	Clinton	171	Lackawanna	1,300	Pike	264
Allegheny	7,617	Columbia	280	Lancaster	2,844	Potter	106
Armstrong	207	Crawford	382	Lawrence	504	Schuylkill	650
Beaver	626	Cumberland	1,402	Lebanon	536	Snyder	134
Bedford	240	Dauphin	1,483	Lehigh	1,881	Somerset	414
Berks	1,767	Delaware	3,040	Luzerne	1,800	Sullivan	41
Blair	638	Elk	154	Lycoming	630	Susquehanna	187
Bradford	370	Erie	1,243	McKean	191	Tioga	244
Bucks	4,136	Fayette	463	Mercer	500	Union	215
Butler	995	Forest	8	Mifflin	191	Venango	276
Cambria	609	Franklin	703	Monroe	703	Warren	219
Cameron	20	Fulton	73	Montgomery	5,458	Washington	1,377
Carbon	211	Greene	223	Montour	65	Wayne	309
Centre County	687	Huntingdon	134	Northampton	1,300	Westmoreland	1,836
Chester	3,976	Indiana	557	Northumberland	301	Wyoming	122
Clarion	203	Jefferson	240	Perry	236	York	1,840
Clearfield	467	Juniata	134	Philadelphia	5,471		

PA Clean Energy Jobs by County

Clean Energy Jobs By Legislative District

<i>Congressional District</i>	<i>Employment</i>
1	4,501
2	3,350
3	4,296
4	4,161
5	3,072
6	6,809
7	4,471
8	4,665
9	3,948
10	4,034
11	2,991
12	4,353
13	1,043
14	4,762
15	3,420
16	2,209
17	1,947
18	1,988

PA Clean Energy Jobs by Congressional District

<i>Upper House District</i>	<i>Employment</i>
1	3,730
2	817
3	363
4	1,245
5	194
6	2,653
7	1,175
8	298
9	3,342
10	1,664
11	1,669
12	890
13	2,235
14	1,837
15	1,727
16	1,788
17	2,463
18	1,111
19	1,266
20	1,206
22	1,862
23	1,370
24	1,427
25	778
26	605

<i>Upper House District</i>	<i>Employment</i>
27	824
28	1,595
29	804
30	1,944
31	1,152
32	1,259
33	599
34	951
35	1,025
36	722
37	3,301
38	1,521
39	1,390
40	775
41	1,275
42	2,264
43	480
44	315
45	295
46	1,148
47	1,046
48	509
49	1,197
50	796

PA Clean Energy Jobs by Upper House District

<i>Lower House District</i>	<i>Employment</i>						
1	464	49	595	99	86	148	882
2	468	50	127	100	111	149	1,089
3	226	51	230	101	373	150	17
4	86	52	156	102	94	151	450
5	796	53	744	103	837	152	290
6	291	54	800	104	336	153	290
7	435	55	328	107	505	154	130
8	496	56	21	108	45	155	337
9	398	57	57	109	148	156	1,614
10	299	58	74	110	263	157	329
11	267	59	369	111	443	158	225
12	427	60	258	112	816	159	463
13	575	61	748	113	345	160	52
14	406	62	332	114	90	161	873
15	435	63	267	115	521	162	329
16	242	64	275	116	447	163	501
17	49	65	328	117	308	165	320
18	545	66	357	118	472	168	35
19	2,416	67	238	119	464	169	33
20	574	68	496	120	16	170	195
21	406	69	263	121	144	171	33
22	554	70	696	122	230	172	385
23	123	71	254	123	382	175	1,703
24	304	72	254	124	172	176	156
25	583	73	291	125	197	177	164
26	821	74	259	126	320	178	56
27	738	75	320	127	37	179	151
28	357	76	816	128	242	181	56
29	769	77	41	129	21	182	1,755
30	8	78	353	130	201	183	152
31	839	79	496	131	742	184	216
32	291	80	98	132	431	185	95
33	144	81	160	133	521	186	61
34	222	82	484	134	189	187	72
35	353	83	517	135	111	188	82
36	180	84	213	136	332	189	41
37	1518	85	205	137	254	190	56
38	70	86	365	138	189	192	30
39	509	87	825	139	242	193	353
40	738	88	172	140	476	194	281
41	414	89	377	141	43	196	12
43	628	90	16	142	519	198	78
44	365	91	525	143	817	199	4
45	41	92	263	144	73	201	22
46	70	93	398	145	17		
47	907	94	57	146	164		
48	33	98	299	147	73		

Energy Efficiency Jobs

Quick Facts

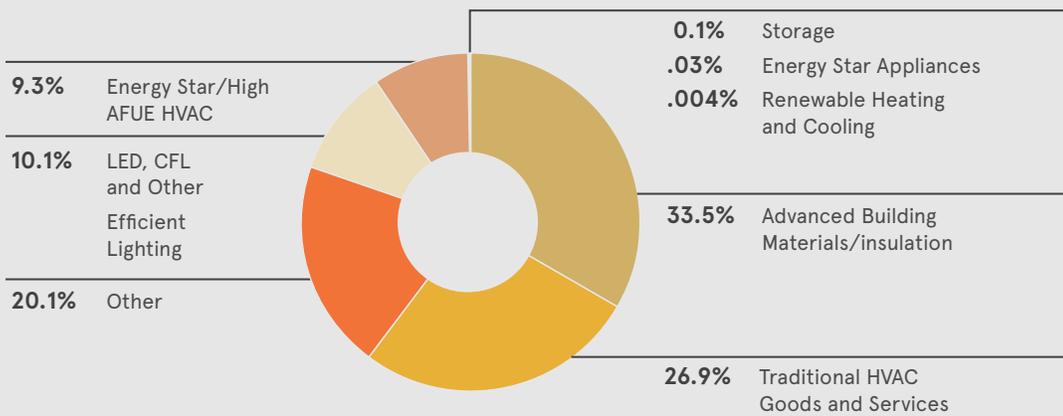
Energy efficiency employs more than 53,000 Pennsylvanians—or approximately 80 percent of the state’s total clean energy workforce. These workers improve the efficiency of commercial and residential buildings and facilities, manufacture Energy Star appliances, and develop advanced energy-saving materials.

80%

of Pennsylvania’s total clean jobs workforce is employed in energy efficiency

The industry with the largest share of efficiency workers is advanced building materials and insulation, which accounts for about one-third of Pennsylvania’s efficiency jobs.

Pennsylvania energy efficiency jobs surged between 2014 and 2015, adding 15,700 workers for a growth rate of 42 percent.



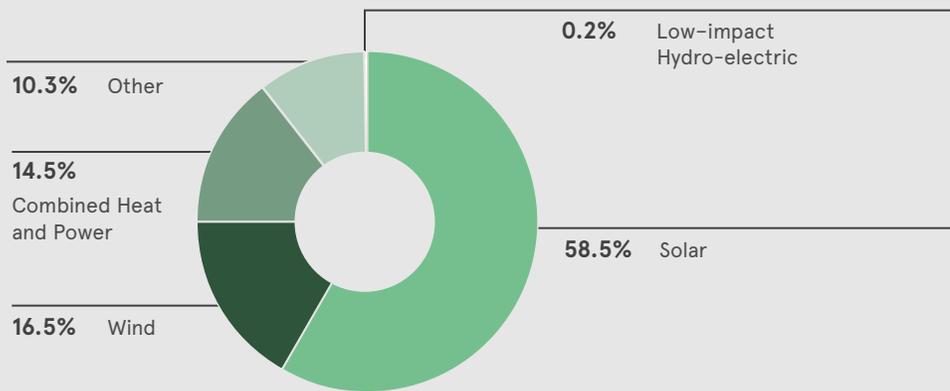
Energy Efficiency Subtechnologies

Renewable Energy Jobs

Solar dominates Pennsylvania’s renewable energy workforce, employing nearly 60 percent, or 5,167 of the workers in the renewables sector. Wind energy employment totals 17 percent of the state’s renewable energy workforce (1,455 jobs), followed by technologies like combined heat and power (15 percent) and low-impact hydroelectric (less than 1 percent).

Between 2014 and 2015, solar and wind both grew, adding 28 and 248 employees, respectively. Low-impact hydroelectric power added 22 jobs. Over the same period, bioenergy declined by 1,999 jobs, mirroring a national trend.

About 60 percent of renewable energy workers spend at least half their time supporting the renewable energy portion of the company they work for, while about 40 percent work on renewable energy-related projects full-time.



Renewable Energy Jobs

Exact Solar reflects growth trajectory of small clean energy businesses



Michael Skala of Yardley, Pa.-based Exact Solar installs a solar array on a residential rooftop. (Photo courtesy of Exact Solar)

IN BUSINESS SINCE 2005, Exact Solar designs and installs three major types of solar energy systems: solar electricity/photovoltaic (PV), solar water heating, and solar pool heating. Based in Yardley, Pa., the company has installed hundreds of residential and small commercial solar arrays in Pennsylvania and New Jersey.

Owner Mark Bortman founded the company after spending a year in Costa Rica apprenticing with a solar industry pioneer. For the next six years, Exact Solar was a one-man show. But as the technology matured and solar costs declined, the industry expanded, affording growth opportunities for companies like Exact Solar.

In 2011, Mark's wife Dara joined him to assist with marketing, sales and administrative tasks. Last year, Exact Solar hired two installers and an office manager who assists with marketing, social media, and paperwork associated with the installations. A third installer was added this year.

A family-owned business that employs Pennsylvanians who are helping the state transition to a clean energy economy, Exact Solar recognizes the importance of smart policy.

For example, the team advocates for policies like extension of the federal solar Investment Tax Credit, or ITC. Enacted in late 2015, the ITC extension will help double U.S. solar employment by 2021, according to the Solar Energy Industries Association.

The Clean Power Plan is another federal policy supported by Exact Solar.

At the state level, Exact Solar supports Pennsylvania policies including the strengthening of the state's renewable portfolio standard.

Other Key Findings

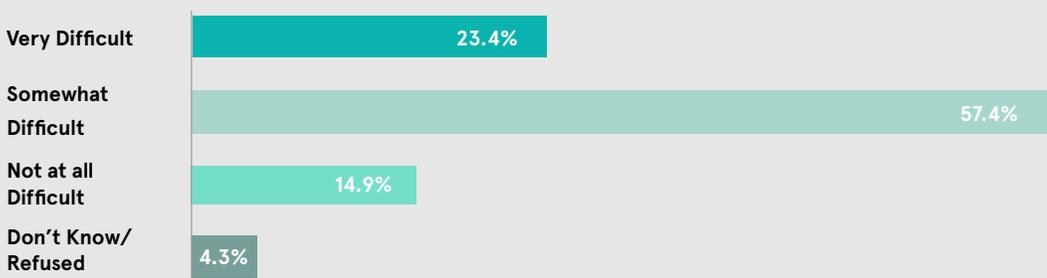
Quick Facts

Pennsylvania companies expressed concern about filling jobs in the future. More than 80 percent of businesses say that it is “somewhat difficult” or “very difficult” to find qualified applicants for available positions. On the other hand, while finding qualified workers remains a challenge, the proportion of employers that reported that hiring was “very difficult” over the past 12 months decreased from about 30 percent last year to less than 25 percent this year.

81%

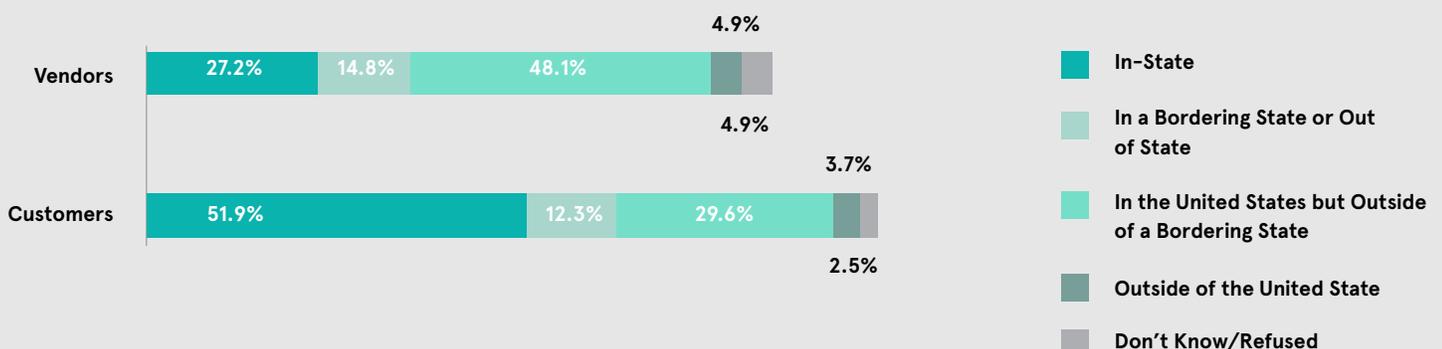
of businesses say it is difficult to find qualified applicants for available positions

This finding points to the importance of training centers like the Energy Coordinating Agency in Philadelphia and the National Sustainable Structure Center at the Pennsylvania College of Technology, a Penn State affiliate, both of which provide training programs for workers seeking jobs in the energy efficiency and renewable energy sectors. Combined, these two programs have trained 18,000 men and women with the skills needed to get a job in Pennsylvania’s clean energy sector.

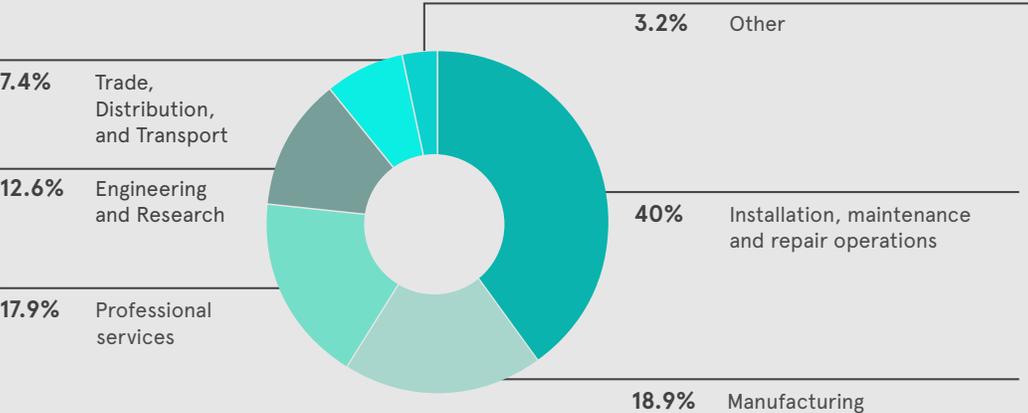


Finding Qualified Workers for Available Positions

Most customers for Pennsylvania’s clean energy industry are in-state consumers and businesses. Fifty-one percent of Pennsylvania companies serve in-state customers; about 4 percent reported international clients.



Installation and maintenance firms comprise the largest wedge of Pennsylvania’s clean energy economy. These firms account for 40 percent of the clean energy establishments across the state. Manufacturing and professional services each account for nearly 20 percent of Pennsylvania’s clean energy establishments.



Policies Matter

Act 129

Pennsylvania Act 129 is the state's bedrock energy efficiency law. Enacted in 2008, it requires the state's seven largest electric utilities to meet savings targets established by the Public Utility Commission.

Under Phase III of Act 129, which runs from 2016 to 2021, the energy savings goals of Pennsylvania's utilities range from 1.6 percent to 5 percent, cumulatively, over the next five years. Phases I and II of Act 129 have helped spur major economic benefits in Pennsylvania—more than \$257 million in energy bill savings last year alone; \$1.2 billion in total bill savings; and 53,000 energy efficiency jobs.ⁱ

Improving utility efficiency through Act 129 by removing an arbitrary investment cap (2 percent of 2006 revenues) could lead to greater economic benefits, state studies show, with Pennsylvania having the potential to meet and exceed even stronger targets.ⁱⁱ

Improving Act 129, as well as strengthening building energy codes and investing in combined heat and power (CHP) to make productive use of “waste heat” from onsite power generation, can help can save Pennsylvanians a total of \$4.7 billion on their electric bills by 2030.ⁱⁱⁱ

Renewable Portfolio Standard

Pennsylvania's main renewable energy law—the Alternative Energy Portfolio Standard (AEPS)—requires utilities to source 18 percent of their electric power from clean energy sources ^{iv} like wind and solar by 2021. This has helped grow the state's wind and solar industries.^v

At 24 wind farms, more than 1,300 megawatts of Pennsylvania wind power have been installed. Meanwhile, 265 megawatts of solar has been installed in the Keystone State, leading to \$2.8 billion in capital investments.^{vi} Solar is one of Pennsylvania's fastest-growing industries, and solar employers anticipate a 19.9 percent growth rate through 2016.^{vii}

However, to help expand the renewable energy sector, the legislature should fix the AEPS.

Currently, the AEPS's solar carve-out requires utilities derive 0.5 percent of their electricity from solar PV by 2021. This goal was met earlier this year. By increasing the solar carve-out, adding incentives for in-state solar development, and generally increasing renewable goals, Pennsylvania can create jobs, expand economic benefits, and help the state meet its renewable energy growth potential.

Clean Power Plan

The federal Clean Power Plan (CPP), released in August, 2015, sets the first-ever limits on carbon pollution from power plants, and has sent a strong, clear market signal to the private sector to ramp up clean energy investments and expand hiring nationwide.

Pennsylvania emerged as an early leader on the CPP in the fall of 2015, holding an extensive public comment period to gather input on what kind of State Implementation

Quick Facts

\$257M

in energy bill savings in 2015 alone

\$1.2B

in total bill savings

\$4.7B

estimated savings on electric bills by 2030

24

wind farms in Pennsylvania

\$2.88B

solar investments

Plan it should develop to implement the CPP. In February 2016, the U.S. Supreme Court placed a “stay” on EPA enforcement of the CPP pending the resolution of ongoing federal litigation. However, while the stay is in effect, states retain the ability to develop their own state plans, and because of market-driven changes already happening in Pennsylvania’s power sector, Governor Wolf has directed his administration to continue planning and stakeholder engagement.

By maintaining momentum to craft a state plan that prioritizes renewable energy and energy efficiency, Pennsylvania can secure a competitive advantage for its in-state clean energy businesses and ensure that whatever regional carbon trading markets emerge reflect Pennsylvania’s interests. Moreover, anything the state does to expand clean energy now will give it a head-start in meeting its carbon-reduction goals under the CPP—and ultimately drive down electricity bills for consumers.

Businesses Respond To Stronger Policies

Pennsylvania’s clean energy business owners recognize the important role that federal and state policies and programs play in expanding their customer bases, increasing their revenues, and creating more jobs.

When asked an aided question, about four in five clean energy firms said they are aware of the renewable energy Investment Tax Credit (ITC). More than half report that the ITC has either “considerably” or “somewhat” increased business prospects.

Fewer firms (43 percent) are aware of Pennsylvania’s Alternative Energy Portfolio Standard or Act 129. Of those aware, about 40 percent report that these state-level policies have “considerably” or “somewhat” increased business prospects.

In an unaided question, firms report the policies that have most contributed to business success include the federal renewable energy Investment Tax Credit (53 percent), state-level policies (38 percent), and other tax exemptions, credits, and rebates (22 percent).

Of employers reporting awareness of the Clean Power Plan with the aided question, 56 percent believe it will “considerably” or “somewhat” increase business prospects.

Conclusion

Pennsylvania's clean energy sector has experienced strong recent job growth in industries like energy efficiency, wind, and solar. With 66,000 jobs and counting, the sector experienced a 15 percent increase over the number of clean energy jobs in the state in 2014.

The sector is primed for continued expansion. If Pennsylvania is to realize the full potential of its clean energy economy—and reap the wide range of economic benefits that come with that, including jobs, savings on energy bills, and increased investment in Pennsylvania—it must take advantage of opportunities to improve its clean energy policies.

These opportunities include strengthening the energy efficiency goals in Act 129; updating Pennsylvania's renewable energy standard; and continuing to develop a state plan for the Clean Power Plan that prioritizes renewable energy and energy efficiency.

In Western Pa. manufacturing facility, 150 workers build high-tech batteries



Aquion's batteries help solar energy power the operations at an off-the-grid ranch in California. Used worldwide, Aquion's batteries are produced in a large, high-tech manufacturing facility in Westmoreland County, Pa. (Photo courtesy of Aquion Energy)



Forty Aquion battery stacks are used to power a 25-kilowatt installation at Mari's Garden, a nursery in Millani, Hawaii. The business's heavy power demand – combined with high Hawaiian electricity costs – made combining a solar PV array with Aquion batteries a smart financial decision. (Photo courtesy of Aquion)

AQUION ENERGY is Aquion Energy is a Pittsburgh-based manufacturer of batteries that can store clean energy. Founded nearly a decade ago, Aquion now employs about 150 people who work in manufacturing, research-and-development, business development, human resources, accounting, and marketing.

Dr. Jay Whitacre is Aquion's co-founder. By researching low-cost ways to store large amounts of energy, he designed a battery using inexpensive, readily available resources including water, sodium and carbon. The batteries—which are housed in stackable black cases that when linked together can be configured into battery banks ranging from kilowatt-hours to megawatt-hours—are manufactured at a 350,000-square-foot manufacturing facility in Westmoreland County.

The batteries are often used in solar applications, including off-grid and microgrid applications. For instance, Stone Edge Farm—a 16-acre urban farm in Sonoma, Calif.—uses 14 Aquion batteries housed in a shipping container. By linking the batteries to a solar array at the farm, the property can store excess solar energy for use at night. The solar-and-battery system is part of a microgrid that produces and stores clean, renewable energy to keep its operations running 24 hours a day without relying on the electric grid.

Worldwide, more than 200 Aquion battery systems are in use in homes, small businesses and at commercial and industrial facilities.

The company is expanding, too—it has received financial backing from Bill Gates and the famed venture capital firm Kleiner Perkins.

In an email, a company representative said Aquion supports policies and incentives that reduce carbon emissions and help finance and implement renewable energy.

"These policies are good for reducing carbon emissions as well as promoting the deployment of energy storage devices," Aquion's representative said.

"The EPA's Clean Power [Plan] is especially beneficial to our business because it will lead to growth in cleaner energy sources at the utility level. As we scale up our business to provide megawatt-scale storage, we can work in conjunction with larger wind [farms] and solar [arrays] to smooth out demand by shifting loads."

About the BW Research Energy Employment Index

Data for this year's report is derived from the comprehensive BW Research Energy Employment Index (EEI). The Index is the result of a rigorous survey effort of traditional and clean energy establishments across all 50 states, based in part on the methodology refined for the 2015 Rhode Island Clean Energy Industry Report. Final employment figures are extrapolated based on the U.S. Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW, Q2). Though QCEW datasets track energy employment across traditional production, transmission, and distribution subsectors, the current structure of the North American Industry Classification System (NAICS) assigns a portion of the nation's energy and energy efficiency work into broad categories of non-energy specific industries, such as construction, wholesale trade, and professional services.

Identifying energy-related employment within these broad industry sectors is particularly important for understanding employment trends across emerging renewable energy and advanced fuel technologies and infrastructures, such as solar, wind, geothermal, biomass, storage, and smart grid. Since rising deployment of efficiency-related technologies has carved out new opportunities for firms in traditional trades to research, manufacture, or install energy efficient products and upgrades, parsing out this employment is especially useful to determine the level of job growth across the nation's energy efficiency subsectors. However, energy efficiency and other clean energy workers are not exactly captured through traditional NAICS alone. For example, a subset of semiconductor manufacturers produces solar panels, while others assemble computer components or medical equipment. Even though the NAICS classifications include a "solar electric generation" subsector, important elements of the solar value chain, such as research, installation, manufacturing, sales, and distribution are embedded within these other broad NAICS categories. While federal labor market data alone presents an incomplete picture of the clean energy workforce, inclusion of these additional manufacturing or construction industries in their entirety would result in exaggerated employment figures, while their exclusion underestimates the clean economy and its workforce.

The data in this report are neither a replacement of the existing BLS data series nor do we attempt to reclassify the current system of industry codes. The Energy Employment Index instead provides an additional layer of employment analysis and may be viewed as a filter that identifies and apportions energy-related jobs from within the broad NAICS classifications and into their respective clean energy or energy efficiency technologies and sub-technologies. The EEI methodology has been used across local, state, and federal energy-related data collection and analysis for nearly a decade, including the first annual U.S. Department of Energy's U.S. Energy and Jobs Report, The Solar Foundation's National Solar Job Census series, and other clean energy industry reports for the Commonwealth of Massachusetts, State of Rhode Island, and numerous other nonprofit agencies across the United States. Both the U.S. Departments of Labor and Energy have reviewed the methodology used for this supplemental survey.

The survey was conducted with a stratified sampling plan represented by industry code (NAICS), establishment size, and geography; these variables are used to determine the proportion of establishments across energy-related technologies and value chain activities. Data from the Index is applied to existing the existing QCEW series in order to filter the universe of potential clean energy establishments from industries such as manufacturing and construction and allocate jobs into their component renewable energy or energy efficient technologies.

The survey was administered by both telephone and web; Castleton Polling Institute conducted phone calls, while the web instrument was programmed internally. All respondents are given a unique ID in order to prevent duplication. In order to participate, respondents must pass a set of screener questions that determine their involvement in the clean energy economy based on technology and employee time dedicated to the clean energy portion of business.

A clean energy firm is defined as being directly involved in the research, development, production, manufacture, installation, sale, or distribution of goods and services related to renewable energy and energy efficiency, including clean fuels and transportation; firms engaged in services

such as consulting, finance, tax, and legal services that support the clean economy are also included in this report.

The sample is split into two categories, referred to as the known and unknown universes; these are treated entirely separate until the employment figures from each are added together to produce final clean energy employment. The unknown universe encompasses the entire range of NAICS codes that could potentially support clean energy workers — agriculture, mining, utilities, construction, manufacturing, wholesale trade, professional services, repair, and maintenance. The known universe is comprised of establishments previously identified as energy-related, either with prior research or through industry associations and government programs. These establishments and their associated employment totals are removed from the unknown universe for both sampling and final employment extrapolations.

The distribution of QCEW establishments within potential energy-related industries was carefully analyzed in order to develop representative sampling clusters for the unknown universe. Incidence rates are developed based off employer responses from the unknown universe — the propensity of firms that report they are involved in clean energy work is

applied to the QCEW dataset to derive final clean energy establishment and employment totals.

For the transport of clean vehicle parts and supplies, this report utilizes a methodology developed by the Department of Energy and the National Renewable Energy Laboratory. Employment related to clean vehicle transport via truck, rail, air, and water was calculated by dividing the value of commodity shipments by the total commodity value for each state. The proportional value of clean vehicle transport was applied to QCEW employment totals for truck, water, air, and rail transportation.

As with previous studies, this report excludes any employment in the retail trade NAICS codes — fuel dealers, motor vehicle dealership, appliance and hardware stores, and other retail establishments. The survey was administered between September 15, 2015 and November 24, 2015 and averaged 14 minutes in length. A total of 16,202 firms were called; 400 establishments took the survey. The margin of error at the 95% level of confidence for energy establishments in Pennsylvania is +/- 4.92%.

i http://www.puc.state.pa.us/Electric/pdf/Act129/SWE_PY6-Financial_Annual_Report.pdf

ii http://www.puc.state.pa.us/Electric/pdf/Act129/Act129-SWE_EE_Potential_Rpt_PPT040815.pdf

iii http://www.ase.org/sites/ase.org/files/pennsylvania_cpp_letter_3.2.16.pdf

iv *Note: not all “alternative” energy that can count toward AEPS goals is truly clean. For example, the AEPS includes as qualifying resources high-carbon biomass and coalbed methane.*

v <http://programs.dsireusa.org/system/program/detail/262>

vi <http://awea.files.cms-plus.com/FileDownloads/pdfs/Pennsylvania.pdf> and <http://www.seia.org/state-solar-policy/pennsylvania>

vii <http://www.thesolarfoundation.org/wp-content/uploads/2016/02/Solar-Jobs-Census-Compendium-2015-Low-Res.pdf>

Acknowledgements

E2 would like to thank all the firms that provided information on their clean energy and transportation activities in response to the Clean Jobs Pennsylvania survey. Researchers could not have gathered this data without respondents' willingness to share their valuable time and insights. We also would like to thank Exact Solar and Aquion Energy for their time and contributions to the company profiles featured in this report.

The publication of this report would not have been possible without the hard work and dedication of the following individuals:

Philip Jordan *BW Research Partnership*

Bob Keefe *E2*

Sarah Lehmann *BW Research Partnership*

Conner Shaw *E2*

Lauren Kubiak *NRDC*

Mark Szybist *NRDC*

Sharon Pillar *for E2*

Matt Elliott *KEEA*

Jeff Benzak *E2*

Eric Miller *KEEA*

