

Wind Energy Sector in the U.S. & Rhode Island – An Overview for Creation of Workforce Development Programs

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About Camoin Associates

Camoin Associates has provided economic development consulting services to municipalities, economic development agencies, and private enterprises since 1999. Through the services offered, Camoin Associates has had the opportunity to serve EDO's and local and state governments from Maine to California; corporations and organizations that include Lowes Home Improvement, FedEx, Volvo (Nova Bus) and the New York Islanders; as well as private developers proposing projects in excess of \$600 million. Our reputation for detailed, place-specific, and accurate analysis has led to projects in 29 states and garnered attention from national media outlets including *Marketplace* (NPR), *Forbes* magazine, and *The Wall Street Journal*. Additionally, our marketing strategies have helped our clients gain both national and local media coverage for their projects in order to build public support and leverage additional funding. We are based in Saratoga Springs, NY, with regional offices in Portland, ME; Boston, MA; Richmond, VA; and Brattleboro, VT. To learn more about our experience and projects in all of our service lines, please visit our website at www.camoinassociates.com. You can also find us on Twitter [@camoinassociate](https://twitter.com/camoinassociate) and on [Facebook](https://www.facebook.com/camoinassociates).

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Executive Summary

As part of the 2017 Real Jobs Rhode Island Planning Grant, Camoin Associates in partnering with North Kingstown Chamber of Commerce, Mayforth Group, and New Commons is working to assess workforce capacity and readiness by defining the competencies for an emerging Rhode Island wind energy technology workforce. The following is a comprehensive data report showing wind energy related industry data for both Rhode Island and the United States.

To get a better understanding of the wind energy industry in the United States and potentials for Rhode Island related to workforce development, Camoin Associates conducted extensive research into both industries relating to wind power and distribution, as well as corresponding occupations to support these industries. After synthesizing multiple data sources and relying heavily on information provided by the Bureau of Labor Statistics, the Camoin Team compiled two specific groups, including 1) a comprehensive list of industry specific 6-digit NAICS codes that both include and support wind energy production, and 2) a comprehensive list of occupation 5-digit SOC codes that both include and support wind energy industries, which can be broken down by phase of production, such as research and development, logistics, and operations. For the full list of these groupings please see Appendix B: Wind Energy NAICS Codes and Appendix C: Wind Energy SOC Codes.

Our research shows that the industries and occupations that directly relate to the wind energy sector have been growing in terms of the number of jobs available over the past five years and overall are projected to continue growing over the next five years. The tables below summarize the historic and projected growth of the wind energy sector overall, including wind energy industries and occupations, in both the United States and Rhode Island.

When analyzing the following report, it is important to note that the wind-related industries and occupations do not necessarily commit all job numbers to wind energy-related activities, instead we are looking at this data to better understand the overarching operating environment related to the wind power industry. In other words, the expansion of the wind industry will require jobs within many different industries, thus not all of the 6,000 wind energy industry jobs within Rhode Island are focusing their work strictly on wind energy related activities.

Historic Wind Energy Sector, 2012-2017				
	2012 Jobs	2017 Jobs	2012 - 2017 Change	2012 - 2017 % Change
United States				
Wind Energy Industry Employment	3,010,283	3,284,263	273,980	9%
Wind Energy Occupations	6,309,385	6,831,232	521,847	8%
Rhode Island				
Wind Energy Industry Employment	6,541	6,969	428	7%
Wind Energy Occupations	18,681	19,896	1,215	7%

Source: EMSI

Projected Wind Energy Sector, 2017-2022				
	2017 Jobs	2022 Jobs	2017 - 2022 Change	2017 - 2022 % Change
United States				
Wind Energy Industry Employment	3,284,263	3,513,346	229,083	7%
Wind Energy Occupations	6,831,232	7,169,835	338,603	5%
Rhode Island				
Wind Energy Industry Employment	6,969	7,328	359	5%
Wind Energy Occupations	19,896	20,427	531	3%

Source: EMSI

Wind Power in the United States

The wind power industry within the United States can be classified as a growing industry, an industry not yet at maturity, and one that is not showing any signs of decline. Some key features of industries classified as growing are that industry revenue grows faster than the economy, new companies are entering the market, and consumers accept and demand the product or service. An additional sign of growth in the industry is that there is rapid technology change and innovation. The industry shows high growth particularly in economic importance and demand.

In 2016, the wind power industry generated \$8.5 billion in revenues, resulting in \$1.3 billion in profits. The industry has also shown annual growth from 2011 through 2016 of 11.6%, and is projected to continue growing through 2021 at an annual growth rate of 18.4%.



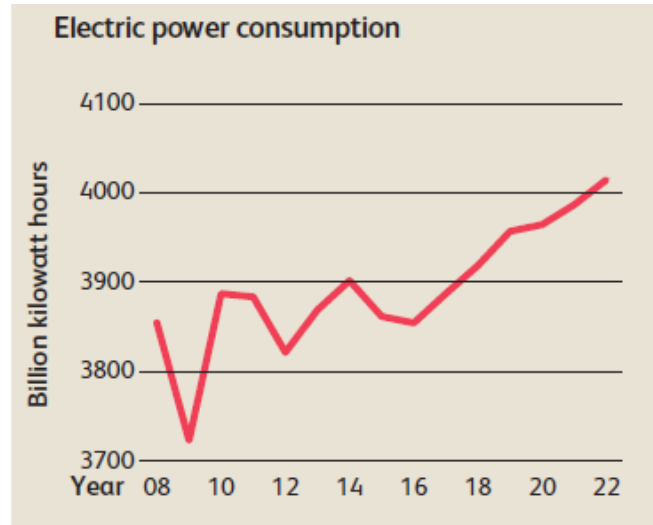
External governmental and market drivers have positively affected the growth of the wind energy industry within the United States. Some of these key drivers include:

- The wind power industry has recently received high levels of **government support and assistance**. Both the federal and state governments have provided incentives for promoting growth in the wind industry. At the federal level, there has been specific laws enacted over the past five years to stimulate growth and innovation. One of the most beneficial incentives being the Production Tax Credit (PTC), which brought down the cost for utilities to transmit energy from wind farms. With this credit, initial project costs decreased, profit margins increased, and subsequently allowed for innovation in the sector to help discover a way to manufacture more efficient and effective wind turbines at a lower cost. In addition to the federal incentives, state governments have also been supportive of wind energy initiatives. Twenty-nine states and the District of Columbia all have renewable energy portfolio standards which force all electricity-generating utilities to diversify the way which they transmit electricity, thereby making renewable energy sources a priority for operations.

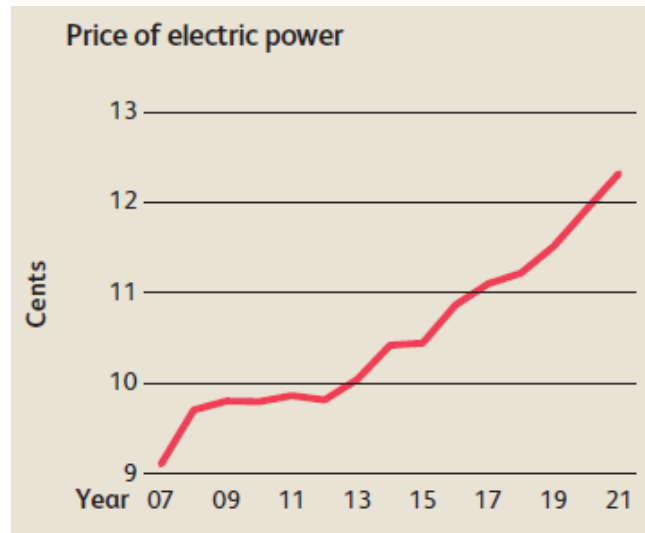
- Another external driver for promoting wind energy is the simple fact that **people are consuming more electricity** than they have historically. Therefore, rising levels of electricity consumption lead to a higher demand for renewable energy.
- Since people are consuming more electricity, meaning the demand for electricity is high, this drives up the **price of electricity**. Higher prices for traditional electricity make consumption of wind powered electricity more desirable for consumers and competitive with traditional forms.
- Lastly, turbine manufacturing **input prices have decreased**. More specifically, the price of steel has decreased. Lower steel prices result in lower costs for manufacturing turbines which allows producers to then generate wind energy at a lower price.

The support from federal and state governments, coupled with the acceptance and demand from consumers, has helped to promote growth in the wind energy industry over the past five years. The industry is projected to continue expanding and maturing, especially with growing concerns about rising greenhouse gas emissions putting more interest and demand on renewable energy resources. States that have taken advantage of abilities to operate wind farms have seen substantial employment growth. For example, Texas, having ranging open space to hold wind turbine farms, houses the most wind power nationally, with nearly 18,000 MW wind capacity.

Due to the wind farms, overall industry employment increased at an annualized rate of 9.4% and added nearly 5,000 workers over the past five years. With significant opportunities for job growth, this industry may become more desirable. Innovation is also projected to help continue to decrease the costs of manufacturing wind turbines, therefore decreasing overall costs and increasing potential profits. Not only is the overall wind industry projected to grow, but new opportunities are continuing to emerge for offshore wind projects. As our research supports, long awaited offshore wind projects are becoming more operational and highly desirable.



Source: IBISWorld



Source: IBISWorld

Historic Wind Energy Industry Employment

The Camoin Team reviewed multiple data sources to get a better understanding of the various industries involved in wind energy production and distribution. After synthesizing these sources and relying heavily on information provided by the Bureau of Labor Statistics, the Camoin Team compiled a list of thirteen 6-digit NAICS code industries ranging from research and development and manufacturing to construction, maintenance and power generation.

The following two tables show Wind Electric Power Generation and twelve other wind energy related industries, their corresponding number of jobs in 2012 and 2017, and the growth rate of jobs over the past five years. The first table shows this information throughout the United States, whereas the second table is specific to Rhode Island.

Over the past five years, the wind energy industry has shown significant growth both within Rhode Island, and across the United States. The U.S. saw growth of 9% over the past five years, an increase of nearly 275,000 jobs within various wind energy related industries. Within the U.S. and Rhode Island, the two wind-related industries with the highest number of jobs in both 2012 and 2017 are Engineering Services and Electrical Contractors and other Wiring Installation Contractors. In the U.S., both industries have nearly 1,000,000 jobs each in 2017; and in Rhode Island, these industries have nearly 3,000 and 2,500 jobs in 2017, respectively.

Arguably, the most noteworthy industry in the grouping is Wind Electric Power Generation, which has the least number of jobs of the grouping within the U.S., only providing about 5,000 jobs in 2017. In Rhode Island, this industry accounts for about 25 jobs in 2017. However, in both the U.S. and Rhode Island, this industry has shown the most significant growth in number of jobs over the past five years, at 60% in the U.S. and 67% in Rhode Island.

When analyzing these tables, it is important to note that the wind-related industries do not necessarily commit all job numbers to wind related activities, instead we are looking at them to better understand the operating environment for the wind industry. In other words, the expansion of the wind industry will require jobs within the Engineering Services industry; however, not all 989,552 jobs within the Engineering Services industry are doing work related to wind energy.

Historic Wind Energy and Related Industries within the United States from 2012 to 2017

Historic Wind Energy Industries - United States (2012-2017)					
NAICS (6-digit)	Description	2012 Jobs	2017 Jobs	2012 - 2017 Change	2012 - 2017 % Change
541330	Engineering Services	929,637	989,552	59,915	6%
238210	Electrical Contractors and Other Wiring Installation Contractors	848,798	985,342	136,544	16%
541712	Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)	445,029	464,252	19,223	4%
811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	235,269	252,088	16,819	7%
221122	Electric Power Distribution	204,769	214,598	9,829	5%
237130	Power and Communication Line and Related Structures Construction	154,872	192,720	37,848	24%
334419	Other Electronic Component Manufacturing	67,877	63,260	(4,617)	(7%)
333618	Other Engine Equipment Manufacturing	44,370	46,175	1,805	4%
333611	Turbine and Turbine Generator Set Units Manufacturing	29,184	29,337	153	1%
541360	Geophysical Surveying and Mapping Services	19,250	16,968	(2,282)	(12%)
333613	Mechanical Power Transmission Equipment Manufacturing	13,983	13,246	(737)	(5%)
333612	Speed Changer, Industrial High-Speed Drive, and Gear Manufacturing	14,044	11,591	(2,453)	(17%)
221115	Wind Electric Power Generation	3,203	5,134	1,931	60%
		3,010,283	3,284,263	273,980	9%

Source: EMSI

The overall wind energy sector is growing and is not fully matured; therefore, growth within this sector is projected to continue. Understanding the trends of these industries in Rhode Island is not necessarily comprehensive due to the immaturity of the overall industry, but it is important to understand the framework in which the industry can grow and develop within Rhode Island. For example, the table below shows that there has been growth over the past five years in six of the related wind energy industries, indicating that there may be future capacity for continued growth. The table also depicts zero jobs for three industries including Turbine and Turbine Generator Set Units Manufacturing, Speed Changer, Industrial High-Speed Drive, and Gear Manufacturing, and Other Engine Equipment Manufacturing. This data is not to say that these industries cannot exist, but instead that they have not previously existed within Rhode Island. The data showing zero jobs does not necessarily represent future capacity of the industry to related workforce in the region.

Historic Wind Energy and Related Industries within Rhode Island from 2012 to 2017

Historic Wind Energy Industries - Rhode Island (2012-2017)					
NAICS (6-digit)	Description	2012 Jobs	2017 Jobs	2012 - 2017 Change	2012 - 2017 % Change
541330	Engineering Services	2,748	2,989	241	9%
238210	Electrical Contractors and Other Wiring Installation Contractors	2,392	2,451	59	2%
541712	Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)	470	686	216	46%
237130	Power and Communication Line and Related Structures Construction	399	396	(3)	(1%)
811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	283	302	19	7%
221122	Electric Power Distribution	33	51	18	55%
334419	Other Electronic Component Manufacturing	135	34	(101)	(75%)
221115	Wind Electric Power Generation	15	25	10	67%
333613	Mechanical Power Transmission Equipment Manufacturing	46	19	(27)	(59%)
541360	Geophysical Surveying and Mapping Services	20	17	(3)	(15%)
333611	Turbine and Turbine Generator Set Units Manufacturing	0	0	0	0
333612	Speed Changer, Industrial High-Speed Drive, and Gear Manufacturing	0	0	0	0%
333618	Other Engine Equipment Manufacturing	0	0	0	0%
		6,541	6,969	428	7%

Source: EMSI

Projected Wind Energy Industry Employment

Similar to the tables shown above, the following two tables show Wind Electric Power Generation and twelve other wind energy related industries, their corresponding number of jobs in 2017, as well as projected number of jobs five years into the future to 2021, and the subsequent growth rate per industry. The first table shows this data throughout the United States, whereas the second table is specific to Rhode Island.

The projection estimates show the same two wind-related industries, Engineering Services and Electrical Contractors and other Wiring Installation Contractors, as dominating in terms of the number of jobs available in the U.S. and Rhode Island.

Both tables show that wind energy and related industries are projected to continue growing over the next five years, at 7% nationally adding nearly 230,000 jobs and 5% within the state adding 359 jobs. The overall average of current

total earnings of wind energy and related industries in the U.S. is \$80,000 and the overall average in Rhode Island is about \$68,000.

Wind Electric Power Generation is projected to grow by 14% nationally and by 12% within Rhode Island over the next five years accounting for an increase in nearly 6,000 and 28 jobs, respectively. Within Rhode Island, Wind Electric Power Generation has the highest current total earnings of all comparable industries, at \$126,000. Having high current total earnings could classify this industry as lucrative and desirable for jobseekers in Rhode Island's workforce. Wind Electric Power Generation also has the highest location quotient of all other industries in the grouping, at 1.47, meaning it is more concentrated in Rhode Island than it is in the nation as a whole.

Projected Wind Energy and Related Industries within the United States from 2017 to 2021

Projected Wind Energy Industries - United States (2017-2022)							
NAICS (6-digit)	Description	2017 Jobs	2022 Jobs	2017 - 2022 Change	2017 - 2022 % Change	Current Total Earnings	2016 Establishments
541330	Engineering Services	989,552	1,050,341	60,789	6%	\$91,895	72,262
238210	Electrical Contractors and Other Wiring Installation Contractors	985,342	1,058,646	73,304	7%	\$57,296	83,121
541712	Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)	464,252	487,046	22,794	5%	\$119,339	16,045
811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	252,088	266,088	14,000	6%	\$54,563	28,181
221122	Electric Power Distribution	214,598	220,844	6,246	3%	\$100,849	5,082
237130	Power and Communication Line and Related Structures Construction	192,720	239,486	46,766	24%	\$71,530	9,021
334419	Other Electronic Component Manufacturing	63,260	62,607	(653)	(1%)	\$70,845	1,502
333618	Other Engine Equipment Manufacturing	46,175	47,832	1,657	4%	\$77,336	312
333611	Turbine and Turbine Generator Set Units Manufacturing	29,337	31,542	2,205	8%	\$87,177	314
541360	Geophysical Surveying and Mapping Services	16,968	18,148	1,180	7%	\$79,091	2,204
333613	Mechanical Power Transmission Equipment Manufacturing	13,246	13,578	332	3%	\$59,457	303
333612	Speed Changer, Industrial High-Speed Drive, and Gear Manufacturing	11,591	11,321	(270)	(2%)	\$60,473	299
221115	Wind Electric Power Generation	5,134	5,866	732	14%	\$96,145	271
		3,284,263	3,513,346	229,083	7%	\$80,981	218,915

Source: EMSI

Projected Wind Energy and Related Industries within Rhode Island from 2017 to 2021

Projected Wind Energy Industries - Rhode Island (2017-2022)								
NAICS (6-digit)	Description	2017 Jobs	2022 Jobs	2017 - 2022 Change	2017 - 2022 % Change	Current Total Earnings	2016 Location Quotient	2016 Establishments
541330	Engineering Services	2,989	3,217	228	8%	\$76,802	0.90	318
238210	Electrical Contractors and Other Wiring Installation Contractors	2,451	2,438	(13)	(1%)	\$52,163	0.76	388
541712	Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)	686	794	108	16%	\$84,764	0.43	98
237130	Power and Communication Line and Related Structures Construction	396	470	74	19%	\$91,209	0.63	37
811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	302	265	(37)	(12%)	\$48,419	0.38	84
221122	Electric Power Distribution	51	55	4	8%	\$76,377	0.07	9
334419	Other Electronic Component Manufacturing	34	14	(20)	(59%)	\$42,761	0.20	3
221115	Wind Electric Power Generation	25	28	3	12%	\$126,032	1.47	2
333613	Mechanical Power Transmission Equipment Manufacturing	19	24	5	26%	\$55,632	0.41	0
541360	Geophysical Surveying and Mapping Services	17	22	5	29%	\$46,112	0.27	3
333611	Turbine and Turbine Generator Set Units Manufacturing	0	0	0	0%	\$0	0.00	0
333612	Speed Changer, Industrial High-Speed Drive, and Gear Manufacturing	0	0	0	0%	\$0	0.00	0
333618	Other Engine Equipment Manufacturing	0	0	0	0%	\$0	0.00	0
		6,969	7,328	359	5%	\$68,045		941

Source: EMSI

Industry Employment Concentration

As mentioned, Wind Electric Power Generation (classified as NAICS code 221115), is arguably the most important and specific industry in the wind energy sector; therefore, it is important to take a specific look at the industry nationally. The following table and map depict the concentration of the Wind Electric Power Generation industry per state across the United States, in terms of the current and projected number of jobs. The table lists thirty-three states, all of which having some number of Wind Electric Power Generation jobs. The seventeen states not included on the list can be assumed to have zero jobs within the Wind Electric Power Generation industry.

As mentioned previously, Texas currently has and is projected to have the highest number of Wind Electric Power Generation jobs at just over 2,000 in 2017 and about 2,300 in 2022, a growth rate of 16%. Rhode Island, is ranked twenty-five out of thirty-three, having 25 Wind Electric Power Generation jobs in 2017.

The following map is color coded to indicate the concentration of jobs. The darker green states indicate a high number of Wind Electric Power Generation jobs in 2017, whereas the light green represents few jobs, and the beige represent zero jobs in this industry. The map shows that southeastern states have far fewer, if any, Wind Electric Power Generation jobs. Texas, California, and Illinois have the most by far.

Thirty of the thirty-three states expect growth in Wind Electric Power Generation over the following five years. The only three states that show decline in this industry include Michigan, Alaska and Wyoming at -25%, -21%, and -7%, respectively.

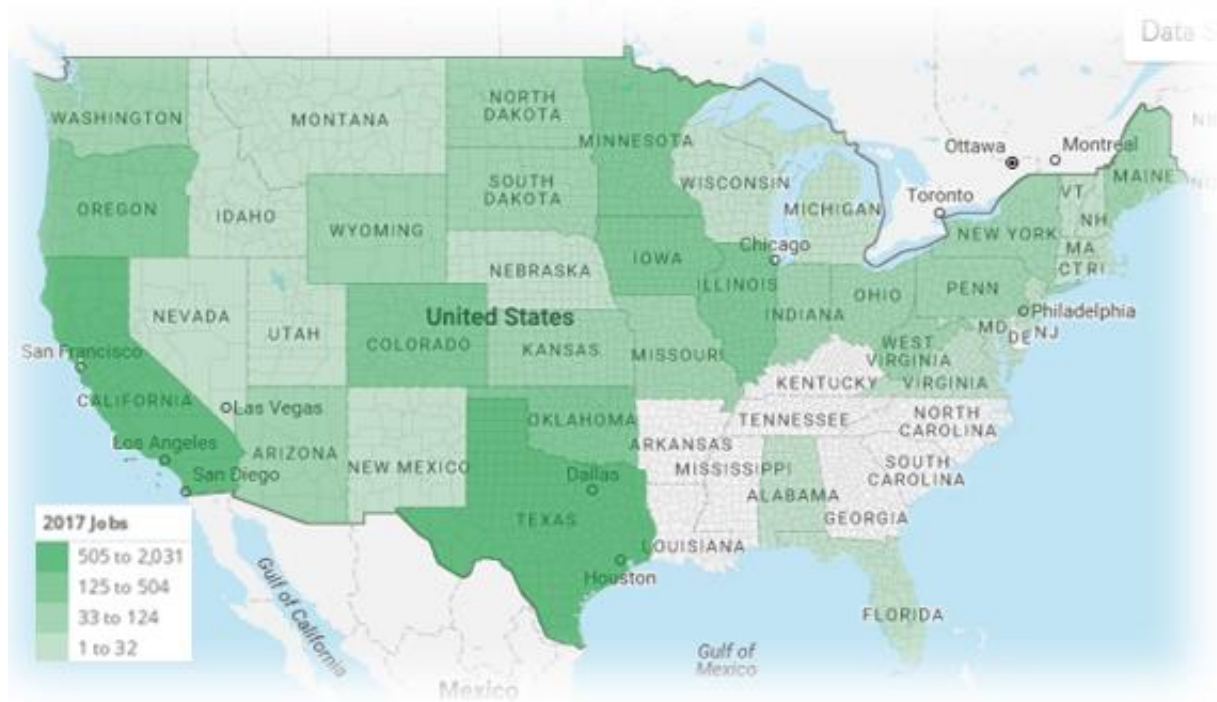
Current and Projected Concentration, by Number of Jobs, within Wind Electric Power Generation (NAICS Code 221115) Across the United States from 2017 to 2021

Wind Electric Power Generation (NAICS 221115) Concentration United States, 2017					
State Name	2017 Jobs	2022 Jobs	2017 - 2022 Change	2017 - 2022 % Change	2016 Location Quotient
Texas	2,031	2,346	315	16%	4.72
California	631	648	17	3%	1.07
Illinois	438	484	46	11%	2.13
Colorado	244	299	55	23%	2.54
Oregon	187	228	41	22%	2.73
Minnesota	180	200	20	11%	1.79
Iowa	174	198	24	14%	3.09
Oklahoma	151	187	36	24%	2.49
North Dakota	123	137	14	11%	7.76
Kansas	116	141	25	22%	2.22
Washington	73	86	13	18%	0.61
Ohio	67	75	8	12%	0.35
South Dakota	63	70	7	11%	4.03
Indiana	62	73	11	18%	0.57
Maine	48	61	13	27%	2.03
Arizona	48	65	17	35%	0.45
New York	46	56	10	22%	0.14
Wyoming	45	42	(3)	(7%)	4.75
Pennsylvania	43	47	4	9%	0.21
Hawaii	40	48	8	20%	1.58
Missouri	40	50	10	25%	0.38
West Virginia	38	48	10	26%	1.48
New Mexico	31	36	5	16%	1.03
Idaho	28	32	4	14%	1.10
Rhode Island	25	28	3	12%	1.47
Nevada	24	29	5	21%	0.52
Nebraska	22	29	7	32%	0.59
Alaska	19	15	(4)	(21%)	1.71
Florida	19	24	5	26%	0.06
Montana	17	21	4	24%	0.96
Michigan	16	12	(4)	(25%)	0.13
Utah	11	16	5	45%	0.20
Massachusetts	11	<10	Insf. Data	Insf. Data	0.10
Total	5,134	5,374	240	5%	

Source: EMSI



Map of Current and Projected Concertation, by Number of Jobs, within Wind Electric Power Generation (NAICS Code 221115) Across the United States from 2017 to 2021



Map Source: Emsi, Google, INEGI

Wind Electric Power Generation

Considering again Wind Electric Power Generation (classified as NAICS code 221115), the following table shows thirty-one of the most commonly associated occupations with this industry throughout the United States. In other words, the following occupations dedicate “X” number of employed people to the Wind Electric Power Generation industry, specifically.

This table shows that Wind Turbine Service Technicians is the occupation dedicating the highest number of jobs, 1,515, to the Wind Electric Power Generation industry, nationally. This occupation is associated with about \$11.00 in median hourly earnings, does not require any specific entry level education or work experience, and has short-term on the job training, making it an accessible occupation for many people in the workforce.

Twenty-two of the thirty-one occupations require no previous work experience. Meaning the majority of occupations related to the Wind Electric Power Generation industry are accessible for people who have no previous work experience.

Eleven occupations, or 35%, require a Bachelor’s degree, and sixteen occupations, or 52%, require either a high school diploma or equivalent or no formal credential.

Jobs, Earnings, Education, and Work Experience, within Wind Electric Power Generation (NAICS Code 221115) Occupations Across the United States, 2017

Staffing Patterns for Wind Electric Power Generation (NAICS 221115) - United States, 2017							
SOC (5-digit)	Description	Employed in Industry (2017)	% of Total Jobs in Industry (2016)	Median Hourly Earnings	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training
49-9081	Wind Turbine Service Technicians	1,515	28.3%	\$11.20	No formal credential	None	Short-term
51-8013	Power Plant Operators	969	19.2%	\$18.51	High school diploma/GED	None	Short-term
43-9061	Office Clerks, General	236	4.7%	\$27.65	High school diploma/GED	5+ years	None
11-1021	General and Operations Managers	201	4.0%	\$74.63	Bachelor's degree	5+ years	None
47-2111	Electricians	191	3.7%	\$37.56	Bachelor's degree	<5 years	None
49-1011	First-Line Supervisors of Mechanics, Installers, and Repairers	169	3.3%	\$29.38	Associate's degree	None	None
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	159	3.2%	\$44.94	Bachelor's degree	None	None
43-6014	Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	152	3.0%	\$17.92	Some college, no degree	None	Moderate-term
29-9012	Occupational Health and Safety Technicians	119	2.4%	\$34.52	Bachelor's degree	<5 years	None
51-1011	First-Line Supervisors of Production and Operating Workers	106	2.1%	\$56.00	Bachelor's degree	5+ years	None
29-9011	Occupational Health and Safety Specialists	95	1.9%	\$31.59	Bachelor's degree	None	Moderate-term
11-9021	Construction Managers	86	1.7%	\$31.83	High school diploma/GED	None	Long-term
17-2071	Electrical Engineers	77	1.5%	\$15.30	High school diploma/GED	None	Short-term
41-3099	Sales Representatives, Services, All Other	72	1.4%	\$31.85	Bachelor's degree	None	None
51-8012	Power Distributors and Dispatchers	69	1.4%	\$17.61	High school diploma/GED	None	Long-term
43-1011	First-Line Supervisors of Office and Administrative Support Workers	66	1.3%	\$25.29	High school diploma/GED	<5 years	None
49-9071	Maintenance and Repair Workers, General	64	1.3%	\$38.86	High school diploma/GED	None	Long-term
13-2011	Accountants and Auditors	63	1.3%	\$24.71	High school diploma/GED	None	Moderate-term
43-4051	Customer Service Representatives	62	1.2%	\$44.55	Bachelor's degree	None	None
49-9051	Electrical Power-Line Installers and Repairers	62	1.2%	\$33.40	Bachelor's degree	None	Moderate-term
13-1041	Compliance Officers	61	1.2%	\$33.81	Bachelor's degree	None	None
11-3031	Financial Managers	59	1.2%	\$26.90	High school diploma/GED	<5 years	None
11-9199	Managers, All Other	56	1.1%	\$23.18	High school diploma/GED	None	Moderate-term

43-3031	Bookkeeping, Accounting, and Auditing Clerks	56	1.1%	\$16.30	High school diploma/GED	None	Short-term
17-2199	Engineers, All Other	50	1.0%	\$35.49	Postsecondary nondegree	None	Long-term
17-3023	Electrical and Electronics Engineering Technicians	50	1.0%	\$30.22	High school diploma/GED	<5 years	None
13-1111	Management Analysts	49	1.0%	\$24.16	High school diploma/GED	None	Apprenticeship
11-1011	Chief Executives	48	0.9%	\$46.80	Bachelor's degree	5+ years	None
47-1011	First-Line Supervisors of Construction Trades and Extraction Workers	45	0.9%	\$14.26	High school diploma/GED	None	Short-term
43-5041	Meter Readers, Utilities	44	0.9%	\$34.58	High school diploma/GED	None	Long-term
43-5081	Stock Clerks and Order Fillers	37	0.7%	\$22.55	Some college, no degree	None	Long-term

Source: EMSI

Industry Workforce Gender

To better understand the current workforce within wind energy and related industries, the following two tables show each industry and the percentage of males and females working within each industry. Overall, both in the United States and Rhode Island, wind energy and related industries are heavily male-dominated. Overall, 77% of the workforce is male in the U.S., and 78% in Rhode Island.

The industry most male-dominated in the U.S. is Power and Communication Line and Related Structures Construction with an 88% male workforce. Whereas, Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology) is the most equally divided, with 59% males and 41% females in the industry. Within Rhode Island, Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology) is the second most equally divided workforce behind Other Electronic Component Manufacturing which has 51% males and 49% females.

Current Percentage of Males and Females within Wind Energy and Related Industries in the United States, 2017

Gender in Wind Energy Industries - United States, 2017			
NAICS (6-digit)	Description	Males % of Industry	Females % of Industry
221115	Wind Electric Power Generation	80%	20%
221122	Electric Power Distribution	77%	23%
237130	Power and Communication Line and Related Structures Construction	88%	12%
238210	Electrical Contractors and Other Wiring Installation Contractors	86%	14%
333611	Turbine and Turbine Generator Set Units Manufacturing	81%	19%
333612	Speed Changer, Industrial High-Speed Drive, and Gear Manufacturing	79%	21%
333613	Mechanical Power Transmission Equipment Manufacturing	79%	21%
333618	Other Engine Equipment Manufacturing	75%	25%
334419	Other Electronic Component Manufacturing	61%	39%
541330	Engineering Services	73%	27%
541360	Geophysical Surveying and Mapping Services	77%	23%
541712	Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)	59%	41%
811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	86%	14%
		77%	23%

Source: EMSI



Current Percentage of Males and Females within Wind Energy and Related Industries in Rhode Island, 2017

Gender in Wind Energy Industries - Rhode Island, 2017			
NAICS (6-digit)	Description	Males % of Industry	Females % of Industry
221115	Wind Electric Power Generation	79%	Insf. Data
221122	Electric Power Distribution	90%	Insf. Data
237130	Power and Communication Line and Related Structures Construction	85%	15%
238210	Electrical Contractors and Other Wiring Installation Contractors	87%	13%
333611	Turbine and Turbine Generator Set Units Manufacturing	0%	0%
333612	Speed Changer, Industrial High-Speed Drive, and Gear Manufacturing	0%	0%
333613	Mechanical Power Transmission Equipment Manufacturing	78%	Insf. Data
333618	Other Engine Equipment Manufacturing	0%	0%
334419	Other Electronic Component Manufacturing	51%	49%
541330	Engineering Services	73%	27%
541360	Geophysical Surveying and Mapping Services	87%	Insf. Data
541712	Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology)	59%	41%
811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance	89%	10%
		78%	22%

Source: EMSI

Historic Wind Energy Occupations

As stated above, the Camoin Team reviewed multiple data sources to get a better understanding of the various occupations relating to wind energy industries including production and distribution. After synthesizing multiple data sources and relying heavily on information provided by the Bureau of Labor Statistics report on Careers in Wind Energy, the Camoin Team compiled a list of twenty-five wind energy related occupations by 5-digit SOC code. These occupations are wide-ranging from engineering to assembling and operation.

The following two tables show twenty-five wind energy related occupations, their corresponding number of jobs in 2012, as well as 2017, and the growth rate over the past five years. The first table shows this information throughout the United States, whereas the second table is specific to Rhode Island.

Over the past five years, the wind energy related occupations have shown growth both within Rhode Island, and across the United States. The U.S. saw growth of 8% over the past five years, an increase of over 520,000 jobs within various wind energy related occupations. Rhode Island also saw 7% growth with an addition of over 1,200 jobs. Within the U.S. and Rhode Island, the top two wind-related occupations, having the highest number of jobs in both 2012 and 2017 are General and Operations Managers and Electricians. In the U.S., General and Operations Managers encompass over 2,000,000 jobs and Electricians encompass another 600,000 jobs in 2017. In Rhode Island, these two occupations have over 6,000 and 2,000 jobs in 2017, respectively.

Twenty-four of the twenty-five occupations are projected to grow both in the U.S. and Rhode Island. The only occupation projected to decline in both the U.S. and Rhode Island is Forging Machine Setters, Operators, and Tenders, Metal and Plastic, losing over 300 jobs in the U.S., a -2% decline and 14 in Rhode Island, a -16% decline.

The occupation showing the most growth in Rhode Island is Environmental Engineers which grew by 16%, adding thirty-six jobs over the past five years. In the U.S., the occupation with the most growth is Wind Turbine Service



Technicians, a significant occupation in terms of developing a sufficient workforce to support wind energy initiatives. This occupation grew at a significant rate of 52%, adding over 2,000 jobs. However, this occupation shows less than ten jobs in Rhode Island and insufficient growth data. This does not mean that the occupations will likely not grow, instead it shows that the occupation has not been prominent in Rhode Island over the past five years; therefore, data is not available to provide substantial growth numbers.

Similar to the analysis of industry data, it is important to note that the wind-related occupations do not necessarily commit all job numbers to wind related activities, instead we are looking at them to better understand the operating environment for the wind industry. In other words, the expansion of the wind industry will require jobs within the Wind Turbine Service Technicians occupation; however, not all 4,617 jobs within the Wind Turbine Service Technicians are necessarily doing work directly related to wind energy. For example, Wind Turbine Service Technicians have the skills required to also be working on communication and power distribution towers; thus, they may not all be using their skills for wind energy related projects.

Historic Wind Energy Related Occupations within the United States from 2012 to 2017

Historic Wind Energy Occupations - United States (2012-2017)					
SOC (5-digit)	Description	2012 Jobs	2017 Jobs	2012 - 2017 Change	2012 - 2017 % Change
11-1021	General and Operations Managers	2,060,330	2,276,961	216,631	11%
47-2111	Electricians	611,310	692,237	80,927	13%
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	498,609	528,560	29,951	6%
51-4121	Welders, Cutters, Solderers, and Brazers	388,486	409,211	20,725	5%
51-4041	Machinists	380,139	407,513	27,374	7%
47-2073	Operating Engineers and Other Construction Equipment Operators	351,656	380,327	28,671	8%
17-2051	Civil Engineers	276,814	296,358	19,544	7%
17-2141	Mechanical Engineers	267,781	290,028	22,247	8%
17-2112	Industrial Engineers	237,101	253,894	16,793	7%
51-2022	Electrical and Electronic Equipment Assemblers	208,852	212,331	3,479	2%
17-2071	Electrical Engineers	176,715	184,928	8,213	5%
11-3051	Industrial Production Managers	167,392	176,612	9,220	6%
13-1081	Logisticians	133,931	143,786	9,855	7%
17-2072	Electronics Engineers, Except Computer	138,766	141,536	2,770	2%
19-2041	Environmental Scientists and Specialists, Including Health	86,936	93,904	6,968	8%
17-2011	Aerospace Engineers	68,583	69,851	1,268	2%
17-3026	Industrial Engineering Technicians	61,409	63,975	2,566	4%
17-2081	Environmental Engineers	50,686	55,515	4,829	10%
19-1029	Biological Scientists, All Other	33,831	34,774	943	3%
17-2131	Materials Engineers	27,235	28,155	920	3%
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	23,769	26,638	2,869	12%
17-2111	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	24,265	26,450	2,185	9%
51-4022	Forging Machine Setters, Operators, and Tenders, Metal and Plastic	19,562	19,225	(337)	(2%)
19-2021	Atmospheric and Space Scientists	10,610	11,447	837	8%
49-9081	Wind Turbine Service Technicians	4,617	7,016	2,399	52%
		6,309,385	6,831,232	521,847	8%

Source: EMSI



Historic Wind Energy Related Occupations within Rhode Island from 2012 to 2017

Historic Wind Energy Occupations - Rhode Island (2012-2017)					
SOC (5-digit)	Description	2012 Jobs	2017 Jobs	2012 - 2017 Change	2012 - 2017 % Change
11-1021	General and Operations Managers	6,134	6,562	428	7%
47-2111	Electricians	2,141	2,292	151	7%
51-4121	Welders, Cutters, Solderers, and Brazers	1,323	1,484	161	12%
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	1,312	1,333	21	2%
51-4041	Machinists	1,125	1,177	52	5%
17-2072	Electronics Engineers, Except Computer	999	1,016	17	2%
17-2141	Mechanical Engineers	905	1,014	109	12%
17-2051	Civil Engineers	780	835	55	7%
47-2073	Operating Engineers and Other Construction Equipment Operators	764	811	47	6%
17-2112	Industrial Engineers	553	583	30	5%
11-3051	Industrial Production Managers	446	460	14	3%
51-2022	Electrical and Electronic Equipment Assemblers	455	455	0	0%
17-2071	Electrical Engineers	389	417	28	7%
13-1081	Logisticians	303	335	32	11%
17-2081	Environmental Engineers	225	261	36	16%
19-2041	Environmental Scientists and Specialists, Including Health	239	259	20	8%
17-3026	Industrial Engineering Technicians	124	127	3	2%
17-2111	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	79	89	10	13%
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	79	82	3	4%
51-4022	Forging Machine Setters, Operators, and Tenders, Metal and Plastic	88	74	(14)	(16%)
17-2131	Materials Engineers	68	71	3	4%
19-1029	Biological Scientists, All Other	53	56	3	6%
17-2011	Aerospace Engineers	51	54	3	6%
19-2021	Atmospheric and Space Scientists	39	42	3	8%
49-9081	Wind Turbine Service Technicians	<10	<10	Insf. Data	Insf. Data
		18,681	19,896	1,215	7%

Source: EMSI



Projected Wind Energy Occupations

Similar to the tables shown above, the following two tables show the same twenty-five wind energy related occupations, their corresponding number of jobs in 2017, as well as projected five years in the future to 2021, and the subsequent growth rate per industry. The first table shows this data throughout the United States, whereas the second table is specific to Rhode Island.

The projection estimates show the same two wind-related occupations, General and Operations Managers and Electricians, as dominating in terms of the number of jobs available in the U.S. and Rhode Island. Both tables show that wind energy related occupations are projected to continue growing over the next five years, at 5% nationally adding over 300,000 jobs and 5% within the state adding over 500 jobs.

Within the nation, twenty-four out of the twenty-five occupations are projected to grow over the next five years. The only occupation projected to decline is Forging Machine Setters, Operators, and Tenders, Metal and Plastic by 6%, losing over 1,000. In Rhode Island, four occupations are projected to decline including Inspectors, Testers, Sorters, Samplers, and Weighers and Industrial Production Managers, both declining at a marginal rate of less than -1%, as well as Electronics Engineers, Except Computer and Forging Machine Setters, Operators, and Tenders, Metal and Plastic declining at -2% and -14%, respectively. In contrast, in Rhode Island, Aerospace Engineers and Environmental Engineers are projected to each grow by 7%; however, both occupations are small and will only be adding four and seventeen jobs, respectively.

Projected Wind Energy Related Occupations within the United States from 2012 to 2017

Projected Wind Energy Occupations - United States (2017-2022)						
SOC (5-digit)	Description	2017 Jobs	2022 Jobs	2017 - 2022 Change	2017 - 2022 % Change	Median Hourly Earnings
11-1021	General and Operations Managers	2,276,961	2,409,445	132,484	6%	\$46.80
47-2111	Electricians	692,237	738,282	46,045	7%	\$24.16
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	528,560	545,198	16,638	3%	\$17.45
51-4121	Welders, Cutters, Solderers, and Brazers	409,211	426,509	17,298	4%	\$18.28
51-4041	Machinists	407,513	433,314	25,801	6%	\$19.47
47-2073	Operating Engineers and Other Construction Equipment Operators	380,327	402,592	22,265	6%	\$21.21
17-2051	Civil Engineers	296,358	312,259	15,901	5%	\$39.17
17-2141	Mechanical Engineers	290,028	304,623	14,595	5%	\$40.11
17-2112	Industrial Engineers	253,894	262,404	8,510	3%	\$40.13
51-2022	Electrical and Electronic Equipment Assemblers	212,331	214,145	1,814	1%	\$14.84
17-2071	Electrical Engineers	184,928	191,232	6,304	3%	\$44.55
11-3051	Industrial Production Managers	176,612	179,492	2,880	2%	\$44.82
13-1081	Logisticians	143,786	149,261	5,475	4%	\$35.70
17-2072	Electronics Engineers, Except Computer	141,536	143,934	2,398	2%	\$47.11
19-2041	Environmental Scientists and Specialists, Including Health	93,904	100,354	6,450	7%	\$32.40
17-2011	Aerospace Engineers	69,851	71,134	1,283	2%	\$51.84
17-3026	Industrial Engineering Technicians	63,975	64,718	743	1%	\$25.86
17-2081	Environmental Engineers	55,515	59,723	4,208	8%	\$40.65
19-1029	Biological Scientists, All Other	34,774	35,654	880	3%	\$36.13
17-2131	Materials Engineers	28,155	28,796	641	2%	\$43.90
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	26,638	29,096	2,458	9%	\$23.55
17-2111	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	26,450	27,709	1,259	5%	\$40.68
51-4022	Forging Machine Setters, Operators, and Tenders, Metal and Plastic	19,225	18,100	(1,125)	(6%)	\$16.86
19-2021	Atmospheric and Space Scientists	11,447	12,175	728	6%	\$43.18
49-9081	Wind Turbine Service Technicians	7,016	9,687	2,671	38%	\$22.55
		6,831,232	7,169,835	338,603	5%	\$33.99

Source: EMSI



Projected Wind Energy Related Occupations within Rhode Island from 2012 to 2017

Projected Wind Energy Occupations - Rhode Island (2017-2022)						
SOC (5-digit)	Description	2017 Jobs	2022 Jobs	2017 - 2022 Change	2017 - 2022 % Change	Median Hourly Earnings
11-1021	General and Operations Managers	6,562	6,810	248	4%	\$56.48
47-2111	Electricians	2,292	2,325	33	1%	\$23.99
51-4121	Welders, Cutters, Solderers, and Brazers	1,484	1,544	60	4%	\$19.27
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	1,333	1,328	(5)	(0%)	\$16.62
51-4041	Machinists	1,177	1,198	21	2%	\$20.43
17-2072	Electronics Engineers, Except Computer	1,016	991	(25)	(2%)	\$56.95
17-2141	Mechanical Engineers	1,014	1,061	47	5%	\$43.19
17-2051	Civil Engineers	835	878	43	5%	\$38.81
47-2073	Operating Engineers and Other Construction Equipment Operators	811	823	12	1%	\$24.39
17-2112	Industrial Engineers	583	596	13	2%	\$40.87
11-3051	Industrial Production Managers	460	459	(1)	(0%)	\$46.68
51-2022	Electrical and Electronic Equipment Assemblers	455	460	5	1%	\$18.80
17-2071	Electrical Engineers	417	438	21	5%	\$50.01
13-1081	Logisticians	335	354	19	6%	\$35.00
17-2081	Environmental Engineers	261	278	17	7%	\$41.42
19-2041	Environmental Scientists and Specialists, Including Health	259	274	15	6%	\$41.31
17-3026	Industrial Engineering Technicians	127	128	1	1%	\$24.08
17-2111	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	89	93	4	4%	\$42.33
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	82	85	3	4%	\$23.24
51-4022	Forging Machine Setters, Operators, and Tenders, Metal and Plastic	74	64	(10)	(14%)	\$15.53
17-2131	Materials Engineers	71	71	0	0%	\$42.74
19-1029	Biological Scientists, All Other	56	58	2	4%	\$40.64
17-2011	Aerospace Engineers	54	58	4	7%	\$67.54
19-2021	Atmospheric and Space Scientists	42	43	1	2%	\$24.05
49-9081	Wind Turbine Service Technicians	<10	11 nsf. Data	nsf. Data	nsf. Data	Insf. Data
		19,896	20,427	531	3%	\$38

Source: EMSI



Occupation Workforce Gender

The following two tables show each occupation and the percentage of males and females working within each occupation. Overall, both in the United States and Rhode Island, wind energy and related industries are heavily male-dominated. Overall, 79% of the workforce is male in the U.S. and Rhode Island.

The occupations most male-dominated in the U.S. are Operating Engineers and Other Construction Equipment Operators, Electricians, both dominated by men at 98%. Ten of the twenty-five occupations are dominated by males at over 90%. The most equally divided occupations included Biological Scientists, All Other with 54% males and 46% females, and Electrical and Electronic Equipment Assemblers, which is the only female dominated industry with just over half (52%), being women. These trends are similar in Rhode Island.

Current Percentage of Males and Females within Wind Energy Related Occupations in the United States, 2017

Gender in Wind Energy Occupations - United States, 2017			
SOC (5-digit)	Description	Males % of Industry	Females % of Industry
47-2073	Operating Engineers and Other Construction Equipment Operators	98%	2%
47-2111	Electricians	98%	2%
51-4022	Forging Machine Setters, Operators, and Tenders, Metal and Plastic	97%	3%
49-9081	Wind Turbine Service Technicians	96%	4%
51-4041	Machinists	96%	4%
51-4121	Welders, Cutters, Solderers, and Brazers	95%	5%
17-2141	Mechanical Engineers	93%	7%
17-2071	Electrical Engineers	92%	8%
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	92%	8%
17-2072	Electronics Engineers, Except Computer	91%	9%
17-2011	Aerospace Engineers	88%	12%
17-2131	Materials Engineers	87%	13%
17-2051	Civil Engineers	87%	13%
11-3051	Industrial Production Managers	84%	16%
19-2021	Atmospheric and Space Scientists	81%	19%
17-2112	Industrial Engineers	81%	19%
17-2111	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	80%	20%
17-3026	Industrial Engineering Technicians	80%	20%
17-2081	Environmental Engineers	75%	25%
11-1021	General and Operations Managers	71%	29%
19-2041	Environmental Scientists and Specialists, Including Health	68%	32%
13-1081	Logisticians	65%	35%
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	60%	40%
19-1029	Biological Scientists, All Other	54%	46%
51-2022	Electrical and Electronic Equipment Assemblers	48%	52%
		79%	21%

Source: EMSI



Current Percentage of Males and Females within Wind Energy Related Occupations in Rhode Island, 2017

Gender in Wind Energy Occupations - Rhode Island, 2017			
SOC (5-digit)	Description	Males % of Industry	Females % of Industry
49-9081	Wind Turbine Service Technicians	Insf. Data	Insf. Data
47-2073	Operating Engineers and Other Construction Equipment Operators	98%	2%
47-2111	Electricians	98%	2%
51-4022	Forging Machine Setters, Operators, and Tenders, Metal and Plastic	96%	Insf. Data
51-4041	Machinists	96%	5%
51-4121	Welders, Cutters, Solderers, and Brazers	95%	5%
17-2141	Mechanical Engineers	93%	7%
17-2071	Electrical Engineers	93%	7%
17-2072	Electronics Engineers, Except Computer	93%	7%
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	91%	Insf. Data
17-2131	Materials Engineers	89%	Insf. Data
17-2011	Aerospace Engineers	88%	Insf. Data
17-2051	Civil Engineers	88%	12%
19-2021	Atmospheric and Space Scientists	88%	Insf. Data
11-3051	Industrial Production Managers	83%	17%
17-2111	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	80%	20%
17-3026	Industrial Engineering Technicians	79%	21%
17-2112	Industrial Engineers	79%	21%
17-2081	Environmental Engineers	78%	22%
19-2041	Environmental Scientists and Specialists, Including Health	72%	28%
11-1021	General and Operations Managers	70%	30%
13-1081	Logisticians	64%	36%
19-1029	Biological Scientists, All Other	58%	40%
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	55%	45%
51-2022	Electrical and Electronic Equipment Assemblers	43%	57%
		79%	21%

Source: EMSI

Wind Energy Occupations Education

The following table shows each of the twenty-five, wind energy related occupations with the corresponding number of jobs in 2017, typical entry level education, required work experience, on-the-job training and regional completions. The first table displays this data across the United States, and the second within Rhode Island.

In the nation and in Rhode Island, of the twenty-five occupations, fifteen require a Bachelor's degree, whereas eight of them require a high school diploma or equivalent. Only two occupations require previous work experience, being General and Operations Managers and Industrial Production Managers, both of which require five or more years of previous experience.



Wind Energy Occupations and Corresponding Jobs, Education, Work Experience, Training, and Regional Completions within the United States, 2017

Wind Energy Occupations Education - United States, 2017						
SOC (5-digit)	Description	2017 Jobs	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training	Regional Completions (2015)
11-1021	General and Operations Managers	2,276,961	Bachelor's degree	5+ years	None	411,966
11-3051	Industrial Production Managers	176,612	Bachelor's degree	5+ years	None	384,014
13-1081	Logisticians	143,786	Bachelor's degree	None	None	11,910
17-2011	Aerospace Engineers	69,851	Bachelor's degree	None	None	5,719
17-2051	Civil Engineers	296,358	Bachelor's degree	None	None	18,867
17-2071	Electrical Engineers	184,928	Bachelor's degree	None	None	29,332
17-2072	Electronics Engineers, Except Computer	141,536	Bachelor's degree	None	None	29,718
17-2081	Environmental Engineers	55,515	Bachelor's degree	None	None	2,493
17-2111	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	26,450	Bachelor's degree	None	None	2,493
17-2112	Industrial Engineers	253,894	Bachelor's degree	None	None	11,116
17-2131	Materials Engineers	28,155	Bachelor's degree	None	None	3,321
17-2141	Mechanical Engineers	290,028	Bachelor's degree	None	None	35,501
17-3026	Industrial Engineering Technicians	63,975	Associate's degree	None	None	18,932
19-1029	Biological Scientists, All Other	34,774	Bachelor's degree	None	None	120,541
19-2021	Atmospheric and Space Scientists	11,447	Bachelor's degree	None	None	1,177
19-2041	Environmental Scientists and Specialists, Including Health	93,904	Bachelor's degree	None	None	15,750
47-2073	Operating Engineers and Other Construction Equipment Operators	380,327	High school diploma/equivalent	None	Moderate-term	3,589
47-2111	Electricians	692,237	High school diploma/equivalent	None	Apprenticeship	14,839
49-9081	Wind Turbine Service Technicians	7,016	Some college, no degree	None	Long-term	5,037
51-2022	Electrical and Electronic Equipment Assemblers	212,331	High school diploma/equivalent	None	Moderate-term	2,438
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	26,638	High school diploma/equivalent	None	Long-term	10,538
51-4022	Forging Machine Setters, Operators, and Tenders, Metal and Plastic	19,225	High school diploma/equivalent	None	Moderate-term	4,481
51-4041	Machinists	407,513	High school diploma/equivalent	None	Long-term	7,670
51-4121	Welders, Cutters, Solderers, and Brazers	409,211	High school diploma/equivalent	None	Moderate-term	35,619
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	528,560	High school diploma/equivalent	None	Moderate-term	676
		6,831,232				

Source: EMSI

Wind Energy Occupations and Corresponding Jobs, Education, Work Experience, Training, and Regional Completions within Rhode Island, 2017

Wind Energy Occupations Education - Rhode Island, 2017						
SOC (5-digit)	Description	2017 Jobs	Typical Entry Level Education	Work Experience Required	Typical On-The-Job Training	Regional Completions (2015)
11-1021	General and Operations Managers	6,562	Bachelor's degree	5+ years	None	1,696
11-3051	Industrial Production Managers	460	Bachelor's degree	5+ years	None	1,384
13-1081	Logisticians	335	Bachelor's degree	None	None	103
17-2011	Aerospace Engineers	54	Bachelor's degree	None	None	0
17-2051	Civil Engineers	835	Bachelor's degree	None	None	57
17-2071	Electrical Engineers	417	Bachelor's degree	None	None	48
17-2072	Electronics Engineers, Except Computer	1,016	Bachelor's degree	None	None	48
17-2081	Environmental Engineers	261	Bachelor's degree	None	None	0
17-2111	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors	89	Bachelor's degree	None	None	0
17-2112	Industrial Engineers	583	Bachelor's degree	None	None	24
17-2131	Materials Engineers	71	Bachelor's degree	None	None	0
17-2141	Mechanical Engineers	1,014	Bachelor's degree	None	None	123
17-3026	Industrial Engineering Technicians	127	Associate's degree	None	None	5
19-1029	Biological Scientists, All Other	56	Bachelor's degree	None	None	793
19-2021	Atmospheric and Space Scientists	42	Bachelor's degree	None	None	0
19-2041	Environmental Scientists and Specialists, Including Health	259	Bachelor's degree	None	None	83
47-2073	Operating Engineers and Other Construction Equipment Operators	811	High school diploma/equivalent	None	Moderate-term	0
47-2111	Electricians	2,292	High school diploma/equivalent	None	Apprenticeship	0
49-9081	Wind Turbine Service Technicians	<10	Some college, no degree	None	Long-term	0
51-2022	Electrical and Electronic Equipment Assemblers	455	High school diploma/equivalent	None	Moderate-term	0
51-4012	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic	82	High school diploma/equivalent	None	Long-term	77
51-4022	Forging Machine Setters, Operators, and Tenders, Metal and Plastic	74	High school diploma/equivalent	None	Moderate-term	4
51-4041	Machinists	1,177	High school diploma/equivalent	None	Long-term	4
51-4121	Welders, Cutters, Solderers, and Brazers	1,484	High school diploma/equivalent	None	Moderate-term	0
51-9061	Inspectors, Testers, Sorters, Samplers, and Weighers	1,333	High school diploma/equivalent	None	Moderate-term	0
		19,896				

Source: EMSI

Wind Energy Education and Training Programs

Wind Energy Education and Training Programs within the United States, 2017

Wind Energy Education & Training Programs			
Project Name	City	State	Type of Provider
Alaska Wind-Diesel Wind Application Center (University of Alaska)	Fairbanks	AK	University
Matanuska-Susitna College	Palmer	AK	Community College
Northwestern Alaska Career and Technical Center	Nome	AK	Other Education
Arkansas State University	Jonesboro	AR	University
John Brown University	Siloam Springs	AR	Community College
Arizona State University	Tempe	AZ	University
Arizona Wind Application Center (Northern Arizona University)	Flagstaff	AZ	University
Coconino Community College	Flagstaff	AZ	Community College
Airstreams Renewables, Inc.	Tehachapi	CA	Other Education
Cal Maritime Academy	Vallejo	CA	University
College of the Desert	Palm Desert	CA	Community College
Humboldt State University	Arcata	CA	University
Kern Community College District	Bakersfield	CA	Community College
Rio Hondo College	Whittier	CA	Community College
Santa Clara University	Santa Clara	CA	University
U.C. Davis - California Wind Energy Collaborative	Davis	CA	Other Education
West Valley College	Saratoga	CA	Community College
Colorado School of Mines	Golden	CO	University
Colorado Wind Application Center (Colorado State University)	Fort Collins	CO	University
Ecotech Institute	Aurora	CO	Other Education
Front Range Community College	Westminster	CO	Community College
Northeastern Junior College	Sterling	CO	Community College
Redstone College	Broomfield	CO	Other Education
University of Colorado - Boulder (Renewable and Sustainable Energy Institute)	Boulder	CO	University
University of Denver - Sturm College of Law	Denver	CO	University
Wind Energy Applications Training Symposium	Golden	CO	Other Education
University of Delaware	Newark	DE	University
District School Board of Pasco County - Energy and Marine Center	Port Richey	FL	Educational Center/Museum
Everglades University	Boca Raton	FL	University
Des Moines Area Community College	Ankeny	IA	Community College
Eastern Iowa Community College	Davenport	IA	Community College
Indian Hills Community College	Ottumwa	IA	Community College
Iowa Lakes Community College	Estherville	IA	Community College



Iowa State University	Ames	IA	University
Iowa Western Community College	Council Bluffs	IA	Community College
Kirkwood Community College	Cedar Rapids	IA	Community College
University of Iowa	Iowa City	IA	University
Vatterott College	Des Moines	IA	Community College
Western Iowa Tech Community College	Sioux City	IA	Community College
College of Southern Idaho	Twin Falls	ID	Community College
Idaho State University	Pocatello	ID	University
Idaho Wind Application Center (Boise State University)	Boise	ID	University
College of Lake County	Grayslake	IL	Community College
Danville Area Community College	Danville	IL	Community College
DeVry University	Downers Grove	IL	Other Education
Gemini Energy Services	Downers Grove	IL	Other Education
Heartland Community College	Normal	IL	Community College
Highland Community College	Freeport	IL	Community College
Highland Community College - West	Elizabeth	IL	Community College
Illinois Institute of Technology (Wanger Institute for Sustainable Energy Research)	Chicago	IL	University
Illinois State University	Normal	IL	University
Illinois Valley Community College	Oglesby	IL	Community College
Kankakee Community College	Kankakee	IL	Community College
Lake Land College	Mattoon	IL	Community College
Western Illinois University	Macomb	IL	University
Ivy Tech Community College	Lafayette	IN	Community College
Purdue University - Calumet	Hammond	IN	University
Cloud County Community College	Concordia	KS	Community College
Colby Community College	Colby	KS	Community College
Kansas Wind Application Center (Kansas State University)	Manhattan	KS	University
University of Kansas	Lawrence	KS	University
Vatterott College - Wichita	Wichita	KS	Other Education
Bluegrass Community and Technical College	Lexington	KY	Community College
Bristol Community College	Fall River	MA	Community College
Cape Cod Community College	West Barnstable	MA	Community College
Greenfield Community College	Greenfield	MA	Community College
Mount Wachusett Community College	Gardner	MA	Community College
University of Massachusetts	Amherst	MA	University
University of Massachusetts-Lowell	Lowell	MA	University
Frostburg State University	Frostburg	MD	University
Hagerstown Community College	Hagerstown	MD	Community College
University of Maryland	College Park	MD	University



Kennebec Valley Community College	Fairfield	ME	Community College
Northern Maine Community College	Presque Isle	ME	Community College
UMaine Advanced Structures and Composites Center	Orono	ME	University
University of Maine	Orono	ME	University
Delta College	University center	MI	Community College
Henry Ford Community College	Dearborn	MI	Community College
Kalamazoo Valley Community College	Kalamazoo	MI	Community College
Lansing Community College	Lansing	MI	Community College
Lawrence Technical University	Southfield	MI	University
Macomb Community College	Warren	MI	Community College
Michigan Institute of Aviation and Technology	Canton	MI	Other Education
Monroe County Community College	Monroe	MI	Community College
Muskegon Community College	Muskegon	MI	Community College
Northwestern Michigan College	Traverse City	MI	Community College
Oakland Community College	Bloomfield Hills	MI	Community College
St. Clair County Community College	Port Huron	MI	Community College
Tuscola Technology Center	Caro	MI	Educational Center/Museum
Fond du Lac Tribal and Community College	Cloquet	MN	Community College
KidWind Project	Saint Paul	MN	Other Education
Minnesota Municipal Power Agency Energy Education Program	Minneapolis	MN	Other Education
Minnesota West Community and Technical College	Canby	MN	Community College
Northwest Technical College	Bemidji	MN	Community College
Riverland Community College	Albert Lea	MN	Community College
University of Minnesota	Rosemount	MN	University
Crowder College	Neosho	MO	Community College
Pinnacle Career Institute	Kansas City	MO	Other Education
State Technical College of Missouri	Linn	MO	Community College
Great Falls College - Montana State University	South Great Falls	MT	Community College
Miles Community College	Miles City	MT	Community College
Montana Wind Application Center (Montana State University)	Bozeman	MT	University
University of Montana	Missoula	MT	University
Cape Fear Community College	Castle Hayne	NC	Community College
Central Carolina Community College	Pittsboro	NC	Community College
College of the Albermarle	Edenton	NC	Community College
Fayetteville Technical Community College	Fayetteville	NC	Community College
North Carolina Clean Energy Technology Center, North Carolina State University	Raleigh	NC	University



North Carolina Museum of Natural Sciences, Prairie Ridge EcoStation	Raleigh	NC	Educational Center/Museum
North Carolina Wind Application Center (Appalachian State University)	Boone	NC	University
Bismarck State College	Bismarck	ND	Community College
Lake Region State College	Devils Lake	ND	Community College
Nebraska Wind Application Center (University of Nebraska)	Lincoln	NE	University
Northeast Community College	Norfolk	NE	Community College
Western Nebraska Community College	Scottsbluff	NE	Community College
Rowan College at Burlington County	Pemberton	NJ	Community College
Clovis Community College	Clovis	NM	Community College
Mesalands Community College	Tucumcari	NM	Community College
New Mexico State University (Southwest Technology Development Institute)	Las Cruces	NM	University
New Mexico State University - Alamogordo	Alamogordo	NM	University
Truckee Meadows Community College	Reno	NV	Community College
University of Nevada - Reno	Reno	NV	University
Bramson ORT College	Queens	NY	Community College
Clinton Community College	Plattsburgh	NY	Community College
Hudson Valley Community College	Troy	NY	Community College
Morrisville State College	Morrisville	NY	Community College
Schenectady County Community College	Schenectady	NY	Community College
State University of New York-Canton	Canton	NY	University
Cincinnati State Technical and Community College	Cincinnati	OH	Community College
Cuyahoga Community College	Cleveland	OH	Community College
Edison State Community College	Piqua	OH	Community College
Lorain County Community College	Elyria	OH	Community College
Northwest State Community College	Archbold	OH	Community College
Owens Community College	Perrysburg	OH	Community College
University of Dayton	Dayton	OH	University
University of Dayton - Online	Dayton	OH	Other Education
Wright State University	Dayton	OH	University
Zane State College	Zanesville	OH	Community College
Francis Tuttle Technology Center	Oklahoma City	OK	Other Education
High Plains Technology Center	Woodward	OK	Other Education
Oklahoma State University, Oklahoma City	Oklahoma City	OK	University
University of Oklahoma College of Law	Norman	OK	University
Clackamas Community College	Oregon City	OR	Community College

Columbia Gorge Community College	The Dalles	OR	Community College
Lane Community College	Eugene	OR	Community College
Marylhurst University	Marylhurst	OR	University
Oregon Institute of Technology	Portland	OR	University
Portland Community College	Portland	OR	Community College
B.F. Environmental Consultants Inc.	Dallas	PA	Other Education
Pennsylvania College of Technology	Williamsport	PA	Community College
Pennsylvania Wind Application Center (Penn State University)	University Park	PA	University
St. Francis University	Loretto	PA	University
University of Pittsburgh at Bradford	Bradford	PA	University
Clemson University	Clemson	SC	University
ENSA, a division of Mallory Safety and Supply	Gary	SD	Other Education
Lake Area Technical Institute	Watertown	SD	Community College
Mitchell Technical Institute	Mitchell	SD	Community College
Amarillo College	Amarillo	TX	Community College
Clarendon College	Clarendon	TX	Community College
Eastfield College	Mesquite	TX	Community College
South Plains College	Levelland	TX	Community College
Texas State Technical College - Harlingen	Harlingen	TX	Community College
Texas State Technical College - West Texas	Sweetwater	TX	Community College
Texas Tech University	Lubbock	TX	University
University of Texas at Austin, School of Law	Austin	TX	University
Western Texas College	Snyder	TX	Community College
Utah State University	Logan	UT	University
Blue Ridge Community College	Weyers Cave	VA	Community College
Dabney S. Lancaster Community College	Clifton Forge	VA	Community College
New River Community College	Dublin	VA	Community College
Virginia Tech Center for Energy and the Global Environment	Arlington	VA	University
Virginia Wind Application Center (James Madison University)	Harrisonburg	VA	University
Vermont Technical College	Randolph Center	VT	University
DNV GL	Seattle	WA	Other Education
Northwest Renewable Energy Institute	Vancouver	WA	Other Education
Walla Walla Community College	Walla Walla	WA	Community College
Wild Horse Wind and Solar Facility and Renewable Energy Center	Ellensburg	WA	Educational Center/Museum
Fox Valley Technical College	Appleton	WI	Community College
Lakeshore Technical College	Cleveland	WI	Community College
Madison Area Technical College	Madison	WI	Community College

Mid-State Technical College	Wisconsin Rapids	WI	Community College
Northeast Wisconsin Technical College	Green Bay	WI	Community College
University of Wisconsin - Madison	Madison	WI	University
University of Wisconsin - Milwaukee	Milwaukee	WI	University
Eastern West Virginia Community and Technical College	Moorefield	WV	Community College
Casper College	Casper	WY	Community College
Laramie County Community College	Cheyenne	WY	Community College
University of Wyoming	Laramie	WY	University

Source: U.S. Department of Energy

Appendix A: Data Sources

Proprietary Data Sources

Economic Modeling Specialists, International (EMSI)

To analyze the industrial makeup of a study area, industry data organized by the North American Industrial Classification System (NAICS) is assessed. Camoin Associates subscribes to Economic Modeling Specialists, Intl. (EMSI), a proprietary data provider that aggregates economic data from approximately 90 sources. EMSI industry data, in our experience, is more complete than most or perhaps all local data sources (for more information on EMSI, please see www.economicmodeling.com). This is because local data sources typically miss significant employment counts by industry because data on sole proprietorships and contractual employment (i.e. 1099 contractor positions) is not included and because certain employment counts are suppressed from BLS/BEA figures for confidentiality reasons when too few establishments exist within a single NAICS code.

Esri Business Analyst Online (BAO)

ESRI is the leading provider of location-driven market insights. It combines demographic, lifestyle, and spending data with map-based analytics to provide market intelligence for strategic decision-making. ESRI uses proprietary statistical models and data from the U.S. Census Bureau, the U.S. Postal Service, and various other sources to present current conditions and project future trends. Esri data are used by developers to maximize their portfolio, retailers to understand growth opportunities, and by economic developers to attract business that fit their community. For more information, visit www.esri.com

IBISWorld

IBISWorld is one of the world's leading publishers of business intelligence, specializing in industry and procurement research. Through its detailed industry reports available at 5-digit NAICS level, IBISWorld provides insight into market conditions for targeted industries, helps to identify major suppliers or supply chain, and provides an understanding of competitor activity. More at www.ibisworld.com

Appendix B: Wind Energy NAICS Codes

NAICS (6-digit)	Industry Title
221115	Wind Electric Power Generation
221122	Electric Power Transmission and Control
237130	Power and Communication Line and Related Structures Construction
238210	Electrical Contractors and Other Wiring Installation Contractors
333611	Turbine and Turbine Generator Set Units
333612	Speed Changer, Industrial High Speed Drive and Gear Manufacturing
333613	Mechanical Power Transmission Equipment Manufacturing
333618	Other Engine Equipment
334419	Other Electronic Component Manufacturing
541330	Engineering
541360	Geophysical Surveying and Mapping
541712	Research and Development in the Physical, Engineering, and Life Sciences
811310	Commercial and Industrial Machinery and Equipment Repair and Maintenance

Appendix C: Wind Energy SOC Codes

Wind Energy Sector SOC Codes		
Phase	Job Title	SOC (5-digit)
Research & Development	Aerospace Engineers	17-2011
	Civil Engineers	17-2051
	Electrical Engineers	17-2071
	Electronics Engineers	17-2072
	Environmental Engineers	17-2081
	Health and Safety Engineers	17-2111
	Industrial Engineers	17-2112
	Materials Engineers	17-2131
	Mechanical Engineers	17-2141
	Engineering Technicians	17-3026
General Manufacturing	Machinists	51-4041
	Computer-controlled Machine Tool Operators	51-4012
	Assemblers	51-2022
	Welders	51-4121
	Inspectors, Testers, Sorters	51-9061
Logistics	Industrial Production Managers	11-3051
Scientists	Logisticians	13-1081
	Atmospheric Scientists	19-2012
	Wildlife Biologists	19-1029
	Geologists	19-2041
Construction	Environmental Scientists	19-2041
	Construction Equipment Operators	47-2073
	Crane Operators	47-2073
	Electricians	47-2111
Operations & Maintenance	Project Managers	11-1021
	Wind Turbine Technicians	49-9081

Source: BLS



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