Environmental and Energy Study Institute

EESI

Fact Sheet

Jobs in Renewable Energy and Energy Efficiency

February 2017

Employment in the renewable energy and energy efficiency sectors in both the United States and abroad continued to experience growth through 2016. According to the U.S. Department of Energy (DOE), renewable energy employment alone (excluding efficiency) grew by nearly 18 percent between Q2 2015 and Q1 2016.[1] The agency reports that **3,384,834 Americans were directly employed by the clean energy industry** (which includes the energy efficiency, smart grid, and energy storage industries; electric power generation from renewables; renewable fuels production; and the electric, hybrid, and hydrogen-based vehicle industries) in Q1 2016. Among the leading U.S. employment sectors were energy-efficient appliances, buildings, solar, wind, and bioenergy.[2] The International Renewable Energy Agency (IRENA) estimated there were **8,079,000 direct and indirect jobs in renewable energy worldwide**, with China, Brazil, the United States, and India among the leaders.[3]

By comparison, DOE estimated that **2,989,844 Americans were directly employed by the fossil fuel industry** (which includes fuels and electric power generation from coal, natural gas, and petroleum; and the manufacturing of gasoline and diesel-powered vehicles and their component parts) in Q1 2016. More specifically, natural gas and advanced gas technologies provided 398,235 jobs, coal provided 160,119, and petroleum provided 515,518, while gas and diesel vehicles supported 1,915,972 jobs.[4]

This fact sheet focuses on employment in the renewable energy and energy efficiency sectors in the United States and around the world. The job figures cited below are sourced from DOE, as well as international organizations, national non-profits, think tanks, and national trade associations. Due to the lack of a single body which conducts job surveys, EESI has collected information from a number of sources which employ different research methodologies and different job definitions in their work. This reality makes it somewhat problematic to compare job estimates directly. Be advised that this represents a best effort to survey the status of renewable energy and energy efficiency jobs with the data that is publicly available.

TRACKING CLEAN ENERGY JOBS IN THE UNITED STATES

The U.S. Bureau of Labor Statistics (BLS) defines **green jobs** as either "jobs in businesses that produce goods and provide services that benefit the environment or conserve natural resources" or as "jobs in which workers' duties involve making their establishment's production processes more environmentally friendly or use fewer natural resources."[5] These definitions include employment in 1) renewable energy; 2) energy efficiency; 3) pollution reduction and removal, greenhouse gas reduction, and recycling and reuse; 4) natural resources conservation; and 5) environmental compliance, education and training, and public awareness.[6]

In Fiscal Year 2010, the Bureau of Labor Statistics began collecting data for green jobs as a way of measuring progress in green technology development. Unfortunately, in March of 2013, the Obama Administration was compelled to order across-the-board spending cuts as part of the amended *Balanced Budget and Emergency Deficit Control Act*, causing BLS to eliminate the Green Careers program, and thereby the collection of green jobs statistics.[7] The program has not yet been resumed.

In January 2017, DOE published its second annual **U.S. Energy and Employment Report (USEER)**. Using the BLS Quarterly Census of Employment and Wages (QCEW) and BW Research Partnership's Energy Employment Index (EEI), USEER presents employment data gathered from the U.S. fossil fuel, nuclear, and green energy industries as of the end of the first quarter of 2016 (Q1 2016).[8] More specifically, USEER compiles employment statistics from four main sectors of the U.S. energy economy: "Electric Power Generation and Fuels," "Transmission, Distribution, and Storage," "Energy Efficiency," and "Motor Vehicles."[9] All citations of USEER findings in this fact sheet will be in reference to the Q1 2016 EEI employment statistics.

The following sections include employment assessments for the energy efficiency and renewable energy sectors from government agencies, nonprofits and industry groups. Many of the assessments include **direct employment** (directly related to on-site operations), **indirect employment** (due to the supply of materials to on-site operations), and **induced employment** (arising from spending by the direct and indirect workers). Data collection methodology and specific job categorizations differ between assessments, because the information for each sector was collected from different sources.

ENERGY EFFICIENCY JOBS IN THE UNITED STATES

USEER found that **the energy efficiency industry directly employed nearly 2,200,000 Americans in its green appliance and green building subsectors**. USEER further states that the energy efficiency sector predicts a job growth rate of 9 to 11 percent for 2017.[10]

For a deeper dive into energy efficiency employment trends by state and locality, please refer to ***Energy Efficiency Jobs in America*** by Environmental Entrepreneurs (E2) and E4TheFuture (Dec. 2016).

http://bit.ly/2017EEjobs

Table 1. Direct U.S. Energy Efficiency Jobs by Sector for Q1 2016

Energy Efficiency Sector	Direct Jobs (U.S.)
Appliances (Traditional HVAC)	520,572
Appliances (Energy Star, including High Efficiency HVAC)	552,147
Appliances (Efficient Lighting)	327,792
Buildings (Construction, Materials, Renewable Heating/Cooling)	563,241
Public Transit	402,978
Energy Storage*	90,831
Smart Grid & Micro Grid	34,635
Vehicles**	215,094
Total	2,707,290

*Includes batteries and other storage methods, and pumped hydro **Includes hybrid electric, plug-in hybrid, electric vehicles, hydrogen, and fuel cell vehicles
Source: "U.S. Energy and Employment Report," U.S. Department of Energy, March, 2016

Appliances: According to USEER, the appliance industry was the largest job provider in the energy efficiency industry, employing 1,400,511 Americans. More specifically, the traditional HVAC industry (whose employees often have "specific training in high efficiency HVAC systems") provides 520,572 jobs, the Energy Star and high efficiency HVAC industry employs 552,147, and the efficient lighting industry employs 327,792.[11]

Buildings: Of the 6.5 million total construction jobs in the United States, about 21 percent of them conduct work in support of the energy efficiency sector. The green buildings construction and/or materials sector provides 446,796 energy efficiency jobs in the United States. More specifically, the renewable heating and cooling subsector employed 116,445 Americans.[12]

Public Transportation: The American Public Transportation Association reported that the public transportation industry grew by roughly 4.2 percent between 2013 and 2014, with the number of operations, maintenance, and administrative jobs increasing from 386,878 to 402,978 (a net job increase of 16,100 jobs).[13] More specifically, the automotive transit sector (i.e., buses, trolleys, demand response, and transit vanpools) employed 301,232 Americans, and the "fixed-guideway" transit sector (i.e., rail, streetcars, ferryboats, etc.) supported 101,746 jobs.[14]

Energy Storage: USEER reports that energy storage supported a total of 90,831 jobs in Q1 2016. Specifically, pumped hydro provided 21,988 jobs, battery storage supported 47,634, while additional storage technologies had 21,209.[15]

Smart Grid & Microgrid: According to USEER, the smart grid sector supported 19,745 jobs, while work on micro grid development provided 14,890 jobs.[16] USEER and E2 also reported that the energy storage sector provided an additional 27,140 jobs (which deal in "clean [energy] distribution") in Q2 2015.[17, 18] In addition, E2 reports that 70 "smart grid/transmission" jobs were announced in 2015.[19]

Vehicles: USEER reported that the "advanced vehicle" industry provided 215,094 jobs in Q1 2016 spanning the manufacturing of the vehicles and their component parts. The employment total accounts for hybrid-electric, plug-in hybrid, full-electric, hydrogen, and fuel cell vehicles in the United States.[20] More specifically, USEER states that the hybrid/plug-in hybrid sector employed 156,363 Americans, the electric vehicle sector employed 41,991, and the hydrogen/fuel cell sector supported 16,740 jobs.[21]

RENEWABLE ENERGY JOBS IN THE UNITED STATES

According to USEER, the **U.S. renewable energy industry provided 677,544 jobs in Q1 2016**.[22] The International Renewable Energy Agency (IRENA), meanwhile, recorded that renewable energy employment in the United States reached 769,000 direct and indirect jobs in 2015 (not including large-scale hydropower employment), a 6 percent increase from the previous year.[23] The discrepancy is partly explained by IRENA's inclusion of both direct and indirect jobs, while DOE included only direct jobs in its calculations. For instance, IRENA's value of 152,000 jobs for U.S. electricity generation from biomass only includes 15,500 direct jobs. IRENA also has significantly higher job estimates for the U.S. liquid biofuels and geothermal industries.

The reader is reminded that significant differences between reported job totals exist for some renewable energy sectors, due to the inclusion of employment estimates from multiple government agencies and trade organizations. Each cited source features its own set of assumptions and methodologies for calculating job totals, resulting in a range of employment estimates for wind, hydropower, geothermal, and other sectors. The variety of estimates were included to provide a fuller understanding of how employment is currently interpreted by industry analysts.

Table 2. Direct U.S. Renewable Electric Power Generation and Fuels Jobs for Q1 2016

Solar	Wind	Hydro	Geothermal	Bioenergy*	Total
373,807	101,738	65,554	5,768	130,677	**677,544**

*Includes corn ethanol, other ethanol, non-woody biomass, woody biomass, and other biofuels
Source: "U.S. Energy and Employment Report," U.S. Department of Energy, January, 2017

Solar: USEER reports that the solar energy industry provided 373,807 direct jobs distributed across manufacturing, installation, distribution, and support services for solar energy, about 260,077 of which were full-time positions.[24] According to The Solar Foundation's annual report, the solar energy industry grew 24.5 percent between November 2015 and November 2016, its fourth straight year of 20-plus percent growth. The report concluded that the solar industry provided a total of 260,077 jobs, distributed across all 50 states.[25] Both USEER and The Solar Foundation defined a solar job as one held by an individual who spends at least 50 percent of their time on solar-related work.[26, 27] IRENA further reports that the solar photovoltaic subsector provided 194,000 jobs, while the solar heating/cooling subsector and the concentrated solar power (CSP) subsector provided roughly 10,000 and 4,000 jobs, respectively.[28]

Wind: USEER found that the wind power industry provided 101,738 jobs in Q1 2016.[29] IRENA, meanwhile, reports that the American wind energy industry employed 88,000 Americans.[30] The American Wind Energy Association (AWEA) corroborates IRENA's 88,000 jobs estimate for the period, claiming that the wind power sector grew by roughly 20 percent between the end of 2014 and the end of 2015.[31] More specifically, AWEA reports that the majority of the industry's growth occurred in the "wind project development and construction" subsector, which employed over 38,000 Americans. AWEA further reports that the manufacturing subsector provided over 21,000 jobs, while the wind turbine servicing subsector employed over 8,800 technicians (identified by the Bureau of Labor Statistics as the fastest growing job in the United States).[32] [33]

Hydropower: According to USEER, the American hydropower industry directly employed 65,554 Americans, 56,259 of whom worked in the traditional hydropower sector and 9,295 in the low-impact hydroelectric subsector.[34] IRENA reported that the "small hydropower" industry directly provided approximately 8,000 jobs; it did not take into account U.S. "large hydropower" employment.[35] In a 2016 report specifically concerning the U.S. hydroelectric industry, DOE concluded that, in 2013, the sector employed around 143,000 Americans, of which 118,000 worked in full-time operational and maintenance positions and 25,000 worked on short-term construction and upgrade projects.[36]

Geothermal: USEER reports that the geothermal power sector directly provided 5,768 jobs in Q1 2016.[37] Alternatively, IRENA estimated that around 35,000 Americans worked in the geothermal industry, which (in contrast to USEER's definition) encompassed both the power and heating subsectors.[38] In a 2016 report, the Geothermal Energy Association (GEA), Geothermal Exchange Organization (GEO), and Geothermal Resources Council (GRC) concluded that the incorporation of the full geothermal power potential of 9 Western states into the electric grid would support approximately 121,140 direct, indirect, and induced jobs. The report estimated that around 19,480 of these jobs would be full-time operational positions, and 101,300 would be temporary construction jobs lasting at least one year.[39]

Wave & Ocean Power: In 2010, the Brookings-Battelle Clean Economy Database found 371 workers were supported by the wave and ocean power industry.[40] The Ocean Renewable Energy Coalition suggests marine and hydrokinetic energy could support 36,000 positions by 2030 in direct and indirect jobs in the United States, if its goal of installing 15 gigawatts of power is met.[41]

Biomass: According to USEER, the U.S. biomass power industry employs 7,980 Americans who work exclusively with biomass electric generation technologies.[42] IRENA, however, reports that "solid biomass" energy production directly provides 15,000 jobs and supports an approximate total of 152,000 jobs in the United States.[43] "Solid biomass" excludes "traditional biomass," which refers to wood, charcoal, agricultural residues or animal dung used for residential cooking and heating, particularly in developing countries. The Biomass Power Association corroborates IRENA's direct jobs estimate, and finds that the more than 15,500 American biomass energy employees working in 80 power-generating facilities across 20 states produce nearly 50 percent of America's total renewable electricity.[44, 45]

Waste-to-Energy: A 2016 Energy Recovery Council report suggests that in 2013, 5,350 direct jobs were supported in the waste-to-energy industry. This number includes workers who are employed on-site and off-site by owners, operators, and local governments involved in the industry. Indirectly, the industry provides another 8,600 jobs, for a total of about 14,000 jobs.[46] A 2015 report published by the National Association of Counties calculates that an average waste-to-energy facility capable of processing 1,500 tons of waste per day provides 248 direct jobs and 52 indirect jobs during construction and 59 permanent direct jobs for the plant's operation and maintenance.[47]

Biogas: Although there is no data for total U.S. employment in biogas, E2 found that the American biogas energy industry announced 193 new jobs in 2015.[48] In 2016, the American Biogas Council reported that over 2,100 biogas systems are currently in operation in the United States. In addition, the report suggested that more than 11,000 additional dairy/swine farms, wastewater treatment plants, and landfill gas projects could be effectively converted into biogas production facilities. The Council concluded that these new systems could support roughly 275,000 temporary construction jobs and 18,000 full-time operational positions.[49]

Renewable Fuels: According to USEER, the U.S. renewable fuels industry directly employed 104,663 Americans.[50] IRENA reports that, in 2015, the U.S. "liquid biofuels" sector provided roughly 277,000 jobs.[51] Alternatively, the Fuels America coalition calculated that in 2014 there were 852,056 total renewable fuels jobs in the United States, 292,166 of which were direct jobs, 226,098 were induced, and 333,792 were in the supply chain.[52] The following is a job breakdown for the three main sectors of renewable fuels.

Ethanol: USEER found that the corn ethanol subsector provided 28,613 jobs.[53] On the other hand, IRENA reports that the U.S. ethanol industry employed 227,562 Americans.[54] According to the Renewable Fuels Association, the domestic ethanol sector supported 357,407 jobs at the end of 2015, 85,967 of which were direct and 271,440 indirect/induced.[55] More specifically, Agricultural and Biofuels Consulting, LLP found roughly 10,400 employees working full-time directly in ethanol production facilities.[56]

Biodiesel: USEER includes American biodiesel jobs with the non-corn ethanol and non-woody biomass sectors, totaling 23,088 jobs in Q1 2016. According to IRENA, the U.S. biodiesel sector employed 49,486 Americans at the end of 2015.[57] The National Biodiesel Board found that the domestic biodiesel directly provided roughly 31,000 jobs and supported a total of more than 62,200 jobs nationwide (as of March 2016).[58, 59] LMC International concluded that the biodiesel industry in the United States employed a total of roughly 47,400 jobs (46,500 in domestic production operations, and 900 in projects relating to imported biodiesel[60]).

Advanced Biofuels: USEER found that biofuels production derived from woody biomass and cellulosic feedstocks supported 30,458 direct jobs in Q1 2016. Additionally, USEER reported that renewable fuel projects involving woody biomass employed 18,031 Americans. In 2013, E2 found that advanced biofuel companies reported they were supporting about 4,500 direct, full-time jobs.[61]

RENEWABLE ENERGY JOBS AROUND THE WORLD

The following data is from the International Renewable Energy Agency. All of the reported data is as of the end of 2015, except for that of the European Union, which dates to the end of 2014.

In its 2016 Renewable Energy and Jobs Annual Report, IRENA estimated that there were approximately 8,079,000 direct and indirect jobs in the renewable energy sector across the world. The nine primary sectors of renewable energy covered by the report were biomass, liquid biofuels, biogas, geothermal, small hydropower, solar photovoltaic (PV), CSP, solar heating/cooling, and wind power. **The report reveals that China leads global employment in renewable energy with roughly 3,523,000 direct and indirect jobs, followed by Brazil, the United States, India, Japan, Germany, and France**.[62]

Across the globe, the solar PV subsector had the highest employment in the renewable energy sector, with around 2,772,000 jobs. Liquid biofuels and wind power followed closely behind, employing around 1,678,000 and 1,081,000 individuals (respectively). While IRENA did not present large hydropower employment on a country-by-country basis, the report states that the industry supported more than 1,300,000 direct jobs worldwide at the end of 2015. The report's total renewable energy employment estimate includes approximately 3,700 ocean energy subsector jobs and 11,000 renewable municipal and industrial waste-to-energy subsector jobs.[63]

The following is a breakdown of green jobs in the countries with the largest amount of renewable energy employment.

Table 3. Direct and Indirect International Renewable Energy and Fuels Jobs (in Thousands)

Sector	China	Brazil	India	Japan	Bangladesh	Germany	France	Rest of E.U.
Solar (PV, Concentrated, Heating/Cooling)	2,395	45	178	378	127	49	27	108
Wind	507	41	48	5	0.1	149	20	162
Large Hydro	442	195	104	n/a	n/a	n/a	n/a	n/a
Small Hydro	100	12	12	--	5	12	4	31
Geothermal	--	--	--	2	--	17	31	55
Biomass	241	--	58	--	--	49	48	214
Biogas	209	--	85	--	9	48	4	14
Liquid Biofuels	71	821	35	3	--	23	35	47
Total	**3,965**	**1,114**	**520**	**388**	**141.1**	**347**	**169**	**631**

Source: "Renewable Energy and Jobs Annual Review 2016," International Renewable Energy Agency, March 2016

China: In addition to being the largest provider of total renewable energy jobs worldwide, IRENA notes that China also leads in seven different renewable energy sectors, in terms of employment. China leads the world in solar PV subsector employment, with the industry providing around 1,652,000 direct and indirect jobs. China also leads the world in large hydropower energy employment, providing more than 442,000 jobs (or roughly 34 percent of the subsector's total global employment). Following solar PV and large hydropower, China's other large renewable energy employment sectors include solid biomass with 822,000 job, solar heating/cooling with 743,000 jobs, wind power with 507,000 jobs, and biogas with 209,000 jobs.[64]

Brazil: According to IRENA, Brazil has the second greatest number of renewable energy jobs worldwide, with a total of 918,000 jobs. Brazil tops the charts globally in terms of liquid biofuel industry employment, with a total of around 821,000 jobs. The liquid biofuel subsector not only directly provides 268,400 sugarcane production, 190,000 ethanol processing and 162,600 biodiesel jobs, but it also indirectly supports 200,000 equipment manufacturing positions. Additionally, the report identifies Brazil as the second largest large-scale hydropower employer, providing approximately 195,000 direct jobs (or roughly 15 percent of the subsector's total global employment). IRENA further notes that the nation offers 41,000 jobs in solar heating/cooling equipment manufacturing and installation, 41,000 jobs in wind power, and 12,000 jobs in small hydropower.[65]

India: India has the fourth largest number of renewable energy jobs globally, employing 416,000 people directly and indirectly in the sector. IRENA identified India's largest renewable energy subsector to be large-scale hydropower, directly employing 104,000 individuals. India's solar PV subsector was its second largest renewable energy employer, supporting roughly 103,000 direct and indirect jobs.[66] India's other large renewable energy employers include the biogas industry (85,000 jobs), the solar heating/cooling industry (75,000 jobs), the solid biomass industry (58,000 jobs), the wind power industry (48,000 jobs), the liquid biofuels industry (35,000 jobs), and the small hydropower industry (12,000 jobs).[67]

Japan: IRENA reports that Japan is the world's fifth largest renewable energy employer, supporting roughly 388,000 direct and indirect jobs. In addition, the report found that Japan trails only China in terms of total solar PV employment, with the subsector supporting around 377,000 direct and indirect jobs. Japan also provides around 5,000 wind power, 3,000 liquid biofuel, and 2,000 geothermal jobs.[68]

Germany: In addition to being the sixth largest renewable energy employer in the world, Germany has the most renewable energy jobs of any single country in the European Union, for a total of 355,000 jobs. Germany leads the European Union in wind power employment, supporting around 149,000 jobs. Germany's other notable subsector-specific employment includes 49,000 jobs in solid biomass, 48,000 jobs in biogas, 38,000 jobs in solar PV, 23,000 jobs in liquid biofuels, and 700 jobs in Concentrated Solar Power. Additionally, Germany employed 8,300 individuals in publicly-funded renewable energy R&D and administration projects.[69]

France: IRENA found that France provided the seventh largest number of renewable energy jobs at the end of 2015, supporting around 170,000 direct and indirect jobs. The nation's two largest renewable energy subsectors were the solid biomass and liquid biofuels industries, which provided approximately 48,000 and 35,000 jobs, respectively. Furthermore, France trailed only the United States in geothermal energy employment, with a total of approximately 31,000 jobs.[70]

Bangladesh: According to IRENA, Bangladesh was the eighth largest renewable energy employer, supporting around 141,000 direct and indirect jobs. The nation provided the fourth largest number of solar PV jobs worldwide, with a total of approximately 127,000. Following solar PV, the report identified Bangladesh's largest renewable energy subsectors as biogas (9,000 jobs) and small hydropower (5,000 jobs).[71]

Rest of the European Union (EU): Excluding Germany and France, the European Union provided around 644,000 total renewable energy jobs (76,300 of which were in Spain). The European Union led the world in geothermal and CSP energy employment, supporting approximately 55,000 and 5,000 jobs, respectively. The European Union also provided the second largest number of solid biomass and small hydropower jobs globally, with a total of around 214,000 and 31,000 jobs, respectively. The report further concluded that the European Union provided around 84,000 solar PV jobs. Within the Union, the United Kingdom trailed only Germany in solar PV employment, with a total of 35,000 jobs. Lastly, IRENA provided employment data for the ocean energy and renewable municipal and industrial waste-to-energy subsectors, which provided 3,700 and 8,000 jobs, respectively.[72]

The European Union is also known for its widespread use of wind power, a sector which employed 162,000 individuals (30,000 of which worked in Denmark alone). IRENA also found that the European Union – specifically Germany, the United Kingdom, and Denmark – led the world in offshore wind employment, with Denmark providing 10,000 of these jobs. [73]

Author: Daniel Lopez
Editor: Brian La Shier

This fact sheet is available electronically (with hyperlinks and endnotes) at *www.eesi.org/papers*.

The Environmental and Energy Study Institute (EESI) is a non-profit organization founded in 1984 by a bipartisan Congressional caucus dedicated to finding innovative environmental and energy solutions. EESI works to protect the climate and ensure a healthy, secure, and sustainable future for America through policymaker education, coalition building, and policy development in the areas of energy efficiency, renewable energy, agriculture, forestry, transportation, buildings, and urban planning.

ENDNOTES

[1] "U.S. Energy and Employment Report," *U.S. Department of Energy*, March, 2016. https://www.energy.gov/sites/prod/files/2016/03/f30/U.S.%20Energy%20and%20Employment%20Report.pdf
[2] "U.S. Energy and Employment Report," *U.S. Department of Energy*, January, 2017. https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf
[3] "Renewable Energy and Jobs Annual Review 2016," *International Renewable Energy Agency*, March, 2016. http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Jobs_Annual_Review_2016.pdf
[4] "U.S. Energy and Employment Report," *U.S. Department of Energy*, January, 2017. https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf
[5] "Measuring Green Jobs," *Bureau of Labor Statistics*, 2010. http://www.bls.gov/green/home.htm
[6] Ibid.
[7] "BLS 2013 Sequestration Information," *Bureau of Labor Statistics*, 2013. http://www.bls.gov/bls/sequester_info.htm
[8] "U.S. Energy and Employment Report," *U.S. Department of Energy*, January, 2017. https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf
[9] Ibid.
[10] Ibid.
[11] Ibid.
[12] Ibid.
[13] "2016 Public Transportation Fact Book Appendix A: Historical Tables," *American Public Transportation Industry*, April, 2016. http://www.apta.com/resources/statistics/Documents/FactBook/2016-APTA-Fact-Book-Appendix-A.pdf
[14] Ibid.
[15] "U.S. Energy and Employment Report," *U.S. Department of Energy*, January, 2017. https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf
[16] Ibid.
[17] Ibid.
[18] "Clean Jobs America," *Environmental Entrepreneurs*, March, 2016. http://www.e2.org/wp-content/uploads/2016/03/CleanJobsAmerica_FINAL.pdf
[19] "Clean Energy Works For Us: Q4 and Year-End 2015 Jobs Report," *Environmental Entrepreneurs*, February, 2016. http://www.e2.org/wp-content/uploads/2016/02/Q4-2015_End-of-Year-Report.pdf
[20] "U.S. Energy and Employment Report," *U.S. Department of Energy*, January, 2017. https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf
[21] Ibid.
[22] Ibid.
[23] "Renewable Energy and Jobs Annual Review 2016," *International Renewable Energy Agency*, March, 2016. http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Jobs_Annual_Review_2016.pdf
[24] "U.S. Energy and Employment Report," *U.S. Department of Energy*, January, 2017. https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf
[25] "National Solar Jobs Census 2016," *The Solar Foundation*, February, 2017. http://www.thesolarfoundation.org/national/?mc_cid=eaf6332238&mc_eid=%5BUNIQID%5D
[26] "U.S. Energy and Employment Report," *U.S. Department of Energy*, January, 2017. https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf
[27] "National Solar Jobs Census 2016," *The Solar Foundation*, February, 2017. http://www.thesolarfoundation.org/national/?mc_cid=eaf6332238&mc_eid=%5BUNIQID%5D
[28] "Renewable Energy and Jobs Annual Review 2016," *International Renewable Energy Agency*, March, 2016. http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Jobs_Annual_Review_2016.pdf
[29] "U.S. Energy and Employment Report," *U.S. Department of Energy*, January, 2017. https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf
[30] "Renewable Energy and Jobs Annual Review 2016," *International Renewable Energy Agency*, March, 2016. http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Jobs_Annual_Review_2016.pdf
[31] "U.S. wind power jobs hit record, up 20 percent in 2016." Press Release, *American Wind Energy Association*, April, 2016. http://www.awea.org/MediaCenter/pressreleasev2.aspx?ItemNumber=8736
[32] Ibid.
[33] "Employment Projects – 2014-2024." News release, *Bureau of Labor Statistics*, December, 2015. http://www.bls.gov/news.release/pdf/ecopro.pdf
[34] "U.S. Energy and Employment Report," *U.S. Department of Energy*, January, 2017. https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf

[35] "Renewable Energy and Jobs Annual Review 2016," *International Renewable Energy Agency*, March, 2016. http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Jobs_Annual_Review_2016.pdf
[36] "Hydropower Vision: A New Chapter for America's 1st Renewable Electricity Source," Executive Summary, *U.S. Department of Energy*, July, 2016. http://energy.gov/sites/prod/files/2016/07/f33/Hydropower-Vision-Executive-Summary.pdf
[37] "U.S. Energy and Employment Report," *U.S. Department of Energy*, January, 2017. https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf
[38] "Renewable Energy and Jobs Annual Review 2016," *International Renewable Energy Agency*, March, 2016. http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Jobs_Annual_Review_2016.pdf
[39] "GEA-GEO-GRC EPA Geothermal Energy State Guides," Fact Sheets, *Geothermal Energy Association, Geothermal Exchange Organization, Geothermal Resources Council*, January, 2016. http://geo-energy.org/GEA_GRC_State_Guides.aspx
[40] "Sizing the Clean Economy," *Brookings-Battelle Clean Economy*, July, 2013. http://www.brookings.edu/research/interactives/aggregate-clean-economy#/?ind=39&geo=4&vis=0&dt=2&z=0&x=0&y=0
[41] "U.S. Marine and Hydrokinetic Renewable Energy Roadmap," *Ocean Renewable Energy Coalition*, November 2011. https://www.ocean-energy-systems.org/library/countries-roadmaps/document/marine-and-hydrokinetic-renewable-energy-roadmap-usa/
[42] "U.S. Energy and Employment Report," *U.S. Department of Energy*, January, 2017. https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf
[43] "Renewable Energy and Jobs Annual Review 2015," *International Renewable Energy Agency*, March, 2015. http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Jobs_Annual_Review_2015.pdf
[44] "About Biomass," Fact Sheet, *Biomass Power Association*, 2016. http://www.biomasspowerassociation.com/pages/about_facts.php
[45] "Monthly Energy Review," U.S. Energy Information Administration, December, 2016 http://www.eia.gov/totalenergy/data/monthly/pdf/sec10_3.pdf
[46] "The 2014 Erc Directory Of Waste-To-Energy Facilities," *Energy Recovery Council*, May, 2014. http://energyrecoverycouncil.org/wp-content/uploads/2016/05/ERC-2016-directory.pdf
[47] "Waste Energy Recovery: Renewable Energy From County Landfills," *National Association of Countries*, February, 2015. http://www.naco.org/sites/default/files/documents/WasteEnergy_FINAL.pdf
[48] "Clean Energy Works For Us: Q4 and Year-End 2015 Jobs Report," *Environmental Entrepreneurs*, February, 2016. http://www.e2.org/wp-content/uploads/2016/02/Q4-2015_End-of-Year-Report.pdf
[49] "Biogas Council: Potential US Biogas Systems," *American Biogas Council,* 2016. https://www.americanbiogascouncil.org/pdf/ABC percent20Biogas percent20101 percent20Handout percent20NEW.pdf
[50] "U.S. Energy and Employment Report," *U.S. Department of Energy*, January, 2017. https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf
[51] "Renewable Energy and Jobs Annual Review 2016," *International Renewable Energy Agency*, March, 2016. http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Jobs_Annual_Review_2016.pdf
[52] "Renewable Fuel Drives Economic Growth Nationwide," *Fuels America*, 2014. http://fuelsamerica.guerrillaeconomics.net/
[53] "U.S. Energy and Employment Report," *U.S. Department of Energy*, January, 2017. https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report_0.pdf
[54] "Renewable Energy and Jobs Annual Review 2016," *International Renewable Energy Agency*, March, 2016. http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Jobs_Annual_Review_2016.pdf
[55] "Fueling A High Octane Future: 2016 Ethanol Industry Outlook," *Renewable Fuels Association*, 2016. http://www.ethanolrfa.org/wp-content/uploads/2016/02/Ethanol-Industry-Outlook-2016.pdf
[56] "Contribution of the Ethanol Industry to the Economy of the United States in 2015," *Agriculture and BioFuels Consulting, LLP*, February, 2016. http://ethanolrfa.org/wp-content/uploads/2016/02/Ethanol-Economic-Impact-for-2015.pdf
[57] "Renewable Energy and Jobs Annual Review 2016," *International Renewable Energy Agency*, March, 2016. http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Jobs_Annual_Review_2016.pdf
[58] "Biodiesel: Fueling Sustainability," Fact Sheet, *Biodiesel - America's First Advanced Biofuel*, March, 2016. http://biodiesel.org/docs/default-source/ffs-basics/biodiesel-fueling-sustainability.pdf?sfvrsn=6
[59] "Production Statistics," *Biodiesel - America's First Advanced Biofuel*, 2016. http://biodiesel.org/production/production-statistics
[60] "The Economic Impact of the Biodiesel Industry on the U.S. Economy," *LMC International*, June, 2016. http://biodiesel.org/docs/default-source/policy--federal/lmc-study-for-nbb_economic-impact-of-biodiesel_june-2016-final.pdf?sfvrsn=2
[61] Solecki, Mary, Anna Scodel, and Bob Epstein. "Advanced Biofuel Market Report 2013: Capacity through 2016," *Environmental Entrepreneurs*, 2013. https://www.e2.org/ext/doc/E2AdvancedBiofuelMarketReport2013.pdf
[62] "Renewable Energy and Jobs Annual Review 2016," *International Renewable Energy Agency*, March, 2016. http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Jobs_Annual_Review_2016.pdf
[63] Ibid.

[64] Ibid.
[65] Ibid.
[66] Ibid.
[67] "Renewable Energy and Jobs Annual Review 2015," *International Renewable Energy Agency*, March, 2015. http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Jobs_Annual_Review_2015.pdf
[68] "Renewable Energy and Jobs Annual Review 2016," *International Renewable Energy Agency*, March, 2016. http://www.irena.org/DocumentDownloads/Publications/IRENA_RE_Jobs_Annual_Review_2016.pdf
[69] Ibid.
[70] Ibid.
[71] Ibid.
[72] Ibid.
[73] Ibid.