



Fact Sheet

Jobs in Renewable Energy and Energy Efficiency

November 2015

This fact sheet examines 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 the U.S. Department of Energy (DOE), as well as international organizations, national non-profits, think tanks and national trade associations. Due to the lack of a single body conducting job surveys, EESI has collected information from a number of sources which employ different research methodologies and different job definitions in their work. This makes it somewhat problematic to compare job estimates directly. In addition, EESI must occasionally refer to reports that are somewhat dated, due to a lack of more recently released information. This fact sheet represents a best effort to survey the status of renewable energy and energy efficiency jobs from the data that is publicly available.

CLEAN ENERGY JOBS IN THE UNITED STATES

The U.S. Bureau of Labor Statistics (BLS) defines a green job 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.”¹ 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 resource conservation; and 5) environmental compliance, education and training, and public awareness.²

In Fiscal Year 2010, the Bureau of Labor Statistics began collecting data for green jobs, as a way of measuring progress in green technology. Unfortunately, in March of 2013 the Administration ordered across-the-board spending cuts as a result of the amended *Balanced Budget and Emergency Deficit Control Act*, causing BLS to eliminate the Green Careers program, and thereby the green job statistics.³ The program has not resumed.

ENERGY EFFICIENCY & RENEWABLE ENERGY EMPLOYMENT

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

The Ecotech Institute used the Bureau of Labor Statistics definition of a green job to calculate the number of clean job openings in 2014. The organization found a 13 percent increase in clean job openings from 2013 to 2014, from 3.6 million clean job openings in 2013 to 3.8 million openings in 2014.^{4,5} The institute estimates that there were 1.2 million clean job openings in the first three months of 2015.⁶

Energy Efficiency

The American Council for an Energy-Efficient Economy (ACEEE) is currently working on a new estimate for energy efficiency jobs in the United States, following a review of the methodologies that can be used to measure such jobs.⁷ Its last analysis dates to 2010, when ACEEE estimated there were 830,000 energy efficiency jobs in the United States, and predicted numbers were increasing at a three percent annual rate.⁸ ACEEE also stated that if the United States were to invest whole-heartedly in energy efficiency, especially new technologies, there could be a net increase of 1.3 to 1.9 million jobs in energy efficiency industries by 2050.⁹

Appliances: According to Environmental Entrepreneurs (E2), as of 2010 federal appliance standards had generated a total of 340,000 jobs. E2 predicts this number will come close to 380,000 by 2030.¹⁰ E2 also reported that in the first quarter of 2015, 200 new jobs were announced in lighting efficiency.¹¹

Buildings: According to a U.S. Green Building Council study conducted by Booz Allen Hamilton, during 2015 the U.S. green building sector will support over 2.3 million jobs. The study also found that green buildings will support more than 3.3 million jobs by 2018, equivalent to one-third of all U.S. construction jobs.¹² Consulting firm McKinsey calculated that an additional 600,000 to 900,000 jobs could be created in buildings efficiency between 2009 and 2020.¹³

Public Transportation: According to Environmental Entrepreneurs' annual jobs reports, in 2013, newly announced projects created 6,900 jobs, projects under construction created 2,749 jobs, and projects in operation created 1,800 jobs, for a total of 11,449 new jobs.¹⁴ In 2014, 2,000 new jobs were announced.¹⁵

Smart Grid and Demand Management: The U.S. Department of Energy (DOE) calculated that the smart grid program, part of the 2009 *American Recovery and Reinvestment Act*, supported a minimum of 47,000 jobs.¹⁶ Environmental Entrepreneurs found that in 2013, there were 8,765 new jobs in smart grid/transmission.¹⁷

Vehicles: To estimate green jobs in the car industry, Environmental Entrepreneurs focuses on "electric and hybrid vehicle manufacturing and vehicle fuel efficiency manufacturing projects." The organization estimates that in 2013, new projects created 1,680 jobs, projects under construction created 100 jobs, and projects in operation created 612 jobs, for a total of 2,392 new jobs.¹⁸ In 2014, E2 found 9,020 additional jobs were announced,¹⁹ and in the first quarter of 2015, 300 new jobs were announced.²⁰

Renewable Energy

According to the International Renewable Energy Agency (IRENA), renewable energy employment in the United States reached 724,000 jobs in 2014, a 16 percent increase from the previous year (IRENA does not include large-scale hydropower in their estimates).²¹

Biogas: Although there is no data for total employment in biogas, E2 found that 125 new jobs were announced at the end of 2014.²² A different E2 report detailed that 60 new jobs were announced in the first quarter of 2015.²³ In 2014, the American Biogas Council found 2,000 biogas systems in operation in the United States, and reported there is a market potential for 12,000 new systems. They determined these new systems could create 300,000 construction jobs and 20,000 permanent jobs.²⁴

Biomass: According to IRENA, the United States currently employs a total of 152,000 direct and indirect workers in the biomass industry.²⁵ The Biomass Power Association calculates that each biomass facility supports up to four jobs per megawatt (MW), with two jobs inside the plant and two working on the "collection, handling, and transportation of the organic fuels used by the plants."²⁶

Fuel Cells: In 2011, Fuel Cells 2000 found that the fuel cell industry was supporting 10,845 jobs, of which 3,615 were direct and 7,230 were indirect.²⁷ While concrete data from 2012 and 2013 is unavailable, E2 found that 222 jobs in this industry were announced in 2014 and 550 new jobs were announced during the first quarter of 2015.^{28, 29} In addition, a DOE report found 1,700 total direct and indirect fuel cell jobs in New York in 2013, 8,400 jobs in Massachusetts in 2013, and 1,010 direct jobs in Connecticut in 2011.³⁰

Geothermal: The International Renewable Energy Agency reported a total of 35,000 geothermal energy jobs in the United States at the end of 2014 in its annual report.³¹ In a 2015 Issue Brief, the Geothermal Energy Association estimated that geothermal power plants employ roughly 1.17 permanent workers per megawatt (MW). If other positions are added to this figure (e.g., related governmental, administrative, and technical positions), the number of geothermal jobs jumps to 2.13 workers per MW. Building geothermal plants also supplies temporary direct employment. During construction, 3.1 workers per MW are employed, and 3.3 workers per MW are employed for equipment manufacturing.³²

Hydropower: In a 2014 report, the American Council on Renewable Energy (ACORE) found that the hydropower industry employs 200,000 to 300,000 workers, and supports a supply chain of more than 2,500 companies in the United States.³³ Navigant Consulting estimated in 2009 that another 1.4 million jobs could be created in the hydropower sector by 2025 if certain policies were enacted.³⁴

Renewable Fuels: The Fuels America coalition calculated there were 852,056 total renewable fuels jobs in 2014; 292,166 of these jobs were direct jobs, 226,098 were induced, and 333,792 were in the supply chain. The coalition determined the economic impact of these jobs to be worth \$184.47 billion. The following is a job breakdown for the three main sectors of renewable fuels.³⁵

Advanced Biofuels: In 2013, Environmental Entrepreneurs found that advanced biofuel companies reported they were supporting about 4,500 direct, full-time jobs, and that the companies predicted they would directly support 8,000 employees by 2016. E2's report added that the supply chain, especially feedstock production, is the greatest employment driver in the advanced biofuels sector. Feedstock production could directly employ 12,300 people by 2016, bringing the direct job total to 20,300. Under this growth scenario, construction work would temporarily provide another 33,000 jobs.³⁶

Biodiesel: In 2013, the National Biodiesel Board said the biodiesel industry supported more than 62,000 jobs.³⁷

Ethanol: According to the Renewable Fuels Association, the ethanol industry supported 83,949 direct jobs at the end of 2014, 148,684 indirect jobs, and 146,582 induced jobs—for a total of 379,215 jobs at the end of 2014.³⁸

Solar: According to The Solar Foundation, as of November 2014, the solar energy industry provided 173,807 direct jobs. This is a 21.8 percent increase in solar jobs from November 2013. Overall, solar jobs growth accounted for 1.3 percent of all new U.S. jobs in 2014. Factoring in indirect and induced job impacts, which amount to 531,200 additional jobs, total employment in the solar energy sector exceeds 705,000 jobs.³⁹

Waste-to-Energy: A 2014 Energy Recovery Council report suggests that 5,350 direct jobs are supported in the waste-to-energy industry. This number includes those workers who are employed on-site and off-site as 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.⁴⁰ A 2015 report published by the National Association of Counties

calculates that a 1,500-tons-per-day waste-to-energy facility creates 248 direct and 52 indirect jobs during construction, and 59 permanent direct jobs for the plant's operation and maintenance.⁴¹

Wave & Ocean Power: In 2010, the Brookings-Battelle Clean Economy Database found 371 workers were supported by the wave and ocean power industry in the United States.⁴² The Ocean Renewable Energy Coalition suggests marine and hydrokinetic energy would support 36,000 direct and indirect positions in the United States by 2030, if its goal of 15 gigawatts of marine power is reached.⁴³

Wind: According to the American Wind Energy Association (AWEA), as of the end of 2014, the wind energy industry had provided a total of 73,000 full-time equivalent jobs in “planning, siting, development, construction, manufacturing and supply chain, and operations” in the United States.⁴⁴ A press release published by AWEA in April 2015 stated that 23,000 of these jobs were added in 2014. Texas, the largest state for wind energy jobs, employs over 17,000 people in the sector.⁴⁵

CLEAN ENERGY JOBS AROUND THE WORLD

Energy Efficiency

Energy efficiency jobs are particularly difficult to measure on the global stage, as definitions vary greatly, and many workers in the building industry are not part of the formal economy. The latest information for global energy efficient data comes from a 2008 green jobs report published by the United Nations Environment Programme (UNEP), in which the organization determined there were a total of four million direct jobs in energy efficiency in the United States and a selection of European countries.⁴⁶ In a 2013 report, SustainLabour estimated 25,900 jobs are created for every one billion euros (\$1,135 billion) invested in energy efficient buildings, and that there were 232,050 jobs currently in the European Union insulation industry.⁴⁷

Renewable Energy

The following data is from the International Renewable Energy Agency (IRENA).

In its 2015 *Renewable Energy and Jobs Annual Report*, the International Renewable Energy Agency (IRENA) estimated there were 7.7 million direct and indirect jobs in the renewable energy sector in 2014. The nine sectors of renewable energy covered by the report were biomass, liquid biofuels, biogas, geothermal, small hydropower, solar photovoltaic (PV), concentrated solar power (CSP), solar heating/cooling, and wind power. The report revealed that China leads global employment in renewable energy with roughly 3.4 million direct and indirect jobs, followed by Brazil, the United States, India, and Germany.⁴⁸

Across the globe, solar PV has the highest employment in the renewable energy sector, with roughly 2.5 million jobs. Liquid biofuels trails closely behind with 1.8 million jobs, followed by wind power at approximately one million jobs.⁴⁹

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

China: In addition to being the largest provider of total renewable energy jobs worldwide, China also leads in eight of the nine different renewable energy sectors. Some of China's biggest renewable energy employment sectors in 2014 were solar PV with 1.6 million direct and indirect jobs, solar heating/cooling with 600,000 jobs, and wind power with 502,400 jobs.⁵⁰

Brazil: According to IRENA, Brazil has the second greatest number of renewable energy jobs worldwide, with a total of 934,000 jobs. Brazil tops the charts globally for jobs in liquid biofuels with a total of 845,000. IRENA also notes that the nation has 41,000 jobs in solar heating/cooling, 36,000 jobs in wind, and 12,000 jobs in small hydropower.⁵¹

India: India has the fourth largest number of renewable energy jobs globally, employing 437,000 people directly and indirectly in the sector. IRENA calculates that India employs the most people in solar PV, with a total of 125,000 jobs, followed by biogas (85,000 jobs), solar heating/cooling (75,000 jobs), and biomass (58,000 jobs).⁵²

Germany: IRENA finds Germany has the most renewable energy jobs in the European Union, as well as the fifth largest number in the world, with a total of 371,000 jobs. Germany is widely known for its use of wind power, a sector that employs 138,000 people. Germany also has 56,000 jobs in solar PV and 52,000 jobs in biomass.⁵³

IRENA reports that Indonesia, Japan, France, Bangladesh and Colombia make up the rest of the top ten countries with the highest number of green jobs.⁵⁴

Author: Sharmen Hettipola
Editor: Laura Small

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.

¹ [“Measuring Green Jobs,”](#) Bureau of Labor Statistics, 2010.

² [“Measuring Green Jobs,”](#) Bureau of Labor Statistics, 2010.

³ [“BLS 2013 Sequestration Information,”](#) Bureau of Labor Statistics, 2013.

⁴ [“Clean Jobs Infographic for 4th Quarter 2013,”](#) Ecotech Institute, February 2014.

⁵ [“Clean Jobs Infographic: 2013 vs. 2014,”](#) Ecotech Institute, April 2015.

⁶ [“Clean Jobs Infographic for 1st Quarter 2015,”](#) Ecotech Institute, May 2015.

⁷ [“Verifying Energy Efficiency Job Creation: Current Practices and Recommendations,”](#) American Council for an Energy-Efficient Economy, September, 2015.

⁸ [“Energy Efficiency and Economic Opportunity,”](#) American Council for an Energy-Efficient Economy, August, 2012.

⁹ Bell, Casey J. [“Energy Efficiency Job Creation: Real World Experiences”](#). American Council for an Energy-Efficient Economy, October 2012.

¹⁰ [“Appliance Efficiency,”](#) Environmental Entrepreneurs, Access Date: July 2015.

¹¹ [“Clean Energy Works For Us: Q1 2015 Jobs Report,”](#) Environmental Entrepreneurs, June, 2015.

¹² [“New Study Finds Green Construction is Major U.S. Economic Driver,”](#) U.S. Green Building Council, September 16, 2015.

¹³ [“Building Efficiency,”](#) Environmental Entrepreneurs, Access Date: July, 2015.

¹⁴ [“Clean Energy Works For Us: 2013 Year-In-Review And Q4 Report,”](#) Environmental Entrepreneurs, March, 2014.

¹⁵ [“Clean Energy Works For Us: Q4 2014 Jobs Report,”](#) Environmental Entrepreneurs, March, 2015.

¹⁶ [“Smart Grid and Demand Management,”](#) Environmental Entrepreneurs, Access Date: July, 2015.

¹⁷ [“Clean Energy Works For Us: 2013 Year-In-Review And Q4 Report,”](#) Environmental Entrepreneurs, March, 2014.

¹⁸ [“Clean Energy Works For Us: 2013 Year-In-Review And Q4 Report,”](#) Environmental Entrepreneurs, March, 2014.

¹⁹ [“Clean Energy Works For Us: Q4 2014 Jobs Report,”](#) Environmental Entrepreneurs, March, 2015.

²⁰ [“Clean Energy Works For Us: Q1 2015 Jobs Report,”](#) Environmental Entrepreneurs, June, 2015.

²¹ [“Renewable Energy and Jobs Annual Review 2015,”](#) International Renewable Energy Agency, March, 2015.

²² [“Clean Energy Works For Us: Q4 2014 Jobs Report,”](#) Environmental Entrepreneurs, March, 2015.

²³ [“Clean Energy Works For Us: Q1 2015 Jobs Report,”](#) Environmental Entrepreneurs, June, 2015.

²⁴ [“Biogas Council: New Biogas Systems will Cut Methane Emissions,”](#) American Biogas Council, March, 2014.

-
- ²⁵ ["Renewable Energy and Jobs Annual Review 2015,"](#) *International Renewable Energy Agency*, March, 2015.
- ²⁶ ["Helping Biopower Help America: Extending Production Tax Credit Vital for Jobs, Clean Electricity and Energy Independence,"](#) Fact Sheet, *Biomass Power Association*, January, 2013.
- ²⁷ ["A Compendium of Job Estimates in the Fuel Cell Industry,"](#) *Fuel Cell 2000*, March 2011.
- ²⁸ ["Clean Energy Works For Us: Q4 2014 Jobs Report,"](#) *Environmental Entrepreneurs*, March, 2015.
- ²⁹ ["Clean Energy Works For Us: Q1 2015 Jobs Report,"](#) *Environmental Entrepreneurs*, June, 2015.
- ³⁰ ["State of the States: Fuel Cells in America 2014,"](#) *U.S. Department of Energy*, December, 2014.
- ³¹ ["Renewable Energy and Jobs Annual Review 2015,"](#) *International Renewable Energy Agency*, March, 2015.
- ³² ["Geothermal Energy Association Issue Brief: Additional Economic Values of Geothermal Power,"](#) *Geothermal Energy Association*, February 2015.
- ³³ ["The Outlook for Renewable Energy in America,"](#) *American Council on Renewable Energy*, 2014.
- ³⁴ ["Job Creation Opportunities in Hydropower,"](#) Navigant Consulting, September 2009.
- ³⁵ ["Renewable Fuel Drives Economic Growth Nationwide,"](#) *Fuels America*, 2014.
- ³⁶ Solecki, Mary, Anna Scodel, and Bob Epstein. ["Advanced Biofuel Market Report 2013: Capacity through 2016,"](#) *Environmental Entrepreneurs*, 2013.
- ³⁷ ["Study: Biodiesel Industry Supporting 62,000 Jobs,"](#) Biodiesel - America's First Advanced Biofuel, November, 2013.
- ³⁸ ["Contribution Of The Ethanol Industry To The Economy Of The United States In 2014,"](#) *Renewable Fuels Association*, February, 2015.
- ³⁹ ["National Solar Jobs Census 2014,"](#) *The Solar Foundation*, January 2015.
- ⁴⁰ ["The 2014 Erc Directory Of Waste-To-Energy Facilities,"](#) *Energy Recovery Council*, May, 2014.
- ⁴¹ ["Waste Energy Recovery: Renewable Energy From County Landfills,"](#) *National Association of Counties*, February, 2015.
- ⁴² ["Sizing the Clean Economy,"](#) *Brookings-Battelle Clean Economy*, July, 2013.
- ⁴³ ["U.S. Marine and Hydrokinetic Renewable Energy Roadmap,"](#) *Ocean Renewable Energy Coalition*, November 2011.
- ⁴⁴ ["U.S. Wind Industry Annual Market Report 2014: Executive Summary,"](#) *American Wind Energy Association*, April, 2015.
- ⁴⁵ ["American wind energy rebounded in 2014; "wind rush" underway in Texas,"](#) News release, *American Wind Energy Association*, April 2015.
- ⁴⁶ ["Green Jobs: Towards Decent Work In A Sustainable, Low Carbon World: Policy Messages and Main Findings for Decision Makers,"](#) *United Nations Environment Programme*, September, 2008.
- ⁴⁷ ["Green Jobs and related policy frameworks and an overview of the European Union,"](#) *SustainLabour: International Labour Foundation for Sustainable Development*, February 2013.
- ⁴⁸ ["Renewable Energy and Jobs Annual Review 2015,"](#) *International Renewable Energy Agency*, March, 2015.
- ⁴⁹ ["Renewable Energy and Jobs Annual Review 2015,"](#) *International Renewable Energy Agency*, March, 2015.
- ⁵⁰ ["Renewable Energy and Jobs Annual Review 2015,"](#) *International Renewable Energy Agency*, March, 2015.
- ⁵¹ ["Renewable Energy and Jobs Annual Review 2015,"](#) *International Renewable Energy Agency*, March, 2015.
- ⁵² ["Renewable Energy and Jobs Annual Review 2015,"](#) *International Renewable Energy Agency*, March, 2015.
- ⁵³ ["Renewable Energy and Jobs Annual Review 2015,"](#) *International Renewable Energy Agency*, March, 2015.
- ⁵⁴ ["Renewable Energy and Jobs Annual Review 2015,"](#) *International Renewable Energy Agency*, March, 2015.