



# Fact Sheet

## Jobs in Renewable Energy, Energy Efficiency, and Resilience (2019)

July 2019

This fact sheet focuses on employment in the renewable energy and energy efficiency sectors in the United States and around the world. According to the 2019 U.S. Energy Employment Report (USEER), 611,000 people worked in zero-emission technology industries, including renewables and nuclear in the United States.<sup>1</sup> The International Renewable Energy Agency (IRENA) recorded even higher renewable energy employment in the United States at 855,000 direct and indirect jobs in 2018.<sup>2</sup> Jobs in energy efficiency experienced significant growth—the sector now employs more than 3 million people in the United States.<sup>3</sup> IRENA reports that, globally, the renewable energy sector employed 11 million people in 2018, 700,000 more than in 2017.<sup>4</sup>

Climate adaptation and resilience stand out as rapidly emerging areas of employment as a result of climate change impacts. These sectors will be critical to track in tandem with jobs in renewable energy and energy efficiency in the coming years. However, the Standard Occupation Classification (SOC) system managed by the Bureau of Labor Statistics does not currently include codes to allow for the comprehensive analysis of employment in these fields. To address the lack of country-wide data, the American Society of Adaptation Professionals (ASAP) has initiated efforts to define and quantify the adaptation and resilience workforce. ASAP's preliminary analysis found that adaptation and resilience employment is predominantly in government (40 percent), non-governmental organizations (36 percent), and the private sector (16 percent).<sup>5</sup> However, ASAP reports that adaptation work is growing fastest in for-profit, private sector companies, including for-profit climate service firms as well as climate-affected firms from a variety of industries across the North American economy. Climate adaptation and resilience jobs cut across a number of different types of work, including communications and outreach, conservation and ecology, economics and finance, education, engineering and design, hazard mitigation, planning, policy, program administration, and project management. Adaptation and resilience work have been both incorporated into existing jobs and resulted in new jobs—one example being the creation of high-level Chief Resilience Officer positions in over 86 cities around the world.<sup>6</sup> While it is not currently possible to report on the total number of people employed in the climate adaptation and resilience field in the United States, this is an important area of job growth to track looking forward.

The job figures cited below are sourced from 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. Given that, this fact sheet represents a best effort to portray the status of renewable energy and energy efficiency jobs with the data that is publicly available.

### Defining Clean Energy Jobs

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."<sup>7</sup> 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.<sup>7</sup>

In Fiscal Year 2010, the BLS began collecting data for clean energy jobs as a way of measuring progress in green technology development. However, 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*. As a result, BLS eliminated the Green Careers program, and thereby the collection of green jobs statistics.<sup>8</sup> The program has not yet been resumed.

The U.S. Energy and Employment Report (USEER) provides the core data for this fact sheet. Until 2017, the report was published by the Department of Energy (DOE). In 2018, the DOE ended its funding for USEER and the National Association of State Energy Officials (NASEO) and the Energy Futures Initiative (EFI) began producing the report. NASEO and EFI maintain the same methodology the DOE created in order to preserve the data's continuity. Using the BLS Quarterly Census of Employment and Wages (QCEW), BW Research Partnership's Energy Employment Index (EEI), and a survey of 30,000 employers in the energy sector, USEER presents employment data gathered from the U.S. fossil fuel, nuclear, and green energy industries as of the end of the fourth quarter of 2018 (Q4 2018).<sup>9</sup> More specifically, USEER compiles employment statistics from five main sectors of the U.S. energy economy: "Fuels," "Electric Power Generation," "Transmission, Distribution, and Storage," "Energy Efficiency," and "Motor Vehicles & Component Parts."<sup>9</sup> All citations of USEER findings in this fact sheet will be in reference to the Q4 2018 employment statistics unless otherwise specified.

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

According to USEER, energy efficiency employment is defined as "employment [that] covers both the production and installation of energy-saving products and the provision of services that reduce end-use energy consumption."<sup>9</sup> The BLS includes work with "energy-efficient equipment, appliances, buildings, and vehicles, as well as products and services that improve the energy efficiency of buildings and the efficiency of energy storage and distribution, such as Smart Grid technologies" as employment in the energy efficiency sector.<sup>10</sup>

USEER reports that in 2018, 2,324,866 people worked in the United States energy efficiency sector.<sup>11</sup> This represents an increase of more than 124,800 energy efficiency jobs since 2016, making it the energy sector with the highest job growth in the country (5.37 percent).<sup>11</sup> Energy efficiency workers are dispersed across the country, with workers employed in all but seven U.S. counties, according to a 2018 report from E2.<sup>12</sup> More than 300,000 people are employed in energy efficiency in rural areas and 900,000 people work in energy efficiency in the country's 25 largest metro areas.<sup>12</sup> The states with the most jobs in energy efficiency are California (310,433), Texas (154,565), New York (117,339), Florida (112,620), Illinois (86,916), Massachusetts (84,556), Michigan (84,052), North Carolina (84,020), Ohio (79,653), and Virginia (76,621).<sup>12</sup>

These jobs are spread out across sectors with more than 50 percent of energy efficiency employees in construction, 20 percent in professional services, and 14 percent in manufacturing.<sup>12</sup> In the construction sector specifically, 17 percent of all construction jobs are in energy efficiency—this is equivalent to more than 1 in every 6 workers.<sup>12</sup> Table 1 shows energy efficiency jobs by sector for Q2 of 2018. The table includes some additional sectors not incorporated into the USEER energy efficiency employment count; these categories of energy efficiency jobs—energy storage, public transit, smart grids/micro grids, and vehicles—bring the total employment in energy efficiency to more than 3,000,000 jobs. In addition to the more than 2.3 million people directly employed in energy efficiency as defined by USEER, BLS finds that about 4,700,000 people work in the retail selling of energy efficiency products.<sup>13</sup>

As a point of comparison, the number of people directly employed in energy efficiency (more than 2.3 million), as measured by USEER, is higher than the number of people (2.25 million) serving as wait staff in bars and restaurants across the entire country.<sup>13</sup>

**Table 1: Energy efficiency jobs by sector for Q2 of 2018. Source: USEER, 2019, unless otherwise specified**

Energy Efficiency Sector	Direct Jobs (U.S.)	Growth compared to Q2 2017 (percent change)
Buildings (Construction, Materials, Renewable Heating/Cooling)	660,639	1.8%
Appliances (Energy Star, including High Efficiency HVAC)	595,331	3.9%
Appliances (Traditional HVAC)	582,108	4.2%
Public transit* <sup>14</sup>	430,000	1.5%
Appliances (Efficient Lighting)	370,562	5.2%
Vehicles (hybrid electric, plug-in hybrid, electric vehicles, hydrogen, and fuel cell vehicles)*	241,053	16.3%
Other sectors	116,225	0.5%
Energy Storage (batteries storage and pumped hydro)*	71,149	-2.9%
Smart and Micro Grids*	45,125	3.9%
<b>Total</b>	<b>3,112,192</b>	<b>1.5%</b>

\*Not counted in USEER's total number for energy efficiency jobs

<sup>14</sup>Data from 2017. Percent change compared to 2016 data

**Buildings:** Of the 7.29 million total jobs in construction in the United States, about 18 percent involve work in support of the energy efficiency sector.<sup>15</sup> This is a slight decrease from 2016, when 21 percent of construction jobs supported energy efficiency. This decrease suggests that construction hiring may be outpacing integration of energy efficiency across the sector. According to USEER, the green buildings construction and/or materials sector provided 660,639 energy efficiency jobs in the United States (up from 446,796 in 2016).<sup>16</sup> More specifically, the renewable heating and cooling subsector employed 128,896 people.<sup>16</sup>

**Appliances:** The appliance industry continues to be the largest employer in energy efficiency. USEER estimates that the industry provided 1,548,001 jobs in 2018, which means that 147,490 jobs have been added since 2016.<sup>17</sup> More specifically, the traditional HVAC industry (whose employees often have "specific training in high efficiency HVAC systems") provided 582,108 jobs, the Energy Star and high efficiency HVAC industry employed 595,331, and the efficient lighting industry employed 370,562.<sup>17</sup>

**Public Transportation:** The American Public Transportation Association's (APTA) 2019 Public Transportation Fact Book, based on 2017 data, highlights that more than 430,000 people directly work for public transportation agencies.<sup>18</sup> APTA states that "many more jobs are supported by the industry. Each \$1 billion investment in public transit supports 50,000 jobs and \$642 million in tax revenue."<sup>18</sup>

**Vehicles:** USEER reported that the "advanced vehicle" industry provided 241,053 jobs in 2018.<sup>19</sup> This employment total accounts for hybrid-electric, plug-in hybrid, full-electric, hydrogen, and fuel cell vehicles in the United States. More specifically, USEER states that the hybrid/plug-in hybrid sector employed 163,271 people, the electric vehicle sector employed 67,973, and the hydrogen/fuel cell sector supported 9,809 jobs.<sup>19</sup> All "advanced vehicle" sectors saw an increase in jobs from 2017 to 2018, with the exception of the hydrogen/fuel cell sector.<sup>19</sup>

**Energy Storage:** USEER reports that energy storage supported a total of 71,149 jobs in 2018.<sup>19</sup> Specifically, pumped hydro provided 8,239 jobs and battery storage supported 62,910.<sup>19</sup> These figures do not include petroleum, natural gas, and other fuels storage which are accounted for in USEER's transmission, distribution, and storage chapter.

**Smart Grid and Microgrid:** According to USEER, the smart grid sector supported 25,000 jobs (an increase of 5,255 from 2016), while work on micro grid development provided 20,125 jobs (an increase of 5,235 from 2016).<sup>19</sup>

## Renewable Energy Jobs in the United States

According to USEER, 611,000 employees worked in zero-emission technology industries, including renewables and nuclear.<sup>19</sup> The International Renewable Energy Agency (IRENA) recorded that renewable energy employment in the United States reached 855,000 direct and indirect jobs in 2018.<sup>19</sup> IRENA reports that the biofuels, solar, and wind power industries provide the most renewable energy jobs in the United States.<sup>19</sup> According to USEER, jobs in electrical power generation, which includes both renewable and nonrenewable energy sources, declined nearly one percent in 2018.<sup>19</sup> In this sector, USEER reports solar power supporting 242,343 jobs, coal supporting 86,202 jobs, and natural gas supporting 43,526 jobs.<sup>19</sup> Renewable energy firms surveyed for the USEER report highlight that a substantial barrier to increasing employment is finding skilled labor to fill positions.<sup>19</sup>

**Table 2: Renewable energy jobs for Q2 of 2018. Source: USEER, 2019, unless otherwise specified**

Sector	Direct jobs (U.S.)	Growth compared to 2017 (percent change)
Solar	242,343	-3.2%
Wind	111,166	3.5%
Renewable Fuels (Corn ethanol, other ethanols including biodiesel, woody biomass, and other biofuels)	106,709	2.2%
Hydropower	66,448	-0.6%
Biomass (Electrical generation)	12,976	4.8%
Geothermal	8,526	7.6%
Waste-to-Energy*	7,000	---
<b>Total</b>	<b>555,168</b>	<b>-0.2%<sup>^</sup></b>

*Note that this table does not include nuclear energy.*

*\*Source: Energy Recovery Council*

*<sup>^</sup>Calculated based on assumption that waste-to-energy jobs remained constant from 2017 to 2018*

**Solar:** USEER reports that the solar energy industry provided 334,992 direct jobs in solar energy manufacturing, installation, distribution, and support services, about 242,343 of which were full-time positions.<sup>19</sup> This represents a 3.2 percent decline in solar jobs, or nearly 8,000 full-time jobs lost.<sup>19</sup> The Solar Foundation's annual census attributes this decline in part to tariffs and uncertain state policies, which halted major solar projects.<sup>20</sup> Despite the recent decline, The Solar Foundation reports long-term growth: between 2013 and 2018, solar employment grew 11 percent annually—six times faster than overall U.S. employment.<sup>21</sup> Both USEER and The Solar Foundation defined a full-time solar job as one held by an individual who spends at least 50 percent of their time on solar-related work. According to the BLS, solar photovoltaic installers is the fastest growing occupation across the entire economy.<sup>22</sup>

**Wind:** USEER found that the wind power industry provided 111,166 jobs in 2018, increasing four percent from 2017.<sup>23</sup> USEER categorizes these jobs as 33 percent construction, 24 percent professional services, and 24 percent manufacturing.<sup>23</sup> The American Wind Energy Association (AWEA) reports 114,000 jobs in the wind power industry.<sup>24</sup> IRENA corroborates this estimate, also reporting 114,000 wind jobs.<sup>25</sup> AWEA specifies that these jobs are spread across all 50 states, which means there are factory and manufacturing jobs even in states that do not have wind farms.<sup>26</sup> The industry is growing, especially for turbine service technicians, which was the second-fastest growing occupation across the entire economy in 2018.<sup>27</sup>

**Renewable fuels:** This section includes employment data for corn ethanol, other ethanols including biodiesel, woody biomass, and other advanced biofuels sectors. Together, these subsectors employ 106,709 people.

USEER found that the corn ethanol subsector directly provided 35,055 jobs, and other ethanol subsectors provided 20,074 jobs.<sup>28</sup> Agricultural and Biofuels Consulting, LLP, estimates overall direct ethanol jobs at 71,367, and calculated the total direct, indirect, and induced job count at 366,000 jobs in 2018.<sup>29</sup> In contrast, when the estimate includes only direct and indirect jobs, IRENA reports that the U.S. ethanol industry supports 238,500 employees.<sup>30</sup>

Estimates on biodiesel employment range substantially. The USEER includes biodiesel employment in its “other ethanols” category which represents 20,074 jobs. However, according to IRENA, the U.S. biodiesel sector expanded to provide 72,300 jobs in 2018.<sup>30</sup> The National Biodiesel Board (NBB) found that domestic biodiesel production supports more than 60,000 jobs nationwide.<sup>31</sup> Going forward, the biodiesel industry faces uncertainty surrounding the biodiesel tax credit. NBB has said that policy uncertainty might harm biodiesel plants and employees.<sup>31</sup> According to the NBB, the industry has higher capacity, but they have been constrained by the low levels EPA has set for biodiesel production in the Renewable Fuel Standard (RFS).

USEER reports that the woody biomass fuels industry provided 33,166 jobs in 2018—an increase of 1,738 since 2017.<sup>32</sup>

According to USEER, other biofuels industries, which include advanced biofuels, employ 18,414 people.<sup>32</sup> This figure has been stable from 2017 to 2018.

**Hydropower:** According to USEER, the U.S. hydropower industry directly employed 66,448 people—54,870 of whom worked in the traditional hydropower sector and 11,578 of whom worked in the low-impact hydroelectric subsector.<sup>32</sup> IRENA reported that the “small hydropower” industry directly provided 9,300 jobs, and the “large hydropower” industry provided 25,850 jobs.<sup>33</sup> The job distribution is about 26 percent manufacturing, 26 percent utilities, 18 percent professional business services, and 16 percent construction.<sup>34</sup>

**Biomass:** According to USEER, the U.S. biomass electrical power industry employs 12,976 people.<sup>35</sup> The industry saw growth in 2018, adding 591 new biomass electric power jobs.<sup>35</sup> There are an additional 29,245 jobs in Combined Heat and Power (CHP) for which the fuels are biomass and natural gas.<sup>36</sup> IRENA, however, reports that “solid biomass” energy production supports approximately 79,700 jobs in the United States.<sup>36</sup> “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.

**Geothermal:** USEER reports that the geothermal power sector directly provided 8,526 jobs in 2018.<sup>37</sup> This number represents an increase of 599 jobs since last year.<sup>37</sup> Alternatively, IRENA’s renewable energy employment dashboard reports that 35,000 employees currently work in the geothermal industry in the United States.<sup>38</sup>

**Waste-to-Energy:** An Energy Recovery Council report suggests that the waste-to-energy industry directly supports approximately 7,000 jobs.<sup>39</sup> This number includes workers who are employed on-site and off-site by owners, operators, and local governments involved in the industry.

**Biogas:** In 2019, the American Biogas Council (ABC) reported that more than 2,200 biogas systems are currently in operation in the United States.<sup>40</sup> In addition, ABC suggested that more than 14,000 additional dairy/swine farms, wastewater treatment plants, and landfill gas projects could be effectively converted into biogas production facilities.<sup>40</sup> The Council concluded that these new systems could support roughly 335,000 temporary construction jobs and 23,000 full-time operational positions.<sup>40</sup>

**Tide, Wave, and Ocean Energy:** The USEER does not include tide, wave, and ocean energy in its assessment; however, IRENA reports that approximately 1,057 people are employed in the sector globally.<sup>41</sup> A subset of these jobs are in the United States, especially in research and development. There is significant potential for wave energy in the United States. According to the Energy Information Administration (EIA), the theoretical annual energy potential off the coast of the United States is estimated at 2.64 trillion kilowatt hours which is approximately 66 percent of all electrical generation in the country in 2017.<sup>42</sup>

## Renewable Energy Jobs around the World

Each year, the International Renewable Energy Agency (IRENA) produces a report, *Renewable Energy and Jobs Annual Review*, which compiles data on employment in renewable energy across countries. The data for this section is drawn from the 2019 report which, unless otherwise noted, is based on data for 2017-2018.

**Table 3. Direct and indirect renewable energy and fuels jobs\***

	China	Brazil	United States	India	European Union (28 countries)
Solar PV	2,194,000	15,600	225,000	115,000	96,000
Biofuel	51,000	832,000	311,000	35,000	208,000
Hydropower	308,000	203,000	66,500	347,000	74,000
Wind	510,000	34,000	114,000	58,000	314,000
Solar heating and cooling	670,000	41,000	12,000	20,700	24,000
Solid Biomass	186,000	---	79,000	58,000	387,000
Biogas	145,000	---	7,000	85,000	67,000
Geothermal	2,500	---	35,000	---	23,000
Municipal and industrial waste	---	---	---	---	---
CSP	11,000	---	5,000	---	5,000
Tide, wave, and ocean energy	---	---	---	---	---
<b>Total</b>	<b>4,078,000</b>	<b>1,125,000</b>	<b>855,000</b>	<b>719,000</b>	<b>1,235,000</b>

\*Table modified from IRENA, 2019 table found on page 35 of the report. See detailed notes about these figures in the IRENA 2019 report.

The *Renewable Energy and Jobs Annual Review 2019* estimates that there were approximately 11,000,000 direct and indirect jobs in the renewable energy sector across the world in 2018.<sup>43</sup> This is an increase from 10.3 million jobs in the sector in 2017.<sup>43</sup> The eleven primary sectors of renewable energy covered by the report are solid biomass, liquid biofuels, biogas, geothermal, hydropower, solar photovoltaic (PV), Concentrated Solar Power (CSP), solar heating/cooling, wind power, municipal and industrial waste, and tide, wave, and ocean energy. New data on off-grid solar employment in developing countries made it possible to include these jobs in the 2019 report under the solar PV section for the first time. China continues to lead global employment in renewable energy with roughly 4,078,000 direct and indirect jobs, and Asian countries provided a total of 60 percent of the jobs in the sector.<sup>43</sup> After China, the countries with the largest employment in renewable energy are Brazil (1,125,000 jobs), the United States (855,000 jobs), and India (719,000 jobs).<sup>43</sup> The European Union, comprised of 28 countries, had 1,235,000 jobs in renewable energy, making it a significant player in the renewable energy field.<sup>43</sup>

Across the globe, solar PV continues to provide the highest employment in the renewable energy sector, with around 3,605,000 jobs.<sup>43</sup> Biofuels and hydropower followed closely behind, employing around 2,063,000 and 2,054,000 individuals, respectively.<sup>43</sup> The table above provides a comprehensive look at China, Brazil, the United States, India, and the European Union's total jobs by renewable energy subsector.

The following is a breakdown of green jobs in the countries with the most renewable energy employment, and a few other countries of interest. The United States—the third largest source of renewable energy jobs—is described in detail in the above section, "Renewable Energy Jobs in the United States."

#### *Top renewable energy job producing countries*

**China:** In addition to being the largest provider of total renewable energy jobs worldwide, IRENA notes that China also leads, in terms of employment, in five different renewable energy sectors—solar PV, wind, solar heating and cooling, biogas, and CSP.<sup>43</sup> China leads the world in solar PV employment, with the industry providing around 2,194,000 direct and indirect jobs, or about 54 percent of the renewable energy jobs in China.<sup>43</sup> China is increasing exports of solar PV to emerging markets through their International Investment Alliance for Renewable Energy.<sup>43</sup> In solar heating and cooling, China employs 670,000 people (16 percent of renewable energy jobs in China).<sup>43</sup> China's other large renewable energy employment sectors include wind power with 510,000 jobs (12.5 percent), hydropower with 308,000 jobs (7.6 percent), and solid biomass with 186,000 jobs (4.6 percent).<sup>43</sup>

**Brazil:** According to IRENA, Brazil continues to have the second greatest number of renewable energy jobs worldwide, with a total of 1,125,000 jobs.<sup>43</sup> Brazil tops the charts globally in terms of liquid biofuel industry employment, with a total of around 832,000 jobs (about 74 percent of renewable energy jobs in Brazil), making up 40 percent of biofuel employment globally.<sup>43</sup> The report identifies Brazil as the third largest hydropower employer, after China and India, providing approximately 203,000 direct jobs or 18 percent of all renewable energy jobs in Brazil.<sup>43</sup> IRENA further notes that the nation offers 41,000 jobs in solar heating/cooling equipment manufacturing and installation (almost 4 percent of renewable energy jobs), 34,000 jobs in wind power (3 percent of renewable energy jobs), and 15,600 jobs in solar PV (1.4 percent of renewable energy jobs).<sup>43</sup>

**India:** India has the fourth largest number of renewable energy jobs globally, employing 719,000 people directly and indirectly in the sector.<sup>43</sup> This is an increase of 303,000 jobs since 2015.<sup>43</sup> According to IRENA, India has overtaken China as the leading provider of jobs in hydropower, directly employing 347,000 individuals, which equates to 48 percent of renewable energy jobs in India.<sup>43</sup> Following recent trends, India's solar PV sector was its second largest renewable energy employer, supporting roughly 115,000 direct and indirect jobs (16 percent of renewable energy jobs).<sup>43</sup> India's other large renewable energy employers include the biogas industry (85,000 jobs or 11.8 percent), the solid biomass industry (58,000 jobs or about 8 percent), the wind power industry (58,000 jobs or about 8 percent), and the liquid biofuels industry (35,000 jobs or almost 5 percent).<sup>43</sup>

## *The European Union*

**European Union (EU):** The European Union provided 1,200,000 total renewable energy jobs in 2017 (the most recent year for EU data on this topic, according to IRENA).<sup>43</sup> Most of these jobs are in Germany, Spain, France, the United Kingdom, and Italy. The European Union led the world in solid biomass energy employment, supporting approximately 387,000 jobs.<sup>43</sup> The European Union supports 314,000 jobs in wind power, a sector for which Europe is well known.<sup>43</sup> The European Union is also home to 208,000 jobs in liquid biofuels, 96,000 jobs in solar PV, 74,000 jobs in hydropower, and 67,000 jobs in biogas.<sup>43</sup>

**Germany:** According to IRENA, Germany has 284,800 jobs in renewable energy which gives it the largest renewable energy workforce in Europe.<sup>43</sup> About half of Germany's renewable energy jobs are in the wind sector (140,800 jobs).<sup>43</sup> Germany also has 44,900 jobs in solid biomass (making up about 16 percent of its renewable energy workforce), 35,000 jobs in biogas (12 percent), 29,300 jobs in solar PV (10 percent), and 15,500 jobs in liquid biofuels (about 5 percent).<sup>43</sup>

**France:** IRENA found that France provided about 105,500 direct and indirect jobs in renewable energy.<sup>43</sup> The nation's two largest renewable energy sectors are the solid biomass and liquid biofuels industries, which provided approximately 33,900 jobs (32 percent of jobs in its renewable energy sector) and 24,400 jobs (23 percent), respectively.<sup>43</sup> France's wind power sector is expanding, and currently supports 18,500 jobs (17.5 percent).<sup>43</sup>

### *Additional countries providing employment in renewable energy*

**Japan:** IRENA reports that Japan is the world's fifth largest renewable energy employer, when the EU countries are grouped together, supporting roughly 267,000 direct and indirect jobs.<sup>43</sup> Japan's renewable energy sector is dominated by solar PV, with 249,800 of its jobs in that field (93 percent of total jobs in the renewable energy sector). About 10,700 jobs are in hydropower (4 percent).<sup>43</sup>

**Mexico:** In total, Mexico's renewable energy sector employs 88,100 people.<sup>43</sup> According to IRENA, Mexico's solar PV capacity reached 2.5 GW in 2018, and the sector employs 23,000 people (26 percent of jobs in renewable energy).<sup>43</sup> The other major employers are hydropower (25,500 jobs, 29 percent), solid biomass (14,400 jobs, 16 percent), wind energy (13,500 jobs, 15 percent), and geothermal energy (7,600 jobs, about 9 percent).<sup>43</sup>

This fact sheet is available electronically (with hyperlinks and endnotes) at [www.eesi.org/papers](http://www.eesi.org/papers).

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*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

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