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EMPLOYMENT AND UNEMPLOYMENT

Solar and wind generation occupations: a look at the next decade

By William Lawhorn

Ben Franklin's lightning experiments led to Thomas Edison's light bulb, which led to the use of motors and machines that powered the world in the 20th Century. Now electricity is the driving force behind modern society, powering everything from the lights in our homes and offices, to our cell phones, and many of the tools we use for everyday tasks like cooking and cleaning. There are several ways to generate this power. For over a century fossil fuels have been the main source of power generation, although important sources, hydroelectric and nuclear facilities have never truly competed with coal and natural gas for total generation capacity. However, advancements in technology have allowed for the rapid expansion of solar and wind generation capacity.

This expansion requires the need for workers who install photovoltaic (PV) panels and install and maintain wind turbines. PV installers assemble, set up, and maintain rooftop and other systems that convert sunlight into energy. Wind turbine technicians (windtechs) install, maintain, and repair wind turbines. Both occupations are projected to grow much faster than the average for all occupations from 2019 to 2029. These occupations will continue to be needed to meet the expected increased demand for renewable electricity generation.

This **Beyond the Numbers** article discusses the factors that are expected to contribute to the growing demand for solar and wind energy generation over the next 10 years, and the resulting opportunities for jobseekers interested in employment as PV installers and windtechs.

Occupational growth over the next decade

Employment of PV installers is projected to grow 50.5 percent from 2019 to 2029, much faster than the 3.7-percent growth that is projected for all occupations. Windtechs are also expected to grow very fast (60.7 percent) over the 2019–29 decade. Both occupations are among the fastest growing occupations from 2019–29.[1] However, because they are both small occupations, this fast growth will only result in a total of about 10,400 new jobs over the projections period. (See table 1.)

Table 1. Selected fastest growing occupations, 2019 and projected 2029 (Numbers in thousands)

Matrix occupation title, 2019	Matrix occupation code	Employment		Change, 2019–29		Median annual wage, 2019[1]
		2019	2029	Number	Percent	
Total, all occupations	00-0000	162,795.60	168,834.70	6,039.20	3.7	$39,810
Wind turbine service technicians	49-9081	7	11.3	4.3	60.7	52,910
Solar photovoltaic installers	47-2231	12	18.1	6.1	50.5	44,890

Footnote:
[1] Wage data cover nonfarm wage and salary workers and do not cover the self-employed, owners and partners in unincorporated firms, or household workers.
Note: For additional information on fast growing projections of employment and wages, see fastest growing occupations.
Source: U.S. Bureau of Labor Statistics, Employment Projections program.

In addition, both occupations pay more than the 2019 median annual wage for all occupations ($39,810), and neither occupation requires a postsecondary degree. PV installers typically need a high school diploma or equivalent, while windtechs typically need a postsecondary nondegree award.[2] The median annual wages earned by both occupations exceed those earned by many occupations that typically require the same level of educational preparation. In 2019, the median annual wage for occupations that typically require a high school diploma for entry was about $37,930; and $39,940 for all occupations that typically require a postsecondary nondegree award for entry.[3] Both occupations typically require on-the-job training to attain competency in the skills needed in the occupation.

Cost of electrical power generation

Renewable energy technologies follow what is commonly referred to as a “learning curve.” [4] As technologies develop and grow in usage over time, the costs of using the technology drops, and more of it gets deployed. In the

case of solar power, for example, the price declines over time and more people are willing to install it, which lowers the costs further, and further increases solar installations.

Electricity generated from renewable energy sources is now less expensive relative to that generated from traditional sources, such as coal and nuclear power.[5] Prices for solar power fell from $144 per megawatt hour in 2008 to $25 per megawatt hour in 2019.[6]

More solar panels have been installed as the costs of installation have dropped. As a result, an increasing share of electricity demand is being met by consumer end users, who do not receive their electricity supply through commercial utilities and the electric grid.[7] End-user energy savings can be considerable over several decades after installation. For example, over a 20-year time period, the electricity cost savings associated with solar panel installations has ranged from $17,000 in Portland, OR to $50,000 in Los Angeles, CA.[8] The national typical cost for a 6-kilowatt (kW) solar installation is about $13,142 after tax credits and $17,760 before.[9] Additionally, there are residential solar companies that lease roof space from homeowners and, in return, offer a reduced rate for electricity to the owners. These leasing arrangements allow for lower costs for users without the upfront installation cost.

As a result of these cost savings, the end-use solar PV share of total electricity generation has more than doubled from 0.4 percent in 2015 to about 1.0 percent in 2019.[10] It is projected to be about 2.0 percent of all electricity generation by 2029.[11]

The levelized cost of energy (LCOE)(the average cost of over the lifetime including fuel and installation costs) for renewables is at or below the marginal cost of conventional power generation sources. This lower cost comparison is expected to continue as the U.S. Energy Information Administration (EIA) projects the unweighted LCOE cost of solar photovoltaic panels will be $31.73 in 2029 and $39.44 for onshore wind in the same year.[12] These projected costs factor in the end of the renewable energy credits, which have lowered installation costs. Costs for wind and solar will be less than half that for coal and nuclear. (See table 2.)

Table 2. Projected Levelized Cost of Energy (LCOE, unweighted, 2019 dollars per megawatthour)

Technology	Projected levelized cost of energy, 2029
Wind, offshore	$118.96
Biomass	92.66
Ultra-super critical coal	79.39
Advanced nuclear	76.69
Combustion turbine	68.54
Combined-cycle	40.01
Wind, onshore	39.44
Geothermal	35.69
Solar photovoltaic	31.73

Note: EIA does not have estimates for hydroelectric in 2029. They do have continuous projections starting in 2032 at $57.37.
Solar photovoltaic costs are expressed in terms of net AC (alternating current) power available to the grid for the installed capacity.
Source: U.S. Energy Information Administration (EIA), Levelized Cost and Levelized Avoided Cost of New Generation, special tabulation.

Renewable technologies continue to evolve and improve. For example, solar panels have achieved 30 to 46 percent efficiency of the transfer of light into electricity in labs today.[13] By contrast, the efficiency range for PV panels in the marketplace today is 19 to 21 percent.[14] Additionally, the adoption of larger and more efficient

turbines may lead to even lower costs.[15] Residential wind turbines are another option. A one-kW system can cost about $7,000 to install, with costs likely to decrease going forward.[16] Improved technologies, which contribute to increased efficiency and lower costs, are the main reason both solar and wind power generation continue to expand.

Increasing demand for renewable energy

Although cost competitiveness is the primary factor driving growth in renewable energy, the ongoing reduction in atmospheric contaminants is another reason people are likely to choose to use renewable sources of energy. Both solar and wind energy are considered cleaner because they produce less carbon dioxide, compared to the amount generated by the use of fossil fuels.[17] Consumers are likely to be increasingly influenced by the cleanliness offered by solar and wind energy, especially as costs continue to remain low.

In 2019, 62 percent of total electricity generation at utility scale facilities was from fossil fuels.[18] Of this share, coal made up 39 percent and natural gas made up 60 percent. Electricity generated from fossil fuels, especially from coal, leads to increased carbon dioxide (CO2) and methane in the atmosphere. These greenhouse gases harm the climate.[19] About one-third of methane emitted into the air is due to the production and transport of coal, natural gas, and oil.[20] Additionally, other contaminants that are released from fossil fuel use, such as sulfur dioxide, ozone, and particulate matter, are known to cause respiratory complications that make people more vulnerable to certain illnesses, such as pneumonia and influenza.[21]

Once solar or wind infrastructure is in place, there is no additional carbon burning contributing directly to more CO2 in the air.[22] Moreover, renewable energy production does not result in any direct additions of sulfurs or other air contaminants. Those who are concerned about pollution and environmental impact may prefer these types of energy sources.[23]

Improved electricity storage capacity

Despite certain economic and social benefits of solar and wind power generation, one of the historical challenges of using renewable energy has been that production levels are variable over time. This is primarily because of variation in the weather—cloud cover reduces solar panels' effectiveness to capture energy and low wind days have the same impact on wind turbines. This variable production makes the ability to store energy for future use very important.

Similar to renewable energy generation technologies, large-scale battery storage technologies also follow a learning curve pattern of development and usage. Storage capacity grew from 59 megawatts (MW) in 2010 to 869 MW by the end of 2018.[24] There is an additional 3,616 MW of largescale battery storage planned to be operational in the United States between 2020 and 2023.[25] From 2015 to 2017, the cost of storage decreased by 61 percent.[26] More opportunities to increase solar and wind power generation will come with continued improvements to and affordability of storage capacity.[27] This will enable excess electricity production to be stored for later use, mitigating some of the challenges presented by lower energy generation conditions, such as cloudy or low wind days.

Solar and wind power job projections?

As demand for solar and wind energy generation increases over the next 10 years, solar and wind energy infrastructure will need to be put in place. This requires a variety of workers, including solar PV installers and windtechs. Over 50 percent more of these workers are projected to be needed by 2029.[28]

Solar panel installation is projected to continue to be one of the top contributors to increased electrical generation in both the EIA and BLS projections periods, leading to the need for more solar PV installers. The demand for these workers is different than the demand for windtechs. PV installers are mostly needed on the front end of the work—installing new panels. After workers install PV systems, there may be some required maintenance, such as cleaning the panels. This work is not typically done by PV installers unless there is damage, which requires panel replacement. Other workers, such as construction laborers or building cleaning workers, are more often involved in maintaining PV systems.

In contrast, windtechs are less dependent on new installations, which tend to fluctuate annually. They are instead needed to maintain and repair existing turbines. The majority of a windtech's work occurs after the turbine is built and commissioned. The demand for these workers is a function of the stock of turbines in operation, which was about 64,000 turbines in 2020.[29] Depending upon the type and age of the wind turbine, maintenance may be required up to few times a year. The systems in turbines wear out over time, and windtechs will be needed to provide more services and maintenance as the current fleet ages.[30]

What does this mean for the future?

The EIA projects expansion of both solar and wind generation capacity to 2030 and beyond in their Annual Energy Outlook 2020.[31] The expansion of capacity will require both solar photovoltaic installers and wind turbine technicians. The share of total electrical power generation projected from solar and wind still trails natural gas production, but the gap is closing as solar and wind continue to take share from coal and nuclear generation.[32] In April 2019, renewable sources of electricity generation surpassed coal-fired generation for the first time.[33]

Although overall demand for electricity is not projected to increase very much in the future, how it is generated will continue to change.[34] The EIA projections detail increased capacity for both solar and wind. The LCOE cost for solar and wind electricity production is now competitive with natural gas and coal-based production. This cost competitiveness is the primary driver of demand for solar and wind energy. The lower cost for solar and wind electricity production is coupled with fewer negative environmental costs associated with carbon dioxide, methane, particulate matter, and sulfur.

In conclusion, improved storage capacity will increase the long-term viability of these sources as stored energy is available when needed rather than as produced. All of these factors will contribute to increased demand in the coming decade for both PV installers and windtechs who install and service this equipment.

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NOTES

[1] EP table 1.2 fastest growing occupations, 2019 and projected 2029. U.S. Bureau of Labor Statistics. September 1, 2020.

[2] More information on the Employment Projections program's Education and Training data is available online.

[3] EP table 5.2 Employment, wages, and projected change in employment by typical entry-level education. U.S. Bureau of Labor Statistics.

[4] See Max Roser, "Why did renewables become so cheap so fast? And what can we do to use this global opportunity for green growth?" *Our World in Data*, December 1, 2020; and Peter O'Connor, "What is the Learning Curve—and What Does it Mean for Solar Power and for Electric Vehicles?" *Union of concerned Scientists*, September 29, 2016.

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[10] Annual Energy Outlook 2020 Power Point, U.S. Energy Information Administration, visited September 24, 2020, slide 57.

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[32] *Annual Energy Outlook 2020*, U.S. Energy Information Administration, January 2020, p.71

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SUGGESTED CITATION

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