

A photograph of two workers in safety gear standing on the nacelle of a wind turbine. The background shows a vast, blue ocean under a clear sky. The image is overlaid with a semi-transparent blue filter.

CLEAN JOBS COLORADO 2017

SEPTEMBER 2017

PRESENTED BY



Environmental
Entrepreneurs



Energy Efficiency Business Coalition

Energy Efficiency
Business Coalition

ABOUT

ABOUT E2

Environmental Entrepreneurs (E2) is a national, nonpartisan group of business leaders, investors, and professionals from every sector of the economy who advocate for smart policies that are good for the economy and good for the environment. Our members have founded or funded more than 2,500 companies, created more than 600,000 jobs, and manage more than \$100 billion in venture and private equity capital. For more information, see www.e2.org or follow us on Twitter at @e2org. E2 is a partner of the Natural Resources Defense Council (NRDC).

ABOUT EEBC

The Energy Efficiency Business Coalition (EEBC) is a member-funded coalition of businesses that provide energy efficient products and services to create healthier homes and businesses by using cost-effective and sustainable methods to reduce energy, water, and waste in buildings. EEBC works with utilities, municipalities, the Public Utility Commission, and the legislature to promote policies and programs that expand the energy efficiency market in Colorado. Our members include energy efficiency contractors (heating and cooling equipment, insulation, LED lighting, window, smart thermostat and occupancy sensors, and other technologies), manufacturers of energy efficiency products and equipment, demand-side management implementation and evaluation experts, demand response companies, engineering and architecture firms, data analytic firms, financing experts, commercial energy service companies, workforce training companies, and home energy auditors. EEBC is managed by a board of directors made up of representatives from member companies, staff, and contract attorneys. As a responsible organization, EEBC has anti-trust, conflict of interest, and client confidentiality protection policies.

ABOUT OUR RESEARCH AND ANALYSIS PARTNERS

BW Research Partnership is a full-service, economic and workforce research consulting firm with offices in Carlsbad, California, and Wrentham, Massachusetts. It is the nation's leading provider of accurate, comprehensive clean energy research studies, including the National Solar Census, wind industry analyses for the National Renewable Energy Laboratory and the Natural Resources Defense Council, and state-level clean energy reports for Massachusetts, Illinois, Vermont, Iowa, and Florida, among others.

The **Economic Advancement Research Institute (EARI)** is a nonprofit research organization focused on economic mobility and regional competitiveness. EARI is primarily focused on studying the impact of policies and systems on economic growth and prosperity across all income levels. EARI has conducted numerous labor market analyses that address key economic sectors with high probability to provide opportunities to underrepresented and disadvantaged populations.

ACKNOWLEDGEMENTS

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INTRODUCTION

There are 66,000 clean energy jobs in Colorado.

The Clean Jobs Colorado 2017 report is part of E2's ongoing effort to better understand the employment impacts of energy efficiency and renewable energy in the state and identify which policies would support additional job creation.

Our analysis of the size and scope of Colorado's clean energy economy shows **more than 66,000 Coloradans** work in the state's clean energy sector. That's more than a **6 percent increase** over the previous year—and it's more than twice as many jobs as there are in the state's fossil fuel industry.ⁱ

Clean Jobs Colorado shows just how much of an impact the fast-growing sector is having on the state's economy. Colorado is a national clean energy leader. The state is home to the National Renewable Energy Laboratory in Jefferson County, the nation's largest low-income community solar project near Fort Collins,ⁱⁱ and hundreds of new electric vehicle (EV) charging stations.ⁱⁱⁱ

Clean energy jobs in Colorado can be categorized either by industry—energy efficiency, renewables, clean vehicles, etc.—or by value chain—i.e., the type of work done within a particular industry to bring a product or service to market.

By industry, most Colorado clean energy workers—about 42,000—work in energy efficiency, a category that encompasses a broad range of jobs including construction workers, electricians, engineers, software developers and marketing professionals.

About 16,000 Coloradans work in renewable energy. The solar and wind industries each employ about 7,500 workers, with industries like geothermal and biomass helping make up the difference.

Another 7,780 Coloradans work in smart grid jobs (which make our electricity system more flexible and renewables-friendly), fuels jobs, and jobs in clean vehicle technologies that help our cars and trucks go further for less money—an important factor in a state where driving distances can be far and electric vehicle (EV) infrastructure is scaling up.

Looking at the clean energy sector value chain, about four in five work in either professional services or construction, while the trades and manufacturing are also well represented in the state's clean economy.

The clean energy job growth Colorado has seen is part of a broader national shift. Businesses, power companies and everyday Americans increasingly recognize the economic and environmental benefits of energy efficiency and renewable energy. Across the United States, more than **3 million people** now work in clean energy and clean transportation.^{iv}

In Colorado, there are clean energy jobs—and vast clean energy potential—in every county, with economic opportunity available to both blue-collar and white-collar workers.

Clean Jobs Colorado 2017 offers the latest evidence that the clean energy sector offers a robust path to grow the state's economy and to unify the state's political differences. There are at least 1,800 clean energy jobs in each of the state's seven congressional districts—with one district home to more than 25,000 clean energy jobs. And there are a clean energy jobs in each of the state's 35 Senate districts and 65 state House districts.

An update to our 2016 report,^v this year's Clean Jobs Colorado report relies on databases and survey data from Colorado employers. More on the report's methodology can be found at the end of the report.

MAIN FINDINGS

OVERALL CLEAN ENERGY JOBS AND GROWTH RATE

CLEAN ENERGY JOBS

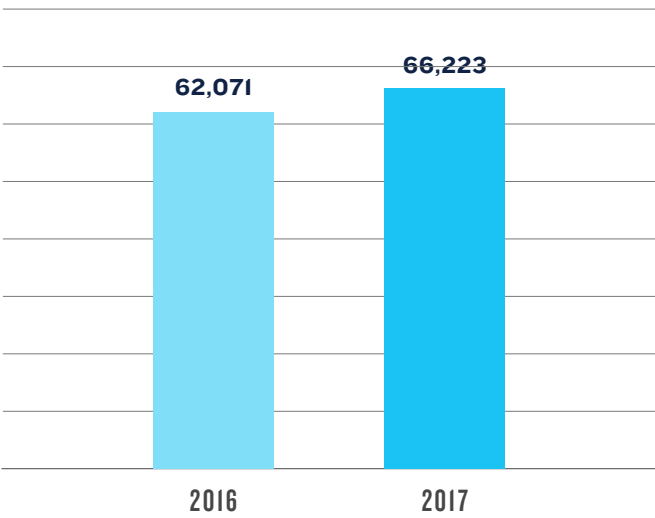
66,223 +4,152

GROWTH RATE

>6%

Colorado has 66,223 clean energy jobs—defined as those positions where at least some portion of time is spent on renewable energy generation, energy efficiency, advanced grid, advanced transportation, or clean fuels. This represents an increase of 4,152 jobs over the previous year’s report,^{vi} for a more than 6 percent growth rate. By comparison, the state’s overall non-farm labor force grew by about 2 percent.

Fig. 1: Clean Energy Jobs in Colorado By Year

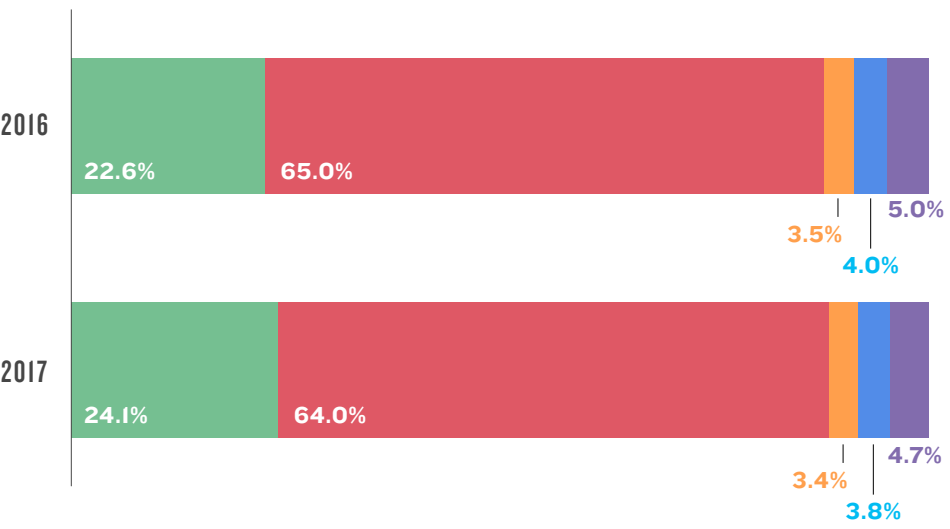


As the following chart shows, the percentage of clean energy jobs within each industry remained relatively constant year over year.

Fig. 2: Clean Energy Technology Sectors

KEY

- RENEWABLE ENERGY
- ENERGY EFFICIENCY
- ADVANCED GRID
- ADVANCED TRANSPORTATION
- CLEAN FUELS



CLEAN ENERGY JOBS BY INDUSTRY

ENERGY EFFICIENCY JOBS

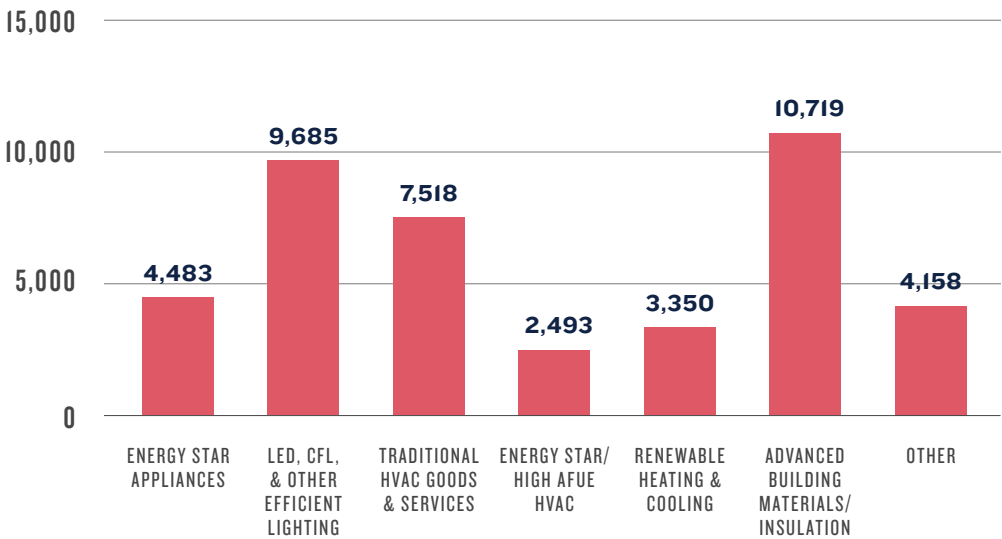
Energy efficiency continues to provide the bulk of clean energy employment in Colorado, with about **42,000 jobs**. The industry's largest segment is advanced building materials, such as insulation, followed by energy efficient lighting and traditional heating, ventilation and air conditioning (HVAC) goods and services.

Investing in energy efficiency benefits the economy directly through increasing jobs in efficiency research and development, manufacturing, and building efficiency upgrades; and indirectly through energy cost savings that can be reinvested into the state's economy, creating new jobs.^{vii}

Fig. 3: Energy Efficiency Jobs Breakdown by Subsector

ACRONYM KEY

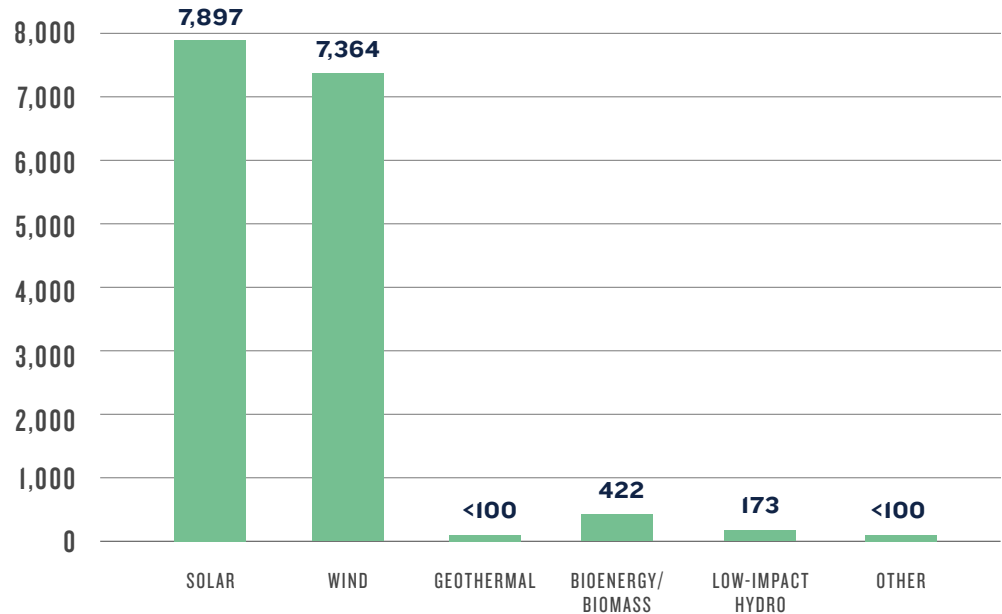
- LED: Light-Emitting Diode
- CFL: Compact Fluorescent Lamp
- AFUE: Annual Fuel Utilization Efficiency
- HVAC: Heating, Ventilation and Air Conditioning



RENEWABLE ENERGY JOBS

The roughly 16,000 renewable energy jobs are predominantly in fast-growing industries like solar and wind.

Fig. 4: Renewable Energy Jobs Breakdown by Subsector



“We all would do well to remember what the military already knows: Our future is stronger and more secure with a robust clean energy industry, and so is our workforce.”^{xiv}

Tony C. Williams, U.S. Army Veteran

As E2’s “Winds of Change” report noted back in 2015, Colorado has transformed itself into a leader for wind energy.^{viii} More than 80 percent of Colorado’s wind energy potential is located in the rural counties of Logan, Prowers, Weld, and Lincoln. In these counties, wind farms have boosted property tax collection by millions of dollars annually, which provides school districts in the area with higher budgets to do things like hire more teachers and purchase more books.^{ix}

Solar has a big impact on the state’s economy too. Colorado is home to at least 433 solar companies that combined have invested close to \$3 billion in the state.^x All this economic activity in Colorado renewable energy means jobs.

According to data from the U.S. Bureau of Labor Statistics, wind turbine technician is the fast-growing occupation in the country, with a median annual wage of more than **\$52,000**. The BLS also cited solar installer as one of the fastest-growing American jobs, with a median salary of about \$40,000.^{xi}

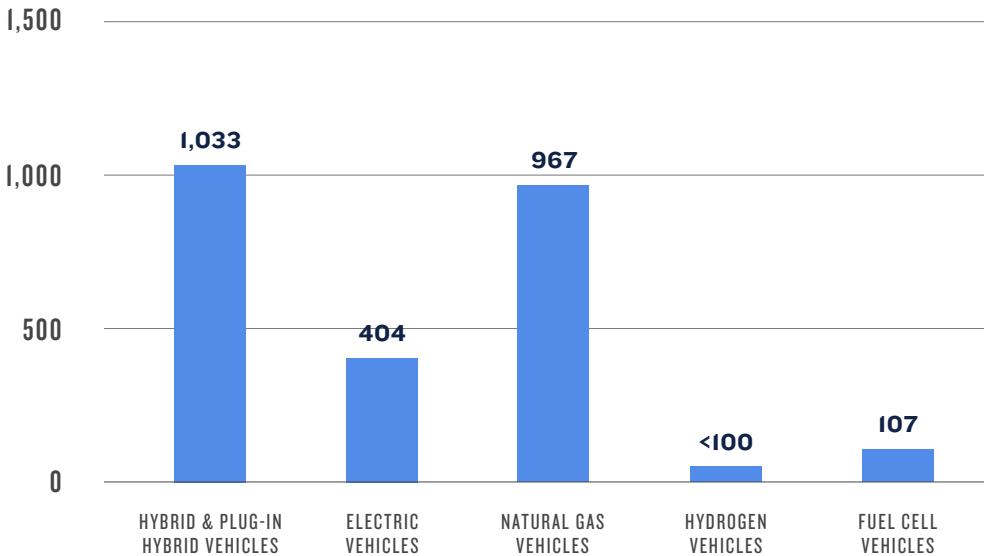
Compared to other industries, renewables hire veterans at a higher rate. Nationally, **11.5 percent of wind industry workers and 11.1 percent of solar industry workers are veterans**. The national average is 7 percent, while the fossil fuel electric power generation sector’s industries range only from 5.1 to 9.8 percent veterans.^{xii}

A big part of the private-sector success veterans are achieving in the clean energy job market stems from the fact that the military is one of the world’s biggest investors in clean energy. At Fort Carson, for instance, the base has achieved net-zero status for energy, meaning it uses renewable energy like a massive solar array to produce all the electricity it needs on-site.^{xiii}

**ADVANCED
TRANSPORTATION JOBS**

Fig. 5: Advanced Transportation Jobs
Breakdown by Subsector

Advanced transportation (including parts and maintenance) employs 2,514 workers. The largest segments of these are:



**FUELS AND
SMART GRID JOBS**

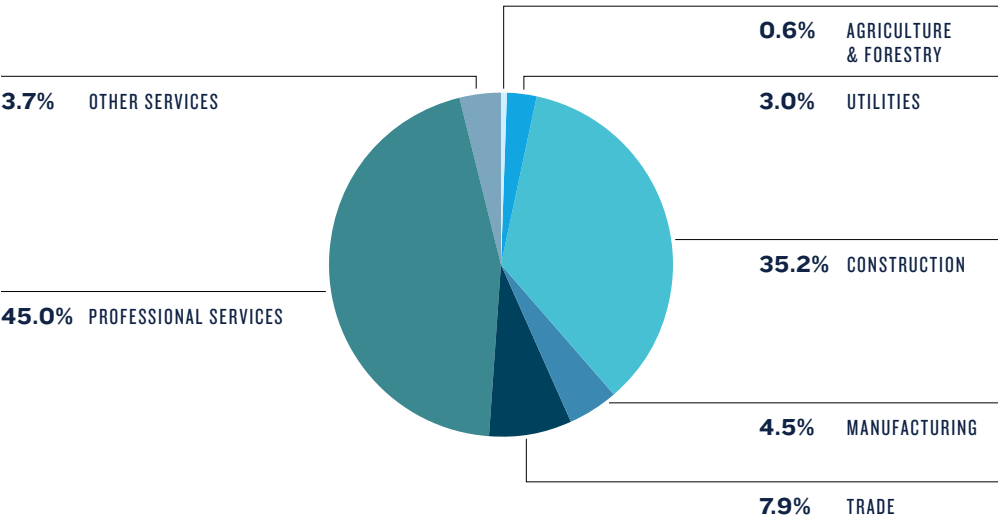
About 3,100 Coloradans work in the fuels sector. About 600 work in woody biomass, an industry whose climate impact must be closely monitored since some biomass industry practices (such as burning whole trees for fuel) emit more carbon than coal.^{xv} Employment in the woody biomass industry in Colorado declined 8.5 percent over the past year.

About 2,200 Coloradans work in the highly technical smart grid industry helping to modernize our electric grid and keep it secure. Relative to other states, this is a high number of jobs. In the entire Midwest region, for example, no state has more than 450 smart grid jobs. In the West, Nevada and Oregon have about 110 smart grid jobs—combined. California, meanwhile, is home to about 4,000 jobs in the smart grid industry.

CLEAN ENERGY VALUE CHAIN

Clean energy workers are employed in a variety of industries throughout the value chain. Within clean energy, approximately 29,790 workers are employed in professional services. This represents about 45 percent of total clean energy employment. About 35 percent work in construction doing things like making our homes, buildings, offices and schools more energy efficient. About 4.5 percent work in the manufacturing industry. Manufacturing workers involved in the clean energy industry do things like make components for LED lighting, help build wind turbine blades and other parts, and assemble ENERGY STAR-rated appliances.

Fig. 6: Clean Energy Value Chain



CASE STUDY

ENERGY EFFICIENCY SAVES COLORADO DAIRY FARMERS MONEY

Will McConnell is a passionate dairy farmer. After all, it's in his blood.

McConnell's grandfather was the state dairy extension specialist in Tennessee, and lost the dairy farm he owned with a partner, during the Great Depression.

After his parents moved the family from Tennessee west to Colorado, McConnell enrolled in Colorado State University's (CSU's) agriculture school, working part time at the university's dairy.

McConnell took a break from college in Fort Collins to serve in the U.S. Navy, returning after his service to finish a degree in animal science. Upon graduation, McConnell worked in Canyon City, Colo., near the banks of the Arkansas River, where he managed the dairy at the local prison.

During his six early years at the prison's dairy, McConnell and his wife, Joelyn, purchased a bankrupt property in 1989. McConnell's family has been in business on the property—called Rainbow Park Dairy—ever since. And recently, they've turned to energy efficiency and solar energy to reduce the farm's electricity and heating costs.

In addition to improving the barn's insulation, the biggest savings were realized by adding motors with variable speeds to the dairy operation's vacuum and milk pumps. Whereas previously pumps were switched on and off to manage milk flow, they now run continuously. The milk is also now cooled more efficiently—with same energy output.

The freshly pumped milk arrives at a holding tank at 50 degrees, saving cooling costs in the milk tank. Previously, milk arrived at 70 degrees. Upgrades like these were done with support from the Colorado Agricultural Energy Efficiency Program, managed by the Colorado Energy Office.



Energy efficiency helps Rainbow Park Dairy—and farms all across Colorado—save money on operational costs. (Stock photo)

Other energy-saving projects are on their to-do list, including a heat-recovery system to take heat from the cooling milk and use it to warm water; and to replace the dairy farm's outdated washing machines with new models that have extra high-speed spin cycles, which cut down on drying costs.

Rainbow Park Dairy hopes cost-sharing with its milk co-op, Dairies Farmers of America, and financing via Colorado's Commercial PACE program, could help ensure these cost- and energy-saving projects are completed.

The dairy farm could potentially benefit from a large solar panel installation, too. McConnell said his son, Rob, who began managing a dairy herd on the farm at 24 years old, eagerly anticipates this project. In the meantime, the dairy farm uses a few small solar panels to charge vehicle batteries and to pump fuel.

The McConnell family's energy-efficient dairy farm now employs eight full-time workers, including one who has been with the farm for 26 years, and two part-time high-school students.

Together they manage a growing the herd, delivering and caring for new calves. Joelyn McConnell is the calf specialist; the farm has not lost a newborn calf in nearly four years.

McConnell started operations with just eight cows in 1989. Today, the dairy farm runs a herd of 1200 heifers, 600 mature, and milking 500 of them three times a day. Rob McConnell owns almost about one-third of the herd. Even his young children are now helping at the dairy with their grandmother feeding and caring for the young calves.

With increased energy efficiency investments, the potential for cost-saving renewable energy projects, and multiple generations now working on the farm, the future looks bright for Rainbow Park Dairy.

—ENVIRONMENTAL ENTREPRENEURS

CLEAN ENERGY EMPLOYMENT BY COUNTY, METRO AREA AND CONGRESSIONAL/LEGISLATIVE DISTRICT*

CLEAN ENERGY JOBS ARE SPREAD ACROSS COLORADO

Data from across the state shows the breadth and depth of clean energy jobs in Colorado. Looking at the state's counties, Denver County is top-ranked in the state with 16,500 overall clean energy jobs, while counties spread across the state, including Mesa, El Paso and Larimer, also fared well.

In terms of metropolitan areas, Denver-Aurora is first with nearly 50,000 jobs, while Boulder, Fort Collins-Loveland and Colorado Springs also are hubs for clean energy jobs.

While Denver clearly has the largest number of jobs, Colorado's rural areas are also home to thousands of clean energy jobs, and there is a tremendous economic development opportunity for the less urban parts of the state. Despite having relatively small populations, La Plata, Pueblo, Eagle, Garfield and Montrose counties all registered at least 400 clean energy jobs.

The data also shows that the distribution of clean energy jobs cross all political boundaries. Indeed, there are clean energy jobs in every Colorado congressional and state legislative district.

EMPLOYMENT BY COUNTY**

Table 1: Top 10 Counties for Clean Energy Employment

RANK	COUNTY	CLEAN ENERGY EMPLOYMENT	RENEWABLE ENERGY GENERATION EMPLOYMENT	ENERGY EFFICIENCY EMPLOYMENT
1	Denver	16,500	3,900	8,200
2	Arapahoe	12,100	3,400	6,000
3	Jefferson	10,500	2,700	6,600
4	Adams	5,300	1,400	1,800
5	Douglas	3,700	800	1,200
6	Boulder	3,000	700	2,200
7	Larimer	2,600	400	2,100
8	Weld	1,700	1-250	1,600
9	El Paso	1,600	300	1,200
10	Mesa	1,200	1-250	1,100

* Jobs rounded to nearest 100 (unless fewer than 250 jobs).

** Though not included in these charts, Clean Energy Employment also includes Advanced Grid, Advanced Transportation, and Clean Fuels.

Fig. 7: Heat Map of Clean Energy Employment by County

KEY

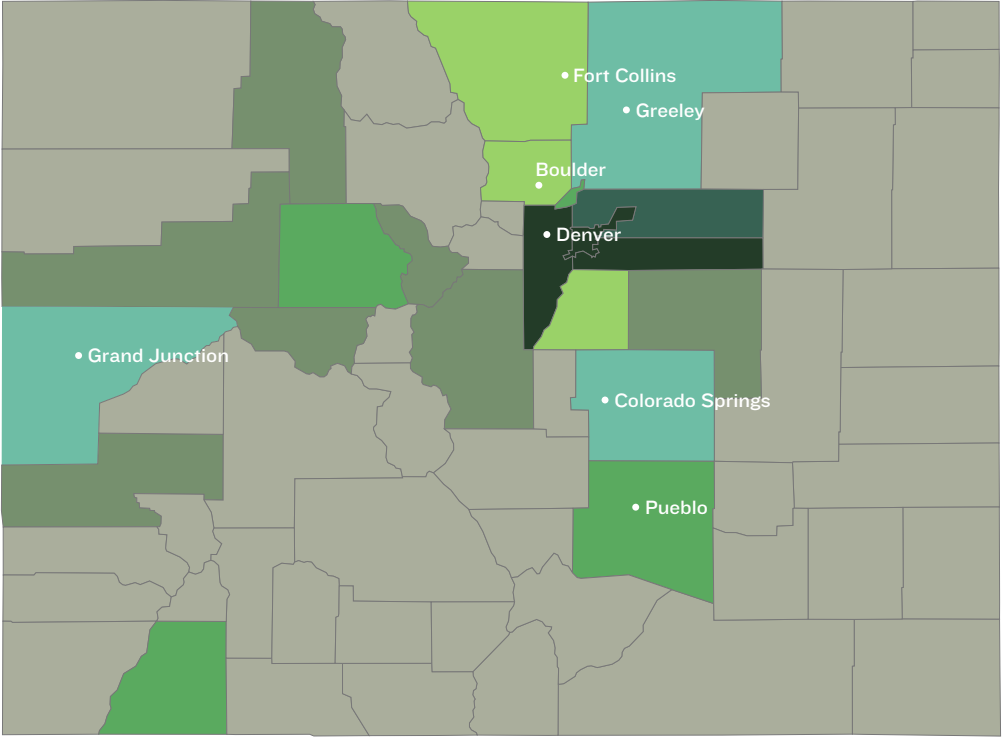
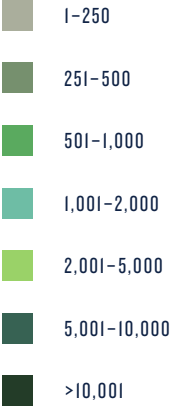


Table 2: Total Clean Energy Employment for All Colorado Counties

COUNTY	CLEAN ENERGY EMPLOYMENT	COUNTY	CLEAN ENERGY EMPLOYMENT	COUNTY	CLEAN ENERGY EMPLOYMENT
Adams	5,300	Fremont	1-250	Morgan	1-250
Alamosa	1-250	Garfield	500	Otero	1-250
Arapahoe	12,100	Gilpin	1-250	Ouray	1-250
Archuleta	1-250	Grand	1-250	Park	400
Baca	1-250	Gunnison	1-250	Phillips	1-250
Bent	1-250	Hinsdale	1-250	Pitkin	500
Boulder	3,000	Huerfano	1-250	Prowers	1-250
Broomfield	800	Jackson	1-250	Pueblo	700
Chaffee	1-250	Jefferson	10,500	Rio Blanco	1-250
Cheyenne	1-250	Kiowa	1-250	Rio Grande	1-250
Clear Creek	1-250	Kit Carson	1-250	Routt	300
Conejos	1-250	La Plata	900	Saguache	1-250
Costilla	1-250	Lake	1-250	San Juan	1-250
Crowley	1-250	Larimer	2,600	San Miguel	1-250
Custer	1-250	Las Animas	1-250	Sedgwick	1-250
Delta	1-250	Lincoln	1-250	Summit	400
Denver	16,500	Logan	1-250	Teller	1-250
Dolores	1-250	Mesa	1,200	Washington	1-250
Douglas	3,700	Mineral	1-250	Weld	1,700
Eagle	600	Moffat	1-250	Yuma	1-250
El Paso	1,600	Montezuma	1-250		
Elbert	300	Montrose	400		

EMPLOYMENT BY METRO AREA

Table 3: Top 5 Metro Areas for
Clean Energy Employment

RANK	METRO AREA (MSA)	CLEAN ENERGY EMPLOYMENT	RENEWABLE ENERGY GENERATION EMPLOYMENT	ENERGY EFFICIENCY EMPLOYMENT
1	Denver-Aurora, CO MSA	49,400	12,800	35,000
2	CO NONMETROPOLITAN AREA	6,400	1,000	5,300
3	Boulder, CO MSA	3,000	700	2,200
4	Fort Collins-Loveland, CO MSA	2,600	400	2,100
5	Colorado Springs, CO MSA	1,700	300	1,400

Table 4: Total Clean Energy
Employment for All Metro Areas

METRO AREA (MSA)	CLEAN ENERGY EMPLOYMENT
Boulder, CO MSA	3,000
CO NONMETROPOLITAN AREA	6,400
Colorado Springs, CO MSA	1,700
Denver-Aurora, CO MSA	49,400
Fort Collins-Loveland, CO MSA	2,600
Grand Junction, CO MSA	1,200
Greeley, CO MSA	1,700
Pueblo, CO MSA	700

CLEAN ENERGY IS A BIPARTISAN ISSUE

Solid common ground exists nationwide and in Colorado on the issue of clean energy. Clean energy consistently wins bipartisan support among lawmakers and state leaders because it saves money and creates jobs in urban and rural areas. A September 2017 story in the Wall Street Journal recognized this trend: “As wind becomes a bigger part of the U.S. electricity mix, it is becoming an economic force in rural communities...,” the Journal wrote. The article also noted that across the country 90 percent of the wind capacity brought online in 2016 was in states that voted Republican in the presidential election.^{xvi}

In Colorado, public opinion on clean energy is favorable across party lines: A recent survey of registered voters from Colorado College’s State of the Rockies Project found that 77 percent of Coloradans support allowing more wind and solar energy projects on public lands.^{xvii}

EMPLOYMENT BY DISTRICT

Table 5: Total Clean Energy
Employment for All Congressional
Districts in Colorado

CONGRESSIONAL DISTRICT	CLEAN ENERGY EMPLOYMENT	RENEWABLE ENERGY GENERATION EMPLOYMENT	ENERGY EFFICIENCY EMPLOYMENT
1	26,700	6,300	17,300
2	8,800	2,000	6,500
3	6,000	900	5,000
4	15,000	4,000	8,200
5	1,800	400	1,300
6	3,900	900	1,300
7	4,300	1,200	1,500

Table 6: Total Clean Energy
Employment for State Senate Districts

STATE SENATE DISTRICT	CLEAN ENERGY EMPLOYMENT	STATE SENATE DISTRICT	CLEAN ENERGY EMPLOYMENT
1	2,700	21	4,900
2	800	22	1-250
3	600	23	400
4	5,400	24	300
5	1,600	25	1,400
6	1,600	26	3,500
7	1,200	27	2,900
8	1,600	28	300
9	700	29	400
10	1-250	30	900
11	400	31	4,900
12	1-250	32	3,100
13	600	33	900
14	1,000	34	6,800
15	1,300	35	800
16	8,400		
17	1,800		
18	800		
19	3,400		
20	1,900		

Table 7: Total Clean Energy
Employment for State House Districts

STATE HOUSE DISTRICT	CLEAN ENERGY EMPLOYMENT	STATE HOUSE DISTRICT	CLEAN ENERGY EMPLOYMENT
1	1,400	41	1-250
2	4,300	42	1-250
3	7,000	43	1-250
4	1,600	44	1-250
5	7,300	45	1-250
6	2,600	46	400
7	900	47	400
8	1-250	48	1,700
9	900	49	1,800
10	2,000	50	1-250
11	700	51	1-250
12	700	52	1-250
13	2,000	53	1-250
14	300	54	1,300
15	1-250	55	1-250
16	400	56	1-250
17	500	57	600
18	1-250	58	700
19	1-250	59	1,100
20	1-250	60	400
21	1-250	61	700
22	2,100	62	300
23	2,100	63	1-250
24	1,900	64	600
25	600	65	400
26	1,100		
27	1,300		
28	2,000		
29	400		
30	3,900		
31	300		
32	300		
33	700		
34	1-250		
35	1-250		
36	700		
37	1-250		
38	700		
39	3,400		
40	1-250		

CASE STUDY

FROM THE ROCKIES TO THE INDIAN OCEAN, BOULDER-BASED CLEAN ENERGY COMPANY'S 35 WORKERS HELP BRING SOLAR, ENERGY EFFICIENCY TO DIVERSE CLIENTELE

About 30 years ago, Tony Boniface was camping on a mountainside when he saw a water pump powered by a solar panel. Inspired by the simplicity and the efficiency of the tiny system, Boniface went on to study electrical engineering and embark on a career in renewable energy.

About a decade later, in 1996, Boniface founded Independent Power Systems, or IPS, a Boulder-based clean energy company that now employs about 35 people across three states.

IPS's workers include solar panel installers, journeyman electricians and sales professionals.

Together, they have installed more than 1,000 grid-tied solar arrays for both residential and commercial customers around the world, and renewable energy sales pro Chris Bentley has been a big part of IPS's recent success.

The company's clients range from the Colorado Rockies—whose Coors Field scoreboard is powered by an IPS array—to a



An IPS solar array at Coors Field powers the scoreboard for all Colorado Rockies home games in Denver. (Photo courtesy of IPS)

U.S. military base in the Indian Ocean, to local brewpubs, to the public library in Bozeman, Mont.

In addition to the solar arrays that constitute the bulk of IPS's business, the company has also developed hundreds of off-grid solar and wind systems, as well as grid-tied wind systems, solar and battery backup systems and generator backup systems. The company also builds electric vehicle (EV) charging systems.

One recent project was completed in the fall of 2016 at Boulder Nissan. The project combined an energy efficiency retrofit with a 150-panel rooftop solar array and is expected to save the car dealership about \$384,000 over the next 25 years.

As more of Boulder Nissan's own customers became aware of the economic and environmental benefits of solar power—especially following a 2015 partnership between the dealership and the City of Boulder that led to the sale of nearly 250 EVs in four months—the car dealership felt it had to respond.

"Our solar project is actually gaining us customers," said Ted Christiano, the dealership's general manager.

Bolstering the ability of IPS to hire more Colorado workers over the years are supportive clean energy policies at the federal, state and local levels. For instance, the federal Investment Tax Credit for solar helps lower installation costs for consumers; the Commercial Property Assessed Clean Energy, or C-PACE, leverages financing mechanisms to help Colorado commercial property owners go solar; and the City of Fort Collins offers rebates to residents and businesses that install PV solar arrays.

Another signature IPS project is Boulder Commons, a commercial real estate development where IPS is installing more than 1,000



Sales professional Chris Bentley, left, poses with his daughter on top of a rooftop solar array recently installed in Colorado by Independent Power Systems. (Photo courtesy of IPS)



An artist's rendering of the east wall of Boulder Commons, a new commercial real estate development that will generate as much energy as it consumes. (Photo courtesy of IPS)

high-efficiency solar panels on the project's roofs, and another 655 panels on the facade of one of the buildings. Annual energy production from the solar PV arrays is estimated to be more than 500,000 kWh, and the site is designed to be "net-zero," meaning 100 percent of its energy needs are being produced on-site over a net annual basis.

While IPS does most of its business in Colorado, the company was in fact founded in Montana. Boniface said it was the maturation of Colorado's clean energy market that drew him to the Centennial State. It was for similar reasons that also drew IPS to Massachusetts, the third state where the company has a presence.

One signature IPS project in Montana is the 144-panel array on the roof of the 62,000 square-foot headquarters of SIMMS, an industry-leading fly-fishing company. Like the array atop the Boulder Nissan dealership, the project is expected to save SIMMS some serious cash—about \$218,000 over the next 25 years.

While its roots are in Boston and its home is in Boulder, IPS has also recently worked with the U.S. military to develop projects at far-flung, remote military bases.

On the Indian Ocean atoll of Diego Garcia where the U.S. Navy has a support facility, IPS installed a pair of grid-tied PV systems, the

first in 2010 and the latest just last year. And IPS also designed and installed an off-grid solar, wind and diesel-powered system along with the U.S. Army Corps of Engineers for an Afghan national army base in Kabul.

—ENVIRONMENTAL ENTREPRENEURS

POLICIES MATTER

There are a number of steps policymakers in Denver and Washington can make, right now, to help create thousands more clean energy jobs in Colorado.

STATE POLICY RECOMMENDATIONS

ENERGY EFFICIENCY

In spring 2017, E2 and a broad coalition of business and other groups supported the Legislature passing the extension of Colorado's energy efficiency savings targets in House Bill 1227.^{xviii} The bill reauthorized an existing policy requiring the Colorado Public Utilities Commission to set 10-year energy savings goals for the investor-owned utilities Xcel Energy and Black Hills Energy.

Through measures like education, rebates and free installation of energy efficiency upgrades in low-income households, the original law helped Xcel and Black Hills Energy customers alone save more than \$1.2 billion, even after accounting for program costs.^{xix} **Every dollar invested in energy efficiency programs saves customers nearly three dollars on their electric bills.**^{xx}

Since the law's initial establishment in 2007, the utilities are expecting to reach 12 percent cumulative energy savings over 10 years. In 2015 alone, these efficiency standards helped save enough energy to power 332,000 households.^{xxi}

Colorado has made good progress on cutting energy waste, but there is plenty of untapped potential. The state ranks 18th in the country in efficiency savings,^{xxii} falling behind states in the region including Arizona, Washington and Oregon.

House Bill 1227 requires the PUC to set a 10-year energy savings goal of at least 5 percent of sales. Analysis of the top-performing energy efficiency program administrators across the country shows much higher levels of savings can be sustained—and improved upon—over time. Some states meet annual savings goals of 3 percent.^{xxiii} **State policymakers should seize this economic growth and consumer saving opportunities, by increasing the energy savings goals over time to at least 2 percent of sales annually.**

When Coloradans save money on their electric bills, they have more to spend elsewhere in the economy, which creates jobs in communities across the state. The installation of energy-efficient equipment and appliances will also add jobs across Colorado. According to a new analysis, strengthening Colorado's efficiency investments to 2 percent of sales per year can create up to 3,900 jobs every year and inject an average of \$340 million annually to the state's economy between now and 2040.^{xxiv} The benefits of these investments will grow over time, as the savings accumulate. By 2040, the numbers are impressive: the study predicts 7,500 additional jobs and \$700 million added to Colorado's economy in 2040 alone.^{xxv}

ELECTRIC VEHICLE (EV) INFRASTRUCTURE

As the latest electric vehicles hit the showrooms, with greater ranges and employing advanced safety innovations and new technologies, Colorado has emerged as a leading state for EV adoption. In 2015, EV sales grew by 15 percent over 2014 levels, and in 2016 they grew by 42 percent over 2015 levels. In 2016, Colorado had the sixth-highest market share in the country for new vehicle sales.^{xxvi} There were about 8,500 EVs in Colorado at the end of 2016. With support from utility investments, this could grow to a significant share of the total number of cars on the road over the next 15 years.^{xxvii}

A recent report by MJ Bradley reveals that adding EV charging stations to the electric system helps to reduce electricity rates for all utility customers. In fact, if more Colorado residents drove more EVs, the cumulative value to the state stemming from avoided fuel and vehicle expenses, reduced utility bills and reduced pollution could reach anywhere from \$7 billion to \$43 billion by 2050, in moderate- to high-EV adoption rate scenarios.^{xxviii}

The electric grid will be more efficiently utilized when EV charging can occur during nighttime, when there is spare capacity on Colorado's electric grid, allowing Coloradans to charge cars, trucks and buses without having to make significant investments in new power plants or power lines. Additionally, utilities are required to return increased revenues associated with off-peak charging to all utility customers in the form of lower electricity rates. Under the high-EV adoption scenario, the average Colorado family would save approximately \$77 annually as a result of lower electric rates.^{xxix} Benefits to large commercial customers would be proportionately greater.

Unfortunately, the major limitation on EV growth in Colorado is the lack of access to charging infrastructure. According to a recent survey conducted by the Southwest Energy Efficiency Project, the most common reasons someone chose not to purchase an EV was lack of public charging stations (50 percent), lack of charging in multifamily housing (37 percent) and lack of workplace charging (29 percent).^{xxx}

The proposal from the Colorado Department of Public Health and the Environment to invest funds from the Volkswagen settlement will make a helpful down payment for state charging infrastructure, but is not enough to solve the problem.

The Legislature can help relieve this situation. Currently, Colorado law restricts how investor-owned utilities (Xcel and Black Hills) can invest in EV infrastructure, which is a barrier to the build-out of electric vehicle charging stations across the state. The law should be modified to lift this restriction and allow investor-owned utilities—the most likely developers of such projects and key partners for many customers investments—to recover charging infrastructure costs in their rates. Expanding EV infrastructure will employ more electrical and construction workers and help get more EVs on Colorado's roads.

Colorado is well-positioned to benefit from the electric vehicle revolution, to the tune of billions of dollars, but the state needs to do more to ensure its citizens have access to electricity as a transportation fuel where they live, work, and play.

RENEWABLE ENERGY

Pending a full review, the Public Utilities Commission should be prepared to approve a proposed update to Xcel's "Electric Resource Plan." The plan would bring up to 2 gigawatts of new wind, solar, and other advanced energy resources to Colorado's energy supply. Clean energy development on that scale could result in up to \$3 billion of capital investments and help add more clean energy jobs to Colorado's workforce.

FEDERAL POLICY RECOMMENDATIONS

Colorado's federal representatives need to support the state's strong and growing clean energy economy through encouraging smart policies in Congress and through the administration. Here are three policies they should pursue:

- The current glide path from a five-year extension that gradually winds down in 2021 for the Production Tax Credit (PTC) for wind, the Investment Tax Credit (ITC) for solar, and tax credits supporting other renewable technologies must be maintained, even in any tax reform legislation. This is a done deal and sectors worth billions of dollars in Colorado depend on the certainty these tax policies produce. Lawmakers should also include energy efficiency credits that were allowed to sunset in 2016 in any new tax legislation. These are 179D and 45L in the tax code.
- Congress should properly fund R&D investments in innovation and efficiency at EERE, ARPA-E and loan guarantee offices/programs at U.S. Department of Energy. These programs feed innovation and encourage global competitiveness both for Colorado companies and for the country as a whole. Allowing cuts proposed in the administration's FY18 budget and in the House of Representatives' Energy & Water FY18 bill to become law would be disastrous for our state. The operations and effectiveness of the National Renewable Energy Laboratory (NREL) alone would be seriously injured from these programs eliminations or serious cuts.
- Colorado lawmakers must stand for sensible and effective fuel efficiency standards as developed by EPA and the Department of Transportation. These standards drive innovation in the automotive sector, making American cars that can be sold all over the world, as well as taking harmful emissions out of Colorado's air while saving our consumers money at the pump.

CASE STUDY

LONG-TIME GRAND JUNCTION ENTREPRENEUR EMPLOYS NEARLY 30 PEOPLE AT THREE SEPARATE CLEAN ENERGY BUSINESSES

Darin Carei has been involved in Colorado's clean energy industry since shortly after he moved to Mesa County in the late 1970s.

His first entree into the industry included publishing a directory of Colorado solar companies and organizing tours of solar-powered homes.

Back then, clean energy was in its infancy, with a few jobs scattered across the state, but things have changed.

Carei now runs three separate clean energy companies that combined, employ about 30 people in Western Colorado. In Carei's home county of Mesa, about 1,200 people now work in the clean energy industry. Statewide, 66,000 Coloradans work in clean energy.

Carei's oldest business is Atlasta solar. Founded in 1979, Atlasta joined an industry in its infancy. For some perspective, consider that when the solar industry's main national trade group was founded in 1974, there were only five members. Today, solar is one of the fastest-growing industries in the country, and its trade group now boasts 1,000 member companies.

Carei said the solar market was rocky for years, with Atlasta surviving on low overhead costs, off-grid installations, and solar hot water systems.

The vast majority of Colorado's clean energy workers—about four in five—work in energy efficiency. Carei's employees are more evenly split, with about 15 working at either one of his two energy efficiency businesses, or at his solar company.

One of Carei's newer businesses is EnergyWise Consulting, which pairs residential energy audits with energy efficiency upgrades.

Carei said the world doesn't yet fully understand the value of energy efficiency in comparison to some of the more sexy options such as granite countertops, flat-screen TVs, and even solar energy.

Part of the problem is lack of support for state policies that can help the industry expand—and along with it, Colorado jobs and consumer savings. With the average up-front cash costs of residential energy efficiency retrofits in Colorado running about \$4,000 to \$8,000, financing mechanisms like Property-Assessed Clean Energy programs, or PACE, could help a lot, Carei said.

According to the U.S. Dept. of Energy, PACE programs allow entities like local and state governments to administer loans with private lenders to fund the up-front cost of energy improvements on commercial and residential properties. Then property owners pay the costs back over time, through their property tax bills.

Colorado's state legislature passed Commercial PACE (C-PACE) in 2010. To date, 18 Colorado counties have adopted this public-private partnership program, and seven more are considering. Other counties across the state, like Mesa, would benefit from C-PACE—it would grow local businesses, create jobs and cut consumer utility bills.

Another way Carei is leveraging the sound economics of energy efficiency to grow his business interests is through a company he founded in 2011 called Synergy Builders. Each year, Synergy Builders constructs about 50 energy efficient homes in Colorado. All of

them are exclusively equipped with ENERGY STAR-rated appliances like refrigerators and washing machines.

"I think overall the added consumer consciousness with regards to increased frugality and reduced waste brought on by the recession (in 2008) has certainly added to the demand for our product," Carei said. "I also believe consumers seem to be just a bit more socially conscious regarding the environmental impacts of the present adversely affecting the long-range future."

The Trump administration's budget, however, aims to slash energy efficiency funding to programs like ENERGY STAR. Launched in 1991 by the George H.W. Bush administration, ENERGY STAR has saved American consumers \$430 billion on their energy bills, according to the U.S. EPA.

"[There are] many stories of growth and recessions, jobs we liked and those not so much, customers and competitors coming and going," he said, reflecting on Atlasta's decades in the energy business.

For now, with three companies and nearly 30 employees to look after, Carei is plenty busy working in a Colorado clean energy industry that grows bigger each year.

—ENVIRONMENTAL ENTREPRENEURS



In Atlasta Solar's home county of Mesa, about 1,200 Coloradans work in the clean energy industry, which statewide is growing at a 6-percent clip. Grand Junction entrepreneur Darin Carei founded three Colorado clean energy companies that combined employ about 30 people, including rooftop solar installers. (Photo courtesy of Atlasta Solar)

CONCLUSION

With about 66,000 clean energy jobs and massive potential for more energy efficiency and renewable energy generation, Colorado can become even more of a regional and national powerhouse in clean energy.

Clean energy workers are now spread across the state. They're in red districts, blue districts, urban areas like Denver and more rural areas like Mesa County.

By adopting stronger clean energy policies now, elected officials in Denver and Washington, D.C., can help create more jobs and ensure a more promising future for all Coloradans.

APPENDIX

METHODOLOGY

Data for this year's report is derived from the comprehensive BW Research Energy Employment Index (EEI) administered in 2015 and growth estimates based on sub-technology industry mix and publicly available employer reported growth estimates from the 2017 U.S. Department of Energy (DOE) United States Energy and Employment Report (USEER).

For state-level growth estimates, BW Research utilized six-digit North American Industry Classification System (NAICS) incidence for clean energy sub-technologies. This "industry mix" was developed by analyzing completed survey incidence nationally for all clean energy sub-technologies. For example, the six-digit NAICS industries below cover all firms that reported solar-related employment in 2016:

NAICS	DESCRIPTION
221114	Solar Electric Power Generation
237110	Water and Sewer Line and Related Structures Construction
237130	Power and Communication Line and Related Structures Construction
238210	Electrical Contractors and Other Wiring Installation Contractors
238220	Plumbing, Heating, and Air-Conditioning Contractors
332312	Fabricated Structural Metal Manufacturing
333414	Heating Equipment (except Warm Air Furnaces) Manufacturing
334413	Semiconductor and Related Device Manufacturing
334512	Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use
335121	Residential Electric Lighting Fixture Manufacturing
335312	Motor and Generator Manufacturing
335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing
423610	Electrical Apparatus and Equipment, Wiring Supplies, and Related Equipment Merchant Wholesalers
523930	Investment Advice
541110	Offices of Lawyers
541310	Architectural Services
541330	Engineering Services
541370	Surveying and Mapping (except Geophysical) Services
541612	Human Resources Consulting Services
541614	Process, Physical Distribution, and Logistics Consulting Services
541618	Other Management Consulting Services
811211	Consumer Electronics Repair and Maintenance
811219	Other Electronic and Precision Equipment Repair and Maintenance
811310	Commercial and Industrial Machinery and Equipment (except Automotive and Electronic) Repair and Maintenance

Estimated growth by sub-technology used industry mix U.S. Bureau of Labor Statistics (BLS) publicly reported growth from 2015–2016 averaged with reported national sub-technology growth (from 2017 DOE USEER). The derived growth estimates were applied to 2015 employment numbers and aggregated by technology and total clean energy employment for final 2016 jobs numbers.

Though the BLS Quarterly Census of Employment and Wages (QCEW) datasets track energy employment across traditional production, transmission, and distribution subsectors, the current structure of the NAICS assigns a portion of the nation's energy and energy efficiency work into broad categories of non-energy specific industries, such as construction, wholesale trade, and professional services.

Identifying energy-related employment within broad NAICS industry sectors is particularly important for understanding employment trends across emerging renewable energy and advanced fuel technologies and infrastructures, such as solar, wind, geothermal, biomass, storage, and smart grid. Since rising deployment of efficiency-related technologies has carved out new opportunities for firms in traditional trades to research, manufacture, or install energy efficient products and upgrades, parsing out this employment is especially useful to determine the level of job growth across the nation's energy efficiency subsectors. However, energy efficiency and other clean energy workers are not exactly captured through traditional NAICS alone. For example, a subset of semiconductor manufacturers produces solar panels, while others assemble computer components or medical equipment. Even though the NAICS classifications include a "solar electric generation" subsector, important elements of the solar value chain, such as research, installation, manufacturing, sales, and distribution are embedded within these other broad NAICS categories. While federal labor market data alone presents an incomplete picture of the clean energy workforce, inclusion of these additional manufacturing or construction industries in their entirety would result in exaggerated employment figures, while their exclusion underestimates the clean economy and its workforce.

The 2015 Index was the result of a rigorous survey effort of traditional and clean energy establishments across all 50 states. Final employment figures were extrapolated based on the QCEW.

The 2017 USEER methodology relies on the most recently available data from the U.S. Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW, Quarter I), together with a detailed supplemental survey of business establishments across the United States designed and conducted by BW Research Partnership on behalf of the U.S. Department of Energy. DOE conducted a comprehensive review of the methodology underlying the 2017 USEER and consulted with the BLS for consistency.

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