2020 California Energy and Employment Report

Produced for the California Energy Commission and California Public Utilities Commission

[bw] RESEARCH PARTNERSHIP

EXECUTIVE SUMMARY

Based on a comprehensive analysis of employer data collected in the fourth quarter of 2019, the 2020 California Energy and Employment Report (CAEER) finds that the Traditional Energy sector employed 411,811 Californians as of the end of 2019. When combined with the Energy Efficiency and Motor Vehicles sectors, California's energy-related sectors employed approximately 956,400 Californians or 5.3 percent of an overall workforce of roughly 18.2 million.[1] Traditional energy, energy efficiency, and motor vehicle employment in total increased by one percent between 2018 and 2019, adding 9,689 net new jobs, almost seven percent of all new job growth in the state.[2]

It is important to note that this report was commissioned before the global Coronavirus (COVID-19) pandemic, which has significantly altered labor market and employment realities across the United States.

Employment

The Electric Power Generation sector employed 182,600 workers in California, a decline of 0.5 percent since 2018; this was largely due to job losses in solar and natural gas generation. California solar installations declined over the past year and natural gas power plants continue to close.

- Solar energy firms employed roughly 124,800 employees, decreasing by 1,690 jobs or 1.3 percent.
- There were about 20,500 natural gas generation workers across the state in 2019, a decrease of 1.4 percent or 283 jobs.
- Traditional hydropower generation employed 11,090 workers in California, a decline of 73 jobs since 2018.
- Wind employment increased by nearly 500 workers (8.4 percent growth), for 6,270 total jobs in 2019.

The Fuels sector employed 77,000 workers, an increase of just over 2,000 jobs, or 2.8 percent in 2019. Employment growth was led by the Professional and Business Services industry, while the Mining and Extraction industry observed substantial job loss; this suggests a rise in legal and financial consultation demand spurred by a declining extraction industry.

- Oil fuels was the largest subsector, accounting for three-quarters of Fuels employment. These employers created the most jobs in the Traditional Energy sector, with 880 new positions, an increase of 1.6 percent to 57,300 jobs.
- Natural gas accounted for the second largest Fuels sector, with 8,254 jobs. Natural gas Fuels employment grew by 5.2 percent over 2019, or an additional 400 workers.
- Coal, ethanol, woody biomass, and other fuels collectively accounted for 15 percent of the Fuels workforce and had a net job change of 789 workers.

Transmission, Distribution, and Storage employed just over 152,200 Californians, unchanged since 2018.

[1] 2019 Annual Average, EMSI.
[2] Total difference between 2019 and 2018 California jobs provided by EMSI.

- The construction and utilities sectors accounted for the majority of Transmission, Distribution, and Storage jobs in California, representing 32 percent and 26 percent of employment, respectively.
- Storage, microgrid, and smart grid technologies all saw employment grow between 2018 and 2019, by a respective two percent, 1.9 percent, and 1.6 percent; together, these subsectors created 943 new jobs.

Energy Efficiency firms employed just over 323,500 Californians, adding 4,990 new jobs between 2018 and 2019 (1.6 percent growth).

- 168,100 Energy Efficiency jobs were in the construction industry, an increase of 3,300 jobs from 2018.
- Energy Efficiency workers working with advanced materials gained the most jobs, increasing by 1,600 (8.1 percent) to a total of 21,700 workers.
- 73,000 Californians were employed primarily around the production and use of ENERGY STAR® certified products and energy efficient building materials.

Motor Vehicles (including component parts) employed about 221,100 workers, adding almost 3,490 jobs in 2019 in California, an increase of 1.6 percent.

- Alternative fuels vehicles, including electric, plug-in hybrids, hybrids, natural gas, and hydrogen/fuel cells, employed 40,627 Californians, roughly 18 percent of all Motor Vehicle jobs in California.
- While national electric vehicles employment declined by more than nine percent over the last year, electric vehicles employment in California grew by 5.6 percent (adding 1,280 jobs to a total of 23,990 workers).[3] This was likely spurred by growth in electric vehicle manufacturing employment.
- Repair and maintenance jobs accounted for more than half (56 percent) of total Motor Vehicles employment in California.

Hiring and Business Challenges

Overall, prior to COVID-19, Traditional Energy firms in California were optimistic about continued employment growth. Employers anticipated 4.9 percent employment growth for 2020, compared to three percent nationally.[4] While COVID-19 has likely impacted short-term employment growth, the employment projections provide insight into employers' perceptions of long-term industry trends.

- Electric Power Generation employers projected the highest growth rate over 2020 (eight percent), followed by,
- Energy Efficiency (five percent),
- Motor Vehicles (four percent),
- Fuels (four percent), and
- Transmission, Distribution, and Storage (three percent).

Hiring difficulty exceeded the national average in California in Electric Power Generation, Transmission, Distribution and Storage, and Motor Vehicles. Respectively, 88, 87, and 87 percent of these employers

[3] USEER 2020
[4] Ibid.

reported it was at least somewhat difficult to hire new employees.[5] The Transmission, Distribution, and Storage sector was the only sector to significantly deviate from nationally reported sector hiring difficulty; the share of California firms reporting hiring as at least somewhat difficult was ten points higher than the national share. Electric Power Generation employers reported the greatest hiring difficulty; 23 percent indicated that hiring had been "very" difficult between 2018 and 2019. These employers also predicted the highest anticipated growth compared to other energy sectors.

Notably, the 2020 CAEER found that California's energy firms recognize a strong need for qualified talent. Across all five technologies, the inability to find qualified talent was cited as either the first or second most significant challenge to growing a profitable energy business.

Wages

- Thirty-four percent of energy occupations in California exceed the overall state median wage for their respective occupations. Meanwhile, 59 percent of entry-level energy wages in California exceeded state entry-level wages for the respective occupations.
- The highest wage differentials across all energy sectors were paid for Material Moving Workers, Continuous Mining Machine Operators, and Electrical and Electronics Repairers (each paying at least 30 percent above state median wages for the respective occupations).
- Among energy occupations that paid less than the state median wage were Mechanical Insulation Workers, Operating Engineers and Other Construction Equipment Operators, as well as Surveying and Mapping Technicians.

Workforce Characteristics

Demographically, energy sectors remain below state averages in employment of women and above state averages in racial or ethnic minorities.[6]

- Women were a smaller portion of the workforce in these sectors, ranging from 25 percent to 30 percent, compared to the overall California economy, where women make up 48 percent of the workforce.
- Sixty-six to 70 percent of workers in these energy sectors identify as White, compared to 72 percent of the overall statewide workforce. Twelve to 13 percent of energy workers within each sector identified as belonging to "two or more races", compared to two percent statewide.
- Veterans accounted for six to eight percent of employment across the energy sectors; this is higher than the California average of four percent.
- Between 11 percent and 15 percent of the energy workforce was 55 years of age or older, significantly lower than the California average of 21 percent.
- The unionization rates for all energy sectors (4 to 11 percent) were below the California average of 15 percent; however, it is important to note that this state average includes public employment which typically boasts much higher unionization rates than the private sector.

[5] These percentages are the sum of respondents that selected "very difficult" and "somewhat difficult".
[6] All California demographic statistics sourced from US Bureau of Labor Statistics Local Area Unemployment Statistics and Economics News Releases. The USEER survey uses U.S. Census Bureau categories for ethnicity and race. The U.S. Census Bureau considers race and ethnicity to be two separate and distinct concepts. Ethnicity determines whether a person is of Hispanic origin or not. Race is defined as a person's self-identification with one or more social groups. An individual can report as White, Black or African American, Asian, American Indian and Alaska Native, Native Hawaiian and Other Pacific Islander, or some other race.

All California energy sectors have a higher share of nonwhite employees compared to the national energy sector averages, as well as a significantly lower share of workers 55 and over.[7]

[7] USEER 2020

INTRODUCTION

BW Research Partnership produced the following 2020 California Energy and Employment Report on behalf of the California Energy Commission and the California Public Utilities Commission. The report details energy and energy-related jobs in California, including historical employment dating back to 2018. Energy employment is defined according to the major sectors and sub-technologies classified in the annual United States Energy and Employment Report (USEER) and can be found in Appendix B of this report. All data presented in this report is based on the 2020 USEER data collection effort, a joint project of the National Association of State Energy Officials (NASEO) and the Energy Futures Initiative (EFI).[8]

The 2020 California Energy and Employment Report (CAEER) analyzes the following five sectors of California's energy economy:

- Electric Power Generation
- Fuels
- Transmission, Distribution and Storage
- Energy Efficiency
- Motor Vehicles

The first three of these sectors make up what is referred to as the "Traditional Energy" sector. While motor vehicle employment is not considered a traditional energy job, this sector is included due to the energy consumption associated with production and end-use vehicle emissions. Similarly, as energy efficiency plays a pivotal role in reducing energy consumption, it is also included as part of a comprehensive assessment of energy and energy-related jobs.

The following report provides a snapshot of California's energy labor market across the above major energy sectors and is inclusive of all energy sub-technologies as defined in the USEER methodology. For more information on the USEER methodology, please refer to Appendix A of this report. For a detailed list of energy sub-technologies that are defined as energy jobs, please refer to Appendix B of this report.

California's electricity generation mix is largely comprised of natural gas, solar photovoltaics (PV), and large-scale hydropower. In 2018, these three energy sources accounted for 70.5 percent of total in-state electricity generation. Natural gas generation is the state's largest source of electricity, followed by solar PV.[9] In 2018, the state announced a goal of relying entirely on zero-emission energy sources for its electricity by 2045. As of 2018, 44 percent of the state's electric power production was from zero-emission sources.[10]

A long-time national leader in solar power, California accounted for more than 37 percent of the nation's 5,551 thousand megawatt hours of solar power production in 2019. Solar accounted for nearly 19 percent of the state's electricity generation, the highest share of any state.[11] Meanwhile, while much of the nation ramps up its natural gas production, both California's natural gas extraction and power production have undergone significant declines. Across the country, annual natural gas electricity

[8] www.USEnergyJobs.org
[9] California Energy Commission
[10] Ibid. "Zero-emission" sources include Nuclear, Hydro, Solar, and Wind.
[11] SEIA

generation grew 66 percent from 2008 to 2018[12]; over that same time span, natural gas generation in California dropped 26 percent.[13]

California improved its Building Energy Efficiency Standards in 2019, as part of the three-year review process. The most recent standards include a solar PV mandate for all new home construction, battery storage and air filter incentives, and thermal envelope and lighting improvements.[14] The American Council for an Energy-Efficient Economy ranks California second in the nation in its energy efficiency policies, which have contributed to California boasting the second lowest residential energy use per capita of any state.[15] [16]

The transportation sector, meanwhile, currently accounts for 40 percent of California's energy consumption by end use.[17] As California aims to reduce its carbon emissions, it has taken steps to increase the prevalence of zero-emission vehicles (ZEVs). California has set a goal of 5 million ZEVs on the road by 2030 as part of its larger goal of cutting greenhouse gas emissions to 40 percent below 1990 levels in the same time.[18] Due to the presence of Tesla's vehicle factory, EVs were also estimated to be California's fifth most valuable export in 2019.[19]

[12] EIA
[13] California Energy Commission
[14] California Energy Commission
[15] ACEEE
[16] EIA
[17] EIA
[18] California Public Utilities Commission
[19] https://www.forbes.com/sites/energyinnovation/2019/09/23/california-electric-vehicle-exports-already-valued-at-3-billion-in-2018-expected-to-hit-35-billion-in-2019/#4b8b81304e27

COVID-19 IMPACTS

The data in this report were collected in the 4th quarter of 2019, before any economic impact of the COVID-19 pandemic. At the end of 2019, the California energy sector was continuing on its path of consistent employment growth, and employers were bullish on the future, projecting 2 to 8 percent growth over 2020.

Obviously, the economic fallout that began with required physical distancing measures implemented in March 2020, has dramatically altered the energy employment landscape. Overall, from March through May, energy and energy-related employment is down by 177,802 jobs—an 18.6 percent decline. Over half of these job losses were from clean energy segments of the sector, but all technology sectors in the energy industry shed jobs.

While the losses in the energy sector – as well as the economy as a whole – are historic, there is reason for hope. Energy jobs are critical, and the transition to zero carbon energy in California will continue post-pandemic. Furthermore, energy jobs are particularly well suited to stimulus. As shown in prior stimulus packages such as the ARRA, investments in energy create American jobs across the supply chain, from R&D to manufacturing, logistics to construction. Finally, a large percentage of the jobs in the energy sector can be conducted while maintaining physical distancing and using personal protective equipment (PPE). As a result, energy jobs should be poised to bounce back much more quickly than other sectors, particularly with sound interventions by the state and federal government.

Clean Energy Jobs

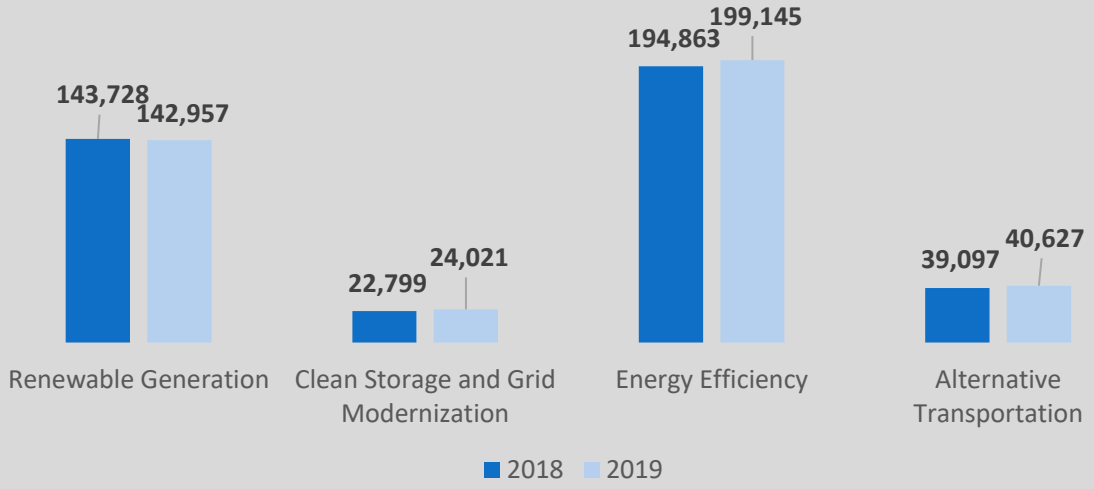
Through its 2018 zero-emission electricity commitments, nation-leading solar and energy efficiency measures, and 2019 zero-emission vehicle goals, California has committed itself to the expansion of clean energy technologies in pursuit of a low carbon future.

California's clean energy industry is defined as the aggregate of establishments that are directly involved with researching, developing, producing, manufacturing, distributing or implementing components, goods or services related to Renewable Energy, Energy Efficiency or Conservation, Smart Grid, Energy Storage, Carbon Management and/or Electric or Hybrid Vehicles. It should be noted that the clean energy technologies included in California's definition are similar to Massachusetts and other state clean energy industry reports. More specifically, California's clean energy employment numbers below do not include traditional hydroelectric power generation, nuclear generation, or combined heat and power generation. These numbers also exclude corn ethanol and woody biomass fuels. For more information on which sub-technologies are included below, please refer to Appendix D.

In 2019, California's clean energy industry employed 406,751 workers, up 2 percent over the past year.

- Renewable generation was the only major technology to not see employment grow this year, dropping a mere half percent since 2019. Solar generation employed 124,800 workers in 2019, the most of any detailed technology. Wind generation, meanwhile, added 1,500 jobs in the past year, accounting for 8 percent employment growth.
- Energy Efficiency led employment growth by major technology, adding 4,300 jobs since 2018.
- Clean storage and grid modernization added 1,200 jobs over the year for 5 percent employment growth.
- Alternative transportation employment, led by 6 percent growth in electric vehicle employment, added 1,500 workers (4 percent growth).

Figure 1. Clean Energy Employment by Major Technology, Q4 2018 – Q4 2019



CHAPTER 1 — ELECTRIC POWER GENERATION

Electric Power Generation (EPG) covers all utility and non-utility employment across electricity-generating technologies, including fossil fuels, nuclear, and renewable energy technologies. Employment totals include workers engaged in facility construction, turbine and other generation equipment manufacturing, and wholesale parts distribution for all electric generation technologies, as well as jobs at utilities.

EMPLOYMENT OVERVIEW

The Electric Power Generation sector employed 182,560 workers in 2019, compared to the previous year's level of 183,420 workers. This represents a 0.5 percent drop in employment from 2018, largely due to a slight dip in solar employment. Nationally, Electric Power Generation employment grew 2.1 percent, with solar employment up for the first time in three years.

In the fourth quarter of 2019 - prior to widespread knowledge of the coronavirus (COVID-19) - employers in the EPG sector expected to see employment increase by 7.6 percent in 2020, adding more than 13,800 new jobs.[20]

Figure 2. EPG Employment Growth, Q4 2018 - Q4 2020 Projected

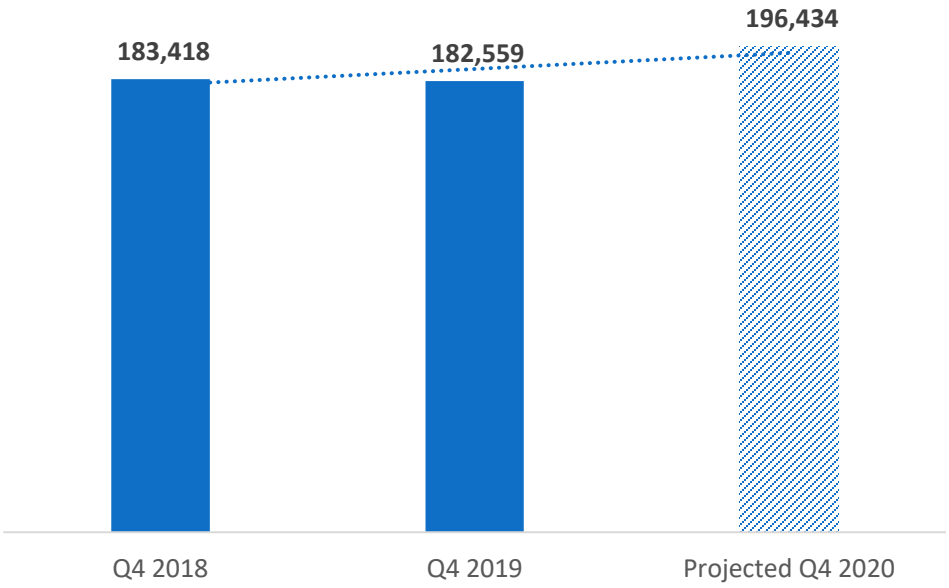
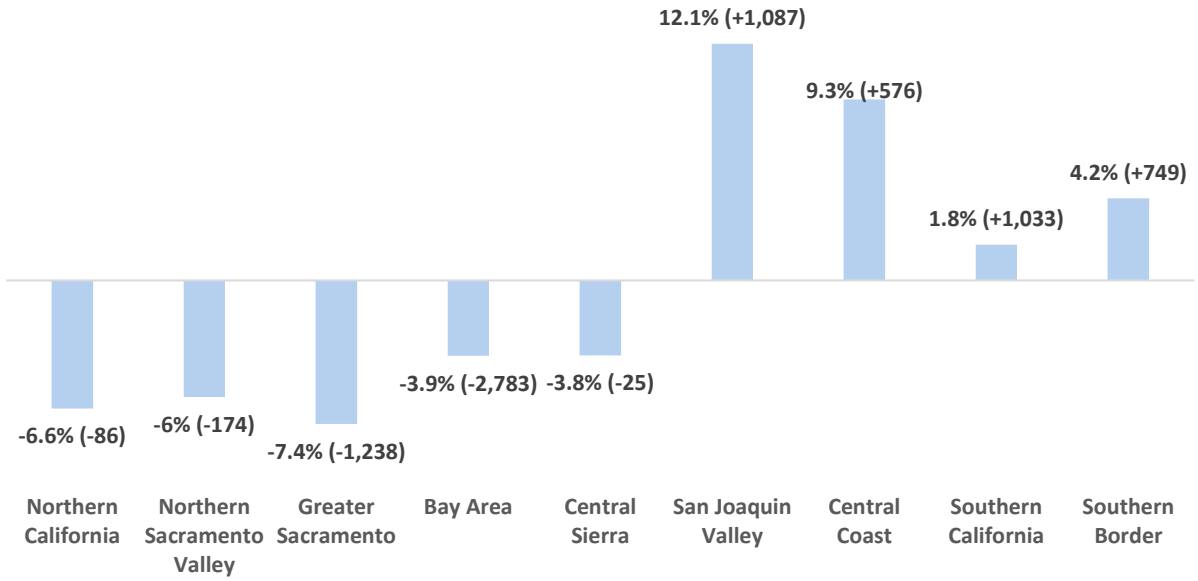


Figure 3. EPG Employment Growth by Region, Q4 2018 – Q4 2019[21]

[20] This estimate is based on employer-reported growth projections, which often tend to be optimistic. Employers project out to their expected needs, which do not account for obstacles faced in the hiring process (small applicant pool, insufficiently qualified applicants, competition, etc.).
[21] A map of the regions, along with selected detailed technology growth, can be found in Appendix C.



Construction jobs comprised nearly 40 percent of the California EPG sector, while utilities, manufacturing, trade, and professional & business service jobs each made up 10 to 20 percent of EPG employment in 2019. Most industries remained stable, but utilities employment decreased by more than 900 jobs.[22]

Solar jobs represented 68 percent of California EPG employment in 2019. As shown in Figure 4, the 2020 CAEER found a one percent drop in 2019 for solar jobs (losing almost 1,700 jobs, for a total of 124,810 jobs). Wind generation employment, meanwhile, added 490 jobs (more than eight percent growth).

This marks the third straight year of solar employment declines, though this one percent drop is less than previous years – solar employment fell 3.2 percent from 2017 to 2018. In general, solar installation in California fell slightly over the past year.[23] Contributing factors to solar employment decline may include increased installation efficiency and a shift away from direct residential sales campaigns, products of a mature in-state market.

Despite nationwide coal employment declines (down 7.2 percent from 2018 to 2019), California saw a slight increase in coal generation employment likely due to its presence in professional services around the decommissioning of out-of-state coal plants. California's slight decrease in natural gas employment (a loss of 283 jobs) was also in contrast to national trends, which were up 8.1 percent over the same period. The decrease is, however, in line with the state's recent declines in natural gas generation; California saw a natural gas power plant close in 2019 and four others are slated to close by the end of 2020.[24] Employment gains around natural gas plant decommissioning only partially offset the direct in-state losses of power plant jobs.

[22] Employment changes, outside of Utilities, are not statistically significant and thus growth is recognized as flat.
[23] SEIA
[24] https://www.latimes.com/environment/story/2019-12-12/california-clean-energy-gas-plants

Figure 4. EPG Employment by Industry, Q4 2018 – Q4 2019

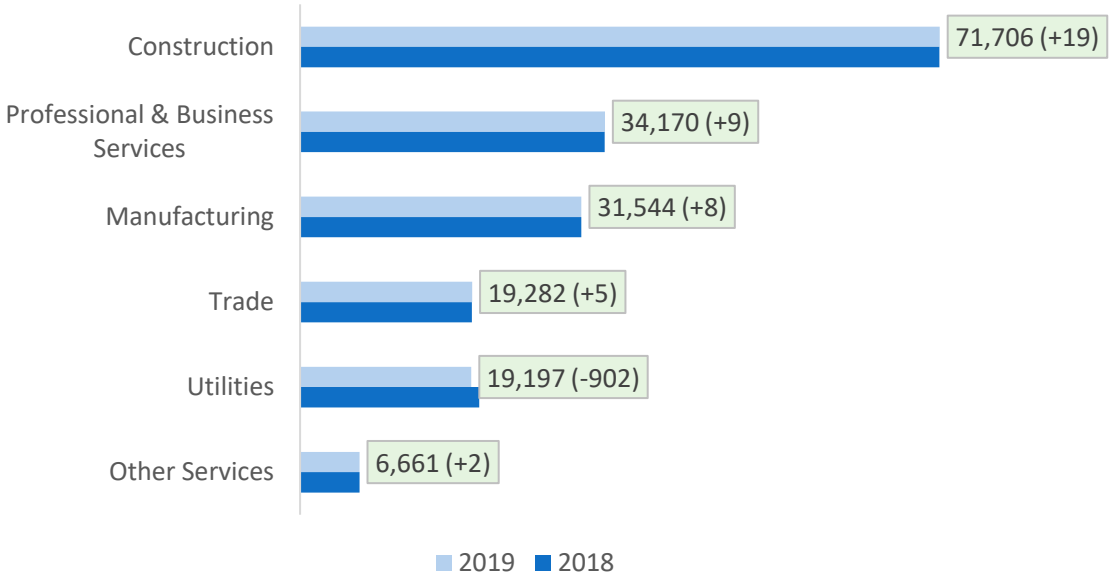
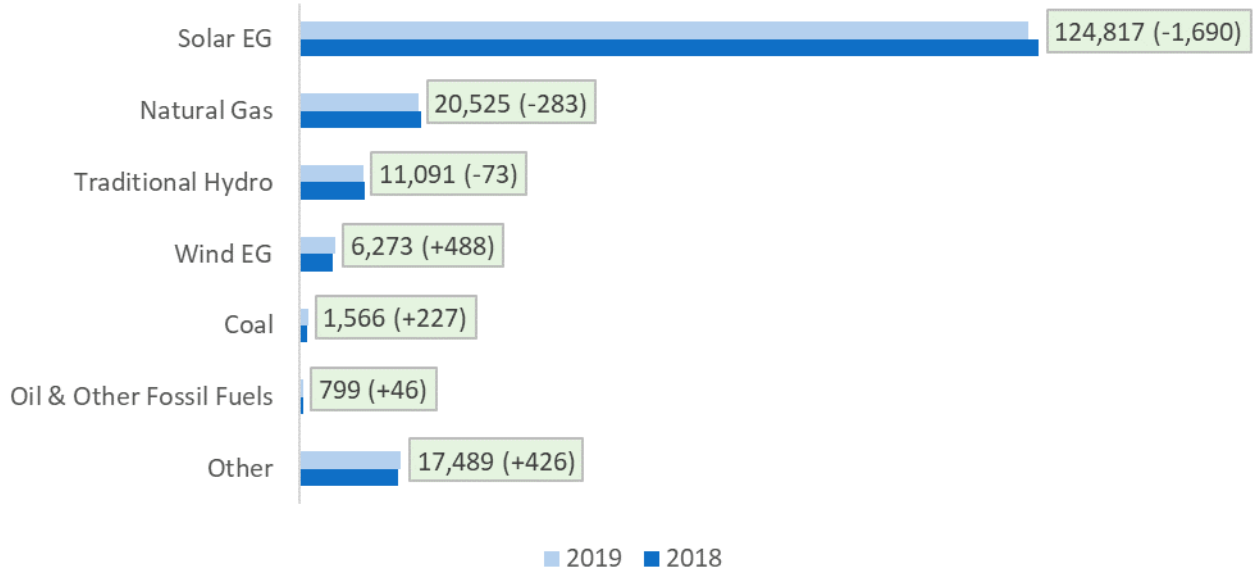
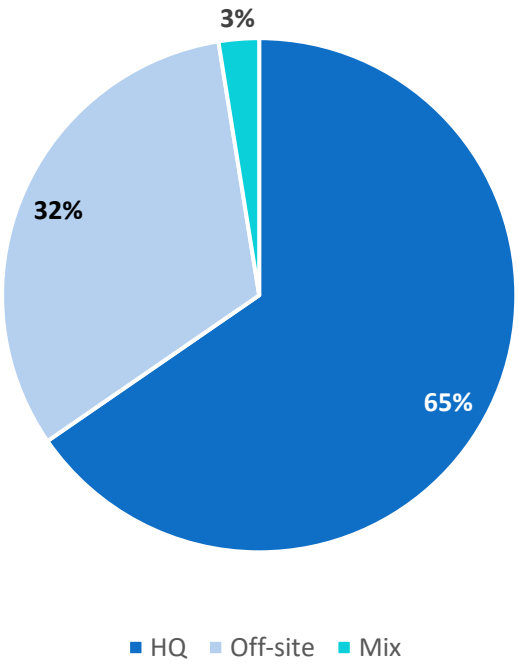


Figure 5. EPG Employment by Detailed Technology Application, Q4 2018 – Q4 2019



Based on staffing patterns, an estimated 65 percent of utility employees within Electric Power Generation worked at utility headquarters, while 32 percent worked off-site.[25] Workers at headquarters are typically positions like Chief Executives and Business Operations Specialists, while on-site workers are more likely to hold positions like Meter Readers and Electrical Power-Line Installers & Repairers.

Figure 6. EPG Utility Employment by Location

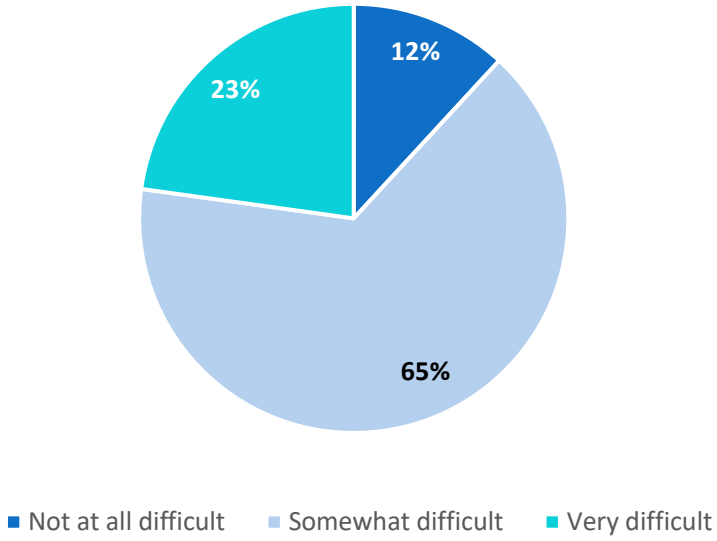


HIRING DIFFICULTY & BUSINESS CHALLENGES

Thirty-six percent of EPG companies in California hired in 2019. Of these firms, nearly two thirds found hiring to be somewhat difficult, while 23 percent found it to be very difficult. Twelve percent of firms did not find hiring to be difficult at all. These rates were consistent with nationally-reported EPG sector hiring difficulty.[26] The top reported reason for hiring difficulty in 2019 was a lack of experience, training, or technical skills, followed by competition due to a small applicant pool, while the most difficult occupations to hire were management positions and engineers/scientists.[27]

[25] Staffing pattern analysis was completed using EMSI 2019 data on Standard Occupational Classification (SOC) employment concentration within Utilities.
[26] USEER 2020
[27] Reasons for hiring difficulty and most difficult occupations were open-ended questions; similar answers were placed into categories, and the top reported categories are listed.

Figure 7. EPG Hiring Difficulty



Top Reasons for Hiring Difficulty

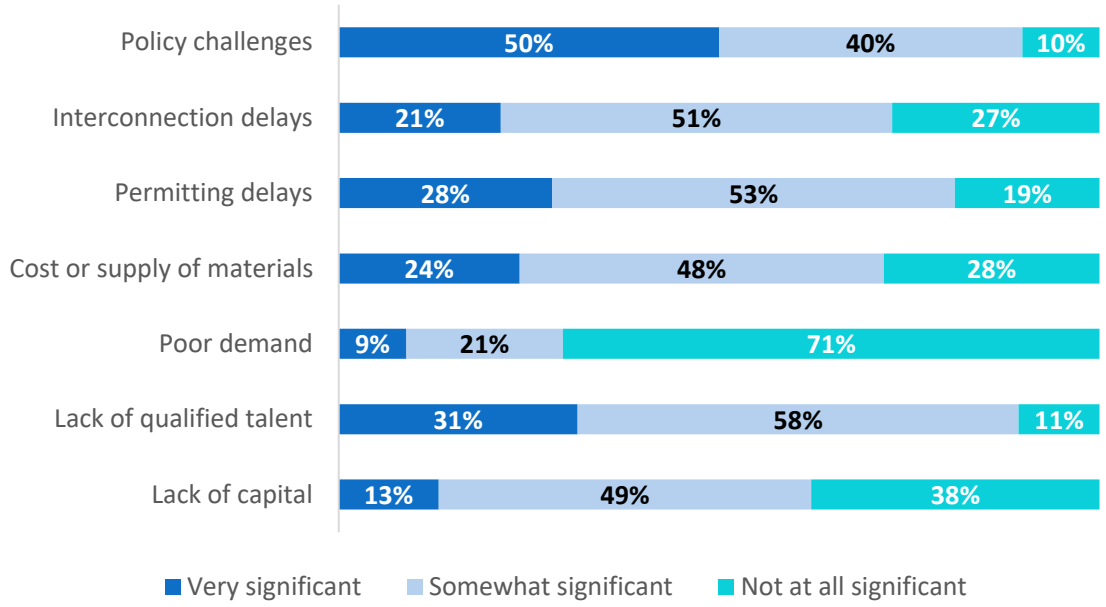
1. Lack of experience, training, or technical skills
2. Competition/ small applicant pool
3. Difficulty finding industry-specific knowledge, skills, and interest
4. Economy/structural problem
5. Insufficient qualifications; certifications or education

Top Difficult to Hire Occupations

1. Management; directors, supervisors, vice presidents
2. Engineers/scientists
3. Installation workers
4. Sales, marketing, or customer service
5. Electrician/construction workers

While employment decline typically lends itself to greater hiring ease, EPG employers actually cite a lack of qualified talent as a possible explanation for industry decline; this may explain the sustained high rates of hiring difficulty. The most significant reasons for business growth difficulty, according to employers in 2019, were policy challenges and lack of qualified talent; 90 percent and 89 percent of employers, respectively, found them to be a very or somewhat significant factor. Fifty percent of all EPG employers surveyed considered policy challenges alone to be very significant in slowing business growth. Policy challenges cited include federal incentive uncertainties, recent changes to Net Energy Metering policies, lack of consistency and predictability of regional utilities, and a lack of clean energy promotion in federal policies.

Figure 8. EPG Significance of Factors in Difficulty Growing a Profitable Business



WAGES

The following table outlines occupational wages for California's EPG sector employees. The table is organized from highest to lowest earning jobs and provides a comparative column for California's statewide median wages for each occupation, as well as the percent difference between the wages.

Table 1. EPG Sector, Median Hourly Earnings

Description	EPG Earnings	CA Earnings[28]	EPG Premium/Discount
Chief Executives	$102.06	$106.62	(4%)
Petroleum Engineers	$81.03	$63.79	27%
Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	$62.09	$48.21	29%
Engineers, All Other	$57.28	$51.59	11%
General and Operations Managers	$54.33	$54.86	(1%)
Information Security Analysts	$52.24	$52.50	0%
Construction Managers	$50.31	$51.47	(2%)
Power Distributors and Dispatchers	$48.32	$40.33	20%
Computer Occupations, All Other	$47.95	$47.12	2%
Power Plant Operators	$44.51	$45.84	(3%)
Gas Compressor and Gas Pumping Station Operators	$41.63	$33.31	25%

[28] EMSI 2019 Annual Earnings with assumed 2,080 annual work hours

Gas Plant Operators	$39.75	$49.95	(20%)
Electrical Power-Line Installers and Repairers	$39.10	$49.15	(20%)
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	$36.99	$39.01	(5%)
Business Operations Specialists, All Other	$36.72	$36.09	2%
Accountants and Auditors	$34.22	$36.39	(6%)
First-Line Supervisors of Mechanics, Installers, and Repairers	$32.42	$36.97	(12%)
Plant and System Operators, All Other	$31.93	$31.53	1%
First-Line Supervisors of Construction Trades and Extraction Workers	$30.98	$37.71	(18%)
Control and Valve Installers and Repairers, Except Mechanical Door	$30.92	$30.43	2%
Wind Turbine Service Technicians	$29.98	$27.08	11%
First-Line Supervisors of Production and Operating Workers	$29.30	$30.11	(3%)
Engineering Technicians, Except Drafters, All Other	$29.21	$33.63	(13%)
Dredge Operators	$28.90	$28.76	0%
Industrial Machinery Mechanics	$28.86	$27.40	5%
Boilermakers	$28.25	$33.94	(17%)
Mobile Heavy Equipment Mechanics, Except Engines	$27.91	$30.55	(9%)
Production, Planning, and Expediting Clerks	$26.60	$23.83	12%
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	$26.26	$26.51	(1%)
Solar Photovoltaic Installers	$25.88	$21.15	22%
Bus and Truck Mechanics and Diesel Engine Specialists	$25.45	$26.36	(3%)
Electricians	$25.08	$30.89	(19%)
Structural Iron and Steel Workers	$24.53	$31.98	(23%)
Plumbers, Pipefitters, and Steamfitters	$24.51	$27.05	(9%)
Bookkeeping, Accounting, and Auditing Clerks	$24.13	$22.28	8%
Drafters, All Other	$23.97	$26.60	(10%)
Brickmasons and Blockmasons	$23.15	$27.45	(16%)
Automotive Body and Related Repairers	$22.98	$23.48	(2%)
Meter Readers, Utilities	$22.55	$27.98	(19%)
Sheet Metal Workers	$22.03	$25.77	(15%)
Automotive Service Technicians and Mechanics	$21.88	$22.04	(1%)
Operating Engineers and Other Construction Equipment Operators	$21.73	$34.19	(36%)
Insulation Workers, Mechanical	$21.70	$37.07	(41%)
Installation, Maintenance, and Repair Workers, All Other	$21.68	$19.75	10%
Welders, Cutters, Solderers, and Brazers	$21.29	$20.56	4%
Carpenters	$21.18	$27.29	(22%)
Maintenance and Repair Workers, General	$21.13	$20.45	3%

Surveying and Mapping Technicians	$20.52	$32.74	(37%)
Drywall and Ceiling Tile Installers	$19.88	$26.78	(26%)
Material Moving Workers, All Other	$18.78	$13.09	43%
Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	$18.56	$20.31	(9%)
Metal Workers and Plastic Workers, All Other	$18.49	$18.95	(2%)
Roofers	$18.17	$23.82	(24%)
Laborers and Freight, Stock, and Material Movers, Hand	$18.05	$13.98	29%
Pipelayers	$17.53	$25.21	(30%)
Insulation Workers, Floor, Ceiling, and Wall	$17.49	$21.97	(20%)
Construction Laborers	$16.27	$21.12	(23%)
Helpers--Installation, Maintenance, and Repair Workers	$16.24	$14.82	10%
Miscellaneous Construction and Related Workers	$14.99	$18.86	(21%)
Helpers--Electricians	$14.92	$17.32	(14%)
Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	$14.72	$15.48	(5%)
Helpers--Carpenters	$14.68	$16.74	(12%)
Assemblers and Fabricators, All Other, Including Team Assemblers	$14.53	$14.79	(2%)
Production Workers, All Other	$14.30	$13.80	4%
Fence Erectors	$13.43	$18.10	(26%)

WORKFORCE CHARACTERISTICS

In 2019, the EPG sector employed fewer female and Hispanic or Latino workers than the California workforce averages (15 and 11 percentage points below, respectively) but more workers that identify as Two or more races and Black or African American (11 and one percentage point(s) above, respectively). Union workers made up six percent of California's EPG sector in 2019, nine percentage points lower than the California unionization rate.[29] Workers 55 and older in the EPG sector were 10 percentage points below the California workforce average.

[29] The Bureau of Labor Statistics does not publish private unionization rates at the state-level. Nationally, public unionization rates are more than five times higher than private sector rates. Energy employment is largely private, contributing to low unionization numbers.

Table 2. EPG Sector Demographics, Q4 2019

	California EPG	California Workforce Averages[30]	National EPG Averages[31]
Male	70%	55%	68%
Female	30%	45%	32%
Hispanic or Latino	26%	37%	18%
Not Hispanic or Latino	74%	63%	82%
American Indian or Alaska Native	1%	<1%	1%
Asian	12%	16%	10%
Black or African American	7%	6%	9%
Native Hawaiian or other Pacific Islander	1%	<1%	1%
White	66%	72%	69%
Two or more races	13%	2%	10%
Veterans	7%	4%	9%
55 and over	11%	21%	14%
Union	6%	15%	7%

[30] Demographics for the statewide workforce are from the Bureau of Labor Statistics, Labor Force Statistics from the Current Population Survey, 2019, and Emsi Population Demographics of California, 2019. Veterans employment is from the Bureau of Labor Statistics, 2018 Veterans News Release, 21 March 2019. https://www.bls.gov/news.release/vet.t06a.htm. Union membership is from the Bureau of Labor Statistics, 2019 Union Members News Release, 22 January 2020. https://www.bls.gov/news.release/pdf/union2.pdf.
[31] US Energy Employment Report 2020

CHAPTER 2 — FUELS

Fuels employment encompasses work related to fuel extraction, mining, and processing, including petroleum refineries and firms that support coal mining, oil, and gas field machinery manufacturing. Workers across both the forestry and agriculture sectors who support fuel production with corn ethanol, biodiesels, and fuel wood are also included in the fuel employment data.

EMPLOYMENT OVERVIEW

The Fuels sector employed just over 77,000 workers in 2019, up 2.8 percent from the previous year's level of nearly 75,000 workers. This jump exceeds the national Fuels employment growth of 1.9 percent. In the fourth quarter of 2019 - prior to widespread knowledge of COVID-19 - employers in the Fuels sector expected to see employment increase by 3.5 percent over 2020, adding approximately 2,720 new jobs for a total of 79,770 jobs.

Figure 9. Fuels Employment Growth, Q4 2018 –Q4 2020 Projected

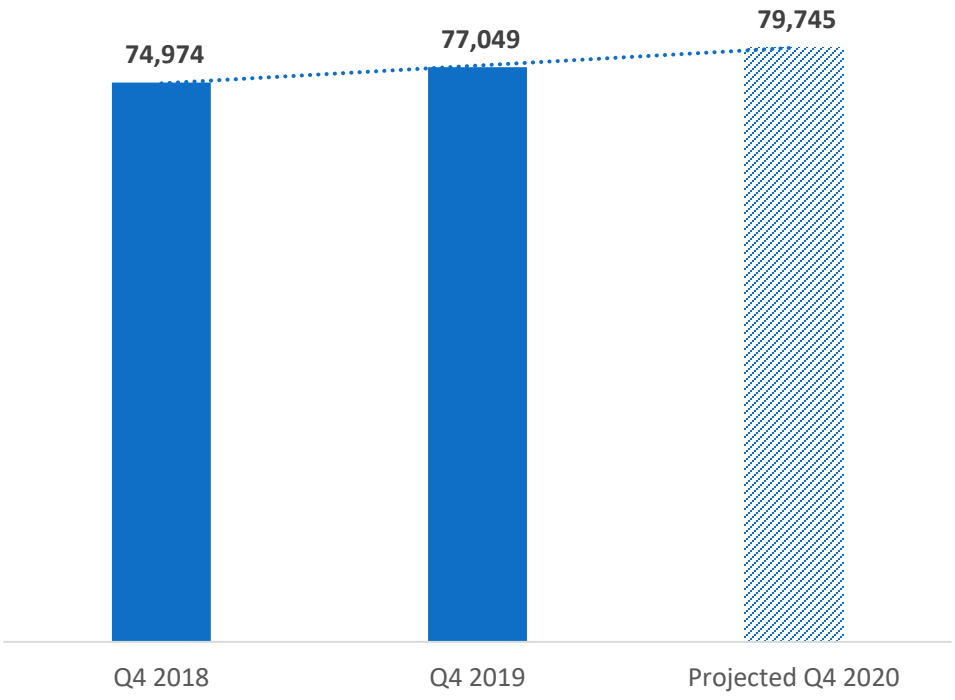
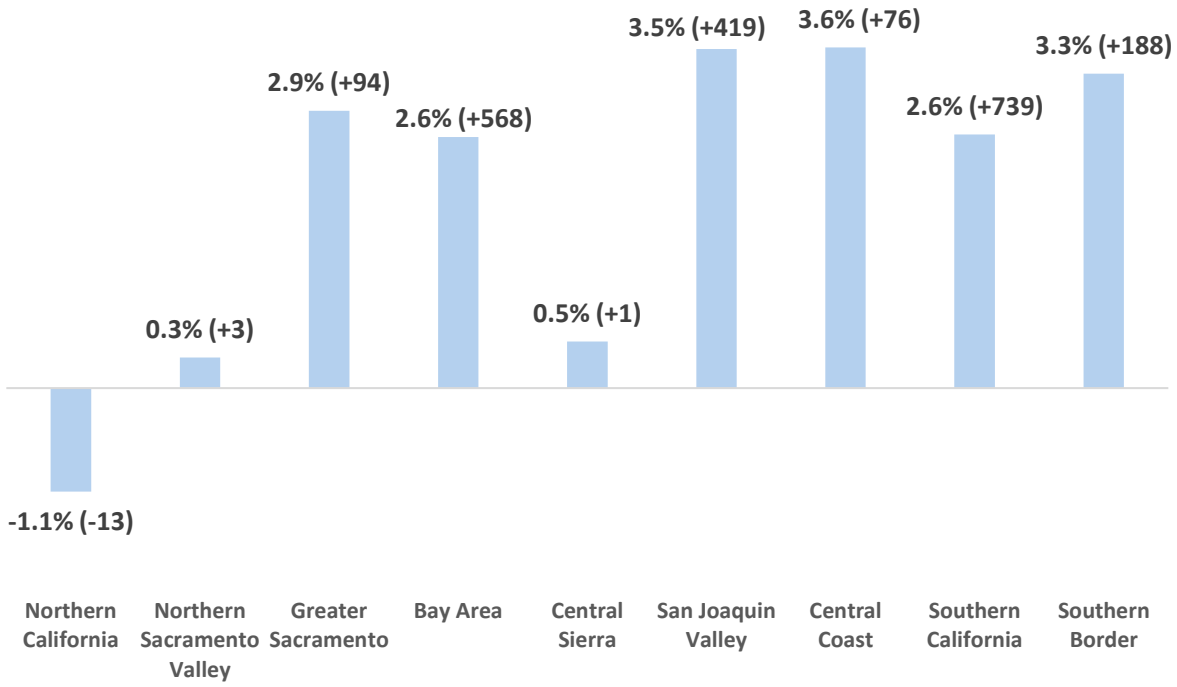


Figure 10. Fuels Employment Growth by Region, Q4 2018 – Q4 2019[32]



Professional and business service jobs comprised 35 percent of the California Fuels sector, while manufacturing jobs made up 27 percent of fuels employment in 2019. Despite overall Fuels sector employment growth in 2019, mining and extraction lost almost 800 jobs. At the same time, professional and business services added over 1,200 jobs in 2019.

Petroleum represented 74 percent of California Fuels employment in 2019. Petroleum production jobs (adding 879 jobs, or 1.6 percent) and natural gas production jobs (adding 407 jobs, or 5.3 percent) had the greatest job growth of detailed Fuels technologies, likely in professional and business services.

[32] A map of the regions, along with selected detailed technology growth, can be found in Appendix C.

Figure 11. Fuels Employment by Industry, 2018-19

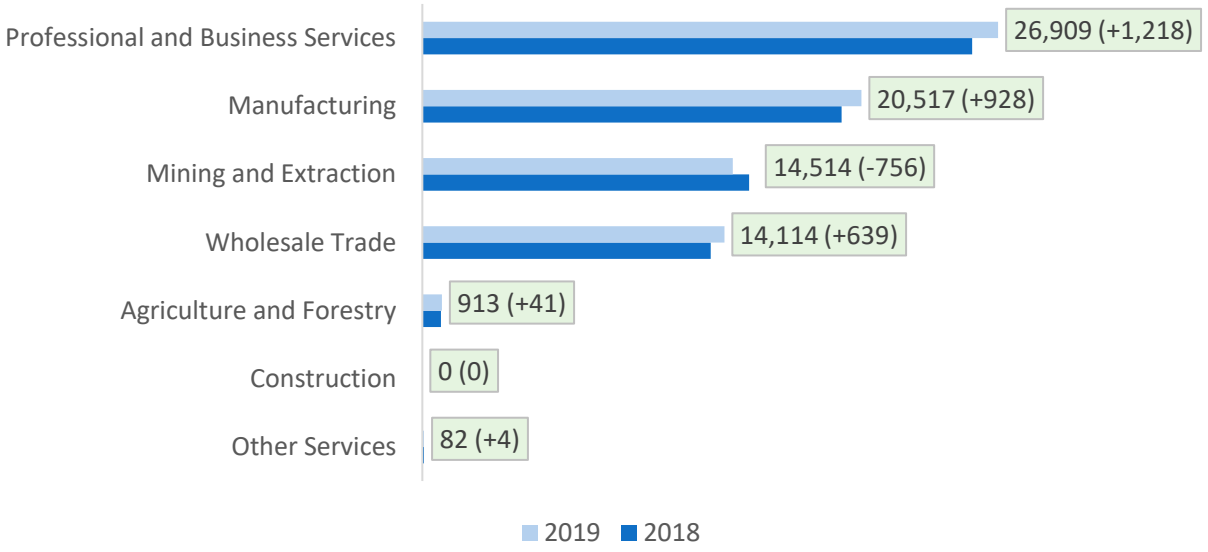
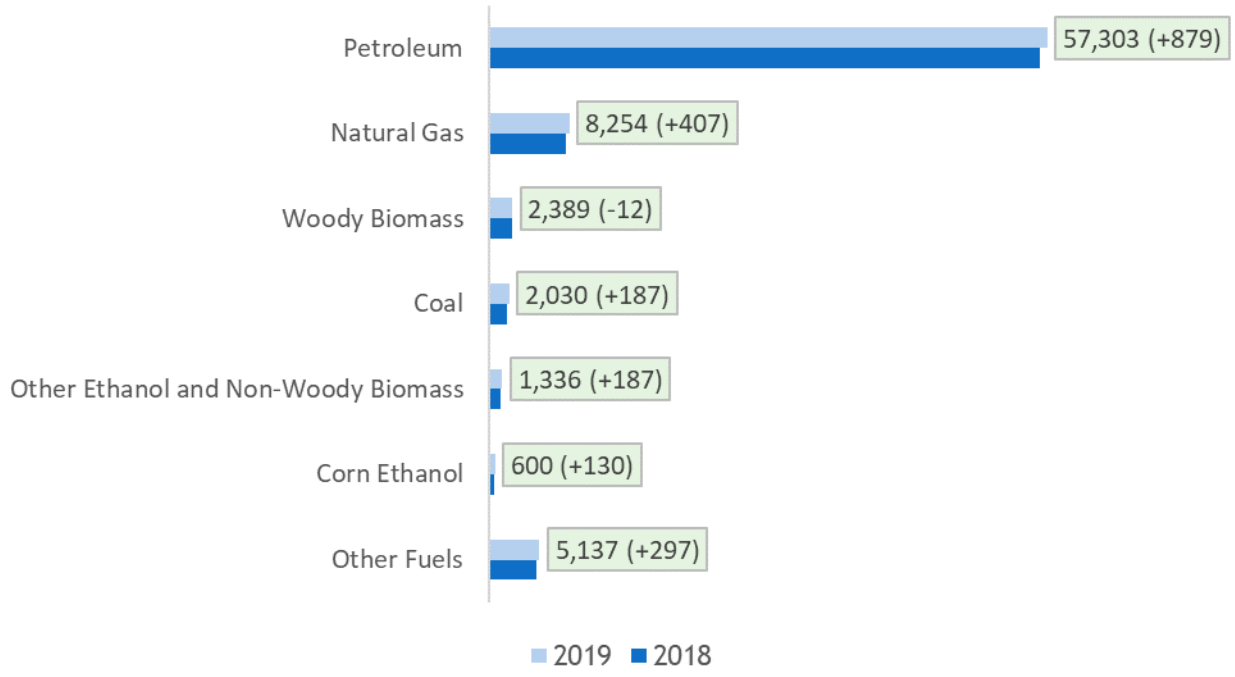


Figure 12. Fuels Employment by Detailed Technology Application, Q4 2018 – Q4 2019[33]

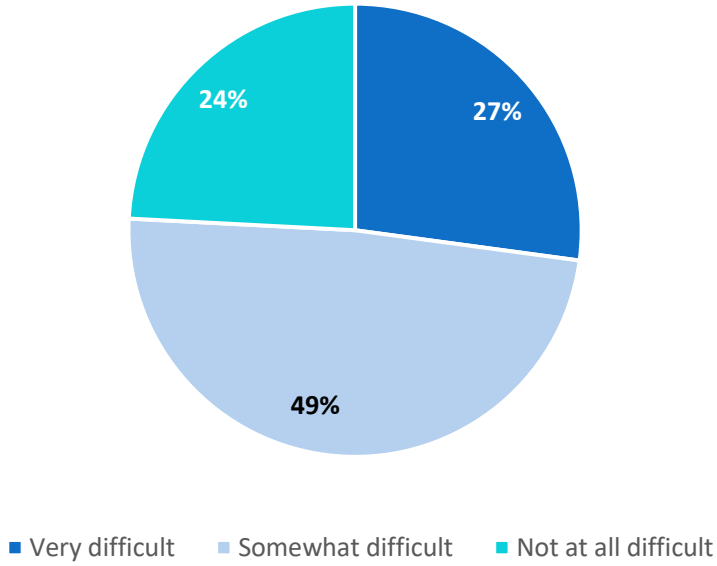


[33] "Other Fuels" includes employers that are not able to assign their workers to a single detailed technology application. We estimate that about 1500 of these employees in California work with Propane fuels while another 400 work with Hydrogen fuels.

HIRING DIFFICULTY & BUSINESS CHALLENGES

Thirty-eight percent of Fuels companies in California hired in 2019. Of these firms, over three-quarters reported hiring difficulty; 49 percent found hiring to be somewhat difficult while 27 percent found hiring to be very difficult. Twenty-four percent of employers reported no hiring difficulty in 2019. These rates were consistent with nationally reported Fuels sector hiring difficulty.[34] The top reported reason for hiring difficulty in 2019 was competition due to a small applicant pool, while the most difficult occupations to hire were drivers/dispatchers.[35]

Figure 13. Fuels Hiring Difficulty



Top Reasons for Hiring Difficulty

1. Competition/ small applicant pool
2. Difficulty finding industry-specific knowledge, skills, and interest
3. Lack of experience, training, or technical skills
4. Cannot provide competitive wages
5. Location

Top Difficult to Hire Occupations

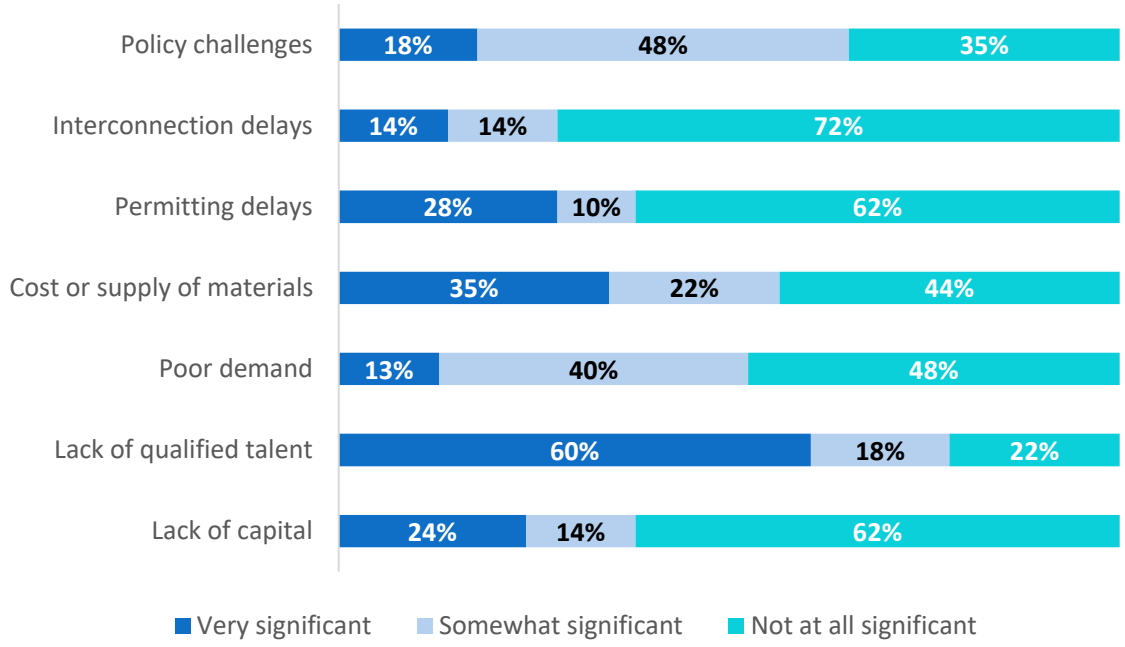
1. Drivers/dispatchers
2. Operations or business development
3. Sanitation/Maintenance

[34] USEER 2020
[35] Reasons for hiring difficulty and most difficult occupations were open-ended questions; similar answers were placed into categories, and the top reported categories are listed.

4. Sales, marketing, or customer service
5. Technician or mechanical support

The most significant reason for business growth difficulty was again a lack of qualified talent, followed by policy challenges; 78 percent and 65 percent of employers, respectively, found these factors to be very or somewhat significant in their ability to grow a profitable business. Sixty percent of firms alone found the lack of qualified talent to be a very significant reason for business growth difficulty.

Figure 14. Fuels Significance of Factors in Difficulty Growing a Profitable Business



WAGES

The following table outlines occupational wages for California's Fuel sector employees. The table is organized from highest to lowest earning jobs and provides a comparative column for California's statewide median wages for each occupation.

Table 3. Fuels Sector, Median Hourly Earnings by Occupation

Description	Fuels Earnings	CA Earnings[36]	Fuels Premium/Discount
Chief Executives	$99.65	$106.62	(7%)
Petroleum Engineers	$83.66	$63.79	31%
Engineers, All Other	$59.14	$51.59	15%
General and Operations Managers	$53.04	$54.86	(3%)

[36] EMSI 2019 Annual Earnings with assumed 2,080 annual work hours

Construction Managers	$51.25	$51.47	0%
Information Security Analysts	$50.57	$52.50	(4%)
Computer Occupations, All Other	$46.42	$47.12	(1%)
Electrical Power-Line Installers and Repairers	$39.87	$49.15	(19%)
Gas Compressor and Gas Pumping Station Operators	$39.08	$33.31	17%
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	$38.49	$39.01	(1%)
Business Operations Specialists, All Other	$37.60	$36.09	4%
Accountants and Auditors	$35.18	$36.39	(3%)
First-Line Supervisors of Mechanics, Installers, and Repairers	$32.18	$36.97	(13%)
Control and Valve Installers and Repairers, Except Mechanical Door	$31.53	$30.43	4%
Wind Turbine Service Technicians	$30.57	$27.08	13%
Engineering Technicians, Except Drafters, All Other	$30.53	$33.63	(9%)
First-Line Supervisors of Construction Trades and Extraction Workers	$30.05	$37.71	(20%)
First-Line Supervisors of Production and Operating Workers	$29.59	$30.11	(2%)
Industrial Machinery Mechanics	$29.42	$27.40	7%
Continuous Mining Machine Operators	$29.35	$21.78	35%
Rotary Drill Operators, Oil and Gas	$28.95	$30.26	(4%)
Boilermakers	$27.98	$33.94	(18%)
Dredge Operators	$27.13	$28.76	(6%)
Explosives Workers, Ordnance Handling Experts, and Blasters	$26.84	$32.99	(19%)
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	$26.77	$26.51	1%
Production, Planning, and Expediting Clerks	$26.67	$23.83	12%
Service Unit Operators, Oil, Gas, and Mining	$25.76	$27.24	(5%)
Drafters, All Other	$25.05	$26.60	(6%)
Electricians	$24.84	$30.89	(20%)
Derrick Operators, Oil and Gas	$24.82	$24.41	2%
Structural Iron and Steel Workers	$24.30	$31.98	(24%)
Plumbers, Pipefitters, and Steamfitters	$24.27	$27.05	(10%)
Heavy and Tractor-Trailer Truck Drivers	$24.03	$22.01	9%
Bookkeeping, Accounting, and Auditing Clerks	$23.57	$22.28	6%
Brickmasons and Blockmasons	$22.93	$27.45	(16%)
Meter Readers, Utilities	$22.61	$27.98	(19%)
Installation, Maintenance, and Repair Workers, All Other	$22.10	$19.75	12%
Sheet Metal Workers	$21.82	$25.77	(15%)
Maintenance and Repair Workers, General	$21.54	$20.45	5%
Operating Engineers and Other Construction Equipment Operators	$21.52	$34.19	(37%)
Insulation Workers, Mechanical	$21.49	$37.07	(42%)

Surveying and Mapping Technicians	$21.44	$32.74	(35%)
Carpenters	$20.98	$27.29	(23%)
Welders, Cutters, Solderers, and Brazers	$20.46	$20.56	0%
Roustabouts, Oil and Gas	$20.23	$16.13	25%
Drywall and Ceiling Tile Installers	$19.69	$26.78	(26%)
Helpers--Extraction Workers	$19.57	$19.00	3%
Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	$18.56	$20.31	(9%)
Roofers	$18.00	$23.82	(24%)
Metal Workers and Plastic Workers, All Other	$17.77	$18.95	(6%)
Material Moving Workers, All Other	$17.63	$13.09	35%
Pipelayers	$17.36	$25.21	(31%)
Insulation Workers, Floor, Ceiling, and Wall	$17.32	$21.97	(21%)
Laborers and Freight, Stock, and Material Movers, Hand	$16.94	$13.98	21%
Helpers--Installation, Maintenance, and Repair Workers	$16.56	$14.82	12%
Construction Laborers	$16.12	$21.12	(24%)
Helpers--Electricians	$15.08	$17.32	(13%)
Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	$14.87	$15.48	(4%)
Helpers--Carpenters	$14.83	$16.74	(11%)
Assemblers and Fabricators, All Other, Including Team Assemblers	$14.53	$14.79	(2%)
Production Workers, All Other	$14.30	$13.80	4%
Driver/Sales Workers	$13.59	$15.84	(14%)

WORKFORCE CHARACTERISTICS

In 2019, the Fuels sector employed substantially fewer female (26 percent) and Hispanic or Latino workers (23 percent) than the California workforce averages (45 percent and 37 percent respectively). Union workers represented four percent of California's Fuels industry in 2019, eleven percentage points below the California average. Veteran employment exceeded the California workforce average by four percentage points.

Table 4. Fuels Sector Demographics, Q4 2019

	California Fuels	California Workforce Averages[37]	National Fuels Averages[38]
Male	74%	55%	75%
Female	26%	45%	25%
Hispanic or Latino	23%	37%	12%
Not Hispanic or Latino	77%	63%	88%
American Indian or Alaska Native	1%	<1%	2%
Asian	9%	16%	5%
Black or African American	5%	6%	7%
Native Hawaiian or other Pacific Islander	1%	<1%	1%
White	70%	72%	77%
Two or more races	13%	2%	8%
Veterans	8%	4%	10%
55 and over	15%	21%	21%
Union	4%	15%	3%

[37] Demographics for the statewide workforce are from the Bureau of Labor Statistics, Labor Force Statistics from the Current Population Survey, 2019, and Emsi Population Demographics of California, 2019. Veterans employment is from the Bureau of Labor Statistics, 2018 Veterans News Release, 21 March 2019. https://www.bls.gov/news.release/vet.t06a.htm. Union membership is from the Bureau of Labor Statistics, 2019 Union Members News Release, 22 January 2020. https://www.bls.gov/news.release/pdf/union2.pdf.
[38] US Energy Employment Report 2020

CHAPTER 3 — TRANSMISSION, DISTRIBUTION AND STORAGE

Transmission, Distribution, and Storage (TDS) encompasses the employment associated with constructing, operating, and maintaining the state's energy infrastructure. It includes workers associated with the entire network of power lines that transmit electricity from generating stations to customers, as well as activities that support power and pipeline construction, fuel distribution and transport, and the manufacture of electrical transmission equipment. However, similar to the USEER, the CAEER does not include gas station employment in this analysis.

EMPLOYMENT OVERVIEW

The Transmission, Distribution, and Storage sector employed more than 152,200 workers in 2019, relatively unchanged from previous year employment. This stagnation comes despite employment growth of 2.1 percent nationally. In the fourth quarter of 2019 - prior to widespread knowledge of COVID-19 - TDS employers expected to add jobs at a 4.6 percent growth in 2020 (7,000 new jobs).

Figure 15. TDS Employment Growth, Q4 2018 –Q4 2020 Projected

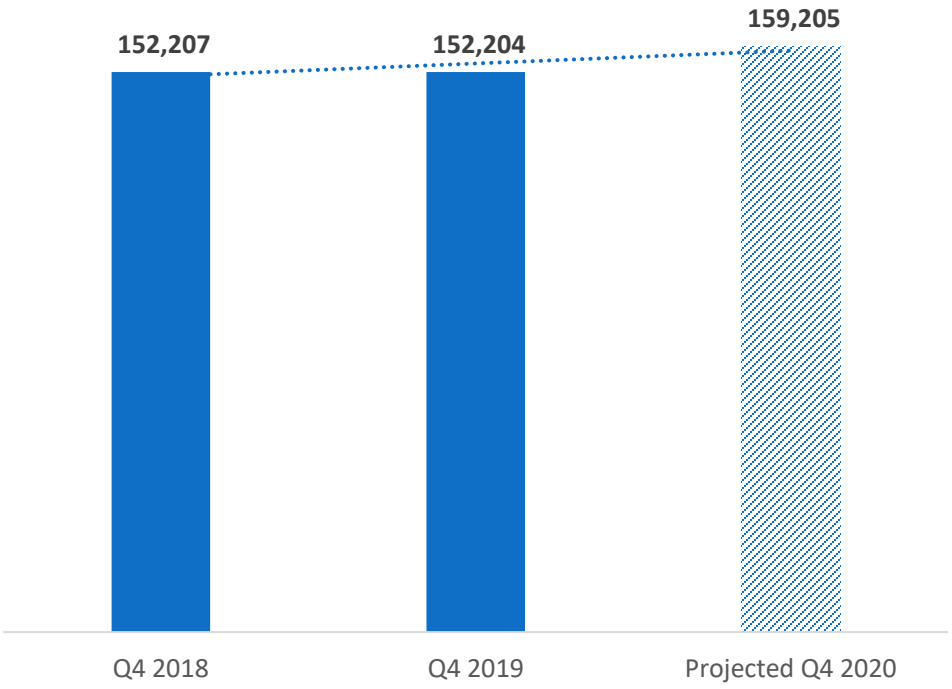
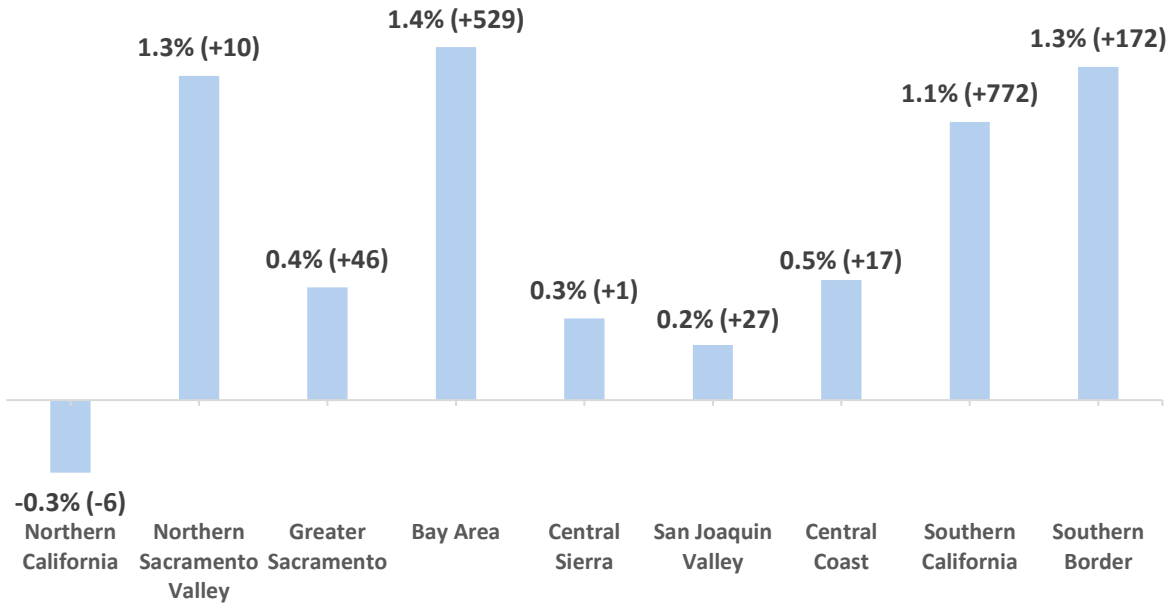


Figure 16. TDS Employment Growth by Region, Q4 2018 – Q4 2019[39]



Construction jobs comprised 32 percent of the California TDS sector in 2019, followed by utilities jobs at 26 percent. Utilities employment increased by 1,200 jobs (3.1 percent) in 2019, while wholesale trade and distribution decreased by 600 jobs.

Traditional TDS jobs – which include the manufacture, construction, repair and operation of traditional electrical, natural gas, and petroleum transmission and distribution systems – represented 67 percent of California EPG employment in 2019. As shown in Figure 16, the 2020 CAEER found no substantial changes in 2019 for TDS jobs by detailed technology. California lost 950 traditional TDS jobs (less than one percent) for a total of 102,650 jobs, but the state gained jobs in all other TDS technologies.

[39] A map of the regions, along with selected detailed technology growth, can be found in Appendix C.

Figure 17. TDS Employment by Industry, Q4 2018 – Q4 2019

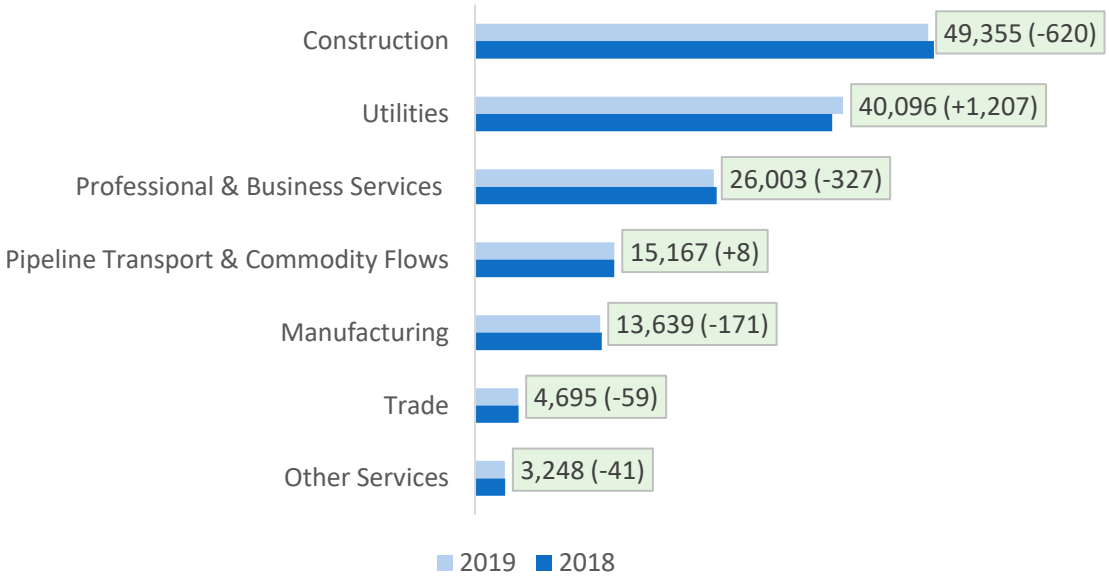
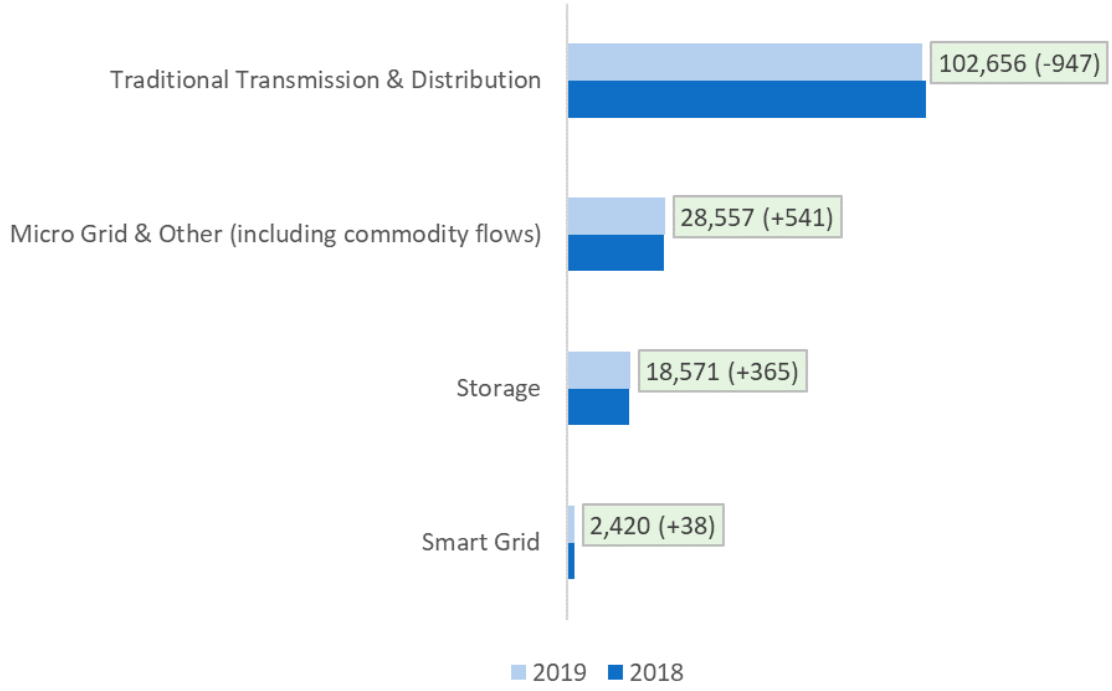
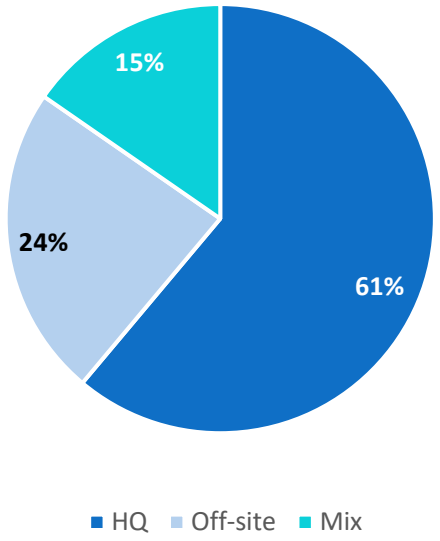


Figure 18. TDS Employment by Detailed Technology Application, Q4 2018 – Q4 2019



An estimated 61 percent of utility employees within TDS worked at utility headquarters, while 24 percent worked off-site.[40] Workers at headquarters are typically positions like Chief Executives and Business Operations Specialists, while off-site workers are more likely to hold positions like Meter Readers and Electrical Power-Line Installers & Repairers.

Figure 19. TDS Utility Employment by Location



HIRING DIFFICULTY & BUSINESS CHALLENGES

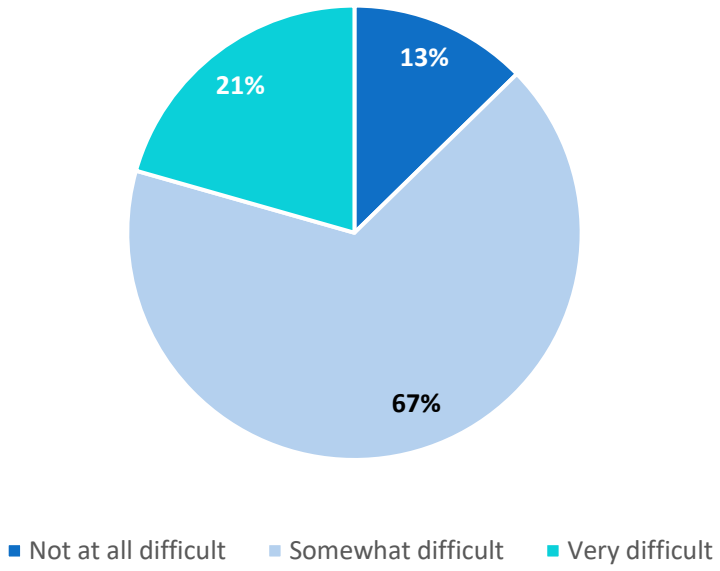
Thirty-five percent of TDS companies in California hired in 2019. These firms reported greater hiring difficulty than the national rates. Two-thirds found of firms found hiring to be somewhat difficult (9 points higher than the national rate), while about one-fifth found it to be very difficult (roughly equivalent to the national rate).[41] Thirteen percent of employers did not find hiring to be difficult in 2019. The top reported reasons for hiring difficulty in 2019 were lack of experience, training, or technical skills and difficulty finding industry-specific knowledge, skills, and interest, while the most difficult occupations to hire were engineers/scientists. [42]

[40] Staffing pattern analysis was completed using EMSI 2019 data on Standard Occupational Classification (SOC) employment concentration within Utilities.

[41] USEER 2020

[42] Reasons for hiring difficulty and most difficult occupations were open-ended questions; similar answers were placed into categories, and the top reported categories are listed.

Figure 20. TDS Hiring Difficulty



Top Reasons for Hiring Difficulty

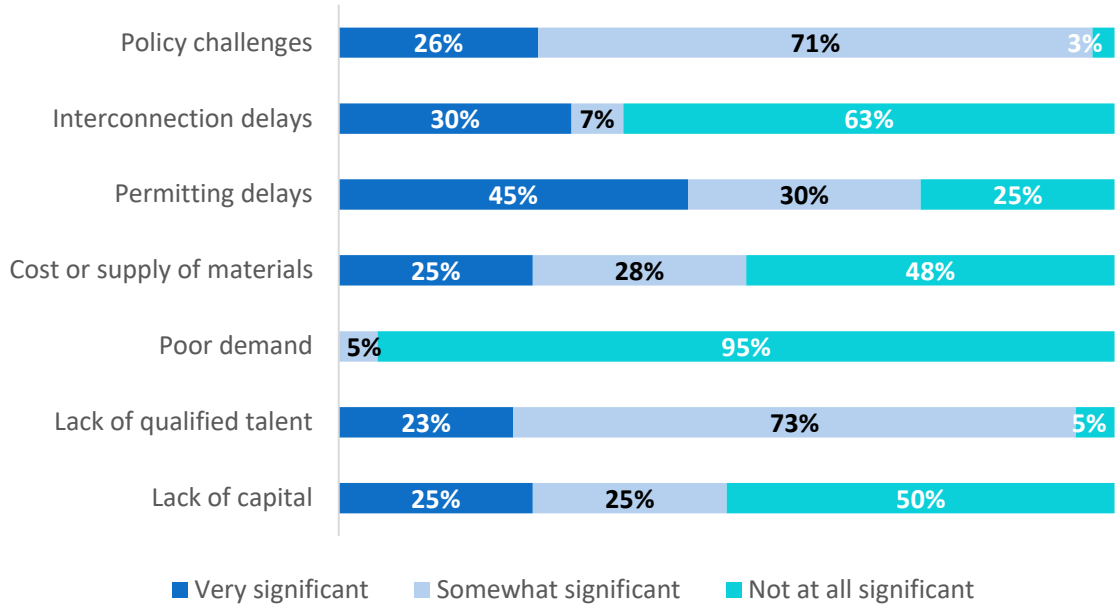
1. Lack of experience, training, or technical skills
2. Difficulty finding industry-specific knowledge, skills, and interest
3. Insufficient qualifications (certifications or education
4. Cannot provide competitive wages
5. Location

Top Difficult to Hire Occupations

1. Engineers/scientists
2. Technician or mechanical support
3. Installation workers
4. Management; directors, supervisors, vice presidents
5. Operations or business development

Ninety-five percent of TDS employers in California cited lack of qualified talent as a very or somewhat signficant reason for business growth difficulty, surpassed only by policy challenges at 97 percent. Policy challenges cited by respondents include confusion and uncertainty around rebates, tax credits, and tariffs. Forty-five percent of TDS employers, meanwhile, found permitting delays to be a very significant factor in slowing business growth.

Figure 21. TDS Significance of Factors in Difficulty Growing a Profitable Business



WAGES

The following table outlines occupational wages for California's TDS sector employees. The table is organized from highest to lowest earning jobs and provides a comparative column for California's statewide median wages for each occupation.

Table 5. TDS Sector Top Earners, Median Hourly Earnings

Description	TDS Earnings	CA Earnings[43]	TDS Premium/Discount
Chief Executives	$101.10	$106.62	(5%)
Petroleum Engineers	$66.11	$63.79	4%
Electrical and Electronics Repairers, Powerhouse, Substation, and Relay	$64.34	$48.21	33%
General and Operations Managers	$53.82	$54.86	(2%)
Information Security Analysts	$51.37	$52.50	(2%)
Construction Managers	$50.31	$51.47	(2%)
Power Distributors and Dispatchers	$47.94	$40.33	19%
Computer Occupations, All Other	$47.16	$47.12	0%
Engineers, All Other	$46.73	$51.59	(9%)
Power Plant Operators	$44.16	$45.84	(4%)
Gas Compressor and Gas Pumping Station Operators	$41.89	$33.31	26%

[43] EMSI 2019 Annual Earnings with assumed 2,080 annual work hours

Gas Plant Operators	$39.43	$49.95	(21%)
Electrical Power-Line Installers and Repairers	$38.54	$49.15	(22%)
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	$36.46	$39.01	(7%)
Accountants and Auditors	$34.02	$36.39	(7%)
First-Line Supervisors of Mechanics, Installers, and Repairers	$31.84	$36.97	(14%)
Plant and System Operators, All Other	$31.68	$31.53	0%
Control and Valve Installers and Repairers, Except Mechanical Door	$30.48	$30.43	0%
Mobile Heavy Equipment Mechanics, Except Engines	$29.68	$30.55	(3%)
First-Line Supervisors of Construction Trades and Extraction Workers	$29.59	$37.71	(22%)
Wind Turbine Service Technicians	$29.55	$27.08	9%
Dredge Operators	$29.07	$28.76	1%
Industrial Machinery Mechanics	$28.45	$27.40	4%
Boilermakers	$28.14	$33.94	(17%)
First-Line Supervisors of Production and Operating Workers	$28.10	$30.11	(7%)
Bus and Truck Mechanics and Diesel Engine Specialists	$27.06	$26.36	3%
Production, Planning, and Expediting Clerks	$26.73	$23.83	12%
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	$25.88	$26.51	(2%)
Electricians	$24.98	$30.89	(19%)
Structural Iron and Steel Workers	$24.44	$31.98	(24%)
Automotive Body and Related Repairers	$24.44	$23.48	4%
Plumbers, Pipefitters, and Steamfitters	$24.41	$27.05	(10%)
Automotive Service Technicians and Mechanics	$23.27	$22.04	6%
Bookkeeping, Accounting, and Auditing Clerks	$23.12	$22.28	4%
Brickmasons and Blockmasons	$23.06	$27.45	(16%)
Meter Readers, Utilities	$22.67	$27.98	(19%)
Sheet Metal Workers	$21.94	$25.77	(15%)
Operating Engineers and Other Construction Equipment Operators	$21.64	$34.19	(37%)
Insulation Workers, Mechanical	$21.61	$37.07	(42%)
Installation, Maintenance, and Repair Workers, All Other	$21.37	$19.75	8%
Carpenters	$21.09	$27.29	(23%)
Welders, Cutters, Solderers, and Brazers	$21.02	$20.56	2%
Maintenance and Repair Workers, General	$20.83	$20.45	2%
Drywall and Ceiling Tile Installers	$19.80	$26.78	(26%)
Material Moving Workers, All Other	$18.89	$13.09	44%
Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	$18.36	$20.31	(10%)

Metal Workers and Plastic Workers, All Other	$18.25	$18.95	(4%)
Laborers and Freight, Stock, and Material Movers, Hand	$18.16	$13.98	30%
Roofers	$18.10	$23.82	(24%)
Pipelayers	$17.46	$25.21	(31%)
Insulation Workers, Floor, Ceiling, and Wall	$17.42	$21.97	(21%)
Construction Laborers	$16.21	$21.12	(23%)
Helpers--Installation, Maintenance, and Repair Workers	$16.01	$14.82	8%
Helpers--Electricians	$15.18	$17.32	(12%)
Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	$14.97	$15.48	(3%)
Helpers--Carpenters	$14.93	$16.74	(11%)
Miscellaneous Construction and Related Workers	$14.83	$18.86	(21%)
Assemblers and Fabricators, All Other, Including Team Assemblers	$14.53	$14.79	(2%)
Fence Erectors	$13.28	$18.10	(27%)
Production Workers, All Other	$12.72	$13.80	(8%)

WORKFORCE CHARACTERISTICS

In 2019, the TDS sector employed fewer female and Hispanic or Latino workers than the California workforce averages (19 and 11 percentage points below, respectively) but more workers that identify as Two or more races and Black or African American (11 and one percentage points above, respectively). The sector was the most unionized of the energy sectors, though remained four percentage points below the California average. Workers 55 and older represent nine fewer percentage points of TDS employment than the California workforce average.

Table 6. TDS Sector Demographics, Q4 2019

	California TDS	California Workforce Averages[44]	National TDS Averages[45]
Male	74%	55%	76%
Female	26%	45%	24%
Hispanic or Latino	26%	37%	17%
Not Hispanic or Latino	74%	63%	83%
American Indian or Alaska Native	2%	<1%	2%

[44] Demographics for the statewide workforce are from the Bureau of Labor Statistics, Labor Force Statistics from the Current Population Survey, 2019, and Emsi Population Demographics of California, 2019. Veterans employment is from the Bureau of Labor Statistics, 2018 Veterans News Release, 21 March 2019. https://www.bls.gov/news.release/vet.t06a.htm. Union membership is from the Bureau of Labor Statistics, 2019 Union Members News Release, 22 January 2020. https://www.bls.gov/news.release/pdf/union2.pdf.
[45] US Energy Employment Report 2020

Asian	11%	16%	9%
Black or African American	7%	6%	10%
Native Hawaiian or other Pacific Islander	1%	<1%	1%
White	66%	72%	69%
Two or more races	13%	2%	9%
Veterans	6%	4%	8%
55 and over	13%	21%	18%
Union	11%	15%	17%

CHAPTER 4 — ENERGY EFFICIENCY

Energy Efficiency employment covers both the production and installation of energy-saving products and the provision of services that reduce end-use energy consumption. For the purpose of this report, Energy Efficiency jobs include the manufacture of ENERGY STAR®-labeled products, as well as building design and contracting services that provide insulation, improvement of natural lighting, and reduction of overall energy consumption across homes and businesses.

EMPLOYMENT OVERVIEW

The Energy Efficiency (EE) sector employed over 323,500 workers in 2019, compared to the previous year's level of 318,500 workers, a growth rate of 1.6 percent (compared to 2.3 percent nationally). In the fourth quarter of 2019 - prior to widespread knowledge of COVID-19 - employers in the EE sector expected to see employment increase by 4.7 percent in 2020, adding approximately 15,150 new jobs.

Figure 22. Energy Efficiency Employment Growth, Q4 2018 –Q4 2020 Projected

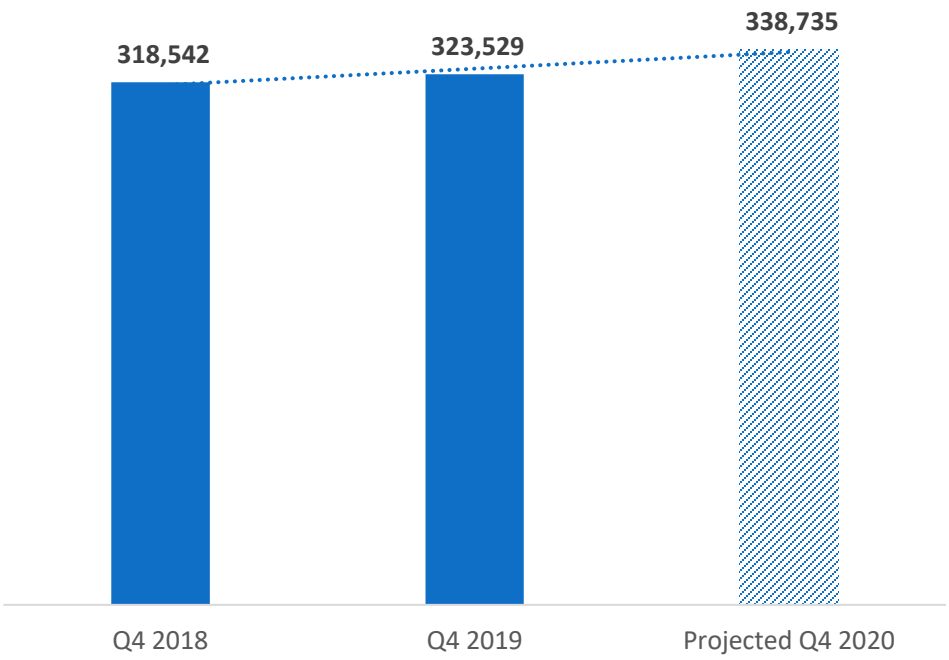
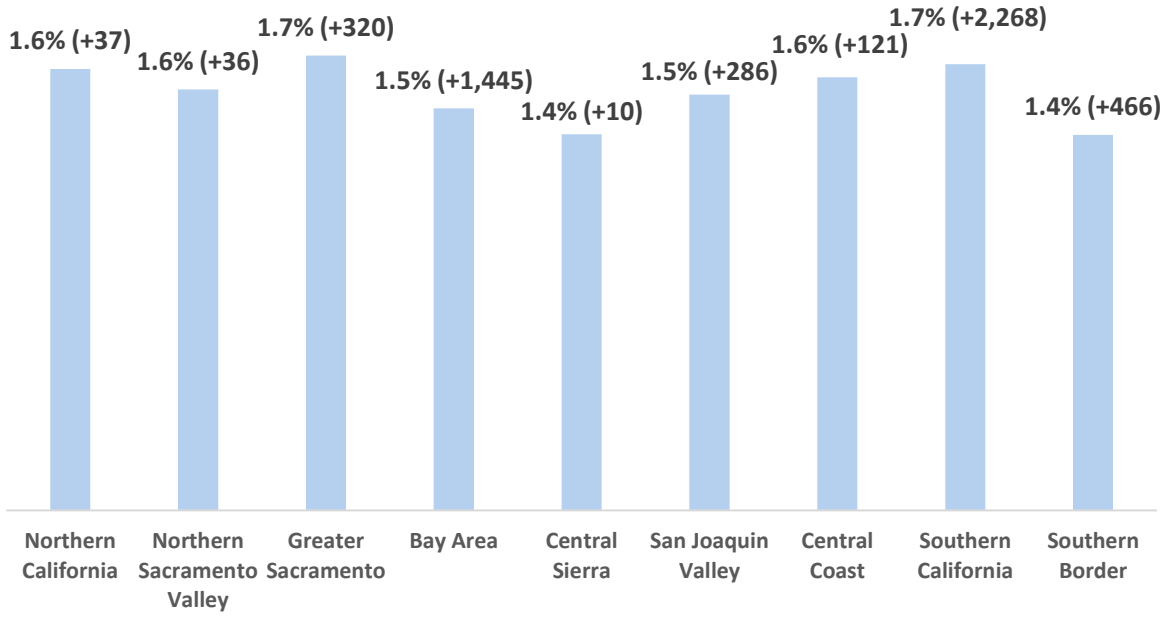


Figure 23. EE Employment Growth by Region, Q4 2018 – Q4 2019[46]



Construction jobs comprised 52 percent of the California EE sector, while professional and business services jobs made up more than 27 percent of EE employment in 2019. Construction employment increased by over 3,300 jobs in 2019, while professional and business services increased by nearly 1,800 jobs. The increase in construction employment was likely aided by 2019 improvements to the Building Energy Efficiency Standards. The only decline across all EE industries was a one percent drop in Manufacturing employment (318 jobs).

Traditional HVAC jobs represented the largest sector with 38 percent of California EE employment in 2019. ENERGY STAR & Efficient Lighting made up 23 percent of the California EE workforce, and High Efficiency HVAC & Renewable Heating and Cooling made up 20 percent. The 2020 CAEER found a large increase in 2019 for Advanced Material EE employment (adding 1,600 jobs, or 8.2 percent). In general, likely due to ambitious energy efficiency policies, ENERGY STAR & Efficient Lighting, High Efficiency HVAC and Renewable Heating & Cooling, and Advanced Materials all grew in employment at higher rates than Traditional HVAC.

[46] A map of the regions, along with selected detailed technology growth, can be found in Appendix C.

Figure 24. Energy Efficiency Employment by Industry, Q4 2018 – Q4 2019

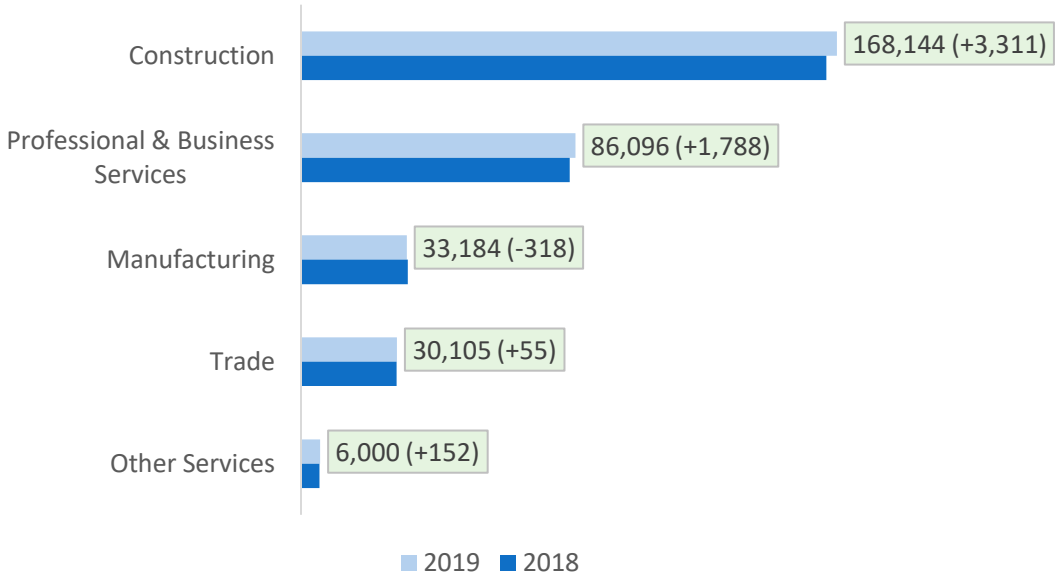
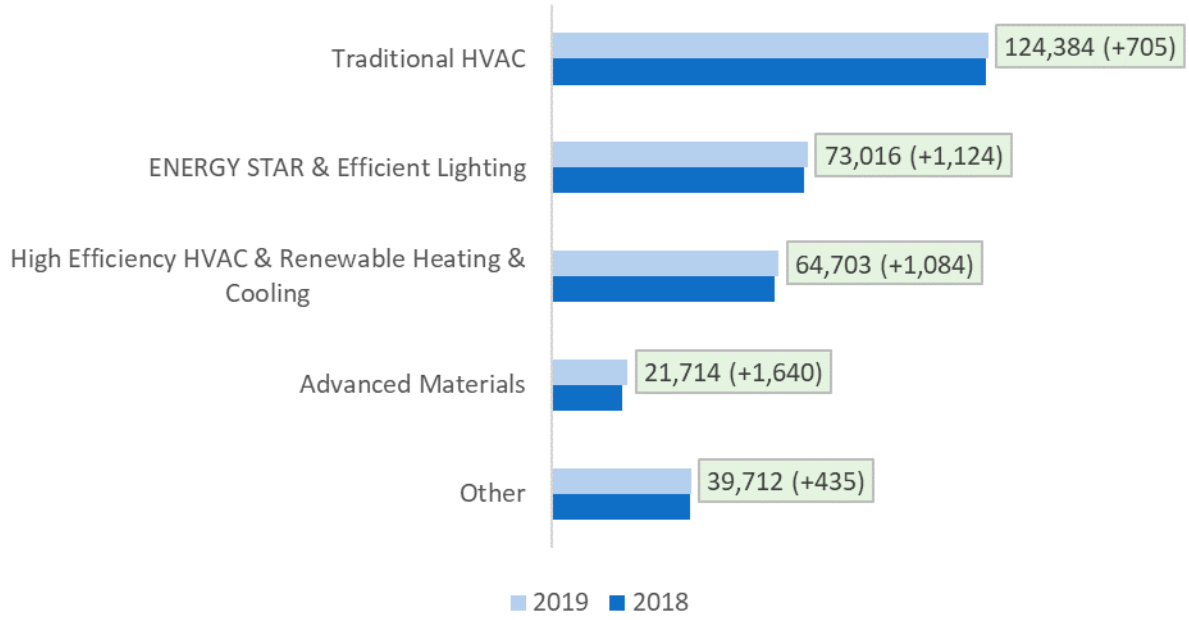


Figure 25. Energy Efficiency Employment by Detailed Technology Application, Q4 2018 – Q4 2019

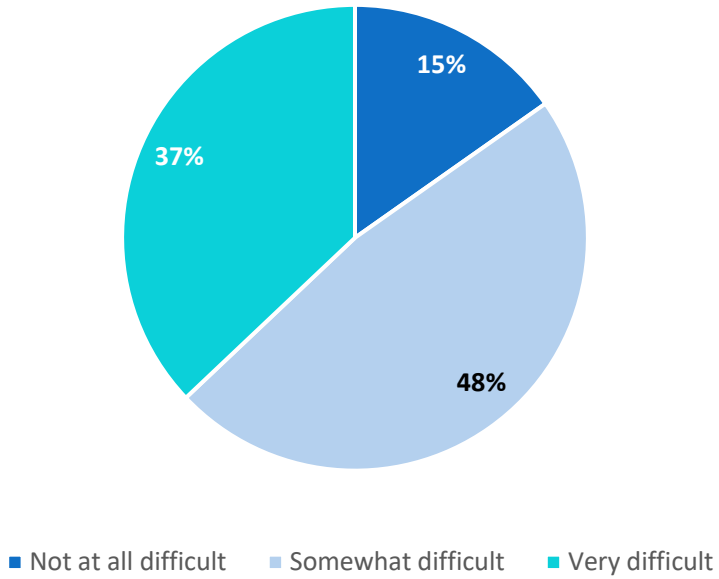


HIRING DIFFICULTY & BUSINESS CHALLENGES

Of the EE companies in California that hired in 2019 (35 percent of EE firms), 48 percent found hiring to be somewhat difficult, while 37 percent found it to be very difficult. Only 15 percent of firms did not find hiring to be difficult at all. These rates were consistent with nationally reported EE sector hiring

difficulty.[47] The top reported reason for hiring difficulty in 2019 was a lack of experience, training, or technical skills, while the most difficult occupations to hire were installation workers, followed by engineers/scientists. [48]

Figure 26. Energy Efficiency Hiring Difficulty



Top Reasons for Hiring Difficulty

1. Lack of experience, training, or technical skills
2. Competition/ small applicant pool
3. Insufficient non-technical skills; work ethic, dependability, critical thinking
4. Insufficient qualifications; certifications or education
5. Cannot provide competitive wages

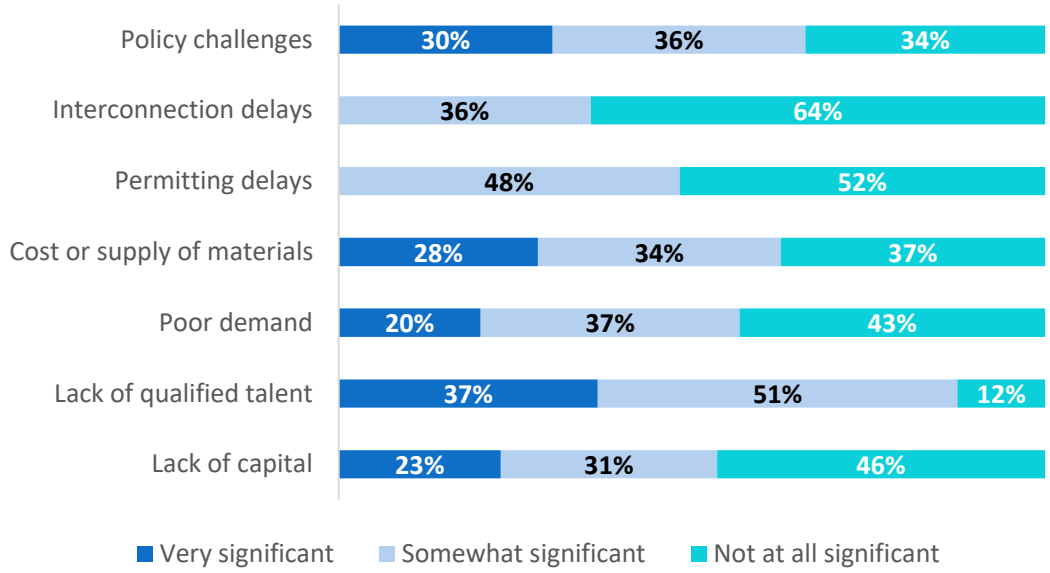
Top Difficult to Hire Occupations

1. Installation workers
2. Engineers/scientists
3. Sales, marketing, or customer service
4. Electrician/construction workers
5. Technician or mechanical support

[47] USEER 2020
[48] Reasons for hiring difficulty and most difficult occupations were open-ended questions; similar answers were placed into categories, and the top reported categories are listed.

The most significant reason for business growth difficulty was again a lack of qualified talent, with 88 percent of employers finding it to be a very or somewhat significant factor; this share is 22 points higher than the next most cited reason for difficulty, policy challenges. In reference to policy challenges, one Energy Efficiency firm explained: "there is a lot of bureaucratic red-tape to get through to get projects off the ground, especially when utility companies are involved."

Figure 27. EE Significance of Factors in Difficulty Growing a Profitable Business



WAGES

The following table outlines occupational wages for California's EE sector employees. The table is organized from highest to lowest earning jobs and provides a comparative column for California's statewide median wages for each occupation.

Table 7. EE Sector Top Earners, Median Hourly Earnings

Description	EE Earnings	CA Earnings[49]	EE Premium/Discount
Chief Executives	$101.53	$106.62	(5%)
Petroleum Engineers	$66.84	$63.79	5%
General and Operations Managers	$54.05	$54.86	(1%)
Information Security Analysts	$51.06	$52.50	(3%)
Construction Managers	$49.14	$51.47	(5%)
Engineers, All Other	$47.25	$51.59	(8%)
Computer Occupations, All Other	$46.87	$47.12	(1%)

[49] EMSI 2019 Annual Earnings with assumed 2,080 annual work hours

Electrical Power-Line Installers and Repairers	$39.60	$49.15	(19%)
Business Operations Specialists, All Other	$37.10	$36.09	3%
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products	$35.79	$39.01	(8%)
Accountants and Auditors	$34.70	$36.39	(5%)
Gas Compressor and Gas Pumping Station Operators	$33.90	$33.31	2%
First-Line Supervisors of Mechanics, Installers, and Repairers	$32.42	$36.97	(12%)
First-Line Supervisors of Production and Operating Workers	$31.45	$30.11	4%
Control and Valve Installers and Repairers, Except Mechanical Door	$31.31	$30.43	3%
Wind Turbine Service Technicians	$30.36	$27.08	12%
First-Line Supervisors of Construction Trades and Extraction Workers	$29.82	$37.71	(21%)
Industrial Machinery Mechanics	$29.22	$27.40	7%
Boilermakers	$28.54	$33.94	(16%)
Production, Planning, and Expediting Clerks	$27.69	$23.83	16%
Heating, Air Conditioning, and Refrigeration Mechanics and Installers	$26.59	$26.51	0%
Electricians	$25.34	$30.89	(18%)
Structural Iron and Steel Workers	$24.78	$31.98	(22%)
Plumbers, Pipefitters, and Steamfitters	$24.76	$27.05	(8%
Dredge Operators	$23.53	$28.76	(18%)
Meter Readers, Utilities	$23.48	$27.98	(16%)
Brickmasons and Blockmasons	$23.39	$27.45	(15%)
Bookkeeping, Accounting, and Auditing Clerks	$23.01	$22.28	3%
Sheet Metal Workers	$22.25	$25.77	(14%)
Installation, Maintenance, and Repair Workers, All Other	$21.95	$19.75	11%
Operating Engineers and Other Construction Equipment Operators	$21.95	$34.19	(36%)
Insulation Workers, Mechanical	$21.92	$37.07	(41%)
Maintenance and Repair Workers, General	$21.40	$20.45	5%
Carpenters	$21.39	$27.29	(22%)
Welders, Cutters, Solderers, and Brazers	$21.24	$20.56	3%
Drywall and Ceiling Tile Installers	$20.09	$26.78	(25%)
Metal Workers and Plastic Workers, All Other	$18.45	$18.95	(3%)
Roofers	$18.36	$23.82	(23%)
Secretaries and Administrative Assistants, Except Legal, Medical, and Executive	$18.11	$20.31	(11%)
Pipelayers	$17.71	$25.21	(30%)
Insulation Workers, Floor, Ceiling, and Wall	$17.67	$21.97	(20%)
Helpers--Installation, Maintenance, and Repair Workers	$16.45	$14.82	11%
Construction Laborers	$16.44	$21.12	(22%)

Assemblers and Fabricators, All Other, Including Team Assemblers	$15.38	$14.79	4%
Material Moving Workers, All Other	$15.29	$13.09	17%
Helpers--Electricians	$15.09	$17.32	(13%)
Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters	$14.88	$15.48	(4%)
Helpers--Carpenters	$14.84	$16.74	(11%)
Laborers and Freight, Stock, and Material Movers, Hand	$14.69	$13.98	5%
Miscellaneous Construction and Related Workers	$14.47	$18.86	(23%)
Production Workers, All Other	$14.22	$13.80	3%
Fence Erectors	$12.96	$18.10	(28%)

WORKFORCE CHARACTERISTICS

Twenty-six percent of jobs in the EE sector were held by women, compared to 45 percent across the statewide workforce. Hispanic or Latino workers in EE were similarly underrepresented, 12 percentage points below the California average. Union workers made up eight percent of the EE workforce, seven percentage points lower than the California workforce average. Workers 55 and older in the EE sector were 10 percent below the California workforce average, while veterans were three percentage points higher.

Table 8. EE Sector Demographics, Q4 2019

	California EE	California Workforce Averages[50]	National EE Averages[51]
Male	74%	55%	75%
Female	26%	45%	25%
Hispanic or Latino	25%	37%	15%
Not Hispanic or Latino	75%	63%	85%
American Indian or Alaska Native	1%	<1%	1%
Asian	9%	16%	6%
Black or African American	6%	6%	8%
Native Hawaiian or other Pacific Islander	1%	<1%	1%
White	70%	72%	77%

[50] Demographics for the statewide workforce are from the Bureau of Labor Statistics, Labor Force Statistics from the Current Population Survey, 2019, and Emsi Population Demographics of California, 2019. Veterans employment is from the Bureau of Labor Statistics, 2018 Veterans News Release, 21 March 2019. https://www.bls.gov/news.release/vet.t06a.htm. Union membership is from the Bureau of Labor Statistics, 2019 Union Members News Release, 22 January 2020. https://www.bls.gov/news.release/pdf/union2.pdf.
[51] US Energy Employment Report 2020

Two or more races	12%	2%	7%
Veterans	7%	4%	9%
55 and over	11%	21%	13%
Union	8%	15%	10%

CHAPTER 5 — MOTOR VEHICLES

Though not considered a sector of the Traditional Energy industry, the Motor Vehicles sector, which includes cars, light-duty and heavy- duty trucks, trailers, and component parts of the foregoing, is included in this report, given both the high energy consumption of their manufacture and their contribution to end-use energy consumption.

EMPLOYMENT OVERVIEW

The Motor Vehicles (MV) sector employed almost 221,100 workers in 2019, compared to the previous year's level of 217,587 workers. This represents a jump in employment of 1.6 percent over 2019, exceeding national MV employment growth (0.8 percent). In the fourth quarter of 2019 - prior to widespread knowledge of COVID-19 - employers in the MV sector expected to see employment increase by 3.7 percent in 2020, adding 8,180 new jobs for a total of about 229,250 jobs.

Figure 28. MV Employment Growth, Q4 2018 –Q4 2020 Projected

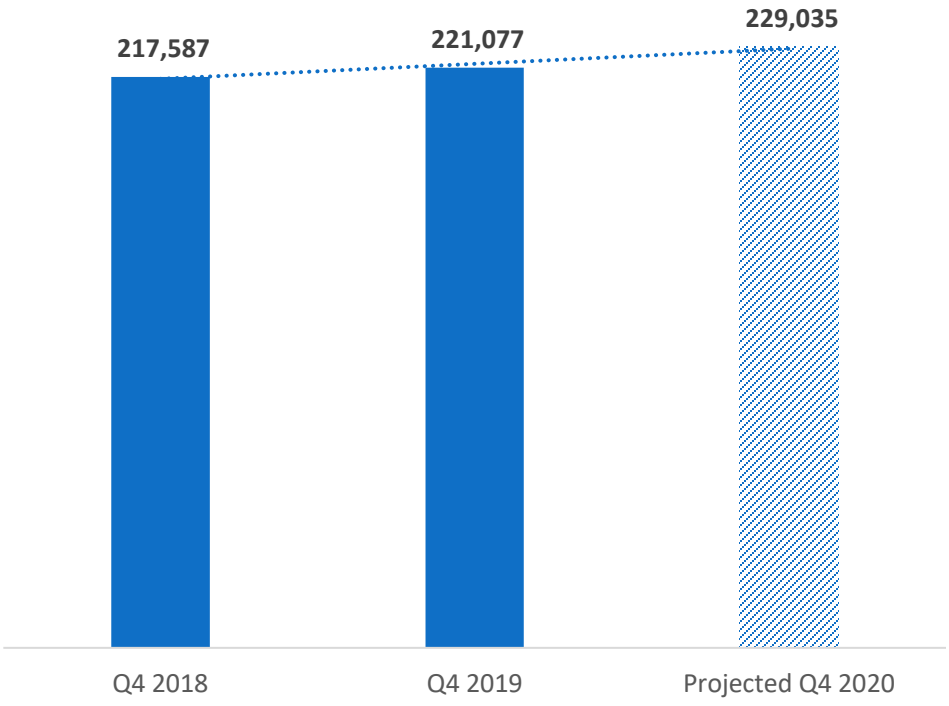
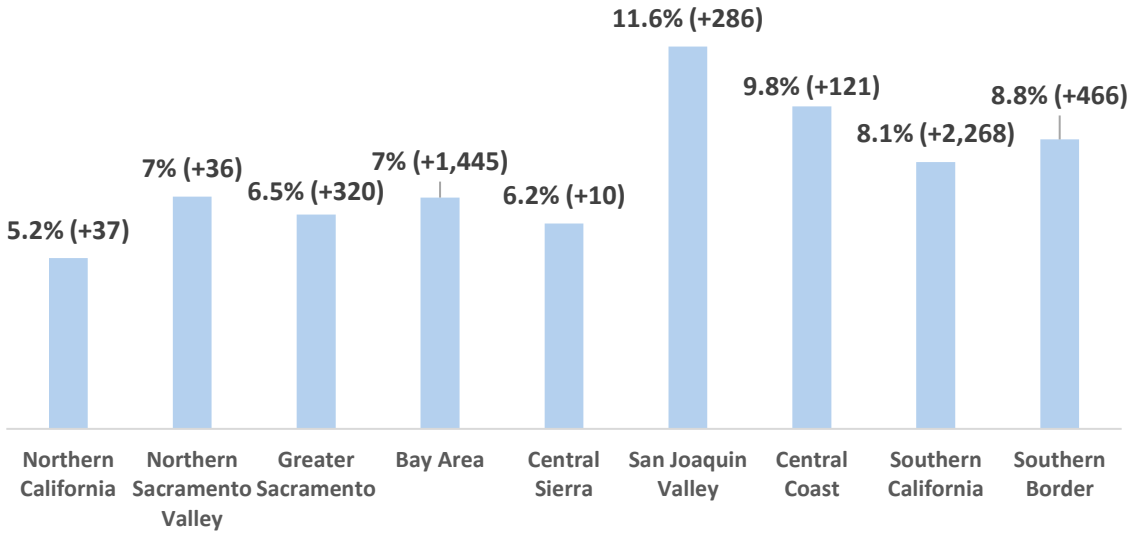


Figure 29. MV Employment Growth by Region, Q4 2018 – Q4 2019[52]



More than 56 percent of California MV workers worked in repair and maintenance jobs. Manufacturing employment increased by almost 3,000 jobs in 2019 (eight percent growth), while professional services employment increased by 560 jobs (seven percent growth).

Gasoline and diesel motor vehicle jobs represented 78 percent of California MV employment in 2019. Alternative fuels' vehicles employed 40,627 workers, or 18 percent of MV jobs in California.[53] The 2020 CAEER found a large increase in electric vehicle employment, adding 1,276 jobs (six percent growth) for a total of 23,985 jobs. While national electric vehicle employment declined over the last year (down nine percent), California's employment growth was found primarily in the manufacturing industry.[54] The gasoline and diesel motor vehicle sector added 1,188 jobs in 2019 (one percent growth) for a total of 171,537.

[52] A map of the regions, along with selected detailed technology growth, can be found in Appendix C.
[53] As a result of additional research and interviews, the USEER has revised upward the number of jobs reported in alternative fuels vehicles in 2018.
[54] USEER 2020

Figure 30. Motor Vehicles Employment by Industry, Q4 2018 – Q4 2019[55]

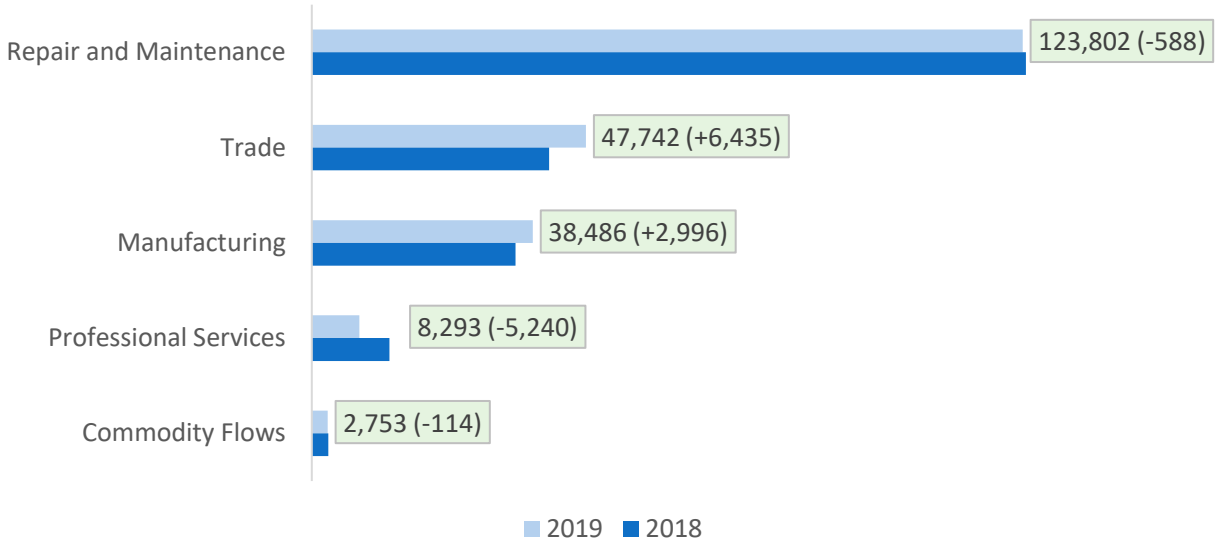
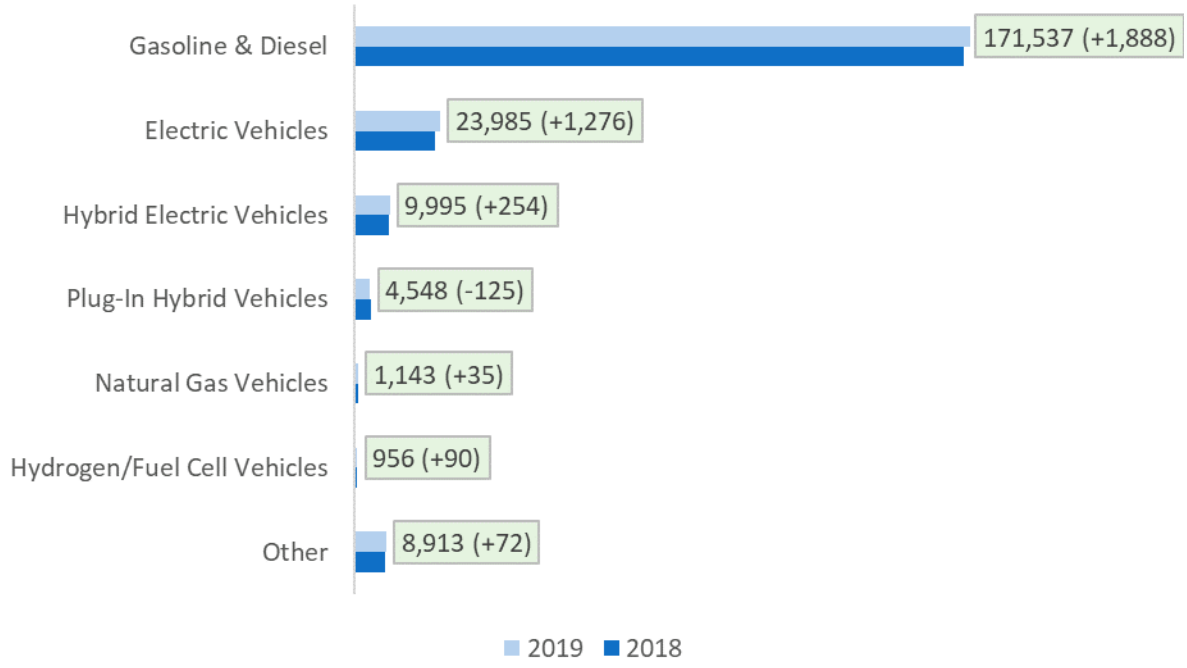


Figure 31. Motor Vehicles Employment by Detailed Technology Application, Q4 2018 – Q4 2019

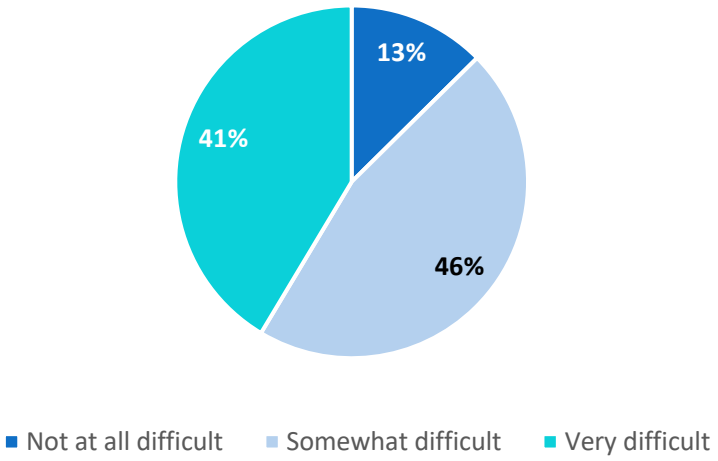


[55] "Commodity Flows" includes all employment related to the pipeline transportation of fuels and the transport (via truck, rail, air, and water) of energy commodities such as coal, fuel oil, gas, motor vehicles, and petroleum. For more information on the USEER methodology, please refer to Appendix A of this report.

HIRING DIFFICULTY & BUSINESS CHALLENGES

Thirty-six percent of MV companies in California hired workers in 2019. Of these, 41 percent found hiring to be very difficult, 46 percent found it to be somewhat difficult, and only 13 percent of firms did not find hiring to be difficult at all. These rates were consistent with nationally reported MV sector hiring difficulty.[56] The top reported reason for hiring difficulty in 2019 was insufficient non-technical skills, including work ethic and dependability, while the most difficult occupations to hire were technicians/mechanical support.[57]

Figure 32. Motor Vehicles Hiring Difficulty



Top Reasons for Hiring Difficulty

1. Insufficient non-technical skills; work ethic, dependability, critical thinking
2. Lack of experience, training, or technical skills
3. Difficulty finding industry-specific knowledge, skills, and interest
4. Cannot pass employment screening
5. Insufficient qualifications; certifications or education

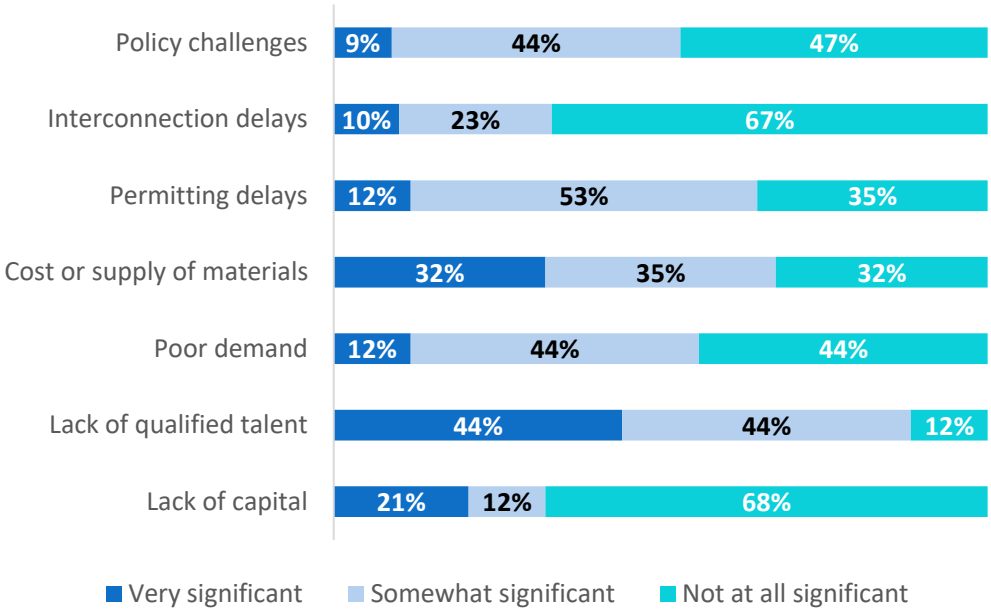
Top Difficult to Hire Occupations

1. Technician or mechanical support
2. Drivers/dispatchers
3. Management; directors, supervisors, vice presidents
4. Administrative support
5. Installation workers

[56] USEER 2020
[57] Reasons for hiring difficulty and most difficult occupations were open-ended questions; similar answers were placed into categories, and the top reported categories are listed.

The most significant reasons for business growth difficulty, according to employers in 2019, were lack of qualified talent and cost or supply of materials; 88 percent and 67 percent of employers, respectively, found them to be a very or somewhat significant factor. Forty-four percent of firms alone found the lack of qualified talent to be a very significant difficulty in growing a profitable business.

Figure 33. MV Significance of Factors in Difficulty Growing a Profitable Business



WORKFORCE CHARACTERISTICS

In 2019, the MV sector employed fewer female and Hispanic or Latino workers than the California workforce averages (20 and 12 percentage points below, respectively) but more workers that identify as Two or more races and Black or African American (10 and one percentage points above, respectively). This sector was also six percentage points less unionized than the California workforce average. The share of workers 55 and older in the MV sector was seven percentage points below the California workforce average, while the share of veterans was three percentage points higher.

Table 9. MV Sector Demographics, Q4 2019

	California MV	California Workforce Averages[58]	National MV Averages[59]
Male	75%	55%	77%
Female	25%	45%	23%
Hispanic or Latino	25%	37%	17%
Not Hispanic or Latino	75%	63%	83%
American Indian or Alaska Native	1%	<1%	2%
Asian	9%	16%	5%
Black or African American	7%	6%	8%
Native Hawaiian or other Pacific Islander	1%	<1%	1%
White	70%	72%	77%
Two or more races	12%	2%	8%
Veterans	7%	4%	9%
55 and over	14%	21%	19%
Union	9%	15%	13%

[58] Demographics for the statewide workforce are from the Bureau of Labor Statistics, Labor Force Statistics from the Current Population Survey, 2019, and Emsi Population Demographics of California, 2019. Veterans employment is from the Bureau of Labor Statistics, 2018 Veterans News Release, 21 March 2019. https://www.bls.gov/news.release/vet.t06a.htm. Union membership is from the Bureau of Labor Statistics, 2019 Union Members News Release, 22 January 2020. https://www.bls.gov/news.release/pdf/union2.pdf.
[59] US Energy Employment Report 2020

CONCLUSIONS

California's energy and energy-related workforce represent an important component of the state's labor market. In total, Traditional Energy, Energy Efficiency, and Motor Vehicle jobs accounted for 5.3 percent of all jobs statewide and continue to be a source of job growth for residents. As California continues its decarbonization efforts, the state can expect additional changes in the employment mix, especially within the Electric Power Generation and Fuels sectors.

A nationwide leader in energy efficiency deployment and policy, California continues to be an example for how strong energy efficiency policies and programs result in both job growth and reductions in per capita energy consumption. With the motor vehicle industry accounting for the largest portion of end-use energy consumption, this sector will likely be the subject of future energy-use discussions. Rising electric vehicle exports and a goal to increase in-state zero-emission vehicle deployment over the next five to 10 years portend additional job shifts for California's Motor Vehicles sector.

In addition to job opportunities, energy and energy-related occupations in California tend to provide above-average wages relative to the median wage for comparable occupations; this is especially true for entry-level workers.

Energy sectors in California are expected to remain a good source of jobs for residents across the state. However, reported hiring difficulties and the inability to find qualified workers might stifle the future growth of businesses, particularly those engaged with newer emissions-reduction technologies that are not yet incorporated into traditional education and training programs. As the state looks towards its energy future, it will become increasingly important to engage with these energy employers to understand the changing dynamics of the workplace and required skillsets.

In the midst of unprecedented economic downturn due to the coronavirus, the energy sector has and will continue to be negatively impacted. Energy employment will rebound over time, though exactly how and when is unknown. However, based on Governor Newsom's recent guidance for a measured return to "normal," the state's carbon goals, and policies already in place, there are a few critical considerations to California's virus response:

Many jobs in clean energy can be resumed in the short-term that can put people with existent skillsets back to work. Jobs that can be performed while maintaining adequate physical distancing and use of personal protective equipment (PPE), and also do not rely heavily on residential consumer spending, should return more quickly. These include, but are not limited to, utility-scale renewable generation and storage projects, non-residential energy efficiency measures (especially in currently closed public buildings), grid modernization efforts, and the construction of EV charging infrastructure. Eventually, high job creation activities like residential energy efficiency and behind-the-meter storage installation will be able to resume as well.

Federal and state policies in the wake of this virus will be critically important, as government intervention is typically required to stimulate growth when current conditions offer market failures. Such measures should consider stimulating segments of the clean energy economy that can employ workers in new markets. Such policies could create opportunities for HVAC contractors, electricians, solar installers, and weatherization workers, currently excluded from the residential market due to physical distancing, in public buildings and commercial properties that are closed to the public or are vacant during evenings and weekends.

The information in this report provides baseline industry outlooks, as well as helps shape policies at the federal and state levels. Through these challenging times, energy is a proven job creator that can play a key role in getting people back to work quickly.

Appendix A. Methodology

The survey was administered by phone and by web, with more than 26,900 outbound calls, 13,400 emails, and 6,000 letters sent to participants across California. The phone survey was conducted by ReconMR. The web instrument was programmed internally, and each respondent was required to use a unique ID in order to prevent duplication.

In total, 4,591 business establishments in California participated in the survey effort. These responses were used to develop incidence rates among industries as well as to apportion employment across various industry categories in ways currently not provided by state and federal labor market information agencies. The margin of error for incidence is +/- 1.42 percent for California at a 95 percent confidence interval.

For full detail on the overall USEER methodology, please visit: https://www.usenergyjobs.org/

The executive summary and appendices, which include the methodology, can be found directly at:

https://www.usenergyjobs.org/2020-report

Download USEER Appendix A

Download USEER Appendix B

Appendix B. Energy Technology List

An energy job is defined as any worker that is directly involved with the research, development, production, manufacture, distribution, sales, implementation, installation, or repair of components, goods, or services related to the following sectors of Electric Power Generation; Electric Power Transmission, Distribution, and Storage; Energy Efficiency; Fuels; and Motor Vehicles. These jobs also include supporting services such as consulting, finance, tax, and legal services related to energy. Included in these sectors are the following sub-technologies that are currently considered to be energy and energy-related activities.

ELECTRIC POWER GENERATION

- Solar Photovoltaic Electric Generation- generating electrical power by converting solar radiation into direct current electricity using semiconductors that exhibit the photovoltaic effect.
- Concentrated Solar Electric Generation - generating solar power by using mirrors or lenses to concentrate a large area of sunlight, or solar thermal energy, onto a small area.
- Wind Generation - converting the wind's kinetic energy into electrical power.
- Geothermal Generation - using steam produced from reservoirs of hot water found a few miles or more below the Earth's surface to produce electricity.
- Bioenergy/Biomass Generation - generating electricity from materials derived from biological sources or any organic material which has stored sunlight in the form of chemical energy.
- Low-Impact Hydroelectric Generation– similar to traditional, but certification criteria are aimed at ensuring that the certified dam adequately protects or mitigates its impacts in eight key resource areas: river flows, water quality, fish passage and protection, watersheds, threatened and endangered species, cultural resources, and public access and recreation opportunities. The eighth criterion requires that the dam not have been recommended for removal (LIHI – Low Impact Hydropower Institute).
- Traditional Hydroelectric Generation - electricity generated by hydropower; the production of electrical power through the use of the gravitational force of falling or flowing water.
- Advanced/Low Emission Natural Gas – efficient, low emission, leak free natural gas, including systems that use any of the following technologies High Efficiency Compressor, Advanced Low NOx Combustion Technology, First Application of Closed Loop Steam Cooling in an Industrial Gas Turbine, Advanced Turbine Blade and Vane Materials, High Temperature TBC and Abradable Coatings, Advanced Row 4 Turbine Blades, 3-D Aero Technology, Advanced Brush Seal.
- Nuclear Generation - converting atomic energy into usable power.
- Coal Generation – the burning of thermal coal to create electricity.
- Oil and other Petroleum Generation - the burning of oil or other petroleum to create electricity.
- Natural Gas Generation, other than Advanced Natural Gas Generation - the burning of natural gas to create electricity.
- Combined Heat and Power - generating electricity and useful thermal energy in a single, integrated system. Heat that is normally wasted in conventional power generation is recovered as useful energy
- Other Generation - includes generation from incineration of other fuels (waste, etc.), tidal generation, and employment that cannot be classified into a single detailed technology.

ELECTRIC POWER TRANSMISSION, DISTRIBUTION, AND STORAGE

Electric Power Transmission and Distribution

- Traditional Transmission and Distribution - allow electricity to move across the country through infrastructure commonly referred to as "poles and wires."
- Smart Grid - an electricity supply network that uses digital communications technology to detect and react to local changes in usage.
- Micro Grids - a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid.
- Other Grid Modernization – other modernization of the Nation's electricity transmission and distribution system to maintain a reliable and secure electricity infrastructure that can meet future demand growth.
- Other Transmission and Distribution – includes commodity flows (air, rail, water, and truck transport of fuels), system efficiency, software that supports all transmission and distribution, site selection, disaster response plans (DRP), incident response plans (IRP), etc., including employment that cannot be classified into a single detailed technology.

Storage

- Pumped Hydro Storage - hydroelectric energy storage used by electric power systems for load balancing. The method stores energy in the form of gravitational potential energy of water, pumped from a lower elevation reservoir to a higher elevation.
- Battery Storage – using a cell or connected group of cells to convert chemical energy into electrical energy by reversible chemical reactions and that may be recharged by passing a current through it in the direction opposite to that of its discharge
    - Lithium Batteries
    - Lead-Based Batteries
    - Other Solid-Electrode Batteries
    - Vanadium Redox Flow Batteries
    - Other Flow Batteries
- Mechanical Storage – uses kinetic or gravitational forces to store energy. Includes flywheels, compressed air, etc.
- Thermal Storage – temporary storage of energy for later use when heating or cooling is needed.
- Liquefied Natural Gas
- Compressed Natural Gas
- Crude Oil
- Refined Petroleum Fuels (liquid)
- Refined Petroleum Fuels (gas)
- Coal Storage (piles, domes, etc.)
- Biofuels, including ethanol and biodiesel
- Nuclear Fuel
- Other Gas Fuel
- Other Liquid Fuel
- Other Storage

ENERGY EFFICIENCY

- ENERGY STAR Certified Appliances – appliances that meet the international ENERGY STAR standard for energy efficient consumer products originated in the United States.
- LED, CFL and Other Efficient Lighting – energy efficient lighting sources.

- Traditional HVAC goods, control systems, and services - heating, ventilation, and air conditioning systems (HVAC), including building retro-commissioning and retrofits connected to heating and cooling.
- ENERGY STAR/ High AFUE HVAC - HVAC that meets the international ENERGY STAR standard for energy efficient consumer products originated in the United States or has high Average Fuel Utilization Efficiency (AFUE) rating of 90 or greater or 15 SEER or greater.
- Solar Thermal Water Heating and Cooling
- Renewable Heating and Cooling - refers to establishments that are involved with heating, ventilation and air conditioning (HVAC) from Renewable Energy sources or work that increases the Energy Efficiency of HVAC systems (solar thermal - uses the sun's energy to generate thermal energy).
- Advanced Building Materials/Insulation - all materials that represent advances in efficiency over the traditional materials.
- Recycled Building Materials
- Reduced Water Consumption Products and Appliances - high efficiency (HE) washing machines, faucet aerators, low flow shower heads, etc.
- Other Energy Efficiency – includes variable speed pumps, other design services not specific to a detailed technology, software not specific to a detailed technology, energy auditing, rating, monitoring, metering, and leak detection, policy and non-profit work not specific to a detailed technology, consulting not specific to a detailed technology, LEED certification, phase-change materials, etc.

FUELS

- Coal Fuel- a combustible black or dark brown rock consisting mainly of carbonized plant matter, found mainly in underground deposits and widely used as fuel.
- Petroleum Fuel - a liquid mixture of hydrocarbons that is present in certain rock strata and can be extracted and refined to produce fuels including gasoline, kerosene, and diesel oil; oil.
- Natural Gas Fuel - flammable gas, consisting largely of methane and other hydrocarbons, occurring naturally underground (often in association with petroleum) and used as fuel.
- Other Fossil Fuel - a natural fuel such as coal or gas, formed in the geological past from the remains of living organisms.
- Corn Ethanol Fuel- ethanol produced from corn that is used as a biomass.
- Other Ethanol/Non-Woody Biomass Fuel, including Biodiesel – fuel made from other materials such as straw, manure, vegetable oil, animal fats, etc.
- Woody Biomass/Cellulosic Biofuel – fuel developed from the by-product of management, restoration, and hazardous fuel reduction treatments, as well as the product of natural disasters, including trees and woody plants (limbs, tops, needles, leaves, and other woody parts, grown in a forest, woodland, or rangeland environment)
- Other Biofuels – other fuel derived directly from living matter.
- Nuclear Fuel - a substance that will sustain a fission chain reaction so that it can be used as a source of nuclear energy.
- Other Fuels

MOTOR VEHICLES

- Gasoline and Diesel Motor Vehicles (excluding freight transport) – vehicles that run on gasoline and diesel internal combustion engines.
- Hybrid Electric Vehicles - use two or more distinct types of power, such as internal combustion engine + electric motor.

- Plug-In Hybrid Vehicles - a hybrid electric vehicle that uses two or more distinct types of power, such as internal combustion engine and an electric motor that is powered by rechargeable batteries, or another energy storage device, that can be recharged by plugging it in to an external source of electric power.
- Electric Vehicles - a vehicle which uses one or more electric motors for propulsion with no onboard generator or non-electric motor.
- Natural Gas Vehicles - an alternative fuel vehicle that uses compressed natural gas (CNG) or liquefied natural gas (LNG) as a cleaner alternative to other fossil fuels.
- Hydrogen Vehicles - uses hydrogen as its onboard fuel for motive power.
- Fuel Cell Vehicles - a type of hybrid vehicle which uses a fuel cell, instead of an engine, in combination with a storage device, such as a battery, to power its on-board electric motor.

Appendix C. Detailed Technology Employment Change by Region, 2018-2019

	Solar Generation	Wind Generation	All Coal	All Natural Gas
Northern California Region (dark green)	-14.4%	3.1%	13.3%	-0.6%
Northern Sacramento Valley Region (light green)	-4.0%	3.1%	13.2%	-0.9%
Greater Sacramento (yellow)	-9.3%	3.1%	13.2%	1.8%
Bay Area (red)	-5.0%	6.4%	13.0%	0.9%
Central Sierra Region (brown)	-9.6%	3.1%	13.6%	1.4%
San Joaquin Valley Region (green)	17.7%	31.9%	13.1%	2.3%
Central Coast (orange)	10.8%	3.1%	13.8%	0.6%
Southern California Region (light blue)	2.3%	5.0%	12.9%	-0.3%
Southern Border Region (purple)	4.6%	3.9%	13.1%	0.2%

	All Oil	Other Generation	Other Fuels	EE	Battery Storage
Northern California Region (dark green)	1.6%	19.7%	-1.9%	-1.6%	12.6%
Northern Sacramento Valley Region (light green)	1.6%	1.7%	-0.7%	-1.5%	11.2%
Greater Sacramento (yellow)	1.6%	125.8%	3.7%	-1.7%	11.5%
Bay Area (red)	1.6%	31.3%	7.0%	-1.5%	12.2%
Central Sierra Region (brown)	1.6%	3.0%	-1.8%	-1.4%	11.2%
San Joaquin Valley Region (green)	1.6%	-25.4%	22.0%	-1.5%	12.2%
Central Coast (orange)	1.6%	-39.8%	11.9%	-1.6%	11.9%
Southern California Region (light blue)	1.6%	-3.3%	7.1%	-1.6%	11.3%
Southern Border Region (purple)	1.7%	-10.6%	9.2%	-1.4%	11.2%

	Smart/Micro Grid	Traditional TDS	Alternative MV	Traditional MV
Northern California Region (dark green)	1.4%	-0.9%	3.3%	-7.6%
Northern Sacramento Valley Region (light green)	1.4%	-0.9%	3.3%	-7.6%
Greater Sacramento (yellow)	1.8%	-0.9%	3.3%	-7.6%
Bay Area (red)	2.0%	-0.9%	13.4%	-7.6%
Central Sierra Region (brown)	1.4%	-0.9%	3.3%	-7.6%
San Joaquin Valley Region (green)	1.5%	-0.9%	3.3%	-7.6%
Central Coast (orange)	1.4%	-0.9%	3.3%	-7.6%
Southern California Region (light blue)	1.7%	-0.9%	3.3%	-7.6%
Southern Border Region (purple)	4.6%	-0.9%	3.3%	-7.6%

Appendix D. Clean Energy Technology List

Renewable Generation

- Solar photovoltaic
- Concentrated solar
- Wind
- Geothermal
- Bioenergy/Biomass
- Low-Impact hydroelectric, including wave/kinetic
- Other clean energy generation

Clean Storage and Grid Modernization

- Smart grid
- Microgrids
- Other grid modernization
- Pumped hydro-power storage
- Battery storage, including battery storage for solar generation
    - Lithium batteries
    - Lead-based batteries
    - Other solid-electrode batteries
    - Vanadium redox flow batteries
    - Other flow batteries
- Mechanical storage (flywheels, compressed air energy storage, etc.)
- Thermal storage, excluding fossil-related
- Biofuels, including ethanol and biodiesel
- Nuclear fuel

Energy Efficiency

- ENERGY STAR Certified Appliances, excluding HVAC
- ENERGY STAR Certified Heating Ventilation and Air Conditioning (HVAC), including boilers and furnaces with an AFUE rating of 90 or greater and air and central air conditioning units of 15 SEER or greater
- Traditional HVAC goods, control systems, and services
- ENERGY STAR Certified Electronics (TVs, Telephones, Audio/Video, etc.)
- ENERGY STAR Certified Windows and Doors
- ENERGY STAR Certified Roofing
- ENERGY STAR Certified Seal and Insulation
- ENERGY STAR Certified Commercial Food Service Equipment
- ENERGY STAR Certified Data Center Equipment
- ENERGY STAR Certified LED Lighting
- Other LED, CFL, and Efficient Lighting
- Solar thermal water heating and cooling
- Other renewable heating and cooling (geothermal, biomass, heat pumps, etc.)

- Advanced building materials/insulation
- Recycled building materials
- Reduced water consumption products and appliances
- Other energy efficiency

Alternative Transportation

- Electric Vehicles
- Hybrid Electric Vehicles
- Plug-in Hybrid Vehicles
- Hydrogen and Fuel Cell Vehicles
- Natural Gas Vehicles