

Industry Overview

Colorado has one of the most diverse energy economies in the nation with access to several natural resources. In fact, Colorado's energy sector has grown to include fossil fuels, consisting of oil, coal, and natural gas, as well as clean-energy technologies such as wind, solar, biomass, energy efficiency controls and applications, and alternative fuel vehicles and fueling infrastructure. The varied energy mix is attributable to several key assets including significant oil and gas reserves, super-compliant coal, vast solar and wind resources, and high-profile intellectual property. In support of a balanced energy policy, Colorado has advanced a diversity of measures, such as the first voter-led renewable energy standard in the nation and financial incentives for homegrown energy resources.



Colorado is an energy powerhouse and is one of the most energy-rich states in the nation. According to the U.S. Energy Information Administration, Colorado ranked sixth in the nation for natural gas production, seventh for crude oil production, and 11th for coal production. In 2016, Colorado ranked ninth in the nation for total installed solar capacity and 10th for installed wind generation capacity. Additionally, Colorado ranked third in the nation for high-tech employment and its universities and technology hubs elevate the state's position as a leader in energy technology and sector advancements.

This report evaluates Colorado's energy industry in two subclusters: (1) cleantech and (2) fossil fuels. The state's energy industry is a significant source of economic activity in Colorado. Combined, the 70,640 direct energy workers earning \$6.9 billion in the state support an additional 204,120 indirect workers earning nearly \$8 billion in all industries throughout the state. In total, the energy industry in Colorado supports 274,760 workers in all industries earning \$14.9 billion annually.

Cluster Definition and Methodology

The fossil fuels subcluster includes companies involved in the extraction of naturally occurring fuels used to produce energy as well as the generation, transmission, and distribution of energy resources. The cleantech subcluster includes companies developing and delivering products and technologies across solar, wind, biomass, and sustainable transportation sectors that improve operational performance, efficiency, or productivity, while reducing energy costs and energy consumption.

It is often difficult to distinguish how an organization's operations are divided between fossil fuels and cleantech components. For example, research is a critical component of all energy industries, from oil and gas to solar and wind energy. So that the two subclusters may be analyzed independently, all energy research entities are included in the cleantech subcluster while all energy transmission and distribution activities are included in the fossil fuels subcluster, even though a portion of the energy may be coming from renewable resources.

Cleantech Economic Profile

The cleantech subcluster includes companies that produce and conserve energy using wind, solar, biomass, fuel cells, hydroelectric resources, and green transportation technologies. Companies that manufacture renewable energy equipment, storage, and power transformers, and businesses that provide engineering and other support services are also included. The subcluster includes energy research companies that provide laboratory testing, scientific and technical consulting services, and institutional research related to the environment, natural resources, and energy. The cleantech subcluster consists of 29, six-digit North American Industry Classification System (NAICS) codes.

ENERGY: Colorado Industry Cluster Profile

Colorado ranked fourth out of the 50 states in cleantech employment concentration in 2016. With direct employment in the cleantech subcluster of 26,270 workers, the state ranked ninth out of the 50 states.¹

Cleantech Employment and Company Profile, 2016

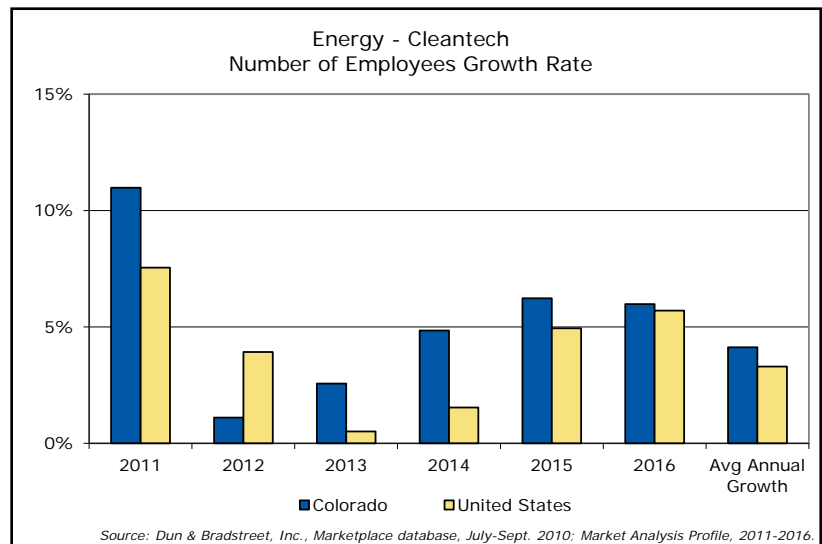
	Colorado	United States
Direct employment, 2016	26,270	875,430
Number of direct companies, 2016	2,130	58,860
One-year direct employment growth, 2015-2016	6.0%	5.7%
Five-year direct employment growth, 2011-2016	22.4%	17.6%
Avg. annual direct employment growth, 2011-2016	4.1%	3.3%
Direct employment concentration	0.8%	0.5%

Sources: Dun & Bradstreet, Inc. Marketplace database, July-Sept. 2010; Market Analysis Profile, 2011-2016; Development Research Partners.

Cleantech Employment

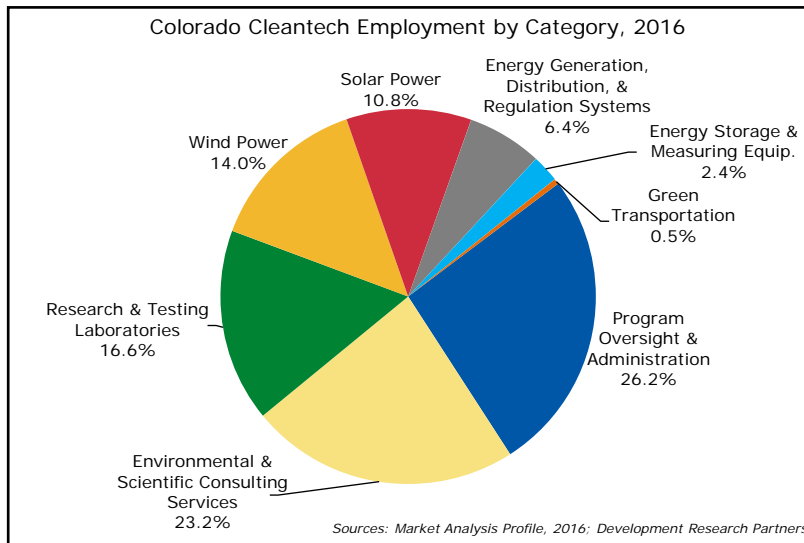
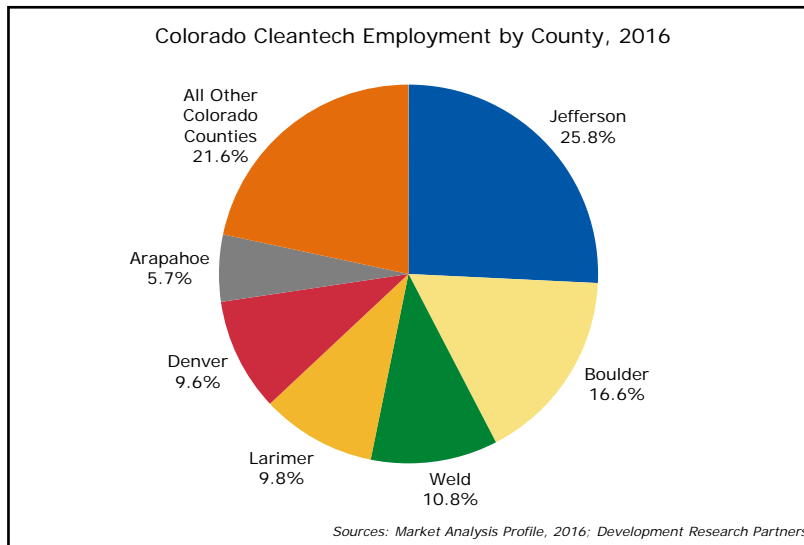
Colorado's cleantech employment (26,270 workers) rose 6 percent in 2016 compared with the previous year's level, adding 1,480 new jobs during the same period. National employment levels also grew over-the-year, rising 5.7 percent, representing an additional 47,180 jobs. Three percent of the nation's cleantech employment is located in Colorado. Between 2011 and 2016, Colorado's cleantech employment rose 22.4 percent, compared with a 17.6 percent increase nationwide. Cleantech companies employed 0.8 percent of the state's total employment base, compared with a 0.5 percent employment concentration nationwide.

Colorado had 2,130 cleantech companies operating in 2016, rising 2.8 percent over the prior year. Nearly 84 percent of these companies employed fewer than 10 people, while 0.7 percent employed 250 or more.



¹ Employment concentration is the direct cluster employment in a state expressed as a percent of total employment in all industries in the same state. Employment concentration is calculated and ranked for the 50 states. Direct employment is the number of employees in the industry cluster in a state. No multiplier effects are included. Direct employment is estimated and ranked for the 50 states.

ENERGY: Colorado Industry Cluster Profile



Cleantech Overview

Colorado's research universities, the U.S. Department of Energy's (DOE) National Renewable Energy Laboratory, and public-private partnerships, like those established through the Colorado Energy Research Collaboratory (Collaboratory) and the Colorado Cleantech Industry Association, provide the foundational research and education needed for new market innovations. These research and educational centers create new opportunities in energy efficiency and renewable energy that allow for cleaner and more efficient use of energy.

The Collaboratory integrates cutting-edge research with industry expertise to accelerate the transfer of energy technologies to the marketplace in the areas of biorefining, solar photovoltaics, wind, and carbon management. Since its launch in 2007, the Collaboratory has shown a 24:1 return on investment using state funding of nearly \$8 million to leverage federal and private-sector dollars, and has helped attract several companies to Colorado. The Collaboratory has drawn \$96.6 million in outside investment over the last eight years and had an economic impact of \$194 million.

The Colorado Cleantech Industry Association (CCIA), an industry association dedicated entirely to cleantech, provides advocacy, capacity building, and education and training to the cleantech sector. CCIA is one of the first, regional cleantech organizations to partner with Advanced Energy Economy, a national trade association representing the advanced energy industry. The Energy Fellows Institute, a CCIA program, is the nation's first program to educate experienced entrepreneurs and executives in the technology sectors of cleantech.

ENERGY: Colorado Industry Cluster Profile

Colorado's 30 federal research laboratories and research institutions—one of the highest concentrations of federal funded science and research centers in the nation—support the state's thriving energy cluster. Employing nearly 8,000 scientists and engineers and generating a more than \$2.3 billion annual economic impact to the region, the laboratories collaborate to encourage the exchange of information and ideas, promote technology transfer, and support innovation.

The National Renewable Energy Laboratory (NREL), located in Golden, is the DOE's only laboratory dedicated to renewable energy and energy efficiency research and development. NREL is home to three national centers including the National Bioenergy Center, the National Center for Photovoltaics, and the National Wind Technology Center. NREL's \$135 million, 182,000-square-foot Energy Systems Integration Facility (ESIF) was named "Laboratory of the Year" by *R&D Magazine* in 2014, an esteemed award for the most important technological innovations. Since 2002, NREL received more than \$4.6 billion in funding. Further, NREL contributed nearly \$701 million to Colorado's economy in fiscal year 2014. NREL collaborates with hundreds of partners across 46 states and 30 countries to commercialize renewable energy and energy efficiency technologies. NREL had nearly 700 active partnerships and established 240 new partnership agreements in 2015. Under these collaborative partnerships, technology is often transferred for commercialization and used in the private sector. NREL has been awarded 40 technology transfer awards since 1997, aided 30 clean-energy startups, issued over 440 U.S. patents, and garnered more than 200 awards and honors for its programs and scientific research. Notable NREL announcements in 2016 included:

- The Institute for Advanced Composites Manufacturing Innovation, NREL, and the state of Colorado repurposed an existing building at NREL's Wind Research Center into the Wind Blade Component Manufacturing Facility. The \$1.6 million facility will serve as a research and development site to help manufacturers build longer, lighter, and stronger wind blades.
- NREL installed its second hydraulic hybrid propulsion system on a passenger shuttle bus, part of its work to comply with federal standards to reduce emissions from its fleets by 2025. The hydraulic hybrid system, manufactured by Loveland-based Lightning Hybrids, improves fuel and braking efficiency. Both buses shuttle more than 500 employees and visitors around NREL's campus.
- NREL was awarded a \$1.4 million DOE grant to lead four projects for the Technology Commercialization Fund. The projects will be used to advance promising renewable energy-related technologies with commercial potential and help strengthen partnerships between national laboratories and private companies.
- NREL partnered with Sandia National Laboratories, Lawrence Berkeley National Laboratory, and SLAC National Accelerator Laboratory to form the Durable Module Materials National Lab Consortium (DuraMat). DuraMat will receive about \$30 million over five years from DOE's SunShot Initiative, which funds projects designed to accelerate the market competitiveness of solar power. DuraMat intends to develop, characterize, and deploy new materials and architectures that will improve the value of photovoltaic (PV) modules for manufacturers, plant developers, financiers, and utilities.

Cleantech Policy and Financing

Colorado's progressive policy initiatives support the state's balanced energy economy. Among the state's notable policies, Colorado is home to the first voter-led renewable energy standard in the nation, achieving 30 percent by 2020. Other policies also make Colorado an attractive cleantech marketplace including the state's commercial property-assessed clean energy (C-PACE) financing program and progressive community solar initiatives. In addition to policies incentivizing technology deployment, Colorado has several programs that provide grants and tax incentives to cleantech companies that invest in Colorado, such as the Advanced Industries Accelerator Program. The Energy Fellows Institute also trains CEOs from other sectors to lead Colorado's cleantech companies.

These policies and incentives are helping to attract cleantech venture capital and funding opportunities to the state. Colorado has consistently been a strong performer in cleantech venture capital. According to PricewaterhouseCoopers, Colorado ranked eighth out of 50 states in cleantech venture capital investments in 2016, totaling \$20.5 million. According to the i3 Platform, the state ranked fourth in deal volume across major U.S. hubs, accounting for 5.3 percent of total venture capital deal volume to cleantech startups. The number of deals from 2012-2014 was nearly quadruple that of the 2007-2009 period, vaulting Colorado into second place nationally in cleantech venture capital deals per one million people. On a dollars per capita basis, Colorado has outperformed the average of the top 10 states, at about \$7 per person.

ENERGY: Colorado Industry Cluster Profile

Cleantech Company Announcements

Colorado's cleantech companies offer advanced technologies and increased innovation to harness new and existing cleantech resources. Notable announcements in 2016 included:

- According to Development Research Partners, more than \$5.4 billion in renewable energy projects have been built in eastern Colorado over the last 16 years. The construction and operation of these renewable energy power facilities have had an estimated \$2.7 billion economic impact in eastern Colorado. Further, wind and solar support about 4,250 jobs at more than 220 cleantech businesses.
- The University of Colorado Boulder received a \$1.8 million grant from the DOE's Advanced Research Projects Agency-Energy to develop a window coating that could improve buildings' energy efficiency. The team will utilize liquid crystals to create a transparent, solid film that is thermally insulating, soundproof, and resists water condensation.
- Denver-based Quantum Renewable Energy Inc. unveiled its new "smart box" technology that combines solar, wind, natural gas, and other renewable power sources to create clean, utility-grade electrical power. The technology reduces consumers' energy costs by anticipating power loads and environmental conditions for renewable energy production.
- According to the Colorado Energy Office, the state is home to 70 energy recycling sites that generate up to 108 megawatts (MW) of power—enough to support 81,000 homes. Recycled energy captures heat that is produced by an industrial process that normally would be vented. The heat is funneled through a turbine to generate electricity for use either on-site, or for sale to a utility to use off-site. Of the total, 10 sites have the capacity to generate up to 56 MW of power.
- Colorado has more than 32,000 customer-sited installed energy systems, with small-scale solar power systems representing the largest share (91.6 percent) of all distributed energy systems, according to the Colorado Energy Office. The *Colorado Customer-Sited Energy Study* determined most of the systems are concentrated in Metro Denver, but there are solar power systems in nearly every county in the state.
- Boulder-based Cool Energy Inc. raised nearly \$1.5 million in new equity funding to support the company's ThermoHeart Engine™ converting waste heat from industrial facilities into clean electricity.
- Continental Control Systems LLC moved its headquarters and manufacturing operations from Boulder to Longmont. The company doubled its space and will add employees to expand its electric power metering and monitoring equipment manufacturing.
- Xcel Energy will offer two pilot programs that adjust electricity rates higher during peak times or boost rates when customers' usage surges. Each program requires smart meters for participants to control their energy use and will allow Xcel to improve grid efficiency. The programs will target 10,000 residential customers in 2017, with a goal of 18,000 by 2019.

Solar Energy

Colorado is one of the nation's leading solar markets, fueled by decreasing costs, increasing innovation, and access to low-cost capital. Key solar announcements and new project developments in 2016 included:

- Boulder-based Namasté Solar began construction on a 3.5-MW ground-mounted solar array for the city of Loveland. The array will replace the Idylwilde hydroelectric facility, which was damaged during the major floods in 2013.
- Tennessee-based Silicon Ranch Corp. constructed a new 13-MW solar farm for the city of Fort Lupton. The 112-acre solar farm will contribute \$20 million in economic impact for the area and will generate enough power to supply about 2,500 households.
- Louisville-based Clean Energy Collective partnered with Xcel Energy to build a community solar facility northeast of Platteville. The 12.5-acre project will include more than 18,000 solar panels, which could power over 450 homes.
- Xcel Energy will add 392 MW of new solar power in the state between 2017 and 2019, including 123 MW of rooftop solar. Xcel will also create a solar power program for low-income customers via rooftop solar power systems, and will create a new 50 MW program for residential and business customers to get up to 100 percent of their energy from renewable sources.
- Solar Alliance Energy expanded its residential, commercial, and industrial solar sales and installations into Colorado, with the opening of an office in Denver.
- Denver was selected to be the site of the 2017 DOE Solar Decathlon competition. The international contest challenges collegiate teams to design, build, and operate solar-powered houses that are cost-effective, energy-efficient, and attractive.
- Xcel Energy will launch two solar power-battery storage tests in Denver as part of the Innovation Clean Technology demonstration project program. The \$9.1 million projects, one in Stapleton and the

ENERGY: Colorado Industry Cluster Profile

other at the Panasonic facility in Denver, will test the use of batteries and microgrid power systems to evaluate utilizing batteries to regulate voltage, reduce peak demand, and cut energy costs.

- Boulder-based Wunder Capital received \$3.6 million in private equity to expand its large-scale solar projects across the nation and grow its existing workforce. Wunder Capital partners with a network of U.S. installers, developers, and distributors to find and assess solar projects to finance.
- Colorado is among 14 states where SolarCity Corp. will offer a new loan program for homeowners to finance installation of solar panels. The program will allow consumers to purchase solar panels through 10-year or 20-year loans instead of leasing them.

Colorado was the first state in the nation to allow community solar systems on the grid. As of 2016, the state has 27 MW of shared solar across 37 projects. About 75 percent of the state's electricity customers can access a community solar project. Further, the state's electric cooperatives have embraced shared solar, accounting for 11 of Colorado's programs. Notable announcements in 2016 included:

- Xcel Energy, Clean Energy Collective, Community Energy Solar Inc., and Denver-based SunShare will supply 29.5 MW of new community solar power systems across Colorado. The companies will build projects via Xcel's Solar Rewards Community programs.
- SunShare opened a new 1.5-MW community solar garden in Arvada. The 13-acre Jefferson County Community Solar Garden project includes more than 4,750 solar panels that could power 300 homes over 20 years.

Wind Energy

Wind is the predominant renewable resource in Colorado and is the fastest-growing energy resource on the grid. Further, the state is a hub for wind manufacturing activity and has created new opportunities in electricity generation, innovation, and research and development. Notable wind announcements in 2016 included:

- Xcel Energy plans to build a 600-MW wind farm and 90-mile transmission line in eastern Colorado. The \$1.1 billion Rush Creek Wind Project will include 300 Vestas wind turbines and would be the state's largest wind farm. The project is slated for completion in late 2018 and will power 180,000 homes, create 7,000 jobs over 25 years, and save ratepayers \$400 million.
- Vestas Wind Systems will add 100 new workers to its Brighton facility. The extension of the federal Production Tax Credit continues to boost demand at the company's Colorado facilities.
- Envision Energy, a China-based wind turbine and energy management software company, opened a research and development office in Boulder. The Global Blade Innovation Center has 12 employees and added workers in 2016.

Biofuels and Bioenergy

Bioenergy is an increasingly important source of Colorado's renewable energy portfolio and is well positioned for continued growth and development. Notable bioenergy announcements in 2016 included:

- Alaska Airlines operated the first-ever commercial flight using Englewood-based Gevo Inc.'s renewable alcohol-to-jet (ATJ) fuel. ATJ biofuel was approved for use by the American Society for Testing and Materials International in March 2016 and is the first aviation biofuel to be certified and approved since 2011.
- Gevo reached a deal with Deutsche Lufthansa AG to supply the airline with up to 8 million gallons of ATJ fuel per year. The five-year deal would supply the airline with about 40 million gallons of fuel.
- Heartland Biogas LLC and Eaton-based A1 Organics completed a \$3.5 million addition to the biogas digester system at the Heartland Biogas Digestion facility near LaSalle. The addition included a new processor that turns solid food waste into slurry that is pumped into a digester that is converted to natural gas.

Research and Education Announcements

Colorado's leading research institutions, educational facilities, and cohort-based programs support the state's dynamic energy industry.

- Aims Community College broke ground on a \$23.8 million Applied Technology Education Center to expand program opportunities in energy technology, welding, and industrial and engineering technology, among others. The 72,000-square-foot facility will include instructional labs and classroom space, which is slated for completion in 2017.

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- Traxion, a new business accelerator focused on supporting energy startups, opened in Golden in 2016. The company invests seed capital and connects participating companies to experienced business mentors and strategic partners. Traxion hosts a 12-week accelerator program to provide founders of start-up businesses with a comprehensive educational program.
- Solar Ready Colorado launched in 2016 as a statewide effort through Solar Energy International (SEI) and industry partners to expand the activities of outreach, recruiting, and training to the state's solar industry and jobs market. Solar Ready Colorado plans to recruit and train 350 people and participants can receive SEI professional certificates in residential and commercial PV systems, battery-based PV, solar business and technical sales, and renewable energy applications.
- Lincoln Tech unveiled a first-of-its-kind program at its Denver campus to train mechanics to work on compressed natural gas (CNG) vehicles. Students will have the option of adding three one-month courses to its diesel mechanics program.

Green Transportation

Colorado is a leader in low-emission transportation and is committed to adopting alternative fuel vehicles (AFVs) to reduce emissions. The combination of state programs and initiatives with cutting-edge technological development have led to advancements in the market including publicly available charging stations, a diversified fuel mix, and low-cost vehicle models. Sales of AFVs in Colorado have grown at a rapid pace in recent years. As of 2015, Colorado was home to more than 77,700 AFVs, including compressed natural gas, converted compressed natural gas, electric, hybrid electric, plug-in electric, and propane vehicles. Market shares are growing rapidly, particularly for electric and natural gas vehicles. The state has doubled its number of such vehicles per million residents in the last six years, to 12,748 vehicles per million people; meanwhile, the total market has expanded by a compound annual growth rate of 15.9 percent. Between 2014 and 2015, new Colorado electric vehicle (EV) registrations increased 15.2 percent and the total number of EVs in Colorado rose 43.4 percent.

Further, Colorado has passed some of the highest tax credits in the nation for natural gas vehicles, EVs, and propane vehicles. Colorado offers more than 600 alternative fueling stations, including over 360 EV charging stations and nearly 800 charging outlets throughout the state. Key developments in Colorado's green transportation market in 2016 included:

- Colorado will join with neighboring states Utah and Nevada on development of an electric vehicle charging network along key highway corridors. The corridors will include Interstates 70, 76, and 25 across Colorado; Interstates 70, 80, and 15 across Utah; and Interstates 80 and 15 across Nevada. Overall, the charging network will connect 2,000 miles of highway. An estimated 8,000 electric vehicles are on the road in Colorado, with the state offering a \$5,000 tax credit on electric-vehicle purchases. Additionally, Colorado is building charging stations on its own through the Charge Ahead Colorado program.
- China-based Hybrid Kinetic Group Ltd. invested \$48 million to obtain 54 percent ownership of Longmont-based UQM Technologies Inc. The partnership will allow UQM to execute its global growth strategy and will provide capital, infrastructure, and access to the China market, the largest EV market in the world.
- UQM Technologies Inc. shipped its initial order for electric drive systems to China-based ITL Efficiency Corporation, which are intended for a test and certification program in 2016. Under the agreement, UQM will make the electric propulsion systems for shuttle buses, delivery trucks, and transit buses through 2017, then shift manufacturing to China.
- UQM Technologies Inc. partnered with Sweden-based Kalmar Motor AB to build its electric motor system for the company's towbarless airplane tug traction drives. Under the agreement, UQM will supply its PowerPhase HD 200 electric motor system.
- Lightning Hybrids LLC raised \$2.3 million in funding to fuel the company's expansion. The company has received significant orders to accommodate large brand fleet, including an order to retrofit 50 United Parcel Service Inc. trucks with hybrid systems. The company will install its systems on 50 Freightliner MT-55 trucks with gasoline engines in the Chicago area.

ENERGY: Colorado Industry Cluster Profile

Major Cleantech Companies

- Advanced Emissions Solutions, Inc.
www.advancedemissionssolutions.com
- AECOM
www.aecom-urs.com
- ARCADIS
www.arcadis.com
- Ascent Solar Technologies, Inc.
www.ascentsolar.com
- Chicago Bridge & Iron Company
www.cbi.com
- Cool Planet Energy Systems
www.coolplanet.com
- GE Energy
www.geenergyconnections.com
- Gevo Inc.
www.gevo.com
- juwi Inc.
www.juwi.com
- Lightning Hybrids, Inc.
www.lightninghybrids.com
- Namasté Solar
www.namastesolar.com
- RavenWindow, LLC
www.ravenwindow.com
- RES Americas, Inc.
www.res-americas.com
- RGS Energy
www.rgsenergy.com
- Senvion USA Corp.
www.repower.com
- SolarCity
www.solarcity.com
- Sundrop Fuels, Inc.
www.sundropfuels.com
- Tetra Tech Inc.
www.tetrattech.com
- UQM Technologies, Inc.
www.uqm.com
- Vestas
www.vestas.com
- Woodward
www.woodward.com

Major Renewable Energy Government and Research Facilities

- CO Department of Natural Resources
www.cdnr.us
- CO Department of Public Health & Environment
www.colorado.gov/cdphe
- CO Department of Regulatory Agencies
www.colorado.gov/dora
- Colorado Energy Office
www.colorado.gov/energy
- Colorado Energy Research Collaboratory
www.coloradocollaboratory.org
- Colorado Energy Research Institute
www.ceri-mines.org
- JILA
www.jila.colorado.edu
- National Center for Atmospheric Research
www.ncar.ucar.edu
- National Institute of Standards & Technology
www.nist.gov
- National Oceanic & Atmospheric Administration
www.noaa.gov
- National Renewable Energy Laboratory
www.nrel.gov
- U.S. Bureau of Reclamation
www.usbr.gov
- U.S. Dept. of Energy, Golden Field Office
www.energy.gov/eere
- U.S. Environmental Protection Agency
www.epa.gov
- U.S. Geological Survey
www.usgs.gov
- Western Area Power Administration
www.wapa.gov

Fossil Fuels Economic Profile

The fossil fuels subcluster includes companies that extract naturally occurring mineral liquids, gases, and solids used to produce energy. The fossil fuels subcluster also includes mining machinery manufacturers and companies that provide mining, exploration, and related support services. Companies providing generation, transmission, and distribution of energy resources are also included. The fossil fuels subcluster consists of 29, six-digit North American Industry Classification System (NAICS) codes.

ENERGY: Colorado Industry Cluster Profile

Colorado ranked ninth out of the 50 states for fossil fuels employment concentration in 2016. With direct employment in the fossil fuels subcluster of 44,370 workers, Colorado ranked ninth out of the 50 states.² While Colorado's drilling and mining activity tends to be concentrated primarily in the Rocky Mountains, along the Western Slope, and in Weld County, fuel refineries, fuel storage, and company back-office facilities are located throughout the Front Range.

Fossil Fuels Employment and Company Profile, 2016

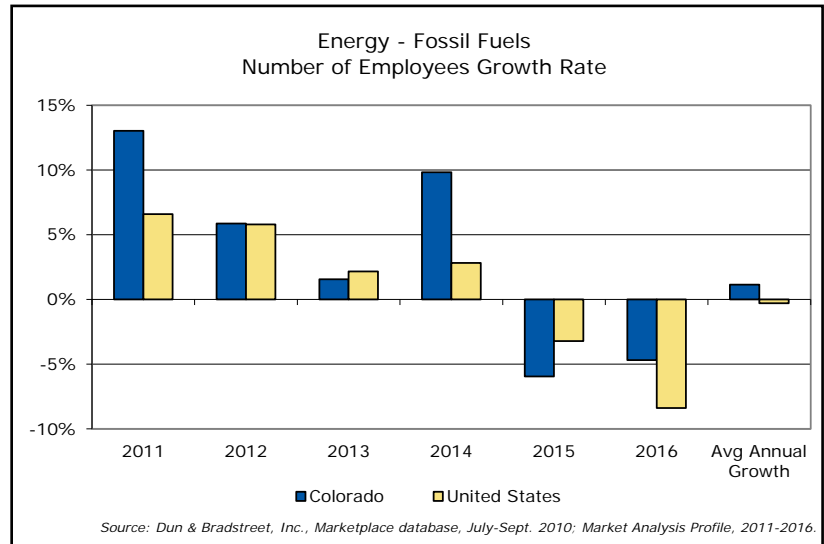
	Colorado	United States
Direct employment, 2016	44,370	1,652,370
Number of direct companies, 2016	2,360	66,800
One-year direct employment growth, 2015-2016	-4.7%	-8.4%
Five-year direct employment growth, 2011-2016	5.9%	-1.5%
Avg. annual direct employment growth, 2011-2016	1.1%	-0.3%
Direct employment concentration	1.4%	1.0%

Sources: Dun & Bradstreet, Inc. Marketplace database, July-Sept. 2010; Market Analysis Profile, 2011-2016; Development Research Partners.

Fossil Fuels Employment

Colorado's fossil fuels employment (44,370 workers) declined 4.7 percent in 2016 compared with the previous year's level. Similarly, national employment levels declined over-the-year, decreasing 8.4 percent. In response to the decline in oil prices, many of the state's fossil fuels companies and operators trimmed payrolls and shifted operations to locations outside of Colorado.

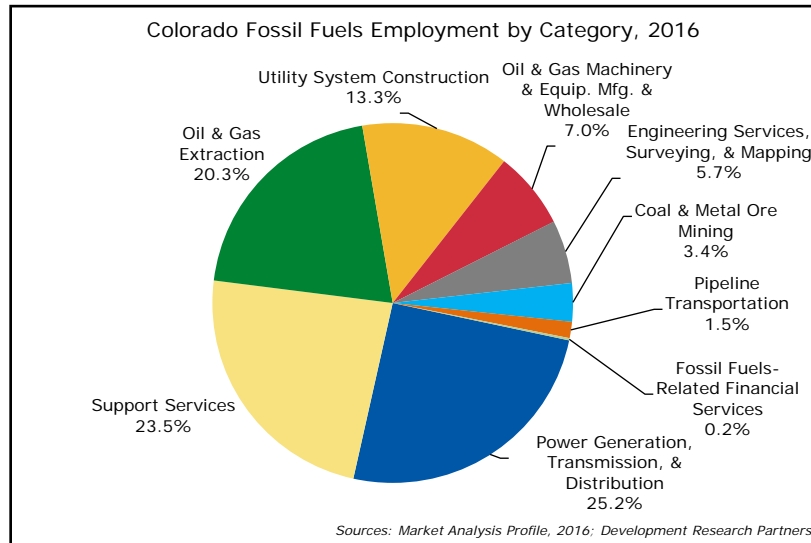
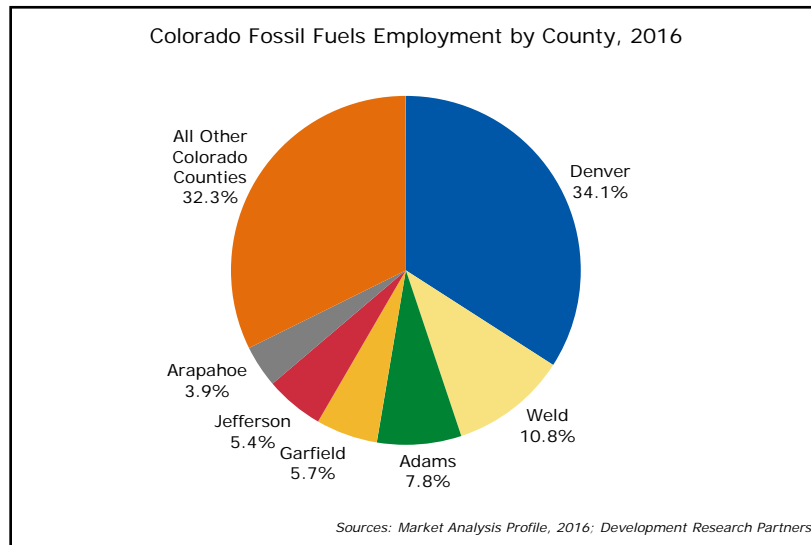
Nearly 3 percent of the nation's fossil fuels employment is located in Colorado. Between 2011 and 2016, Colorado's fossil fuels employment rose 5.9 percent, compared with a 1.5 percent decrease nationwide. Fossil fuels companies employed 1.4 percent of the state's total employment base, compared with a 1 percent employment concentration nationwide.



About 2,360 fossil fuels companies operated in Colorado in 2016. Approximately 71 percent of these companies employed fewer than 10 people, while 1 percent employed 250 or more.

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Fossil Fuels Overview

Colorado offers abundant and diverse natural resources and the state's major geologic basins contain some of the largest fossil fuel deposits—including oil, natural gas, and crude oil—in the nation. While many fossil fuel companies conduct business operations from the Metro Denver region, the majority of the drilling is concentrated along the Western Slope of the Rocky Mountains and in Weld County. Colorado's active wells totaled nearly 54,040 as of December 2016, with over 63 percent of total active wells located in Weld and Garfield Counties.

Colorado's crude oil production has been rising with the increased use of directional drilling and hydraulic fracturing technologies, and output nearly doubled from 2013 to 2015. In 2015, the state supplied about 3 of every 100 barrels of U.S. crude oil output. Colorado's Niobrara shale formation—located in northeast Colorado's rich Denver-Julesburg Basin (DJ Basin) and extending into parts of adjacent Wyoming, Nebraska, and Kansas—has led to substantial economic benefits including job creation, infrastructure development, export possibilities, and technological development. The 7,000-foot-deep geologic layer could hold more than 4 billion barrels of recoverable oil reserves. Based on proved reserves, the Wattenberg field in the DJ Basin is the fourth-largest U.S. oil field. The Piceance Basin in northwestern Colorado is the other primary petroleum-producing area in Colorado. As part of the Piceance Basin, the Mancos Shale formation is the second-largest field of recoverable natural gas in the U.S. According to the U.S. Geological Survey, the Mancos Shale formation holds about 66 trillion cubic feet of recoverable natural gas and is enough to supply the energy needs of the nation for more than two years.

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Fossil Fuels Company Announcements

Following trends that started in mid-2014, the price of oil declined through 2016 from highs once above \$100 a barrel to under \$30 a barrel in early 2016. Even though the decline in global oil prices has impacted oil and gas development strategies over the last year, a number of company developments and new projects were announced in 2016:

- BP plc will move the headquarters of its U.S. Lower 48 onshore business from Houston to downtown Denver. The company anticipates the office will open with at least 200 employees in early 2018, with more staff to be added later. The new office will improve access to key producing basins in the region and will create a strategic platform for growth.
- Denver-based Synergy Resource Corp. purchased 33,100 acres of Noble Energy Inc.'s undeveloped oil and gas properties in the DJ Basin. The \$505 million deal will help the company be a leading operator in the Wattenberg Field.
- Synergy Resources Corp. plans to expand its Denver headquarters into a larger space at the Denver Energy Center. The relocation will expand the company's office space from 38,000 square feet to 43,000 square feet.
- Anadarko opened a new Integrated Operations Center in Platteville to monitor and manage operations in the Wattenberg field. The facility serves as a centralized dispatch center to route real-time remote-monitoring communications between the field's 6,800 wells, 3,700 tank facilities, and an incident management team.
- Aurora-based Wagner Power Systems partnered with Houston-based FlexGen Power Systems to provide a new hybrid power system that will reduce noise, pollution, and wellhead costs in the DJ Basin. The FlexGen Solid State Generator utilizes energy storage, power conversion, and controls to eliminate load transients associated with natural gas, dual fuel, and diesel engines.
- Denver-based Exciter Energy Services Inc. partnered with Houston-based National-Oilwell Varco Inc. to deliver a new generation of drilling rigs. The high-tech drilling rig design features soundwall barriers to hide and shield its noise and lights from nearby homes, and links to existing power grids or liquefied natural gas for near-zero emissions. Five rigs are destined for Colorado in early 2017.
- Denver-based U.S. Energy Corp. will purchase 40 percent interest in Ironhorse Resources LLC's stake in the DJ Basin. The company will invest nearly \$10 million for drilling and completing wells in three core areas, with activity beginning in late 2016.
- Denver-based Extraction Oil & Gas Inc. received state approval for 22 new oil wells at the Triple Creek drilling site in Greeley. The location will be a flagship energy development facility that utilizes some of the best technologies available in the industry.
- Bill Barrett Corp., a Denver-based oil producer, will restart its horizontal drilling operation in the DJ Basin. The company plans to drill a dozen new wells into production by the first quarter of 2017.

Merger and Acquisition Activity

Fossil fuels companies in Colorado announced several mergers and acquisitions in 2016.

- Denver-based DCP Midstream Partners LP acquired the assets of a joint venture between Phillips 66 and Spectra Energy Corp. to create the largest natural gas liquids producer and gas processor in the U.S. The \$11 billion combined company will be renamed DCP Midstream LP and will help simplify its corporate structure and expand its projects in key U.S. producing basins, including the Denver-Julesburg Basin.
- Denver-based Liberty Oilfield Services Holdings acquired the U.S. assets of Canada-based Sanjel and has been repairing pumps, blenders, and other equipment from the acquisition. The company also secured \$191 million from existing investors, which allowed the company to increase its staff.
- Denver-based Crestone Peak Resources acquired Encana Oil & Gas Inc.'s oil and gas assets in the DJ Basin, totaling 51,000 acres. The \$900 million deal marked the end of Encana's oil-focused drilling and production operations in the state.
- ARB Midstream LLC acquired a controlling interest in Platte River Gathering System, a pipeline system that gathers crude oil in the DJ Basin. The Platte River pipeline system is capable of gathering up to 157,000 barrels per day from wells scattered across more than 40 miles of pipelines. The system also includes an unloading facility at the Lucerne Hub and plans for storage tanks that can hold up to 600,000 barrels of oil.
- Denver-based Magellan Petroleum Corp. plans to merge with Houston-based Tellurian Investments Inc. to become a liquefied natural gas (LNG) company. The newly formed company will be able to access more attractive financing to build liquefaction plants to export LNG overseas.

ENERGY: Colorado Industry Cluster Profile

Technological Advancements

Several companies and organizations have developed technology to eliminate emissions from oil and natural gas sites. Key announcements in 2016 included:

- Colorado State University (CSU) received a \$3.5 million DOE grant to design, construct, and operate a test facility to simulate and measure methane emissions. The facility will be operated jointly by CSU and the Colorado School of Mines to simulate steps of the natural gas supply chain including underground pipelines, midstream compression, and wet and dry gas production.
- Johnstown-based Oilfield Clean Energy Solutions Inc. and Platteville-based Redi Services, LLC partnered to demonstrate new emissions-eliminating technology. The Phoenix Pyrolytic Technology® removes hydrocarbon emissions and other waste byproducts at oil and natural gas well sites.

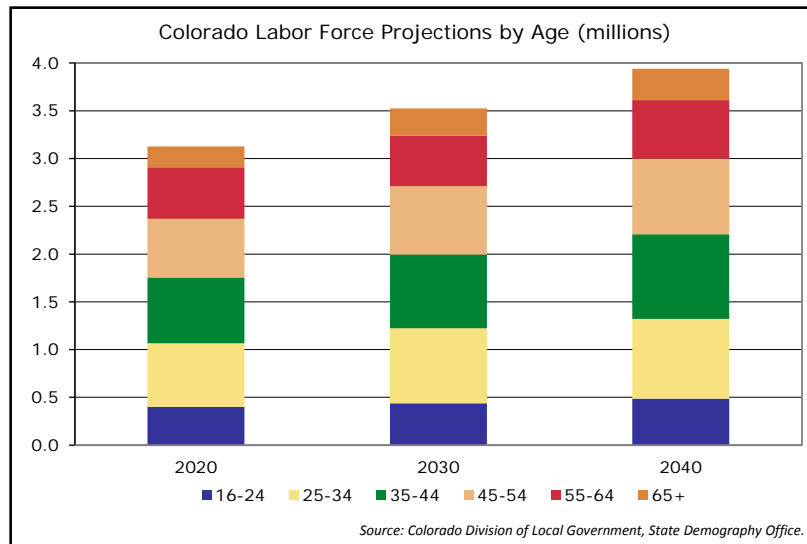
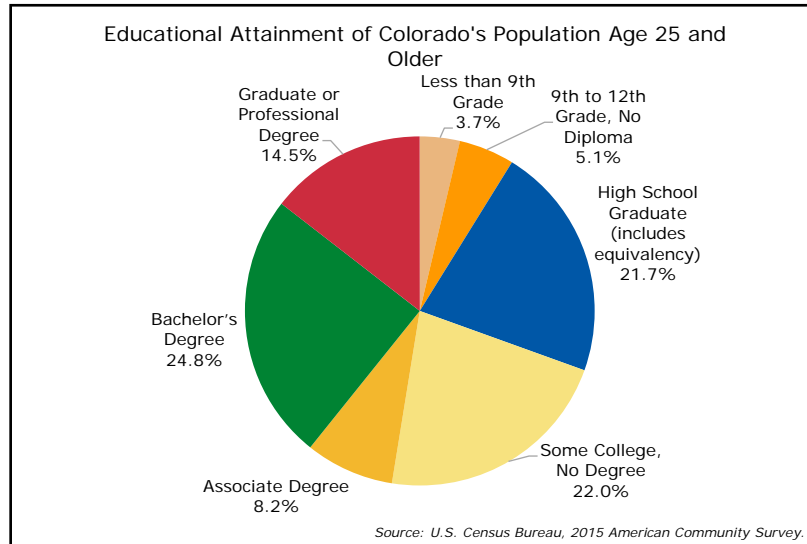
Major Fossil Fuels Companies

- Anadarko Petroleum Corporation
www.anadarko.com
- Antero Resources
www.anteroresources.com
- Arch Coal, Inc. (West Elk Mine)
www.archcoal.com
- Bill Barrett Corp.
www.billbarrettcorp.com
- Black Hills Corporation
www.blackhillscorp.com
- BP America
www.bp.com
- Cimarex Energy
www.cimarex.com
- Colorado Springs Utilities
www.csu.org
- ConocoPhillips Co.
www.conocophillips.com
- Crossfire LLC
www.crossfire-llc.com
- DCP Midstream
www.dcpmidstream.com
- Encana Corporation
www.encana.com
- Halcón Resources Corp.
www.halconresources.com
- Halliburton
www.halliburton.com
- InfraSource, Inc.
www.infrasourceus.com
- Intermountain Rural Electric Association
www.irea.coop
- Kinder Morgan
www.kindermorgan.com
- MarkWest Energy Partners, L.P.
www.markwest.com
- Noble Energy, Inc.
www.nobleenergyinc.com
- Northern Pipeline Construction
www.gonpl.com
- PDC Energy, Inc.
www.pdce.com
- QEP Resources
www.qepres.com
- Schlumberger Ltd.
www.slb.com
- Shell Exploration and Production
www.shell.com
- SM Energy Co.
www.sm-energy.com
- Suncor Energy Inc.
www.suncor.com
- Superior Energy Services Co.
www.superiorenergy.com
- TransMontaigne Inc.
www.transmontaigne.com
- Tri-State Generation & Transmission Assoc.
www.tristategt.org
- TwentyMile Coal Co. (Peabody Energy)
www.peabodyenergy.com
- United Power
www.unitedpower.com
- Westmoreland Coal Company
www.westmoreland.com
- Whiting Petroleum Corp.
www.whiting.com
- Williams
www.co.williams.com
- Xcel Energy
www.xcelenergy.com

Energy Workforce Profile

Many companies choose locations because of the available workforce. With nearly half of Colorado's 5.6 million residents under the age of 35, employers can draw from a large, young, highly educated, and productive workforce. Of Colorado's adult population, 39.2 percent are college graduates and 91.2 percent have graduated from high school. The state has the nation's second-most highly educated workforce as measured by the percentage of residents with a bachelor's degree or higher.

The attractiveness of the state draws new residents through in-migration. The state's population is expected to grow 31.2 percent from 2020 to 2040, driving a 26 percent increase in the state's labor force over the same period. It is important to note the changing composition of the workforce supply as the baby boomers begin to retire, which will pose implications for businesses whose employee pool includes significant numbers of these workers.



ENERGY: Colorado Industry Cluster Profile

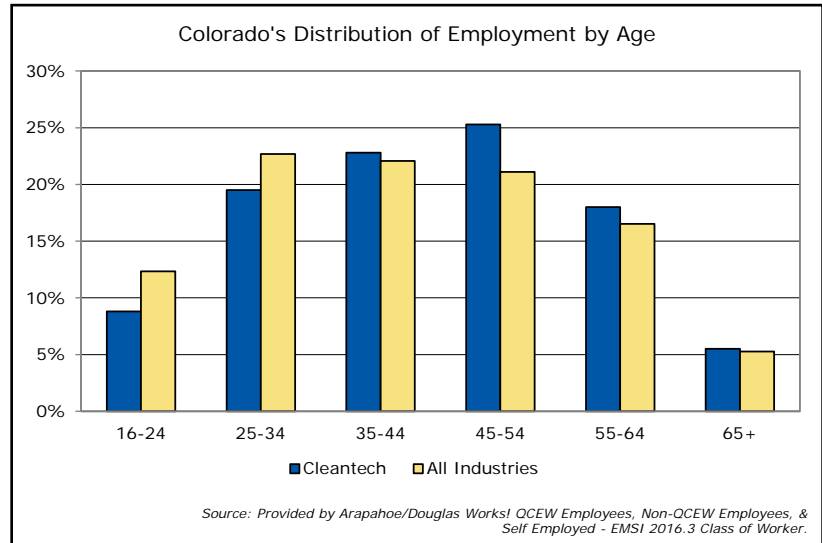
Cleantech Workforce Profile

Age Distribution

Colorado's cleantech industry employs 26,270 people and includes a large pool of talented, well-educated, and highly skilled workers. The cleantech subcluster has a larger share of employees (66.1 percent) that are between the ages of 35 and 64 years old, compared with the age distribution of all industries across the state (59.7 percent).

The cleantech workforce supply consists of four main components: those currently working in the industry; those doing a similar type of job in some other industry; the unemployed; and those currently in the education pipeline. The Colorado Cleantech Occupation & Salary Profile below includes the 10 largest cleantech occupations in the state. For

these 10 largest occupations, the chart details the total number of workers employed in that occupation across all industries, the number of available applicants that would like to be working in that occupation, the number of recent graduates that are qualified for that occupation, and the median and sample percentile annual salaries.



Wages

The 2015 average annual salary for cleantech employees was \$79,100 in Colorado, compared with the national average of \$79,360. Colorado's cleantech payroll reached nearly \$2 billion in 2015.

Colorado Cleantech Occupation & Salary Profile, 2016

10 Largest Cleantech Occupations in Colorado	Total Working Across All Industries (2016)	Number of Available Applicants (2016)	Number of Graduates (2015)	Median Salary	10th Percentile Salary	25th Percentile Salary	75th Percentile Salary	90th Percentile Salary
1. Electricians	18,705	23	698	\$45,136	\$28,480	\$35,024	\$57,884	\$70,084
2. Business operations specialists, all other	42,503	1,658	53	\$73,112	\$40,186	\$53,560	\$95,971	\$123,989
3. Engineers	43,856	1,670	3,662	\$95,350	\$60,821	\$75,672	\$120,682	\$148,458
4. Plumbers, pipefitters, & steamfitters	10,281	47	73	\$46,381	\$30,699	\$37,231	\$58,408	\$67,325
5. Secretaries & administrative assistants, except legal, medical, & executive	65,910	7,250	65	\$35,568	\$22,963	\$28,600	\$43,680	\$52,478
6. Office clerks, general	48,315	5,315	0	\$34,861	\$20,842	\$26,458	\$45,739	\$57,866
7. Heating, air conditioning, & refrigeration mechanics & installers	6,376	75	331	\$51,917	\$34,103	\$42,356	\$60,451	\$71,833
8. Physical scientists	10,536	396	1,390	\$87,756	\$51,244	\$65,552	\$115,786	\$143,049
9. Information & record clerks, all other	9,051	81	0	\$39,730	\$27,099	\$32,642	\$47,628	\$58,662
10. General & operations managers	43,197	2,005	10,870	\$104,745	\$47,471	\$69,510	\$161,993	\$237,759

Notes: The number of available applicants is a point-in-time measurement of the number of people who have registered in Colorado's workforce development system's statewide database, Connecting Colorado, as being able and available to work in a particular occupation. Results should be interpreted with caution since registration in Connecting Colorado is self-reported. In addition, the skills rubric may assign up to four occupation codes for each registrant. Therefore, the number of available applicants could be inflated. Source: Provided by Arapahoe/Douglas Works!; QCEW Employees, Non-QCEW Employees, & Self Employed - EMSI 2016.3 Class of Worker.

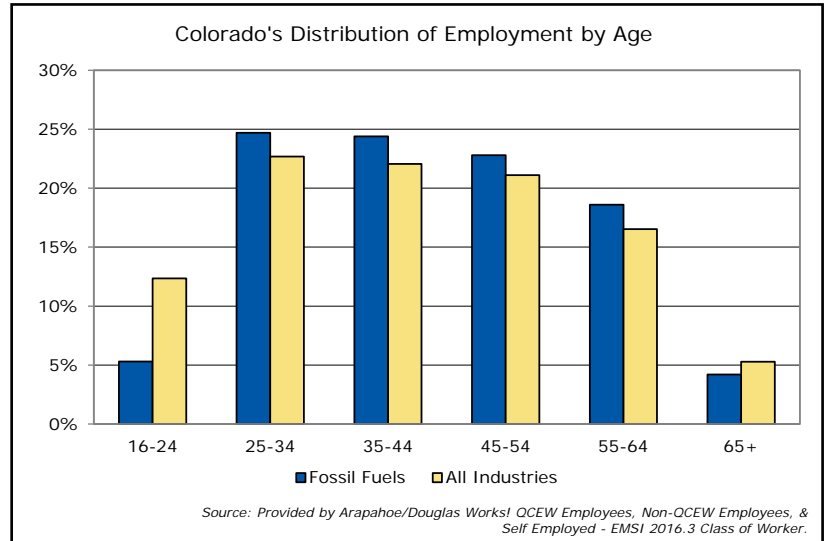
ENERGY: Colorado Industry Cluster Profile

Fossil Fuels Workforce Profile

Age Distribution

Colorado's fossil fuels industry employs 44,370 people and includes a large pool of talented, well-educated, and highly skilled workers. The fossil fuels subcluster has a larger share of employees (90.5 percent) that are between the ages of 25 and 64 years old, compared with the age distribution across all industries (82.4 percent).

The fossil fuels workforce supply consists of four main components: those currently working in the industry; those doing a similar type of job in some other industry; the unemployed; and those currently in the education pipeline. The Colorado Fossil Fuels Occupation & Salary Profile below includes the 10 largest fossil fuels occupations in the state. For these 10 largest occupations, the chart details the total number of workers employed in that occupation across all industries, the number of available applicants that would like to be working in that occupation, the number of recent graduates that are qualified for that occupation, and the median and sample percentile annual salaries.



Wages

Wages in the fossil fuels subcluster are among the highest across all industry clusters. The 2015 average annual salary for a fossil fuels worker was \$107,000 in Colorado, compared with the national average of \$101,670. Colorado's fossil fuels payroll reached nearly \$5 billion in 2015.

Colorado Fossil Fuels Occupation & Salary Profile, 2016

10 Largest Fossil Fuels Occupations in Colorado	Total Working Across All Industries (2016)	Number of Available Applicants (2016)	Number of Graduates (2015)	Median Salary	10th Percentile Salary	25th Percentile Salary	75th Percentile Salary	90th Percentile Salary
1. Civil engineers	8,504	163	473	\$79,712	\$52,151	\$64,218	\$101,175	\$128,506
2. Mechanical engineers	6,457	317	837	\$83,174	\$54,284	\$66,623	\$109,304	\$137,333
3. Service unit operators, oil, gas, & mining	2,523	132	0	\$45,720	\$32,492	\$37,956	\$54,035	\$66,987
4. Roustabouts, oil & gas	2,624	313	0	\$38,818	\$27,910	\$32,502	\$48,684	\$60,277
5. Secretaries & administrative assistants, except legal, medical, & executive	65,910	7,250	65	\$35,568	\$22,963	\$28,600	\$43,680	\$52,478
6. Business operations specialists, all other	42,503	1,658	53	\$73,112	\$40,186	\$53,560	\$95,971	\$123,989
7. Construction laborers	30,267	2,903	17	\$30,958	\$22,164	\$26,268	\$35,805	\$41,996
8. Accountants & auditors	37,977	1,481	1,242	\$66,622	\$41,434	\$51,667	\$87,568	\$113,734
9. Electrical power-line installers & repairers	2,345	41	123	\$68,558	\$39,520	\$52,590	\$83,706	\$94,982
10. First-line supervisors of construction trades & extraction workers	15,604	480	1,113	\$60,214	\$39,461	\$48,929	\$73,908	\$90,488

Notes: The number of available applicants is a point-in-time measurement of the number of people who have registered in Colorado's workforce development system's statewide database, Connecting Colorado, as being able and available to work in a particular occupation. Results should be interpreted with caution since registration in Connecting Colorado is self-reported. In addition, the skills rubric may assign up to four occupation codes for each registrant. Therefore, the number of available applicants could be inflated. Source: Provided by Arapahoe/Douglas Works!, QCEW Employees, Non-QCEW Employees, & Self Employed - EMSI 2016.3 Class of Worker.

ENERGY: Colorado Industry Cluster Profile

Education & Training

Colorado's higher education system provides an excellent support system for businesses in the state. There are 28 public higher education institutions in Colorado, consisting of 13 four-year and 15 two-year public institutions offering comprehensive curricula. In addition, there are more than 100 private and religious accredited institutions and more than 350 private occupational and technical schools offering courses in dozens of program areas throughout the state. Although not exhaustive, a list of the major, accredited educational institutions with the greatest number of graduates for each of the 10 largest energy occupations in Colorado are included below. A directory of all higher education institutions with corresponding websites may be accessed via <http://highered.colorado.gov>.

- Colorado School of Mines
www.mines.edu
- Colorado State University
www.colostate.edu
- Colorado State University Global Campus
www.colostate.edu
- Colorado Technical University Online
www.coloradotech.edu
- Ecotech Institute
www.ecotechinstitute.com
- Front Range Community College
www.frontrange.edu
- Emily Griffith Technical College
www.emilygriffith.edu
- Metropolitan State University of Denver
www.msudenver.edu
- Regis University
www.regis.edu
- University of Colorado: Boulder, Colorado Springs, Denver
www.cu.edu
- University of Denver
www.du.edu

Key Reasons for Energy Companies to Locate in Colorado

Colorado is a top-10 fossil fuels location offering access to one of the most energy rich regions in the United States.

- **Coal** - Colorado was the 11th-largest coal-producing state in the nation in 2015 and borders Wyoming, the nation's largest coal producer. Colorado produced 18.9 million short tons of coal, representing 2.1 percent of the nationwide supply in 2015. (U.S. Department of Energy, Energy Information Administration, 2016)
- **Natural Gas** - Colorado ranked sixth among natural-gas producing states, accounting for 6.2 percent of U.S. natural gas production. Colorado was the leading producer of coalbed methane and has the largest reserves of coalbed methane in the nation, representing nearly 30 percent of the nation's total production. (U.S. Department of Energy, Energy Information Administration, 2016)
 - The Rockies Express Pipeline (REX) is one of the largest natural gas pipelines ever constructed in the nation, measuring more than 1,700 miles in length. The pipeline extends from northwestern Colorado to eastern Ohio and has 1.8 billion cubic feet per day of long-haul design capacity. REX has recently begun firm service from Appalachian basins to Midwest Markets. (U.S. Department of Energy, Energy Information Administration, 2016; Tallgrass Energy, 2016)
- **Oil** - Colorado ranked as the nation's seventh-largest oil producer, reaching its highest level on record with 126 million barrels of crude oil in 2015. Colorado ranked sixth in the number of active rotary rigs as of September 2016, and Colorado had the seventh-highest proven oil reserves in the nation totaling 1,451 million barrels in 2014. (U.S. Department of Energy, Energy Information Administration, 2015; Baker Hughes, 2016; Colorado Oil and Gas Conservation Commission, 2016)
- Colorado is home to the fourth-largest U.S. oil field and 11 of the nation's 100 largest natural gas fields are located wholly or partly in the state. (U.S. Department of Energy, Energy Information Administration, 2016)
- Colorado ranked first nationwide in National Science Foundation (NSF) geoscience awards—more than \$1.3 billion—or 28 percent of the nation's total in 2009. The funding represents about \$864 per capita in NSF geoscience awards. (National Science Foundation, 2009)

ENERGY: Colorado Industry Cluster Profile

Colorado is a top-10 cleantech location with access to clean energy resources and robust renewable energy generation requirements.

- **Wind** - Colorado ranked as the eighth-largest generator of wind energy in the nation and ranked 10th for total installed wind power capacity as of October 2016. Wind provided more than 14 percent of all in-state electricity production. (U.S. Department of Energy, Energy Information Administration, 2016; American Wind Energy Association, 2016)
 - Colorado ranked ninth in utility-scale wind generation in 2015. (Clean Edge, Inc., 2016)
 - Colorado ranked first for the number of facilities that manufacture major components of utility-scale wind turbines and ranked fourth in the nation for wind power capacity additions in 2015. (American Wind Energy Association, 2016)
- **Biomass** - Colorado more than doubled its biomass electricity generation between 2010 and 2015. While biomass accounts for nearly 2 percent of the state's renewable energy generation, roughly 25 percent of the state's 24 million acres of forestland have high or moderate potential for future biomass production. (U.S. Department of Energy, Energy Information Administration, 2016)
- **Solar** - Colorado ranked ninth in the nation for total installed solar capacity in 2016, with 574 megawatts (MW) and 109,000 solar-powered homes. (Solar Energy Industries Association, 2016)
 - Southern Colorado has four solar energy zones that could produce over 1,800 MW of energy when fully developed, enough to power over 700,000 homes. (U.S. Department of the Interior, 2016)
 - Colorado ranked among the top 10 solar-friendly states in 2016. (SolarPowerRocks.com, 2016)
 - Colorado had the 10th-most solar power capacity per capita in the nation, totaling 99 watts per person in 2015. (Environment America Research & Policy Center, 2016)
- **Water** - Hydroelectric power accounted for nearly 19 percent of Colorado's renewable net electricity generation in 2015, the second-largest share behind wind power. The state has more than 100 existing and potential hydropower facilities. (U.S. Department of Energy, Energy Information Administration, 2016; Colorado Energy Office, 2016)
- Colorado ranked 11th in the nation for renewable energy generation in 2014 (excluding hydroelectric power) and ranked among the top 20 in the nation for the percent of electricity generated from renewable resources. (U.S. Department of Energy, Energy Information Administration, 2016)
- Colorado ranked sixth on the Clean Edge 2016 "U.S. Clean Tech Leadership Index." (Clean Edge, Inc., 2016)
- Colorado ranked fifth in the nation for the number of Leadership in Energy and Environmental Design (LEED)-certified buildings per capita. (U.S. Green Building Council, 2016)
- Colorado ranked as the second-least expensive energy state in the nation and had the third-lowest monthly electricity cost in 2016. (WalletHub, 2016)
- Colorado ranked among the top 10 states in electric, hybrid, and plug-in vehicles per one million residents in 2015. (Clean Edge, Inc., 2016)

Colorado is at the forefront of energy development, with a location that offers:

1. The ability to recruit and retain senior management and scientific talent

- Colorado has one of the nation's most educated workforces, ranking second among the 50 states for percentage of residents (39.2 percent) with a bachelor's degree or higher. (U.S. Census Bureau, 2015 American Community Survey)
- Colorado ranked ninth in the nation for the number of science, engineering, and health doctorate holders as a percent of the workforce. (National Science Foundation, 2015)
- Colorado ranked among the top 10 states for solar jobs per capita and total solar employment. (The Solar Foundation, 2016)
- Colorado ranked among the top five states for wind-related employment, accounting for nearly 7 percent of the nation's total wind-related jobs in 2015. (American Wind Energy Association, 2016)
- Colorado ranked fifth in the nation for the number of new clean energy jobs created in 2015, with 2,650 new clean energy jobs announced during the year. (Environmental Entrepreneurs, 2016)

2. Proximity to energy-related higher education programs and research centers

- Colorado ranked ninth for the number of science, engineering, and health graduate students per 1,000 individuals ages 25 to 34 years old in 2013. (National Science Foundation, 2015)
- Colorado School of Mines is one of the few universities in the world to offer programs from baccalaureate through doctorate levels in all key fields related to energy and is the only institution in the world that offers doctoral programs in five of the major earth science disciplines. (Colorado School of Mines, 2016)

ENERGY: Colorado Industry Cluster Profile

- The Education Corporation of America's Ecotech Institute in Aurora is the world's first and only college entirely focused on preparing graduates for careers in cleantech through eight associate degree programs. In 2016, Ecotech Training launched to provide cleantech courses and certifications to individuals across the nation. (Ecotech Institute, 2016)
- The Colorado State University (CSU) Energy Institute is the central, unifying hub of scholarly excellence in energy-related research, education, and outreach. Headquartered at CSU's Powerhouse Energy Campus, the Institute aims to increase collaboration with industry and governmental partners to solve energy problems and create new research and educational opportunities. (Colorado State University, 2016)
- The Solar Technology Acceleration Center (SolarTAC) is the largest test facility for solar technologies in the U.S., occupying 74-acres at the 1,760-acre Aurora Campus for Renewable Energy. (The Solar Technology Acceleration Center, 2016)

3. Access to the research of a broad collection of federal laboratories and private R&D activities

- Key federal offices located in Colorado include the National Center for Atmospheric Research; the Office of Surface Mining Reclamation and Enforcement; the U.S. Bureau of Land Management; the U.S. Bureau of Ocean Energy Management, Regulation and Enforcement; the U.S. Bureau of Reclamation; the U.S. Forest Service; the U.S. Department of Energy; the U.S. Environmental Protection Agency; the U.S. Geological Survey; and the Western Area Power Administration.
- Firms with fossil fuel energy R&D programs include Anadarko Petroleum, BP America, Encana, Noble Energy, Shell Exploration & Production, and Suncor Energy.

4. Business organizations and public policy programs designed to encourage industry growth.

- Legislation passed in 2016 expands existing tax credits for alternative fuel vehicle (AFV) purchases. House Bill 1332 (2016) provides between \$5,000 and \$20,000 for the purchase or conversion of a light-medium or heavy-duty AFV.
- Sales and use tax is exempt for equipment used in R&D of medical devices or clean technology. The exemption refunds up to \$50,000 per year in sales and use taxes for companies with less than 35 employees and more than 50 percent employed in Colorado. (Exemption clarified in Colorado House Bill 15-1180)
- The Colorado Energy Coalition (CEC) is a consortium of leaders and stakeholders dedicated to strengthening the business climate in Colorado supporting all sectors of the energy industry. The CEC's mission is to brand Colorado as the Balanced Energy Capital of the West. (Metro Denver EDC, 2016)
- The Colorado Clean Energy Cluster (CCEC) is an economic development organization dedicated to growing clean energy jobs and aims to expand the clean energy sector through innovative and entrepreneurial projects and initiatives. CCEC's initiatives include FortZED, the International Cleantech Network, C3E, and Net Zero Water. (The Colorado Clean Energy Cluster, 2016)
- The Advanced Industries Accelerator (AIA) Programs promote growth and sustainability in Colorado's advanced industries, including advanced manufacturing, aerospace, bioscience, electronics, energy and natural resources, infrastructure engineering, and technology and information. Since 2013, the AIA program has granted over \$35 million to nearly 230 organizations. These industries account for nearly 30 percent of the state's wage earnings, nearly 30 percent of the total sales revenue across all industries, and nearly 35 percent of the state's total exports. (The Colorado Office of Economic Development and International Trade, 2016)

Energy Industry Cluster Definition

NAICS Code*	NAICS Description	SIC Code	SIC Description
Fossil Fuels			
211111	Crude petroleum & natural gas extraction	1311	Crude petroleum & natural gas
211112	Natural gas liquid extraction	1321	Natural gas liquids
212111	Bituminous coal & lignite surface mining	1221	Bituminous coal & lignite surface mining
212112	Bituminous coal underground mining	1222	Bituminous coal underground mining
212291	Uranium-radium-vanadium ore mining	1094	Uranium-radium-vanadium ores
213111	Drilling oil & gas wells	1381	Drilling oil & gas wells
213112	Support activities for oil & gas operations	1382	Oil & gas field exploration services

ENERGY: Colorado Industry Cluster Profile

Energy Industry Cluster Definition Cont'd

NAICS Code*	NAICS Description	SIC Code	SIC Description
213112	Support activities for oil & gas operations	1389	Oil & gas field services, NEC
213113	Support activities for coal mining	1241	Coal mining services
221111	Hydroelectric power generation	4911	Electric services
221111	Hydroelectric power generation	4931	Electric & other services combined
221111	Hydroelectric power generation	4939	Combination utilities, NEC
221112	Fossil fuel electric power generation	4911	Electric services
221112	Fossil fuel electric power generation	4931	Electric & other services combined
221112	Fossil fuel electric power generation	4939	Combination utilities, NEC
221113	Nuclear electric power generation	4911	Electric services
221113	Nuclear electric power generation	4931	Electric & other services combined
221113	Nuclear electric power generation	4939	Combination utilities, NEC
221121	Electric bulk power transmission & control	4911	Electric services
221121	Electric bulk power transmission & control	4931	Electric & other services combined
221121	Electric bulk power transmission & control	4939	Combination utilities, NEC
221122	Electric power distribution	4911	Electric services
221122	Electric power distribution	4931	Electric & other services combined
221122	Electric power distribution	4939	Combination utilities, NEC
221210	Natural gas distribution	4923	Natural gas transmission & distribution
221210	Natural gas distribution	4924	Natural gas distribution
221210	Natural gas distribution	4925	Mixed, manufactured, or liquefied petroleum gas production and/or distribution
221210	Natural gas distribution	4931	Electric & other services combined
221210	Natural gas distribution	4932	Gas & other services combined
221210	Natural gas distribution	4939	Combination utilities, NEC
237120	Oil & gas pipeline & related structures construction	1623-00	Water, sewer, & utility lines
237120	Oil & gas pipeline & related structures construction	1623-01	Oil, gas line & compressor station construction
237120	Oil & gas pipeline & related structures construction	1623-9900	Water, sewer, & utility lines, NEC
237120	Oil & gas pipeline & related structures construction	1623-9903	Pipe laying construction
237120	Oil & gas pipeline & related structures construction	1623-9904	Pipeline construction, nsk
237130	(P) Power & communication line & related structures construction	1623-9901	Electric power line construction
237130	(P) Power & communication line & related structures construction	1623-9906	Underground utilities contractor
237130	(P) Power & communication line & related structures construction	1629-0503	Oil refinery construction
237130	(P) Power & communication line & related structures construction	1629-9905	Power plant construction
324110	Petroleum refineries	2911	Petroleum refining
325110	Petrochemical mfg.	2869-04	Fuels
333131	Mining machinery & equipment mfg.	3532	Mining machine & equip., except oil & gas field machine & equip.
333132	Oil & gas field machinery & equipment mfg.	3533	Oil & gas field machinery & equipment
423520	(P) Coal & other mineral & ore merchant wholesalers	5052	Coal & other minerals & ores
486110	Pipeline transportation of crude oil	4612	Crude petroleum pipelines
486210	Pipeline transportation of natural gas	4922	Natural gas transmission
486210	Pipeline transportation of natural gas	4923	Natural gas transmission & distribution
486910	Pipeline transportation of refined petroleum prod.	4613	Refined petroleum pipelines
523910	(P) Misc. intermediation	6792	Oil royalty traders
523999	(P) Misc. financial investment activities	6211-0303	Oil & gas lease brokers
523999	(P) Misc. financial investment activities	6211-0304	Oil royalties dealers
533110	(P) Lessors of nonfinancial intangible assets (except copyrighted works)	6792	Oil royalty traders
541330	(P) Engineering services	8711-03	Petroleum, mining, & chemical engineers
541360	(P) Geophysical surveying & mapping services	1382	Oil & gas field exploration services

ENERGY: Colorado Industry Cluster Profile

Energy Industry Cluster Definition Cont'd				
NAICS Code*	NAICS Description	SIC Code	SIC Description	
Cleantech				
221114**	Solar electric power generation			
221115**	Wind electric power generation			
221116**	Geothermal electric power generation			
221117**	Biomass electric power generation			
221118**	Other electric power generation			
221330	(P) Steam & air-conditioning supply	4961-9904	Steam supply systems, including geothermal	
237110	(P) Water & sewer line & related structures construction	1781-9901	Geothermal drilling	
238210	(P) Electrical contract. & other wiring install. contractors	1731-0202	Energy management controls	
238220	(P) Plumbing, heating & air-conditioning contractors	1711-0403	Solar energy contractor	
238310	(P) Drywall & insulation contractors	1742-0204	Solar reflecting insulation film	
314994	(P) Rope, cordage, twine, tire cord, & tire fabric mills	2296-03	Cord & fabric for reinforcing fuel cells	
325180	(P) Other basic inorganic chemical mfg.	2819-06	Fuels & radioactive compounds	
325193	Ethyl alcohol mfg.	2869-0104	Ethyl alcohol, ethanol	
333414	(P) Heating equipment (except warm air furnaces) mfg.	3433-9904	Solar heaters & collectors	
333611	(P) Turbine & turbine generator set units mfg.	3511	Turbines & turbine generator sets	
334413	(P) Semiconductor & related device mfg.	3674-0305	Photovoltaic devices, solid state	
334413	(P) Semiconductor & related device mfg.	3674-0306	Solar cells	
334413	(P) Semiconductor & related device mfg.	3674-9901	Fuel cells, solid state	
334512	Automatic environmental control mfg. for residential, commercial, & appliance use	3822	Environmental controls	
334515	(P) Instrument mfg. for measuring & testing electricity & electrical signals	3825-0305	Electrical power measuring equipment	
334515	(P) Instrument mfg. for measuring & testing electricity & electrical signals	3825-0306	Energy measuring equipment, electrical	
334519	(P) Other measuring & controlling device mfg.	3829-0218	Solarimeters	
335311	(P) Power, distribution, & specialty transformer mfg.	3612	Power, distribution, & specialty transformers	
335312	(P) Motor & generator mfg.	3621-03	Control equipment for electric buses & locomotives	
335312	(P) Motor & generator mfg.	3621-9909	Windmills, electric generating	
335911	Storage battery mfg.	3691	Storage batteries	
335999	(P) All other misc. electrical equipment & component mfg.	3629-0102	Electrochemical generators (fuel cells)	
336111	(P) Automobile mfg.	3711-0104	Cars, electric, assembly of	
336390	(P) Other motor vehicle parts mfg.	3799-0302	Cars, off-highway: electric	
423720	(P) Plumbing & heating equipment & supplies (hydronics) merchant wholesalers	5074-0208	Heating equipment & panels, solar	
482111	(P) Line-haul railroads	4011-9901	Electric railroads	
541380	(P) Testing laboratories	8734-00	Testing laboratories	
541380	(P) Testing laboratories	8734-9902	Calibration & certification	
541620	(P) Environmental consulting services	8748-9905	Environmental consultant	
541620	(P) Environmental consulting services	8999-07	Earth science services	
541620	(P) Environmental consulting services	8999-09	Scientific consulting	
541690	(P) Other scientific & technical consulting services	8748-9904	Energy conservation consultant	
541712	(P) Research & development in the physical, engineering, & life sciences (except biotechnology)	8731-03	Natural resource research	
541712	(P) Research & development in the physical, engineering, & life sciences (except biotechnology)	8733-9902	Research institute	
924110	(P) Administration of air & water resource & solid waste management programs	9511-00	Air, water, & solid waste management	

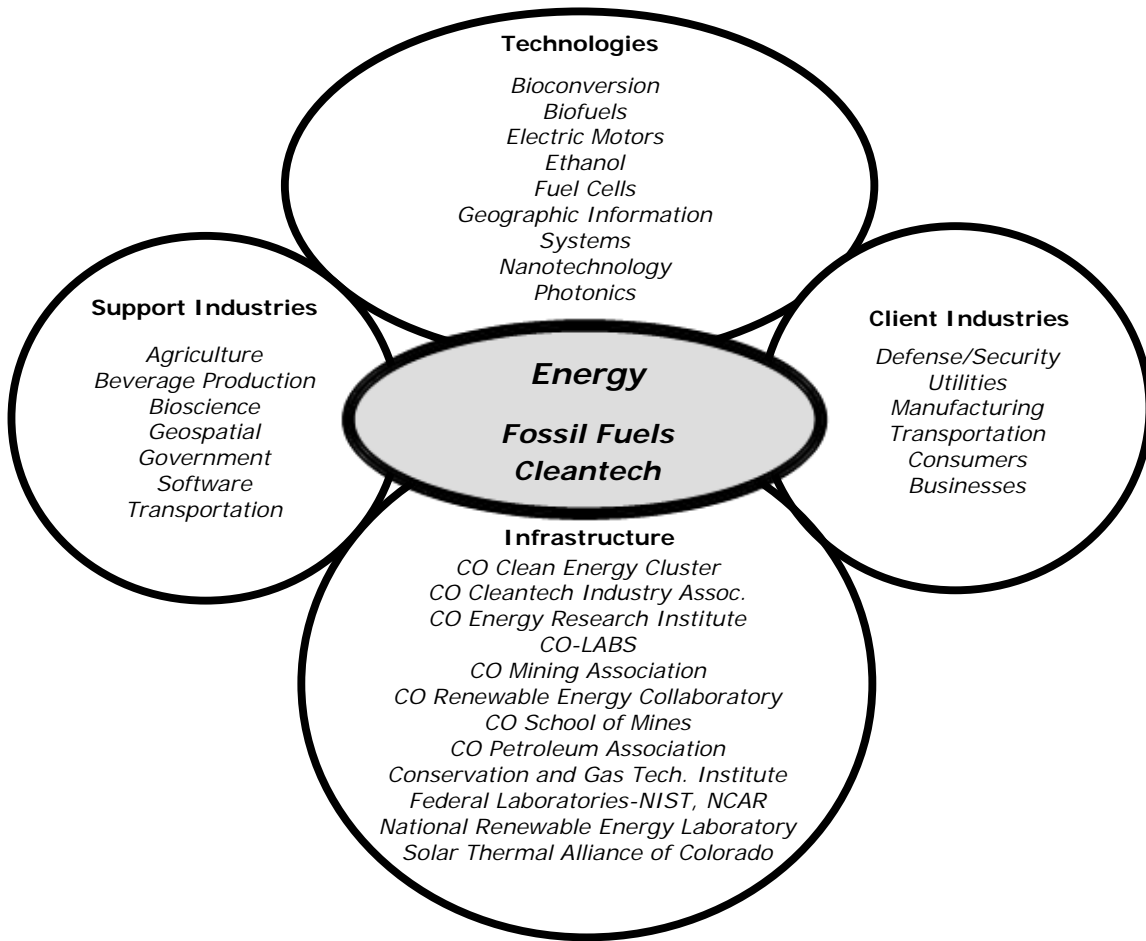
*(P) indicates that only part of the NAICS industry category is represented in the industry cluster definition.

**The NAICS codes are reviewed every five years for potential revisions to reflect new and emerging industries and to allow for industry changes. In 2012, NAICS code 221119 was reclassified into five new industries to distinguish solar (221114), wind (221115), geothermal (221116), biomass (221117), and other electric (221118) power generation. As a result, 221119 was removed from fossil fuels and reclassified into cleantech. Data is limited or not yet available for these five new industries.

Note: NEC indicates "not elsewhere classified."



Energy Industry Cluster Relationships



For additional information, contact us:



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