

COLORADO:

Oil & Natural Gas Resource Guide



COLORADO
OIL & GAS
ASSOCIATION

2020



Hello,

Colorado is a national leader when it comes to oil and natural gas development.

This industry is a pillar of our state's economy, and we've worked with our regulators for years to implement comprehensive oil and gas rules that are arguably the toughest in the world. Our top priority in that effort has been and will always be safety. Protecting our employees, the communities where we operate and the air, water and lands that we all value as Coloradans.

The resource guide that follows summarizes the work that has taken place and describes many of the positive results we have experienced. We believe it is far better to produce our energy right here at home, than to rely on other countries for those same resources -- countries that often maintain poor labor standards and less than desirable environmental protections.

With employees that live and work along the Front Range and throughout the West Slope, we can ensure a high quality, Colorado-based product that can be sustainably developed for decades to come.

As you read this document, should you have any questions, please do not hesitate to contact us.

Sincerely,

A handwritten signature in dark ink, appearing to read "Dan Haley". The signature is fluid and cursive, with the first name "Dan" and last name "Haley" clearly distinguishable.

Dan Haley
President & CEO
Colorado Oil & Gas Association



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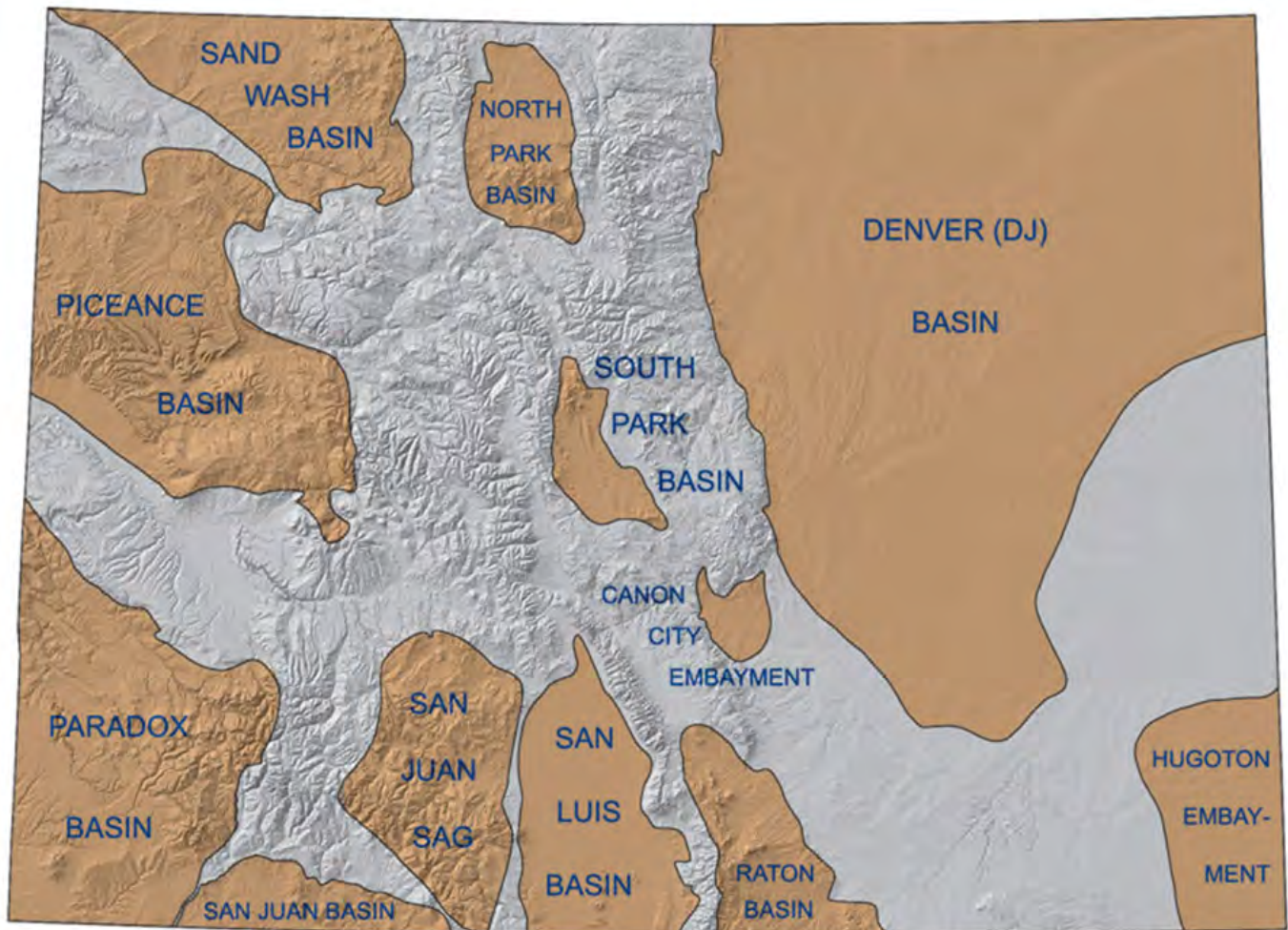
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Oil & Natural Gas Development 101

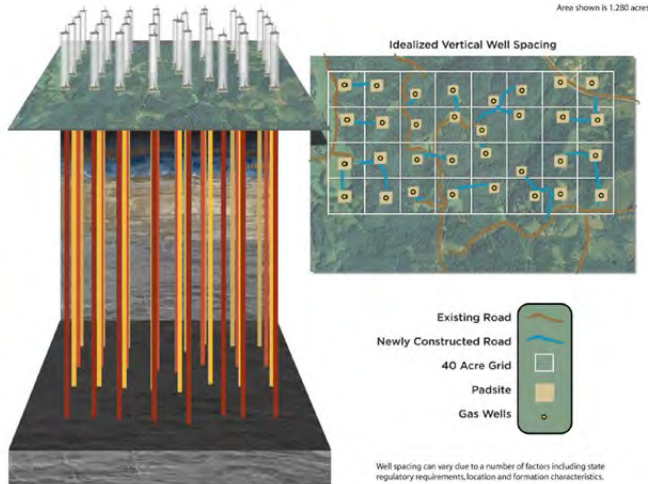
History of Colorado's Oil & Gas Industry

- First US well drilled in 1859
- First CO well drilled 1860
- Boulder Oilfield developed, 1901
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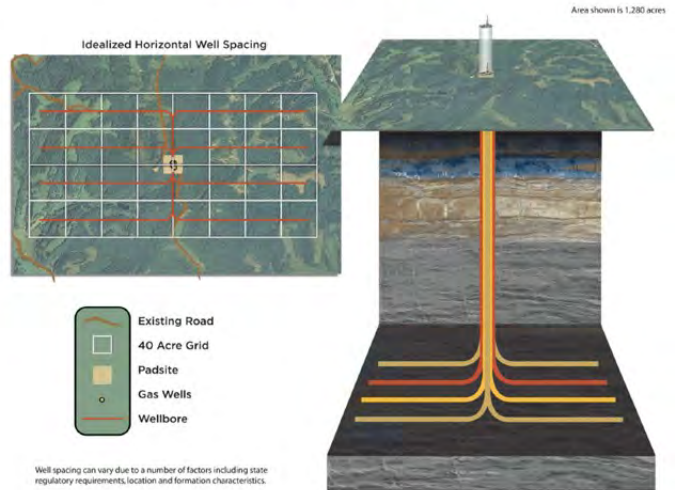


Drilling Footprint

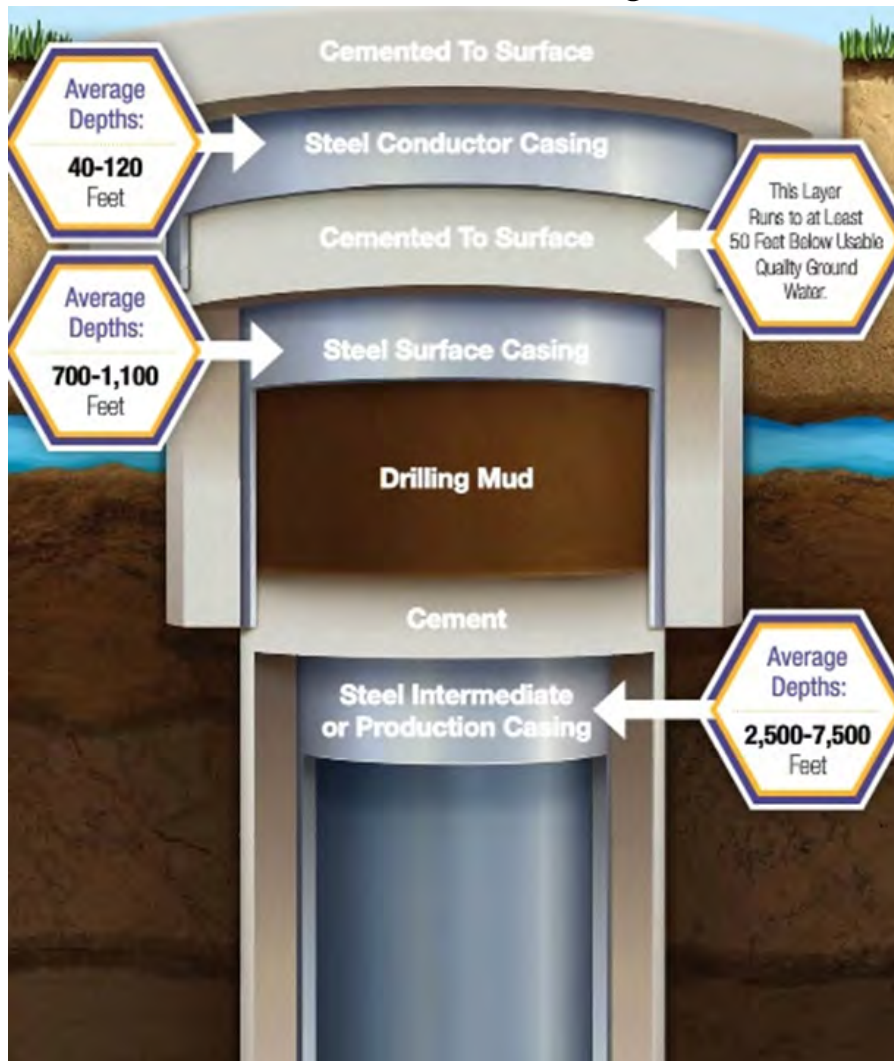
Vertical Drilling



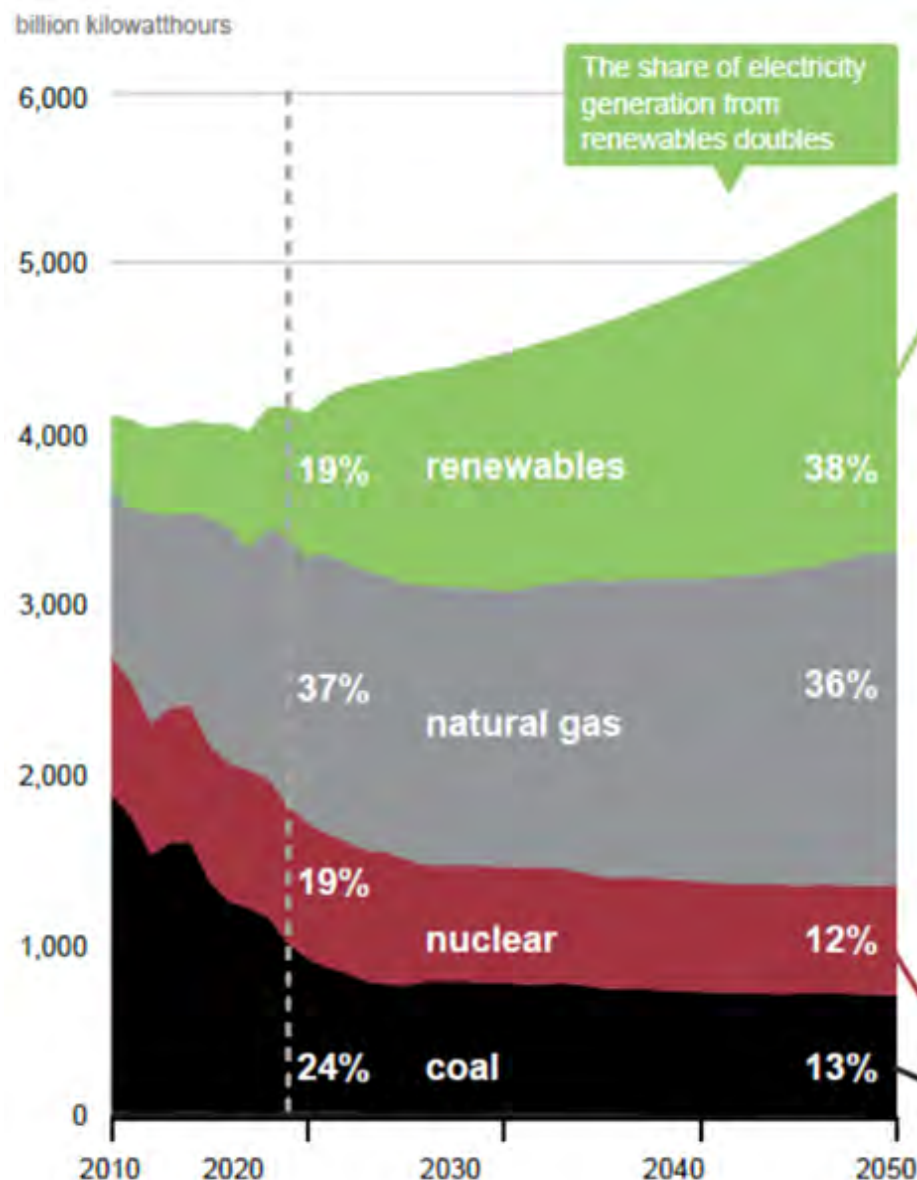
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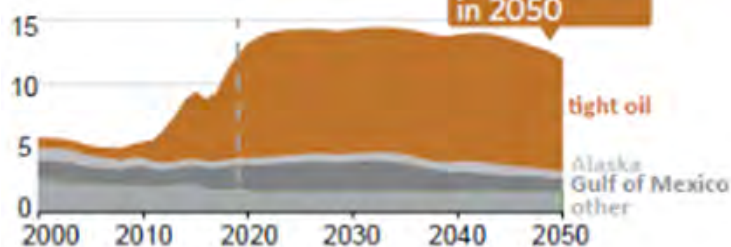
U.S. Forecasted Energy Mix



U.S. Energy Information Administration

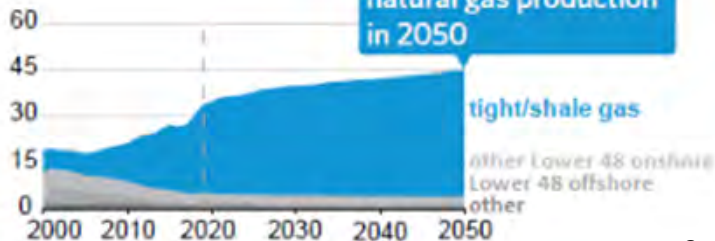
crude oil...

U.S. crude oil production
million barrels per day



and natural gas.

Dry natural gas production by type
trillion cubic feet

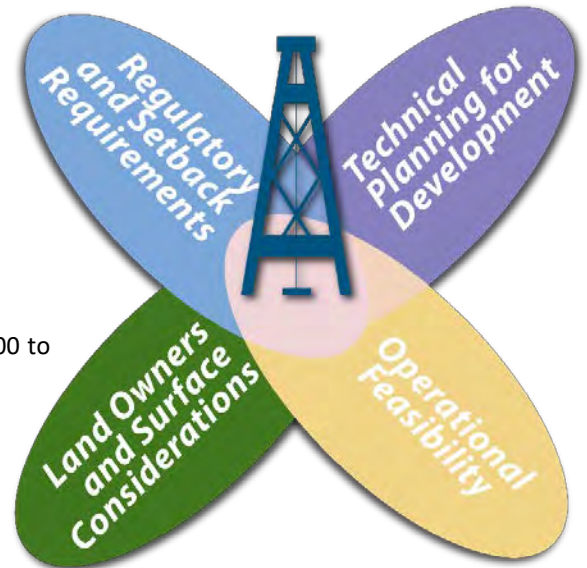




Siting an oil and natural gas facility involves several factors, starting with mineral ownership and an operator's ability to physically access that property with modern horizontal drilling practices, and ending with conditional requirements often required by local governments.

The overall success of an oil and natural gas development location begins with preliminary site analysis. That includes factors like surface access to minerals based on existing community development and zoning, environmental impacts, safety, geology, topography, adequate vehicle access to and from the site, wildlife, ecologically sensitive areas, floodplain limitations, stormwater control, and much more. In addition to the site analysis characteristics, economic balance must be considered prior to any development proposal begins to ensure that the project will be financially solvent.

Historically, operators would drill single wells accessing an area of about 400 to 500 feet, with the requirement of drilling many different surface locations. Modern practices allow operators to drill horizontally up to 1.5 to 2 miles away from a single location. This allows for contemporary pad sites where multiple wells are drilled, creating economies of scale for oil and natural gas operations and the use of cost-effective emission reduction controls, which greatly reduces the environmental footprint at the surface while also improving air quality in the long run.



Site Selection

Each area of consideration is coordinated through a diverse set of specialized staff who analyze technical data, ownership information, negotiate surface locations, determine regulatory requirements and assess operational viability all while looking through the lens of compliance, safety and environmental responsibility.

Technical Planning for Development

Development Rights: Development leases, which are the contracts between the operator and mineral owners, grant an operator surface access and the right to drill in exchange for an ongoing payment to the mineral owner based on production, which is called a royalty.

Geologic Evaluation: Identifying and characterizing the geology of the resource, such as rock [porosity](#), [permeability](#), and subsurface [faulting](#), is critical. That analysis also includes reviewing previous development (both vertical and horizontal) within the area of interest. This evaluation looks at the ideal horizontal length of the proposed wellbores, the best portion of the formation to target, and the economics.

Drilling Evaluation: Drilling staff must assess and determine drilling location feasibility, including proposed distances, likely torque and drag that will occur while drilling, and identification of historical wells to prevent collisions with existing infrastructure. Staff will establish rig-specific requirements for all proposed locations and provide guidance on the surface footprint required for development. (See "[directional drilling](#).")

Completions Assessment: The Completions team must also review and comment on proposed wellbore configurations, develop a detailed water plan to include sourcing, transportation, and storage of water, and assess other operations in the area to avoid possible interference.



Land Owners and Surface Considerations

Land Due Diligence: Staff will conduct thorough title reviews to determine the most viable well and production facility siting options. This effort includes a comprehensive review of surface and mineral ownership, existing and planned or potential future use of surface properties, and an initial understanding of surface owners' support for development of oil and natural gas.

Surface Owners Rights: In Colorado, both the surface and mineral owner have established legal rights and protections which arise under statutory and common law (court cases). The best means of mutually accommodating each owner's rights is through open engagement and proactively working to address any questions or desires.

1. The [Reasonable Accommodation Doctrine](#) - Mineral owners must reasonably accommodate surface use.
2. Surface Owner's Protection Act (2007 Colorado state statute) - Requires the negotiation of a surface owner agreement between the surface owner and the oil and natural gas company.

Surface Owner Consultation and Negotiations: When locations are proposed, comprehensive surface-related impacts and decisions are discussed with surface owners when siting a well and/or production facility, for example: disturbance area, well count and spacing, road access, power, flowlines and pipelines, crops, construction, environmental mitigation, and surface reclamation, which are then formalized in a contract between the surface owner and company.

Regulatory and Setback Requirements

Setback Regulations: Well siting decisions are highly influenced by the regulatory framework governed by the Colorado Oil and Gas Conservation Commission, which can include minimum setback requirements from occupied structures, property lines, roads, and other considerations. Often, these matters are specifically addressed in contract language, or they may trigger additional regulatory processes once a siting/location preference is determined.

Operational Feasibility

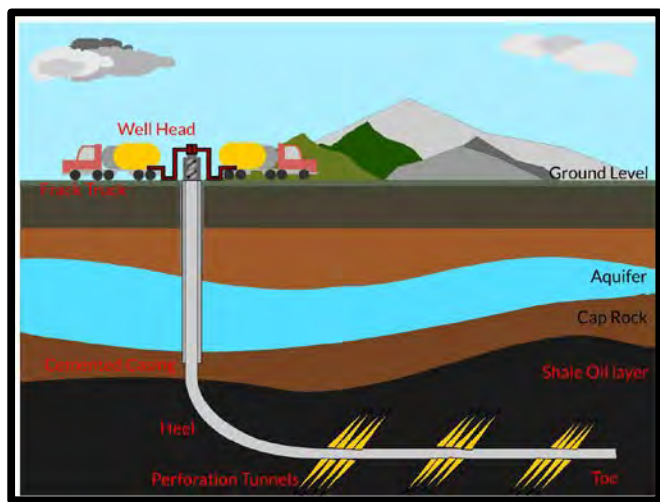
Assessing Operational Feasibility: Review of existing surface infrastructure for compatibility and suitability with the proposed location can reveal the need for new roads, power sources, flowlines and pipelines, and mitigation and reclamation actions.

Detailed Location Assessment: Operational feasibility for a potential site is further determined by conducting a detailed location assessment reviewing floodplain, wildlife impacts, local permitting, off-lease location, urban mitigation areas, federal minerals, in addition to setback requirements from homes, buildings, density, schools, and daycare centers.

Additional Resources & Information

Colorado Oil & Gas Conservation Commission (COGCC) | www.cogcc.state.co.us
 The American Association of Professional Landmen (AAPL) | www.landman.org/home
 The Denver Association of Petroleum Landmen (DAPL) | www.dapldenver.org



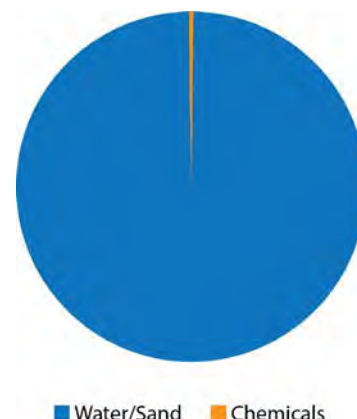


Hydraulic fracturing, or “fracking,” is a process to extract oil and natural gas deposits from tight rock formations. A mixture of pressurized water, sand, and chemicals is pumped into the formation creating tiny fissures in targeted areas of the source rock. These tiny fissures allow oil and natural gas to escape and flow through piping up to the surface. First tried 70 years ago, hydraulic fracturing became widely used in the last two decades after horizontal drilling began to replace [vertical drilling](#). The combination of horizontal drilling and fracturing allows more efficient recovery of resources with a much [smaller environmental footprint](#) than drilling multiple vertical wells. Over [95 percent of the wells](#) in the U.S. are hydraulically fractured at some point during their lifetime.

Hydraulic Fracture Fluid

Hydraulic fracturing fluid, or “fracking fluid,” is [99.5 percent water and sand](#). The remaining percentage is made up of chemicals commonly found in everyday products, such as toothpaste, detergent, and even ice cream, that often can be purchased at your grocery store.

Additive	Main Compound	Common Use
Diluted Acid	Hydrochloric, Muriatic Acid	Swimming Pools
Biocide	Glutaraldehyde	Dental Disinfectant
Breaker	Ammonium Persulfate	Bleaching Hair
Crosslinker	Borate Salts	Laundry Detergents
Iron Control	Citric Acid	Food Additive
Gelling Agent	Guar Gum	Biscuits
Scale Inhibitor	Ethylene Glycol	Antifreeze
Surfactant	Isopropanol	Glass Cleaner
Friction Reducer	Polyacrylamide	Water and Soil Treatment

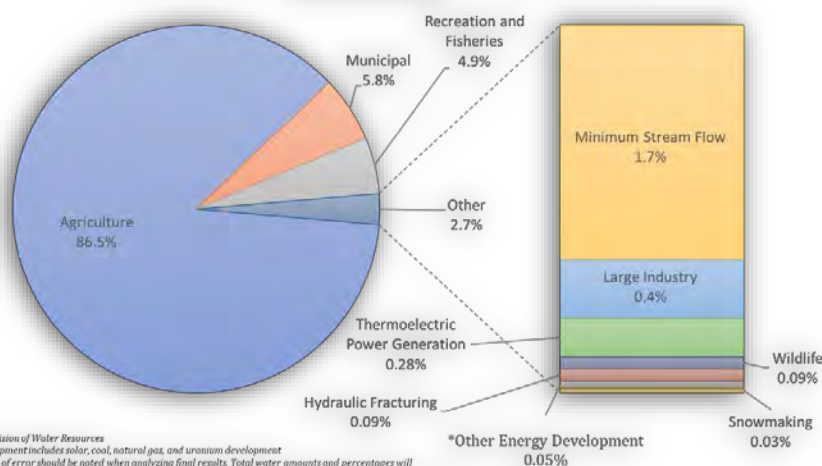


Groundwater Protection

Hydraulic fracturing occurs thousands of feet below ground. Colorado was the first state to [require disclosure of chemicals](#) and their concentrations, and the first state to [require groundwater testing](#) before and after drilling. Additionally, Colorado requires that each well must be encased in [multiple layers of industrial-grade steel casing](#), which is then surrounded by cement to create multiple layers of protection. At least [26 studies](#), including those from the Environmental Protection Agency (EPA) and the U.S. Geological Survey (USGS), have found that the hydraulic fracturing process doesn’t contaminate groundwater.

Water Use

Colorado Water Utilization by Sector, 2011-2015
 Agriculture uses the majority of Colorado water; energy sector consumes less than 1% of total



Source: Colorado Division of Water Resources
 *Other energy development includes solar, coal, natural gas, and uranium development
 Note: A small margin of error should be noted when analyzing final results. Total water amounts and percentages will vary slightly from year-to-year based on supplies from varying monsoon and demands resulting from varying climatic conditions

Relatively speaking, a very small amount of water is used during oil and natural gas development. Hydraulic fracturing uses 0.1 percent of Colorado's total water use annually. Approximately 85 percent of the state's water is used by Colorado's important agriculture sector.

Much of the water used during the fracturing process is treated in waste water plants and is often recycled. While the recycled water will not be used for drinking water, it can be re-used for additional drilling projects.

Additional Resources & Information

Sources

Colorado Oil & Gas Conservation Commission (COGCC) | www.cogcc.state.co.us
 United States Geological Survey (USGS) | www.usgs.gov
 U.S. Department of Energy | www.energy.gov
 FracFocus | www.fracfocus.org

COGA FACT SHEET

▶▶▶ Everyday Products & Uses

Oil and natural gas are an integral part of our everyday lives, and it's not only the gasoline we put in our cars or the natural gas that heats our homes or businesses. Oil and natural gas are used in everyday products such as lipstick and deodorant and life-saving medical devices, such as MRI machines and pacemakers.

Byproducts from oil refining is used to produce plastics, as well as lubricants, waxes, tars and even asphalt for our roads.

Nylon, polyester, and many types of fabrics we use that allow us to camp, recreate, and enjoy the outdoors are all made possible by oil and natural gas. In fact, all forms of transportation including the manufacturing of planes, trains, cars, boats, bikes, scooters, skateboards, and even electric cars require oil and

natural gas products and components. And don't forget those diapers, pacifiers, and toys used by parents and babies around the world that are all made with oil or natural gas or both. Because of the wide variety of products made possible by oil and natural gas, the U.S. consumed approximately [7.3 billion barrels](#) of petroleum in 2017.



Everyday products made possible by oil and natural gas





Products that save and maintain healthy lives

Notably, petroleum products are widely used throughout the healthcare industry, from the operating room to those items that support healthy living in our modern society. That includes important lifesaving products and equipment such as pacemakers, MRI machines, IV bags and tubes, surgical instruments, monitors, and stethoscopes. It also includes items that can be critical to daily life, such as prosthetics, hearing aids, glasses, and contact lenses.

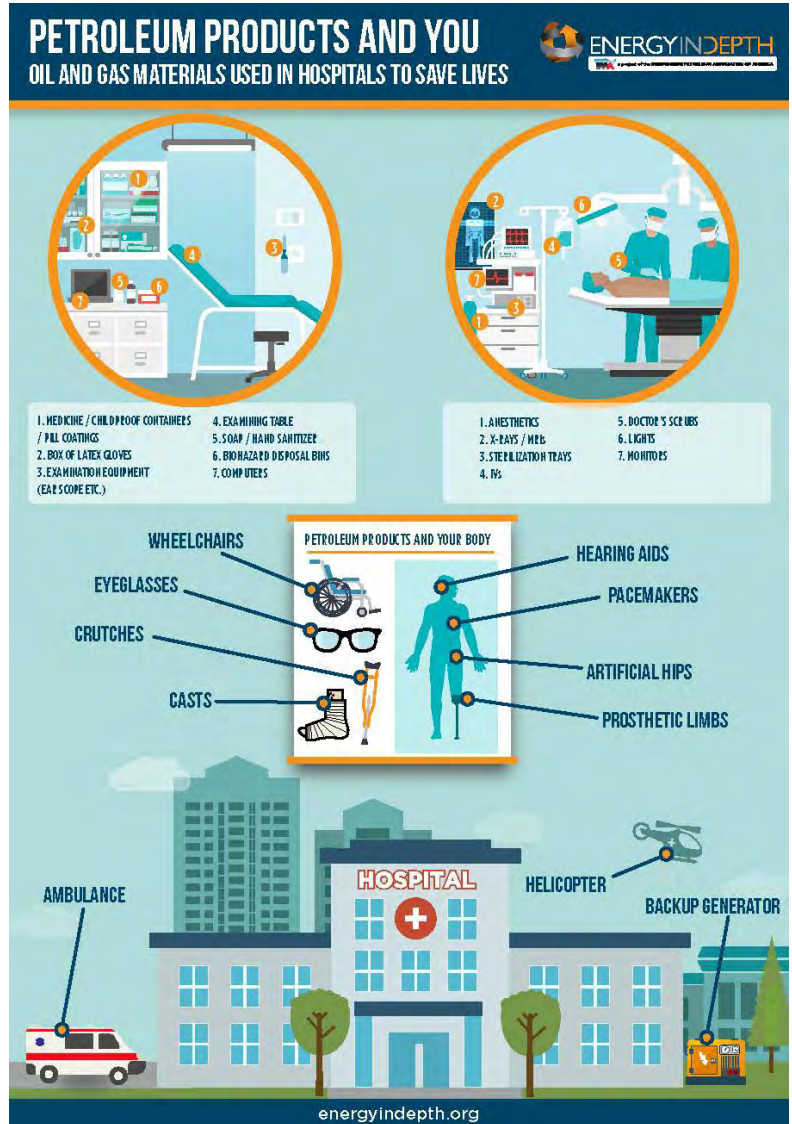
Chemicals derived from petroleum also help make soaps, antiseptics, aspirin, and lifesaving pharmaceuticals used by emergency care doctors and physicians.

Many of these items are often taken for granted, but they are important for healthy and productive living in the 21st century.

Additional Resources & Information

Sources

U.S. Energy Information Administration | www.eia.gov
 Energy in Depth (EID) | www.energyindepth.org
 U.S. Department of Energy | www.energy.gov
 The Colorado Energy Office | www.colorado.gov/energyoffice





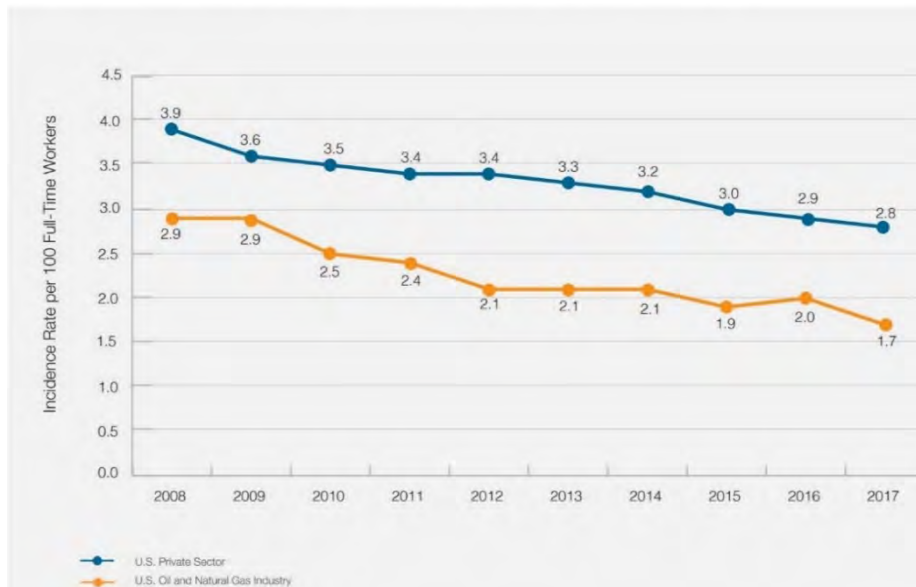
Safety

Colorado oil and natural gas operators are an integral part of one of the safest industries in the country.

The [U.S. Bureau of Labor Statistics](#) found that working in the oil and natural gas industry is on average, safer than the construction and manufacturing industries, hospitality, educational and health services, and even state government.

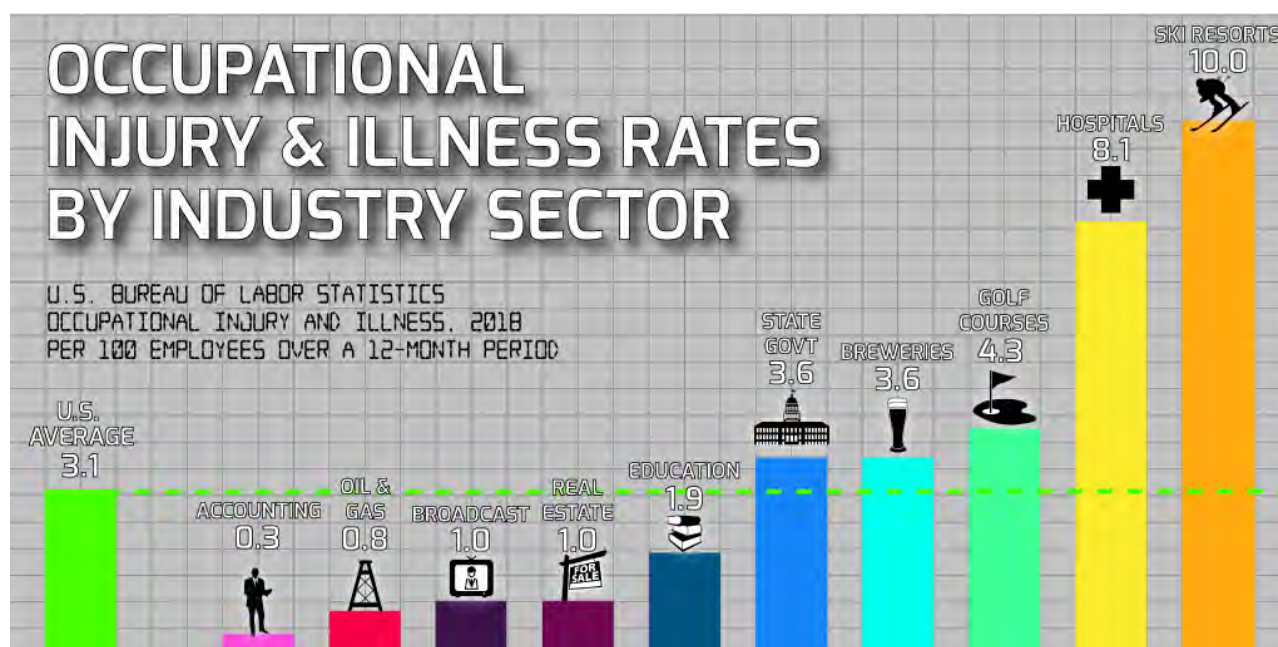
In 2017, the rate of job-related injuries and illnesses for the oil and natural gas industry was 1.7 per 100 full-time workers compared to a rate of 2.8 for the entire [U.S. private sector](#). Even as the U.S. average occupational incident rate rose to 3.1 in 2018, the oil and natural gas industry rates [dropped to 0.8](#) per 100 full-time workers, and have [continued to decline year over year](#).

U.S. Oil and Natural Gas Industry vs. U.S. Private Sector (2008-2017)
Injuries and Illnesses Incidence Rates



Incidence Rates of Occupational Injuries by Industry

The [Survey of Occupational Injuries and Illnesses \(SOII\)](#) presents estimates of counts and incidence rates of employer-reported workplace injuries and illnesses by industry and type of case, as well as detailed estimates of case circumstances and worker characteristics for cases that resulted in days away from work. According to the BLS Report, there were 2.8 million nonfatal workplace injuries and illnesses reported in the United States by private industry employers in 2018, unchanged from 2017.





Industry's Commitment to Safety

• Prevention

- ✓ Operations are intentionally designed to reduce the risk of injury and incident.
- ✓ Many operations are monitored 24/7 and are designed to automatically shut in remotely, further preventing risk of injuries and incidents.
- ✓ Anyone who comes on an active site has stop-work authority if they see anything unsafe occurring.

• Training

- ✓ Colorado employees attend regular, mandatory safety training sessions.
- ✓ Operators conduct spontaneous safety drills in coordination with local responders to ensure everyone has the skills and confidence to effectively respond to a situation.

• Industry Collaboration

- ✓ Through innovation, applied learnings and tailoring operations in ways that benefit communities and improve the safety of employees.
- ✓ Applying best safety practices and train employees on incident prevention.
- ✓ Serving as a resource to community first responders on incident responses.
- ✓ Engaging in active campaigns like Colorado811 to educate excavators and the general public on the industry's underground infrastructure of pipelines to avoid incident and injury.



Goal of zero injuries and incidents



Continuously monitored operations



Automatic, remote shut-in capabilities



Stop-work authority at all active sites



Regular, mandatory safety training for employees



Active safety drills in collaboration with local first responders

Additional Resources & Information

Sources

American Petroleum Institute (API) | www.api.org
 United States Department of Labor (BLS) | www.bls.gov



On October 17, 2019, the Colorado Department of Public Health and Environment (CDPHE) released an oil and natural gas health effects [study](#) titled, *Human Health Risk Assessment for Oil & Gas Operations in Colorado*. This study follows CDPHE's 2017 *Assessment of Potential Public Health Effects from Oil and Gas Operations in Colorado*. That earlier [study](#) reviewed more than 10,000 air samples in regions of Colorado where people are living near oil and natural gas development. It concluded that all measured air concentrations were below short- and long-term safe levels.

Measurements are an important tool for understanding actual health risks, which is why CDPHE continues to collect air samples. In fact, an additional [5,000 samples](#) near well pads and communities have been taken by the state's state-of-the-art mobile monitoring lab in the past few years. Similar to the CDPHE 2017 study, not one of the mobile lab measurements were at a level that could cause short- or long-term health effects to nearby residents.

CDPHE's 2019 health study took a different approach and reviewed data from Colorado State University's emission study, taken from 2013-2016. Authors then developed an air dispersion model to make thousands of predictions of air concentrations and hypothetical exposures to populations living between 150 to 2,000 feet from a well pad under worst-case conditions.

Chronic Results

The model found all simulated long-term, chronic exposures to individual substances (like benzene) at 500 feet or more from production operations, which can continue for up to 30 years, were below health guideline levels. The study says, "chronic exposures during production operations were below guideline levels at the 500-ft distance in all scenarios." This result confirms there are no anticipated long-term health impacts, including cancer, for people living near oil and natural gas development.

Acute Results

The model predicted in isolated scenarios that benzene, toluene, and ethyltoluenes, at smaller well pads during flowback activities, could exceed short-term, acute exposure health guideline levels at short distances.

North Front Range – The model used to simulate oil and natural gas operations in the North Front Range predicted infrequent, worst-case scenarios where the highest one-hour exposures exceeded health guideline values for benzene during flowback.

Western Slope – The model used to simulate oil and natural gas operations on the Western Slope predicted infrequent, worst-case scenarios where the highest short-term exposures exceeded health guideline values for benzene during flowback, as well as ethyltoluene and toluene for some other pre-production phases.

Authors of the study emphasize that modeling was "highly conservative, in that these highest-estimated exposures occur when the highest chemical emissions are highly concentrated by 'worst-case' meteorological conditions onto a hypothetical person who is outdoors or in a highly ventilated area, which might happen only rarely." By using thousands of simulations, the study suggests "acute (short-term) health risk can be exaggerated when applying an air dispersion model to the improbable coincidence of the highest emission-release rate with worst-case meteorological conditions."

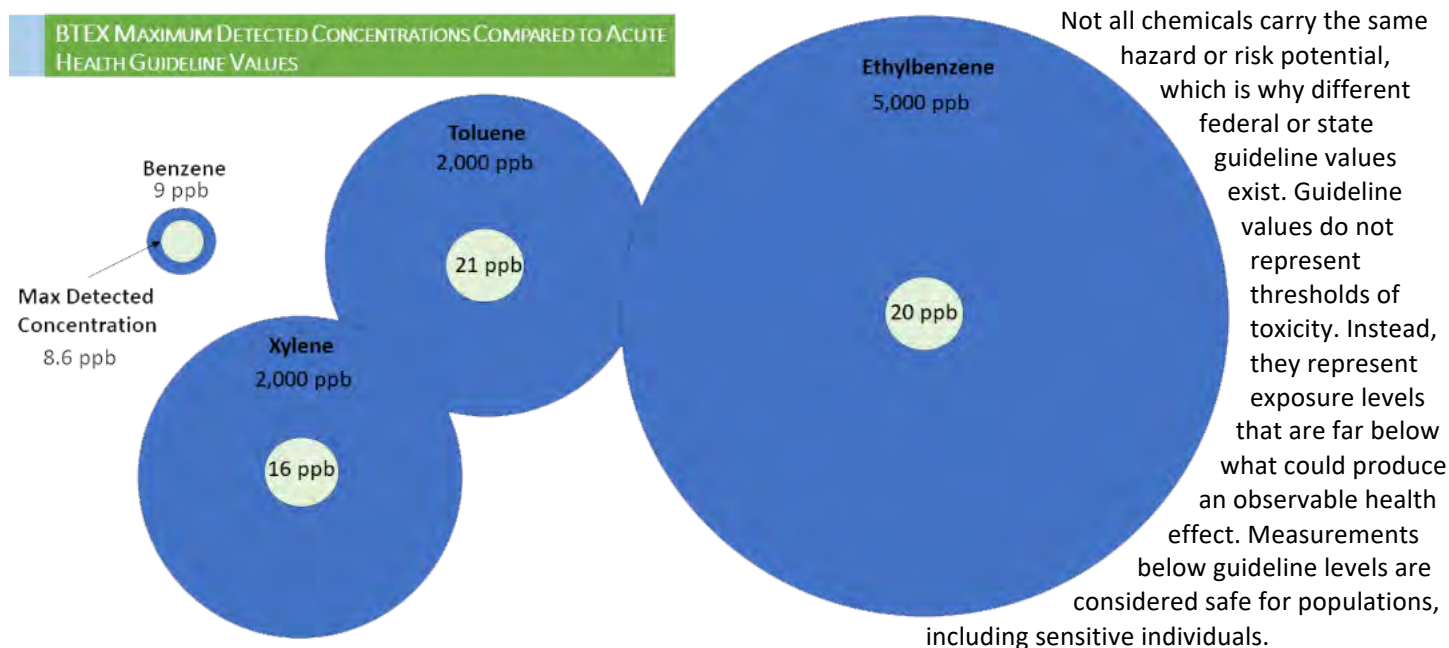
In summation, under worst-case, hypothetical scenarios involving acute exposures only, the study determined that the potential for health risks could occur. However, even in those extremely rare situations, according to federal risk assessment guidelines, none of those worst-case modeled results were at levels that might produce observable health impacts. More information about those guideline levels is below.

Industry Practices

The 2019 CDPHE health study specifically identified the pre-production flowback stage as an area of potential concern under worst-case scenarios for acute exposure only, not chronic exposure. Current industry practices during flowback are significantly different than when the measurements were taken (2013-2016) to inform the model. Techniques at the time included open-air tanks, and in some cases "[green completions](#)." Today, open-air tanks for flowback are not used in urban areas and green completions are commonplace. In some cases, operators have moved to enhance green completions and have a variety of best practices to further reduce emissions from this phase of development.

Health Guideline Values

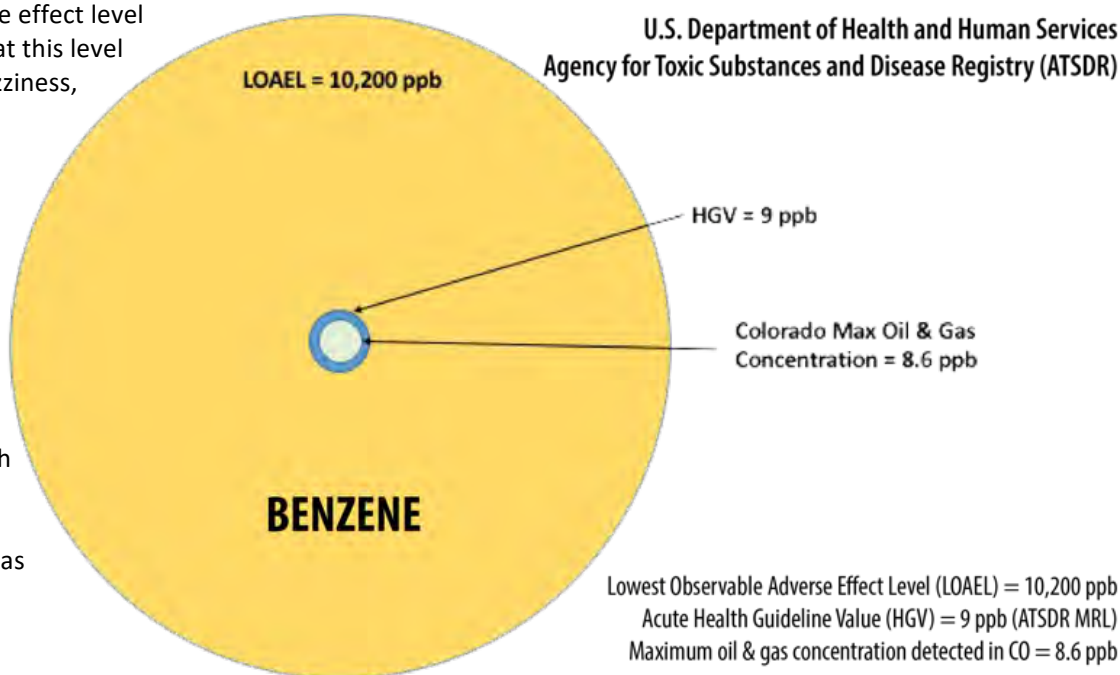
BTEX MAXIMUM DETECTED CONCENTRATIONS COMPARED TO ACUTE HEALTH GUIDELINE VALUES



In the chart above, adhering to Colorado's 500-foot setback distance, the highest confirmed measurement of chemicals commonly associated with oil and natural gas development have all been below health guideline values. Benzene, Toluene, Ethylbenzene, and Xylene (BTEX) are the chemicals most often monitored and measured. The chart shows the maximum confirmed detection of each chemical taken in Colorado (green circle) and the corresponding federal health guideline value from the Agency for Toxic Substances and Disease Registry (ATSDR) used to evaluate health risk (blue circle).

There is a big difference between health guideline values and the actual concentrations that may produce observable effects. The chart below illustrates these differences in benzene concentrations. Drawing from known toxicology studies, the U.S. Department of Health and Human Services' Agency for Toxic Substances and Disease Registry (ASTDR) was able to determine the lowest observable adverse effect level (LOAEL). Benzene exposures at this level (10,200 ppb) could lead to dizziness, headaches, nose and throat irritation. The ATSDR's health guideline value is set much lower at 9 ppb, to be highly conservative.

Measurements of benzene in Colorado at distances of 500 feet or greater have been near that health guideline value, which is much lower than the 200 ppb that someone may be exposed to while filling up their car at a gas station.



STUDIES OF OIL AND GAS EMISSIONS

Hess et al., “Assessing Agreement in Exposure Classification between Proximity-Based Metrics and Air Monitoring Data in Epidemiology Studies of Unconventional Resource Development,” Int J Environ Res Public Health, 2019 ([study link](#)). This study was conducted by a research team at Shell. This peer-reviewed study, published in the International Journal of Environmental Research and Health, tested the assumption that oil and gas well activity can be used as a reasonable proxy for exposure to air pollution. The researchers concluded: “The question we essentially asked was, if [Pennsylvania] monitoring sites were instead a sample of epidemiology study subjects’ homes with monitors placed outside the front door, how well does the categorization of exposure agree between the two methods? We found that they did not agree well at all with the same exposure quartile assigned in roughly one in four observations, and the opposite category assigned for roughly 25%.”

Leken et al. “The climate and health effects of a USA switch from coal to gas electricity generation,” Elsevier B.V., 2016 ([study link](#)). This Carnegie Mellon University peer-reviewed study found that increased use of natural gas would result in further sulfur dioxide (SO₂) reductions from current levels of 90 percent and 60 percent for nitrogen oxide (NO_x), reducing national annual health damages by \$20-\$50 billion annually.

National Bureau of Economic Research. “Can Natural Gas Save Lives? Evidence from the Deployment of a Fuel Delivery System in a Developing Country,” 2016 ([study link](#)). This study examines the relationship between an increase in natural gas use and adult and elderly mortality rates. The study finds, “the expansion of natural gas services has caused significant reductions in the both the adult and the elderly mortality rates.” The paper focuses on 81 Turkish provinces, 71 of which have switched from a coal-based fuel delivery system to natural gas over the last two decades. The study shows that when a natural gas network is deployed in a province, air quality improves compared to those provinces without an access to natural gas, and subsequently the rates of mortality go down for all age groups including infants, adults, and the elderly. Furthermore, the study finds that the mortality gains are primarily driven by reductions in cardio-respiratory deaths, which are more likely to be due to conditions caused or exacerbated by air pollution.

Bunch et al. “Evaluation of impact of shale gas operations in the Barnett Shale region on volatile organic compounds in air and potential human health risks,” Science of the Total Environment, 2013 ([study link](#)). This peer-reviewed study of air emissions across the Barnett Shale, conducted by ToxStrategies, concluded that “shale gas activities have not resulted in VOC levels that pose a health concern.” The study found that VOCs associated with shale gas were all below health-based CVs and VOCs associated with shale gas showed acceptable chronic risk and hazard. The study’s abstract states, “The analyses demonstrate that, for the extensive number of VOCs measured, shale gas production activities have not resulted in community-wide exposures to those VOCs at levels that would pose a health concern.” The study’s conclusions were based on Texas Commission on Environmental Quality (TCEQ) data.

Tanaka et al. “Asserting the climate benefits of the coal-to-gas shift across temporal and spatial scales,” *Nature Climate Change*, 2019 ([study link](#)). The study used a “multimetric approach” to analyze both short-term and long-term climate impacts and found that “a recent synthesis study gave a leakage estimate of 2.3% for the United States...CH₄ measurements and inventory data are concentrated in the United States, leaving the leakage estimates in the other parts of the world more uncertain. Leakage rates outside of the United States could be high due to fewer regulatory oversights on environmental issues, among other factors.” The study also discussed the climate benefits of shifting from coal to gas stating, “We found that the coal-to-gas shift is consistent with climate stabilization objectives for the next 50-100 years. Our finding is robust under a range of leakage rates and uncertainties in emissions data and metrics. It becomes conditional to the leakage rate in some locations only if we employ a set of metrics that essentially focus on short-term effects. Our case for the coal-to-gas shift is stronger than previously found...”

Vaught et al. “Temporal variability largely explains top-down/bottom-up difference in methane emission estimates from a natural gas production region,” *Proceedings of the National Academy of Sciences of the United States of America*, 2018 ([study link](#)). The study was a response to a finding that suggested methane emissions rates were 60 percent higher than what federal data showed, but the PNAS study showed that could be the result of how top-down aircraft measurements are extrapolated to annual averages. “Study area total emissions exhibited significant variability throughout the day. On both days of the study period, modeled emissions peaked during mid-afternoon hours due to MLUs performed and recorded by production facility operators,” the study said.

Barkley et al. “Quantifying methane emissions from natural gas production in north-eastern Pennsylvania,” *U.S. Department of Energy*, 2017 ([study link](#)). The study was funded by the Department of Energy and conducted by researchers at Penn State University. It found that methane leakage rates from natural gas wells and other infrastructure in the Northeast Marcellus shale are roughly 0.4 percent of production. 3.2 percent is the threshold for natural gas to maintain its climate benefits. The study said, “Using the model optimization technique presented in this study, we find a weighted mean natural gas emission rate from unconventional production and gathering facilities of 0.36% of production with a 2 σ confidence interval from 0.27 to 0.45% of production. This emission rate is supported by four mass balance calculations, which produce a mean of 0.40% and a 2 σ confidence interval of 0.08–0.72% of production. Applied to all the wells in our study region, this mean rate results in a leakage rate of 20MgCH₄ h⁻¹ for the year 2015.” Additionally, an EID review of EPA data shows that U.S. natural gas systems had a methane leakage rate of only 1.2 percent in 2015.

Lan et al. “Long-Term Measurements Show Little Evidence for Large Increases in Total U.S. Methane Emissions Over the Past Decade,” *National Oceanic and Atmospheric Administration, University of Colorado at Boulder*, 2019 ([study link](#)). The study shows that previous estimates of methane emissions were greatly overstated. The study stated, “Our estimated increases in North American ONG CH₄ emissions (on average $\sim 3.4 \pm 1.4$ % yr⁻¹ for 2006-2015, $\pm\sigma$) are much smaller than estimates from some previous studies and below our detection threshold for total emissions increases at the east coast sites that are sensitive to U.S. outflows. We also find an increasing trend in ethane/methane emission ratios which has resulted

in major overestimation of oil and gas emissions trends in some previous studies.” The study suggests that methane emissions may have been overestimated by as much as 10 times.

Nisbet et al. “Rising atmospheric methane: 2007–2014 growth and isotopic shift,” Department of Earth Sciences at Royal Holloway, University of London, 2016 ([study link](#)). The study showed the rising methane emissions rates around the world wasn’t due to oil and natural gas production, but rather because of tropical wetlands and agriculture. The study’s lead author said, “Our results go against conventional thinking that the recent increase in atmospheric methane must be caused by increased emissions from natural gas, oil, and coal production. Our analysis of methane’s isotopic composition clearly points to increased emissions from microbial sources, such as wetlands or agriculture.” The study also stated the data analyzed found “both the majority of this methane increase and the isotopic shift are biogenic.”

Schwietzke et al. “Improved Mechanistic Understanding of Natural Gas Methane Emissions from Spatially Resolved Aircraft Measurements,” National Oceanic and Atmospheric Administration, University of Colorado at Boulder, 2017 ([study link](#)). This study finds that emission estimates reported in a series of studies used to justify federal methane regulations may have been significantly exaggerated because of the time that measurements were taken: “O/NG emissions are systematically higher during daytime hours when TD and BU measurements have been made, and lower at night”

EID, Colorado Health Officials Debunk Lung Association’s Ozone Report Card (May 6, 2015), ([study link](#)). CDPHE Air Pollution Control Division Director Will Allison revealed that the ALA’s 2015 report card on air quality in Colorado ignored a full year of air quality data from 2014, which shows ozone levels getting better, not worse. Colorado’s response to ALA also wasn’t unique to Colorado. Widespread criticism of the ALA reports poured in from across the country in recent years from the Pittsburgh Post-Gazette’s editorial board, as well as government agencies and regulators like EPA Region 7, the Indiana Department of Environmental Management, Maryland Department of the Environment, Texas Commission on Environmental Quality and Hamilton County Department of Environmental Services.

EID, Latest EPA Data Show U.S. Greenhouse Gas Emissions at Lowest Levels Since 1992 (Apr. 16, 2019), ([study link](#)). According to April 2019 EPA GHG Inventory, total U.S. greenhouse gas emissions in 2017 reached their lowest levels since 1992. Total U.S. GHG emissions fell by 12 percent and total GHG emissions from fossil fuel combustion decreased nearly 15 percent between 2005 and 2017. Meanwhile, U.S. oil and natural gas production increased more than 80 percent and 51 percent, respectively, and natural gas consumption increased 23 percent, according to the Energy Information Administration.

McDuffie et al., “Influence of Oil and Gas Emissions on Summertime Ozone in the Colorado Northern Front Range,” 2016 ([study link](#)). A 2016 study conducted by NOAA and the University of Colorado demonstrates that the oil and natural gas industry accounts for just a small portion of total ozone in Colorado’s northern Front Range. The study found that on high ozone days, when ozone levels reach to approximately 70 ppb, 17 ppb of that ozone is produced locally (the remainder is from regional background sources or residual ozone produced locally during previous days) and that on average, oil and gas emissions account for about 3 ppb or 17 percent of the daily infusion of VOCs that create ground-level ozone.

Michael A. Levi, Revisiting a Major Methane Study, Council on Foreign Relations (Oct. 12, 2012), ([study link](#)). Discussing research published in the Journal of Geophysical Research on why NOAA's 2012 estimates on methane rates from oil and gas production in the Denver-Julesburg basin were unsupportable and explaining that methane leakage rates—even prior to the 2014 landmark rulemaking—were most likely between 1 and 2 percent.

EID, Let's Take a Closer Look at the Boulder Air Quality Study (Jan. 18, 2019), ([study link](#)). Analyzing Detlev Helmig's air monitoring data drawing connections between high ozone levels in the region and oil and gas development east of the city in Weld County. According to Professor Helmig, the monitoring did not actually include “ozone production modeling” or “a study that would attribute ozone to particular sources.” In fact, the monitoring “did not even include ozone.”

EID, Ethane Study Pushes Alarmist Claims on Ground-Level Ozone, Methane Emissions (Jun. 20, 2016), ([study link](#)). Detailed analysis of Detlev Helmig's 2016 research on methane and ozone levels using ethane as a tracer gas.

EID, U.S. Natural Gas Leads all Energy Sources in Carbon Emission Reductions (Nov. 19, 2019), ([study link](#)). The shift in the United States to building more natural gas power plants has led to the reduction of more than 2.8 million metric tons of carbon dioxide emissions since 2005, making it the largest source of energy-related carbon savings, according to recent data from the Energy Information Administration.

Bamber et al., “A Systematic Review of the Epidemiologic Literature Assessing Health Outcomes in Populations Living near Oil and Natural Gas Operations: Study Quality and Future Recommendations,” Int J Environ Res Public Health, 2019 ([study link](#)). A comprehensive and systematic literature review by the CDPHE and the Pennsylvania Department of Health of existing epidemiological studies on the health effects of unconventional oil and gas development (20 epidemiological studies with 32 health outcomes), concluded that “(s)tudies of populations living near ONG operations provide limited evidence (modest scientific findings that support the outcome, but with significant limitations) of harmful health effects including asthma exacerbations and various self-reported symptoms.”

McMullin et al., “Exposures and Health Risks from Volatile Organic Compounds in Communities Located near Oil and Gas Exploration and Production Activities in Colorado (U.S.A.) ,” Int J Environ Res Public Health , 2018 ([study link](#)). A CDPHE conducted risk assessment. The researchers identified 56 VOCs emitted from oil and gas industry operations while reviewing 47 air monitoring datasets in 34 regions in Colorado. The report concluded that measured ambient air data collected at distances greater than 500 feet around oil and gas development activities did not exceed EPA health guidance values for either long-term or short-term exposures

Long et al., “Synthesis and Health-Based Evaluation of Ambient Air Monitoring Data for the Marcellus Shale Region,” Journal of the Air * Waste Management Association, 2019 ([study link](#)). The objective of this research effort was to publish the findings of an evaluation of the growing number of ambient air monitoring data collected in the Marcellus Shale region. The data were evaluated to determine if there was evidence of potential community-level air quality-related health concerns. The ambient air data evaluated indicate that pollutants in the Marcellus

shale region are found in concentrations that are typically below health-based air comparison values. Where there were exceedances, they were sporadic and not focused on any specific chemical, time, or site and could have been the result of non-industry emission sources

McCallum et al., “Health Impact Assessment of an Oil Drilling Project in California,” Int J Occup Med Environ Health, 2016 ([study link](#)). A Health Impact Assessment was conducted to evaluate potential health effects in community where a proposed oil development product project in Hermosa beach , California. The authors concluded that the project would have no substantial effects on the community’s health.





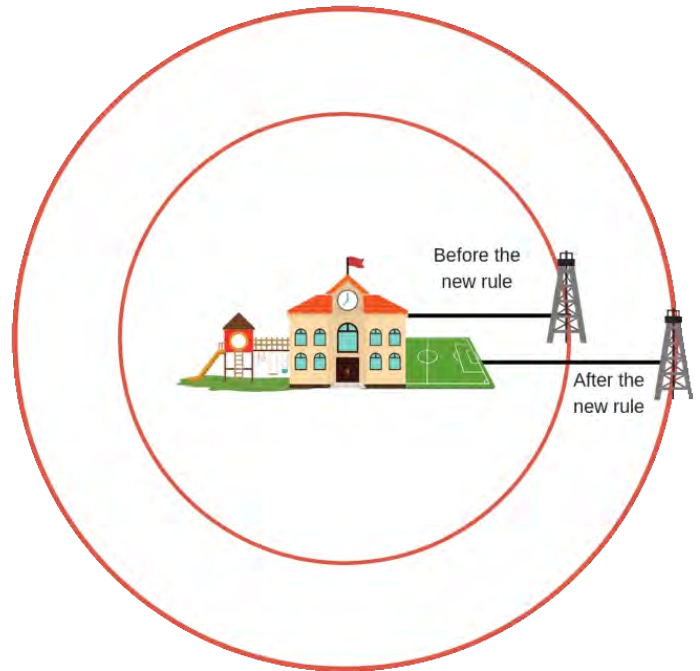
Strengthening School Setbacks

The oil and natural gas industry prides itself on finding constructive solutions to complex issues that arise with developing Colorado's energy resources in rapidly urbanizing areas. One such issue was the buffer zone between schools, child care facilities, and oil and natural gas drilling.

In response to community feedback, the Colorado Oil and Gas Association (COGA) worked in conjunction with key stakeholders, including environmental groups and school districts, to reach an agreement regarding the December 2018 Colorado Oil and Gas Conservation Commission (COGCC) rulemaking on changes to the state's school setback distances.

The existing high occupancy building setback requirement of 1,000 feet did not change; however, the definition of a school facility was greatly expanded. The new definition effectively broadens the boundary to include not just the school building, but also surrounding facilities, such as playgrounds, athletic fields, fences, and other outdoor areas.

Child care centers and sites of future school facilities (including private and charters) are covered by this expanded rule.



The Stakeholders

Crafting this new rule would not have been possible without the work of all parties involved.

Educators:

Adams 12 Five Star Schools
(Brighton) 27J School District Colorado
Association of School Boards

Environmentalists:

Conservation Colorado League of
Oil and Gas Impacted Coloradans
Western Colorado Alliance

Industry Representatives:

Colorado Petroleum Council
Colorado Oil and Gas Association



The Process Works

The process that led to this expanded regulation exemplifies how a good faith stakeholder process can produce regulations that empower interested stakeholders and give them a greater voice, while still allowing one of Colorado's top industries to continue the vital work of providing affordable energy for all.

Additional Resources & Information

Sources

Colorado Oil & Gas Conservation Commission (COGCC) | www.cogcc.state.co.us

Colorado Department of Public Health & Environment (CDPHE) | www.colorado.gov/cdphe

Colorado Oil and Gas Association's Regulatory Overview:

www.coga.org/regulatoryoverview



The oil and natural gas molecules produced in Colorado are among the cleanest in the world. Under Colorado's rigorous regulatory framework and environmental rules that are widely seen as the gold standard, Colorado companies are utilizing state-of-the-art technology and innovation to decrease emissions, reduce leaks, limit venting and flaring, and disturb less land. The end result is abundant, efficient and affordable energy sourced and produced locally in one of the safest and most environmentally sound manners anywhere. That matters, particularly if the alternative is relying on energy produced by countries with poor labor standards and environmental practices.



Environment



COLORADO
OIL & GAS
ASSOCIATION

COGA | Climate Change

The Colorado Oil and Gas Association (COGA) shares the concerns of both governments and citizens about climate change and climate change risks.

Oil and natural gas are the primary source of energy for the global economy, supplying roughly 70 percent of total global energy demand. The environmental benefits are, and will continue to be profound, as natural gas as an energy source has a low carbon dioxide emissions profile.

CURRENT STATUS AND CHALLENGES

The shale revolution in the United States has led to major new discoveries of natural gas reserves that can be developed efficiently at low cost. The production and use of natural gas, particularly in the electric production sector as a result of the shale gas revolution, is a key element in achieving these lower CO₂ levels which, in turn, benefit the efforts to combat climate change. That market phenomenon is encouraging electric utilities across the country to displace coal generation with natural gas generation. As a result, in 2016, the United States emitted the lowest rate of CO₂ in the past 20 years. When analyzed on a per person basis, CO₂ emissions in 2016 were lower than recorded levels over the past 50 years. Additional technology developments at the wellhead have aided in reduced methane emissions from the production of natural gas, as well.

In the United States, total energy consumption, along with total fossil fuel consumption, have been nearly flat for the last decade and, notwithstanding projected total population increases, are projected to continue this nearly flat rate of total energy consumption in the coming decades, largely due to increased energy efficiency. The EIA reports that energy intensity in the United States has been declining steadily since the early 1970s, and projects that declines in energy intensity will continue. That data is made more impressive by the fact that adjusted for inflation, the nation's economy in 2015 was 15 percent larger than it was in 2005, but both energy intensity and carbon intensity decreased over the same period. Thus, according to the EIA, the United States used 15 percent less energy per unit of GDP and produced 23 percent fewer energy-related carbon dioxide emissions per unit of GDP than in 2005.

Though the EIA also reports that worldwide energy intensity “decreased by nearly one-third between 1990 and 2015,” lower-income developing countries are seeing rapid growth in total energy consumption, contributing to increasing global CO₂ emission rates. Rising energy consumption is enabling higher living standards and improved life expectancy rates. Importantly, use of oil and natural gas has helped the ambitious Millennium Development Goals to be met early. These goals set a target to halve the proportion of people who earn less than \$1.25 per day between 1990 and 2015.

The past 100 years have seen more people lifted out of poverty than ever before in human history and life expectancy for the average human has roughly doubled. While the tremendous improvement of the human condition has much to celebrate, there remain over one billion people still living in dire poverty with no access to electricity, and a remarkable 38 percent of the global population lacks basic cooking facilities. There are another billion people with only intermittent access to electricity. One of the world's central challenges is bringing reliable, affordable energy to these less fortunate billions. Balancing the need to energize the lives of those in developing nations, while simultaneously addressing climate change, is a significant challenge for humanity.

THE WAY FORWARD

Ideas for the future should always be informed by the past. Humans began to meaningfully impact the environment roughly 10,000 years ago with the advent of agriculture. Just as improvements in agricultural methods have dramatically increased the productivity of each acre farmed, we are also making tremendous progress in both the efficiency of energy consumption and in reducing the carbon intensity of each unit of energy produced. Nevertheless, population growth and an increasing number of people in the developing world having access to electricity and energy, thus increasing per capita energy consumption, far outstrip the reductions in CO2 emissions in the developed world, therefore creating a challenging imbalance.

COGA is in favor of continued progress toward cleaner production of oil and natural gas. Clean, affordable energy is the backbone of America and the world's future, and we believe oil and natural gas have an important role to play in that future. COGA acknowledges that while uncertainties remain, climate change is a global issue warranting deliberations by governments, businesses, and the general public. For the conversation going forward COGA urges that the following principles guide action:

- Governmental actions should rely upon market-based mechanisms;
- Governmental policies should emphasize long-term certainty for investment decisions;
- Federal and state policies should encourage private and public investment in energy research, development, and technology commercialization;
- Policies should acknowledge that energy investment across all economic sectors continues to yield social and economic dividends;
- Governmental policies must avoid undue harm to the economy and should encourage job development; and
- Private and public decision making on energy policies should consider the disproportionate impact of higher energy costs on those living on fixed-incomes and the poor.

CONCLUSION

While we recognize uncertainties remain, we share the concerns of governments, businesses, and citizens about climate change risks. We are committed to doing our part to encourage industry efforts that will reduce emissions by implementing efficiency measures, developing innovative technologies, and participating constructively in the conversation on how our state and country can best address this challenge. We believe solutions must balance the need to energize the lives of those struggling to access affordable energy, while simultaneously responding to climate change and powering a broader economy. Bountiful supplies of natural gas will be a critical part of the solution to this global issue, and COGA is committed to being an engaged stakeholder in that discussion.



Innovations and Emission Reductions

Several of the [innovations](#) that have occurred along Colorado's Front Range include but are not limited to: tankless production, low-bleed pneumatics, electric powered drill rigs, electric pumping engines, fence line and community air monitoring, water recycling, beneficial water reuse with industrial partners, solar PV and battery storage for monitoring and small pump operations, increased pipeline usage to reduce truck traffic, light mitigation, noise barriers, quiet hydraulic fracturing equipment, as well as community coordination to identify, plug, and reclaim old verticals wells to reduce cumulative emissions. These innovations and other [emerging applications](#), while not possible in all circumstances, can improve operational efficiency and provide significant emission reductions that would otherwise lead to regional ozone formation and global climate change.

According to the International Energy Agency (IEA) the United States saw the [largest decline](#) in energy-related CO₂ emissions in 2019 on a country basis. In fact, advanced economies are seeing good success in their emission reduction efforts. Part of that is due to fuel switching to natural gas, which is a low-carbon fuel. Most climate concerns about natural gas relates to methane emissions, but according to the [EPA](#) methane emissions are being reduced while production increases.

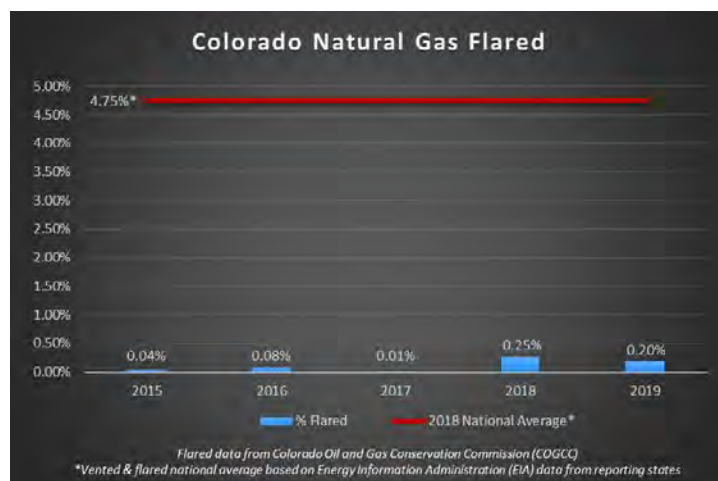
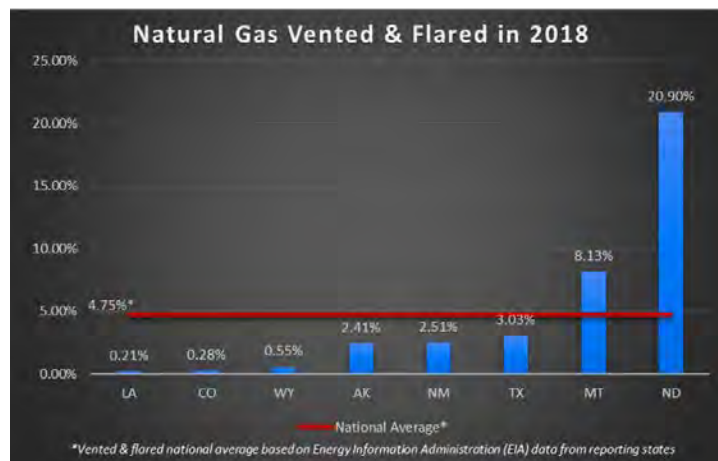
Colorado is leading the pack with sizable reductions. Methane is emitted with volatile organic compounds (VOCs), which contribute to ozone formation, so controls to mitigate VOCs also mitigate methane, and provide both air quality and climate change benefits. From [2011 to 2017](#), Colorado's oil and natural gas industry saw a nearly 50 percent reduction in emissions and inventories modeled out to [2023](#) project further decreases, particularly in the nonattainment area.

Venting and Flaring

One way to reduce emissions is to reduce venting and flaring. Venting natural gas occurs for safety reasons, due to excess pressures, unless there is control equipment installed onsite. Flaring is a common way to mitigate that venting and is accomplished by a controlled burn, reducing emissions that would otherwise be vented directly into the atmosphere. There is an economic incentive to limit venting and flaring, and in the chart on the right and below, it's clear Colorado oil and natural gas operators are [national leaders](#) when it comes to keeping product in the pipe.

Looking at Colorado-specific flaring [data](#) between 2015-2019, local operators have maintained very low flaring rates.

In fact, while the national average was 4.75 percent, Colorado oil and natural gas companies flared only 0.20 percent in 2019.



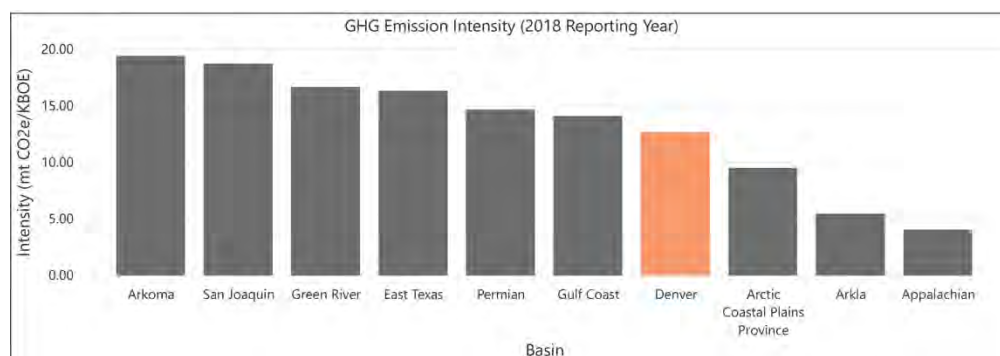


Leak Detection and Repair

Another way to reduce emissions is with strong leak detection and repair practices. Methane makes up [84 percent](#) of leaks associated with oil and natural gas development, so detecting those leaks and fixing them quickly is important. In 2014, Colorado was the first state in the country to establish leak detection and repair requirements (LDAR), and according to the [state health department](#), more than 2.2 million LDAR inspections at Colorado oil and natural gas locations occurred between 2014 and 2018. In fact, there were 725,583 inspections in 2018 alone, with leaks reported only 3.2% of the time. When 2019 numbers are compiled and finalized later in summer 2020, total LDAR inspections will be closer to 3 million.

Emissions Intensity

Another metric for understanding oil and natural gas emissions is by looking at emissions intensity. In short, this is calculated by dividing the CO2 equivalents (CO2e) produced per barrel of oil equivalent (BOE). It's important to note that each oil and natural gas



formation is different from the other, and there are no apples-to-apples comparisons when using this metric. Different geology, different depths, and different techniques required to develop the resource all come into play. However, the chart above lists the 10 resource basins with the lowest GHG emission intensities in the country. It confirms that the emissions intensity of the Denver-Julesburg (DJ) Basin is one of the lowest.

Energy Density

Energy density can be expressed as the amount of energy generated per acre, or the number of acres needed to produce one megawatt of energy, including related mining, transmission, [capacity factors](#), and waste. Coal, nuclear, and natural gas all feature the [smallest physical footprint](#) of about 12 acres per megawatt produced. Solar and wind use 43.5 and 70.6 acres per megawatt respectively, and hydropower from large dams uses 315.2 acres per megawatt. Contemporary decision-making about constructing electric generation facilities rarely considers the value that comes from energy density. However, those technologies with a high energy density result in smaller surface impacts, and they allow for increased efficiencies with economies of scale.

Colorado Regulations

The State of Colorado is a national leader in its commitment to safe and responsible development of Colorado's oil and natural gas resources. Over the past decade Colorado has implemented [precedent-setting regulations](#) from baseline groundwater testing and monitoring to air regulations targeting methane leak detection and repair. The rules are widely viewed as some of the most rigorous in the country and around the world.



Air Quality Standards



Thousands of air quality measurements have been taken near oil and natural gas sites in Colorado over the past decade, and no measurement attributable to oil and natural gas has been above EPA or Health and Human Services health guideline values, according to monitoring by the state, industry, and third parties.

It is important to understand the difference between guideline values and standards. Guideline values are levels that carry no observable risk. For example, think of a standing on a shoreline where jellyfish are known to sometimes float 150 feet out in the water. As

long as you stay on shore, there is no risk. However, once you enter the water standards may exist to help instruct practices. A standard for a person swimming 50 feet from shore might simply include a sign on the beach notifying swimmers of jellyfish, but swimming beyond 150 feet might include a recommendation for swimmers to wear a wetsuit.

When it comes to air quality, while health guideline values represent emission levels that carry no observable risk, emission [standards](#) are based on the combination of exposure (amount of time) and concentration (amount of chemical) that a person may encounter in various circumstances. The concentration of a chemical during one-hour, eight-hour, and 24-hour segments matters, and regulatory standards are based on these variations. Acceptable exposure timeframes and acceptable concentration levels are used to set standards for different populations. That is why there are different standards for the general public versus industry employees.

Employees in the field have personal monitoring devices attached to their clothing. Those monitors track exposures and concentrations, informing individuals about safe and unsafe conditions. Similarly, fixed-monitors further away at the edge of an oil and natural gas development site, or at an established setback distance, may be used to measure exposure and concentration levels for the general public. Standards are then set based on these various conditions, in order to ensure workforce and public safety.

Stages of Development

There are four stages of active oil and natural gas development. Drilling is the first stage as the wellbore and protective casings are installed thousands of feet beneath the surface. Hydraulic fracturing comes next, as fluid, sand, and a small amount of chemicals are used to open cracks within the shale formation. The third stage is called flowback, when hydraulic fracturing fluid and naturally occurring water locked within the formation (produced water) are removed. The final stage is production, which begins after infrastructure is installed to collect and transport oil and natural gas as the resource comes to the surface. While 70 percent to 80 percent of a well's production occurs within the first three to five years, a well may produce for up to 20 to 30 years.

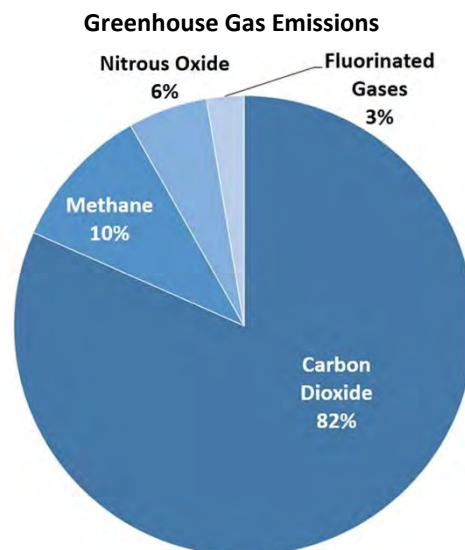
It's important to note that monitoring by the state, industry, and third parties over the past ten years, looking at all stages of development, has never produced emission measurements that would lead to short or long-term health impacts when adhering to Colorado setback standards.

What Do We Measure and Why?

Carbon dioxide (CO₂) is the principle driver of global climate change, but methane is also a contributor, as is seen in the chart below. Colorado was the first state in the nation to enact leak detection and repair (LDAR) regulations in 2014 to reduce methane emissions. In December 2019, those rules were made more rigorous by the Air Quality Control Commission and are the toughest air regulations in the country. While policies to reduce and manage methane are important for addressing climate change, methane is non-toxic, does not produce direct health effects, and does not contribute to ozone formation.

Eleven chemicals make up roughly 98 percent of emissions that occur during oil and natural gas development:

Methane	83.9%
Ethane	5.0%
Propane	3.6%
Butane	1.8%
Pentane	0.9%
Isobutane	0.8%
Isopentane	0.7%
Propylene	0.4%
Hexane	0.3%
Ethylene	0.3%
Benzene	0.0% <i>(a minimal amount of benzene is released during the four stages of development, but as the only chemical from oil and natural gas development that is a known carcinogen, it is important to include on this list. Click here for more information on benzene.)</i>



U.S. Environmental Protection Agency (2019). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2017

While the largest emissions from development (methane 84 percent; ethane 5 percent) are not contributors to ozone formation according to the [EPA](#), the other nine chemicals on the list above are classified as volatile organic compounds (VOCs). When VOCs are combined with nitrogen oxides (NO_x) and sunlight, they will demonstrate varying reactivity rates, and given enough time can lead to ozone formation. High levels of ozone can cause respiratory issues, particularly in sensitive populations and those with asthma. Due to these direct health impacts, Colorado has regulations in place to reduce VOC and NO_x emissions from the oil and natural gas industry, as well as emissions from other contributors, such as cars, boats, lawnmowers, and even paints.

It is important to note that the chemicals listed above coexist within an oil and natural gas formation. So, efforts to reduce VOCs also reduce methane emissions, and vice versa, providing a shared benefit for our climate and our air quality. The combination of tough regulations and new technologies already have led to sizable emission [reductions](#), which are [projected](#) to continue to fall in coming years.



Colorado's oil and natural gas industry continues to reduce emissions and mitigate the effects of ground-level ozone as part of its ongoing commitment to being good stewards of our natural resources and protecting the environment.



What is Ozone?

Ozone is a secondary pollutant formed when volatile organic compounds (VOCs) and nitrogen oxides (NOx) combine in the presence of sunlight and heat. Examples of VOC sources include paints, solvents, formaldehyde, methane, benzene, engine exhaust, household cleaners, as well as decomposing plants, animals, and landfill material. NOx comes from fuel combustion, fertilizer, and lightning.

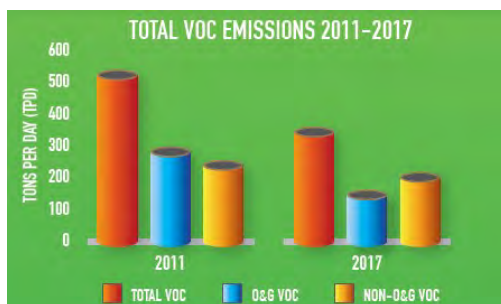
During thunderstorms lightning will split nitrogen molecules

in earth's atmosphere, of which 78-percent is nitrogen. Ozone formation is most prevalent in urban areas when VOCs and NOx combine during hot, sunny weather.

Ozone can lead to difficulty breathing, as it causes the muscles in the airways to constrict, trapping air in the alveoli, which are tiny air sacs in the lungs. For this reason, young children, older adults, and people with asthma stand the greatest risk. This leads to wheezing, shortness of breath, and may lead to lung infections.

Nonattainment Area

The Denver Metro/North Front Range (DMNFR) area has been unable to meet the 2008 EPA ozone standard of 75 parts per billion over an 8-hour average, and it remains in moderate nonattainment status. A vast majority of ozone levels in the DMNFR nonattainment area, approximately 70 to 80 percent, qualify as background ozone, according to the Regional Air Quality Council ([RAQC](#)). Background ozone is formed by a combination of naturally occurring emissions and ozone that is transported to the Front Range from international and other domestic sources. Consequently, addressing ozone related challenges in Colorado is an extremely difficult, economy-wide undertaking, as only 20 to 30 percent of the emissions needed to form ozone in the nonattainment area are produced by Colorado-based human activities.



Emission Reductions

Colorado's oil and natural gas industry has seen significant reductions of ozone-causing emissions in recent years because of technological innovation, regulatory initiatives, and leadership from within the industry. Over the past six years, the state's oil and natural gas industry cut its emissions of Volatile Organic Compounds (VOCs) in the Denver Metro/North Front Range (DMNFR) ozone nonattainment area by [nearly 50 percent](#), all while oil production quadrupled statewide.



“Despite the air pollution challenges associated with increasing population, our ozone levels have improved over time.” – CDPHE

Notable Efforts

Between 2017 and 2019, COGA member companies will proactively plug and reclaim an estimated 6,000 oil and natural gas wells. Based on average production from the plugged and reclaimed wells and Colorado Air Pollution Control Division (APCD) default emission factors for tanks and loading, these efforts will provide additional annual emissions savings.

Over the past three years, the oil and natural gas industry also has participated in a voluntary and coordinated emission reduction initiative during APCD forecasted high-ozone days. Possible ozone mitigation activities include but are not limited to the following:

- Alternate vehicle fueling times
- Reduced vehicle traffic and miles traveled
- Managed drilling and completions on high ozone days to reduce emissions
- Lower emitting tank load outs
- Delayed operational activities (e.g., pigging, well unloading) on high ozone days
- Additional aerial surveys to detect and fix leaks

Additional Resources

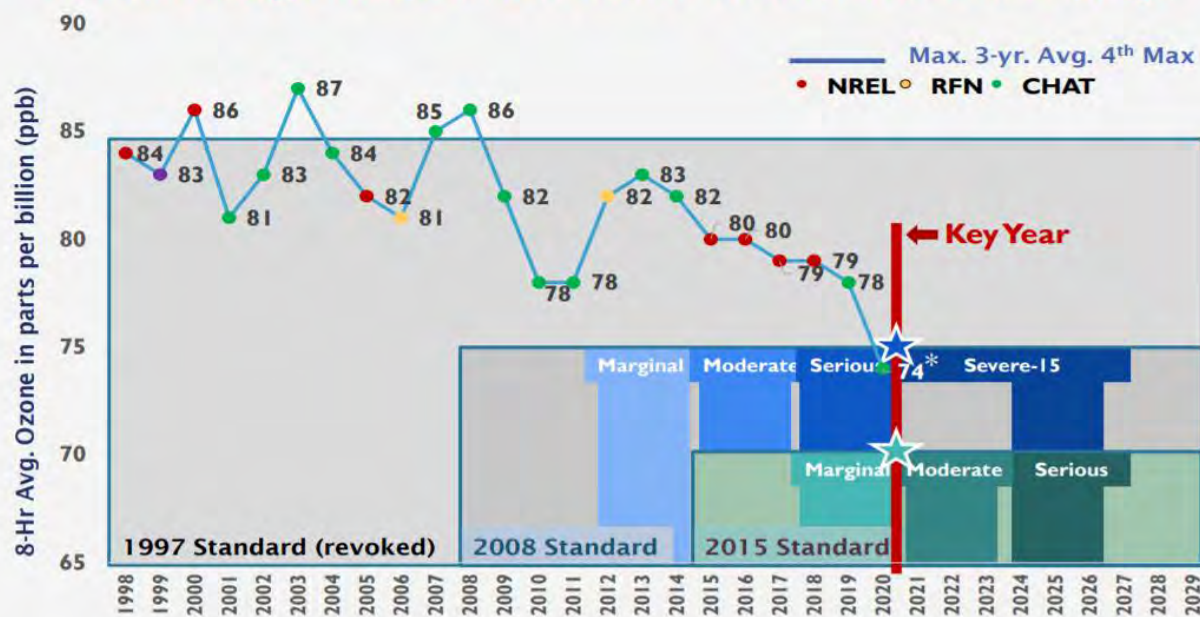
Every Coloradan has an opportunity to reduce their emission profile. Additional information and resources are available at www.coga.org/factsonceo to give the public and policymakers a deeper look at the ozone issue in Colorado. COGA is also promoting the efforts of [Simple Steps. Better Air](#), the public education initiative by the Regional Air Quality Council (RAQC).

Sources

Colorado Department of Public Health & Environment (CDPHE) | www.colorado.gov/cdphe
Regional Air Quality Council (RAQC) | www.raqc.org
Colorado Oil & Gas Association (COGA) | www.coga.org

8-HOUR OZONE TRENDS AND FEDERAL STANDARDS

3-Year Design Values in the Denver Metro/North Front Range



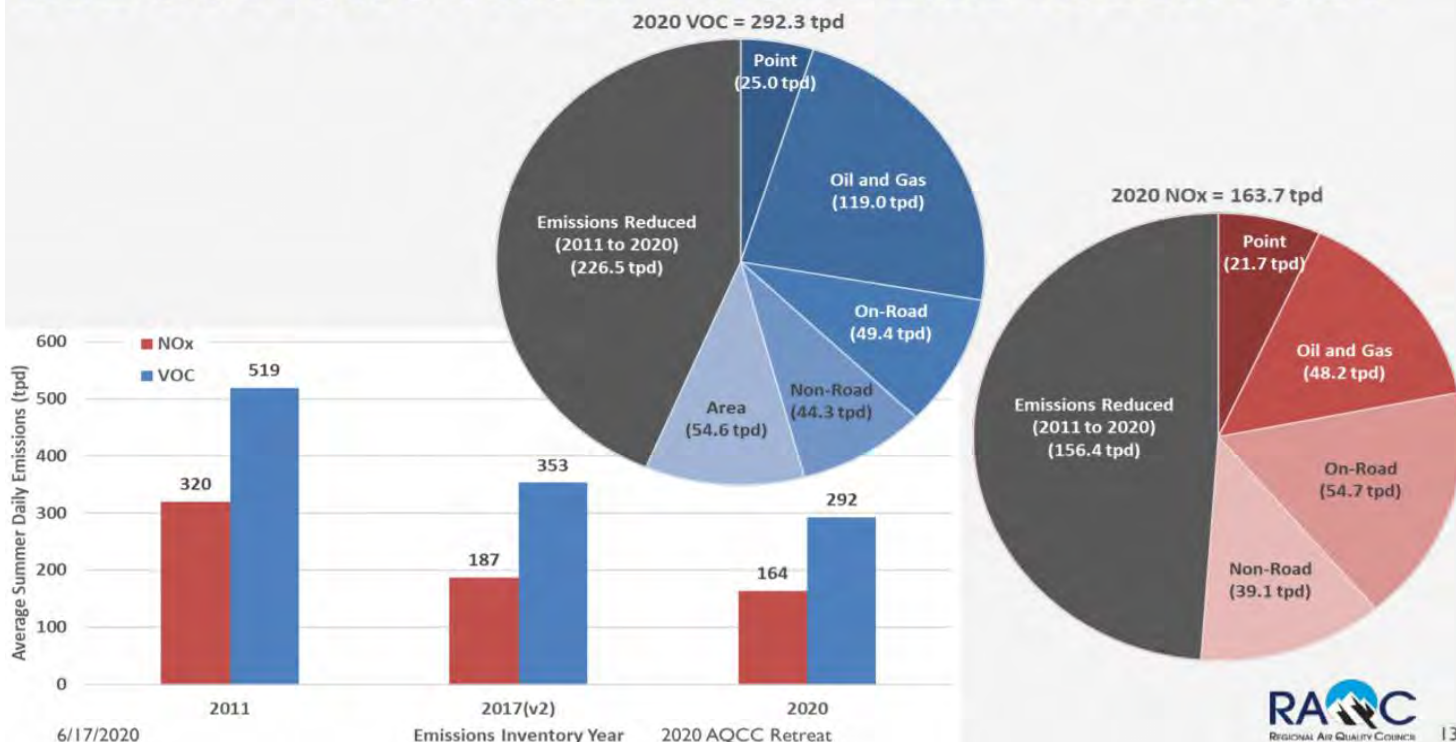
8-Hour Ozone Standard: Based on a three-year average of the annual fourth-highest daily 8-hour maximum ozone concentration.
*Current as of 6/9/20.

6/17/2020

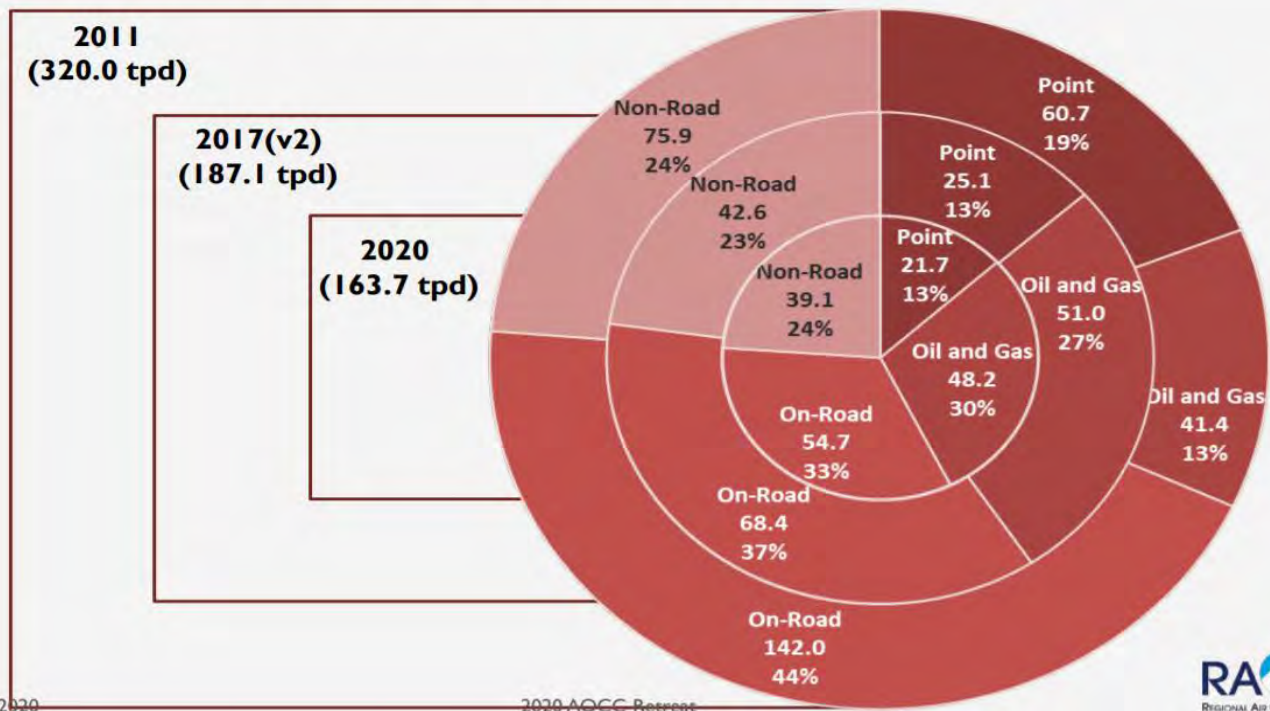
2020 AQCC Retreat



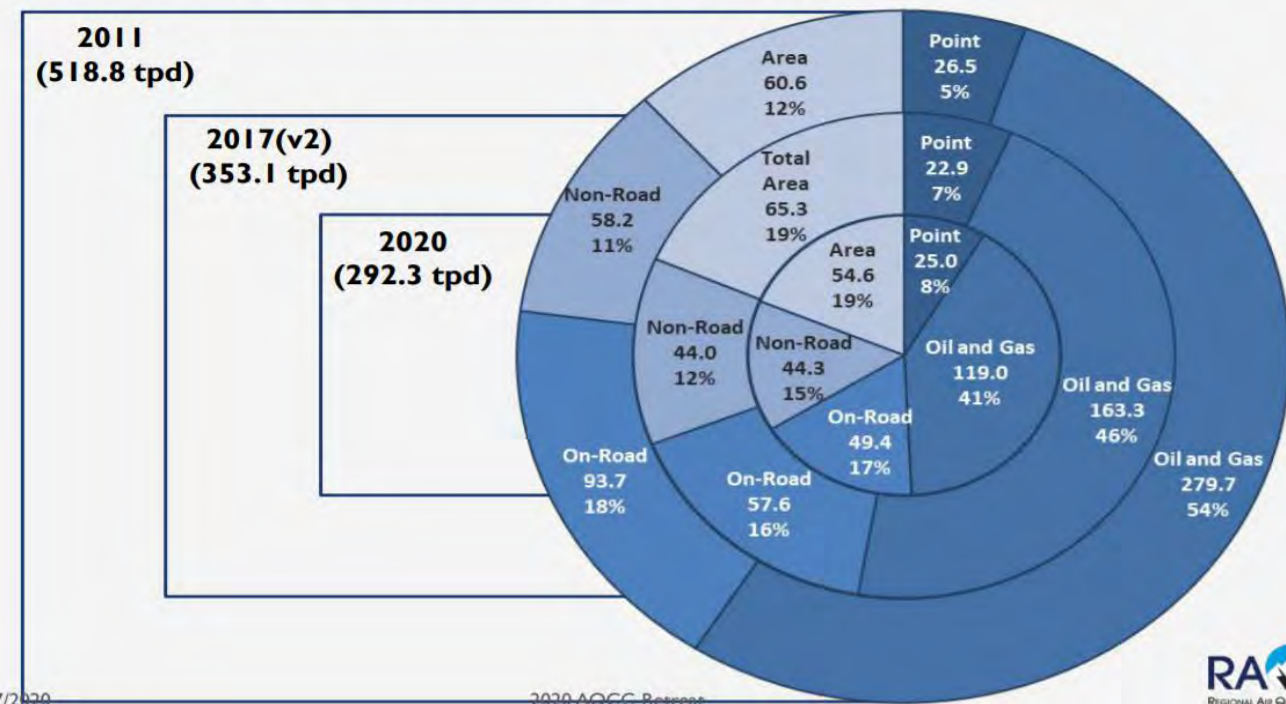
REDUCTIONS FROM BASE YEAR INVENTORY



NOX EMISSION INVENTORIES



VOC EMISSION INVENTORIES





Protection of Colorado's groundwater is one of our highest priorities. The oil and natural gas industry coordinates with the Colorado Department of Public Health and Environment ([CDPHE](#)) and the Colorado Oil and Gas Conservation Commission ([COGCC](#)) regarding all water related regulatory oversight.

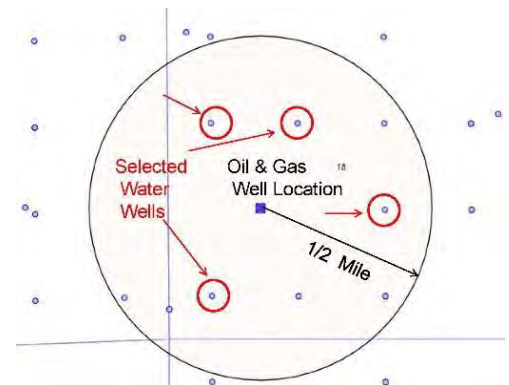
Most drilling operations in Colorado occur well below the water table, typically 6,000 feet below the aquifer or deeper. For reference, that equates to hydraulic fracturing activity occurring at a distance of roughly 23 football fields below the nearest source of groundwater.

COGCC Rule 609

Established in 2013 by the COGCC to provide additional protections, [Rule 609](#) states that groundwater sampling must occur before and after drilling.

Initial sampling is required within 12 months prior to development, with subsequent sampling required from the same locations between six and 12 months after drilling, and further sampling between 60 and 72 months. Samples include basic groundwater analysis parameters, but specifically measures total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene, and xylenes (BTEX). Those measurements will indicate if groundwater in the vicinity of a well has been impacted by drilling.

Full analysis of all water samples are submitted to the COGCC and made publicly available on their [website](#).



The Groundwater Protection Council (GWPC)

[The Groundwater Protection Council](#), in conjunction with the [Colorado Oil and Gas Conservation Commission](#), has developed a publicly available, searchable database of groundwater, surface water, and soil sample analytical results referred to as the COENV database. The COENV database has sampling data dating back as far as 1941 and currently contains over 16,800 sample locations and 47,560 individual samples (as of December 4, 2018). Since the statewide rules for groundwater sampling went into effect on May 1, 2013, the COGCC has received a total of 10,760 water samples from 3,000 separate locations from operators in compliance with these rules.



Well Casing

In addition to groundwater testing requirements, the state also requires structural wellhead and wellbore protections known as casings. As rig crews drill to different depths, they install steel casings and cement around the production tubing and then pressure test those protections to ensure proper installation. In Colorado, at least two layers of waterproof cement and steel casing are required around the production tubing to separate the wellbore from aquifers. This provides stability during drilling operations and significant groundwater protection.

Additional Resources & Information

Colorado Oil & Gas Conservation Commission (COGCC) |

www.cogcc.state.co.us

Colorado Department of Public Health & Environment |

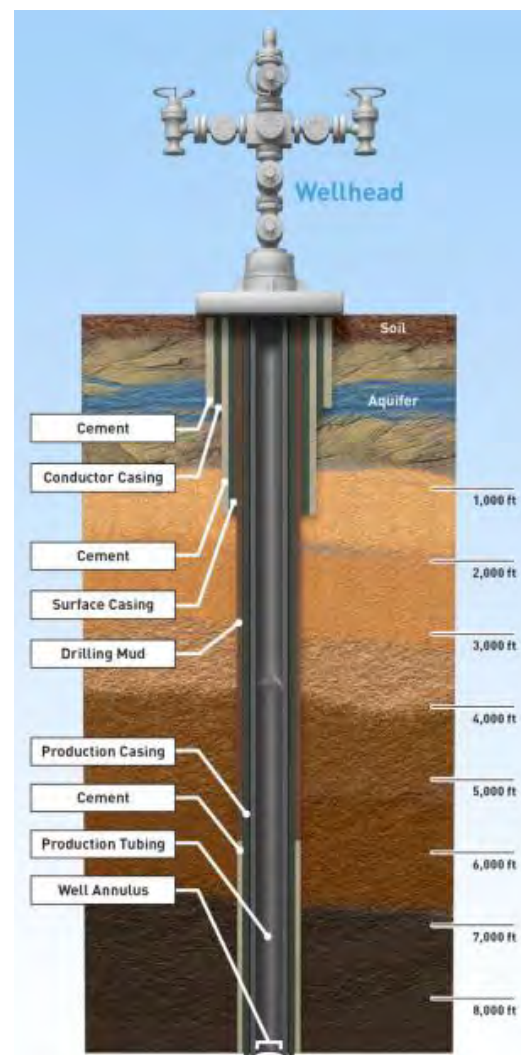
www.colorado.gov/cdphe

Colorado Oil and Gas Association's Regulatory Overview |

www.coga.org/RegulatoryOverview

Groundwater Protection Council | www.gwpc.org

FracFocus | www.fracfocus.org





Regulation



More Than Twenty Rulemakings in Nine Years

The State of Colorado is a national leader in its commitment to fostering safe and responsible development of Colorado's oil and gas resources. Over the past nine years Colorado has implemented precedent-setting regulations from baseline groundwater testing and monitoring to air regulations targeting methane leak detection and repair.



This regulatory timeline provides summary information on significant legislative and regulatory efforts affecting Colorado's oil and natural gas industry from 2011 through 2020.

2011 [Hydraulic Fracturing Disclosure Rulemaking](#)

Requires comprehensive public disclosure of the chemicals used in hydraulic fracturing treatments.

2013 [Baseline Water Quality Sampling Rulemaking](#)

Rigorous mandatory groundwater sampling and monitoring rules.

[Setback Rulemaking](#)

Created a uniform 500-foot statewide setback, applicable in both rural and urban areas and a 1,000-foot setback from high occupancy buildings such as schools, nursing homes and hospitals.

[Wildlife Map Update Rulemaking](#)

Keeping maps updated provides state regulators with information to ensure that sensitive species are appropriately accounted for during exploration.

[Spills and Releases Rulemaking](#)

Tightened spill reporting requirements to broaden the definition of what needs to be reported and requires that spills are reported within 24 hours to landowners and local governments.

2014 [Air Emissions from Oil and Gas](#)

Colorado's Air Quality Control Commission passed precedent-setting rules targeting air emissions from the oil and natural gas industry.

2015 [Complainant Rulemaking](#)

COGCC implements a streamlined process for the public to submit complaints. The [online portal](#) makes the agency's methods for receiving, processing, addressing, closing and communicating complaints more effective and transparent. It includes guidance for making a complaint, what a complainant can expect and the rights of the complainant.

[Flood Lessons Learned Rulemaking](#)

The state updated its regulations to require remote shut-in capabilities and secondary containment areas around tanks. Additional reporting of equipment and wells in existing floodplains also was required.

[Enforcement and Penalty Rulemaking](#)

Fines were increased from \$1,000 to \$15,000 for each violation and eliminated the \$10,000 overall cap for violations.

2016 [State Implementation Plan \(SIP\)](#)

Strengthened rules to reduce ozone levels for the Denver Metropolitan and North Front Range nonattainment area.



Governor's Oil and Gas Task Force Rulemaking

The Task Force was comprised of 21 members representing local government, civic organizations, environmental interests, agriculture, and affected industries. They put forward 9 recommendations that empowered local governments in the permitting process and allowed for site specific mitigation as a condition of permit approval.

2017 AQCC CTG Rulemaking & Revisions to Reg 7

To further reduce ground-level ozone, improve air quality, and comply with federal requirements, new rules were passed to reduce emissions from oil and natural gas sources.

2018 Requirements call 811 Underground Facilities (SB 167)

This legislation brought Colorado into compliance with new damage prevention enforcement rules issued by the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration in 2015.

Flowline Rulemaking

Dozens of new rules pertaining to flowlines and other types of piping systems were approved, along with other regulations increasing transparency in safety and gas leak reporting.

School Setback Rulemaking

The definition of a school facility was greatly expanded and broadens the 1,000-foot boundary to include not just the school building, but also surrounding facilities, such as playgrounds, athletic fields, fences, and other outdoor areas.

2019 500 Series Rulemaking

As directed by SB19-181, this rulemaking enabled the use of administrative law judges and hearing officers to ensure the COGCC is properly processing applications.

Flowline Rulemaking

Following the 2018 rule changes, additional public disclosure, inspection, and deactivation requirements were added.

AQCC Regulation Number 7 & Regulation Number 3

Reg 7 addresses control of Ozone and control of Volatile Organic Compounds and Nitrogen Oxide emissions. Reg 3 addresses stationary source permitting and air pollutant emission notice requirements.

2020 Wellbore Integrity Rulemaking

This rule strengthened the groundwater protection requirements for oil and natural gas development.

AQCC Regulation Number 22

This rule developed Colorado greenhouse gas reporting and emission reduction requirements.

At the time of this update (July 15, 2020) additional COGCC, AQCC and WQCC rulemakings are planned for the calendar year, including new air, water, and comprehensive rule changes at the COGCC that will emphasize health, safety, and the environment.

Additional Resources & Information

Colorado Oil & Gas Conservation Commission (COGCC) | www.cogcc.state.co.us

Colorado Department of Public Health & Environment | www.colorado.gov/cdphe





Community Engagement



COLORADO
OIL & GAS
ASSOCIATION

COMMUNITY IMPACT REPORT

A close-up photograph of a man smiling, wearing dark sunglasses and a bright yellow t-shirt. The t-shirt features a black logo of two hands shaking, with the text 'GIRLS CLUBS' and 'COMMUNITY' partially visible below it. The background is a clear blue sky.

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LETTER FROM COGA PRESIDENT & CEO

Colorado is a special place. We are so fortunate to live and work here, and as you will see in this report, our members work hard every day to make Colorado an even better place to live.

Colorado's oil and natural gas industry truly cares about the communities where we live and work.

At COGA, we are grateful to serve an industry of more than 100,000 employees statewide – individuals and families – who are so invested in their communities and the lives of their friends and neighbors. The oil and gas industry has a long tradition of giving back – after all, we all care deeply about the people, environment, and shared experiences that make our great state so exceptional. Social responsibility is part of who we are as an industry.

COGA's members have demonstrated leadership on issues that Coloradans care about – not just through words, but through action, investing millions each year and volunteering hundreds of thousands of hours. This report showcases the overwhelming commitment of COGA's members and their employees to Colorado and the profound impact of their work in our own backyard.

This year, we expanded our report to highlight some of the positive environmental gains our industry has collectively accomplished in recent years. Much like our direct investment with community partners, Colorado's oil and natural gas industry is leading the nation with investments in technology and innovation that have accelerated our progress as responsible environmental stewards.

Our collective and ongoing work, whether out in the field or volunteering at a nonprofit, brings alignment to the values we all share – clean air and clean water, safe schools and strong families, support for our communities, and protecting the beautiful state that we all call home.

Sincerely,



A handwritten signature in black ink that reads "Dan". The signature is stylized with a large, looped 'D' and a simple 'an'.

Dan Haley
President & CEO
Colorado Oil & Gas Association

LETTER FROM COMMUNITY OUTREACH & INVESTMENT COMMITTEE CO-CHAIRS

COGA's Community Outreach and Investment Committee engages all COGA members in coordinated efforts that maximize our collective impact. As a statewide trade association, COGA members reach every corner of Colorado, providing opportunities to foster positive social and environmental outcomes that are tailored to the communities we serve. On the heels of defeating Proposition 112 in the fall of 2018, our industry faced a tough legislative session in 2019 and worked to remain competitive in a tight market. Looking back, what is most remarkable about 2019 is the way our industry came together and stayed together in support of our communities and each other.

Being a good steward in the community is more than just a license to operate; it is a fundamental part of who we are as an industry in Colorado. In 2019, we took our efforts to a new level with the creation of the Colorado Energy Foundation, a 501(c)(3) supporting organization of COGA. The Colorado Energy Foundation provides new opportunities for the industry to amplify existing philanthropic efforts of the oil and gas industry in Colorado and develop new community partnerships through strategic investments. We look forward to showcasing the results of these efforts in future reports.

This report details what the oil and gas industry has contributed this past year and reflects on our 150-year history in Colorado. While the numbers in this report are impressive, they also represent the partnerships we have curated throughout the years and industry allies during tumultuous times. Many partners featured in this report understand the impact our industry has on the state and step up to support us again and again. It is partners like these that our member companies look to align with and encourage you to as well.

COGA is now in the third year of sharing this Community Impact Report and looks forward to working with you to make an even larger impact in 2020!

Sincerely,



Chair:
Sally Hallingstad
Whiting Petroleum Corporation



Vice Chair:
Liz Wright
Liberty Oilfield Services

ENVIRONMENTAL PROGRESS

Colorado leads the nation when it comes to monitoring and regulating emissions, tank inspections, leak detection and repair, groundwater protection, and the plugging and reclaiming of wells.

Colorado's oil and natural gas industry has seen significant emissions reductions in recent years because of technological innovation, regulatory initiatives, and leadership from within the industry.

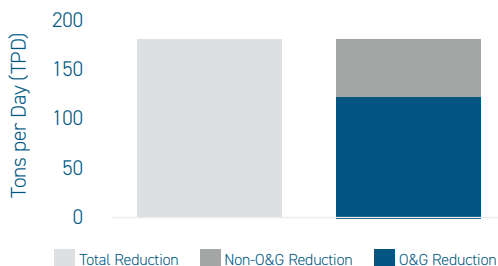
60,000 TONS

Methane emissions savings per year

Exciting innovations are taking shape in Colorado's oil and natural gas fields as new technologies and practices are implemented. Our air quality has been improving, and this industry deserves a share of the credit. Protecting Colorado's environment, while providing the energy and products we all use every day, is one of our core objectives. After all, we live here, too, and we value clean air.

- Dan Haley, President and CEO,
Colorado Oil & Gas Association

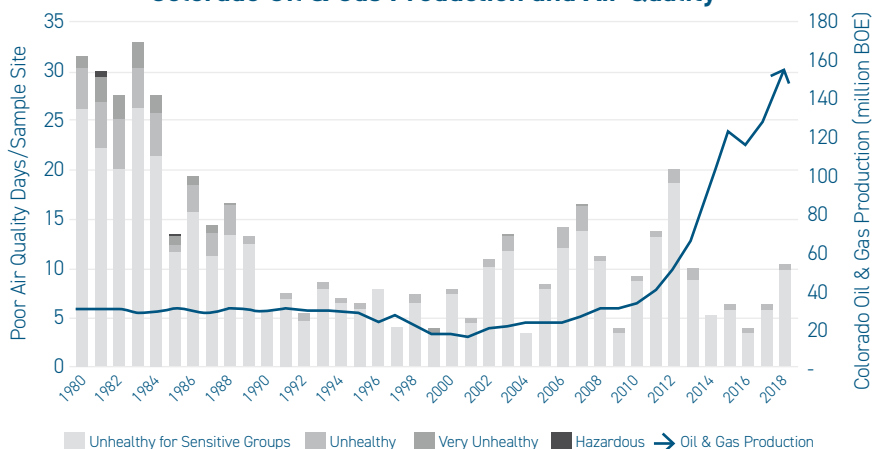
Volatile Organic Compound (VOC) Emissions Reduced 2011 to 2017



CLIMATE, EMISSIONS, AND OZONE

↓ 50% VOC emissions have decreased by over 50% since 2011 while production has quadrupled.

Colorado Oil & Gas Production and Air Quality



2.2 MILLION

Leak Detection and Repair (LDAR)
inspections since 2014 *CDPHE

www.coga.org/factsonceo

INDUSTRY EFFORTS

COMMUNITY PARTNERS

COGA members supported more than 600 organizations and programs in 2019. Our industry's community partners focus on a wide range of causes, including arts, education, recreation, environment, homelessness, health, and hunger. The chart on the next page represents our collective monetary and volunteer support of Colorado's community-based organizations.

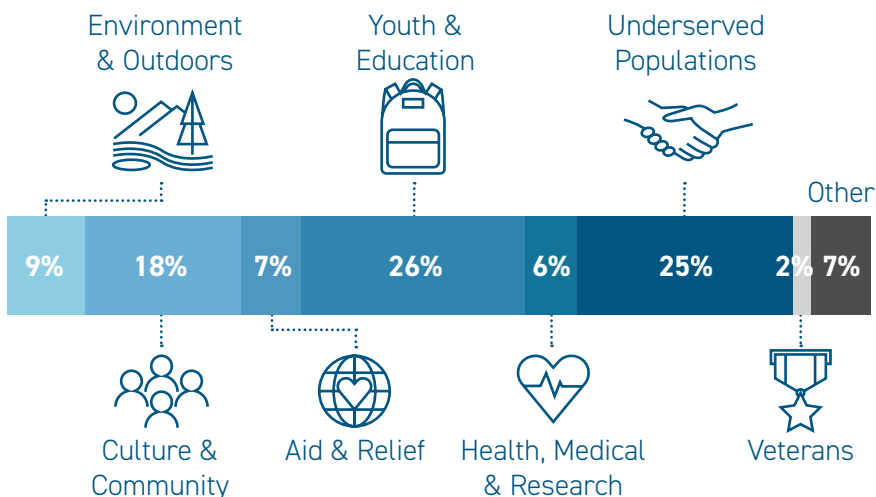
600+ COGA members served more than 600 organizations in Colorado

Including...

- ACE Scholarships
- Alzheimer's Association
- American Cancer Society
- American Diabetes Association
- American Red Cross
- Boy Scouts of America
- Colorado CASA
- Colorado Symphony Association
- Denver Center for the Performing Arts
- Denver Dumb Friends League
- Denver Museum of Nature & Science
- Denver Rescue Mission
- Denver Scholarship Foundation
- Food Bank of the Rockies
- Freedom Service Dogs
- Goodwill Industries
- Leukemia & Lymphoma Society
- Metro Caring
- Mi Casa Resource Center
- Mile High United Way
- National Multiple Sclerosis Society
- Project Angel Heart
- Ronald McDonald House Charities
- SafeHouse Denver
- Special Olympics
- Susan G. Komen
- Urban Peak
- Water for People
- Weld Food Bank
- The Wild Animal Sanctuary



AREAS OUR INDUSTRY SERVED IN 2019



“It's nice to be able to form bonds outside of the work place. It doesn't necessarily have to happen at a happy hour or an event where you're spending money to get together... You know, you can have a good time but also be able to help others, so it's really nice to be able to do that.

- Great Western Petroleum, LLC employee



INVESTING IN COLORADO

VOLUNTEER WORK

Many of our oil and gas member companies offer community-based employee incentives like paid time off to volunteer for nonprofit organizations and matching donation programs.

72,976 hours volunteered
to organizations
across Colorado



“We are fortunate to work with partners like Noble Energy who commit to helping families realize their dreams of homeownership each year in Weld County. This year, they helped facilitate 50 Noble volunteers to build a Habitat home. We are so grateful for their leadership, time, and support.

- Cheri Witt, Executive Director,
Weld Habitat for Humanity



DONATIONS

\$40,124,240

donated by COGA members over the past three years.
\$13,132,461 was donated in 2019 alone.



“Your gift gives families unprecedented access to expert pediatric care. We are here for every child and family who needs us, thanks to donors and leaders like you. By investing in outstanding clinical care, transformative research, and initiatives to build healthier communities, you are providing the critical support needed to make leaps forward for children’s health.

- Jen R. Darling, President and CEO,
Children’s Hospital Colorado Foundation

IMPACTING LIVES

In addition to financial contributions and volunteer time, COGA members made tangible impacts in local communities by providing specific services and resources to underserved populations throughout the state.

\$950,000+

Total dollar value of in-kind contributions donated to Colorado-based charitable organizations in 2019

250+

care packages
sent to troops



200,000+

meals prepared and packaged



5,000+

pounds of food donated
and sorted



MAKING A DIFFERENCE AROUND THE STATE



2,000+

toys donated

3,000+

backpacks packed and donated



Once again, COGA members volunteered hundreds of hours to help build houses with Habitat for Humanity for Colorado families in need



120+

pints of blood donated



20+

scholarships



400+

bikes built and donated

COMMUNITY LEADERSHIP

COGA members are not only contributors, but also leaders in local communities where they live and work – **serving on more than 100 nonprofit boards throughout Colorado**. Our members received numerous awards for their service to the community, including:

Civic 50 Colorado

HighPoint Resources

Colorado Department of Health and Environment (CDPHE)

Gold Environment Leadership Award

Extraction Oil & Gas

Waste Management of Colorado

GPA Midstream Association

CEO Award for Company Service

DCP Midstream

Grand Junction Chamber of Commerce

Person of the Year

Quint Shear, CEO, Shear Inc.

Leukemia & Lymphoma Society

Chairman's Leadership Award

Enerplus Resources

Mile High United Way

Champion of Hope Award

Burns & McDonnell

Volunteers for Outdoor Colorado (VOC)

Corporate Partner of the Year

Noble Energy

Weld Food Bank

Overall Winner, Compete to Beat Hunger

Occidental Petroleum



HighPoint Resources was ranked as one of the 50 most civic-minded companies in Colorado by Points of Light, CSR Solutions of Colorado & True Impact.

Xcel Energy was awarded the Corporate Advocate of the Year Award from the Hispanic Chamber of Commerce at its annual Bravo Awards for its long-time commitment to the Chamber and commitment to supplier diversity.



MARDI GRAS BALL

Since 2017, COGA's Mardi Gras Ball has raised over \$600,000 for direct community investment. To better manage this overwhelming generosity, the Colorado Energy Foundation was incorporated in 2019. The Colorado Energy Foundation and COGA co-hosted the 4th Annual Mardi Gras Ball on February 21, 2020. All proceeds from the 2020 Mardi Gras Ball will benefit the Colorado Energy Foundation and the nonprofit partners it supports.



Mardi Gras Ball

Through the generous support from COGA in 2019, Boys & Girls Clubs of Weld County (BGCWC) has impacted the lives of over 3,000 youth across Weld County in the most positive ways possible. The support has helped BGCWC provide a truly world-class club experience to its members that focuses on enabling each child to work toward achieving academic success, improving their physical and mental well-being, and realizing an overall higher quality of life.

– Terry Adams, CEO, Boys & Girls Clubs of Weld County

COGA members raised \$176,630 for BGCWC, and as a result of the oil and gas industry's investment, the BGCWC facilitated student success in the following areas:

95%

of members expect to go to college

70%

of members feel like they are equipped to be leaders

75%

of members received mostly A's and B's in school

\$176,630

raised for Boys & Girls Clubs of Weld County in 2019

COMMUNITY IMPACT AWARD HONOREES

Colorado's oil and natural gas industry has a long history of supporting local nonprofits throughout the state. The Community Impact Awards, presented at the Mardi Gras Ball, recognize those who have had a fundamental impact on our communities through their significant contributions and commitment to service.

Each honoree shares a common thread – supporting our communities through a long tradition of giving back and ongoing contributions that have endured and strengthened the lives of our friends and neighbors.

In 2019, the following organizations were honored for fostering an environment of corporate giving and prioritizing serving their community through service, support, and donations.



HighPoint Resources focuses its community engagement efforts on health and human services, education, and the environment, with a particular emphasis concerning youth programs and education in areas of development. Annually, it invests both financially and with in-kind donations to various organizations and offers employee donation matching, sponsors volunteer activities, and encourages all employees to volunteer for nonprofit community organizations.



DCP Midstream, LP and its employees invest time, talent, and hard work into organizations that improve the communities where they operate, work, and live. Over the last 10 years, DCP's charitable giving program has directed more than \$10 million to Colorado's nonprofit communities while fostering a strong company culture of volunteerism and engagement.

FROM OUR EMPLOYEES

“I’M PROUD TO WORK FOR A COMPANY THAT HONORS VETERANS AND PROVIDES SUPPORT TO MILITARY FAMILIES.”

– DCP Midstream employee

Reading with kids at the elementary school down the street from my house through Power Lunch is so rewarding! I am making an impact on the kids in my neighborhood. Liberty allowing us to take the time every Tuesday to do this means so much. Seeing the kids over the summer riding bikes and having them wave or say hello makes me feel even more connected to the community. I love it!

– Liberty Oilfield Services employee



If you have never been to a Special Olympics event, I can't tell you how incredible it is. Being around these special athletes will give you a different outlook on life. You'll have fun, laugh, maybe get a tear in your eye, and give more high-fives in one day than you will in years!

– Caerus Oil and Gas LLC employee

FROM OUR NEIGHBORS

“FRIENDS SUPPORTING FRIENDS... THERE IS NOTHING GREATER.”

*- Bob O'Connor, CEO,
Weld Food Bank*

At RAFT, volunteer support is absolutely critical to our ability to upcycle donated materials into innovative activity kits that stimulate students' curiosity and engage them in learning. Your work helps us to support over 290,000 students throughout the state of Colorado by providing teachers with access to ultra-low-cost resources and lessons that save time and support curriculum. Thank you again for supporting RAFT Colorado, educators, and the environment. We look forward to future opportunities with Centennial!

*- Kristy Blodgett, Corporate Engagement and Volunteer Coordinator,
RAFT Colorado*

I wanted to say thank you again for organizing and bringing in the group yesterday! We very much appreciate the support from DCP Midstream; you all are truly making a difference in our kiddos' lives! The group helped fill 800 backpacks, restocked our supply line, and loaded 400 backpacks for an agency partner that was picking up! Amazing!

*- Nichole Karpinsky, Director of Volunteer Services,
A Precious Child*





Economics and Taxes



Economic Impact in Colorado



- 89,000 direct and indirect jobs in Colorado's upstream & midstream sectors
 - More than 200,000 direct, indirect, induced jobs in Colorado industry-wide
- \$31 billion annual economic impact
- \$10.8 billion in employee income to CO households
- \$1 billion in public revenue each year
 - \$600 million in taxes for public education





Colorado's oil and natural gas industry is one of the state's largest taxpayers. It also adheres to a system that is unlike any other energy tax framework in the country, making state-to-state comparisons incredibly difficult, if not impossible.

Colorado's oil and natural gas taxes are paid primarily through three mechanisms: the local ad valorem tax

(assessed by each county and various local municipal taxing authorities), the state severance tax, and the state conservation mill levy.

Local Ad Valorem Property Tax

In the 1970s, Colorado legislators intentionally designed the state's oil and natural gas tax system to keep a majority of tax revenues in the communities where development occurs, through what is called a local ad valorem property tax. Roughly 70 to 80 percent of the industry's tax obligation goes to local governments, school districts, fire districts, sanitation districts, water districts and a variety of other local taxing entities. In addition, half of the state severance tax obligation goes back to local governments through the mineral impact grant program. This locally emphasized tax structure is very different from all other states, where a severance tax goes exclusively to state governments to serve state-determined priorities, which may or may not include a local benefit. The property assessment rate for Colorado's oil and natural gas industry is 87.5 percent, which is 3 times larger than other businesses and more than 12 times larger than residential property. For example, homeowners are taxed by multiplying 7.15 percent of the gross property valuation of their home, times the local mill levy. A business is taxed by multiplying 29 percent of the gross property value of the business, times the local mill levy. And finally, oil and natural gas is taxed by multiplying 87.5 percent of the gross sales value of production at the wellhead, times the local mill levy. In counties like Weld there are more than 300 different taxation authorities, such as fire districts and school districts, many of which have overlapping boundaries. The county treasurer collects these various taxes and distributes the revenues to the appropriate local jurisdiction.



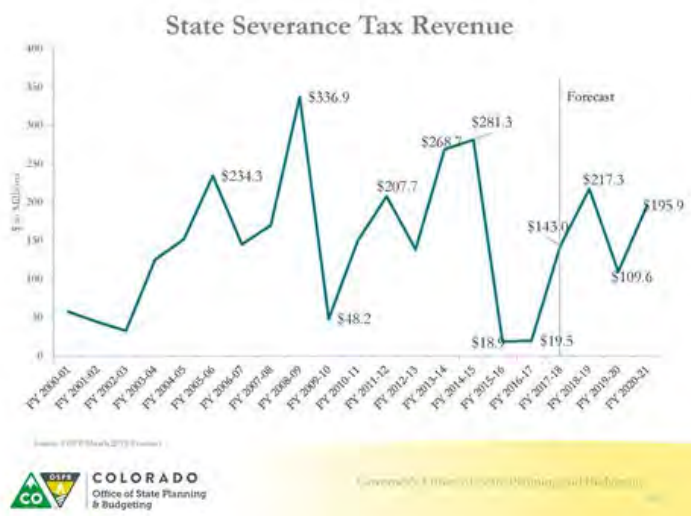
State Severance Tax

Colorado's state severance taxes are paid after the local obligation is fulfilled. Companies may deduct 87.5 percent of what they've paid to local entities from their state severance tax via the local ad valorem tax credit. This is important because unlike other states, in Colorado the local property tax rates discussed above vary dramatically from jurisdiction to jurisdiction. In some counties the tax obligation may be high, and in others it may be quite low. The credit normalizes a company's combined local-state tax requirement. For example, if a local jurisdiction's tax rates are low, then a company's state severance tax will be higher, and vice versa. Also mentioned above, 50 percent of Colorado's severance taxes are given back to local governments via the local mineral impact fund. This further emphasizes the local prioritization of Colorado's oil and gas tax system.

Colorado severance taxes are subject to the normal fluctuations of commodity prices and therefore, the tax imposed will vary from year-to-year.

Additional severance tax highlights include:

- The tax is based on sales revenue and is imposed on the owner-level.
- A statutory tiered-rate structure, based on total revenue per owner, determines the owner's tax rate.
 - Under \$25,000 = 2%
 - \$25,000 to \$99,999 = 3%
 - \$100,000 to \$299,999 = 4%
 - \$300,000 and up = 5%
- The system exempts revenues from very low-producing wells (15BBL/D and 90MCF/D).



Conservation Mill Levy

The third tax, the conservation mill levy, is set by the Colorado Oil and Gas Conservation Commission (COGCC). The mill levy is assessed on the market value of all oil and natural gas produced at the well. Revenues supply the Oil and Gas Conservation and Environmental Response Fund. That fund pays for the plugging and reclamation of orphan wells and pays for part of the COGCC annual budget. A portion of severance tax pays for the remainder of the agency's staffing and operational costs.

Economic Analysis

When you step back and also account for individual and corporate incomes taxes, the total fiscal flow to the state and local governments amounts to approximately \$1 billion per year. From that \$1 billion in tax revenue, approximately \$600 million goes to public education, which includes both K-12 and higher education.

A 2019 University of Colorado at Denver economic study, [Colorado Oil and Natural Gas Industry Economic & Fiscal Contributions](#), specifically looked at upstream and midstream sectors only, including direct and indirect jobs, in order to better understand the tax base from that portion of the industry. This [summary](#) describes a few of the economic impact studies that have been completed and how they differ.

Over time, taxes paid by Colorado's oil and natural gas industry have provided billions of dollars to local communities and to state coffers. This industry is an important part of our economy, as well as an important part of Colorado's tax base.

Additional Resources & Information

Colorado Oil & Gas Conservation Commission (COGCC) | www.cogcc.state.co.us
 Colorado Department of Public Health & Environment | www.colorado.gov/cdphe



Colorado Oil & Gas Industry Economic and Fiscal Contributions, 2017

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Colorado Oil & Gas Association

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Lecturer, Global Energy Management Program, University of Colorado Denver



March 2019

EXECUTIVE SUMMARY

- Colorado has a diverse economy relative to the industrial balance of the nation on whole.
- Mining and mineral extraction, which includes oil and natural gas industries, is indicative of that diversity, representing more than twice the share of GDP in Colorado as compared to the national economy.
- Oil and natural gas industries are an important part of the broader mining sector in Colorado
 - o In particular, upstream and midstream oil and gas industry activity is associated with substantial economic and fiscal impacts in the state.
 - o This analysis focuses on upstream and midstream oil and natural gas industries, a significant part of the broader mining and mineral extraction sector in Colorado.
- Economic Measures of Oil & Gas Industry Activity:
 - o The total workforce associated with upstream and midstream oil and gas activity in Colorado exceeds 89,000 positions, accounting for \$10.8 billion in employment income circulating through the state economy.
 - Nearly 30,000 workers are directly employed by establishments or working as sole proprietors in Colorado oil and natural gas sector industries.
 - The complete oil and natural gas sector supply chain includes positions in establishments outside the narrowly-classified oil and natural gas sector. Accounting for those indirectly employed in oil and gas suggests there are over 38,000 workers engaged in upstream and midstream activities in the state.
 - Expenditures of earnings by Colorado's upstream and midstream oil and natural gas sector workforce induces nearly 51,000 additional employed positions in a wide variety of sectors throughout the state.
 - The combination of direct, indirect, and induced employed positions associated with upstream and midstream oil and natural gas sector activities in Colorado exceeds 89,000.
 - o The value of upstream and midstream oil and natural gas industry output is estimated at \$19 billion in 2017, adding approximately \$13.5 billion to state domestic product.
 - o These economic measures are associated with establishments in upstream and midstream oil and natural gas industries only, and exclude employees, wages, value, and output from refining and marketing and other sectors supporting downstream activities.

- Fiscal Measures of Oil & Gas Industry Activity:
 - Through various fees and taxes paid by upstream and midstream oil and natural gas sector establishments and workers, oil and gas activity in Colorado is associated with at least seven distinct streams of public revenues, amounting to over \$990 million received by various state and local governmental organizations in 2017.
 - Much of the public financial impact of the industry flows to education and social assistance programs throughout the state.

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I. Introduction

Resource development enterprises engage in high-value industrial activities. As a result, they are associated with total employment and fiscal flows that are disproportionately larger than indicated by direct measures of business activity. Stakeholders with interests in such enterprises – employees, policymakers, and the public at large – will find useful a detailed examination of economic and fiscal flows associated with various resource development industries. Such an examination may be of interest to Coloradoans in particular, where the economy is both more diversified than the nation at a whole, and relatively more dependent on resource development. This report focuses on the upstream and midstream oil and natural gas sector in Colorado. We document economic and fiscal impacts of oil and natural gas industry activities.

Mining and resource development, broadly defined, include some of the highest-value industries in Colorado. Recent data from the U.S. Bureau of Labor Statistics (BLS) shows average weekly earnings in the mining and logging industry were \$1,506 in January 2019.¹ Earnings in the industry were the highest of goods-producing industries and lagging only utilities when compared to both goods-producing and service-providing industries.

Table 1: Employment and GDP Shares in Colorado Industries

----- Industry -----	Colorado 2017			
	----- Employment -----		----- GDP -----	
	(# jobs)	(% total)	(\$millions)	(% total)
Educational Services, Health Care, And Social Assistance	554,195	19.3%	25,312.9	7.3%
Professional And Business Services	414,464	14.4	51,068.2	14.8
Government And Government Enterprises	412,002	14.3	42,297.7	12.3
Arts, Entertainment, Recreation, Accommodation, And Food Services	339,669	11.8	17,890.7	5.2
Retail Trade	271,129	9.4	18,578.4	5.4
Construction	166,614	5.8	19,317.0	5.6
Finance, Insurance, Real Estate, Rental, And Leasing	163,317	5.7	70,291.9	20.4
Manufacturing	144,434	5.0	23,015.2	6.7
Wholesale Trade	106,726	3.7	20,024.1	5.8
Transportation And Warehousing	86,281	3.0	12,953.2	3.8
Other Services (Except Government And Government Enterprises)	82,831	2.9	7,975.4	2.3
Information	74,287	2.6	18,823.2	5.5
Mining, Quarrying, And Oil And Gas Extraction	25,580	0.9	11,187.3	3.2
Agriculture, Forestry, Fishing, And Hunting	17,644	0.6	2,660.2	0.8
Utilities	13,976	0.5	3,837.7	1.1
All Industry Total	2,873,149		\$ 345,233.1	

Sources: employment data from Colorado Information Marketplace, Employee Counts by Industry in Colorado
GDP data from Colorado Comprehensive Annual Financial Report, for the Fiscal Year Ended June 30, 2018, p. 13.

¹ U.S. Bureau of Labor Statistics, Employment Situation, February 1, 2019, Table B-3.

Table 1 shows 2017 employment and gross domestic product (GDP) in Colorado industries, ordered by total number of industry jobs.² Employment in mining, quarrying, and oil and gas extraction was 25,580, representing approximately 0.9 percent of state employment in 2017.³ In contrast, GDP in Colorado attributable to mining, quarrying, and oil and gas extraction was approximately \$11.2 billion, or 3.2 percent of total national GDP attributable to Colorado in 2017. Mining, quarrying, and oil and gas extraction rank third among Colorado industries as measured by the extent to which the share of value created (as measured by GDP) exceeds these relatively narrowly-defined measures of employment.⁴

Table 2: GDP in Colorado and U.S. Industries

----- Industry -----	2017 GDP			
	---- Colorado ----		----- U.S. -----	
	(\$millions)	(% total)	(\$billions)	(% total)
Finance, Insurance, Real Estate, Rental, And Leasing	\$70,291.9	20.4%	\$ 4,057.1	20.8%
Professional And Business Services	51,068.2	14.8	2,426.3	12.5
Government And Government Enterprises	42,297.7	12.3	2,453.7	12.6
Educational Services, Health Care, And Social Assistance	25,312.9	7.3	1,700.3	8.7
Manufacturing	23,015.2	6.7	2,179.6	11.2
Wholesale Trade	20,024.1	5.8	1,174.1	6.0
Construction	19,317.0	5.6	781.4	4.0
Information	18,823.2	5.5	1,050.8	5.4
Retail Trade	18,578.4	5.4	1,087.1	5.6
Arts, Entertainment, Recreation, Accommodation, And Food Services	17,890.7	5.2	804.7	4.1
Transportation And Warehousing	12,953.2	3.8	608.7	3.1
Mining, Quarrying, And Oil And Gas Extraction	11,187.3	3.2	268.6	1.4
Other Services (Except Government And Government Enterprises)	7,975.4	2.3	416.1	2.1
Utilities	3,837.7	1.1	307.5	1.6
Agriculture, Forestry, Fishing, And Hunting	2,660.2	0.8	169.2	0.9
All Industry Total	\$ 345,233.1		\$ 19,485.2	

Sources: Colorado GDP data from Colorado Comprehensive Annual Financial Report, for the Fiscal Year Ended June 30, 2018, p. 13.
U.S. GDP data from U.S. Bureau of Labor Statistics, Gross Domestic Product by Industry, Second Quarter 2018.

Mining and resource development is a relatively important and distinctive part of the Colorado economy. Table 2 shows GDP by industry in Colorado and the U.S in 2017. Industries are ordered by GDP shares in Colorado. Mining, including oil and natural gas extraction, accounts for a relatively large share of GDP in Colorado as compared to the nation overall. These resource industries rank second in significance in Colorado relative to the nation, as measured by the extent to which the share of state

² Colorado Information Marketplace data is based on the Bureau of Labor Statistics Quarterly Census of Employment and Wages establishment surveys and therefore excludes sole proprietor employment.

³ Mining excluding oil and gas was 4,051 jobs, implying oil and gas extraction employment accounts for approximately 84 percent of this measure of total Mining, Quarrying, and Oil and Gas Extraction employment.

⁴ Mining, Quarrying, and Oil and Gas Extraction industry share of GDP is 2.4 percentage points larger than its share of employment. This difference is exceeded by Finance etc. (14.7%) and Information (2.9%); and is followed by Wholesale Trade (2.1%) and Manufacturing (1.6%).

GDP directly attributable to an industry in Colorado exceeds the share of national GDP attributable to that industry.⁵

Finally, the relative importance of resource industries in Colorado is part and parcel of the state's greater industrial diversity as compared to the nation. Measures of industrial concentration illustrate industrial balance in Colorado. The four highest GDP-producing industries nationwide account for a greater share of total GDP than do the four highest GDP-producing industries in Colorado (more than 57 percent nationwide vs. less than 55 percent in Colorado). And the four lowest GDP-producing industries in Colorado account for a greater share of total GDP than do the four lowest GDP-producing industries nationwide (7.4 percent in Colorado vs 6.0 percent nationwide.)⁶

The importance of resource industries within a diverse Colorado economy motivates this study. We focus on the upstream and midstream oil and natural gas sector in particular. Oil and gas extraction is the largest share of the broader mining sector in Colorado, representing approximately 84 percent of Mining, Quarrying, and Oil and Gas Extraction establishments' employment in 2017. We include midstream oil and natural gas activities as business and regulatory conditions similarly affect regional employment and investment decisions in the upstream and midstream in Colorado. We consider broader measures of industry activity to account for sole proprietor employment. We examine total employment, production, and fiscal payments (taxes and other fees paid to government) associated with upstream and midstream oil and natural gas sector establishments in Colorado.

We estimate oil and natural gas sector establishments and supporting industries employ over 38,000 workers. And the expenditure of the wages and proprietor earnings from those workers induces nearly 51,000 additional jobs. These 89,000 jobs account for \$10.8 billion of Colorado employment income. Individual income taxes generate approximately \$234.7 million in revenue for the state.

Various taxes and fees paid by oil and gas industry establishments result in payments to a variety of government entities in Colorado. Total fiscal flows to the state and municipal governments – including individual and corporate income taxes, property taxes paid to counties, production taxes paid to the state, and lease and royalty income on production on state and federal lands – amount to over \$990 million per year. Industry-related taxes and fees support a broad range of public services in Colorado, including schools, public safety, and environmental conservation.

This report was prepared by Michael J. Orlando for the University of Colorado Denver Global Energy Management Program at the request of the Colorado Oil and Gas Association (COGA). Dr. Orlando is Managing Director of Econ One Research in Denver and Lecturer in the University of Colorado Denver Business School Global Energy Management Program. He has broad and extensive experience in energy and resources in general and oil and natural gas in particular. Spanning a career of over 30 years, he has worked as a reservoir engineer, policy and research economist, lecturer of finance and political risk analysis and strategy, and consultant to industry and government. He holds degrees in Petroleum and

⁵ Mining, Quarrying, and Oil and Gas Extraction industry share of GDP in Colorado is 1.9 percentage points larger than its share of GDP nationwide. This difference is exceeded only by Professional and Business Services (2.3%); and is followed by Construction (1.6%), Arts etc. (1.1%), and Transportation and Warehousing (0.6%).

⁶ Based on these measures, the Herfindahl-Hirschman Index (HHI) of industry concentration calculates to 0.1064 for Colorado and 0.1098 for the U.S. A higher HHI indicates a higher degree of concentration.

Natural Gas Engineering, Business Administration, and Economics. Dr. Orlando's biographical summary is available online at <https://www.econone.com/staff-member/michael-orlando/>.

The next section describes the scope of this report and methods use for this research. Section III presents direct measures of oil and gas industry activity. Section IV discusses broader measures of economic impacts associated with industry activity presented in the previous section. Section V summarizes public financial or 'fiscal' cash flows associated with direct and indirect measures of economic activity presented in sections III and IV. The final section offers concluding remarks.

II. Scope and Methods of Analysis

This analysis examines industrial activity, economic impacts, and fiscal impacts associated with upstream and midstream oil and natural gas sector activities in Colorado. The sector is defined to include upstream and midstream activities because the business environment in these industries is determined, to varying degrees, by common market and regulatory conditions.⁷

For the purposes of this study, the Colorado oil and gas sector is defined as business activities at establishments in the oil and gas extraction industry and several supporting industries as defined by the U.S. Census Bureau North American Industrial Classification System (NAICS). The NAICS divides the economy into 20 sectors and multiple industries within each of these sectors.⁸ The system is designed to classify into the same ‘industry’ those economic units of production – firms, organizations, establishments – that utilize similar production processes.⁹

The following ‘industries’ are included in the present analysis:

- Subsector 211 = Oil and Gas Extraction: a subsector of sector 21 (Mining, Quarrying, and Oil and Gas Extraction); includes the **Crude Petroleum Extraction** (211120) and **Natural Gas Extraction** industries (211130); includes establishments in industries that develop and/or operate oil and gas properties; may produce crude petroleum, natural gas, products from oil shale and oil sands, hydrocarbon liquids, and/or sulfur from natural gas production.¹⁰
- Industry 213111 = **Drilling Oil and Gas Wells**: an industry in subsector 213 (Support Activities for Mining) in sector 21; includes establishments engaged in drilling of wells on a contract basis.¹¹
- Industry 213112 = **Support Activities for Oil and Gas Operations**: an industry in subsector 213 in sector 21; includes establishments engaged in activities in support of oil and gas operation on a contract basis, excepting geophysical surveying and mapping, and site preparation and related construction activities.¹²
- Industry 237120 = **Oil and Gas Pipeline and Related Structures Construction**: an industry in subsector 237 (Heavy and Civil Engineering Construction) in sector 23 (Construction); includes establishments and specialty trade contractors engaged in construction and repair of pipelines, storage tanks, and refineries.¹³
- Subsector 486 = Pipeline Transportation: a subsector of sector 48 – 49 (Transportation and Warehousing); includes **Pipeline Transportation of Crude Oil** (486110), **Pipeline Transportation of Natural Gas** (486210), **Pipeline Transportation of Refined Petroleum Products** (486910), and

⁷ This analysis does not include the petroleum refining industry as commodity market conditions have a very different impact on the business environment of such establishments as compared to upstream and midstream industries. And the refining industry is characterized by regulatory conditions relatively distinct from those in upstream and midstream industries. As a result, to the extent that ‘downstream’ refining is affected by varying business and/or regulatory conditions in a way similar to upstream and midstream industries, use of this study to characterize changes in such business and/or regulatory conditions will understate impacts on Colorado economic and fiscal conditions.

⁸ Executive Office of the President, Office of Management and Budget, 2017, p. 3.

⁹ Ibid.

¹⁰ Ibid., p. 105.

¹¹ Ibid., p. 115.

¹² Ibid., p. 116.

¹³ Ibid., p. 128.

All Other Pipeline Transportation (486990); includes establishment engaged in pipeline transportation of crude petroleum and petroleum products, transportation and transport-related storage of natural gas, and non-hydrocarbon transportation that may be related to petroleum production (e.g. water supply systems.)¹⁴

Direct activity of the Colorado oil and gas sector is summarized by employment, in both firms and among sole proprietors, and employment income. In some cases, these ‘inputs’ to oil and gas industry establishments result in relatively easily countable intermediate outputs, such as well drilling. And measures of Colorado oil and gas sector final output are readily identifiable, such as oil and gas production.

But these direct measures of activity summarize only a small part of the overall scope of oil and gas industry activities in Colorado. Total economic activity associated with Colorado oil and gas sector industries is a result of direct effects, indirect effects, and induced effects.

Direct effects refer to those inputs, workers and wages, to establishments classified within Colorado oil and gas sector industries, as defined above. Direct workers include, for example, staff geologists working for a natural gas prospector, roustabouts working for a drilling contractor, and welders working for a pipeline construction company.

Indirect effects refer to those workers and wages in establishments serving as suppliers to Colorado oil and gas sector industry establishments. For example, welding establishments are contracted by firms in a variety of industries, some of which are in the oil and natural gas sector. Those welding establishment workers and incomes necessitated by commercial engagements with Colorado oil and natural gas sector establishments are considered indirect economic effects of sector industry activities.¹⁵

Finally, induced effects refer to those workers and wages attributable to spending of earnings by workers directly and indirectly employed in the production of oil and gas in Colorado. Well operators, water supply truck drivers, and contract welders, among others, spend much of their income in Colorado. The share of employment spent, for example, at hardware stores and restaurants and ski resorts attributable to direct and indirect oil and gas industry workers is ‘induced’ by activities in the oil and gas sector.¹⁶

Economic measures of direct, indirect, and induced activities are quantified using an input-output (I-O) model. I-O models “provide a detailed picture of the flow of products and resources within a given economy and between that economy and the outside world.”¹⁷

This study uses an I-O model developed by IMPLAN Group, LLC. The IMPLAN model incorporates data from various sources. Primary inter-industry input-output relationships are obtained from the Bureau of

¹⁴ Ibid, p. 394-395.

¹⁵ The number of indirect workers in an industry may be expressed as a multiple of direct workers in that industry. The sum of direct and indirect employment relative to direct employment is often referred to as a Type I Multiplier.

¹⁶ The number of induced workers in an industry may be expressed as a multiple of direct workers and/or direct and indirect workers in that industry. The sum of direct, indirect, and induced employment relative to direct employment is often referred to as a Type II Multiplier or a Social Accounting Matrix (SAM) Multiplier.

¹⁷ Hughes 2018, p. 5.

Economic Analysis.¹⁸ Other principal sources of data include the U.S. Bureau of Labor Statistics and the U.S. Census Bureau.

The IMPLAN I-O model is used to calculate total employment impacts (the sum of direct, indirect, and induced employment), employment income, industry value added, and industry output associated with the Colorado oil and natural gas sector in 2017. The model is also used to estimate these measures of industry impact for a select number of individual counties in Colorado.

Total Colorado oil and natural gas sector economic activity is likely higher than the estimates provided in this model. First, the I-O analysis conducted for this study does not account for direct and indirect employment in other states that may induce jobs and associated economic activity in Colorado. For example, Colorado establishments may acquire inputs from out of state, and Colorado oil and gas resources may be developed by oil and gas industry establishments located outside the state. This analysis does not estimate Colorado employment and associated economic measures induced by out of state workers directly and indirectly employed to develop and produce Colorado oil and natural gas resources.

Second, the I-O analysis conducted for this study does not account for refining industry employment in Colorado that is associated with upstream and midstream oil and natural gas sector activities. The present analysis is designed to estimate measures of oil and natural gas business activity that are subject to market and regulatory conditions common to oil and natural gas. Some share of Colorado refining employment and business activity may be so categorized, though any value in particular would be speculative. Consequently, direct refining employment and associated economic activity is excluded from the analysis altogether.

Colorado oil and natural gas sector fiscal flows are estimated from a broad range of sources, reflecting the wide variety of taxes and fees associated with sector activity in the state. Payments to public entities are estimated for state taxes on income and production and county property taxes. Additional payments to the state are estimated for lease auction bonus payments, leasing and surface use agreement fees, and royalties for production on state land. Similarly, these values are estimated for production on federal land because some share of those payments are returned to the state.

State individual and corporate income taxes are estimated using the IMPLAN I-O model. Fees paid for production on state lands are obtained from the State Land Board. And fees paid for production on Federal lands are obtained from the U.S. Department of Interior, Office of Natural Resources Revenue. County property taxes are estimated from the State Department of Local Affairs, Division of Property Taxation assessments and representative millage rates on oil and natural gas property. State severance taxes are obtained from the Colorado Department of Revenue. Oil and Gas Conservation and Environmental Response Fund revenues are obtained from the Colorado Oil and Gas Conservation Commission

Total Colorado oil and gas sector fiscal impacts are likely to exceed these values to the extent that some state public financial sources are excluded from this analysis. For example, motor vehicle fees for vehicles registered to oil and gas sector establishments and real and personal property tax payments by industry workers are excluded from this summary.

¹⁸ Cheney 2018. Also, see Bureau of Economic Analysis 2017.

III. Industry Activity

This section presents several direct measures of activity associated with upstream and midstream oil and natural gas sector industry establishments in Colorado, as defined in the previous section.

Table 3 presents direct employment, employment income, and number of business establishments in Colorado oil and natural gas sector industries in 2017. Establishment counts are obtained from the BLS Quarterly Census of Employment and Wages (QCEW). Employment counts are the sum of workers as reported in the BLS QCEW and sole proprietors as reported in the U.S. Census Bureau (Census) Nonemployer Statistics (NES). Employment income is defined as the sum of BLS QCEW wages and Census NES sole proprietor income.

Table 3: Colorado Oil and Gas Sector, 2017

Industry	Employment	Employment	Firms
		Income	
		(Millions)	
(1)	(2)	(3)	(4)
Extraction	10,833	\$1,634	402
Drilling	1,799	158	86
Support Activities	11,989	1,056	874
Pipeline Construction	3,936	272	99
Pipeline Transportation	1,347	182	65
Total	29,904	\$3,301	1,526

Sources: Bureau of Labor Statistics, Quarterly Census of Employment and Wages;
U.S. Census Bureau, Nonemployer Statistics

Forty percent of Colorado oil and gas sector workers are employed in support activities. Another 36 percent are employed in oil or natural gas extraction establishments, either as sole proprietors or workers in one of 402 firm establishments. The remainder of sector employees work in drilling, pipeline construction, or pipeline transportation establishments.

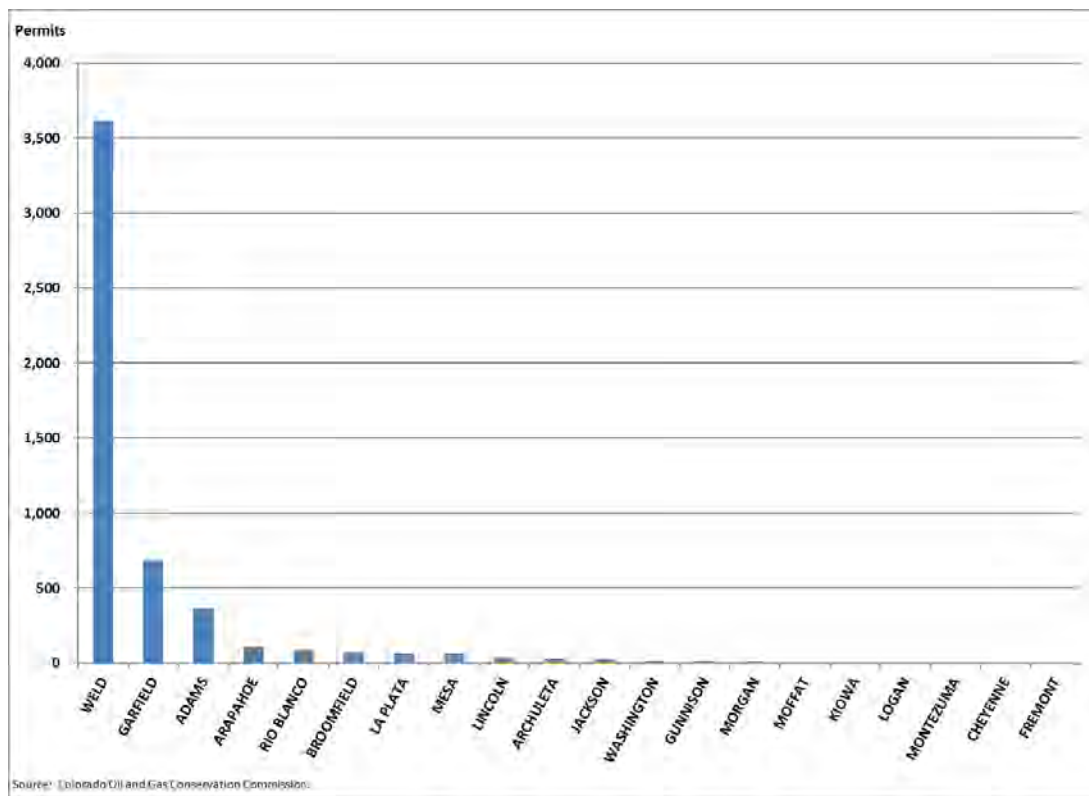
Workers in the extraction industries earned, on average, the highest incomes in the broader sector in 2017: \$151 thousand per employee.¹⁹ Pipeline transportation industry workers earned average incomes of \$135 thousand. Drilling and support activity industries workers received approximately \$88 thousand per worker in 2017. And pipeline construction industry workers earned \$69 thousand.

Drilling activity is relatively geographically concentrated in Colorado. Figure 1 presents the number of drilling permits approved by the Colorado Oil and Gas Conservation Commission in each county for the 12 month period through February 2, 2019. Nearly 90 percent of approved permits are located in three counties, Weld, Garfield, and Adams. An additional 16 counties account for the remaining 8.5 percent

¹⁹ Employment incomes represent the sum total of all forms of compensation, including benefits.

of approved drilling permits. The remaining 44 of 64 Colorado counties had no drilling permits approved in the 12 month period.

Figure 1: Colorado Drilling Permits
(approved permits, 12 months through 2-2-19)



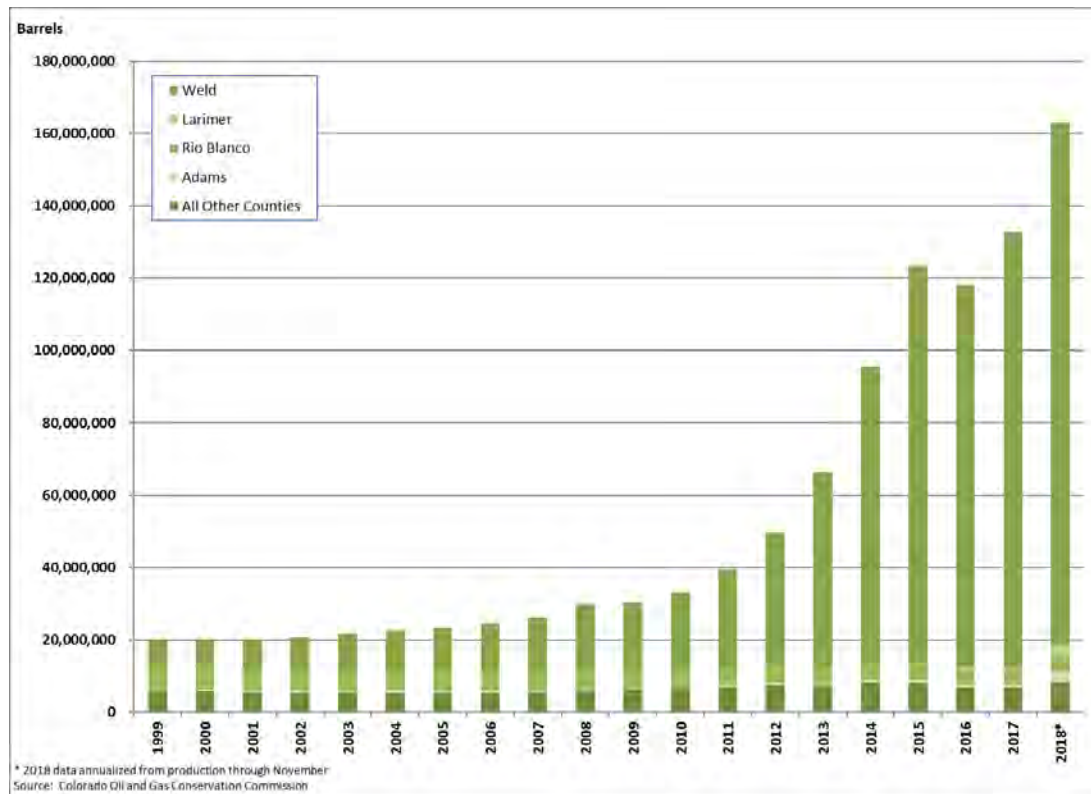
Over 80 percent of approved permits were located in the greater Denver-Julesburg basin. An additional 16 percent of permits were located in Piceance Basin counties. The remainder of approved permits were spread throughout seven other productive basins across the state.

Oil production is also geographically concentrated in Colorado, particularly since the advent of shale oil development in 2008. Figure 2 shows annual production in Colorado in the 20 years through 2018. Total oil production in the state grew approximately 50 percent in the 10 years following 1999. Total oil production has grown over 400 percent in the 10 years ending in 2018. Currently, approximately 93 percent of Colorado oil production is located in the three most productive counties in the Denver-Julesburg basin – Weld, Larimer, and Adams. The most oil-productive county outside this area, Rio Blanco, generated 2.3 percent of total state oil production in 2018.

The growth in oil production in Colorado is greatly dependent on the emergence of shale oil plays, and to a greater degree than the growth observed in U.S. oil production overall. Since the beginning of

1999, U.S. oil production is up approximately 100 percent, less than a quarter of oil production growth experienced in Colorado.²⁰

Figure 2: Colorado Annual Oil Production



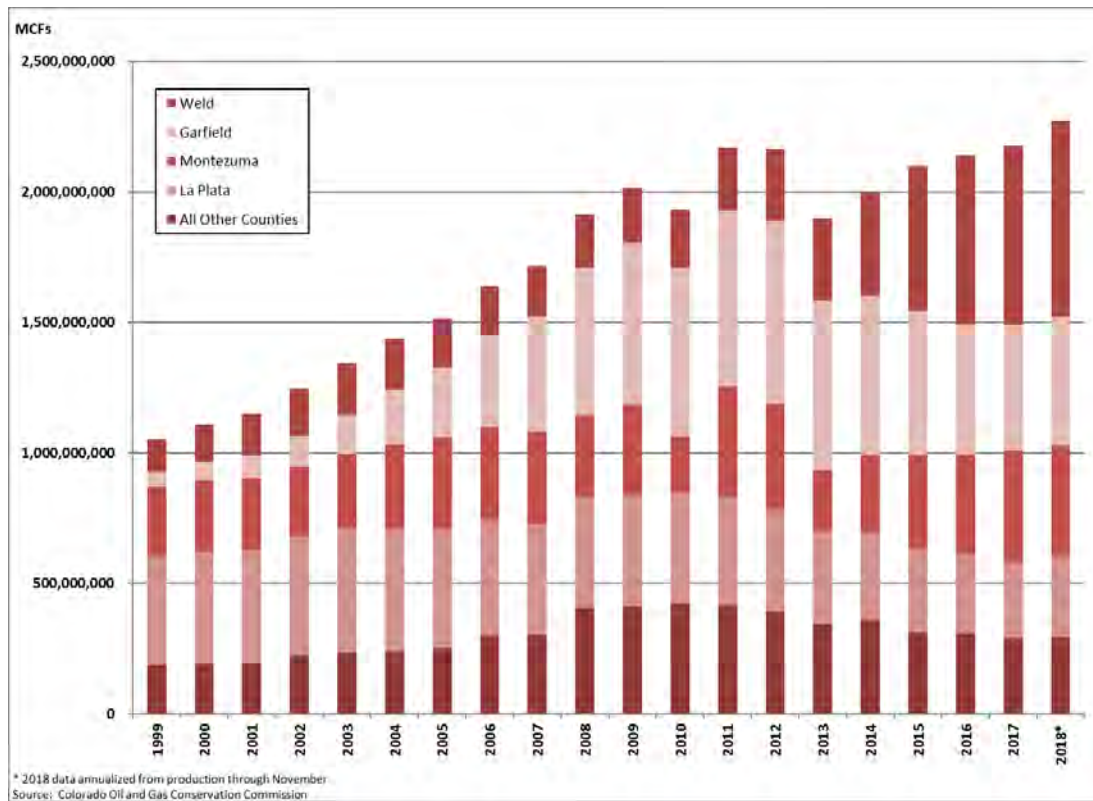
The production of natural gas in Colorado is less geographically concentrated as compared to oil. The top four most natural gas productive counties in 2018 are located in four different productive basins throughout the state – the Denver-Julesburg, the Piceance, the Paradox, and the San Juan.

Overall, growth in natural gas production has been modest as compared to that of oil. This is likely a result of stable but low commodity prices in spite of substantial growth in the use of natural gas for electrical power generation.

It is also interesting to note the geographic dispersion of growth in Colorado natural gas production over the past two decades. In the 10 years following 1999, much of the state's growth in natural gas production was from Garfield County in the Piceance Basin. Since the advent of shale oil, which is often produced with associated gas, much of the growth in Colorado natural gas production has occurred in Weld County.

²⁰ U.S. Energy Information Administration, author calculations.

Figure 3: Colorado Annual Natural Gas Production



IV. Economic Measures of Industry Activity

Direct measures of industry activity presented in preceding section are associated with a broader set of economic impacts. The upstream and midstream oil and gas industry employs many resources in addition to the workers on payroll in industry establishments. These supply-chain expenditures indirectly support workers in related industries. And earnings expenditures of workers and owners, both directly and indirectly employed by industry establishments, induce additional economic activity and employment in a broad range of sectors, from housing to entertainment to healthcare and other services.

Figure 4 presents a complete estimate of employment associated with Colorado oil and gas sector industry establishments. Overall employment – the sum total of direct, indirect, and induced jobs – is estimated at 89,340 jobs in 2017. Approximately one third of these positions represent workers employed directly in oil and gas industry establishments. Over half of total industry-supported employment is induced by income derived from the broader oil and gas sector supply chain.

Table 4: Colorado Oil and Gas Sector Employment Counts, 2017

Industry	Direct	Indirect	Induced	Total
(1)	(2)	(3)	(4)	(2)+(3)+(4) (5)
Extraction	10,833	4,618	19,498	34,949
Drilling	1,799	663	2,487	4,949
Support Activities	11,989	1,569	8,113	21,671
Pipeline Construction	3,936	1,116	1,998	7,051
Pipeline Transportation	1,347	694	18,679	20,720
Total	29,904	8,661	50,775	89,340

Note: estimates from IMPLAN input-output model

Support activities represent the largest industry in the Colorado oil and gas sector as measured by direct employment. However, establishments in oil and gas extraction indirectly employ nearly three times the number of workers as are employed in the support activities supply chain.

The pipeline transport sector has a high impact on induced employment relative to direct employment in the industry in 2017. This high induced multiple is a result of several factors. First, this industry has the highest labor income per worker of any industry in Colorado in the IMPLAN model. Second, the sum of wages, salaries, and proprietor income exceeded total output in 2017, reflecting capital losses and net investment in this industry in the study period. Finally, induced employment is further elevated because pipeline transportation has the highest share of total income received as proprietor income, which the IMPLAN model assumes is fully expended in the local area. The induced multiple of direct

pipeline transportation jobs is likely to decline in future periods if net investment declines to capital replacement, as expected in future years when pipeline capacity has caught up with local demand.²¹

Table 5 repeats total statewide sector employment impacts presented in table 4. In addition, Table 5 presents employment measures for eight counties significantly associated with four major producing basins in Colorado.²² Employment in these counties accounts for approximately two-thirds of overall employment associated with the oil and gas sector in Colorado. Approximately 75 percent of direct employment and all indirect employment occurs in the selected counties. Roughly half of induced employment occurs in these counties, with the remainder of jobs induced by oil and gas sector employee expenditures occurring in other counties throughout Colorado.

Table 5: Colorado Oil and Gas Sector Employment Counts, 2017
(Statewide and Selected Counties)

Geographic Unit	Direct	Indirect	Induced	Total
(1)	(2)	(3)	(4)	(2)+(3)+(4) (5)
Colorado, statewide	29,904	8,661	50,775	89,340
<i>Denver-Julesburg Basin</i>				
Weld County	8,519	1,621	3,062	13,202
Adams County	1,487	901	2,280	4,669
Boulder County	228	1,969	179	2,376
Denver County	8,399	3,354	20,410	32,163
<i>Piceance Basin</i>				
Garfield County	1,618	438	520	2,576
Rio Blanco County	725	267	250	1,242
<i>San Juan Basin</i>				
La Plata County	928	542	757	2,228
<i>Raton Basin</i>				
Las Animas County	390	119	155	664

Note: estimates from IMPLAN input-output model

Weld County contains the largest number of workers directly employed by oil and gas sector establishments. Denver accounts for the largest number of workers in the broader supply chain, and

²¹ The IMPLAN induced multiple of direct jobs was 13.9 for Colorado pipeline transportation in 2017. That multiple was 5.9 in 2014, 9.7 in 2015, and peaked at 18.9 in 2016.

²² Results from the IMPLAN total state model and the multi-regional models used to calculate county-level effects can only be compared in a qualitative sense. In counties with few firms in an industry, employment and wage data is suppressed by reporting agencies. In those cases, we estimate employment and earnings using industry establishment averages at the state level. These approximations will produce county-level results that do not necessarily sum to those of statewide aggregate model estimates.

those induced by oil and gas sector worker expenditures statewide. Boulder has a large number of indirectly employed positions relative to direct positions in the county, reflecting a significant number of firms and proprietors participating in the regional supply chain.

We can characterize activity associated with the oil and gas sector by several economic measures, in addition to employment counts. Table 6 presents employment income, value added, and output associated with total sector employment and business activity. Output is the value of production in a given year. It represents total industry revenues adjusted for net changes in production. Value added represents total industry output net of the value of intermediate inputs needed to produce that output. Value added can also be thought of as that share of production remaining after payments to inputs and therefore available to be paid to workers (i.e. employment income), owners (i.e. returns on invested capital), and the government (i.e. taxes and fees). Thus, employment income is that portion of value added that is not paid to owners or taxes.

Table 6: Colorado Oil and Gas Sector Economic Impact Measures, 2017

Industry	Employment*	Employment* Income	Value Added	Output
(1)	(2)	(3)	(Millions) (4)	(5)
Extraction	34,949	\$4,152	\$5,636	\$8,080
Drilling	4,949	528	786	1,085
Support Activities	21,671	1,693	2,295	3,225
Pipeline Construction	7,051	419	619	1,089
Pipeline Transportation	20,720	4,010	4,209	5,514
Total	89,340	\$10,800	\$13,545	\$18,994

Notes: estimates from IMPLAN input-output model

* Employment measures include direct, indirect, and induced effects

Nearly two thirds of oil and gas sector output is attributable to upstream industries - extraction, drilling, and support activities. In comparison, employment income is more evenly split between upstream and midstream industries, with less than 60 percent of income attributable to direct, indirect, and induced employment in extraction, drilling, and support activities.

Table 7 presents these economic measures for the statewide oil and gas sector and selected counties. Approximately eighty five percent of industry output is attributable to activity in the eight counties selected to illustrate four principal productive basins in Colorado. Nearly 59 percent of industry output is associated with activities in Denver County. In comparison, only 36 percent of sector employment occurs in Denver, indicating employment is broadly distributed throughout the state as compared to the location for recording sales revenue.

On a per capita basis, Colorado oil and gas sector activities are relatively evenly distributed across the basins highlighted here, although *per capita* measures suggest a significant industry presence Rio Blanco County due to a relatively low population.

Table 7: Colorado Oil and Gas Sector Economic Impact Measures, 2017
(Statewide and Selected Counties)

Geographic Unit	Employment*	Employment Income*	Value Added	Output
			(\$Millions)	
(1)	(2)	(3)	(4)	(5)
Colorado, statewide	89,340	10,800	13,545	18,994
<i>Denver-Julesburg Basin</i>				
Weld County	13,202	1,259	1,637	2,249
Adams County	4,669	913	1,030	1,316
Boulder County	2,376	136	204	363
Denver County	32,163	7,551	9,063	11,124
<i>Piceance Basin</i>				
Garfield County	2,576	197	284	432
Rio Blanco County	1,242	113	136	233
<i>San Juan Basin</i>				
La Plata County	2,228	173	208	398
<i>Raton Basin</i>				
Las Animas County	664	49	76	119

Note: estimates from IMPLAN input-output model

In most counties highlighted, industry presence as measured by employment per 1,000 county population ranges from 40 to 46. Adams and Boulder counties have significantly less employment on a population-normalized basis. Rio Blanco County has the highest concentration of oil and gas sector employment.

Upstream and midstream oil and gas sector employment income, value added, and industry output also appear more evenly distributed across selected counties when normalized by county population than when considered on a gross basis as presented in Table 7. Weld, Garfield, La Plata, and Las Animas counties have similar measures of population-normalized employment income, value added, and output, suggesting similar degrees of industry significance in county economic output.

By these measures, the upstream and midstream oil and gas industry is approximately twice as significant in Weld, Garfield, La Plata, and Las Animas county economies as compared to the statewide normalized measures of economic impact. Industry significance is approximately five-times statewide averages in Denver County, and nine to ten-times statewide averages in Rio Blanco County. Adams

County is most typical of statewide industry significance by these measures, even while it has a lower share of county workforce associated with the industry as compared to the state overall

Table 8: Colorado Oil and Gas Sector Population-Normalized Economic Impact Measures, 2017
(Statewide and Selected Counties)

<u>Geographic Unit</u>	<u>Population</u>	<u>Employment*</u>	<u>Employment</u>	<u>Value</u>	
			<u>Income*</u>	<u>Added</u>	<u>Output</u>
(1)	(2)	(per 000's pop'n) (3)	(4)	(5)	(6)
Colorado, statewide	5,607,154	15.93	1.93	2.42	3.39
<i>Denver-Julesburg Basin</i>					
Weld County	304,633	43.34	4.13	5.37	7.38
Adams County	503,167	9.28	1.81	2.05	2.62
Boulder County	322,514	7.37	0.42	0.63	1.13
Denver County	704,621	45.65	10.72	12.86	15.79
<i>Piceance Basin</i>					
Garfield County	59,118	43.57	3.33	4.80	7.31
Rio Blanco County	6,420	193.53	17.60	21.17	36.22
<i>San Juan Basin</i>					
La Plata County	55,589	40.07	3.12	3.73	7.15
<i>Raton Basin</i>					
Las Animas County	14,238	46.63	3.41	5.35	8.33

Note: estimates from IMPLAN input-output model, normalized by U.S. Census population estimates July 1, 2017

V. Fiscal Measures of Industry Activity

Colorado upstream and midstream oil and gas sector activities yield a broad range of fiscal resources. Fiscal flows associated with oil and gas activities include state personal income taxes paid by workers in sector establishments. In addition, oil and gas extraction industry establishments pay the following fees and taxes:

- State lease bonus payments, land lease payments, surface use agreement fees, and royalties on oil and gas produced from state lands.
- Federal lease bonus payments, land lease payments, surface use agreement fees, and royalties on oil and gas produced from Federal lands.²³
- County property taxes on the value of oil and gas producing land, equipment and structural improvements on the land, and the value of the oil and gas produced from the land.²⁴
- State severance taxes on the value of production from private lands, state lands, Federal lands, and tribal lands.²⁵
- A levy to fund oil and gas regulation.
- State corporate income taxes.

Public financial payments from these sources totaled over \$990 million in 2017, flowing through state and local governments to a broad range of beneficiaries.

Table 9: Total Fiscal Flows from Colorado Oil and Gas Sector to various Colorado Governments

<u>Fiscal Source</u>	<u>Amount (\$millions)</u>	<u>Time Period</u>	<u>Primary Uses</u>
Individual Income Tax	\$ 234.7	2017	education, social assistance
State Lands & Minerals	99.4	FY 2017 – 18	education, parks & wildlife, public buildings
Federal Lands & Minerals	84.7	2017	education, social assistance
Property Tax	457.1	2107	education, local governments
State Severance Tax	96.1	FY 2017 – 18	local impact grants, energy innovation, water & resources
Oil & Gas Conservation and Environmental Response Fund	13.2	FY 2016 – 2017	oil & gas regulation
Corporate Income Tax	<u>8.1</u>	2017	education, social assistance
TOTAL:	\$993.3		

²³ A share of Federal payments are returned to the state in which they originate.

²⁴ The share of production from a tribal land that is owned by that tribe is not subject to county property tax.

²⁵ The share of production from a tribal land that is owned by that tribe is not subject to state severance tax.

Table 9 summarizes fiscal flows from the Colorado upstream and midstream oil and gas sector. Property taxes represent the largest source of public revenue from oil and gas sector activities. Nearly \$460 million in taxes on oil and gas property were paid or payable to a broad range of taxing districts and authorities across Colorado in 2017. Property and income taxes represent approximately 70 percent of tax revenue generated by oil and gas industry activity in the state in 2017. These and other fiscal flows serve a variety of uses, the most significant of which is public education.

Colorado individual income taxes are assessed at a rate of 4.63 percent of taxable income.²⁶ The IMPLAN I-O model used in this analysis estimates a total of \$234.7 million of individual income taxes paid by direct, indirect, and induced workers associated with oil and gas sector establishments, after various permissible exclusions and deductions.

Individual income tax payments are part of the state's general fund. General fund receipts are allocated to variety of statutory and discretionary uses, including education (41.8%), social assistance (34.6%), justice (5.8%), business, community, & consumer affairs (5.0%), transportation (4.9%), and other categories.²⁷

Fees associated with oil and gas extraction on state lands in Colorado are managed by the State Board of Land Commissioners. The Land Commissioners manage several trusts for the benefit of Colorado public schools and a variety of other public institutions and purposes. Trust assets include 2.8 million acres of surface land and four million acres of mineral rights.²⁸ The trusts receive receipts for mineral lease bonus payments, leasing fees, surface use fees, and mineral royalties.

Table 10 presents various oil and gas industry payments to seven trusts from fiscal year 2010 – 11 through fiscal year 2017 – 18. Trusts receiving oil and gas related fees in the most recent fiscal year include the School Trust (for public schools), the CSU Trust (for Colorado State University), the Internal Improvements Trust (for Colorado parks and wildlife), and the Public Buildings Trust.²⁹ In Fiscal Year 2017 – 18, oil and gas related revenues to these trusts totaled \$99.4 million. School Trust oil and gas revenues accounted for 99 percent of total oil and gas revenues to State Board of Land Commissioners managed trusts.³⁰

Over the past eight fiscal years, oil and gas revenues have been sufficient to cover a large share of distributions from the School Trust and the CSU Trust. In addition, trust distributions in excess total oil and gas revenues may be attributable to investment earnings on oil and gas trust revenues retained for investments in previous years. Thus, oil and gas revenues may be an important contributor to trust sustainability.

In the case of the School Trust, oil and gas revenues have covered between 80 percent and 95 percent of trust distributions. They were sufficient to cover 81 percent of School Trust distributions in the most

²⁶ Colorado Department of Revenue, 2018b, p. 5.

²⁷ Ibid., p. 2.

²⁸ Colorado State Board of Land Commissioners, Income and Inventory Report, Fiscal Year 2017 – 18, p. 2.

²⁹ In addition to the four trusts listed above, three additional trusts received some oil and gas related revenue from Fiscal Year 2010 – 11 to Fiscal Year 2017 – 18: the Hesperis Trust (Fort Lewis College), the Penitentiary Trust (Colorado Department of Corrections), and the CU Trust (University of Colorado).

³⁰ In Fiscal Year 2017-18, the CSU Trust received \$666 thousand, the Internal Improvements Trust received \$640 thousand, and the Public Buildings Trust received approximately \$8 thousand.

recently completed fiscal year. In the case of the CSU Trust over this time period, oil and gas revenues have covered between 84 percent and 127 percent of trust fund distributions. They were sufficient to cover 94 percent of CSU Trust distributions in the most recently completed fiscal year.

Table 10: Colorado State Board of Land Commissioners,
Oil and Gas Revenues to All Trusts

REVENUES (millions)	<u>FY 2010-11</u>	<u>FY 2011-12</u>	<u>FY 2012-13</u>	<u>FY 2013-14</u>	<u>FY 2014-15</u>	<u>FY 2015-16</u>	<u>FY 2016-17</u>	<u>FY 2017-18</u>
- MINERALS -								
Oil Royalties	\$17.53	\$27.35	\$34.04	\$76.61	\$79.24	\$42.07	\$44.02	\$56.05
Gas Royalties	16.13	17.44	13.80	23.47	26.13	17.48	20.71	25.15
Bonus	63.26	78.45	53.18	50.04	50.70	42.68	20.29	15.34
Oil and Gas Rentals	1.40	2.25	2.62	2.35	1.97	1.62	1.19	1.30
- SURFACE -								
Surface Use Agreements	0.32	0.21	0.49	0.65	0.52	0.75	0.50	1.56
Total Oil & Gas Revenues	\$98.65	\$125.70	\$104.14	\$153.12	\$158.56	\$104.60	\$86.72	\$99.40
TRUSTS DISTRIBUTIONS (millions)	\$112.70	\$132.47	\$118.44	\$166.54	\$179.91	\$130.62	\$109.03	\$122.31
Oil & Gas Revenue as share of total distributions	0.88	0.95	0.88	0.92	0.88	0.80	0.80	0.81

Source: Colorado State Board of Land Commissioners, Income and Inventory Reports, Fiscal Years 2014-15, 2015-16, 2016-17, 2017-18.

Fees associated with oil and gas extraction on Federal lands in Colorado are administered by U.S. Department of Interior Office of Natural Resources and Revenue. Federal mineral lease (FML) revenues from oil and gas producers include lease auction bonus payments, surface use and other fees, ongoing lease rental payments, and royalties on produced minerals. Approximately 50 percent of these payments are returned to their state of origin.³¹

Figure 4 shows total FML oil and gas revenue from Colorado from 2008 through 2017.³² Total fees associated with oil and gas sector activity on federal lands in Colorado were \$169.4 million in 2017. Approximately 96 percent of these fees were mineral royalty payments. In the decade ending 2017, total federal lands oil and gas fees in Colorado ranged from \$347.0 million in 2008 to \$147.8 million in 2016. Assuming 50 percent of Federal fees are returned to Colorado, the state will receive \$84.7 million from Federal lands oil and gas fees in 2017. As these fees are paid into the state general fund, we assume uses may be estimated in proportion to general fund uses.

Property taxes in Colorado are levied by local governmental jurisdictions (counties, municipalities, special purpose tax districts, etc.) on property values assessed in accordance with state statutes. Oil and gas lands are assessed at 87.5 percent of production value. Other commercial property is assessed at 29 percent of market value. The residential property assessment rate is revised annually to maintain a statutory ratio between total property tax collections from commercial property and those from residential property.

³¹ Colorado General Assembly, Legislative Council Staff, Colorado Online Tax Handbook – Severance Tax.

³² Some values may be negative on net due to credits for excess payments in previous years.

Figure 4: Oil and Gas Fees Paid on Federal Lands in Colorado

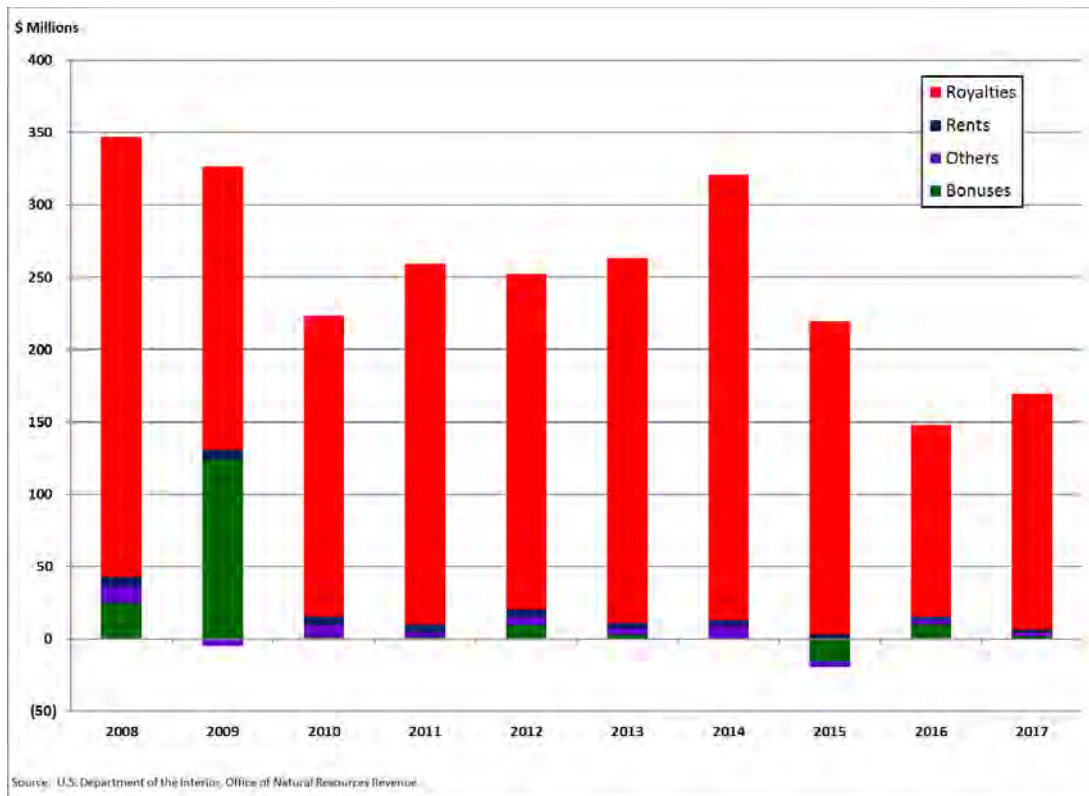


Table 11 presents assessed property values and effective mill levies for oil and gas property from 2013 through 2017. Oil and gas properties are assessed a tax on the value of lands, improvements to those lands, and personal property. Improvements generally refer to unsalvageable investments, such as drainage or roads. Personal property refers to salvageable or investments such as equipment installed on the land.

Table 11: Oil and Gas Assessments and Levies

year	Land	Assessed Values (millions)			effective mill levy	tax assessment
		Improvements	Personal Property	Total		
2013	\$6,829.0	\$6.0	\$1,945.3	\$8,780.2	50.6	\$444.5
2014	9,112.8	2.3	1,994.2	11,109.3	50.9	565.8
2015	11,175.2	4.5	2,164.3	13,344.0	52.1	695.6
2016	6,099.8	9.0	2,139.9	8,248.7	59.0	486.9
2017	5,381.4	8.8	2,124.0	7,514.1	60.8	457.1

Sources: State of Colorado, Department of Local Affairs, Division of Property Taxation, Annual reports, 2013 to 2017.
Garfield County Assessor, Weld County Assessor.

For the purpose of property taxation, oil and gas lands are valued at a uniquely high rate among commercial properties in Colorado, and according to the revenues obtained from production from those lands. Improvements and personal property are valued similarly to other commercial property in Colorado, and on a cost basis. Oil and gas lands are assessed at 87.5 percent of the value of primary production.³³ Improvements and personal property are assessed at 29 percent of their depreciated cost. Property taxes due are calculated by multiplying the product of market (in the case of production from land) or cost basis (in the case of improvements and personal property) and the assessment rate (87.5 percent in the case of primary production, 29 percent in the case of improvements and personal property) by the property tax mill levy corresponding to the location of the taxable property.

In 2017, Weld and Garfield oil and gas property assessed values represented nearly 76 percent of total oil and gas property assessed values in 2017. Therefore, effective mill levies are estimated from a weighted average of the effective mill levies on oil and gas properties in Weld and Garfield counties.³⁴ The average is weighted in proportion to oil and gas property value between Weld and Garfield counties in 2017, approximately 81 / 19.

Because oil and gas lands are valued according to production, land values will vary with commodity price fluctuations. However, because property taxes are paid in arrears (i.e. taxes due are calculated according to prior-year assess values), variation in assessments and taxes will lag commodity price fluctuations. Colorado oil and gas property tax assessments ranged from \$444.5 million to \$695.6 million from 2013 to 2017. We estimate a total of \$457.1 million in property tax payments due in 2018 to various tax authorities in Colorado are associated with the 2017 assessed value of oil and gas produced from lands, improvements on those lands, and personal property (equipment, etc.) associated with those lands. Given higher average crude oil prices in 2018 as compared to 2017, we expect property taxes due in 2019 to exceed this 2018 estimate.

Colorado levies severance taxes on production of coal, metallic minerals, molybdenum, oil and gas, and oil shale. Oil and gas severance taxes are assessed on wells producing in excess of 15 barrels of oil per day or 90 thousand cubic feet of gas per day. Taxes are assessed on gross income net of deductions for transportation, manufacturing, and processing prior to sale.³⁵ Wells subject to the tax are assessed at a rate of two to four percent of gross income below \$300 thousand per year, and five percent for gross income in excess of \$300 thousand per year. Oil and gas producers are permitted a credit for 87.5 percent of county land taxes. County taxes on surface facilities are not creditable against state severance taxes.

Table 12 shows Colorado oil and gas net severance tax collections for fiscal years 2013 – 14 through 2017 – 18. Oil and gas severance tax revenue was \$96.1 million in the most recently completed fiscal year. Oil and gas net severance tax receipts averaged \$136.1 million per year over the past five fiscal years. As expected, the variation in severance tax receipts follows movements in oil prices throughout the time period.

³³ Secondary production is assessed at 75 percent of sales value.

³⁴ Obtained from Weld and Garfield County Assessors, respectively.

³⁵ Ibid.

Table 12: Colorado Oil and Gas Net Severance Tax Collections

<u>Fiscal Year</u>	<u>Collections (millions)</u>
2013 – 2014	\$235.2
2014 – 2015	284.7
2015 – 2016	79.0
2016 – 2017	(14.3)*
2017 – 2018	96.1

* refunds exceeded collections in FY 2017.

Source: Colorado Department of Revenue, 2018 Annual Report.

Colorado severance taxes are allocated to a variety of energy, resource, and local uses.³⁶ By statute, the first \$1.5 million of annual receipts flows to the Innovative Energy Fund. The remainder of severance tax revenues is split evenly between the Department of Natural Resources Severance Tax Trust Fund and the Department of Local Affairs Local Government Severance Tax Fund. The Severance Tax Trust Fund allocates funds to natural resource and energy related programs and water and other capital projects. The Local Government Severance Tax Fund allocates approximately 70 percent to local impact grants and loans, with the remaining 30 percent distributed to local governments according to metrics proportionate to local oil and gas and mining activities.

The Oil and Gas Conservation and Environmental Response Fund is maintained through a levy on the production value of oil, natural gas, and CO₂ sales net of exemptions.³⁷ Allocations from the Fund constituted over half of the Colorado Oil and Gas Conservation Commission budget in fiscal year 2016 – 17, with the remainder largely funded by the state severance tax.³⁸ The levy was raised to 1.1 mills from 0.7 mills in February 2018.³⁹ At that time, the rate hike was expected to raise an additional \$4.8 million for the fund in 2018,⁴⁰ bringing the total expected levy for the year to \$13.2 million.

Colorado corporate income taxes are assessed at a rate of 4.63 percent of taxable income.⁴¹ The IMPLAN I-O model used in this analysis estimates a total of \$8.1 million of corporate income taxes paid by establishments in the Colorado oil and gas sector, after various permissible exclusions and deductions.

³⁶ Ibid.

³⁷ Colorado Revised Statutes §34-60-124.

³⁸ Colorado Oil and Gas Conservation Commission, 2016.

³⁹ Finley, 2018.

⁴⁰ Ibid.

⁴¹ Colorado Department of Revenue, 2018a, p. 8.

VI. Conclusion

Resource industries are an important part of a diverse Colorado economy. And those industries comprising the upstream and midstream oil and natural gas sector represent a significant share of Colorado resource industries. This study examines economic and fiscal impacts from upstream and midstream oil and natural gas industry activities in Colorado.

Colorado has been a significant driver of nationwide growth in U.S. shale oil and gas production. With the advent of shale-play-focused innovations in 2008, oil production in Colorado has grown more than four times that of nationwide growth in oil production. And much of the growth in natural gas production in the state is associated with oil production.

Nearly 30,000 workers are directly employed by establishments or working as sole proprietors in Colorado oil and natural gas sector industries. The complete oil and natural gas sector supply chain includes over 8,600 additional positions in establishments outside those narrowly-classified to upstream and midstream industries. Accounting for those indirectly employed in sector activities, over 38,000 workers were engaged in upstream and midstream oil and natural gas activities in 2017.

Expenditures of earnings by Colorado's upstream and midstream oil and natural gas sector workforce induce nearly 51,000 additional employed positions in a wide variety of sectors throughout the state. Total employment associated with the sector – including those directly employed by sector establishments, those in supporting industries whose employment is indirectly supported by sector activities, and those whose employment is induced by expenditures of sector earnings – exceeded 89,000 in Colorado in 2017.

Total workforce earnings associated with the sector are estimated at \$10.8 billion in 2017. We estimate the value of industry-associated output was \$19 billion in 2017, adding approximately \$13.5 billion to state domestic product. These economic measures are associated with establishments in upstream and midstream oil and natural gas industries only, and exclude employees, wages, value added, and output from refining and marketing and other sectors supporting downstream activities.

Various fees and taxes are paid by upstream and midstream oil and natural gas sector establishments and workers. In some cases, these public revenue streams exceed or do not have a counterpart in other industries. For example, as in other industries, oil and natural gas establishments and workers pay income taxes to the state and some municipalities. And the oil and natural gas sector pays property taxes to counties and municipal governments. Unlike other industries, the assessment rate on oil and gas lands value is 75 to 87.5 percent, as compared to 29 percent for the general assessment rate for corporate property. And unlike other industries, oil and natural gas extraction establishments pay royalties and taxes on the value production, in addition to taxes paid on earnings. The state receives royalties for oil and gas production from state and federal lands and severance taxes on all production in Colorado.

Various taxes and fees on oil and natural gas activity produce at least seven distinct streams of public revenue in Colorado. We estimate the various public revenue streams amounted to over \$990 million received by various state and local governmental organizations in Colorado in 2017. Much of the public financial impact of the industry flows to education and social assistance programs in the state.

REFERENCES

- Cheney, Phil, 2018, IMPLAN Data Sources, <https://implanhelp.zendesk.com/hc/en-us/articles/1150009674448-IMPLAN-Data-Sources> accessed February 24, 2019.
- Colorado Department of Revenue, 2018 Annual Report, July 1, 2017 – June 30, 2018, December 19, 2018.
- Colorado Department of Revenue, Colorado C Corporation Income Tax Filing Guide, 112 Book, October 11, 2018.
- Colorado Department of Revenue, Colorado Individual Income Tax Filing Guide, 104 Book, November 13, 2018.
- Colorado General Assembly, Legislative Council Staff, Colorado Online Tax Handbook – Severance Tax, <https://leg.colorado.gov/agencies/legislative-council-staff/severance-tax> accessed March 6, 2019.
- Colorado Information Marketplace, Employee Counts by Industry in Colorado, <https://data.colorado.gov/Labor-Employment/Employee-Counts-by-Industry-in-Colorado/>, accessed February 26, 2019.
- Colorado Office of the State Controller, Colorado Comprehensive Annual Financial Report, for the Fiscal Year Ended June 30, 2018.
- Colorado Oil and Gas Conservation Commission, Finance Unit – Annual Funding and Budget, Fiscal Year 2016 – 17, https://cogcc.state.co.us/documents/about/TF_Summaries/GovTaskForceSummary_Funding&Budget.pdf accessed March 11, 2019.
- Colorado Revised Statutes, Title 34: Mineral Statutes; Section 34-60-124: Oil and Gas Conservation and Environmental Response Fund.
- Colorado State Board of Land Commissioners, Income & Inventory Report, Fiscal Year 2014 – 15.
- Colorado State Board of Land Commissioners, Income & Inventory Report, Fiscal Year 2015 – 16.
- Colorado State Board of Land Commissioners, Income & Inventory Report, Fiscal Year 2016 – 17.
- Colorado State Board of Land Commissioners, Income & Inventory Report, Fiscal Year 2017 – 18.
- Executive Office of the President, Office of Management and Budget, *North American Industry Classification System*, 2017, https://www.census.gov/eos/www/naics/2017NAICS/2017_NAICS_Manual.pdf accessed February 28, 2019.
- Finley, Bruce, 2018, “State raises tax on oil, gas to build environmental cleanup fund during a boom time,” *The Denver Post*, February 13, <https://www.denverpost.com/2018/02/13/colorado-raises-tax-oil-gas-environmental-cleanup-fund> accessed March 11, 2019.

Hughes, David W., 2018, "A primer in Economic Multipliers and Impact Analysis Using Input-Output Models," University of Tennessee Institute of Agriculture, paper W644.

U.S. Bureau of Labor Statistics, Employment Situation, February 1, 2019.

U.S. Bureau of Labor Statistics, Gross Domestic Product by Industry, Second Quarter 2018, <https://www.bea.gov/data/gdp/gdp-industry> accessed February 25, 2019.

U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages.

U.S. Census Bureau, Nonemployer Statistics.

U.S. Department of Commerce, Bureau of Economic Analysis, November 2017, Concepts and Methods of the U.S. National Income and Production Accounts, <https://www.bea.gov/sites/default/files/methodologies/nipa-handbook-all-chapters.pdf> accessed February 24, 2019.

U.S. Department of Interior, Office of Natural Resources Revenue.

U.S. Energy Information Administration, Petroleum & Other Liquids, U.S. Field Production of Crude Oil, <https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=MCRFPUS1&f=M> accessed March 5, 2019.

Summary of Economic Analysis

- This 2019 report is similar to the 2015 CU Leeds School of Business report; however, the modeling is more conservative in the 2019 study. Both reports were limited to upstream and midstream oil and gas activity, making it different and narrower from other reports that include downstream and retail oil and gas impacts. The study was conducted by researchers with the University of Colorado Denver and Econ One Research, Inc. The analysis is based on the most recent data available (2017) from the U.S. Bureau of Economic Analysis (BEA).
- The 2015 CU study, which analyzed 2014 data, showed 102,000 direct, indirect, and induce employees within the upstream and midstream subsectors. The 2019 CU study, drawing from 2017 U.S. Bureau of Economic Analysis data, looks at the industry as it began its rebound from a prolonged commodities slump in 2015 and 2016. In 2017, the upstream and midstream subsectors in Colorado consisted of 89,000 direct, indirect, and induced employees. The CU study further explains significant efficiencies that were found in industry as it overcame a low commodity marketplace. The price of oil in 2014 reached \$114/barrel, while the price of oil averaged \$51 in 2017.
- The upstream and midstream subsectors of the industry provide a significant amount of public revenue, primarily in the form of local ad valorem and state severance taxes. In fact, \$1 billion in local and state taxes were paid by these subsectors in 2017 alone.
- There are three widely accepted economic modeling tools: IMPLAN, RIMS-II, and REMI. IMPLAN and RIMS-II are static input-output models that are typically used to account for inter-industry flows of past transactions. In this study, CU Denver and Econ One Research used IMPLAN to run an historical exercise, using Bureau of Economic Analysis data, to look at the economic and fiscal impacts of upstream and midstream oil and gas activity in 2017.
- The API study by PricewaterhouseCoopers is another study often referenced. It applied a methodology that captures all supply chain sectors, including gas stations and manufacturing that are also related to the oil and natural gas industry. API also used IMPLAN, but again, captured all supply chain sectors, while the CU Study specifically considered the upstream and midstream subsectors of the oil and natural gas industry.
- Another study commonly referenced was conducted by the Common Sense Policy Roundtable (CSPR), through the REMI Partnership, which conducted analysis regarding the potential economic and fiscal impacts of SB19-181. That analysis relied on the REMI model, which is a dynamic modeling tool used to forecast economic flows/activity. REMI is often used to analyze future economic impacts of policy decisions.

2020

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