Colorado Oil and Natural Gas employment in 2023 and how it compares to other industries

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Executive Summary

Oil and natural gas is widely recognized as an important core industry in Colorado, growing in its share of state Gross Domestic Product (GDP), and serving as a core economic generator of state economic activity. However, the industry's impact in supporting economic security in Colorado households is less well understood. This research employs an alternative approach to studying occupational structures, both within the oil and natural gas industry and compared to other industries, to demonstrate the importance of oil and natural gas employment in supporting family economic security in the state.
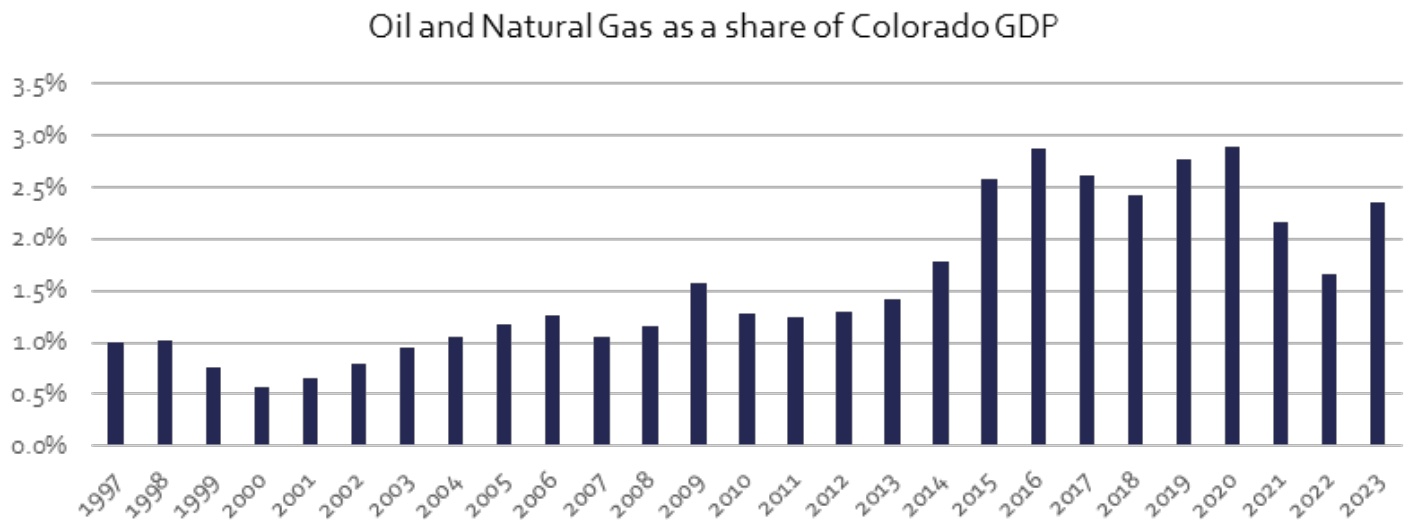
The analysis of oil and natural gas employment reported below finds that 1) across the occupational structure within in the industry, 2) across regions of Colorado, and 3) for Coloradans seeking economically meaningful employment in fields that do not require a post-secondary credential, working in the oil and natural gas industry provides significant opportunities for economic security. Specifically, this analysis finds the following for calendar year 2023:

- For almost all occupations within oil and natural gas, workers reported earning higher wages than workers in the same occupations in the average of all other Colorado industries combined.
- Occupations require different levels of education. In oil and natural gas occupations that do not require a post-secondary degree, workers in oil and natural gas earned more than in the same occupations in the average of all other industries.
- In all regions with oil and natural gas related earnings, the combined earnings were higher in the oil and natural gas industry occupations than in the same occupations reported by respondents in the same region but in all other industries combined.
- Due to the higher earning profile, oil and natural gas occupations better supported self-sufficiency than the same occupations in all other industries combined. In many cases one oil and natural gas job in a household was sufficient for self-sufficiency without a second income in the household.
- Households with workers in the oil and natural gas industry are less reliant on public programs such as SNAP and Medicaid than households with workers in the same occupations but in other industries.

Oil and natural gas is an important base industry in Colorado and one that is growing in its share of the state's economy. In 1997, oil and natural gas related economic activity represented approximately one percent of state GDP; by 2023 that share had more than doubled. Recently, the sector's share of the Colorado economy peaked at almost three percent of state GDP, above the national average of just under one percent of GDP nationally in 2023.

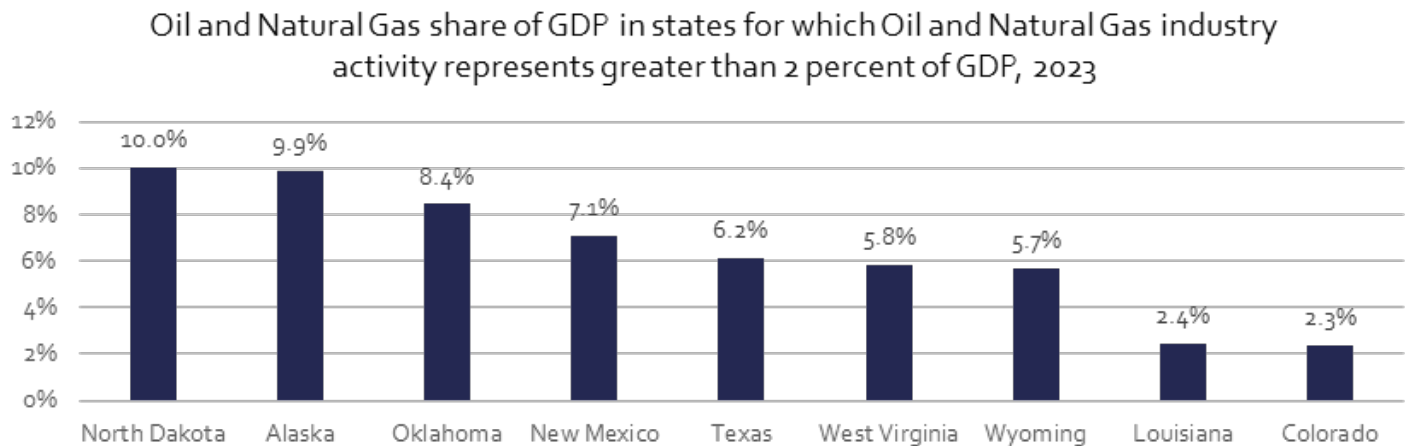Figure 1. Oil and Natural Gas as a share of the Colorado economy

Oil and Natural Gas as a share of Colorado GDP
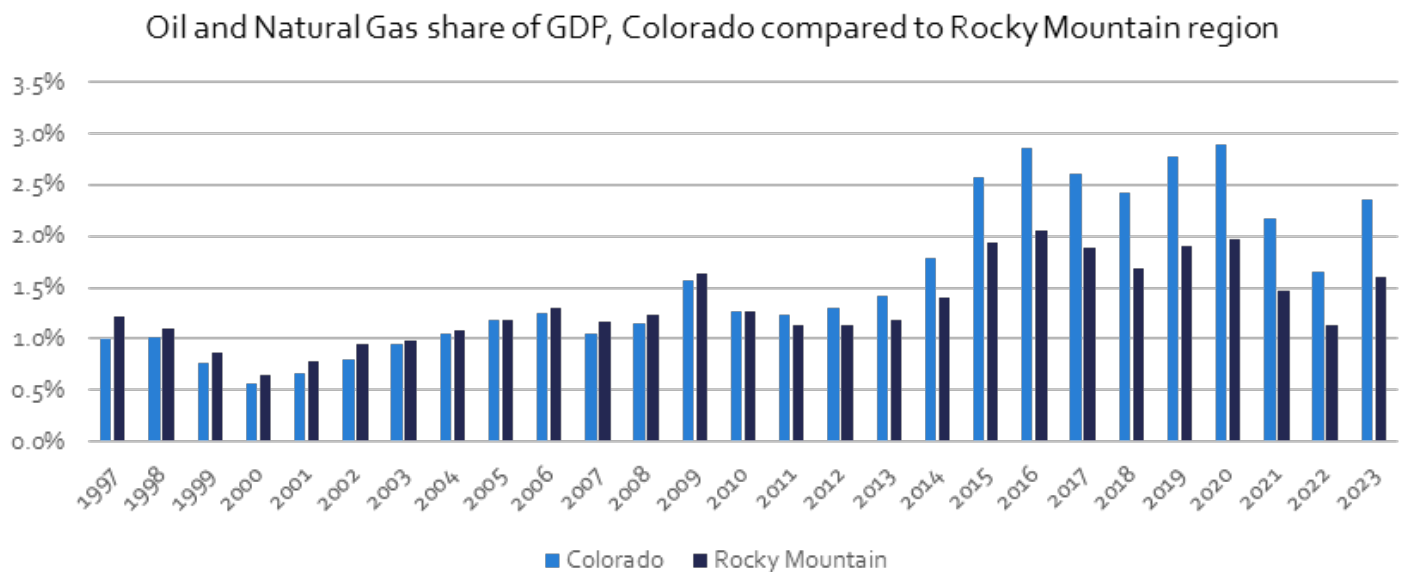
Source: CFC calculation from BEA data

In 2023, Colorado ranked 9th among the states for share of GDP provided by oil and natural gas. Compared to the Rocky Mountain region, starting in the early 2010s and continuing to date, oil and natural gas has commanded an increasingly larger share of GDP in Colorado than in the region overall, a persistent reversal of the previous trend.

Figures 2a and 2b. Comparison of the top Oil and Natural Gas states as a share of their state's economy and of Colorado to the Rocky Mountain region

Oil and Natural Gas share of GDP in states for which Oil and Natural Gas industry activity represents greater than 2 percent of GDP, 2023

Source: CFC calculation from BEA data

Oil and Natural Gas share of GDP, Colorado compared to Rocky Mountain region

Source: CFC calculation from BEA data

While the state level statistics demonstrate the relative contribution of the oil and natural gas industry to the overall economy of the state, they also can mask the importance of the industry to regions and even households across Colorado where the industry's relatively high paying jobs are an important ballast in local economies. According to the latest annual data from the Bureau of Labor Statistics, oil and natural gas extraction accounted for 6,587 jobs in Colorado in 2023. Those jobs accounted for approximately $1.69 billion in wages in that same year for an average statewide wage of just over $255,000.

However, average wages, often skewed by high outliers, also do not tell the full story, particularly as it relates to the economic welfare of Colorado households. Instead, the contribution of oil and natural gas employment to households across the state needs to be told with a more nuanced assessment. This study, which employs an innovative data approach tailored to a deeper analysis of oil and natural gas related employment, provides that nuanced assessment. The findings reported below demonstrate that across the occupational structure within in the oil and natural gas industry, across regions of Colorado, and for Coloradans seeking economically meaningful employment in fields that do not require a post-secondary credential, working in the oil and natural gas industry provides significant opportunities for economic security for Coloradans.

Data and Methodology

Employment data are classified by occupation and industry. Industry refers to the sector of the economy. Occupation refers to the specific role of the worker. While industries are mutually exclusive, occupations can exist across industries. Just think about how many industries employ workers in occupations such as accounting.

This study focuses on the occupations within the oil and natural gas industry. The occupations in the oil and natural gas industry vary from ones such as "derrick, rotary drill, and service unit operators, and roustabouts, oil, gas, and mining" which are specific to the oil and natural gas industry to functions such as accounting, purchasing, engineering and welding which are occupations that exist in many industries including oil and natural gas. Further, this analysis is specifically concerned with the ability to compare occupations within oil and natural gas to those same occupations in other industries – across regions and by the educational requirements necessary to qualify for specific occupations.

The data challenge is that employment data are most often reported either *by industry* or *by occupation*, but not both. Industry data alone for oil and natural gas do not differentiate by occupation and do not allow for the comparison of occupations across and within the industry. Occupation data alone do not allow for the segmentation of occupations by industry and thus do not allow for the identification and study of occupations specifically in oil and natural gas.

Since this analysis is interested specifically in the occupational opportunities within the oil and natural gas industry and how those opportunities compare to the same or other occupational choices in other industries, it required an innovative data approach, one that gave access to occupational data by industry. The solution was to use Census data. While not an official employment data series, the Public Use Microdata Sample of the American Community Survey (ACS PUMS) provided the opportunity to analyze household level survey responses to questions regarding occupation by industry and to further analyze the occupations for earnings as well as other household and demographic characteristics associated with the respondents.

According to the US Census Bureau, "the ACS PUMS files are a set of records from individual people or housing units, with disclosure protection enabled so that individuals or housing units cannot be identified."[1] The advantage of the PUMS data is the ability to create custom queries to create estimates that are not available in the pretabulated ACS tables. Specific to this analysis, the fact that the PUMS survey includes questions about occupation, industry, earnings, geographic location within the state, and other socio-demographics of the household allowed for the following comparisons:

- Earnings by occupation for occupations in oil and natural gas compared to the same occupations in other industries
- Earnings by educational requirement for the occupation, both within the oil and natural gas industry and in other industries (for this comparison the occupational data from the ACS PUMS were cross walked to the BLS data on educational requirement)
- Comparisons by region of the earnings of oil and natural gas occupations compared to those of workers in the same occupations but in industries other than oil and natural gas

1   https://www.census.gov/programs-surveys/acs/microdata.html#:~:text=Public%20Use%20Microdata%20Sample%20(PUMS),-The%20Census%20Bureau's&text=The%20ACS%20PUMS%20files%20are,and%205%2Dyear%20PUMS%20files.

- An assessment of the capacity for oil and natural gas jobs, by occupation, by region and by educational requirement to support household self-sufficiency (for this analysis, the ACS PUMS data were combined with the data from the self-sufficiency standard calculated by the Center for Women's Welfare at the university of Washington)
- A comparison of select household socioeconomic variables between households with an oil and natural gas earner vs. households with workers in other industries

While the ACS PUMS allows for the powerful comparisons outlined above, there are some limitations inherent in the use of sample data for this type of analysis. First, since the ACS is not the official source for data on employment and earnings, when the individual survey responses are weighted up to the population the values by occupation or industry do not tie to the employment related data reported by the BLS or BEA.[2] Second, as a household level sample, the ACS data report by place of residence of the respondent, not by place of employment. For this reason, the regional values reported will not tie to regional employment data from other sources. Further, the point estimates reported are derived from a survey sample and weighted to the overall population. This makes those estimates subject to margins of error, and those margins generally get larger as the data are stratified along increasing numbers of dimensions (for example occupation by industry by region). And finally, the findings and comparisons are sensitive to the reported occupation, industry and earnings mix for the survey year. If the mix of occupations within an industry were to change significantly in subsequent years, the findings also could vary significantly. For this reason, the comparisons derived from the ACS PUMS survey should be interpreted as the state of the economy at the point in time of the survey – in this case the year 2023.

The data: Distribution of occupations reported within oil and natural gas

In 2023, Colorado respondents to the ACS PUMS survey reported working in 26 occupations within the oil and natural gas industry. Those occupations are presented in Figure 3.

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2   For example, the weighing to the population of all oil and natural gas workers as reported in the ACS PUMS results in a statewide estimate of 5499 oil and natural gas workers. For the same 2023 calendar year, the BLS reports 6587 oil and natural gas workers in the QCEW (covered employment for unemployment purposes).

Figure 3. Occupations within the Oil and Natural Gas industry reported by ACS PUMS respondents, 2023

Chief executives	General and Operations Managers	Computer and Information Systems Managers	Purchasing Managers	Transportation, Storage, and Distribution Managers	Property, Real Estate, and Community Association Managers
Managers, nec (including Postmasters)	Compliance Officers, Except Agriculture	Accountants and Auditors	Mechanical Engineers	Petroleum, mining and geological engineers, including mining safety engineers	Physical Scientists, nec
Life, Physical, and Social Science Technicians, not elsewhere classified	Security Guards and Gaming Surveillance Officers	First-Line Supervisors of Office and Administrative Support Workers	Bookkeeping, Accounting, and Auditing Clerks	Weighers, Measurers, Checkers, and Samplers, Recordkeeping	First-Line Supervisors of Construction Trades and Extraction Workers
Derrick, rotary drill, and service unit operators, and roustabouts, oil, gas, and mining	Mining Machine Operators	Extraction workers, not elsewhere classified	Control and Valve Installers and Repairers	Welding, Soldering, and Brazing Workers	Other production workers including semiconductor processors and cooling and freezing equipment operators
		Driver/Sales Workers and Truck Drivers	Pumping Station Operators		

Source: IPUMS USA, University of Minnesota, www.ipums.org

Of the occupations within oil and natural gas reported by respondents to the 2023 ACS PUMS, the one with the lowest wages in 2023 was property, real estate and association managers with a reported average wage of $27,154. At the high end, the interpretation is more difficult.

The Census Bureau has a convention of suppressing reported earnings in the 99.5 percentile by reporting the wage as a pre-determined value.[3] In 2023, that pre-determined in Colorado was $636,000 and the following four high paying occupations within oil and natural gas had respondents whose earnings were coded consistent with this suppression technique:

- Chief executives
- General and operation managers
- Computer and information system managers
- Petroleum mining and geological engineers

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3   In 2023 this value was $636,000 which represents "the state means of values above the listed value for that specific Census year". (IPUMS USA, University of Minnesota, www.ipums.org)

Beyond those four occupations whose reported earnings are affected by the suppression convention, the highest reported earnings were from Managers, not elsewhere classified with reported annual average wages of $163,333.

Digging deeper, the data show that oil and natural gas workers are not distributed evenly across occupations. As the graphic in Figure 4 shows, the highest concentrations of workers in the industry occur in the following two occupations:

- Derrick, rotary drill, and service unit operators, and roustabouts, oil, gas, and mining
- First-line supervisors of construction trades and extraction workers.

According to the ACS PUMS data, these two occupations account for just over 27 percent of oil and natural gas workers. The unique opportunity in oil and natural gas is that these highly concentrated occupations also are relatively high paying.

In 2023, the average reported annual wage for Derrick, rotary drill, and service unit operators, and roustabouts, oil, gas, and mining was $106,159 and for First-line supervisors of construction trades and extraction workers it was $100,000. The relatively higher concentration of workers in these occupations with relatively higher wages provides for economic opportunity within the industry. And, as the comparisons presented later in this report will show, this distribution of workers toward higher paying occupations positively affects the other comparisons – specifically by educational requirements and region – and particularly provides for opportunity in the following educational cohort and regions:

- In the educational cohort of those with less than a post-secondary degree as these oil and natural gas occupations are accessible to those with less than a college degree, and
- In the regions largely around Mesa and Weld counties in which these jobs are heavily concentrated.

Figure 4. Distribution of Oil and Natural Gas occupations among 2023 ACS PUMS respondents

Distribution of Oil and Natural Gas occupations among ACS PUMS respondents

Source: IPUMS USA, University of Minnesota, www.ipums.org.

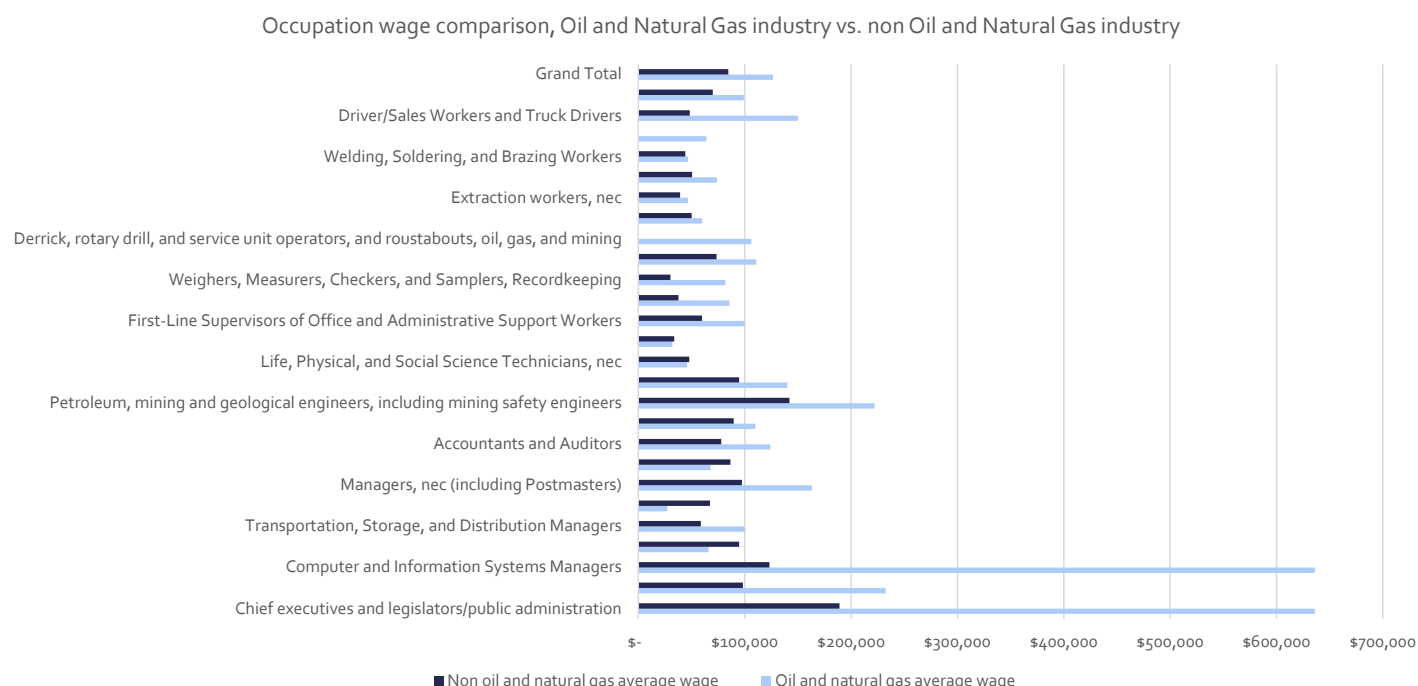Note: 'nec' = not elsewhere classified

In 2023, workers in most occupations in oil and natural gas reported higher earnings than workers in the same occupations but in other industries. This pattern was consistent when comparing occupations by their educational requirements and geographically across Colorado. The three key findings highlighted below detail these comparisons.

Finding 1. For all but five occupations, oil and natural gas workers reported earning higher wages than workers in the same occupations in the average of all other Colorado industries combined.

Figure 5. 2023 reported earnings by industry, Oil and Natural Gas vs. all other occupations

Occupation wage comparison, Oil and Natural Gas industry vs. non Oil and Natural Gas industry

■ Non oil and natural gas average wage ■ Oil and natural gas average wage

Sources and notes: Source: CFC calculation from 2023 ACS PUMS data, IPUMS USA, University of Minnesota, www.ipums.org.
The following 4 occupations are skewed by the Census convention of coding responses in the 99.5 percentile with the top value for the specific Census year (for Colorado this was $636,000):
- Chief executives
- General and operations managers
- Computer and information systems managers
- Petroleum mining and geological engineers

The occupation derrick, rotary drill and service unit operators... exists only in oil and gas. Therefore, this occupation does not have a comparison to all other occupations. All ACS PUMS point estimates are subject to margins of error.
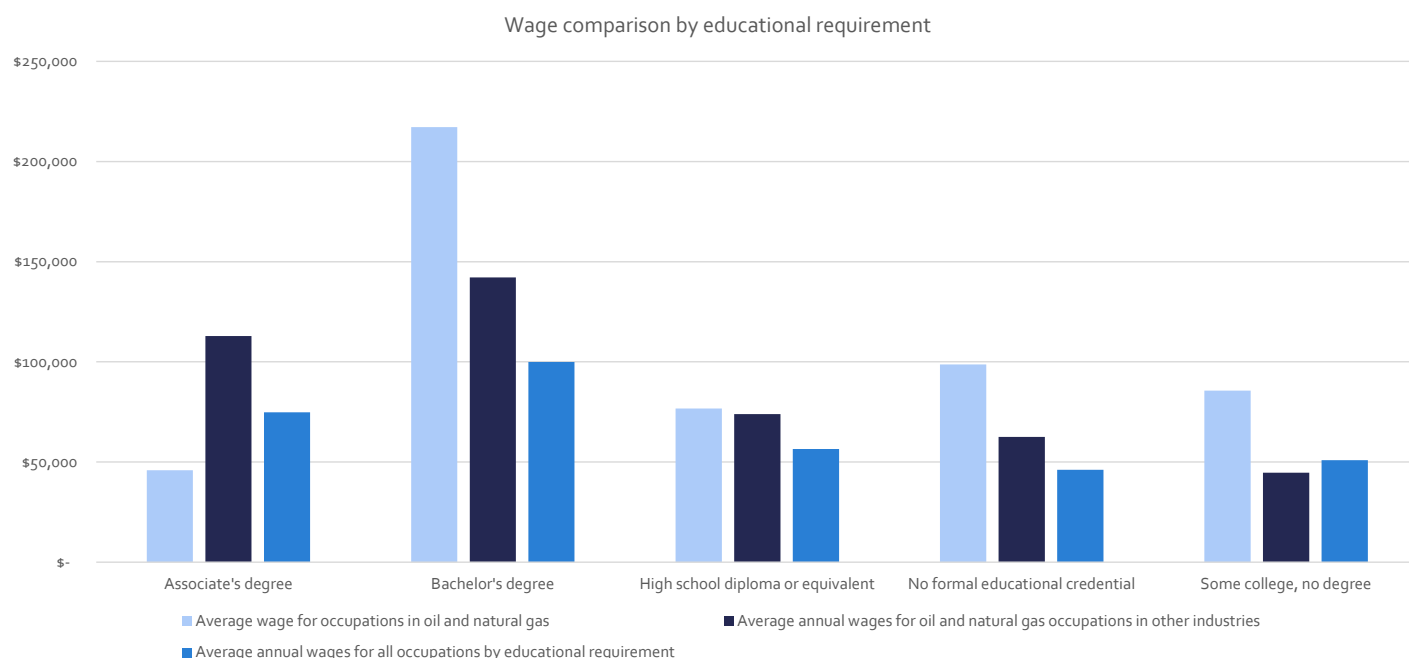'nec' = not elsewhere classified

Finding 2. The Bureau of Labor Statistics (BLS) assigns an educational requirement to all occupations. For occupations in oil and natural gas, at all education requirement levels except Associate's degree[4], workers reporting earning more in oil and natural gas than in the same occupations in the average of all other

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4   In the 2023 ACS PUMS, respondents in the oil and natural gas industry reported employment in only one occupation that the BLS characterizes as requiring an Associate's degree (Life, Physical, and Social Science Technicians, not elsewhere classified). A comparison to a sole occupation is potentially subject to large margins of error and should be interpreted in light of this limitation in comparison.

industries. Furthermore, by education level, oil and natural gas workers earned more (again except at the Associate's degree level) than for the average of all workers in all occupations across all industries.

Figure 6. Wage comparison by educational requirement, 2023

Wage comparison by educational requirement

Legend:
- Average wage for occupations in oil and natural gas
- Average annual wages for oil and natural gas occupations in other industries
- Average annual wages for all occupations by educational requirement

Sources and notes: Source: CFC calculation from 2023 ACS PUMS data, IPUMS USA, University of Minnesota, www.ipums.org and from the OES data from the BLS. The following 4 occupations are skewed by the Census convention of coding responses in the 99.5 percentile with the top value for the specific Census year (for Colorado this was $636,000):
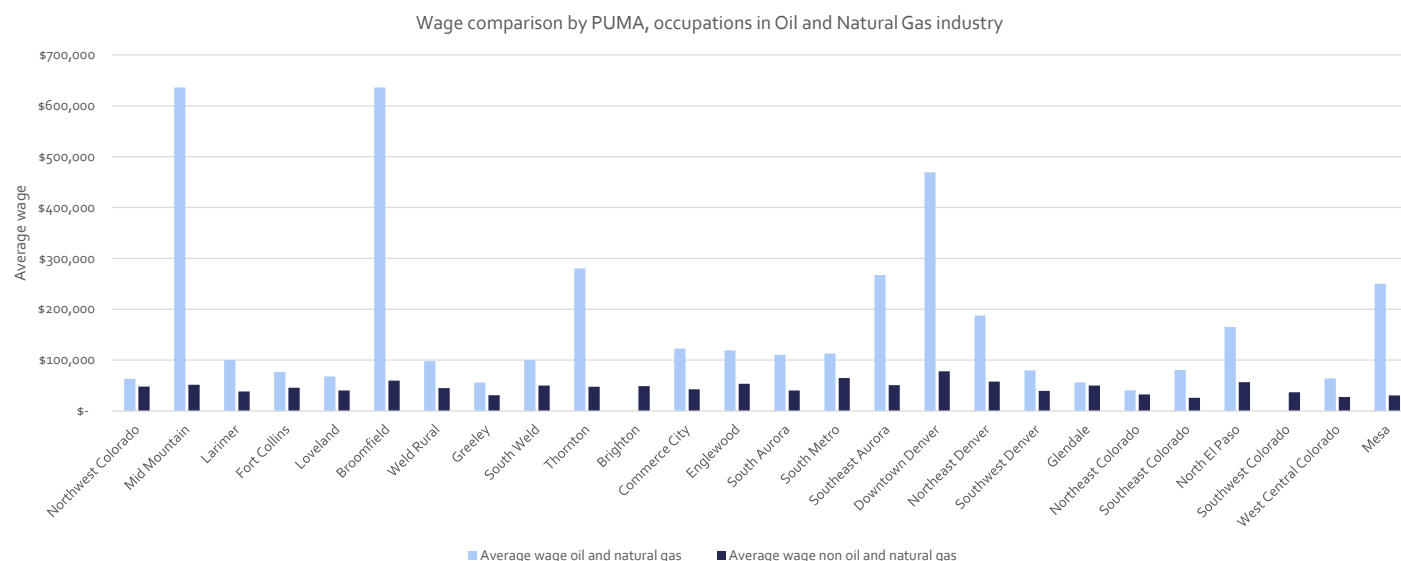
- Chief executives
- General and operations managers
- Computer and information systems managers
- Petroleum mining and geological engineers

Findings also are sensitive to the specific 2023 mix and concentration and distribution of workers across occupations by educational requirement. Therefore, this comparison is specific to the occupational mix in 2023. This comparison was completed by matching the specific oil and gas occupations to the educational requirements by occupation as reported in the Occupational Employment and Wage Statistics database as published by the Bureau of Labor Statistics (https://www.bls.gov/oes/). In 2023, only one oil and gas occupation required an Associate's Degree. All ACS PUMS point estimates are subject to margins of error.

Finding 3. In 2023, in all regions where ACS respondents reported oil and natural gas income, the combined occupations by region[5] had higher reported average wages in the oil and natural gas industry than in the same occupations in the same region but in all other industries combined.

Figure 7. Wage comparison by region (regions designated by PUMAs)

Wage comparison by PUMA, occupations in Oil and Natural Gas industry

Sources and notes: Source: CFC calculation from 2023 ACS PUMS data, IPUMS USA, University of Minnesota, www.ipums.org. PUMAs are Public Use Microdata Areas, a Census geography. The following 4 occupations are skewed by the Census convention of coding responses in the 99.5 percentile with the top value for the specific Census year (for Colorado this was $636,000):

- Chief executives
- General and operations managers
- Computer and information systems managers
- Petroleum mining and geological engineers

This convention affects the following PUMAs: Mid mountain, Broomfield, Downtown Denver and Southeast Aurora.

Findings also are sensitive to the specific 2023 mix and concentration and distribution of workers across occupations by region. Therefore, this comparison is specific to the occupational mix as geographically distributed in in 2023. All ACS PUMS point estimates are subject to margins of error. ACS PUMS data are by place of residence, not employment.

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5   In the ACS PUMS, the region is designated by a specific Census geography call a Public Use Microdata Area (PUMA). PUMAs are Census designated geographies drawn with non-overlapping boundaries to contain approximately 100,000 people. Since PUMAs are equal in size by population, they tend to cover large geographical areas in the less populated parts of the state and much smaller geographical areas in the highly populated regions.

Across industries, educational requirements and regions, the wages in oil and natural gas occupations compare strongly to wages in the same occupations in other industries. But ultimately it is the capacity for one's earnings to support the cost of living that is most important. That is, does the employment pay wages that are sufficient to support a household? Comparing industry wages to the nationally recognized self-sufficiency standard is one approach to making that assessment.

The self-sufficiency standard is developed periodically by the Center for Women's Welfare at the University of Washington's School of Social work.[6] The calculations are completed for every county in the state and for 791 unique household types. Household types are combinations of adults and children, by age, living together in one structure. The most recent calculations for Colorado were completed for calendar year 2022.

According to the website for the self-sufficiency standard:

> The **Self-Sufficiency Standard** is a budget-based, living wage measure that defines the real cost of living for working families at a minimally adequate level. The Standard is an affordability measure and an alternative to the official poverty measure.
>
> **The Self-Sufficiency Standard** determines the amount of income required for working families to meet basic needs at a minimally adequate level, taking into account family composition, ages of children, and geographic differences in costs.[7]

This analysis assessed occupations within the oil and natural gas industry for their capacity to support self-sufficiency for four representative household types:

- 1 adult, 1 preschool aged child, 1 school aged child
- 1 adult, 2 school aged children
- 2 adults, 1 preschool aged child, 1 school aged child
- 2 adults, 2 school aged children

Since the standard is reported at the county level only, the county amounts were averaged into a statewide and regional (combinations of counties) self-sufficiency standards. These calculated measures were then used to make the comparisons between wages reported by occupation, educational requirement and region and the wages necessary to support the representative household types selected for the analysis.

It is important to note that the arithmetic average of all 64 counties and the regional averages are not exact representations of the specific statewide or regional costs to support the households. Therefore, the analysis of oil and natural gas wages compared to the averaged self-sufficiency standards should be interpreted as illustrative of the capacity of these jobs to support self-sufficiency but not an exact accounting.
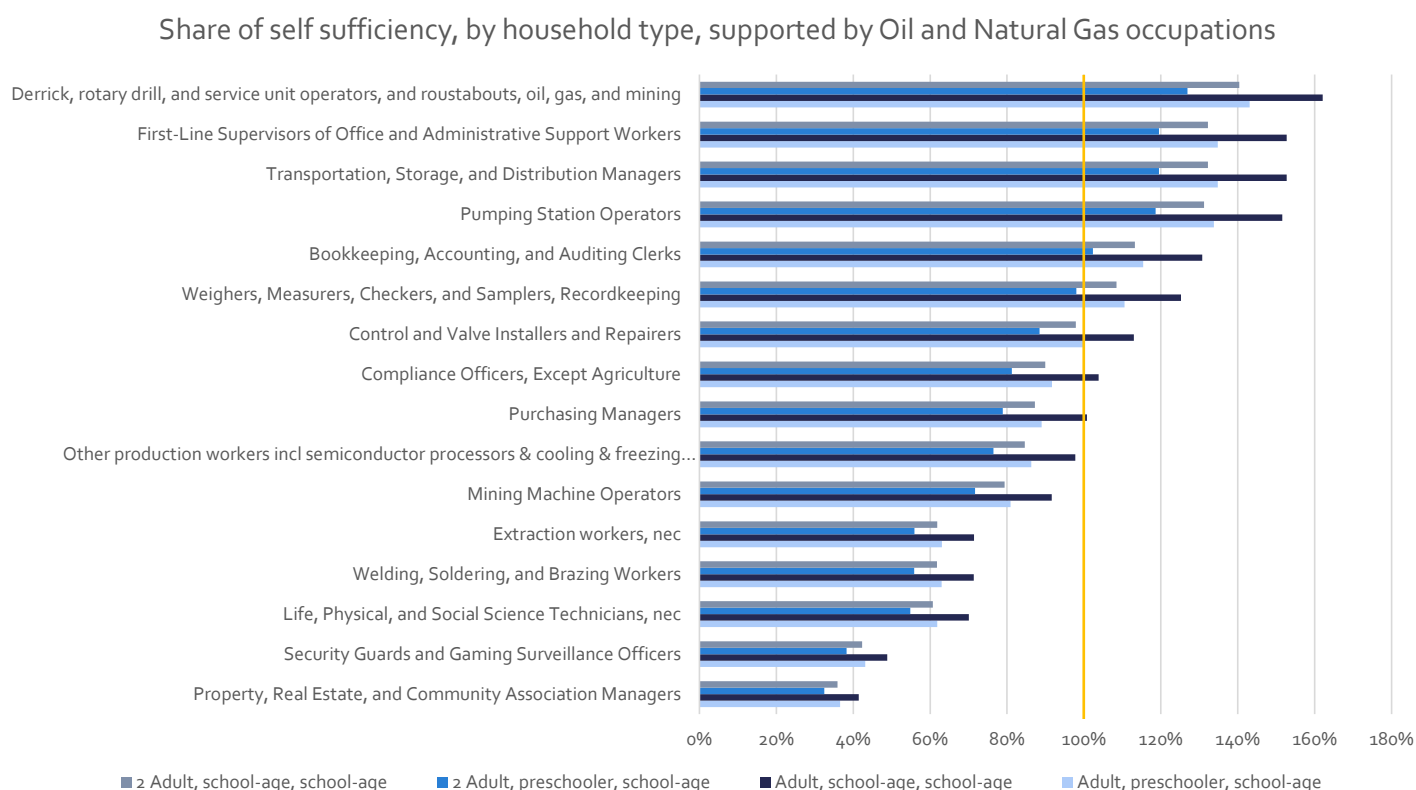
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6   https://selfsufficiencystandard.org/colorado/
7   https://selfsufficiencystandard.org/

The key self sufficiency findings are as follows:

Self-sufficiency finding 1. Of the 16 occupations for which census respondents reported average wages of $107,000[8] or less, ten of the occupations support self-sufficiency for at least one of the four representative household types. Six of the occupations increasingly support self-sufficiency for a household with two adults and children, meaning that with one oil and natural gas worker in those households it is not necessary for the second adult to contribute earnings in order to achieve self-sufficiency.

Figure 8. Assessment of self-sufficiency for occupations within Oil and Natural Gas with reported average wages of $107,000 or less

Share of self sufficiency, by household type, supported by Oil and Natural Gas occupations

Sources and notes: CFC calculation from 2023 ACS PUMS and Self-sufficiency standard.
IPUMS USA, University of Minnesota, www.ipums.org.
Center for Women's Welfare at the University of Washington's School of Social work at https://selfsufficiencystandard.org/colorado/
All point estimates subject to margin of error and the use of ACS responses results in findings that are sensitive to the number of workers in each occupation.
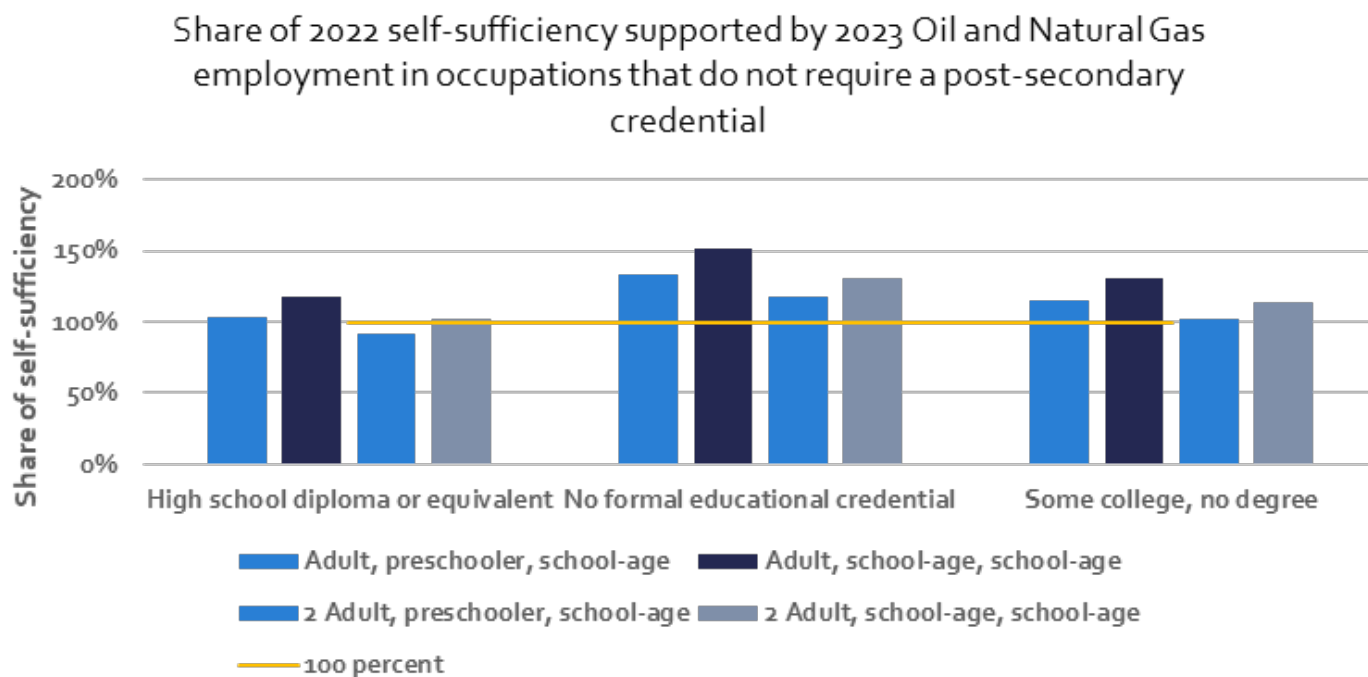
Self-sufficiency finding 2. Oil and natural gas employment provides a path to self-sufficiency for workers without a post-secondary degree. In 2023, the average wages reported by respondents without a post-secondary degree nearly universally supported self-sufficiency for all household types, including those with

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8        $107,000 was selected as the cutoff in order to include the occupation Derrick, rotary drill, and service unit operators, and roustabouts, oil, gas, and mining. This occupation is unique to the oil and natural gas industry, employs a high percentage of respondents in 2023, and has reported averages wages of just over $106,000.

two adults. For those household types with two adults, a single oil and natural gas job, on average, was supporting the household.

Figure 9. Assessment of self-sufficiency for Oil and Natural Gas occupations stratified by educational requirement

Share of 2022 self-sufficiency supported by 2023 Oil and Natural Gas employment in occupations that do not require a post-secondary credential

Sources and notes: CFC calculation from 2023 ACS PUMS, BLS and Self-sufficiency standard. IPUMS USA, University of Minnesota, www.ipums.org.Center for Women's Welfare at the University of Washington's School of Social work at https://selfsufficiencystandard.org/colorado/
All point estimates subject to margin of error and the use of ACS responses results in findings that are sensitive to the number of workers in each occupation.

Furthermore, when compared to 1) the same occupations in all industries other than oil and natural gas and to 2) the average of all occupations statewide in all industries, occupations in oil and natural gas outperform in their ability to support self-sufficiency for all occupations that do not require a post-secondary degree. [9]
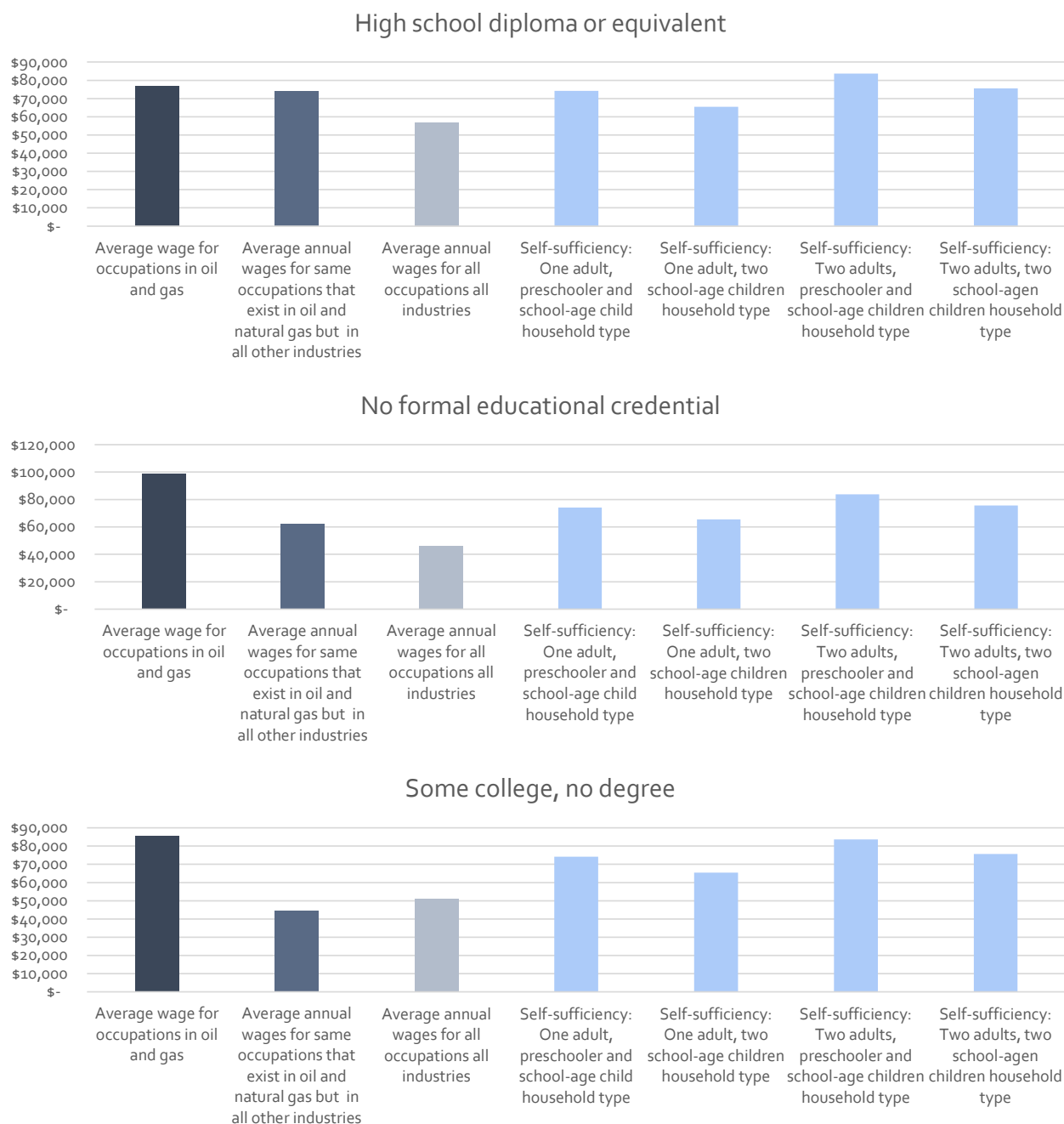
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9   The Bureau of Labor Statistics designates the following educational requirements as the ones that do not contain a post-secondary degree:
- High school diploma or equivalent
- No formal educational credential
- Some college, no degree.

Figures 10 a-c. Occupations that do not require a post-secondary degree and their capacity to support self-sufficiency

High school diploma or equivalent

No formal educational credential

Some college, no degree
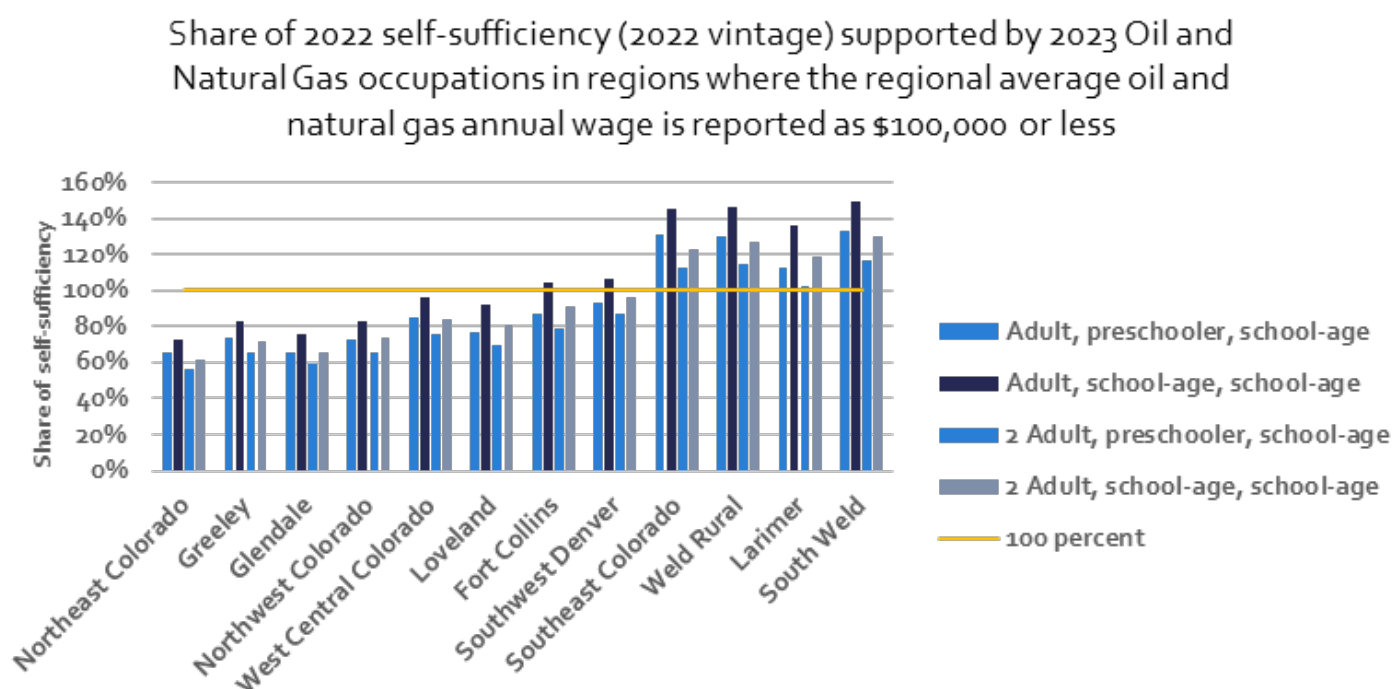

Sources and notes: CFC calculation from 2023 ACS PUMS, BLS and Self-sufficiency standard. IPUMS USA, University of Minnesota, www.ipums.org.Center for Women's Welfare at the University of Washington's School of Social work at https://selfsufficiencystandard.org/colorado/

All point estimates subject to margin of error and the use of ACS responses results in findings that are sensitive to the number of workers in each occupation.

Self-sufficiency finding 3. In the 12 regions in which the average reported oil and natural gas wages were $100,000 or less, oil and natural gas occupations supported self-sufficiency for at least one of the four representative household types in six of the regions. Additionally, in all regions, oil and natural gas average reported wages outperform the average wages in the same occupations in other industries in relation to self-sufficiency.

Figure 11. Assessment of self-sufficiency for Oil and Natural Gas occupations stratified by region

Sources and notes: CFC calculation from 2023 ACS PUMS and Self-sufficiency standard.
IPUMS USA, University of Minnesota, www.ipums.org.
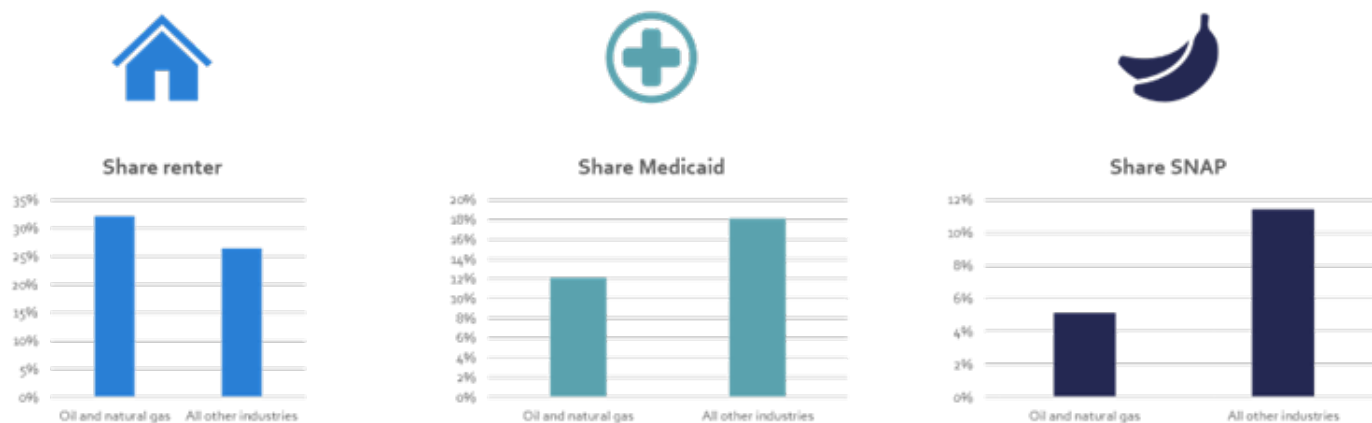Center for Women's Welfare at the University of Washington's School of Social work at https://selfsufficiencystandard.org/colorado/

All point estimates subject to margin of error and the use of ACS responses results in findings that are sensitive to the number of workers in each occupation. ACS PUMS data are by place of residence, not employment.

Self-sufficiency finding 4. Consistent with the better ability for wages in the oil and natural gas industry to support household needs, households with at least one oil and natural gas earner reported less reliance on Medicaid and SNAP. Oil and natural gas households had a higher share of renters than households with workers in other industries, but that likely is more related to the mobile nature of many oil and natural gas occupations than capacity to buy a home.

Figure 12. Comparison of selected household characteristics between households with oil and natural gas workers and those without.

Sources and notes: CFC calculation from 2023 ACS PUMS. IPUMS USA, University of Minnesota, www.ipums.org. All point estimates subject to margin of error.

The oil and natural gas industry in Colorado is recognized for its contributions to the state's economy, particularly in regions of the state where the significant activity is concentrated. Statewide statistics demonstrate its growing share of the state's economy and its overall contribution to employment and earnings. This study goes beyond those top level statistics to focus specifically on industry earnings in a more granular fashion: by occupation, by educational requirements, and by region.

This assessment employed an innovate data approach, using the Census' ACS PUMS survey to measure the impact of the 26 occupations identified by survey respondents working in the oil and natural gas industry and compare them to the responses related to the same occupations but in other industries. Almost universally, oil and natural gas employment was reported as providing higher wages whether stratified by occupation, educational requirement, or region. And, this higher earning capacity was demonstrated to better move households toward self-sufficiency, reducing reliance on assistance programs relative to households statewide with workers in other industries.