2022 Colorado Tech Industry Report

PRESENTED BY COLORADO TECHNOLOGY ASSOCIATION

Underwritten by:

COLORADO
Office of Economic Development & International Trade

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2022 Colorado Tech Industry Report

INTRODUCTION

Colorado Technology Association (CTA) has been stewards of the state's tech economy since 1994. CTA represents over 300 members including the top technology companies, organizations, and institutions across the state of Colorado. As the lead organization for tech policy and tech development, the organization has committed to collect and publish statewide data on the tech sector. CTA has contracted with Economic Leadership LLC, a consulting firm with a long history of evaluating state technology performance, to build a report that will evaluate the current state of the tech sector in Colorado. To develop a full picture of the industry, Economic Leadership LLC collected a wide variety of data, surveyed CTA members, and conducted interviews with tech leaders in the state. This report shows final statistics for tech in 2021. This report serves as a resource of data and trends for the economic development community, policy makers, and the tech industry.

The tech sector has a robust presence in the state and this summary underlines its vitality and importance to the greater Colorado economy.

HIGHLIGHTS:

- The tech industry directly accounts for 9 percent of Colorado's employment and 18 percent of the gross state product.
- Despite two turbulent years in the national economy, Colorado's tech industry has added 9,680 net jobs since 2019.
- Employment at firms in the IT industry grew by 22 percent from 2016 to 2021, the 7th fastest growth rate in the nation.
- In the next five years, Colorado tech occupations across all industries are predicted to grow by an additional 11 percent, the 6th highest predicted growth rate across all fifty states.

Colorado Technology Industry Summary Statistics, 2021

Indicator	State Technology Industry	State Total	State Total Percentage
Employees	272,461	2,890,134	9.4%
Establishments	26,301	229,415	11.5%
Earnings (millions)	$37,698	$216,075	17.4%
Sales (millions)	$101,644	$679,860	15.0%

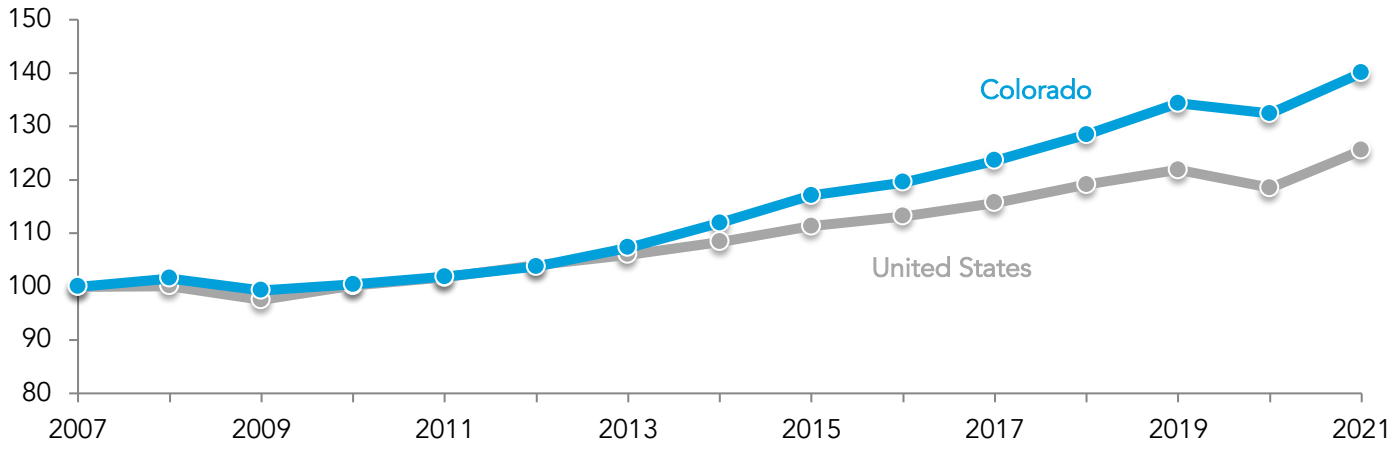
Source: EL estimates based on Lightcast 2022.4

SECTION 1. STATE OF THE INDUSTRY & REGIONAL TRENDS

The overall economy in Colorado has boomed in the last decade. Since 2013, the real gross state product has grown at higher rates than the national average. A significant contributor to this economic growth has been population growth. In the last decade, there has been an influx of highly educated and young workers to the state. The state added over 318,350 people aged 20 to 44 years old in the last ten years. Tech employers that were interviewed highlighted how the quality of life in Colorado helps make recruiting workers easier. This surge of young, working-aged people has sparked the state's economy and increased its pool of workers.

Colorado and National Real GDP Change, 2007-2021

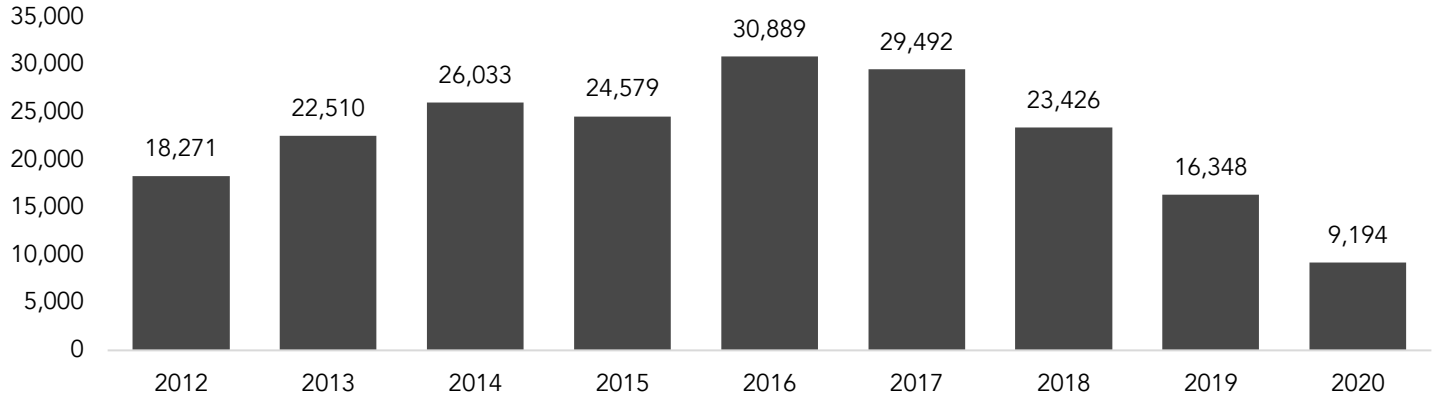
100 = 2007 Real GDP Level



Source: Lightcast 2022.4

Data from IRS tax records show a sharp increase in domestic migration in recent years. Even in 2020, a year when relocating was difficult due to the pandemic, more people moved to the state than left the area.

Colorado Net Domestic Taxpayer Migration, 2012-2020



Source: Lightcast 2022.4
Note: Based on IRS data from individuals who file taxes.

The IRS data reveals that the biggest portion of in-bound migration is coming from the big cities of California, Phoenix, and Chicago. Most of these new residents are moving to the Denver area. When the outbound migration is subtracted to gather total net migration, some of the Front Range counties like Douglas and Weld just outside of the bigger metro areas saw the biggest net gains.

Top In-Bound and Out-Bound Migration Counties, 2020

Top Five In-Bound Counties		Top Five Outbound Counties	
Los Angeles County, CA	+4,948	Maricopa County, AZ	-6,804
Maricopa County, AZ	+4,840	Clark County, NV	-2,574
Cook County, IL	+3,453	Los Angeles County, CA	-2,302
San Diego County, CA	+2,867	San Diego County, CA	-2,208
Harris County, TX	+2,806	Harris County, TX	-2,076

Source: Lightcast 2022.4
Note: Based on IRS data from individuals who file taxes.

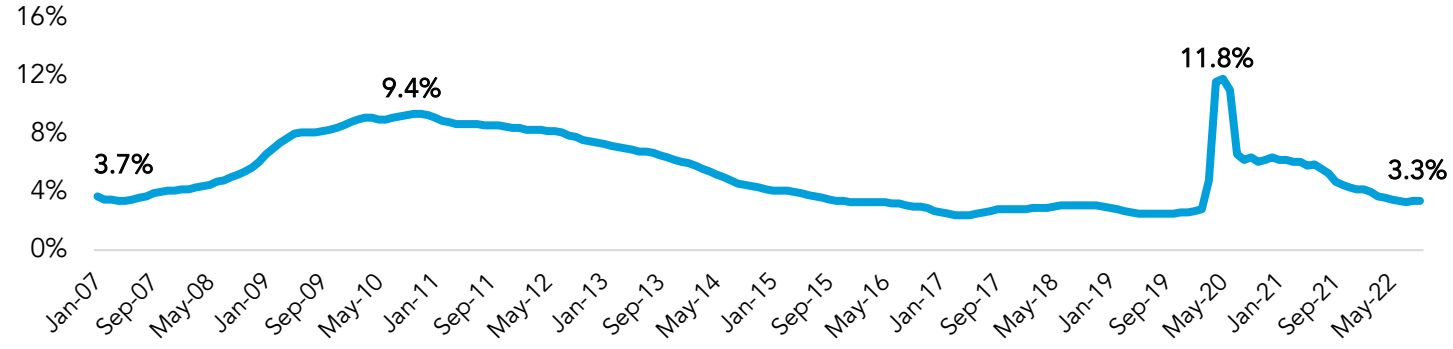
Top Migration Patterns in Colorado Counties, 2020

Top Five In-Bound Counties		Top Five Net Migration Counties	
Denver	+59,116	Douglas	+6,318
Arapahoe	+50,586	Weld	+5,338
El Paso	+49,538	El Paso	+1,836
Jefferson	+40,538	Pueblo	+1,310
Adam	+37,099	Mesa	+1,171

Source: Lightcast 2022.4
Note: Based on IRS data from individuals who file taxes.

While Colorado is a beautiful state with majestic mountains and an enviable quality of life, in-migration is also strong because the economy is performing well, and job opportunities are numerous. The state has had consistent low rates of unemployment even in the recovery periods after the Great Recession and the COVID-19 lockdown phase.

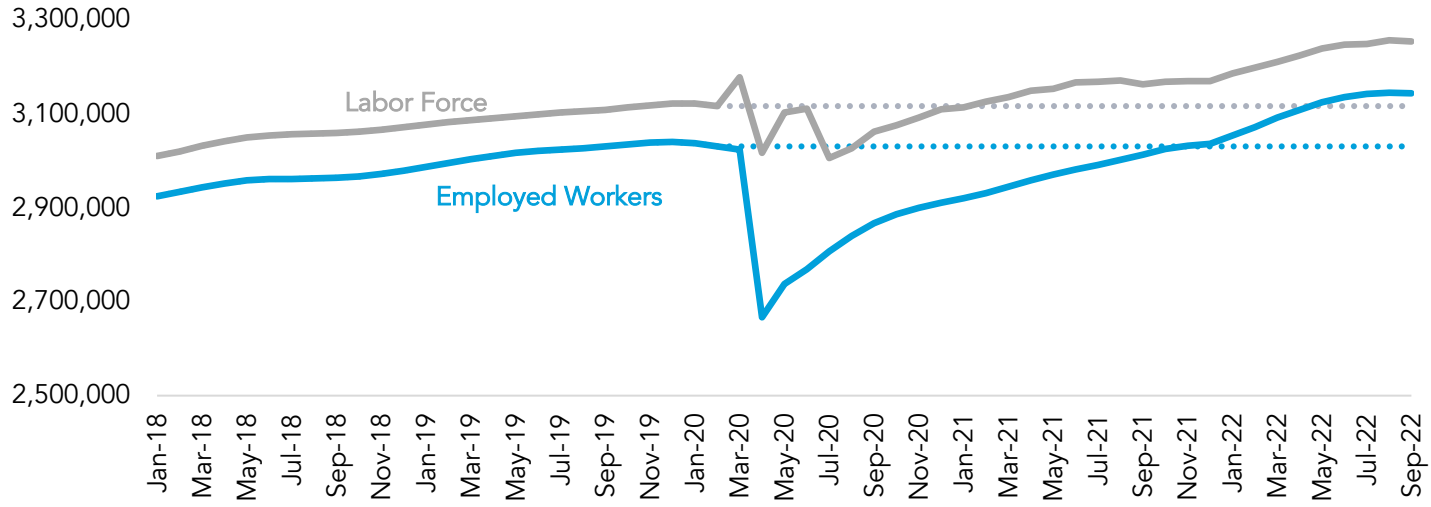
Colorado Unemployment Rate, Jan 2007 – Sept 2022



Source: Bureau of Labor Statistics (2022)

Despite the disruption of the pandemic, the Colorado economy has also been able to quickly return to pre-pandemic levels of labor force and employment. By the fall of 2021, the state returned to pre-COVID levels of employment and has continued to rise steadily in the last year. Colorado also avoided the deep cuts to its labor force that other states have seen during this time. Colorado's labor force participation rate is at higher level today than before the pandemic.

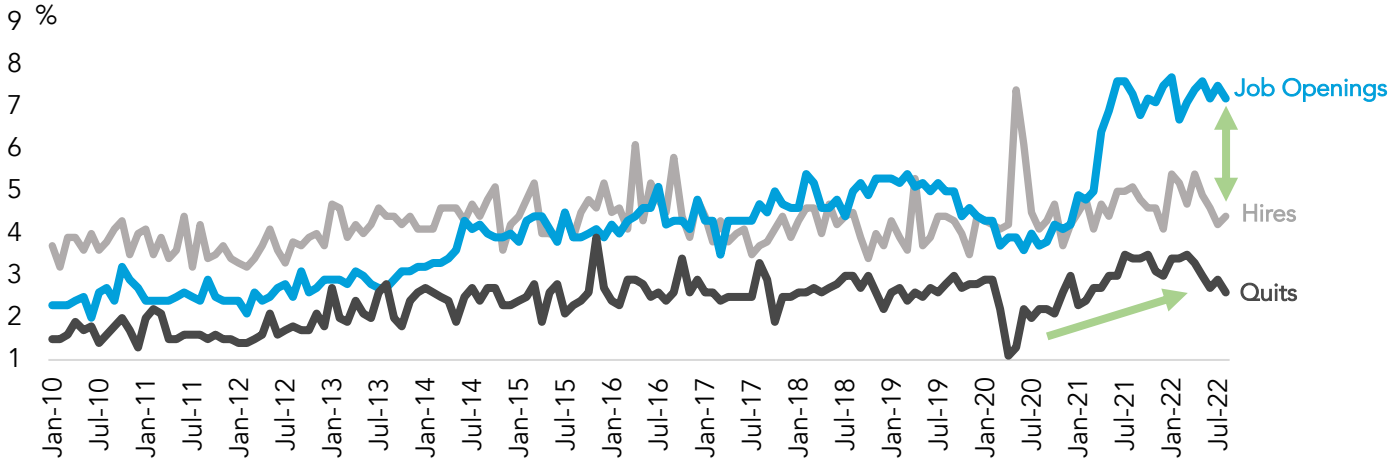
Colorado Labor Force and Employed Workers, Jan 2018 – Sept 2022



Source: BLS (2022)

Despite this recovery, the state is still experiencing the national challenge to increased growth and the struggle to fill open job positions. Demand and business conditions remain strong leading to a high rate of job openings. However, hiring has not been able to keep pace. This pattern matches national and global labor shortages. Buoyed by the number of openings, workers are also taking the opportunity to find better fitting positions, leading to a recent increase in the number of quits.

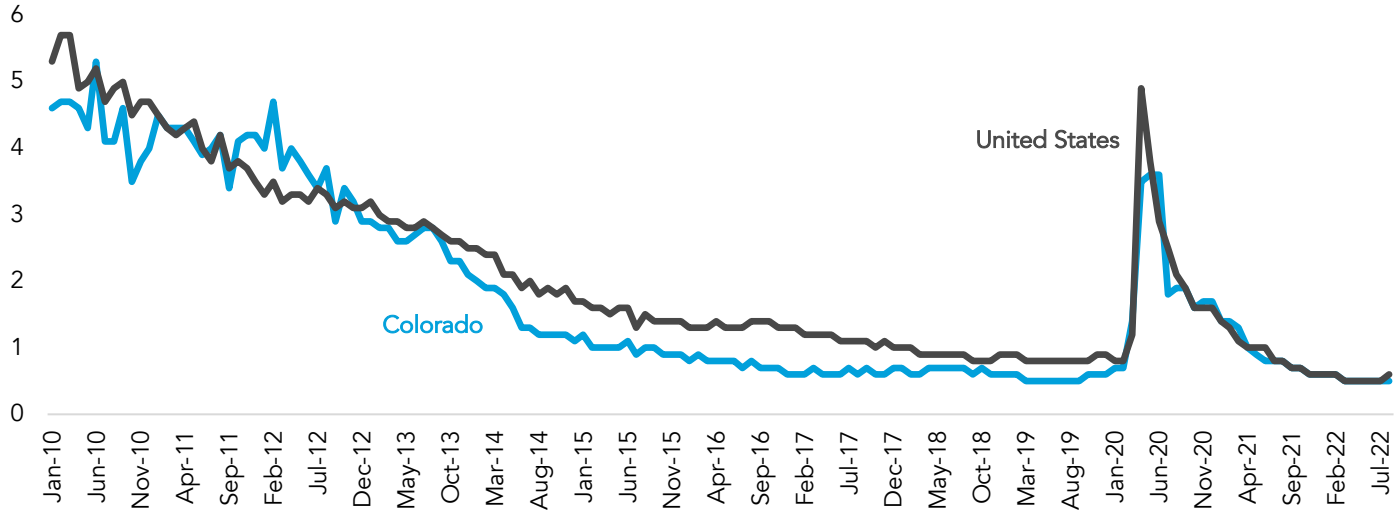
Colorado Rate of Job Openings, Quits, and Layoffs, 2010-2022



Source: BLS (2022)

In the past, there were usually multiple unemployed workers in the economy for every job opening. In the recovery from the Great Recession this number has become increasingly smaller, with Colorado's labor market being even tighter than the national economy.

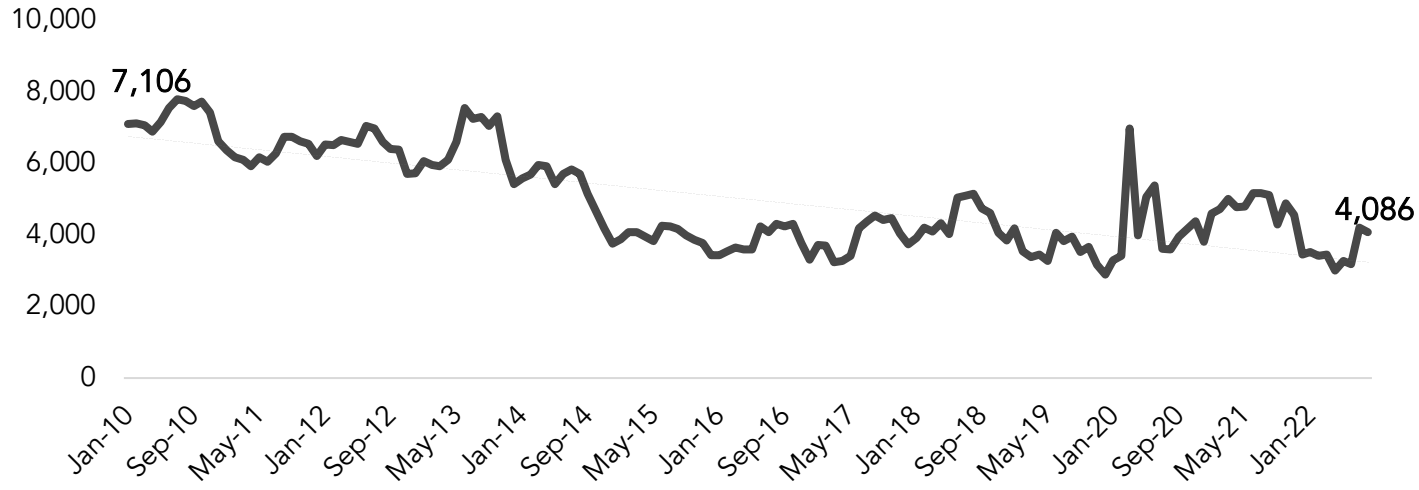
Unemployed Persons Per Job Opening Ratio, 2010-2022



Source: BLS (2022)

After the COVID lockdown spike, this number has reached new lows. Now there are more job openings than unemployed workers. Broader population trends like persistent low birth rates, Baby Boomer retirements, and lower rates of international migration are limiting workforce growth in Colorado and across the nation. The number of people in Colorado unemployed with experience in computer and mathematics has steadily declined in the last twelve years, thinning options for employers looking to fill these positions.

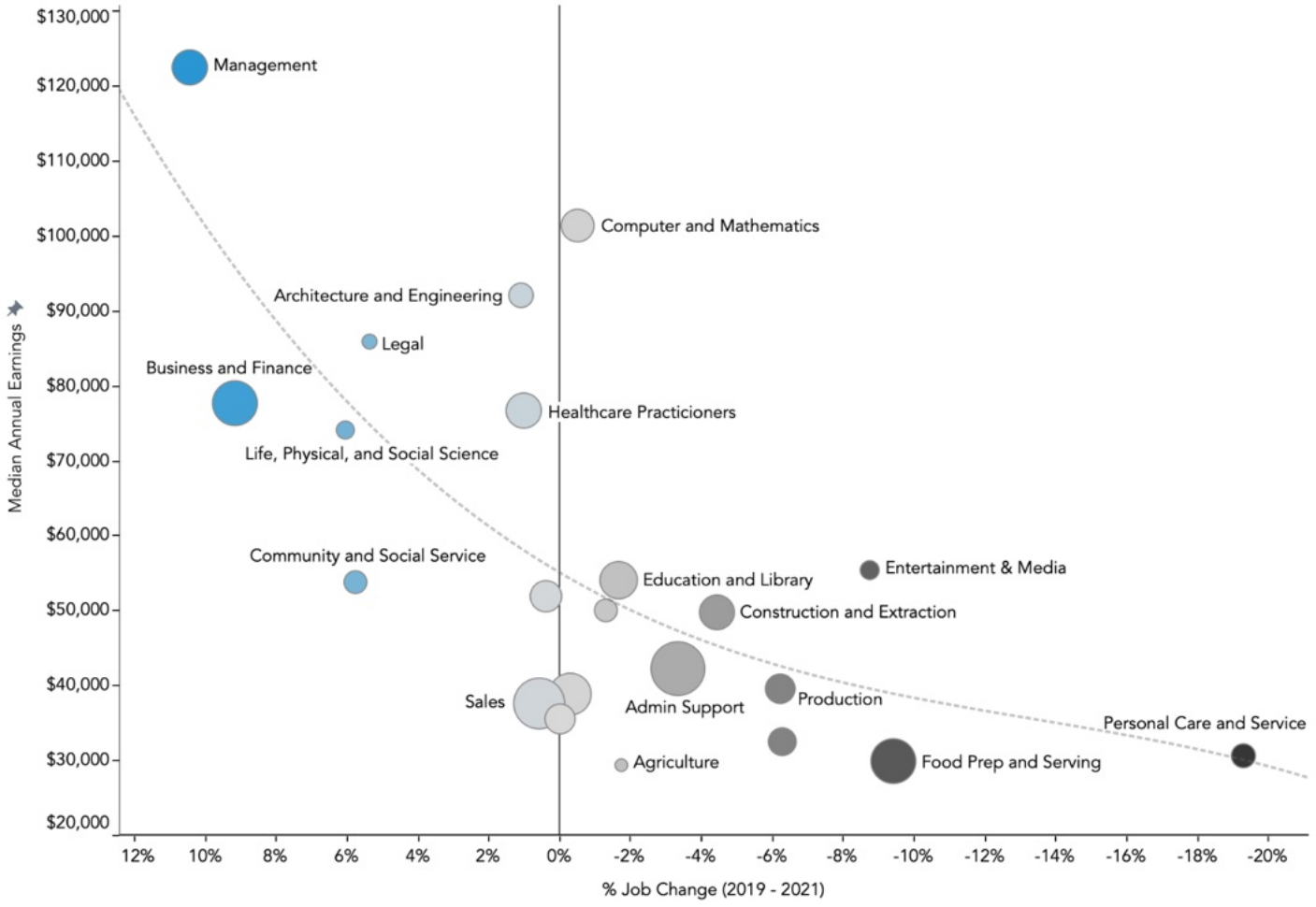
Computer and Mathematics Unemployed Workers in Colorado, Jan 2010 – Aug 2022



Source: Lightcast 2022.4

The recovery from the pandemic has been uneven across the nation and in Colorado. At the end of 2021, low wage jobs like food preparation and production still had significant job losses. Meanwhile, despite the challenges, high wage jobs that were able to adapt to remote work quickly and serve customers virtually added jobs. Knowledge-based jobs in finance or science, for example, have offered high median earnings and been less disrupted by the pandemic. This report will detail how the tech industry has been a key support to Colorado's economy during this timeframe and how tech offers workers stable and high wage opportunities.

Colorado Pandemic Impacts by Occupation and Earnings



Source: EL calculations based on Lightcast 2022.4

SECTION 2. THE COLORADO TECH INDUSTRY

To define Colorado's technology industry, Economic Leadership identified 88 separate 6-digit NAICS code industries to characterize the "Total Technology Industry" for the state and for comparison with other US states. A full list of each 6-digit industry is available in the appendix of this report. These categories are based on several definitions of the technology industry. The primary source for defining the technology industry was based on TechAmerica Foundation's Technology

Industry Classification. Other state and city tech industry reports were evaluated, and this report maintains a definition that is comparable to those reports.

To measure tech occupations that exist across all industries, Economic Leadership reviewed 85 separate 5-digit SOC codes to determine how many tech workers exist in the state across all industries. In addition to the data analysis, Economic Leadership surveyed CTA's members and received 53 responses as well as conducting detailed interviews with eight tech leaders in the state. Quotes from these interviews and survey findings will be presented alongside statistical data throughout the report.

To calculate trends of the tech sector in terms of employment, wages, and establishments, Economic Leadership utilized data developed by Lightcast (formerly EMSI Burning Glass), which is largely based on the Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages dataset. Lightcast data fills in gaps from the BLS non-disclosure policy by amalgamating several economic data sources to allow for granular review of economic data.

The data presented in this report are calculations based on Lightcast data for the year 2021. Most trend data presented is for the 5-year period from 2016-2021. This approach is retrospective but allows for the most accurate assessment of the tech industry because it incorporates the finalized numbers from public sources. Some data such as unemployment and job postings offer more real-time analysis and are presented in the tech occupations section of the report.

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Source: EL estimates based on Lightcast 2022.4

In 2021, the tech industry in Colorado employed over 272,461 workers at 26,301 tech establishments. This accounts for over 9 percent of the total jobs in the state. The tech industry has an even more pronounced role in the economy in terms of establishments, wages, and sales. The tech industry paid almost $38 billion in earnings to workers in the state. This represented over 17 percent of all wages paid in the state.

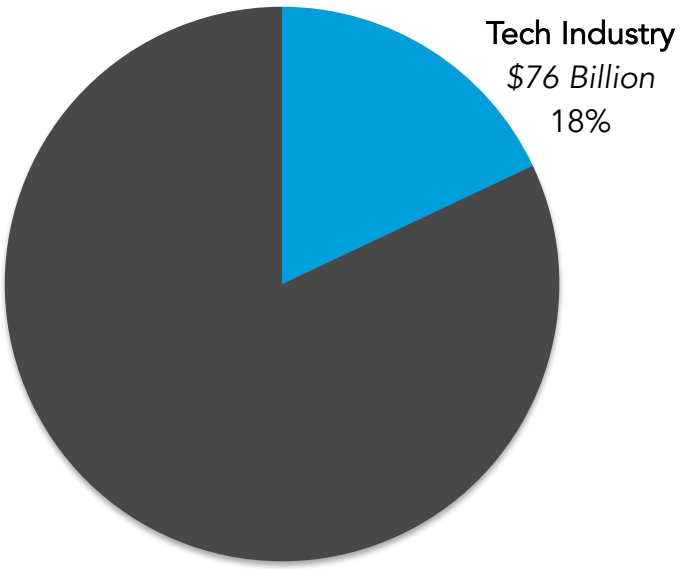
Colorado Technology Industry Economic Contributions, 2021

Indicator	Technology Industry	State Total	State Total Percentage
Taxes Paid (millions)	$4,822	$26,652	18.1%
Exports (millions)	$58,293	$372,770	15.6%
GSP (millions)	$76,163	$423,560	18.0%

Source: EL estimates based on Lightcast 2022.4

The industry also contributes heavily to Colorado's tax revenue, exports, and gross state product (GSP). The tech industry generated over $76 billion in GSP in 2021, accounting for 18 percent of the state's total economic output.

Technology Industry Contribution to Colorado's Gross State Product, 2021

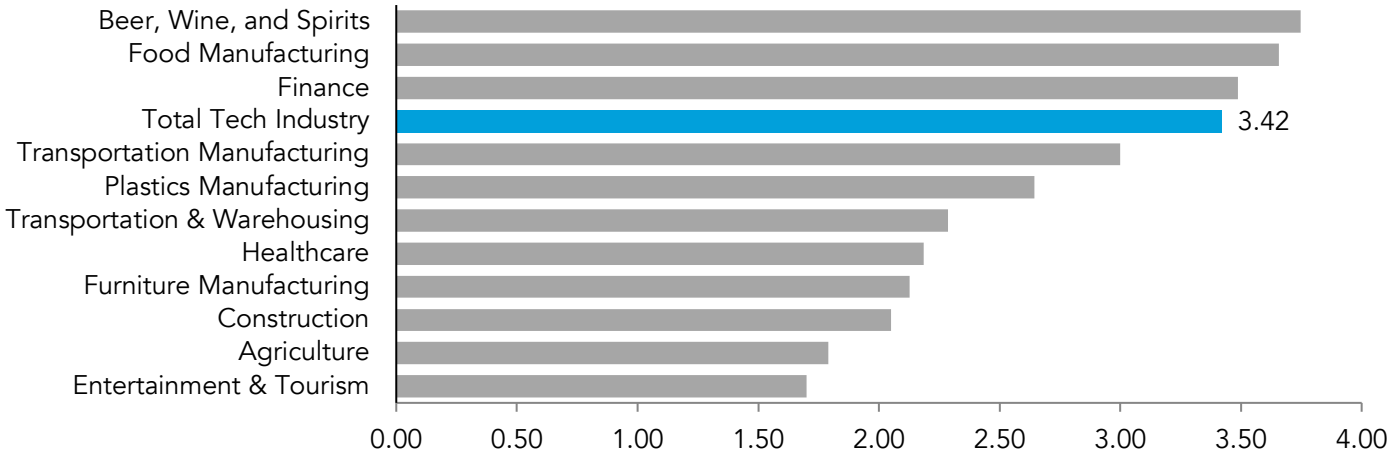


Source: EL estimates based on Lightcast 2022.4

"Many people don't realize the extent of the tech sector in the state. Tech is not as visible to a community as a manufacturing plant, sports stadium, or a bank even though the economic impact may be larger."

The tech industry creates a profound ripple effect throughout the economy. In 2021, when one job was added in the tech industry, another 2.42 jobs were added elsewhere in the economy. This amounts to a total job impact of 3.42. This multiplier of 3.42 jobs was one of the largest across the Colorado economy. When tech leaders were asked if they thought those outside of the industry understood the impact the sector has on the state economy, many thought the positive impacts were only understood to a certain degree. Many believed the importance of the industry to the state could be further conveyed.

Colorado Job Multiplier by Selected Industries, 2021



Source: EL estimates based on Lightcast 2022.4

To measure the tech industry more granularly the industry was broken down into four sub-categories:

- Energy Technology
- Environmental Technology
- Life Sciences
- IT, Telecom, Hardware & Software (IT)

The Information Technology (IT) group includes industries related to hardware manufacturing, software services, telecommunications, and other computer related services. Energy Technology includes industries related to fossil fuel and renewable power operations. Environmental Technology includes industries related to electrification, batteries, environmental consulting, and waste remediation services. Life Sciences includes industries related to pharmaceutical manufacturing and research and development in biotechnology.

Colorado's Technology Industry by Sub-Categories, 2021

Technology Categories	Employment, 2021	Employment Change, 2019-2021	Employment Change, 2016-2021	Establishments, 2021	Sales, 2021 (millions)	National Location Quotient
Energy Tech	24,647	-25.9%	-13.5%	1,568	$16,509	1.42
Environmental Tech	16,910	2.8%	14.5%	1,632	$3,590	1.17
Life Sciences	78,632	6.9%	18.8%	6,389	$21,998	1.43
IT	152,272	9.1%	22.1%	16,713	$59,547	1.56
TOTAL TECH	**272,461**	**3.7%**	**16.4%**	**26,301**	**$101,644**	**1.48**

Source: EL estimates based on Lightcast 2022.4

Note: Some values may not add to the exact total due to rounding.

Location quotients offer an understanding of the concentration of an industry in an economy. Location quotients greater than 1.00 indicate that industry is more concentrated in Colorado than the national average and is a significant part of a region's economic base. Industries with high location quotients often generate a significant portion of the economy's exports and wealth. Remarkably, Colorado has high location quotients for each of the four sub-categories. This highlights a tech industry that is diverse with many types of operations. Overall, the industry is 48 percent more concentrated than the national average.

The IT group of industries accounts for 56 percent of the total tech industry employment in the state. Job growth has been strong in each sub-category except energy tech. Even in the last two years of the pandemic, the entire tech industry added a net of 9,680 jobs, a 3.7 percent growth rate. The Denver metro area accounts for more than half of the tech industry. About 62 percent of the IT jobs in the state are located in the Denver-Aurora-Lakewood metropolitan statistical area (MSA).

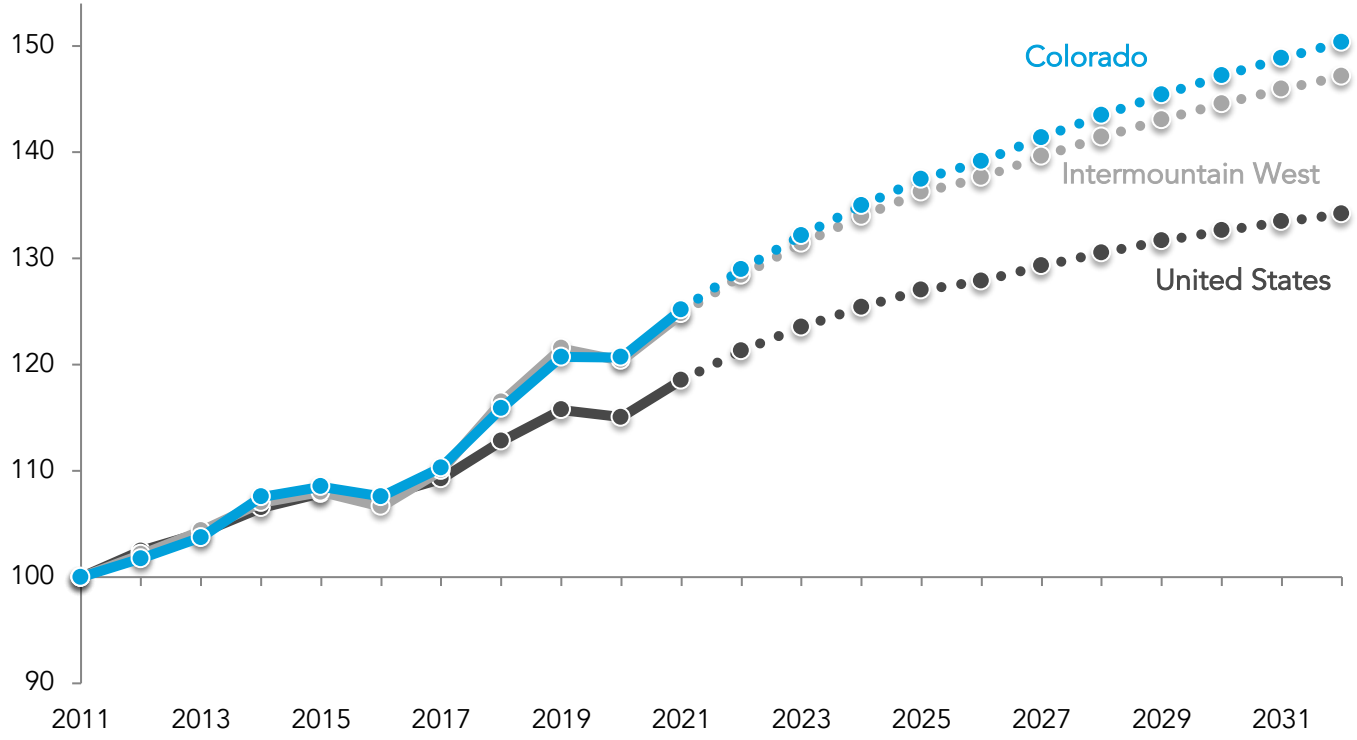
Denver's Tech Industry by Sub-Categories, 2021

Technology Categories	Denver MSA Employment, 2021	Denver Share
Energy Tech	11,539	47%
Environmental Tech	8,167	48%
Life Sciences	41,128	52%
IT	94,616	62%
TOTAL TECH	**155,449**	**57%**

Source: EL estimates based on Lightcast 2022.4

Long Term Tech Industry Employment Trends

2011 Employment Levels = 100



Source: EL estimates based on Lightcast 2022.4

Job growth in Colorado's tech industry has been strong since the recovery from the Great Recession. The state followed national trends of growth, but then in 2017 started to accelerate and grow at even higher rates. Colorado has been the strongest player in the emergence of tech in the Intermountain West. The future looks strong for the industry as Lightcast models predict growth over the next 10 years for the state at a higher rate than the nation and the average for the Mountain West region.

The tech industry can also be evaluated by the type of product produced, services or manufactured goods. In Colorado, a significant majority of the tech industry was involved in providing tech services. Tech manufacturing is also more concentrated in the state than national levels. Both the services and manufacturing portions of the tech industry are adding jobs at robust rates.

Colorado's Tech Industry by Output Categories, 2021

Technology Output Categories	Employment, 2021	Employment Change, 2019-2021	Employment Change, 2016-2021	Establishments, 2021	Sales, 2021 (millions)	National Location Quotient
Tech Services	237,878	3.8%	17.0%	25,543	$88,497	1.58
Tech Manufacturing	34,583	2.7%	11.8%	758	$13,148	1.03
TOTAL TECH	**272,461**	**3.7%**	**16.4%**	**26,301**	**$101,644**	**1.48**

Source: EL estimates based on Lightcast 2022.4

In Colorado in 2021, the average earnings per worker in the tech industry was $153,400 a year. The average earnings for workers across all industries in the state is about $81,900. A tech industry worker earns almost double the average worker in the state. This metric of earnings includes all the wages and supplements received by a worker. Supplements include employee benefits and on average accounted for about $21,700 of a tech industry worker's earnings in Colorado.

Average Annual Earnings per Worker by Sub-Industry, 2021

Technology Categories	Colorado	National Average
Energy Tech	$172,700	$167,000
Environmental Tech	$93,200	$92,200
Life Sciences	$136,200	$145,800
IT	$166,000	$181,500
All Categories	**Colorado**	**National Average**
Tech Services	$155,200	$162,600
Tech Manufacturing	$141,600	$161,900
TOTAL TECH INDUSTRY	**$153,400**	**$162,500**

Source: EL estimates based on Lightcast 2022.4

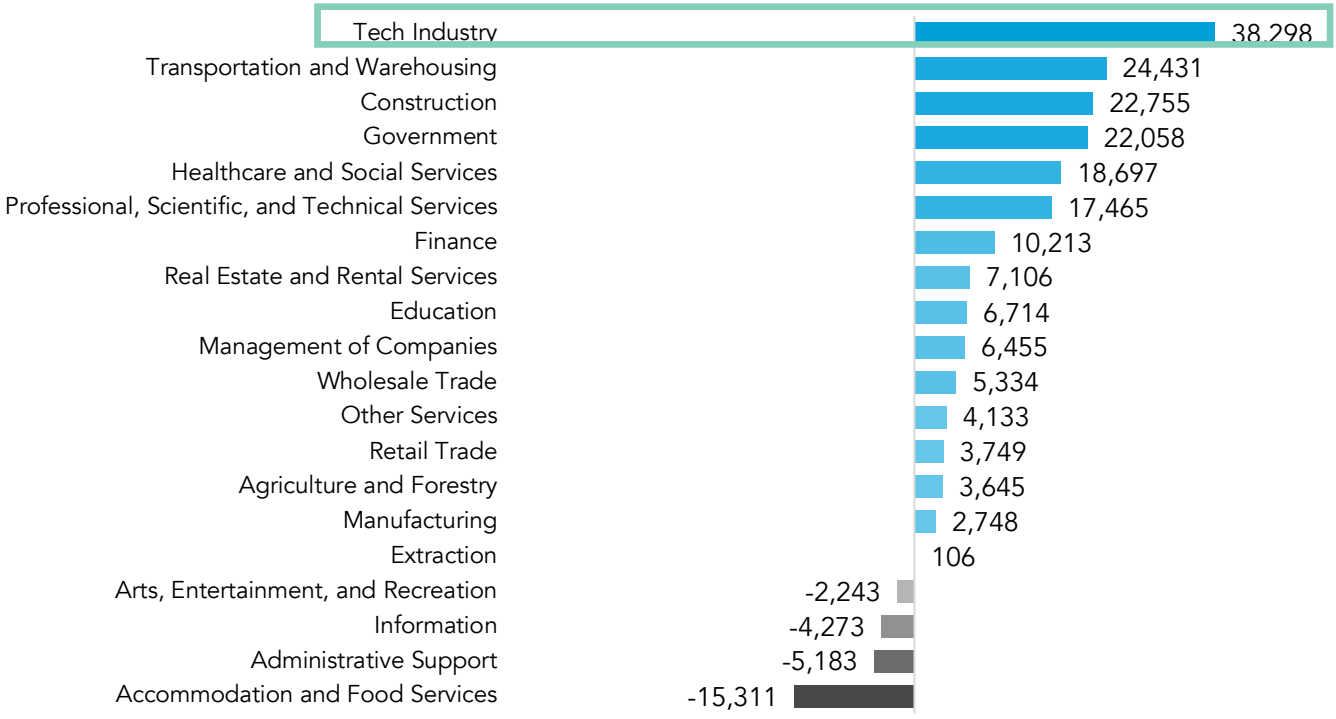
The industries were also aggregated into more detailed groupings, super sub-industries. This breakdown shows that software services are a significant driver of the tech industry growth in the state. Jobs in this group have grown by 33 percent from 2016 to 2021. Again, growth and concentration are strong across almost all categories in Colorado.

Colorado's Tech Industry by Super Sub-Industries, 2021

Super Sub-Industries	2021 Employment	Employment Change (2016-2021)	Establishments (2021)	National Location Quotient
Software	92,352	33.2%	13,562	1.69
Engineering, Environmental, & Clean Tech	47,210	16.0%	4,193	1.86
Internet & Telecommunications	43,232	7.5%	2,864	1.66
Other Energy and Power Generation	24,236	-13.7%	1,530	1.42
R&D and Testing	23,305	21.5%	2,665	1.08
Electronics Hardware	16,688	10.1%	287	0.99
Life Science Manufacturing	15,201	16.2%	400	1.12
Remediation and Waste Management	9,826	22.7%	763	1.11
Renewable Energy	412	0.1%	38	1.11
TOTAL TECH INDUSTRY	**272,461**	**16.4%**	**26,301**	**1.48**

Source: EL estimates based on Lightcast 2022.4

Net Jobs Change in Colorado by Industry, 2016-2021

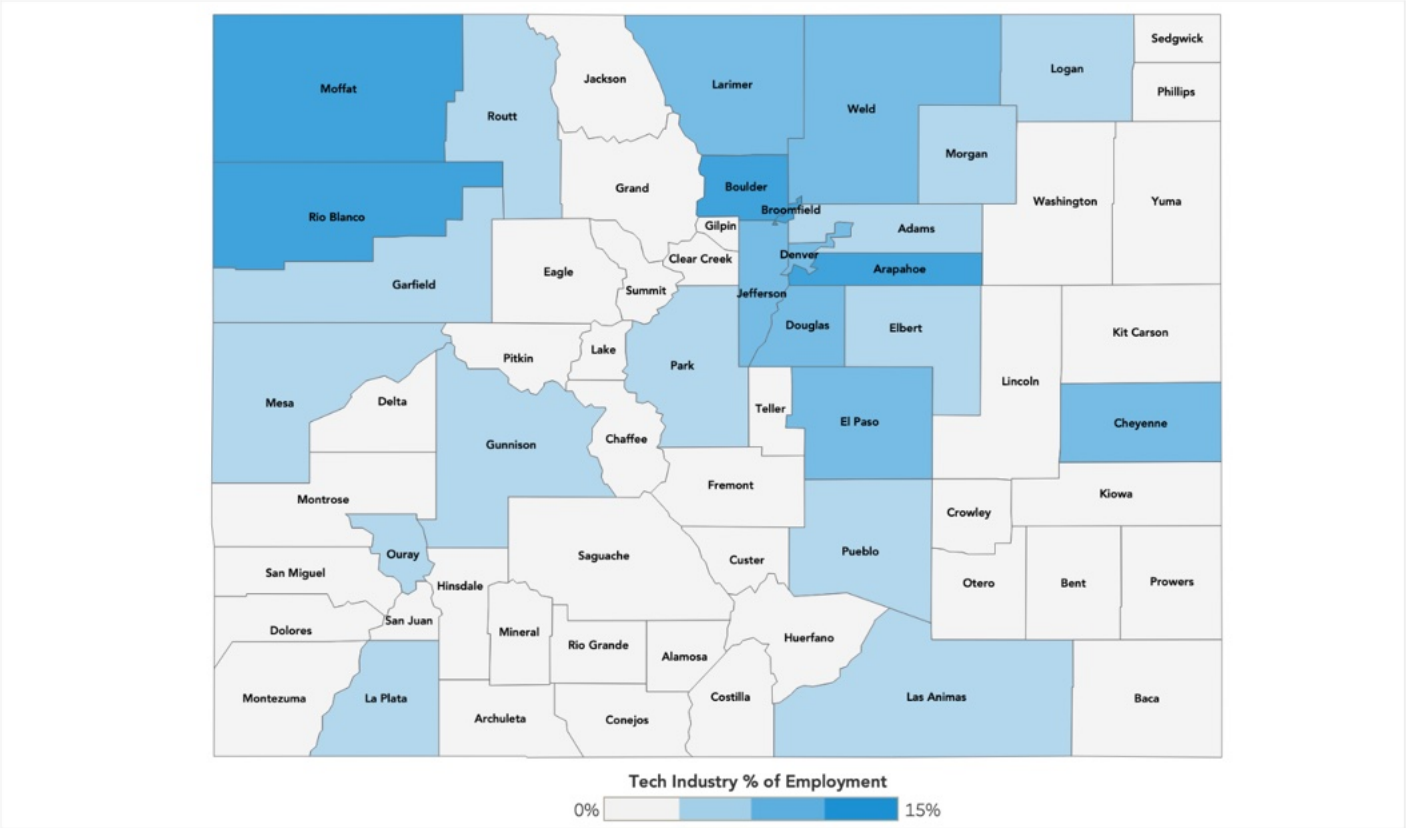


Source: EL estimates based on EMSI 2022.4

Over the last five years, the tech sector added almost 38,300 net new jobs, the most jobs added by any major industry in the state. The next biggest growth contributors were transportation and warehousing and construction. Accommodation and food services and the arts, entertainment, and recreation industries experienced net declines largely due to the lockdown phase of the COVID-19 pandemic and limits on travel.

Across the state, the tech industry is most concentrated in front range counties. Some western slope counties have large energy-based economies that account for sizable portions of their total economy. The counties with a smaller tech industry presence tend to be rural and more reliant on agriculture and/or tourism.

Tech Industry Jobs as a Percentage of Total Jobs, 2021

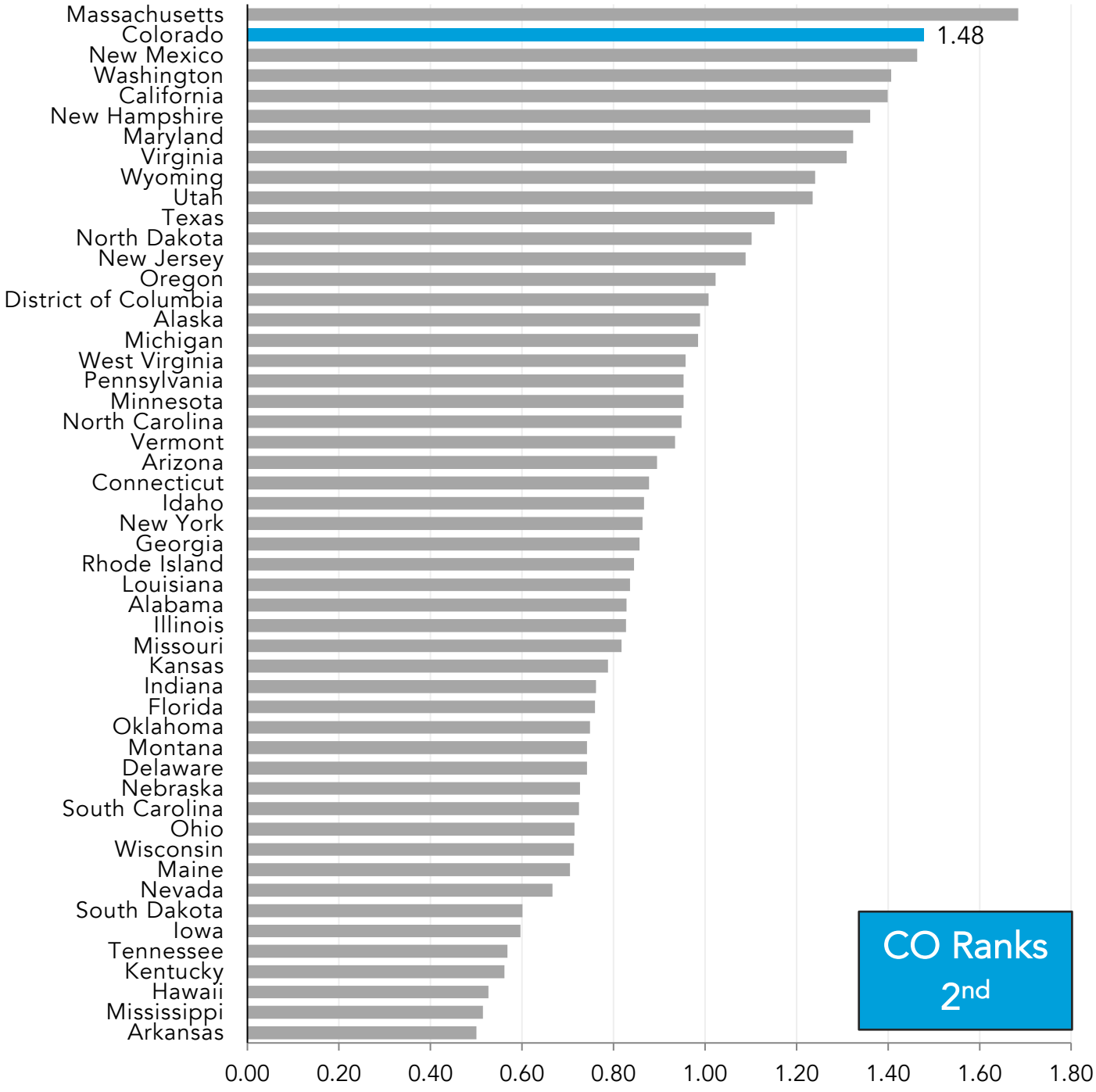


Source: EL estimates based on Lightcast 2022.4

SECTION 3. STATE COMPARISONS OF TECH INDUSTRY METRICS

An important focus of the state of the industry report is to compare Colorado with other states in the country. This will help place the state's performance in context, identifying strengths and areas for attention. In 2021, Colorado was the second most concentrated tech industry economy, only behind Massachusetts.

Total Tech Industry Location Quotient (2021)

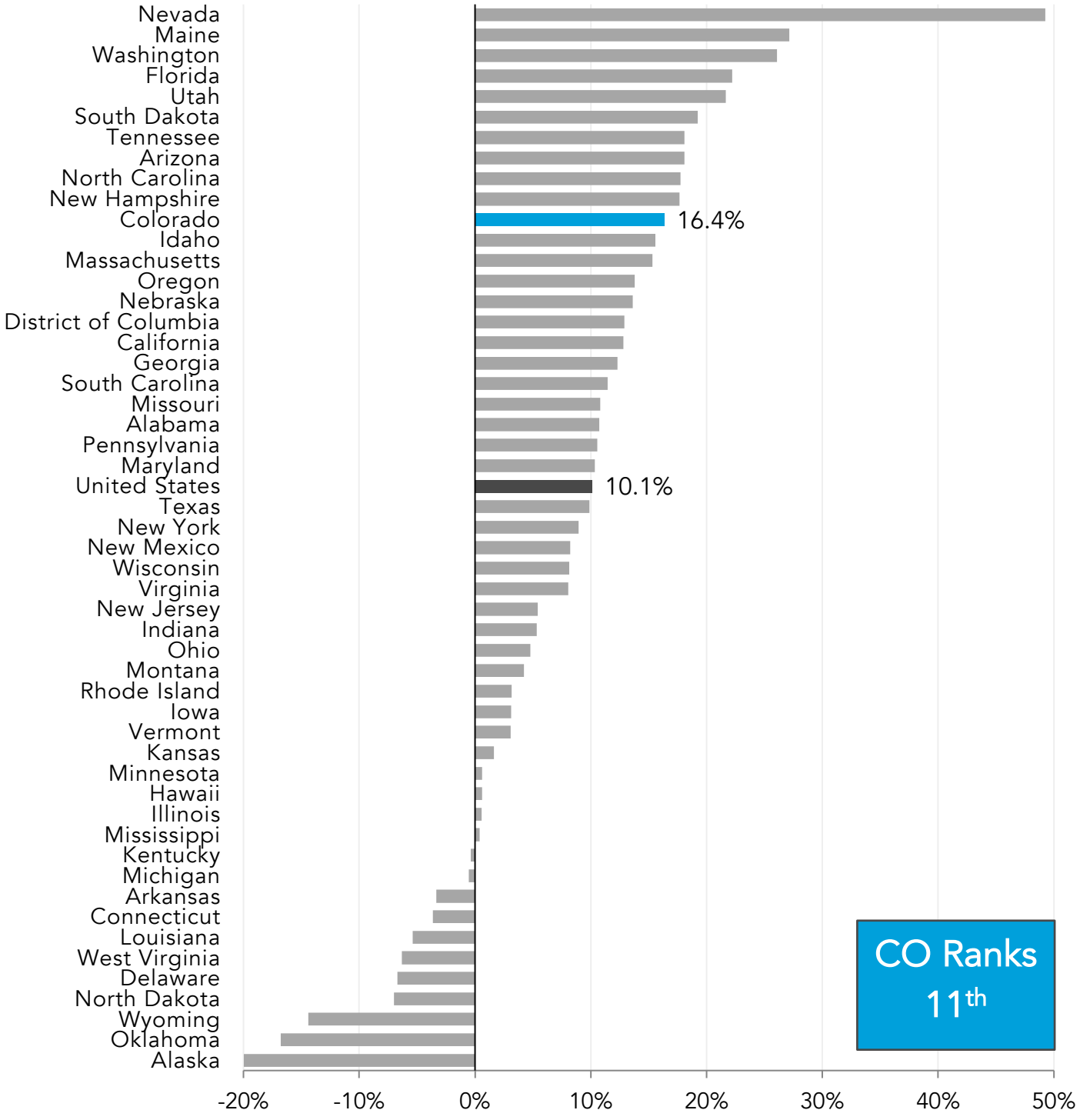


Source: EL estimates based on Lightcast 2022.4

Looking at growth patterns for the tech industry, Colorado grew tech industry employment by over 16 percent in the last five years. This was the 11th fastest growth rate in the nation. Other Mountain West states, Nevada and Utah also scored high. The number one state, Nevada, is growing at a high rate due, in part, to the rapid expansion at the Tesla Gigafactory in Reno. Despite the permeation of

technology into our daily lives not all states are experiencing tech sector growth. All companies still evaluate states on the availability of skilled workers and the likelihood of attracting workers to that state, the business climate and costs, infrastructure, broadly defined, and risk factors.

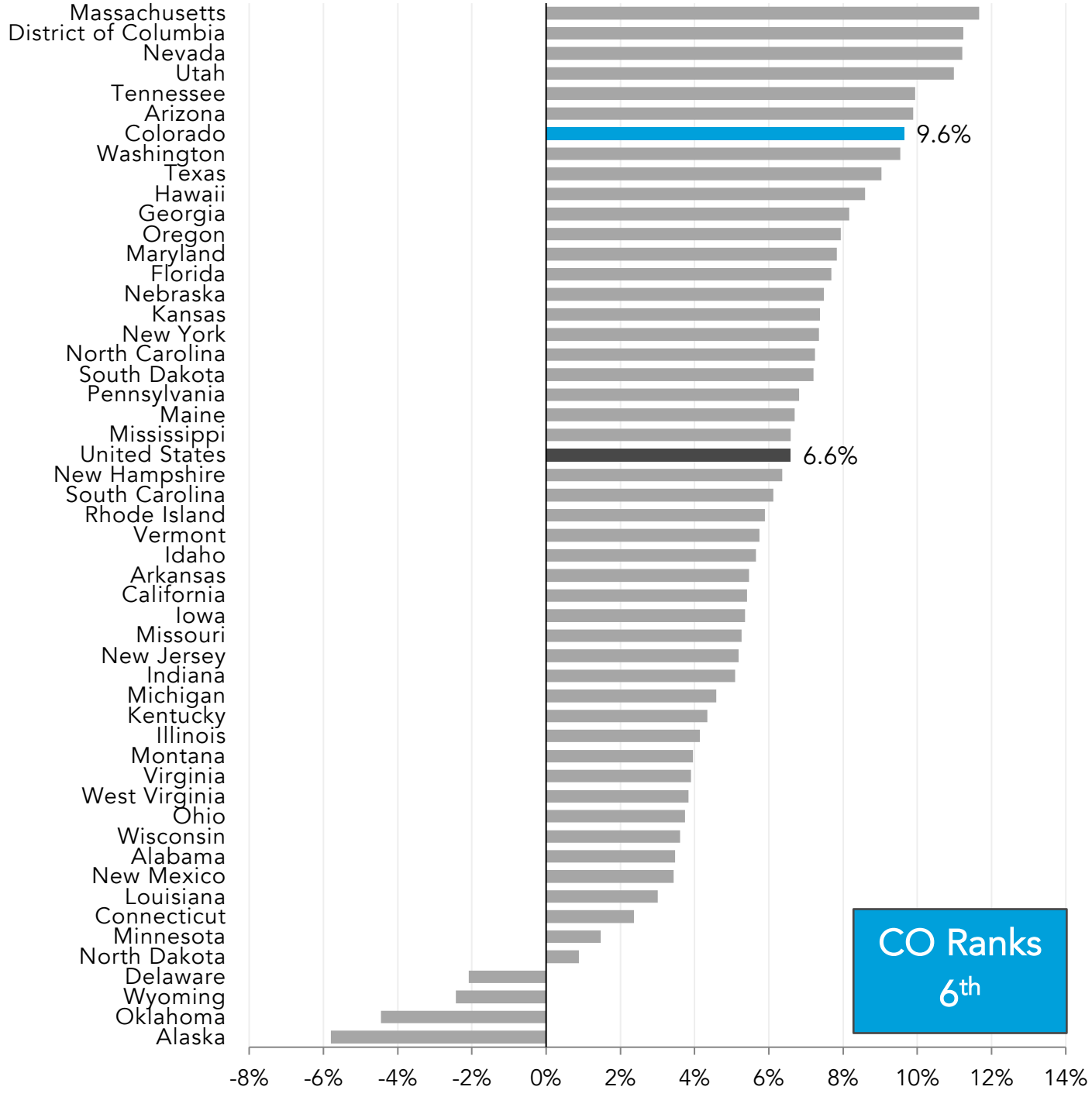
Total Tech Industry Employment Growth (2016-2021)



Source: EL estimates based on Lightcast 2022.4

Based on Lightcast models that measure the historical 5-year, 10-year, and 15-year growth trends to predict future growth, Colorado is estimated to increase employment in the tech industry by 9.6 percent from 2022 to 2027. This is the 6th highest growth rate predicted across the nation. Other Mountain West states like Arizona, Utah, and Nevada also rank in the top ten.

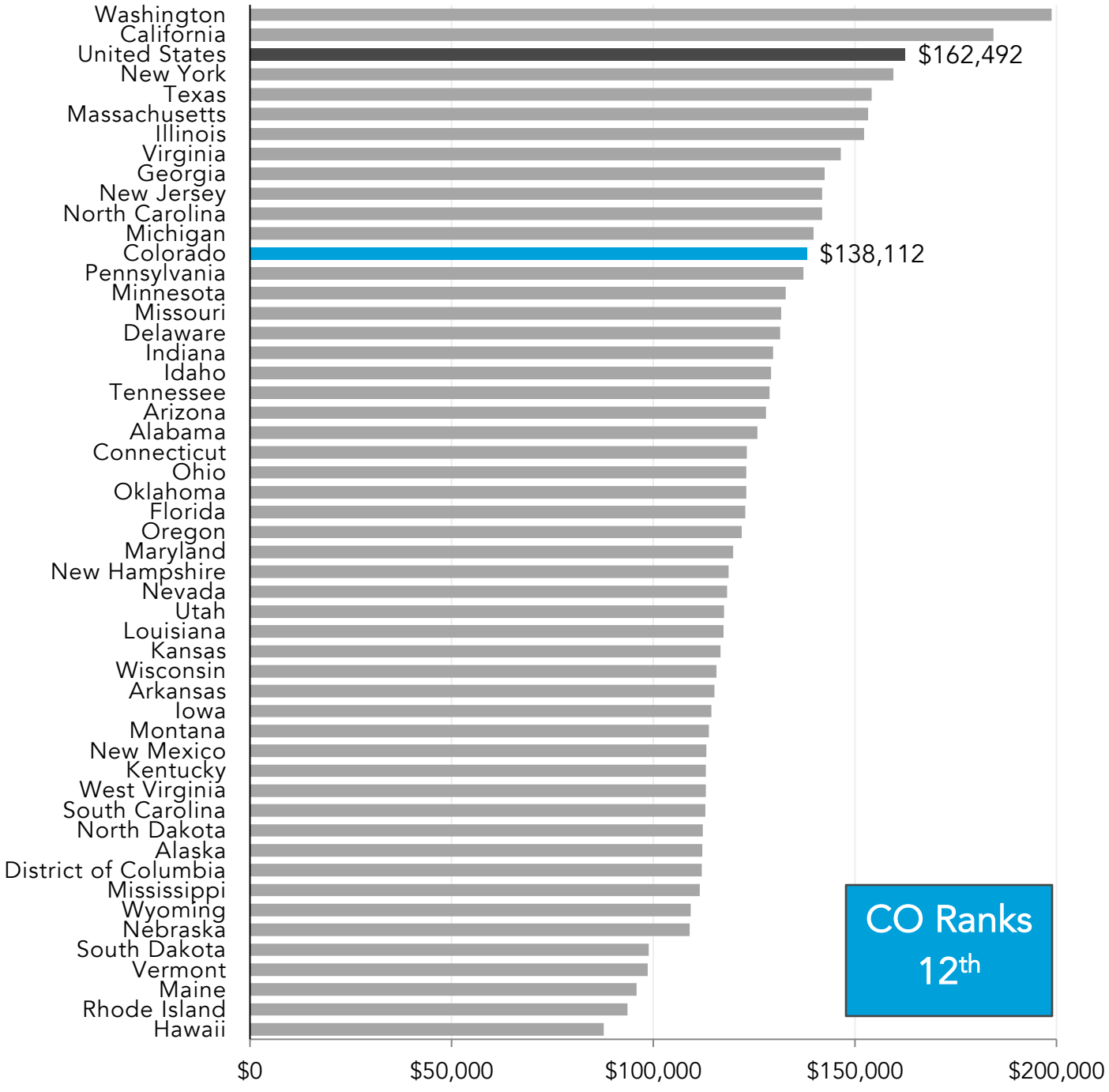
Expected Total Tech Industry Employment Growth (2022-2027)



Source: EL estimates based on Lightcast 2022.4

Wages are a key recruiting tool. Workers weigh their salary with the cost of living when comparing locations. Colorado has a cost-of-living score of 111.10, the national average is 100, indicating essential items like housing, food, and transport are more costly in Colorado than other places in the nation. Even with this higher cost of living, when wages are adjusted, the average tech industry worker earns over $138,100. This is the 12th highest average earnings level in the country.

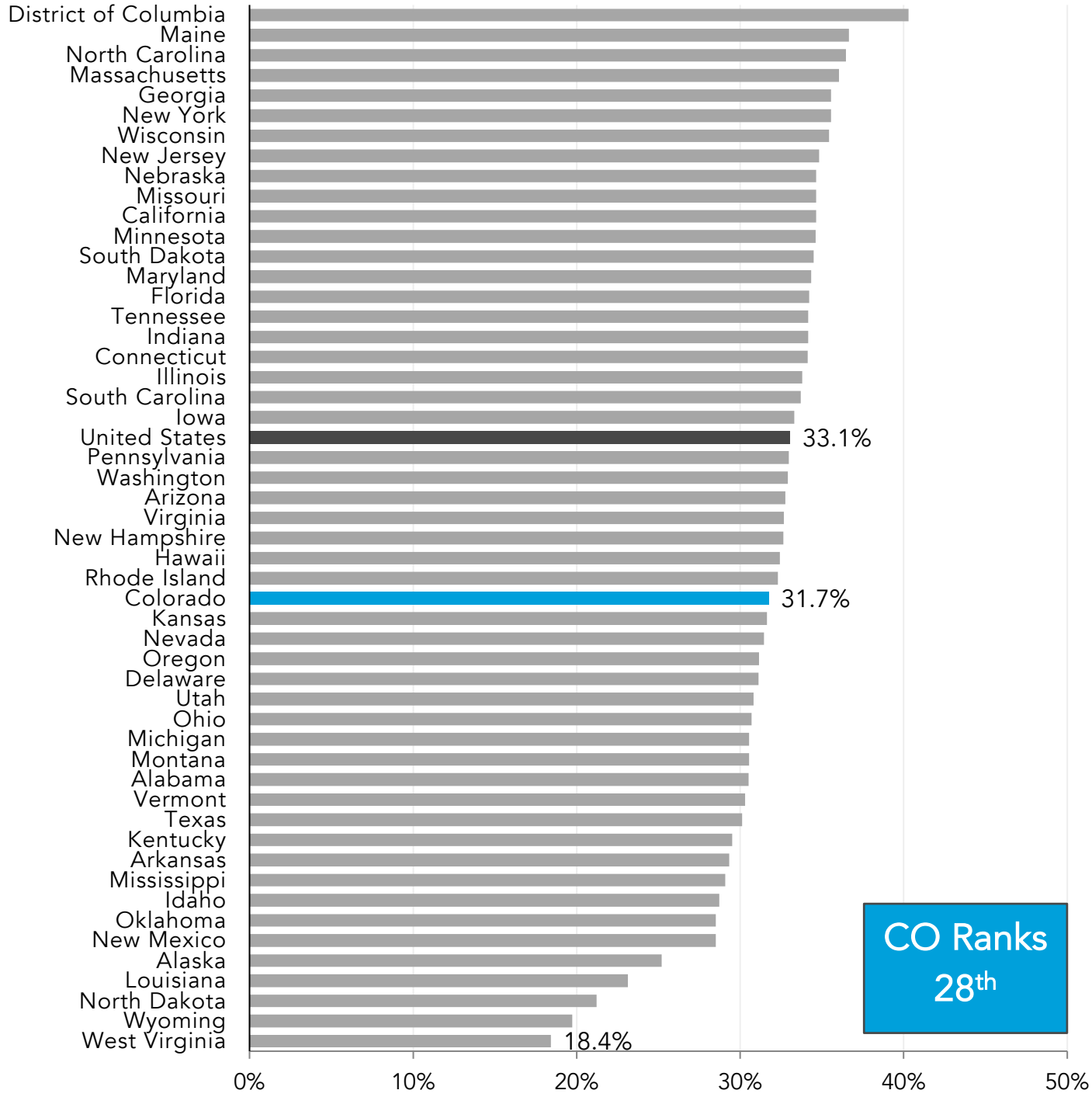
Average Annual Earnings for Total Tech Industry Employees with Purchasing Power (2021)



Source: EL estimates based on Lightcast 2022.4

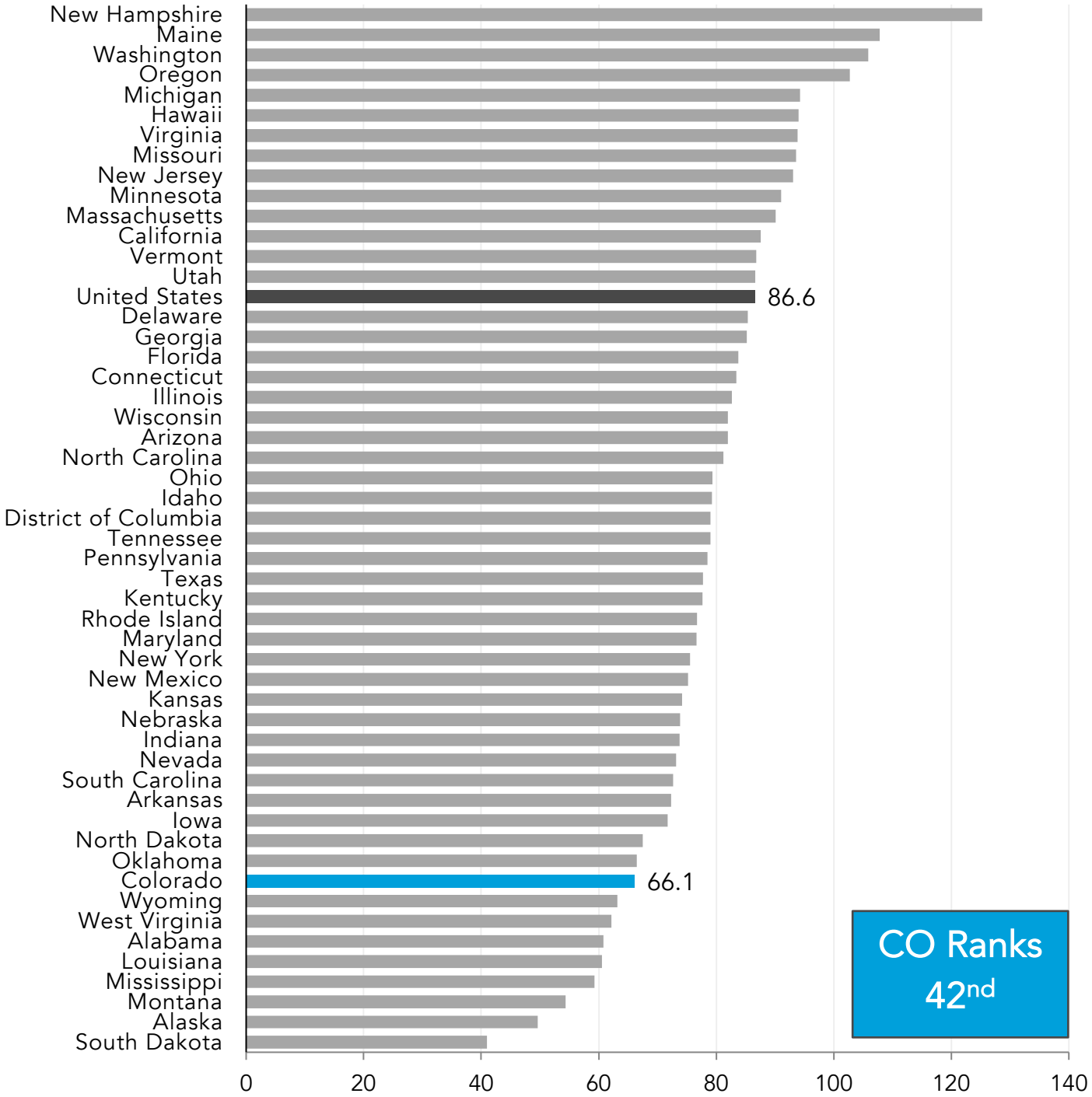
The next area of focus shows an area where the state is lagging and could work to improve its standing. This is in the diversity of the tech industry workforce. The state ranked in the middle of pack for gender diversity, 28th, and below the national average. Every state was well below an equal distribution along gender.

Percentage of Women in the Tech Industry Workforce (2021)



Source: EL estimates based on Lightcast 2022.4

Total Tech Industry Diversity Index (2021)



Source: EL estimates based on Lightcast 2022.4

The tech industry diversity index is calculated by dividing the percentage of tech industry workers who identify as people of color or in the Hispanic community by the ratio present in the overall population. Therefore, if a state has a tech industry diversity index lower than 100, this indicates that the tech industry is less diverse compared to the state's overall population. A value of 100 would

mean the tech industry is representative of the state's overall population. Only four states had a diversity index score above 100. Colorado scored in the bottom 15 states, 42nd, and below the national average. This indicates that people of color are underrepresented in the tech industry in Colorado.

Several of the tech leaders interviewed spoke about diversity as a weakness for the state's tech sector. They wanted to see the whole population of the state benefit from the success of the sector. Companies noted, however, that finding diverse employees in the state is difficult. One hirer noted they've had to hire remote workers from other cities, like Austin and Atlanta, to diversify their workforce.

There is interest among tech employers to look at workers beyond the traditional postsecondary pipelines, but this is happening slowly. One tech leader believed that human resource departments still have work to do to broaden their talent searches. The opportunity exists to train more existing Colorado residents and keep them in the state with jobs in tech. Paid apprenticeships are popular in the trades and could be adopted by tech to expand the labor pool.

"Getting underrepresented groups into a tech career can increase their income by 123 percent."

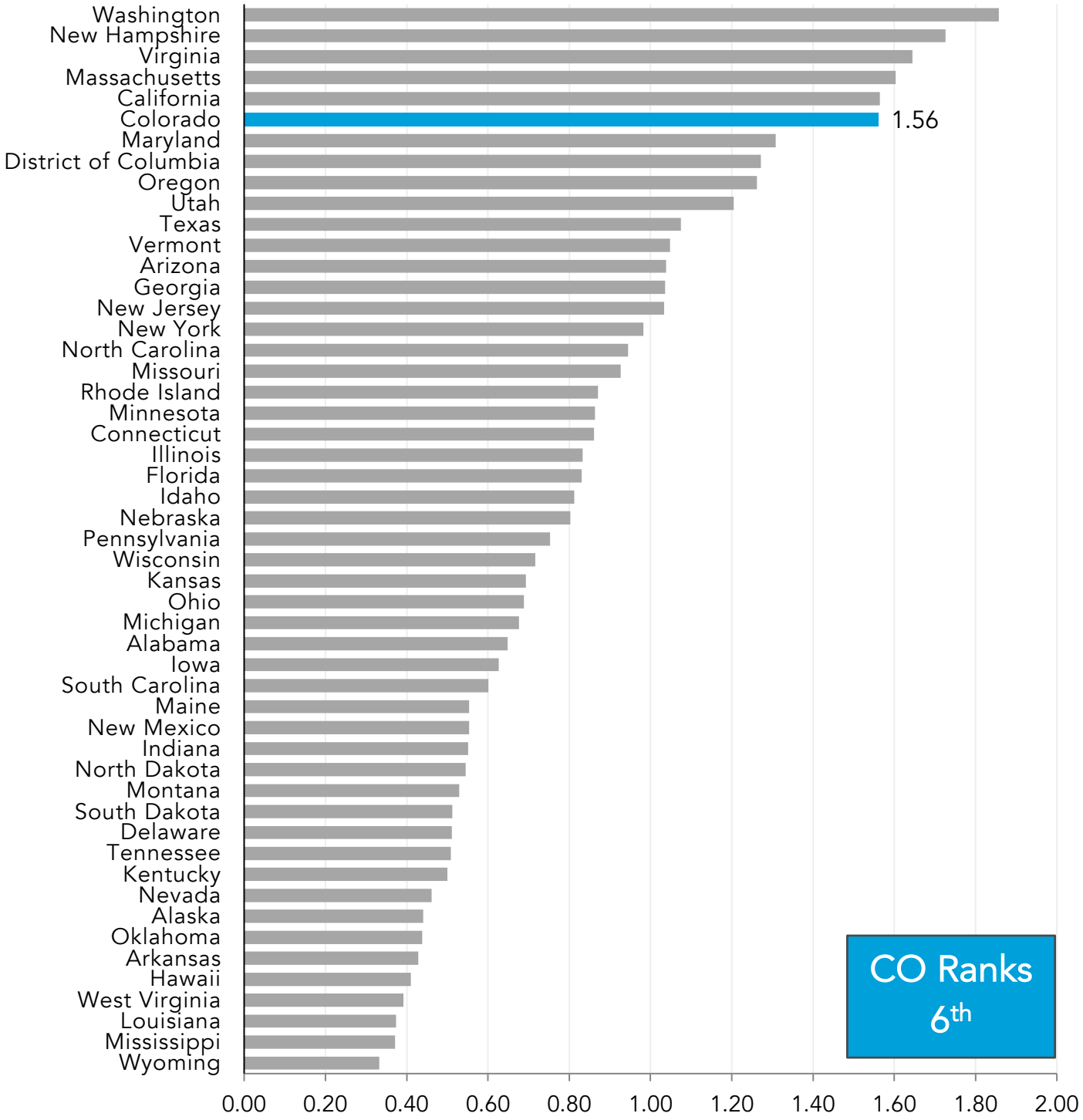
Another tech leader believed offering incentives for entrepreneurs from underrepresented groups (BIPOC, LGBTQIA, women) to start their company in the state could be a way to improve the diversity of the tech sector.

Total Tech Industry		
Metric	Value	Rank
Total Tech Industry Location Quotient (2021)	1.48	2
Total Tech Industry Employment Growth (2016-2021)	16.4%	11
Expected Total Tech Industry Employment Growth (2022-2027)	9.6%	6
Average Annual Earnings for Total Tech Industry Employees with Purchasing Power (2021)	$138,112	12
Percentage of Women in the Tech Industry Workforce (2021)	31.7%	28
Total Tech Industry Diversity Index (2021)	66.1	42

IT INDUSTRY SUBGROUP

Next, the IT sub-industry was compared to other states. This group of industries represents the high-tech core including hardware manufacturing, internet, data storage, telecommunications, and software companies. In 2021, the IT industry accounted for 5.3 percent of Colorado's employment with a location quotient of 1.56. This is the sixth most concentrated IT economy in the nation, just behind California.

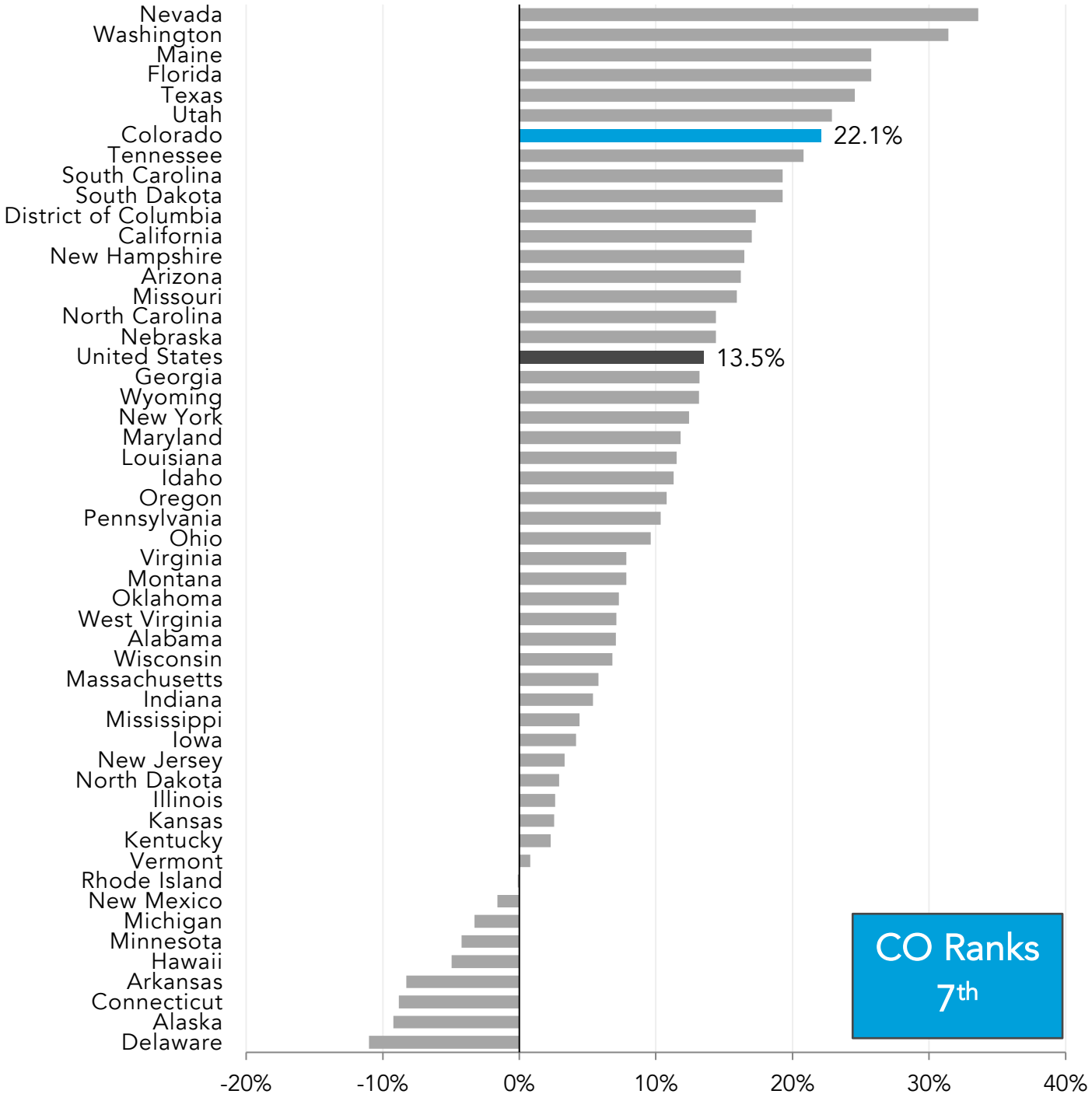
IT Industry Location Quotient (2021)



Source: EL estimates based on Lightcast 2022.4

Growth in the IT subgroup has been stronger than the total tech industry. The increase of IT employment in Colorado by over 27,570 jobs (22 percent) was the 7th fastest growth rate in the nation from 2016 to 2021.

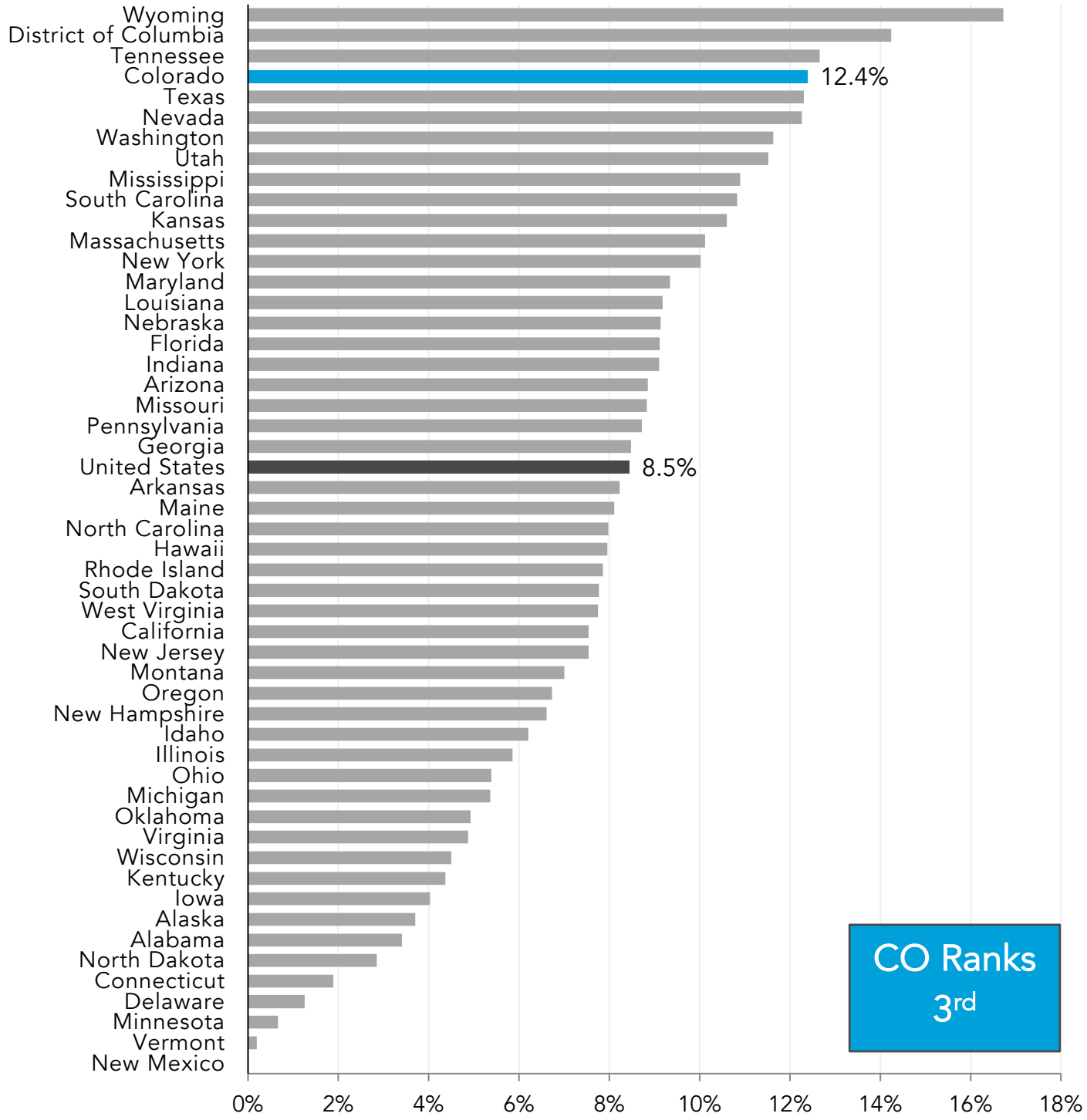
IT Industry Employment Growth (2016-2021)



Source: EL estimates based on Lightcast 2022.4

Lightcast's predictive models estimate a future five-year growth rate over 12 percent, ranking as the third fastest growing IT state. The District of Columbia is not counted in the state rankings but is presented in charts. Colorado's neighbor, Wyoming, is predicted to have the highest growth in IT in the next five years.

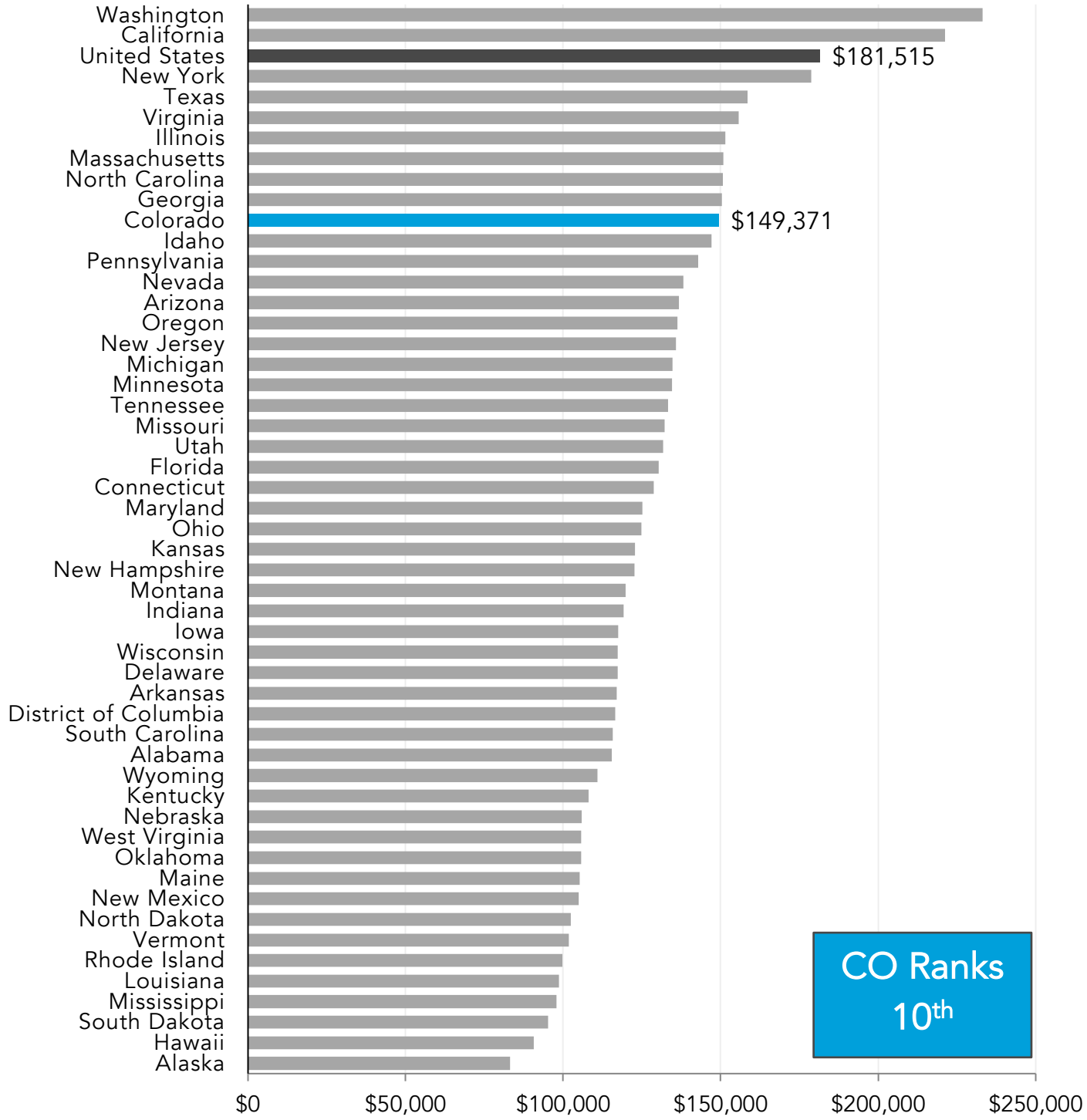
Expected IT Industry Employment Growth (2022-2027)



Source: EL estimates based on Lightcast 2022.4

IT wages in Colorado are even more competitive than the overall tech industry, the state ranks 10th in the nation in cost-of-living adjusted average earnings.

Average Annual Wage for IT Industry Employees with Purchasing Power (2021)



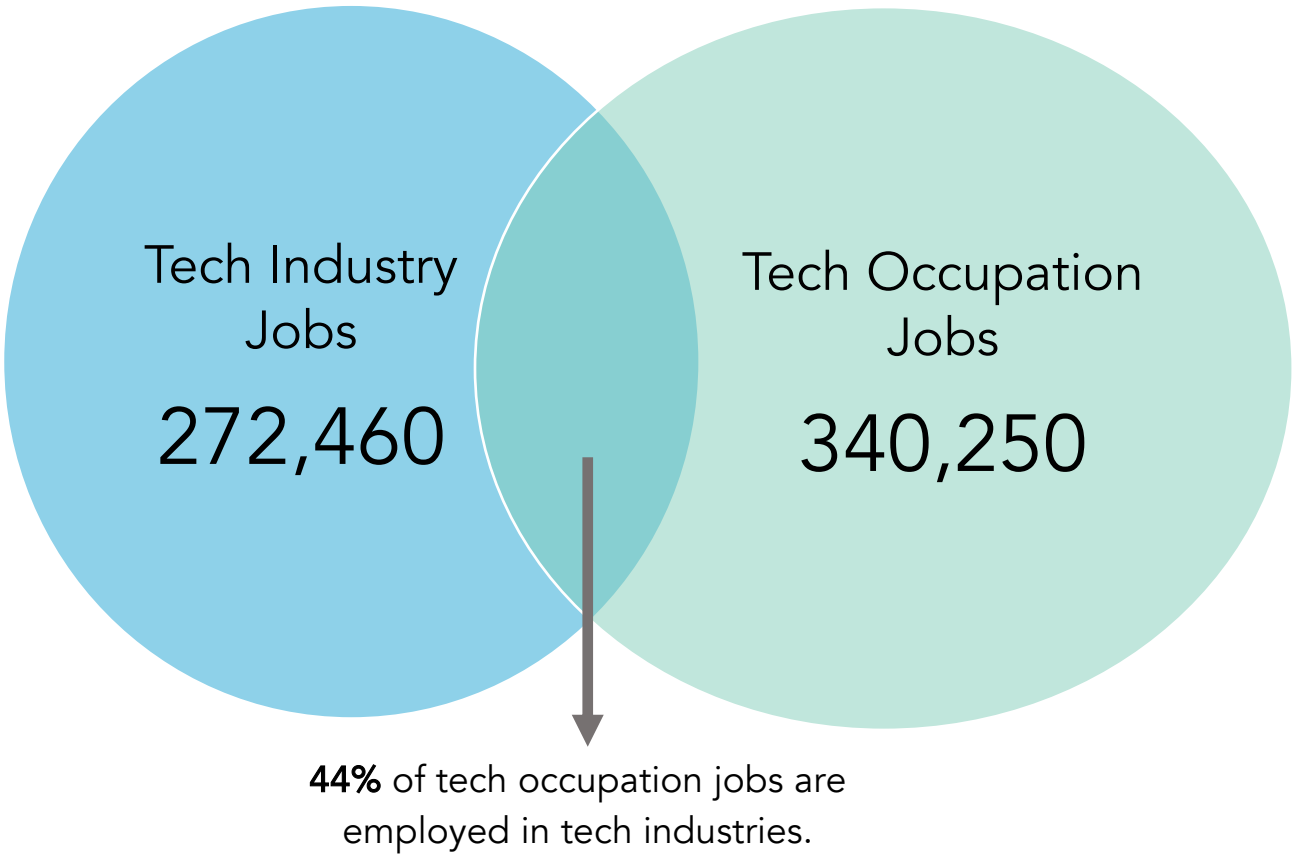
Source: EL estimates based on Lightcast 2022.4

IT Industry		
Metric	Value	Rank
IT Industry Location Quotient (2021)	1.56	6
IT Industry Employment Growth (2016-2021)	22.1%	7
Expected IT Industry Employment Growth (2022-2027)	12.4%	3
Average Annual Wage for IT Industry Employees with Purchasing Power (2021)	$149,371	10

SECTION 4. TECH OCCUPATIONS

Technology workers today are present in almost every industry. Technology has permeated most businesses and is increasingly important to company competitiveness especially in industries like banking, energy, and healthcare. To account for the number of tech occupations that exist across all industries, Economic Leadership reviewed 85 separate 5-digit Standard Occupational Codes (SOC) codes focusing mostly on STEM driven work. A complete list is included in the appendix.

Staffing Patterns of Tech Industries and Tech Occupations, 2021



Source: EL estimates based on EMSI 2022.4

In 2021, there were 340,250 tech workers employed across the Colorado economy. This is a more sizable number than the 270,460 workers who are employed at tech companies. When these occupations are cross-referenced with the tech industry codes, it is found that about 44 percent of tech workers work at a tech industry firm. The rest of the tech workers are spread across industries like finance, construction, and healthcare.

Top 10 Tech Occupations in Colorado, 2021

Description	2021 Occupations	Change in Employment, 2016-2021	Median Annual Wage[a]	Annual Openings	Turnover Rate
Software Developers	40,402	6%	$121,140	3,685	36%
Business Operations Specialists, All Other	35,343	55%	$78,460	4,440	49%
Project Management Specialists	25,994	48%	$97,030	3,160	49%
Market Research Analysts and Marketing Specialists	24,312	55%	$76,460	3,650	57%
Computer User Support Specialists	16,706	11%	$60,860	1,590	46%
Network and Computer Systems Administrators	12,039	-4%	$95,120	1,000	42%
Management Analysts	11,540	9%	$90,610	1,300	54%
Civil Engineers	11,496	19%	$95,310	1,285	36%
Computer Systems Analysts	11,306	21%	$101,630	1,370	41%
Computer and Information Systems Managers	10,028	46%	$164,070	1,220	38%
All Tech Occupations[b]	**340,254**	**20%**	**$93,960**	**41,550**	**44%**

Source: EL estimates based on Lightcast 2022.4

[a] Wage estimate is different from the average annual wage values in the previous charts. The average annual wage value is calculated across all occupations in the tech industry and measures the average versus the median.

[b] This is a sum of the 85 SOC codes (see appendix) not only the 10 most common occupations displayed in the table above.

Software developers are the top occupation of the tech workers group, accounting for almost 12 percent of the workforce. Every year, on average, 41,550 tech jobs need to be filled to accommodate for growth and retiring workers.

The Denver-Aurora-Lakewood MSA is host to 211,210 tech jobs. This is about **62 percent** of all tech jobs in the state.

Analyst jobs were among the top occupations and experiencing the most growth. The increase of Big Data has created demand for workers who can help process and dissect information. This shows that from a talent perspective, cultivating a tech workforce is not just about coding websites and apps, but it is also critical to have capable individuals well versed in statistics and mathematics.

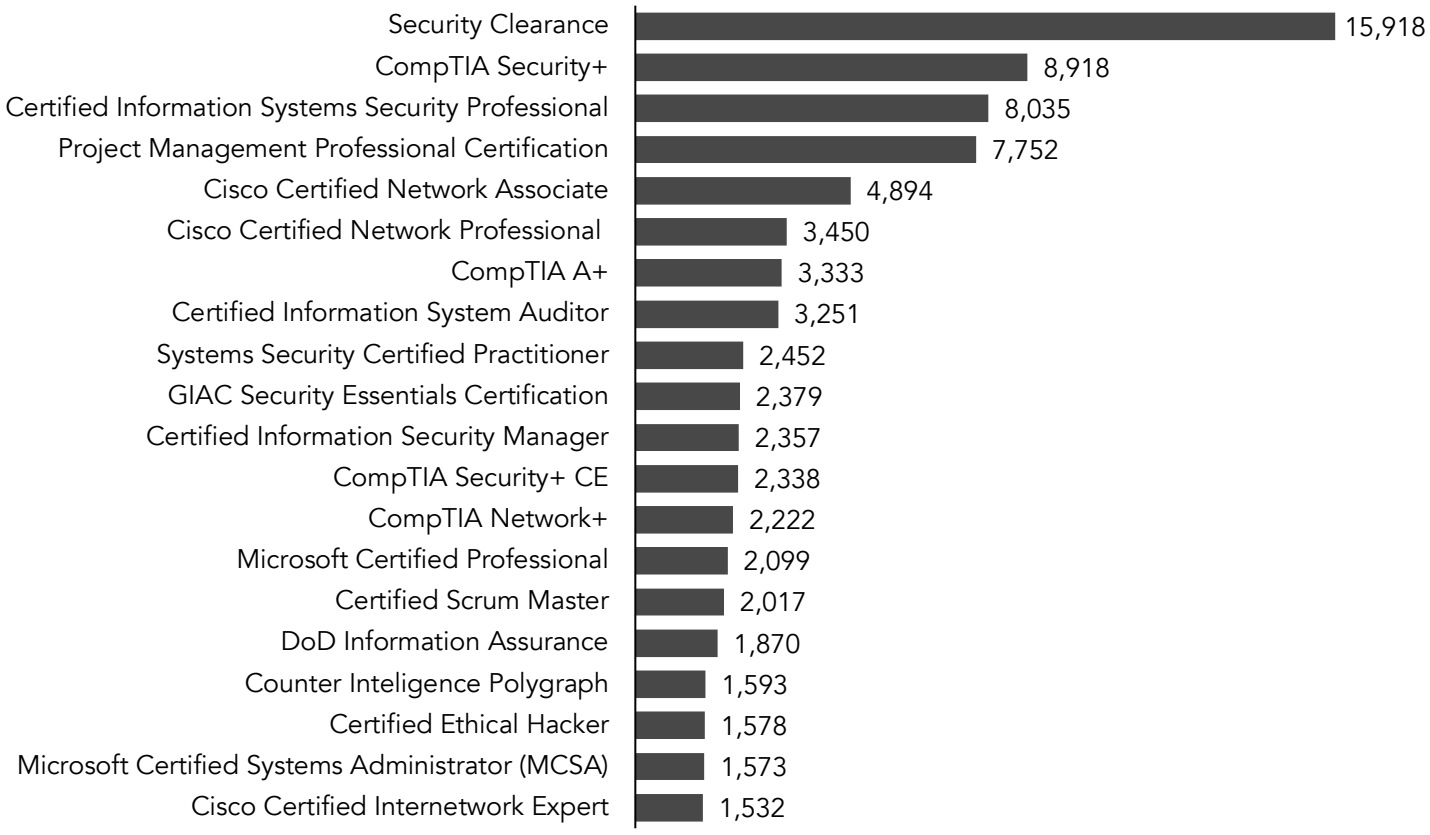
Top 5 Tech Occupations in Growth

Top Five in Net Job Growth		Top Five in Growth Percentage	
Business Operations Specialists, All Other	+12,586	Nuclear Technicians	+649%
Market Research Analysts and Marketing Specialists	+8,607	Mathematical Science Occupations	+391%
Project Management Specialists	+8,451	Data Scientists	+173%
Information Security Analysts	+3,207	Actuaries	+138%
Computer and Information Systems Managers	+3,168	Information Security Analysts	+123%

Source: EL estimates based on Lightcast 2022.4

Information security analysts were one of the fastest growing tech occupations in Colorado, indicating the emergence of cybersecurity professionals. Emerging technologies like blockchain increase security demands in the industry. When reviewing the top certifications listed in online job postings for Colorado tech jobs, security credentials were in the highest demand. Colorado's cybersecurity industry benefits from the large military presence in the state. There are six military bases in Colorado. Most of these are Air Force bases including the Air Force Academy in Colorado Springs. The federal government employed 5.4 percent of all the tech occupations in Colorado. Tech jobs in the military specifically are up 63 percent (about 1,430 jobs) in the last five years.

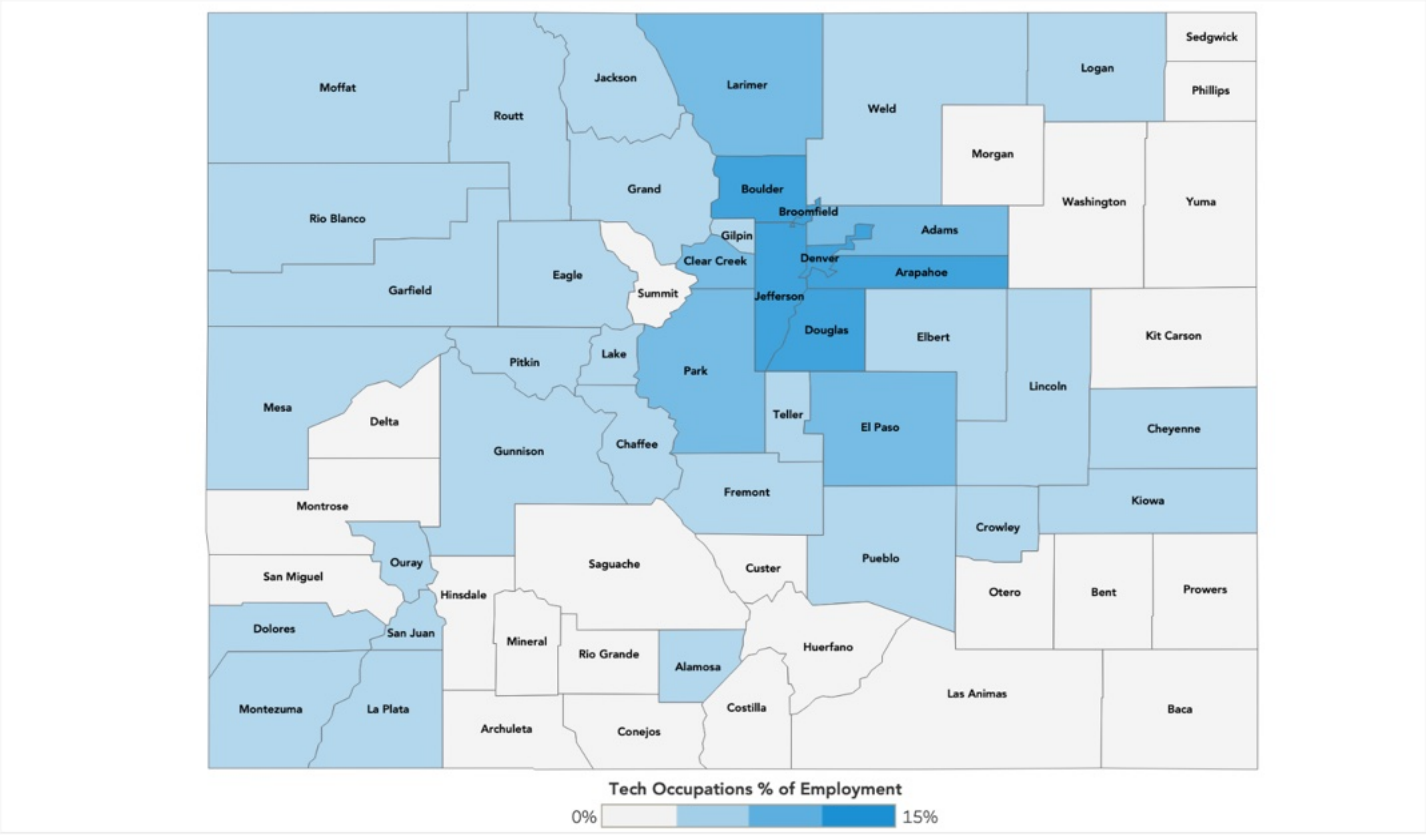
Top Certifications Listed in Job Postings for Colorado's Tech Occupations, Jan 2021 – Nov 2022



Source: EL estimates based on Lightcast 2022.4

Like tech industry jobs, tech occupations tend to strongly concentrate in the more urban counties. About 22 percent of Broomfield County's workers are tech workers. However, tech workers have permeated more places than IT industry jobs. The eastern and southern parts of the state have the lowest concentrations of tech workers.

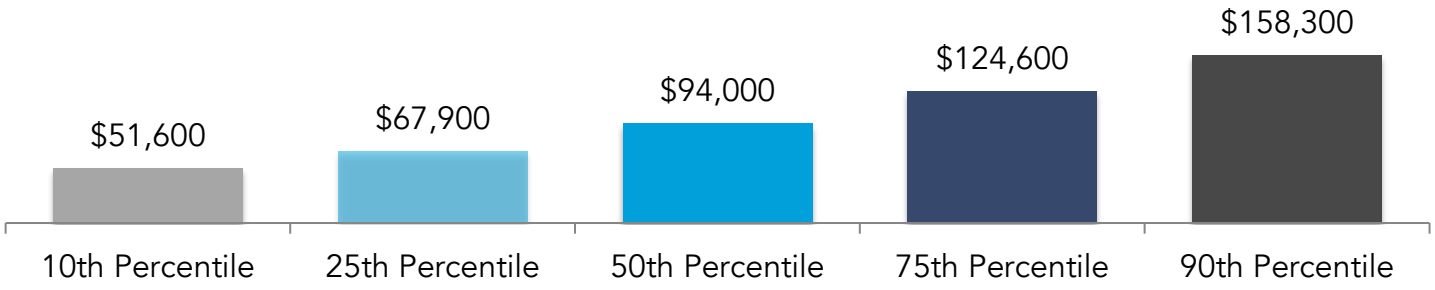
Tech Occupations as a Percentage of All Occupations, 2021



Source: EL estimates based on Lightcast 2022.4

While the median earnings for a tech occupation are around $94,000, the true earnings can range based on industry and experience. The lowest percentile earns about $51,600 and the highest can earn about $158,300 a year.

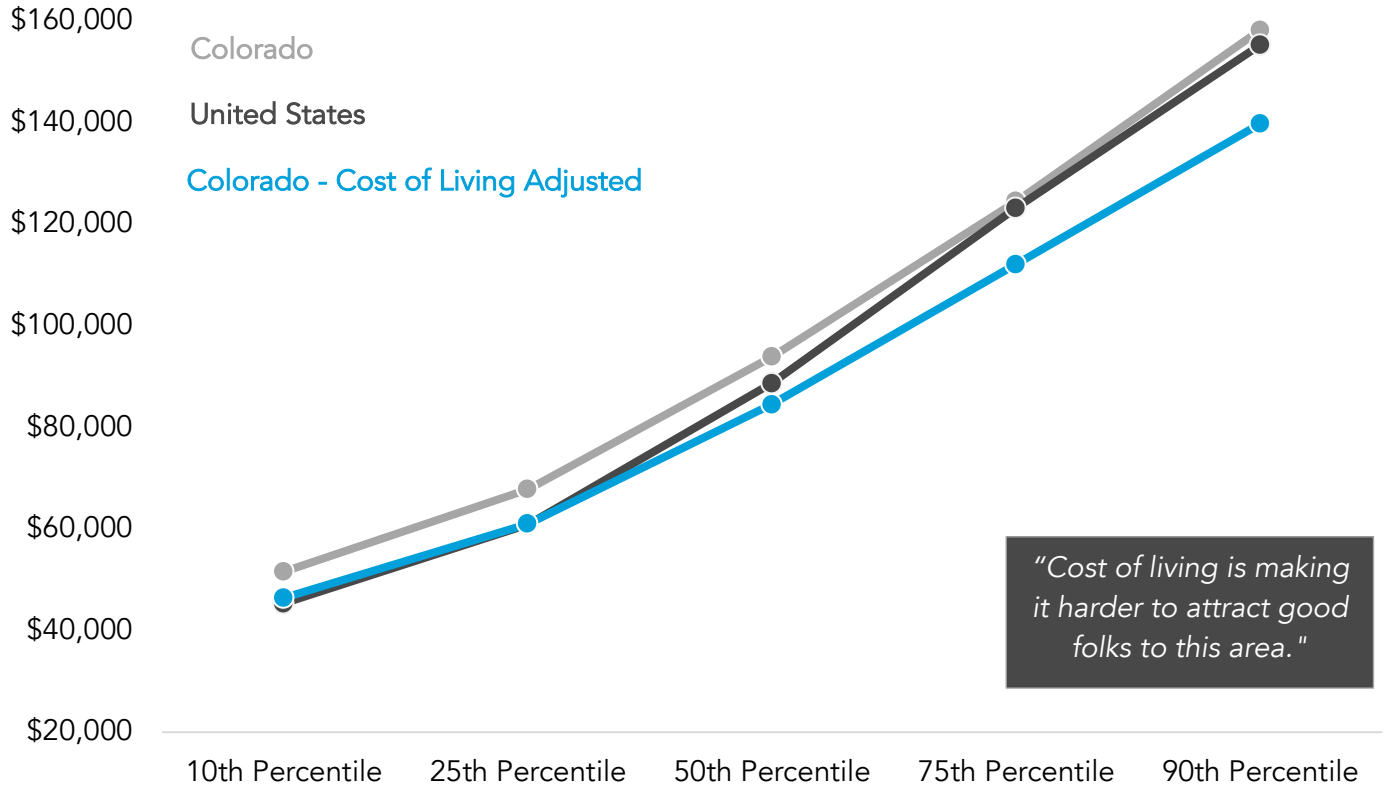
Wage Distribution of Tech Occupations in Colorado, 2021



Source: EL estimates based on Lightcast 2022.4

Finding enough workers with the skills that are in demand is the top competitive factor in today's economy. The cost of living of any state can be a factor in worker location decisions. Colorado is the 16th highest state in terms of cost of living. A wage of $100 is only worth about $90 in Colorado due to the higher prices of goods compared to the national average. Lower paid and entry level tech positions are comparable to the national average, but at higher paid positions earnings are lower compared to other locations in the US when the cost-of-living adjustment is included. As a growing state, managing the rising cost of living will be a challenge for Colorado in the coming years.

Tech Occupation Wage Distribution Comparison by Location, 2021

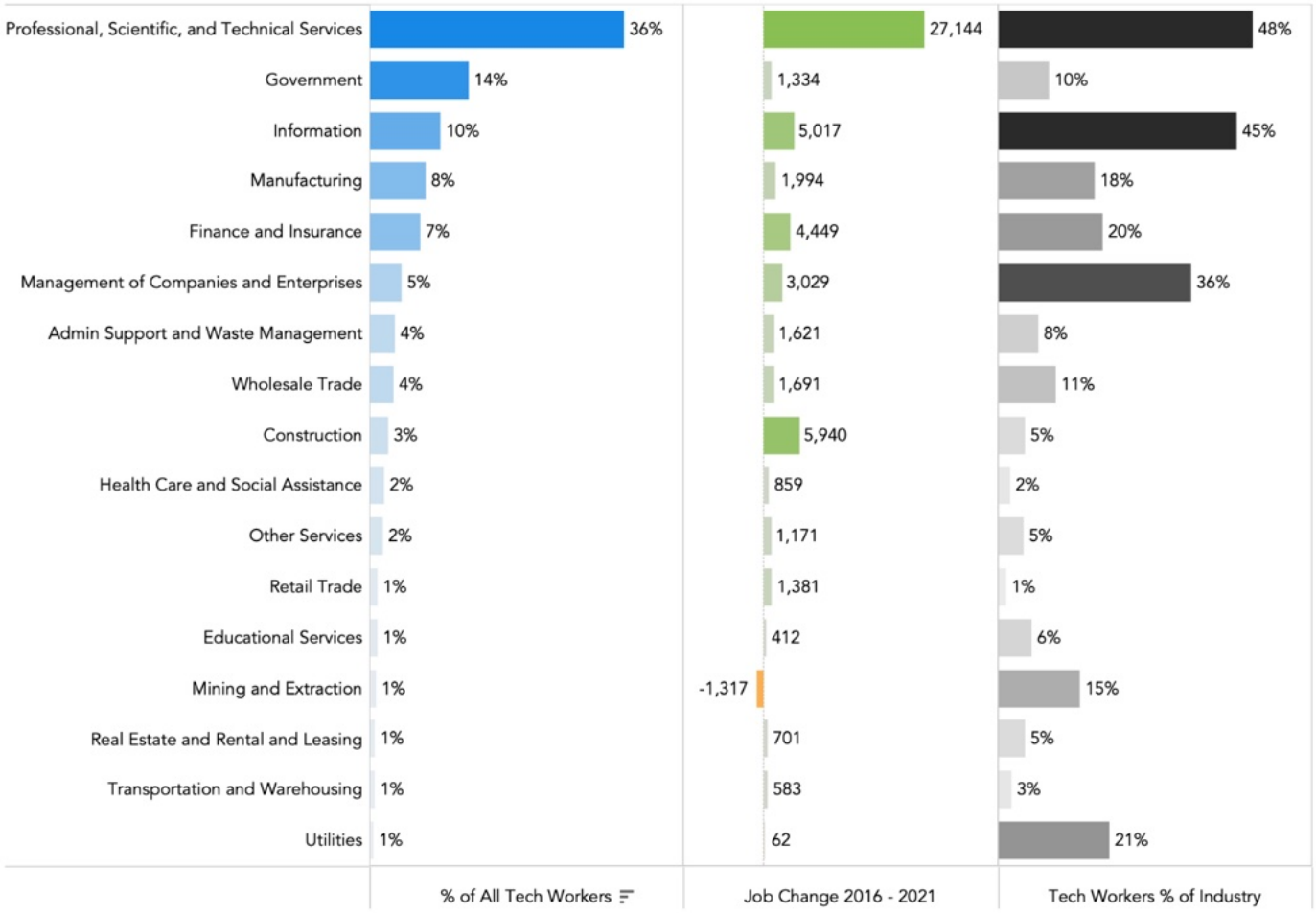


Source: EL estimates based on Lightcast 2022.4

As mentioned, these tech occupations exist across many different industries. The chart below demonstrates which industries (2-digit level) employ tech workers in Colorado. Beyond the expected Professional Services and Information industries, tech workers are also present and growing strongly in government, information, manufacturing, finance, and healthcare. In finance and insurance, about 20 percent of all jobs in the industry are tech occupations and 4,450 tech workers were added over in the last five years. Tech workers now account for 18 percent of the manufacturing industry as production has become more automated and integrated.

As discussed previously, cybersecurity and military tech is a large component of government's large share of tech workers in the state. Several of the tech leaders interviewed were excited about the future of tech in the state because they believed the state could be a major player in some of the next iterations of the tech industry. Many of those opportunities are outside the traditional tech space including robotic technology for manufacturing automation and the green energy economy.

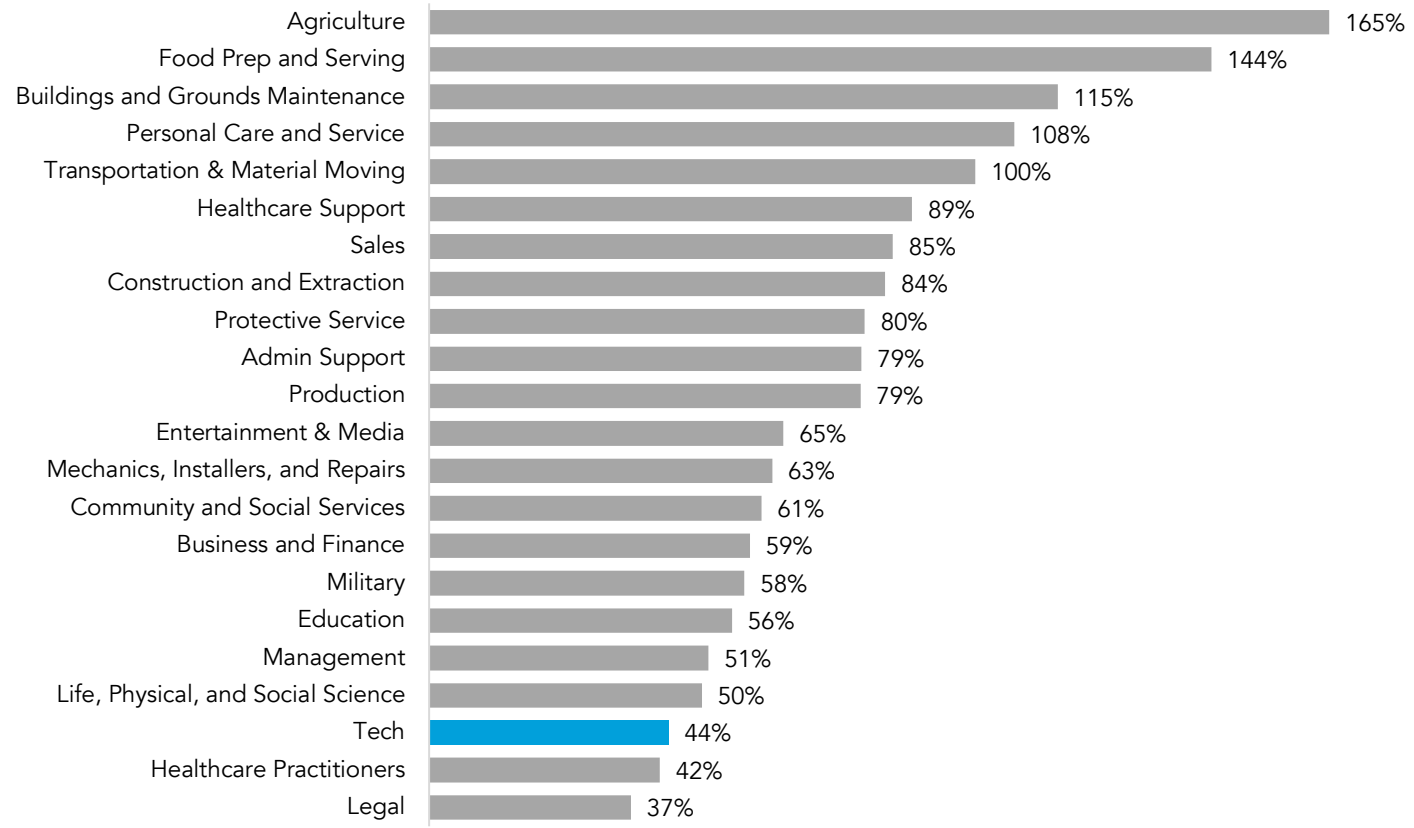
Top Industries Employing Tech Occupations, 2021



Source: EL estimates based on Lightcast 2022.4

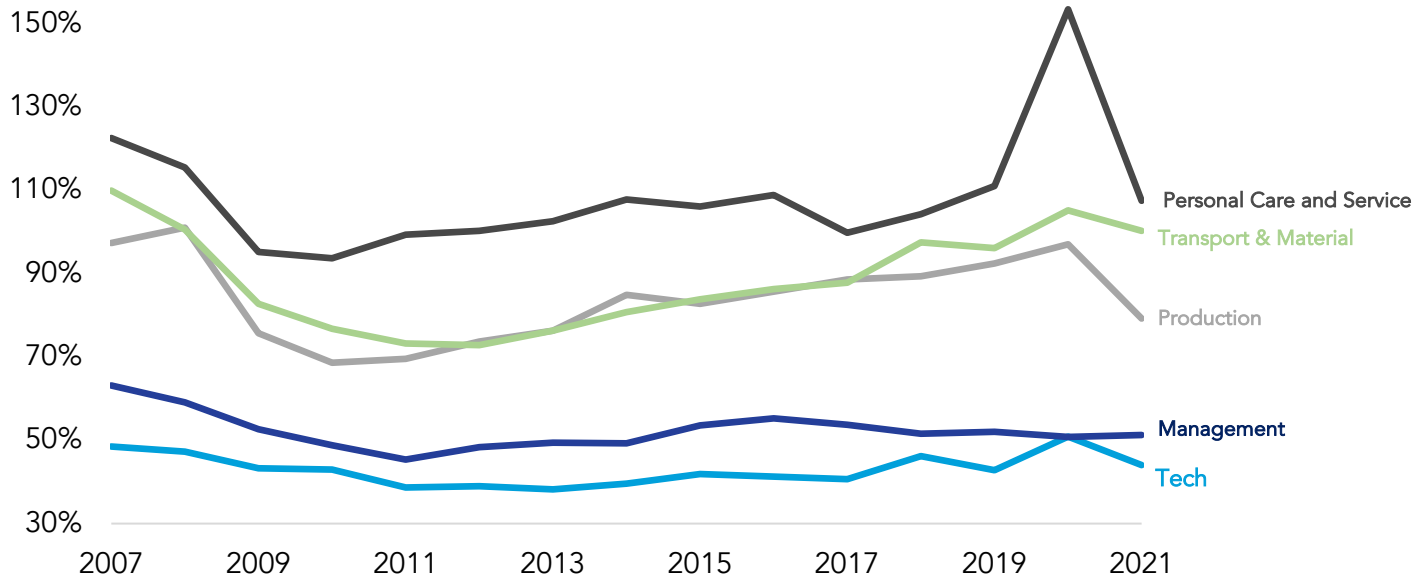
Quit rates have risen in the wake of the pandemic in Colorado and the nation. Turnover across occupations can be measured by taking the number of separations (when a social security number is removed from a payroll) by the total number of employees in the field. This turnover rate provides a sense of churn in workers in the field. For tech jobs, the rate was about 44 percent in 2021. This was one of the lowest rates in Colorado's economy. The turnover rate in tech has increased slightly in recent years, but not to the extent like personal service or warehousing jobs.

Colorado Turnover Rate by Occupation Type, 2021



Source: EL calculations based on Lightcast 2022.4

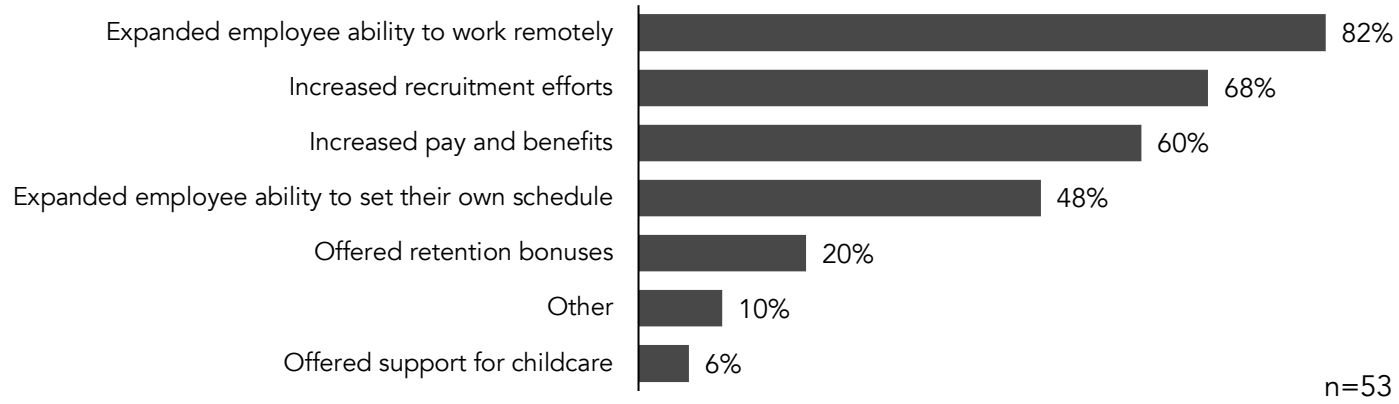
Colorado Turnover Rate by Occupation Type, 2021



Source: EL calculations based on Lightcast 2022.4

In a knowledge-based job like many tech jobs, it can be very difficult and costly to find another worker with the same skills. Despite lower turnover rates than other positions, companies in Colorado have been willing to take steps to retain tech workers in this economy. In the survey to CTA members, management indicated they had expanded access to remote work, offered flexible scheduling, and increased pay/bonuses.

Efforts to Recruit and Retain Workers by Colorado Tech Companies



Source: CTA Member Survey (2022)

Tech occupation data offers the opportunity to look granularly at the demographics of the workforce. Similar to the earlier calculation of the diversity index of the tech industry, an index was created to determine which demographic groups were underrepresented in tech occupations. The percentage of the demographic group in the tech occupations is divided by the percentage of the demographic group in the overall Colorado population and multiplied by 100. If the value is lower than 100 then the demographic group is underrepresented in tech occupations. If the value is over 100, the demographic group is overrepresented in tech occupations. Looking at gender, women account for one-third of tech occupations while accounting for one-half of the population.

Gender Distribution of Tech Occupations in Colorado, 2021

Demographic	Tech Occupations	CO Population	Index
Women	33%	49%	67.3
Men	67%	51%	131.9

Source: EL estimates based on Lightcast 2022.4

In Colorado, 77 percent of tech workers are white, and they are overrepresented in tech occupations when compared to the state's population. Workers who are Asian are also well-represented (index over 100) in the tech workforce. Other groups of color do not fare as well. Hispanic people accounted for 10 percent of tech occupations but make up 22 percent of the state's total population. The representation rates for Native communities and black people in the tech workforce were also very low in the state.

Race/Ethnicity Distribution of Tech Occupations in Colorado, 2021

Demographic	Tech Occupations	CO Population	Index
White	77%	67%	114.4
Hispanic or Latino	10%	22%	44.6
Asian	8%	3%	223.7
Black or African American	3%	4%	76.0
Two or More Races	2%	2%	94.7
American Indian or Alaska Native	0.3%	0.6%	47.2
Native Hawaiian or Other Pacific Islander	0.1%	0.2%	64.4

Source: EL estimates based on Lightcast 2022.4

Diversity Index of Tech Management Jobs, 2021

Demographic	Tech Leadership Index
Women	59.6
Men	139.3
White	121.3
Hispanic or Latino	32.9
Asian	201.5
Black or African American	56.8
Two or More Races	78.0
American Indian or Alaska Native	37.4
Native Hawaiian or Other Pacific Islander	64.6

Source: EL estimates based on Lightcast 2022.4

When looking specifically at tech management roles across the state, women are even less represented. Most racial and ethnic categories have lower index scores at the leadership level than the overall tech workforce.

The same diversity index was calculated for the overall tech workforce of the Denver metro area. The representation of women in tech roles was slightly improved in Denver compared to the state. Most racial and ethnic categories have lower scores in Denver than the state overall, with the exception of Native American and Pacific Islander workers.

Diversity Index of Denver Tech Jobs, 2021

Demographic	Denver MSA Index
Women	68.3
Men	131.3
White	120.4
Hispanic or Latino	42.5
Asian	177.1
Black or African American	58.9
Two or More Races	91.3
American Indian or Alaska Native	59.3
Native Hawaiian or Other Pacific Islander	59.3

Source: EL estimates based on Lightcast 2022.4

The age of the tech workforce was also compared against the age breakdown of the overall state workforce. Tech occupations tend not to rely on the very young but have a higher level of young and middle-aged workers.

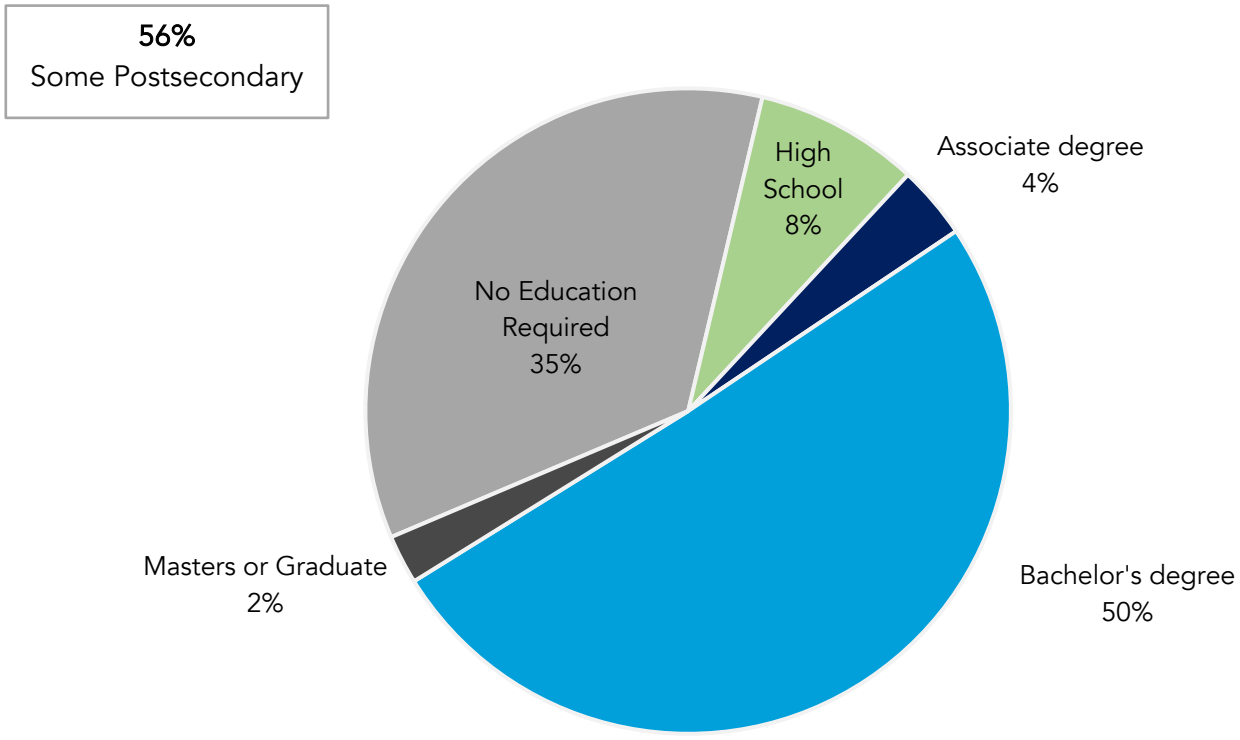
Age Distribution of Tech Occupations in Colorado, 2021

Demographic	Tech Occupations	CO Workforce	Index
Age 21 and below	1%	7%	16.3
Age 22 to 34	31%	29%	106.8
Age 35 to 54	48%	42%	115.9
Age 55+	19%	22%	88.8

Source: EL calculations based on Lightcast 2022.4

One of the ways to increase the equity of tech jobs is to focus on skills-based hiring. While many companies have started to remove their education requirements to expand their labor force pool, a review of job postings in the last three years reveals that about 56 percent of postings for tech jobs required some form of postsecondary education.

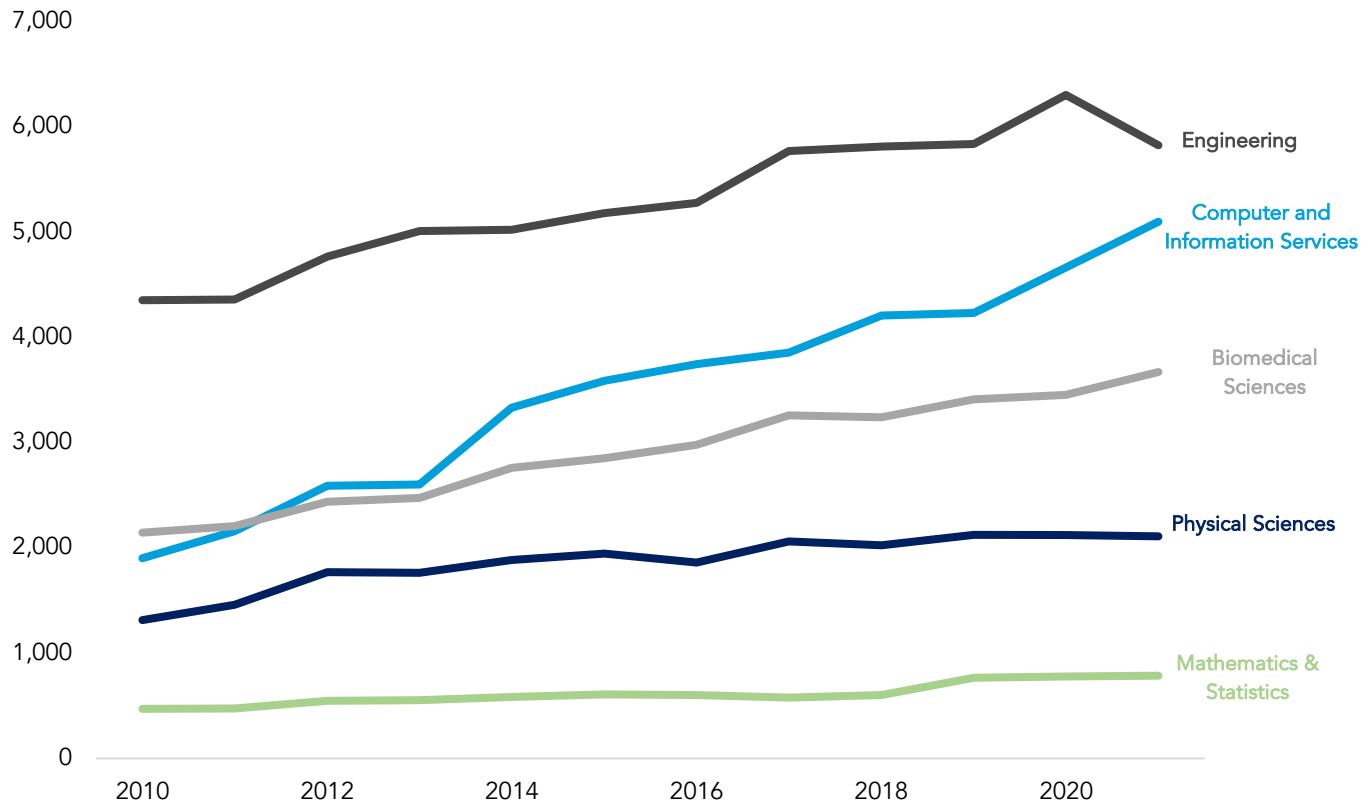
Minimum Education Level Required in Colorado Tech Job Postings, Jan 2019 – Oct 2022



Source: EL estimates based on Lightcast 2022.4

Fortunately, the postsecondary education completions (certificates and degrees) for computer and information sciences have risen in recent years in the state. Colorado is still mostly known for its engineering education.

Annual Education Completions in Colorado for Selected Programs, 2003-2021

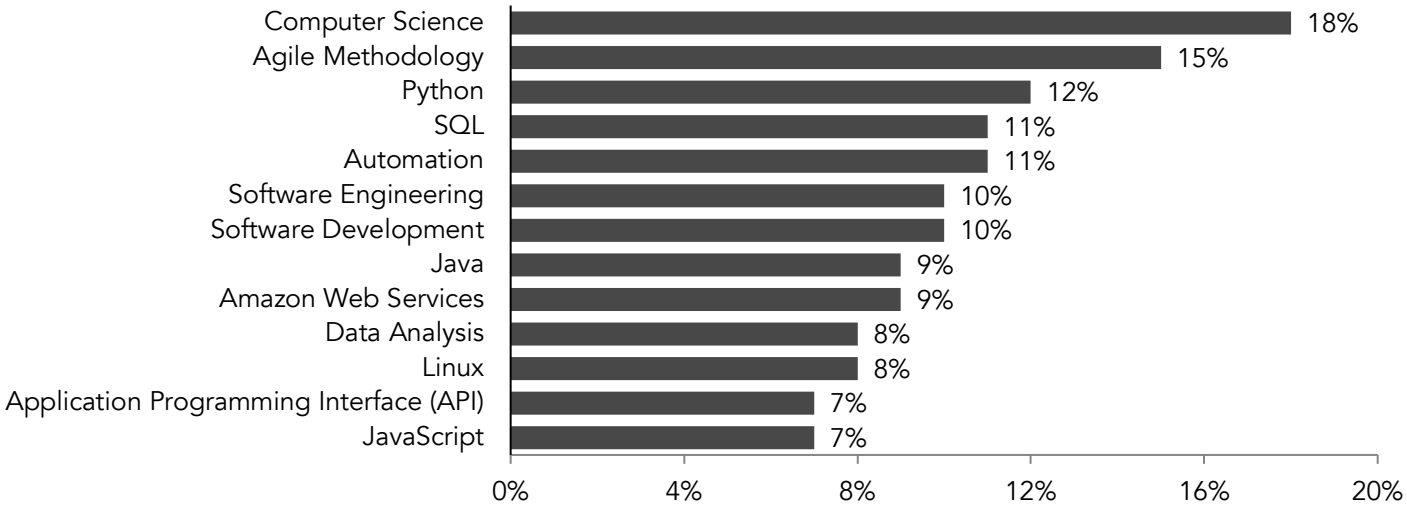


Source: EL estimates based on Lightcast 2022.4

In 2021, 35 postsecondary institutions offered almost 5,100 degrees or certificates in computer science. Almost half, 46 percent, of these completions are bachelor's degrees. Another 18 percent are certificates that can be earned in two years or less. About 71 percent of the computer science completions were offered as distance learning programs. Distance learning programs for computer science are up 200 percent in the state in the last decade. The increase in computer science and other STEM education is encouraging as it shows the skilled workforce is growing. However, the tech industry in Colorado averaged over 13,400 hires per month in 2021. This has left many of the Colorado-based companies to recruit workers from outside the state according to interviews with tech leaders.

While computer science education is still listed as a preference in many of Colorado's tech job postings, specific software skills are also important. Short-term training that focuses on specific programming languages like SQL, Python, and Java could be helpful in filling talent gaps more quickly than 4-year computer science degrees.

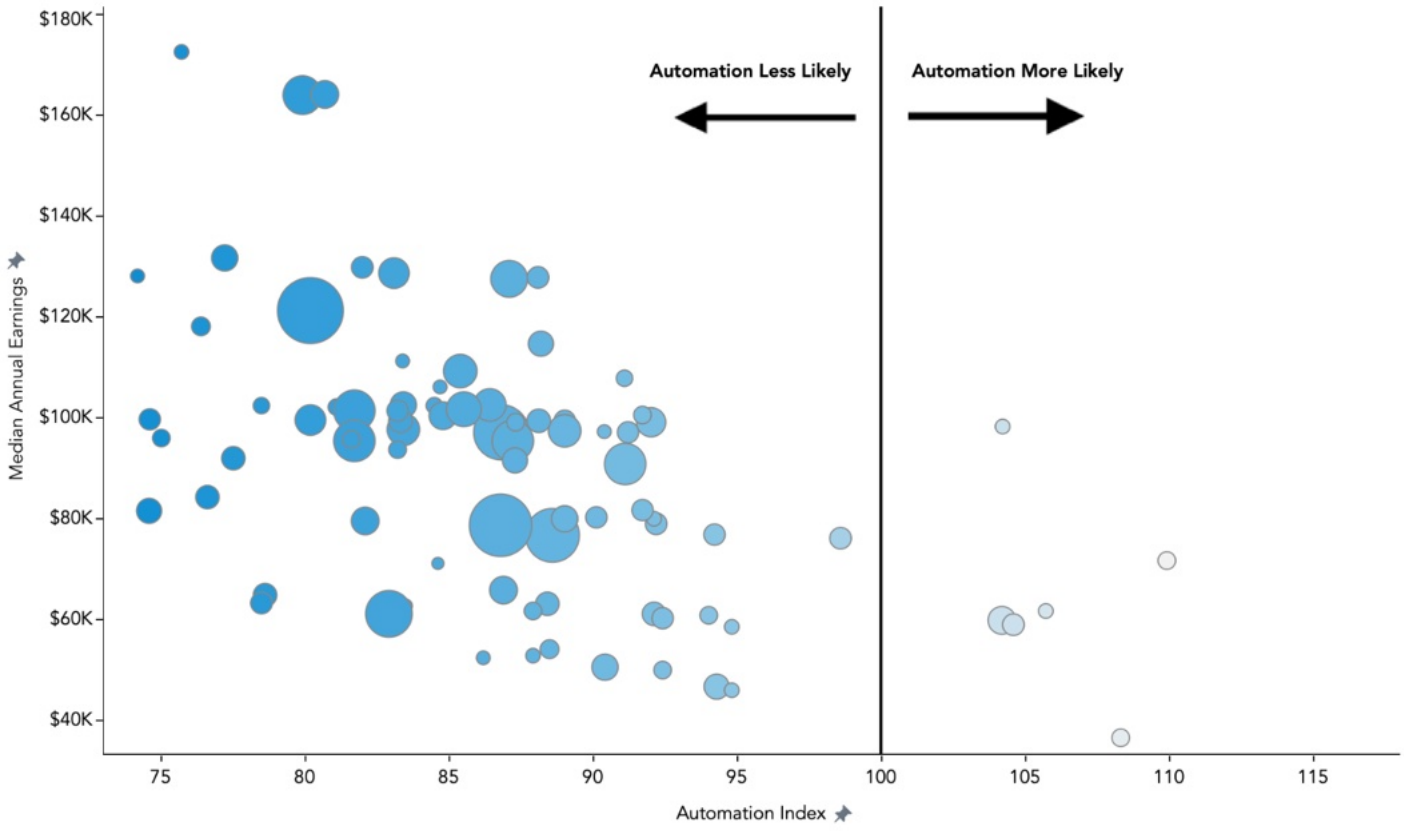
Top Skills Listed in Job Postings for Colorado's Tech Occupations, Jan 2021 – Nov 2022



Source: EL estimates based on Lightcast 2022.4

Expanding the pathways to tech jobs is so imperative because these jobs offer high wages and have lower risk of being automated in the future.

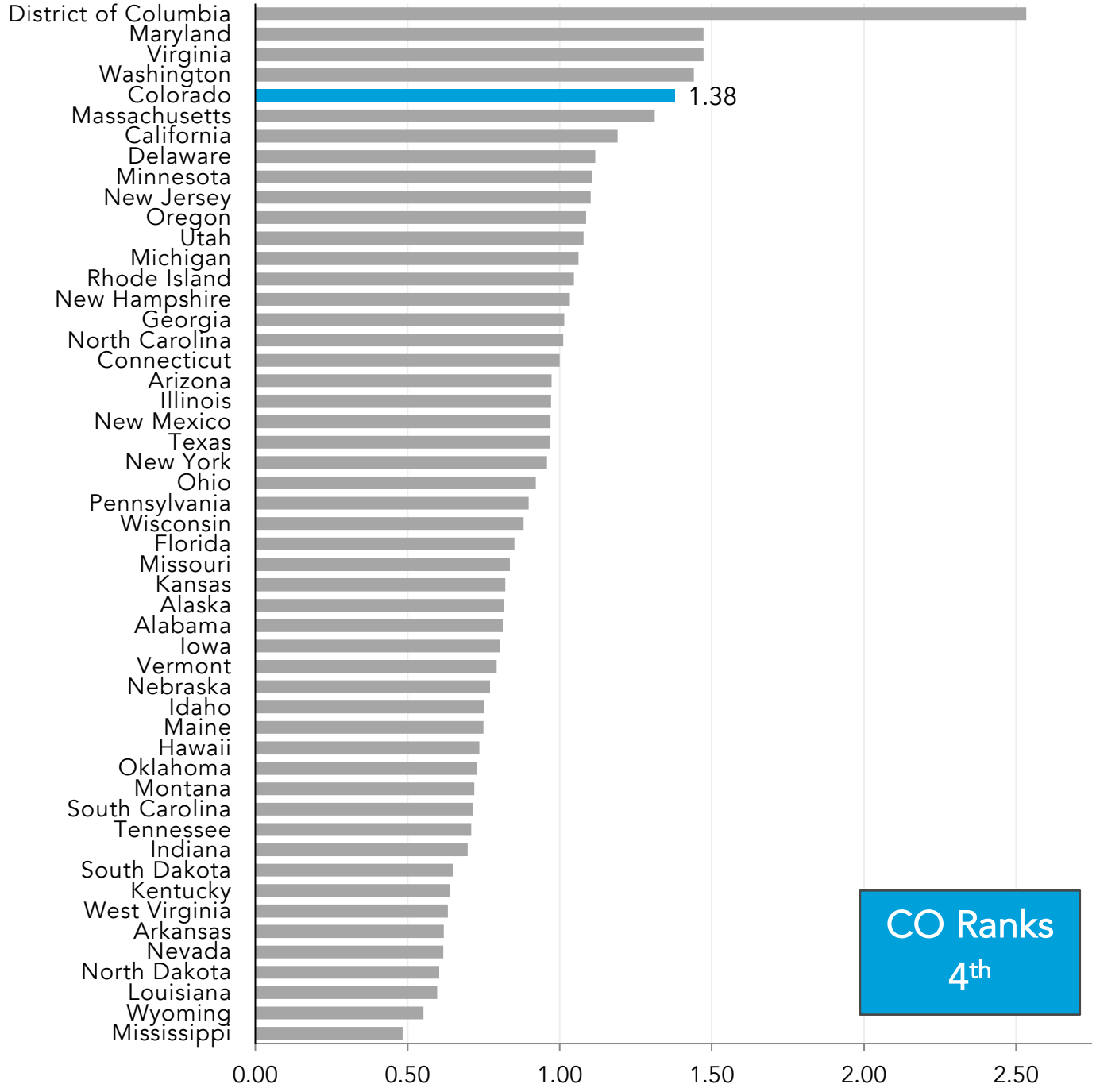
Colorado Tech Occupations by Automation Index and Median Wage, 2021



Source: EL estimates based on Lightcast 2022.4

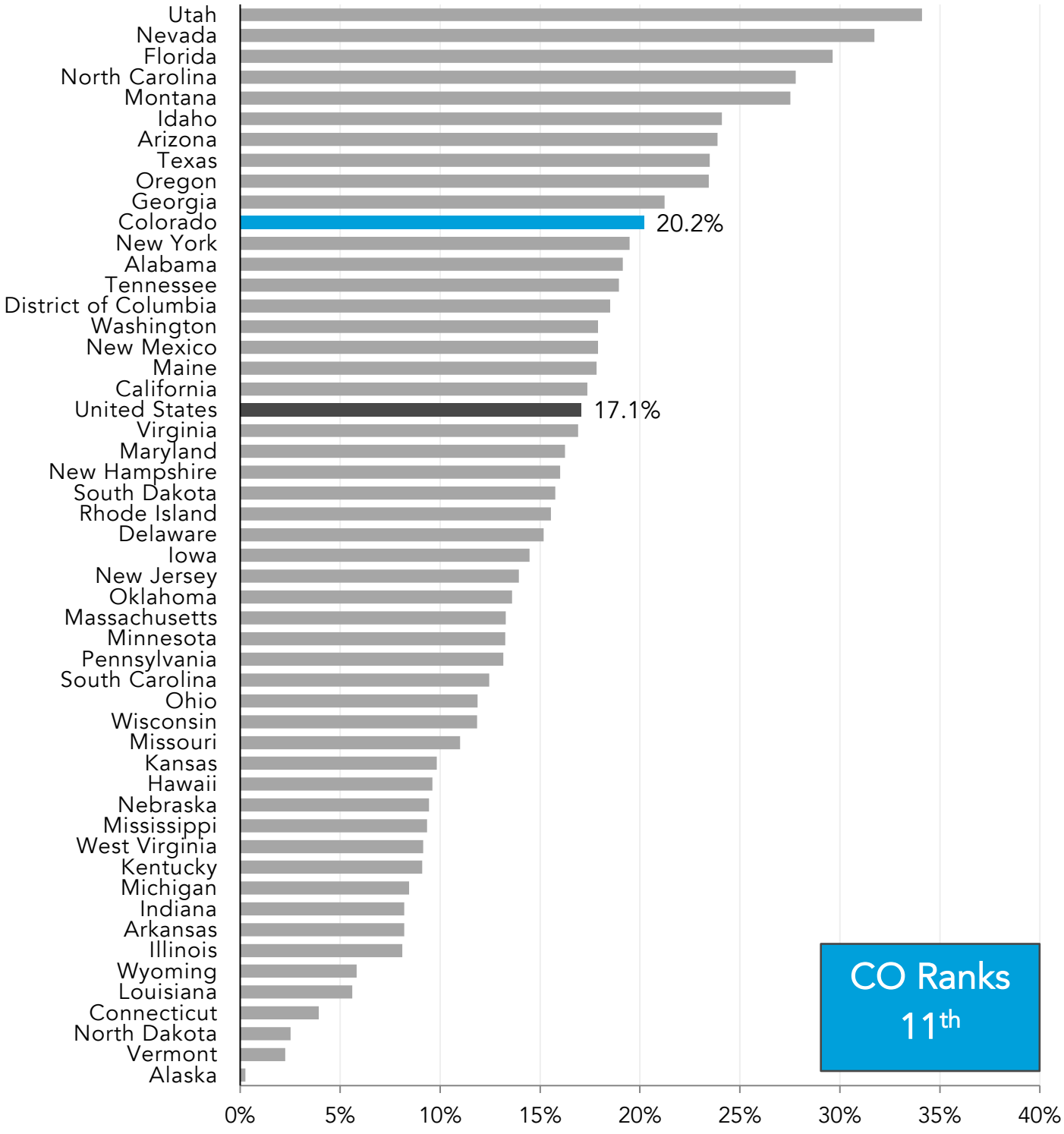
When the performance of tech occupations in Colorado are compared against the rest of the nation, again, the state ranks among the best. Tech jobs are uniquely concentrated in Colorado's economy, experienced strong growth, and are predicted to grow at the 3rd highest rate for the next five years. Despite the higher cost of living reducing tech workers' purchasing power, median earnings for tech occupations in Colorado are still in the top 15 states in the nation.

Tech Occupations Location Quotient (2021)



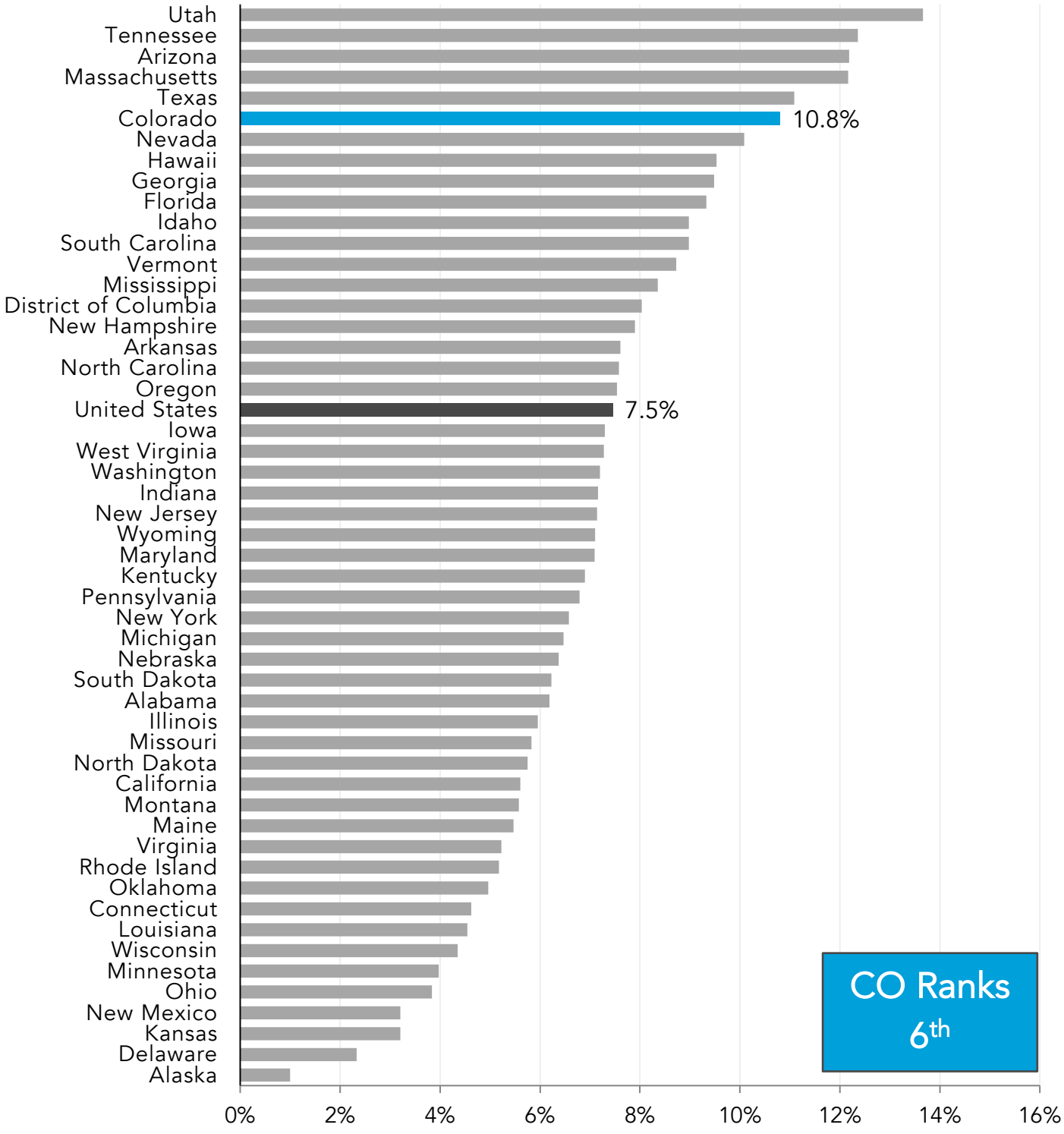
Source: EL estimates based on Lightcast 2022.4

Tech Occupations Growth (2016-2021)



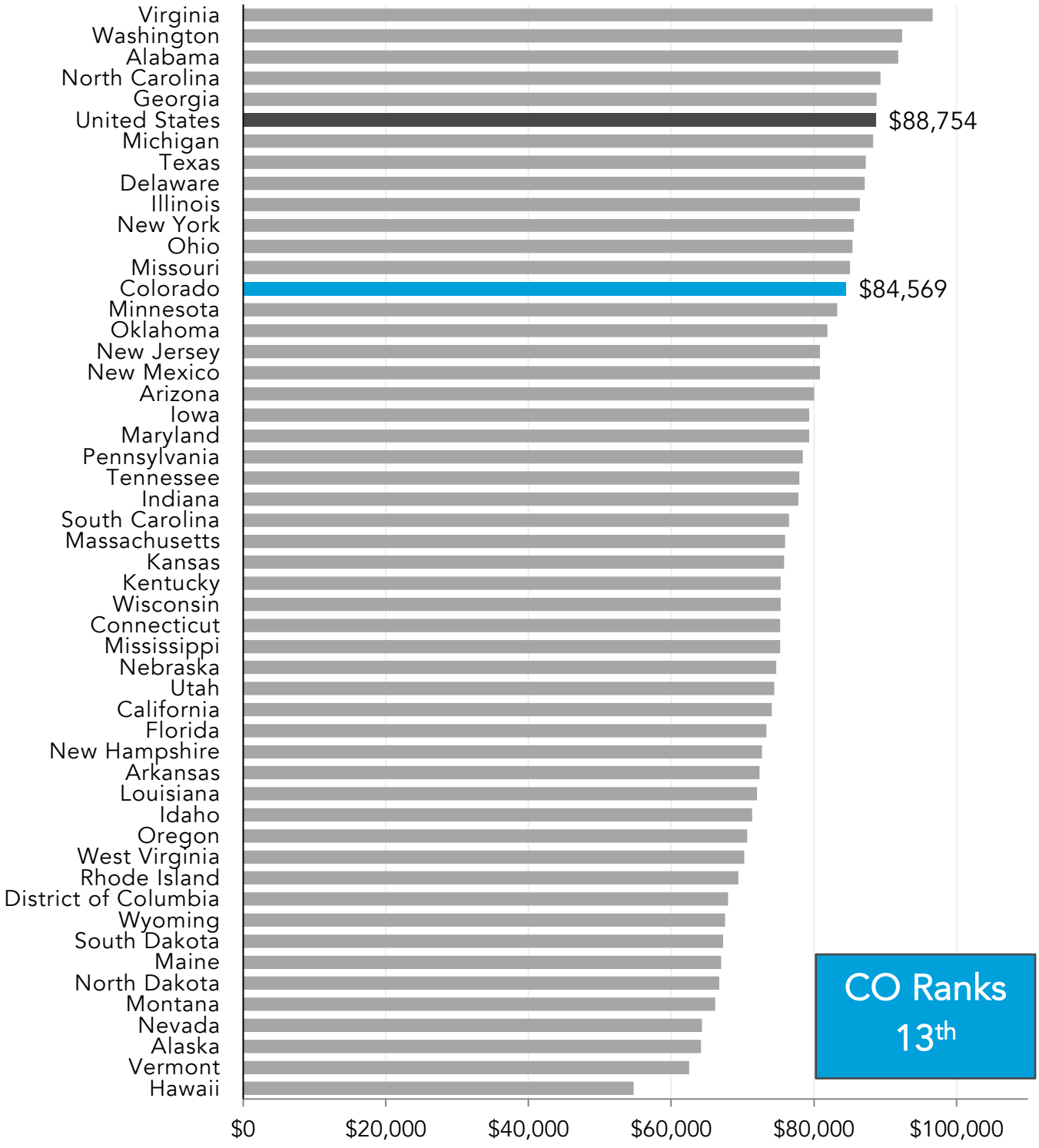
Source: EL estimates based on Lightcast 2022.4

Expected Tech Occupations Growth (2022-2027)



Source: EL estimates based on Lightcast 2022.4

Median Annual Earnings Adjusted for Purchasing Power (2021)



Source: EL estimates based on Lightcast 2022.4

Tech Occupation State Comparisons

Tech Occupations		
Metric	Value	Rank
Tech Occupations Location Quotient (2021)	1.38	4
Tech Occupations Growth (2016-2021)	20.2%	11
Expected Tech Occupations Growth (2022-2027)	10.8%	6
Median Annual Earnings Adjusted for Purchasing Power (2021)	$84,569	13

SECTION 5. STATE COMPARISON OF TECHNOLOGY INFRASTRUCTURE

Similar to other parts of the economy, the technology sector requires a solid infrastructure to flourish. Logistics firms must have good highways to conduct their business, agriculture needs good ports for export, and many manufacturers need modern water systems. A strong technology infrastructure is often referred to as a "knowledge-based economy". The World Bank defines strong knowledge-based economies on four pillars:

- Entrepreneurship incentives,
- Skilled and educated labor force,
- Physical infrastructure access for technology and communications, and
- Innovation ecosystem that fosters collaboration between academia, private sector, and government.

Using this framework, we evaluated the technology infrastructure of Colorado by comparing factors such as research, funding access, patents, STEM education, and university technology transfer. This section compares indicators that reflect a state's technology infrastructure and assesses Colorado's position amongst other states.

R&D Funding Rank by Source, 2019

Funding Source	CO Ranking
Federal	6th
State	24th
Business	21st
Academic	19th
TOTAL R&D	**16th**

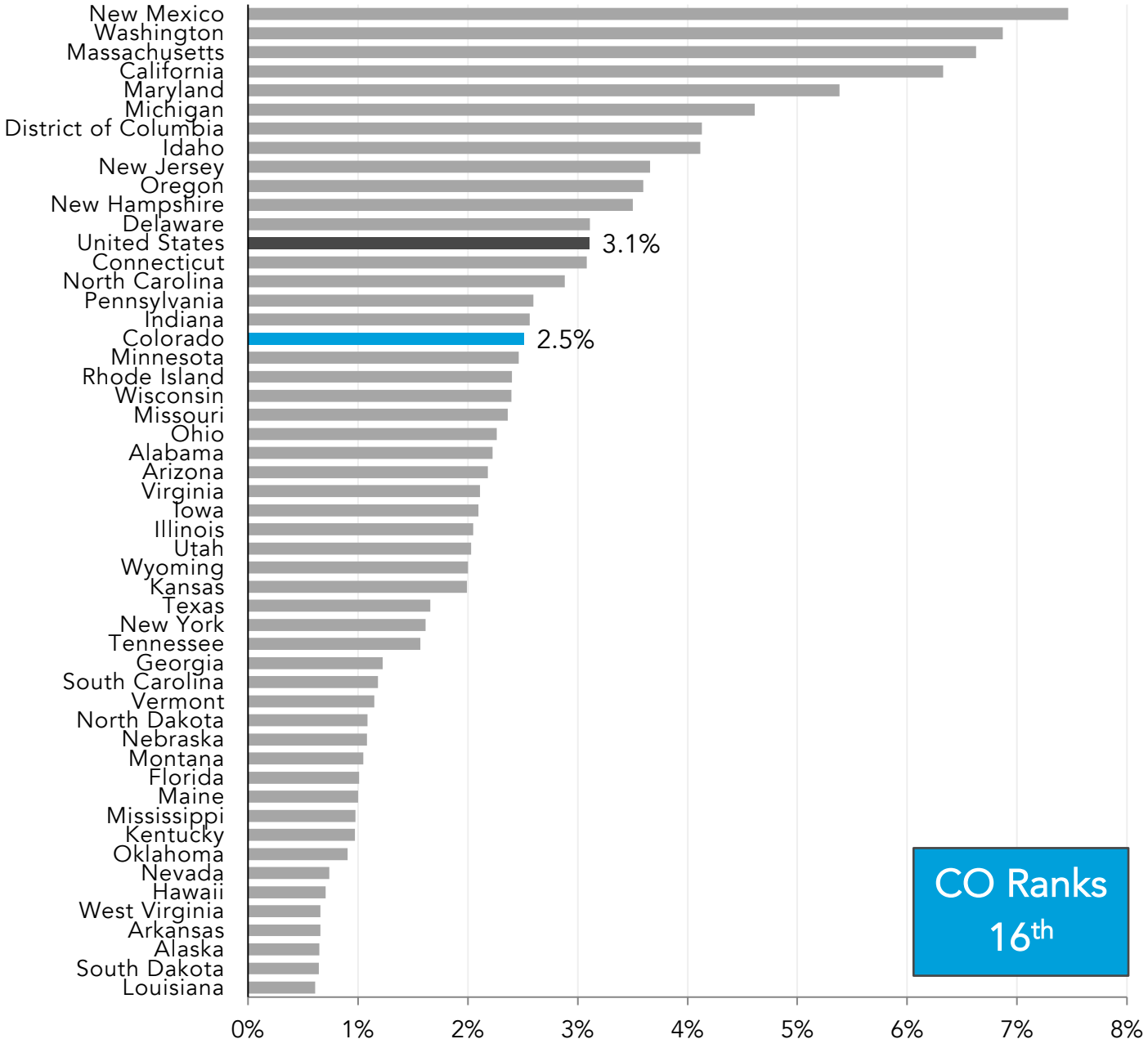
Source: National Science Foundation (2022)

Research & Development (R&D) funding is a major component of a technology sector's infrastructure. R&D funding helps companies and universities develop new technologies that can be commercialized and spur tech growth. Looking at the total R&D obligations, including federal, state, and private funding sources, across all states and found that Colorado ranks 16th in the nation when standardized by gross state product (GSP).

As the chart shows, significant amounts of federal research and development is concentrated in the states with large federal facilities. New Mexico understandably ranks first in this list with its high levels of funding to federal labs, including the Los

Alamos National and Sandia National Laboratories, relative to the state's gross product. Colorado benefits from its concentration of 33 federal laboratories in the state, including the National Oceanic and Atmospheric Administration (NOAA) lab and the National Renewable Energy Laboratory (NREL). In fact, the state ranks 6th in the nation in federal funding per worker. The federally funded research labs in the state were found to contribute about $2.6 billion to the economy and supported over 17,600 jobs in 2016, according to research from UC-Boulder. The other sources of R&D funding, however, rank lower in the state, resulting in the middle-of-the-pack ranking overall.

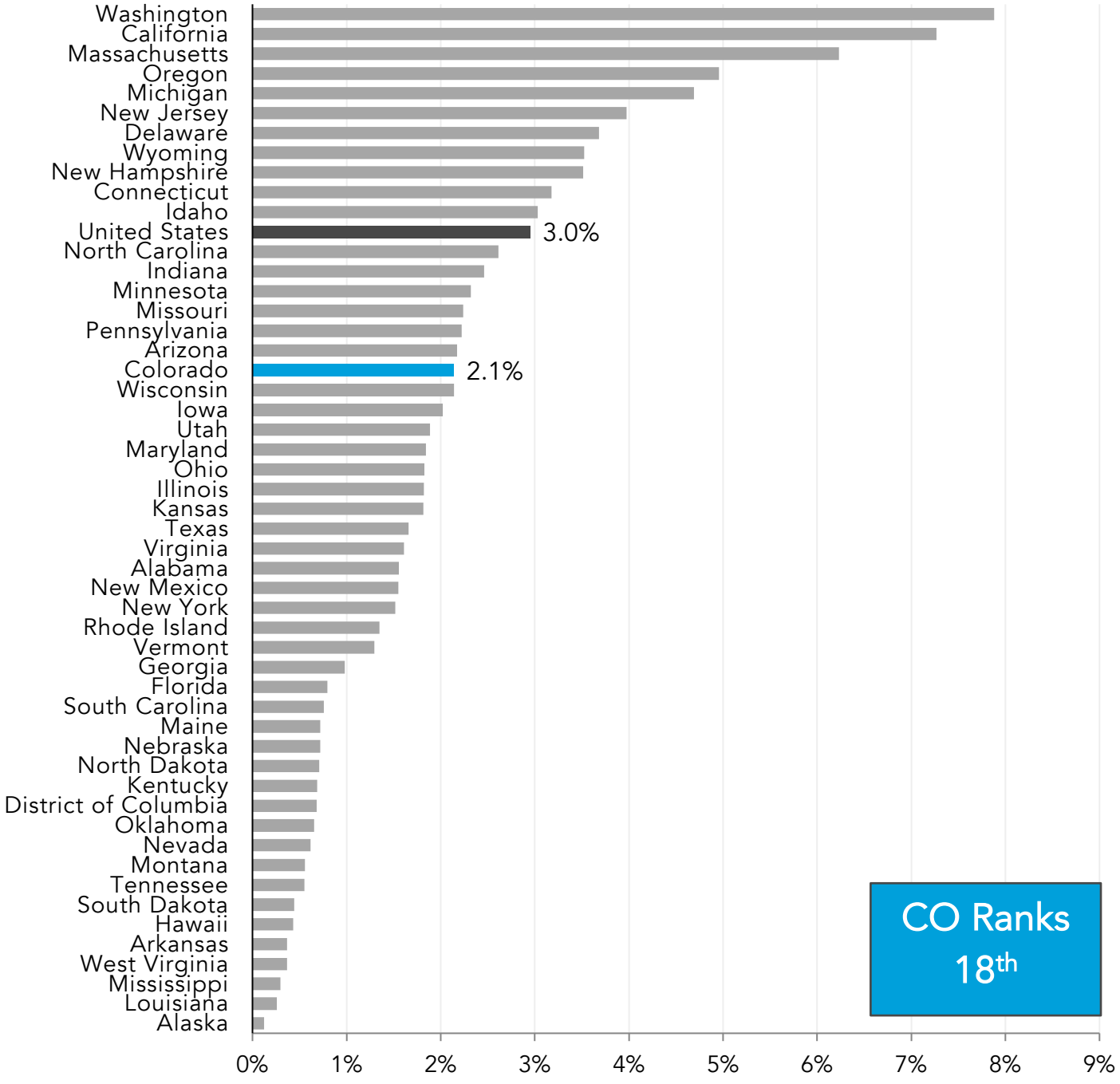
Total R&D as a Percentage of GSP, 2019



Source: National Science Foundation (2022)

Another indicator of a technology development atmosphere is the number of private R&D spending as a percentage of the state's private output. This demonstrates R&D driven by companies themselves for profit driven innovation which is even more likely to spur commercialization. Business performed R&D funding made up for 2.1 percent of Colorado's private sector GSP in 2020, ranking it 18th in the nation. The Pacific states of California, Washington, and Oregon all top this list.

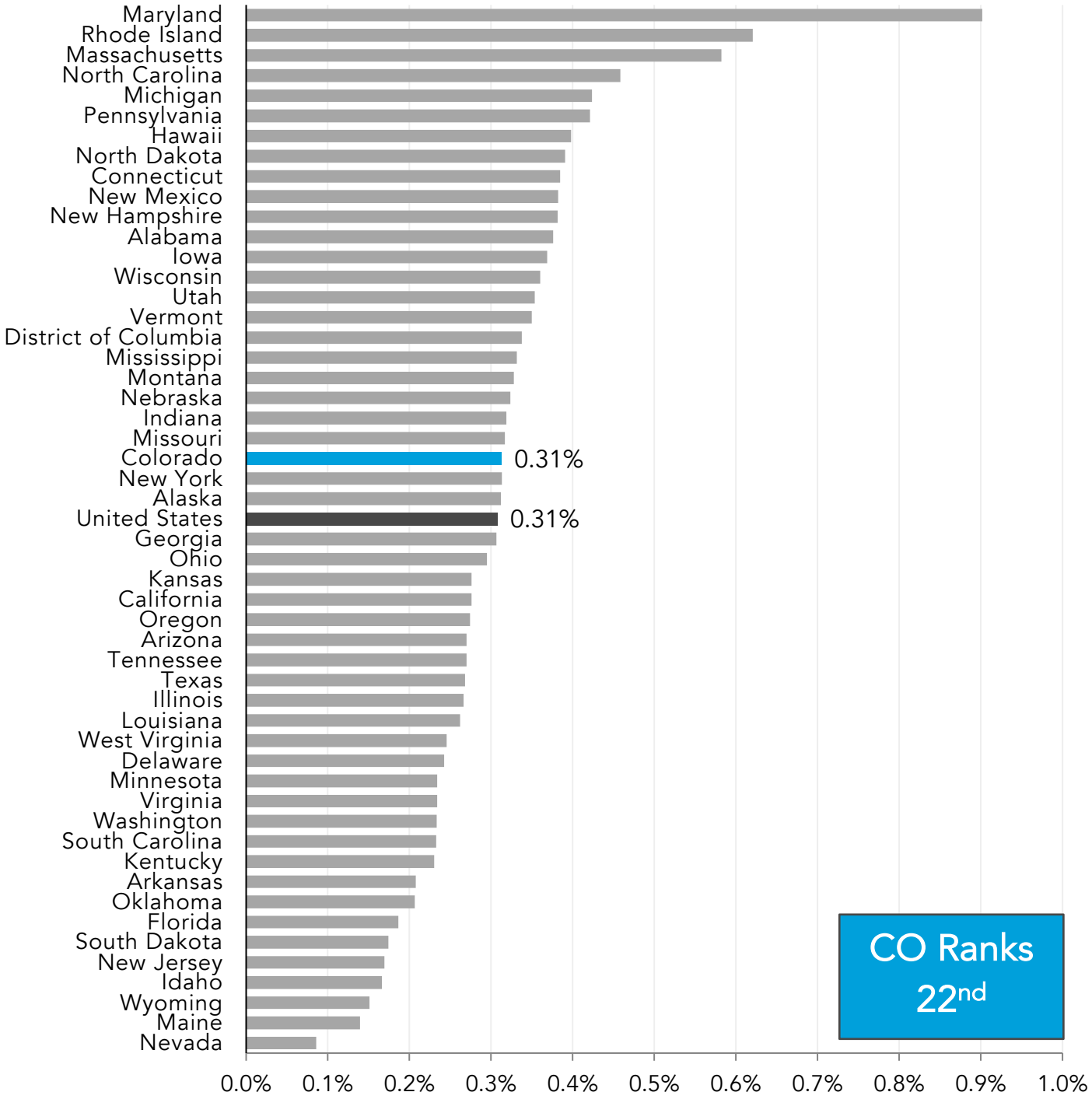
Business Performed R&D as a Percentage of Private Industry Output, 2020



Source: National Science Foundation (2022)

The fourth source of R&D funding is academic. Here, science & engineering funding in higher education is evaluated specifically. The technology that comes from this research can be spun off to create new companies. Colorado ranked 22nd amongst the states and scored above the national average.

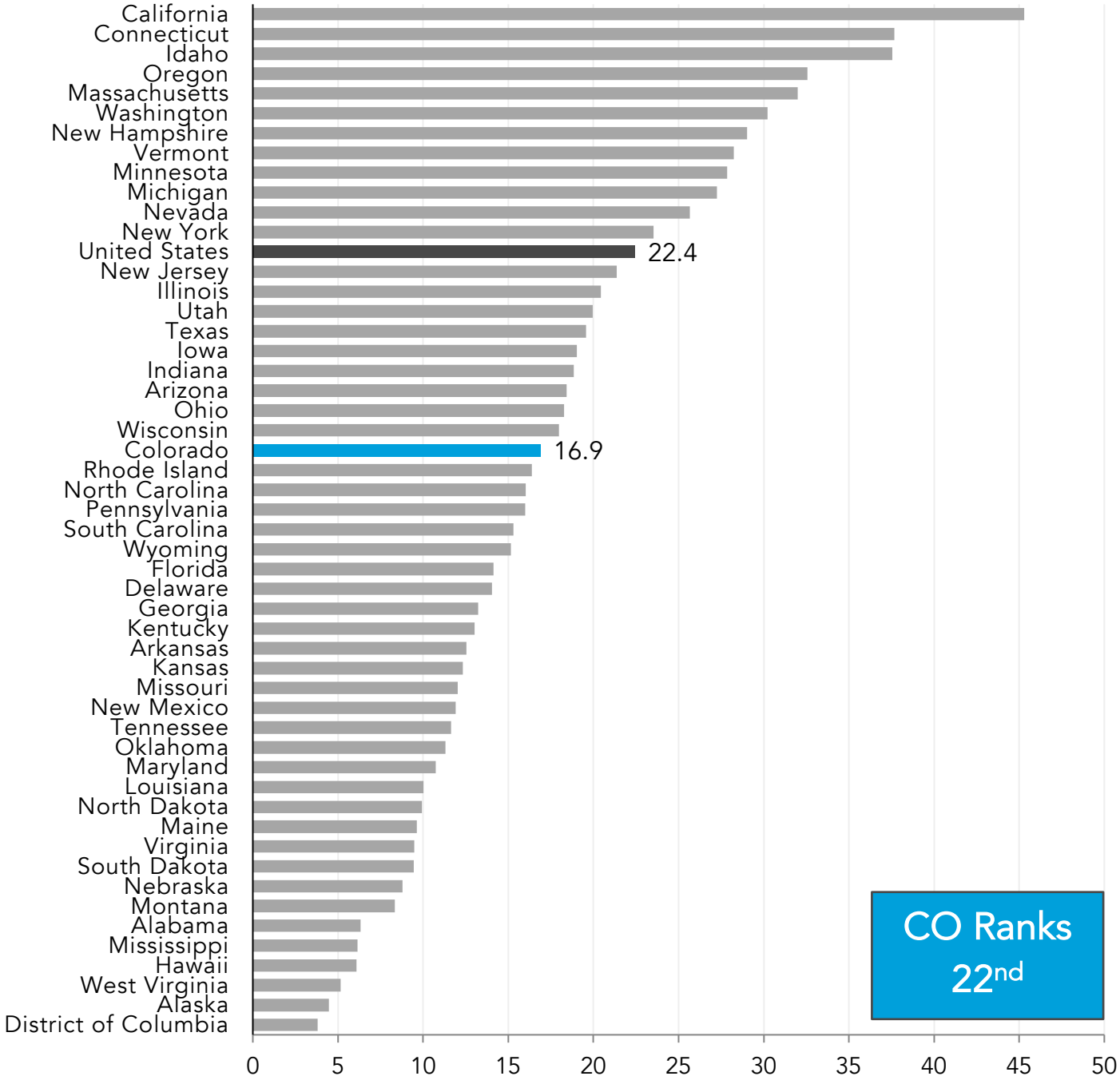
Higher Education R&D in Science & Engineering as a Percentage of GSP, 2020



Source: National Science Foundation (2021)

Patents awarded can also indicate the level of innovation occurring in a place. Patents usually spur economic growth, particularly in high-cost industries like pharmaceuticals. For this metric, patents are standardized by the number of science and engineering workers. In 2020, Colorado averaged about 16.9 patents per 1,000 science and engineering workers. This ranks the state 22nd in the nation.

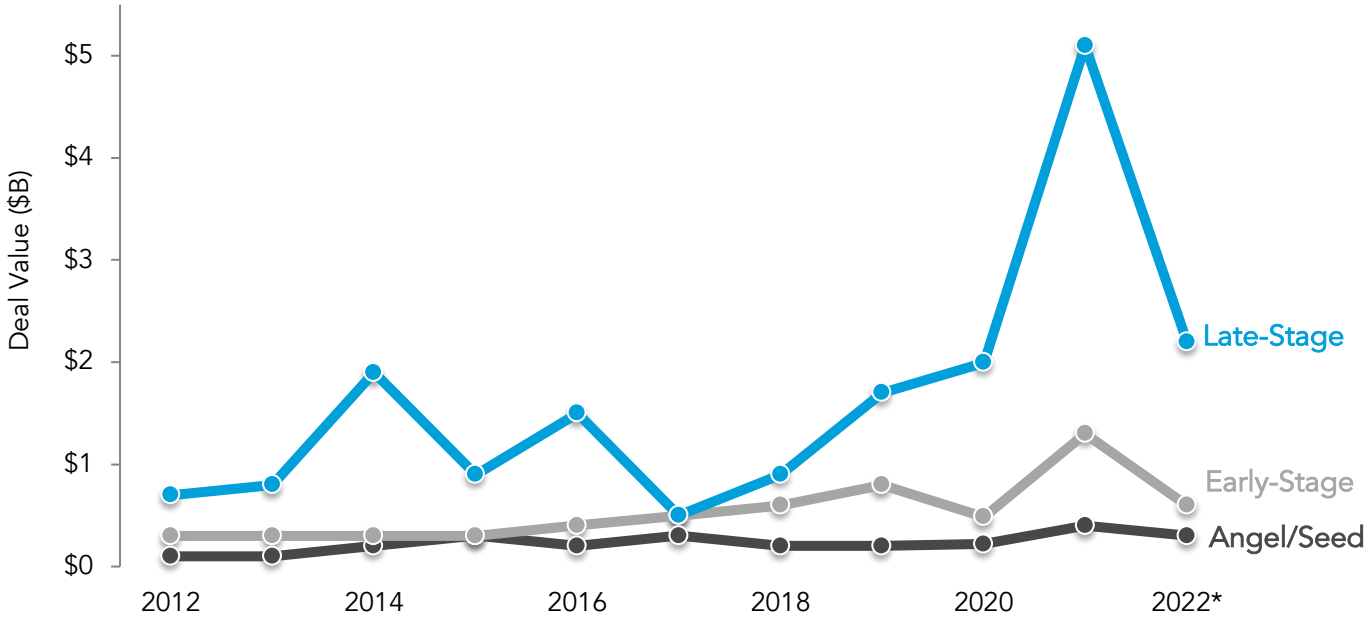
Patents Issued per 1,000 Science & Engineering Workers, 2020



Source: National Science Foundation (2022)

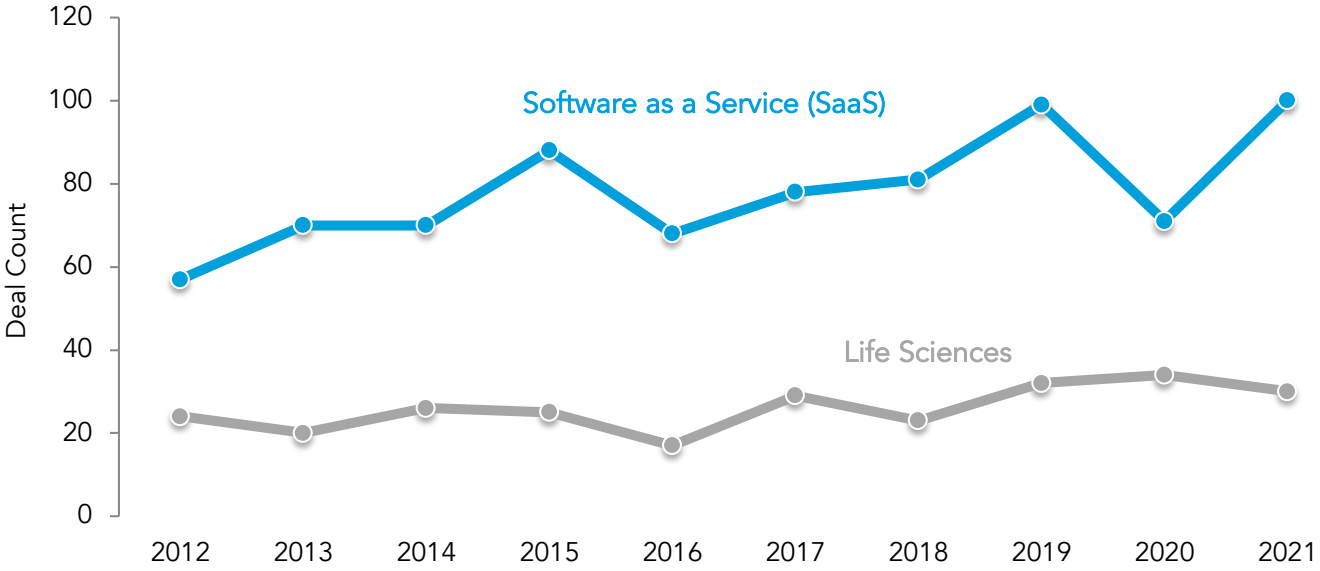
Venture capital is often an essential tool for start-up companies to grow into a large mainstream tech leader and to get to market quickly. Traditional tech economies like California, Massachusetts, and Washington are still accumulating much of the nation's venture capital. Venture capital invested in Colorado is on the rise. Software as a service (SaaS) funding has led the way in the state. Angel/seed funding has only seen small increases over the last decade according to data from Colorado-based Innosphere Ventures.

Venture Capital Invested in Colorado by Stage, 2012-2022



Source: Innosphere Ventures (2022)
Note: 2022 values are as of June 30, 2022

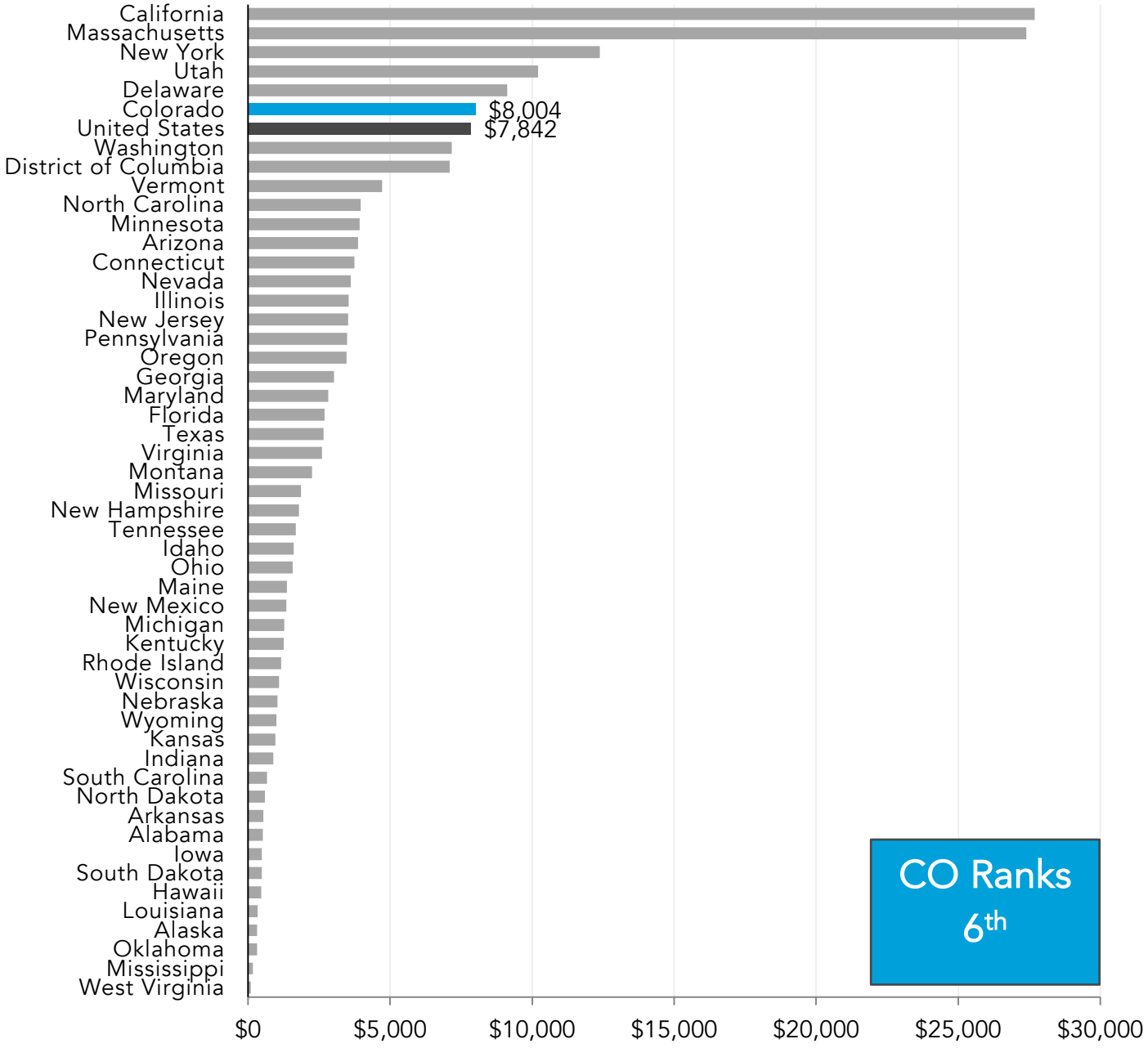
Venture Capital Deals in Colorado by Key Verticals, 2012-2021



Source: Innosphere Ventures (2022)

When compared with other states, Colorado ranked 6th in terms of venture capital when standardized by the size of the state economy. A small handful of states are winning in securing access to capital and Colorado is clearly one of those top states. One trend highlighted by a tech leaders was that the majority of Colorado's funding was coming from out of state rather than from local investors. In 2021, about 79 percent of lead VC capital was funded solely from out-of-state. In comparison, neighboring Utah's level was only 58 percent. Increasing local investor sources can help keep innovative startups in the state rather than relocating to near their investors.

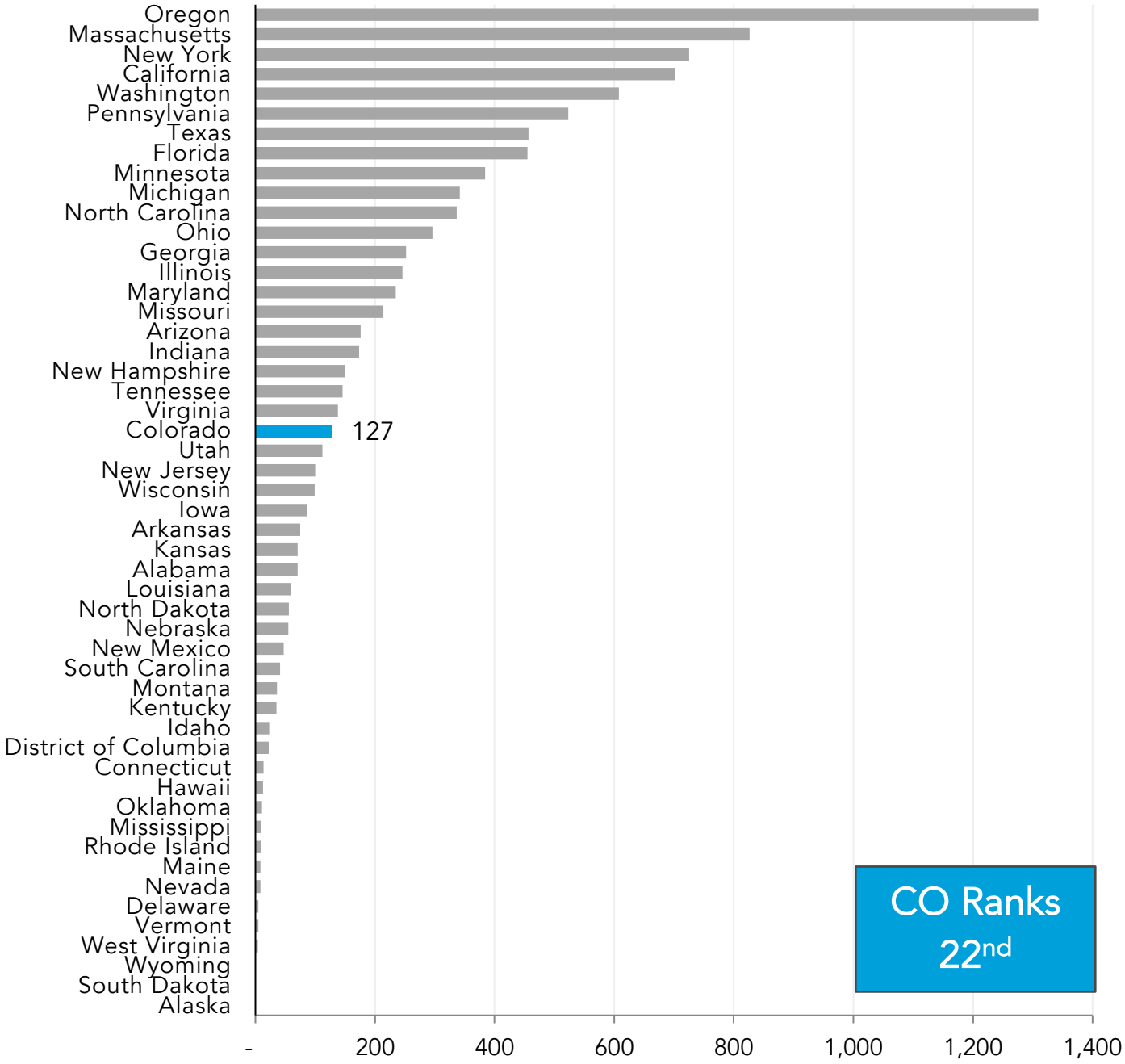
Venture Capital Invested Per $1 Million of GSP, 2016-2021



Source: National Venture Capital Association (2022) and BEA (2022)

Successful new developments from research occurring at universities can be commercialized and help spur new private sector growth in an area. The ability of a state to capitalize on its research capabilities and turn them into marketable concepts means more tech start-ups and jobs. This level of tech transfer can be measured by the number of options and licenses of university IP that is spun off to the private sector. In 2020, 127 licenses and options of university-developed technology were executed in the state. Colorado ranks 22nd in this tech transfer metric.

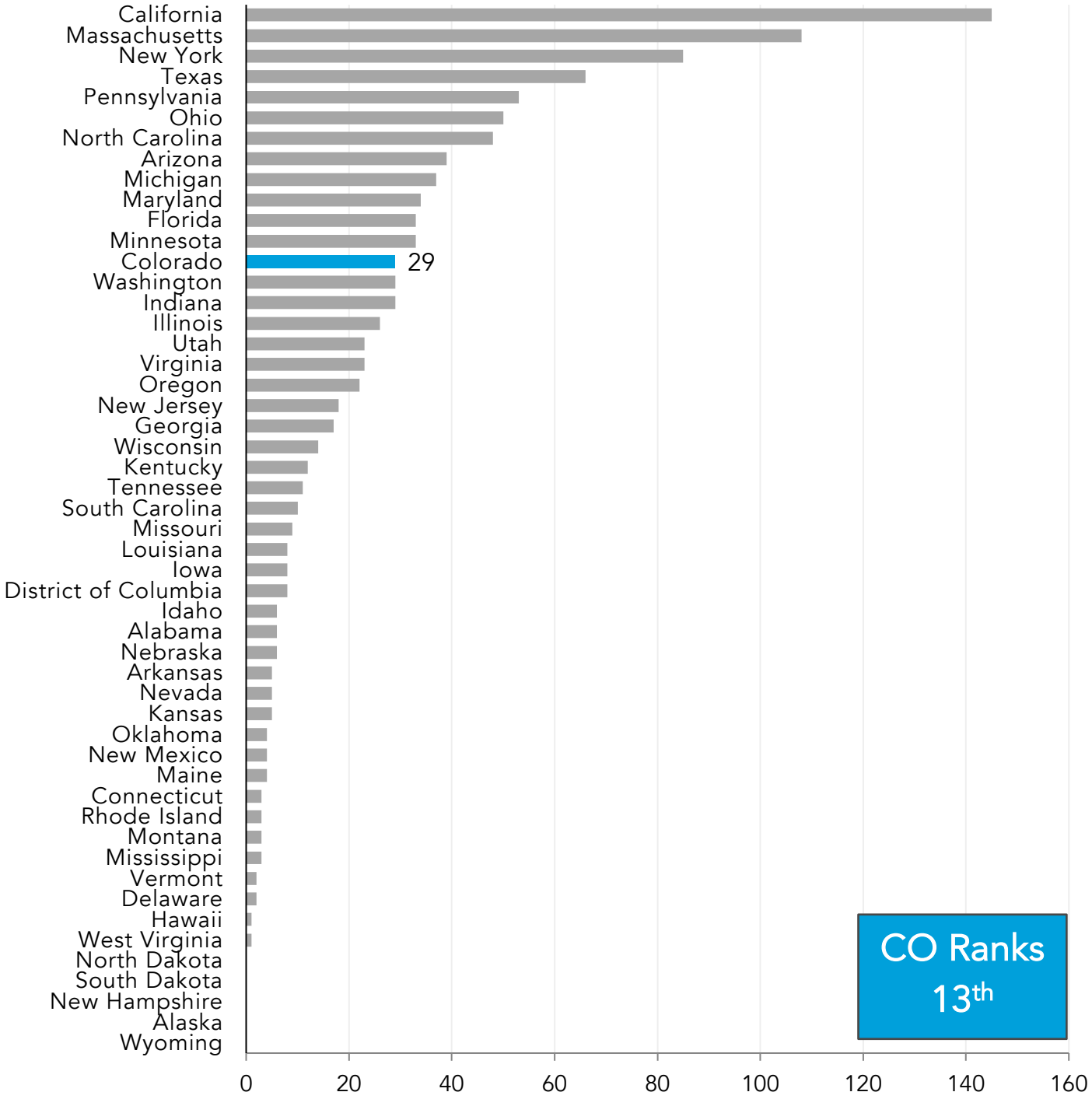
Technology Licenses and Options Executed from Universities, 2020



Source: Association of University Technology Managers [AUTM] (2021)

Another measure of technology transfer, the number of start-ups from universities, can indicate the level of entrepreneurship interest within a state's universities as well as its ability to convert research assets and public funding into economic opportunities. Colorado universities produced 29 startups in 2020, the 13th highest amount in the country.

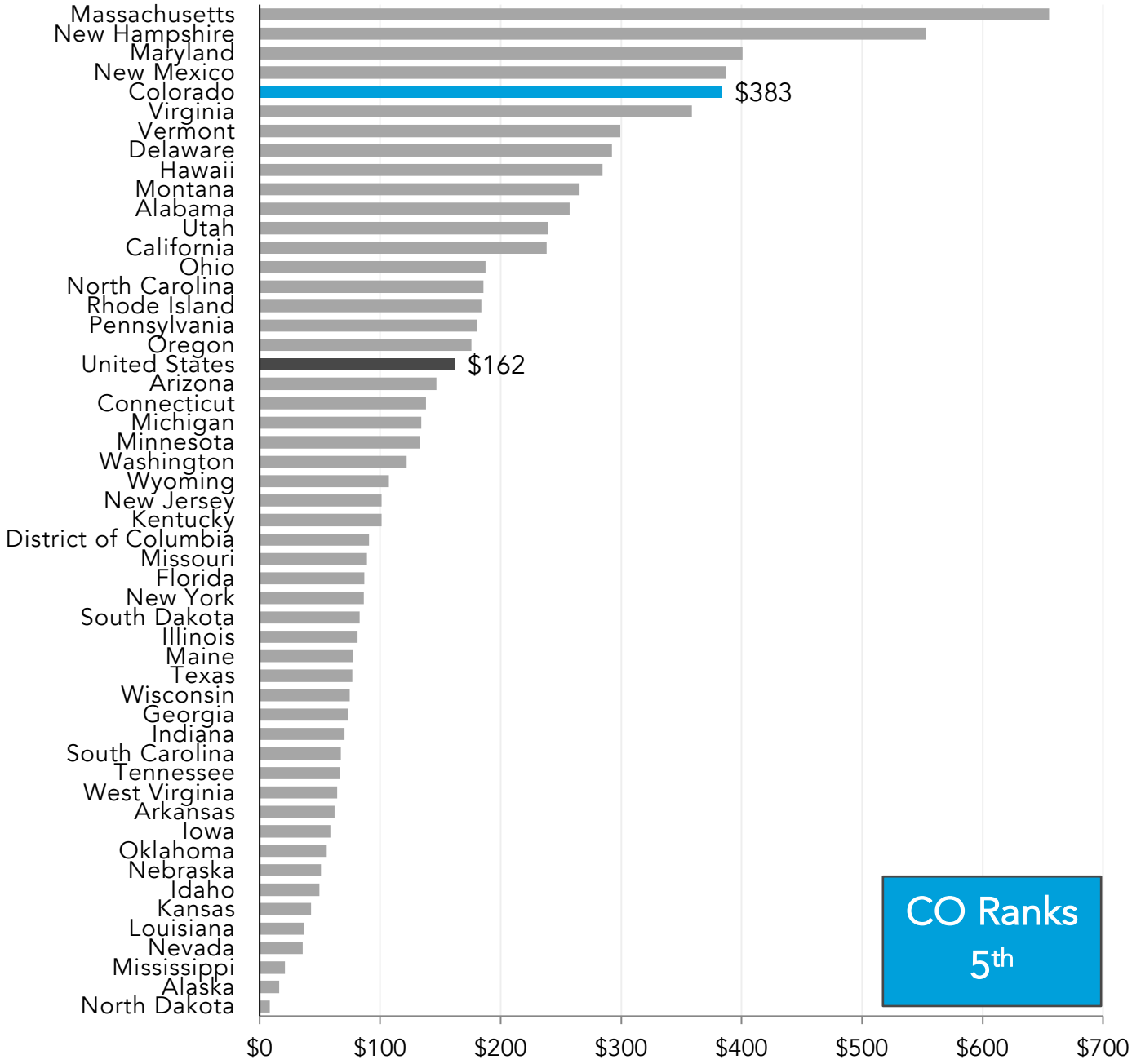
Start-Ups from Universities, 2020



Source: AUTM (2021)

One option for new companies seeking funding for high-tech R&D is the federal government's Small Business Innovation Research (SBIR) and the Small Business Technology Transfer (STTR) funding programs. These programs support and encourage American innovation by investing in small businesses during their concept and prototype development phases with the goal of reaching commercialization. SBIR/STTR funding can be critical early-stage funding for high-reward concepts. From 2016-2021, when the level of SBIR/STTR funding is standardized by the size of the state economy, Colorado has the 5th highest rate of funding.

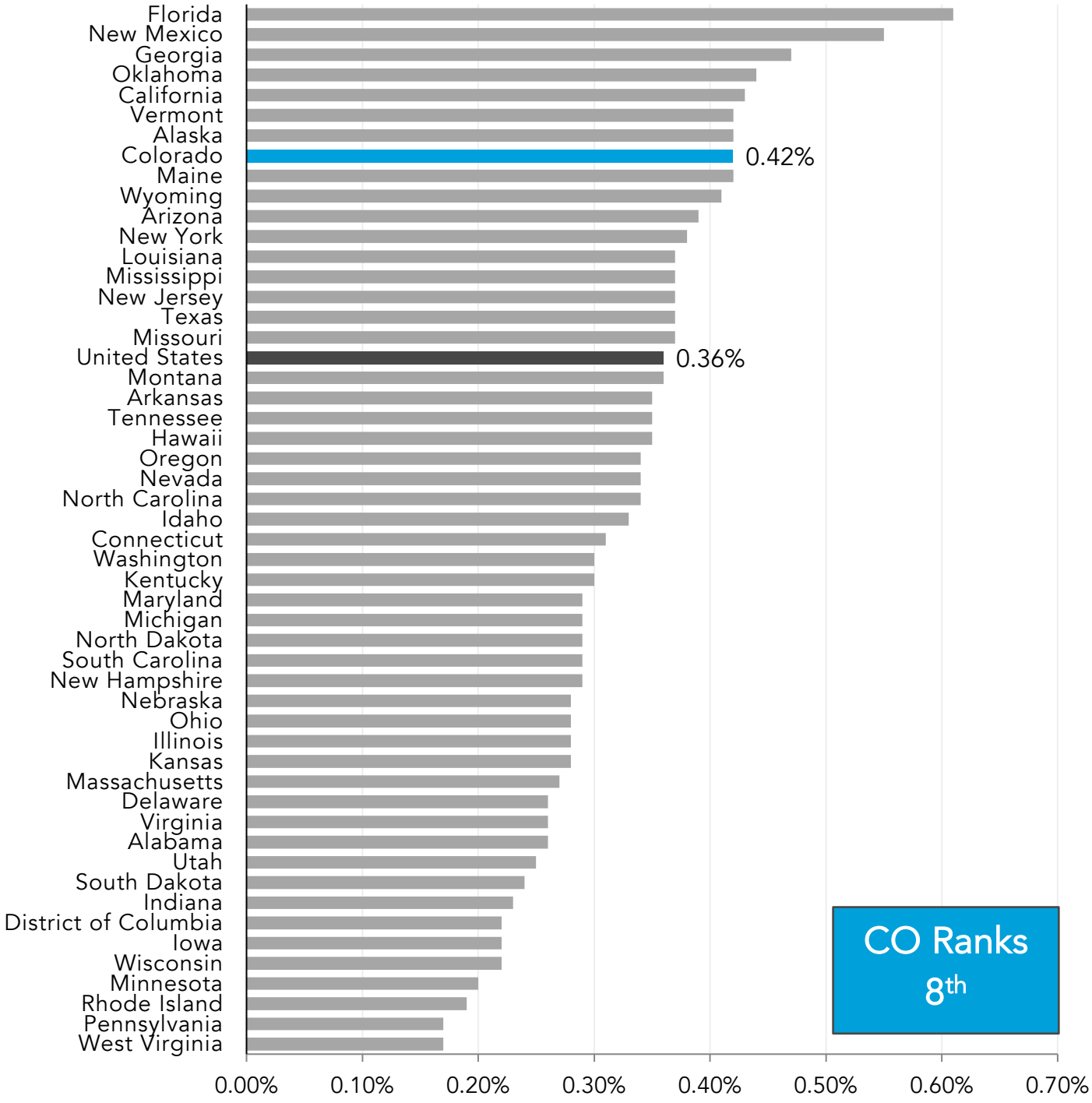
SBIR and STTR Funding Per $1 Million of GSP, 2016-2021



Source: EL estimates based on Small Business Innovation Research [SBIR] (2022) and BEA (2022).

Entrepreneurs are the lifeblood of a knowledge-based economy. Each year the economy is replenished and reenergized by entrepreneurial activity. Business that originates in one location often look to grow and establish their roots in that same region. In 2021, the Kauffman Foundation found that Colorado had the 8th highest rates in the nation.

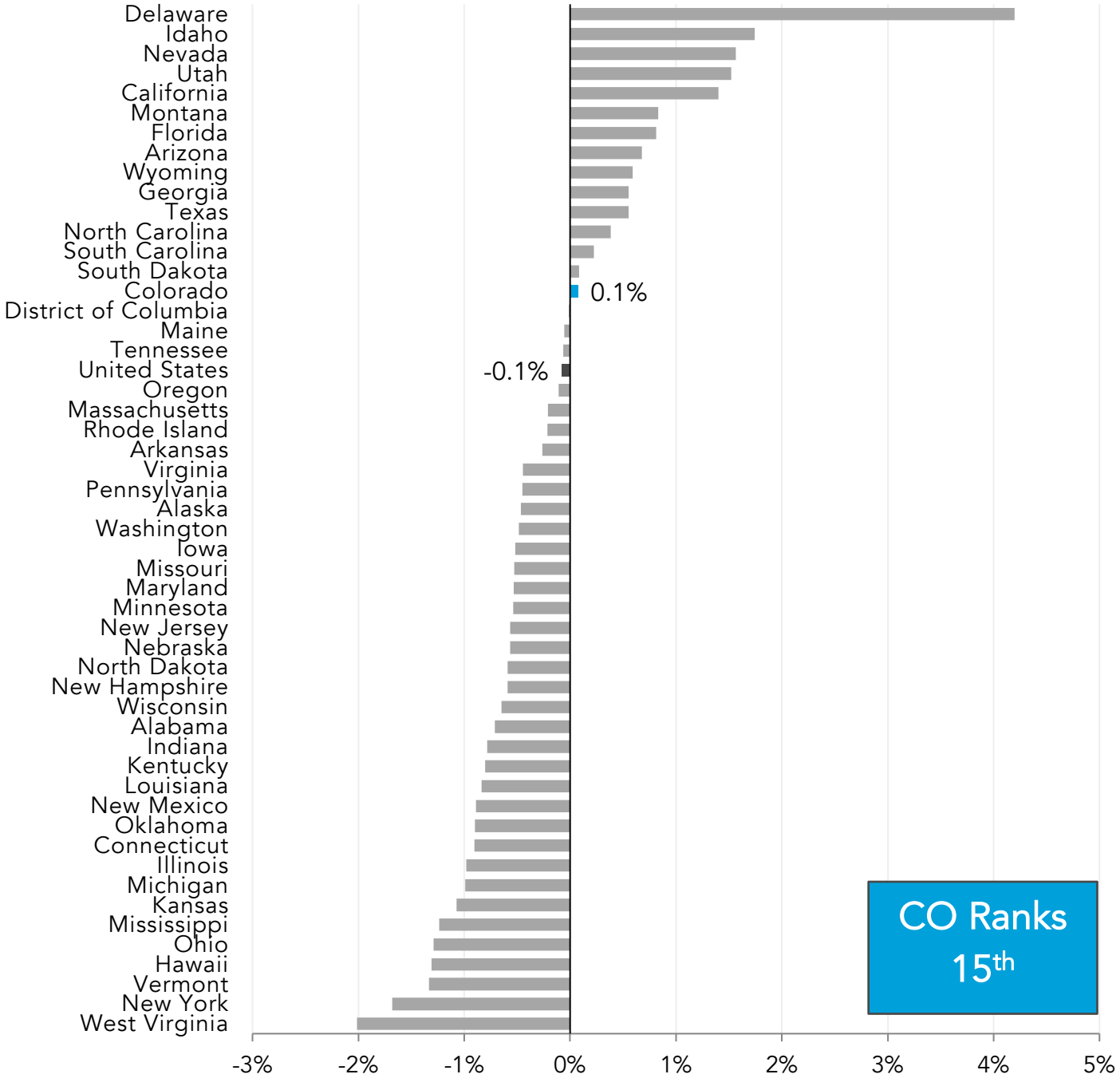
Rate of New Entrepreneurs, 2021



Source: Kauffman Foundation (2022)

The US Census Bureau tracks the number of companies entering and those who exit the market. Comparing the rates of entrance and exit can provide a measure of business dynamism. High dynamism fosters more competition, economic equality increases, and innovation. In Colorado, the rate was just positive in 2020, which is one of the top 15th states and impressive considering the pressure on businesses that year.

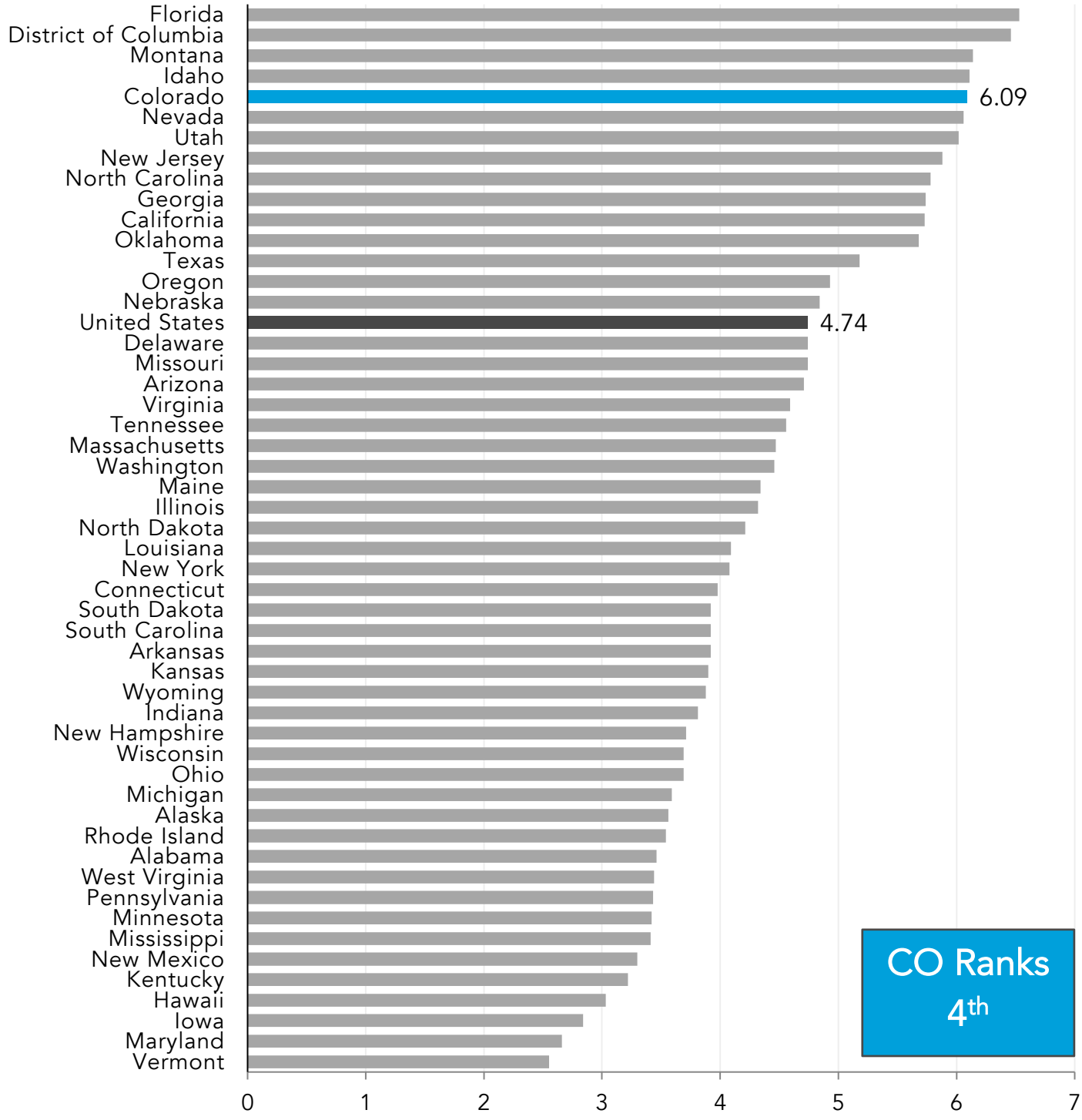
Business Opening vs Closing Rate, 2020



Source: US Census Bureau (2022)

Another metric for the churn of new jobs is the start-up job creation rate. This is the average number of jobs created by a start-up in their first year. Colorado had the 4th highest rate, with each startup averaging six employees in their first year.

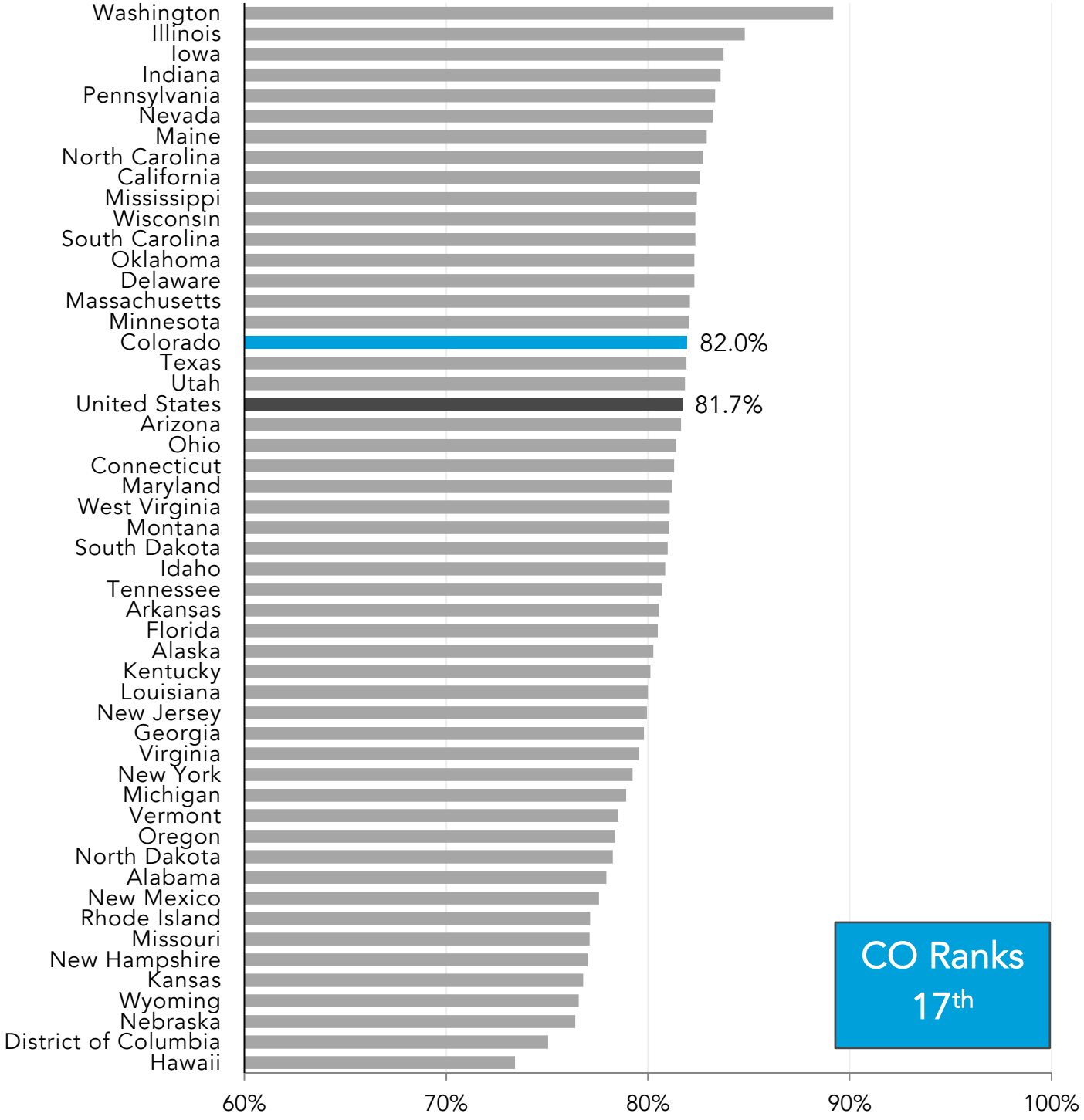
Start-Up Early Job Creation Rate, 2021



Source: Kauffman Foundation (2022)

The final entrepreneurial indicator looked at the one-year survival rate of start-ups. In 2021, 82 percent of startups made it through their first year in Colorado. This rate is higher than the national average and the state ranks 17th.

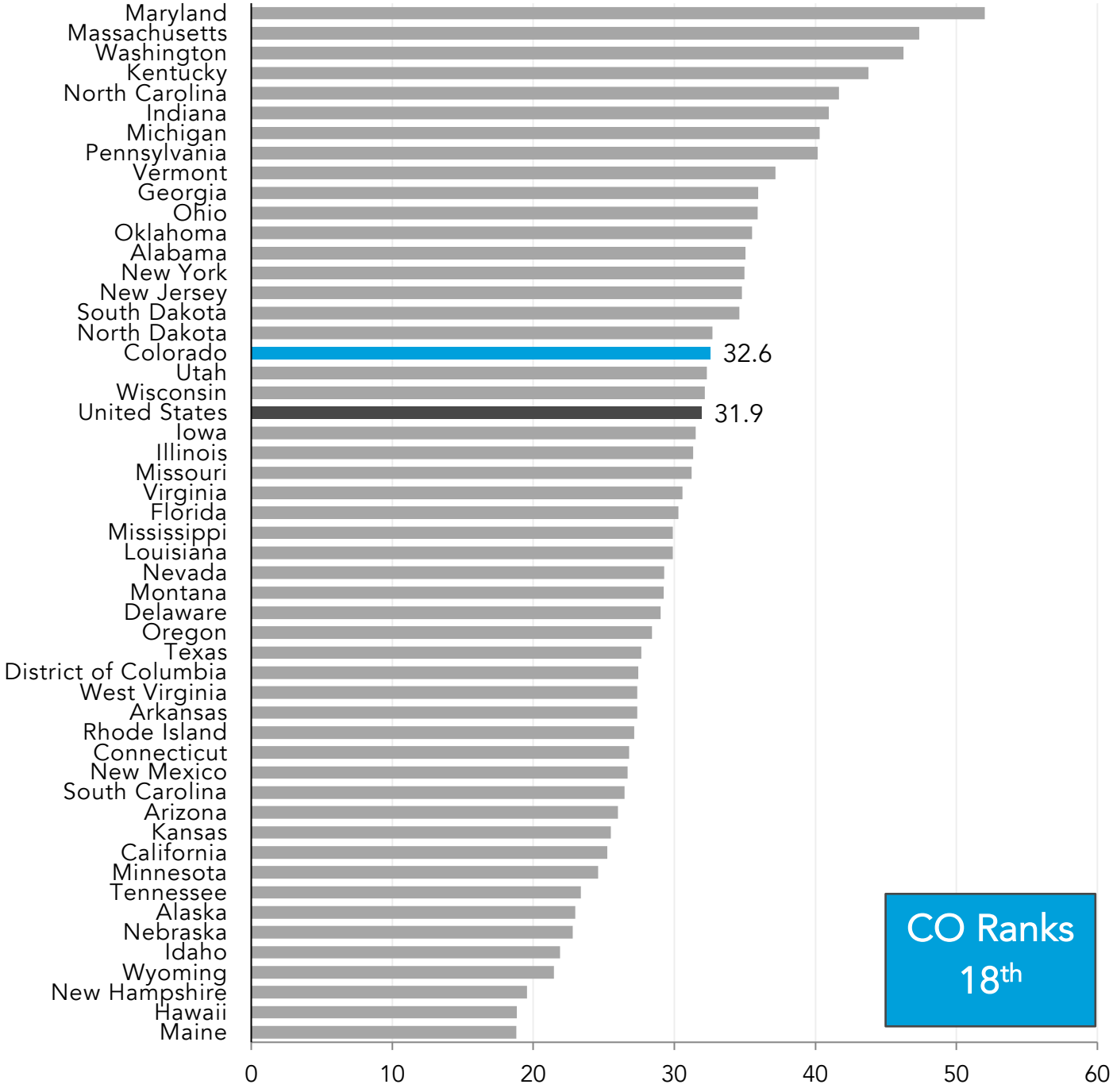
Start-Up Early Survival Rate, 2021



Source: Kauffman Foundation (2022)

One of the essential components of infrastructure for a knowledge-based economy is a skilled labor force. Tech occupations often require science, technology, engineering, and math (STEM) bachelor's degrees for basic entry-level positions. In 2021, Colorado produced 12,058 STEM degrees or certificates. When standardized by the number of enrolled postsecondary students in each state, Colorado had a level higher than the national average and ranked 18th across the country.

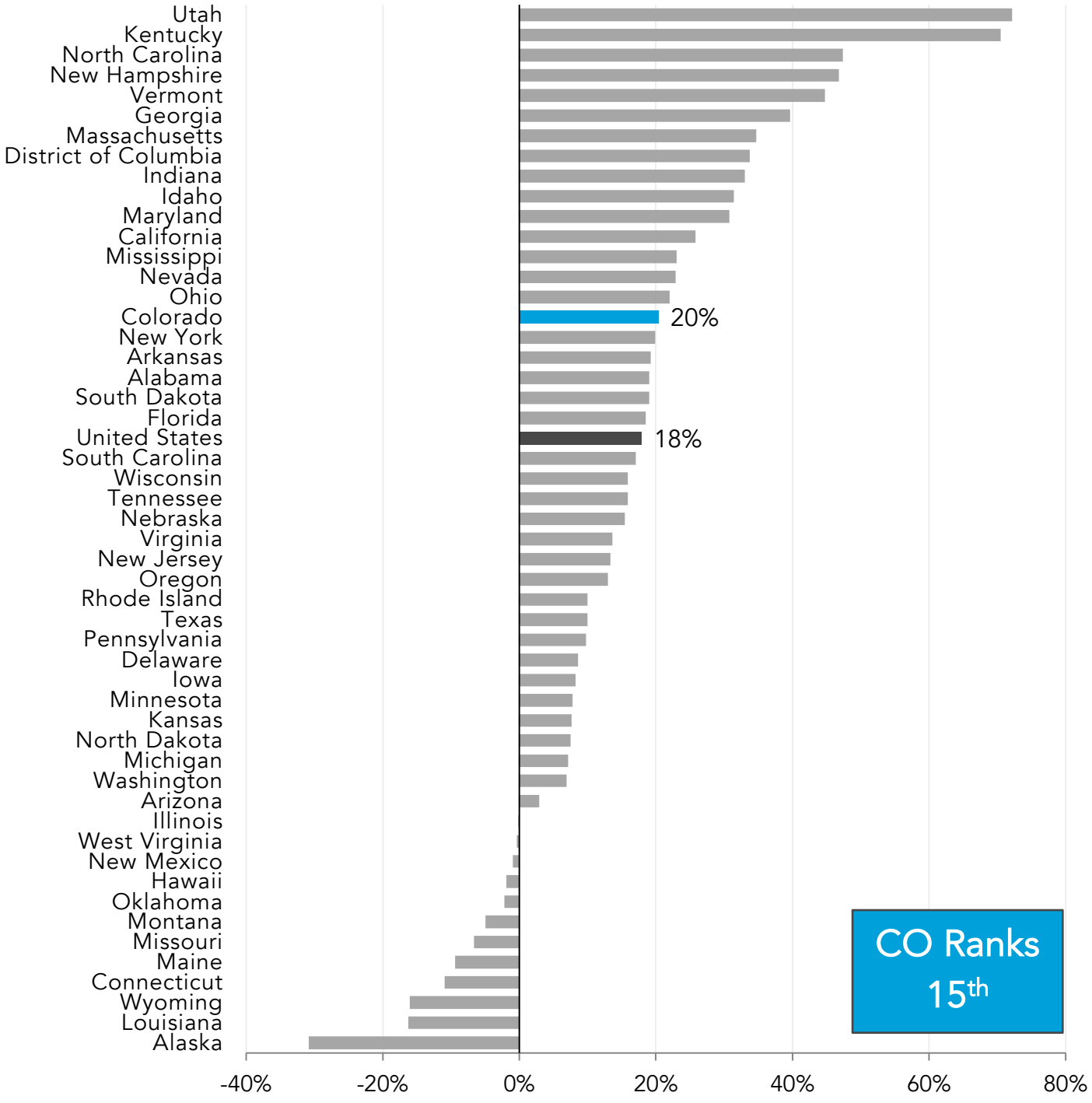
Completed STEM Education Programs per 1,000 Enrolled Students, 2021



Source: EL estimates based on Lightcast 2022.4 and National Center for Education Statistics (2022)

Over the past few years, many states have focused their efforts on growing the number of STEM students in their educational systems. We looked at the growth of STEM program completions from 2016 to 2021 and found that Colorado had experienced an increase of 20 percent. The state ranks 15th among all fifty states.

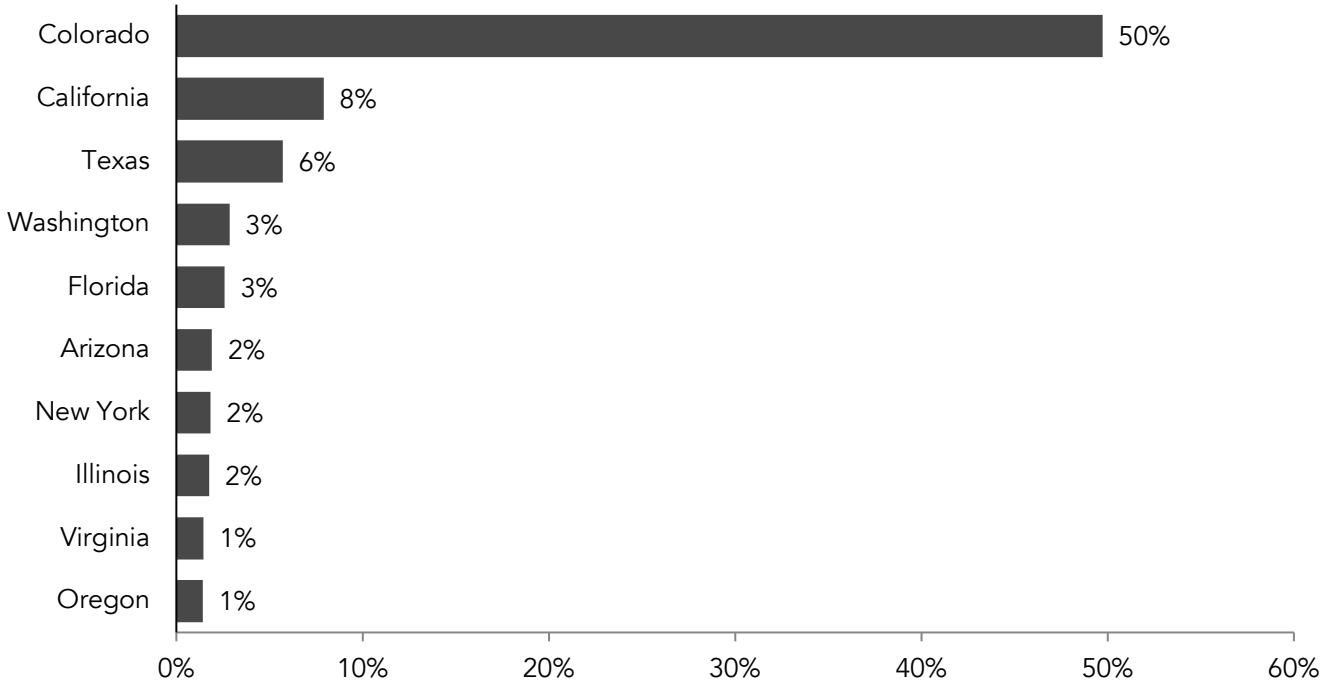
Percent Change in STEM Education Program Completions, 2016-2021



Source: EL estimates based on Lightcast 2022.4

When online professional profiles for individuals who had received a STEM degree, award, or certificate from a Colorado postsecondary institution were reviewed, there were 315,360 profiles that had been updated since 2016. Over 53,150, about half, of these profiles listed their current location in Colorado. About 8 percent were currently working in California and another 6 percent were working in Texas. While this analysis of online profiles is not a total accounting of all the STEM graduates coming out from Colorado schools, it does provide some indication that a significant portion of those educated in STEM in Colorado do stay and work in the state. This highlights how supporting local postsecondary institutions can help expand the local tech labor pool.

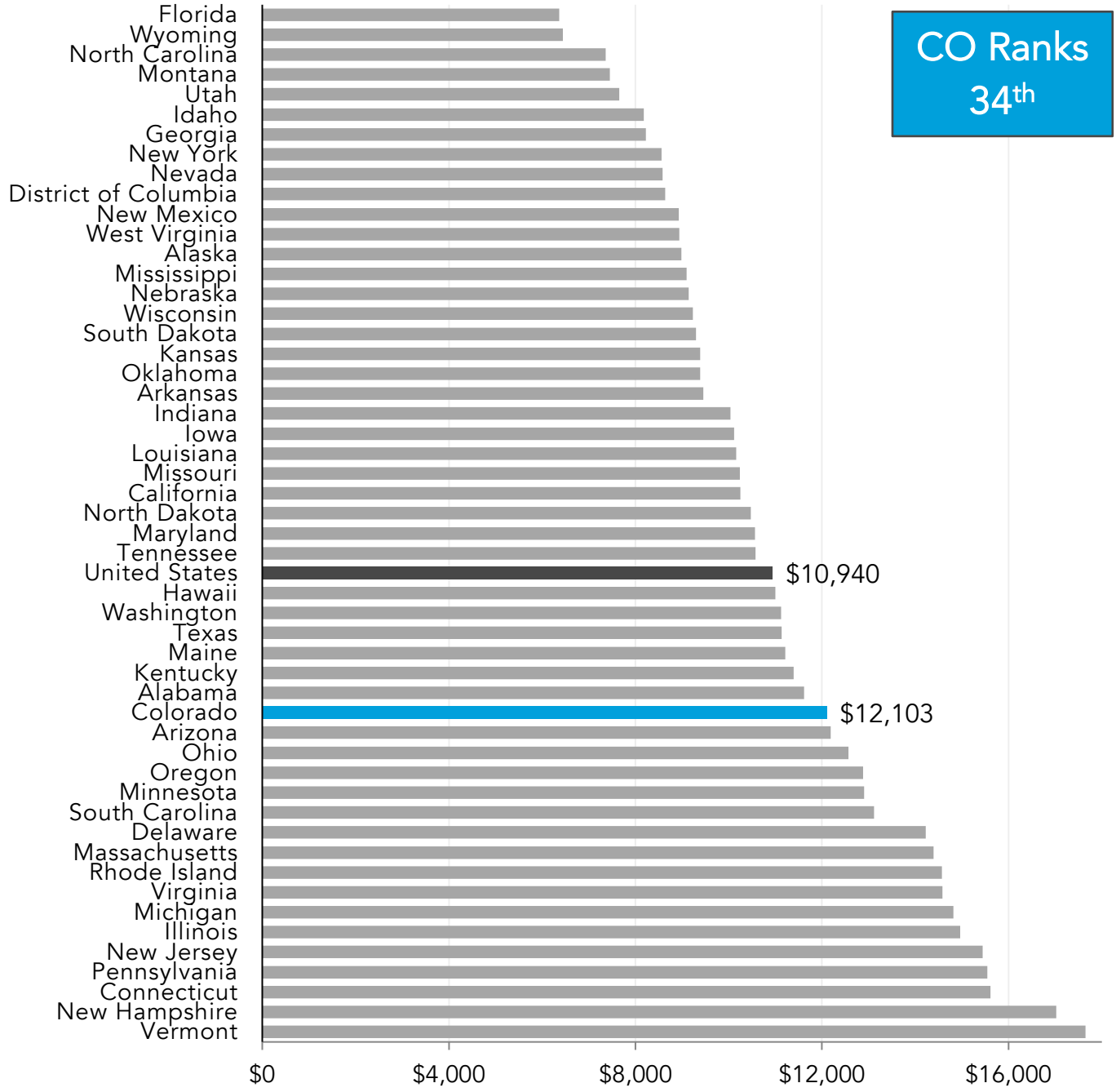
Current Location of STEM Program Completers from Colorado Schools



Source: EL estimates based on Lightcast 2022.4
Note: This data comes from online profiles of individuals who have updated their profile since 2016.

A key to generating local talent is offering affordable tuition to in-state students. Students today are keenly aware of the educational debt burden. High in-state tuition can send talented students to other states where even the lower out-of-state tuition is lower. For the 2022-23 school year, the average 4-year public university tuition is over $12,100 for in-state tuition in Colorado. This cost is higher than the national average and ranks the state 34th.

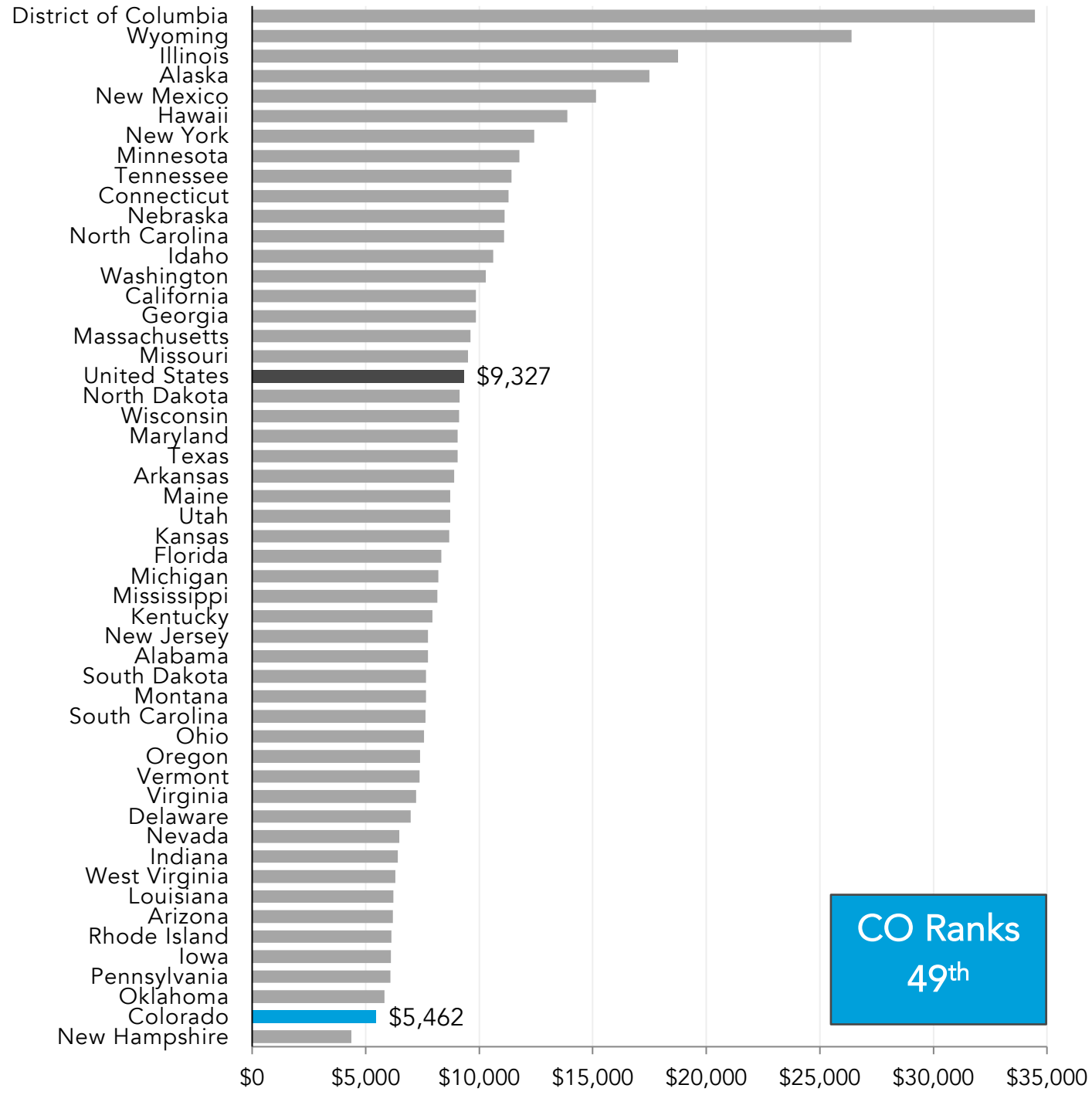
Average In-State Tuition, 2022-2023



Source: College Board (2022)

One of the reasons tuition costs are rising across all states is that funding for higher education was reduced during the Great Recession and never recovered. Tuition increases have not been able to accommodate these decreases in funding, this has resulted in reduced offerings at colleges and reduced research faculty. Colorado has the 2nd lowest funding rate, 49th overall, in the country with $5,460 of state spending per full time student. With this low level of funding, in-state tuition could increase and thus threaten the local talent pipeline.

State Spending on Higher Education Per FTE Student (2021)

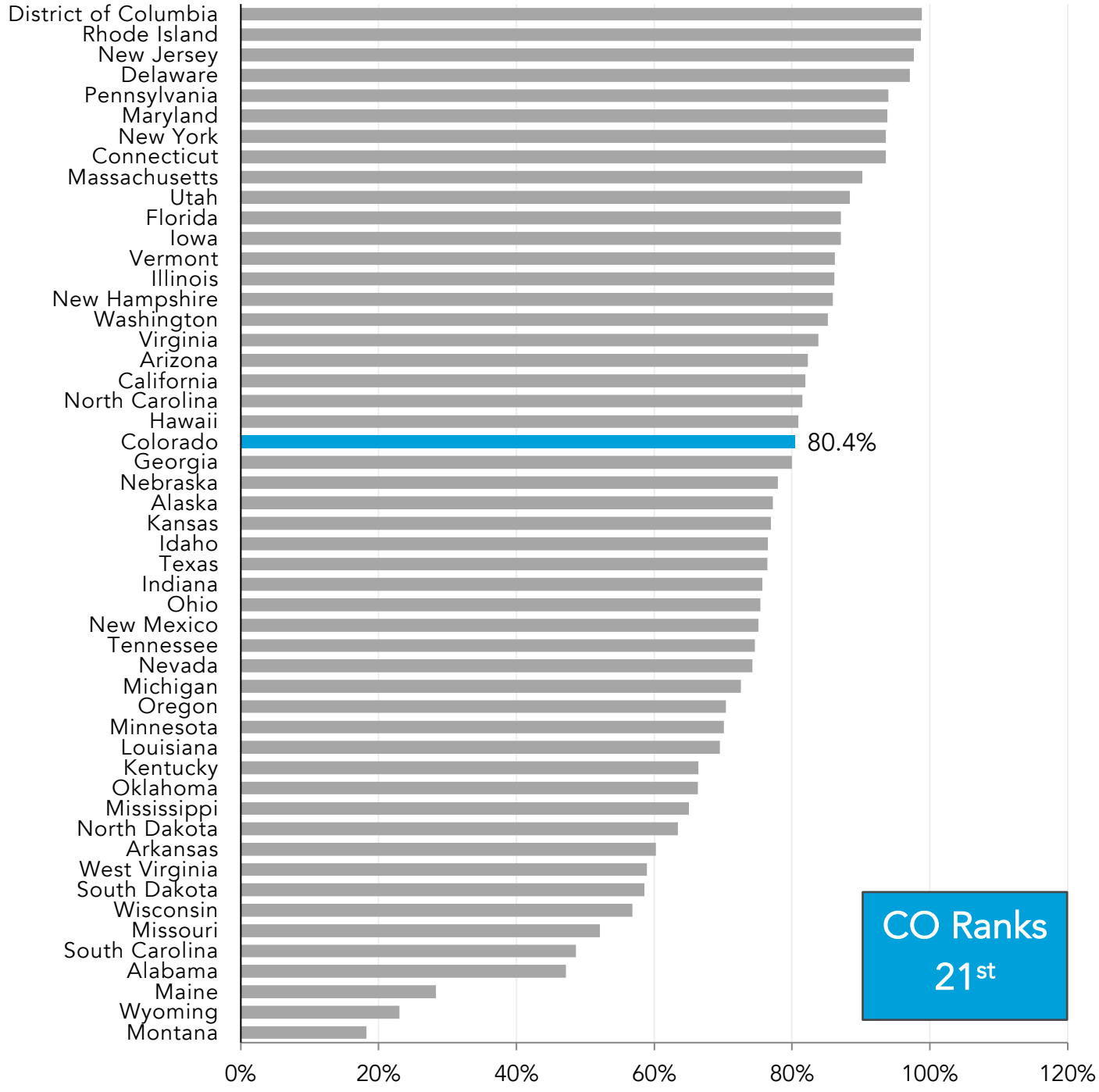


Source: State Higher Education Executive Officers (SHEEO) [2022]

High-speed broadband internet is a priority for many states and a good indicator of connectivity for a knowledge economy. Access is the first step in making sure everyone can be plugged into the information economy. The FCC defines broadband access at 25 megabytes per second (Mbps) for downloading and 3 Mbps for uploading. Many agree this threshold is not fast enough for working

from home. Therefore, data that measures a 100 Mbps download and 25 Mbps upload speed for all 50 states was used. This research found 80.4 percent of Colorado's population had access to this level of broadband in 2021. Colorado ranks in the middle of the pack at 21st for high-speed broadband access.

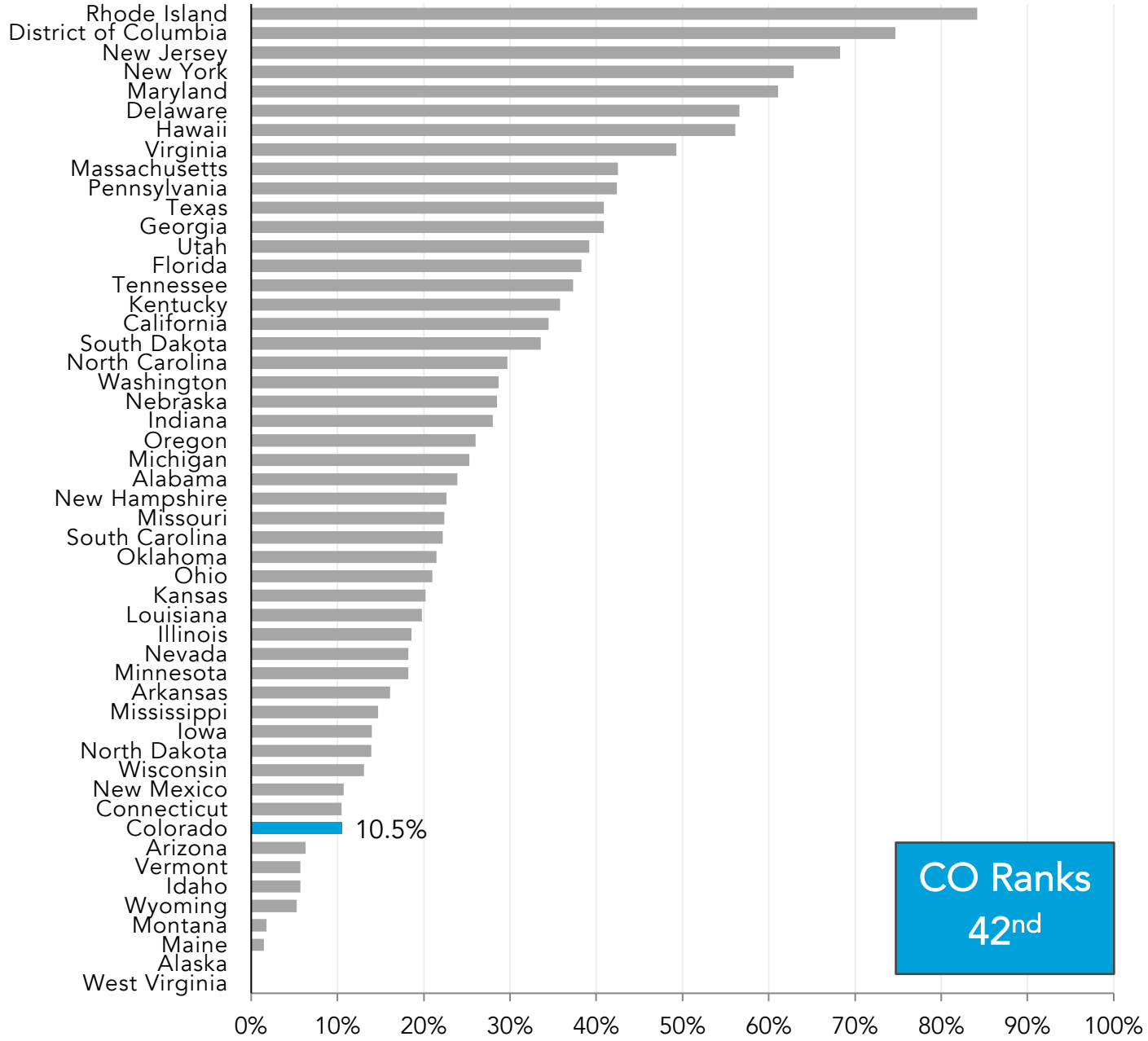
Percentage of Population with Access to High-Speed Broadband (100/25 Mbps), Q3 2021



Source: BroadbandNOW Research (2021)

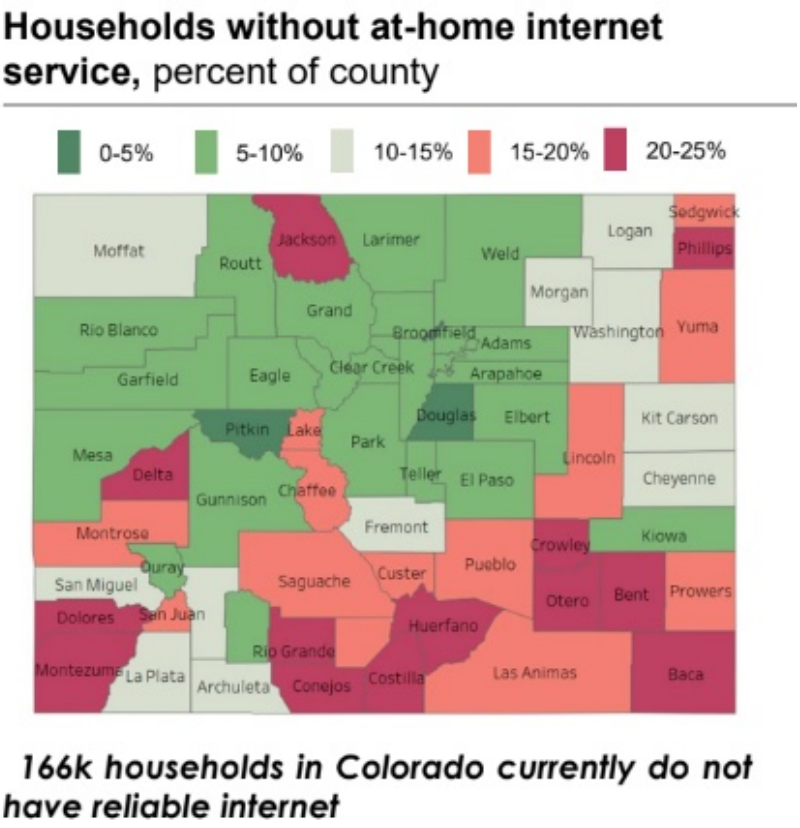
The availability of broadband must be paired with adoption by communities to ensure that all households are connected to the internet. Research has shown that adoption has a stronger link to economic benefit than just broadband availability. The central piece to adoption is affordability. Affordable plans were defined as under $60 per month in Q3 of 2021. Only 10.5 percent of Colorado's population had access to high-speed broadband at an affordable price. Colorado ranks 42nd across all 50 states for this metric. This indicates broadband pricing is making adoption difficult for many in the state.

Percentage of Population with Access to Affordable High-Speed Broadband Plans, Q3 2021



Source: BroadbandNOW Research (2021)

Remote work has the potential to spread tech workers into more geographically diverse locations. To be able to reap any benefits of remote work, rural areas need to have access to reliable and fast internet. According to research from the state governor's office, over 166,000 Colorado households lacked reliable internet connection. Many of the counties with the highest percentage of households without internet service were in the more rural areas of the state. Even in areas where agriculture predominates, internet connection will be crucial to benefitting from the technological advancements coming from the AgTech sector. The availability and adoption of broadband can also expand the employment opportunities for existing residents in rural areas.



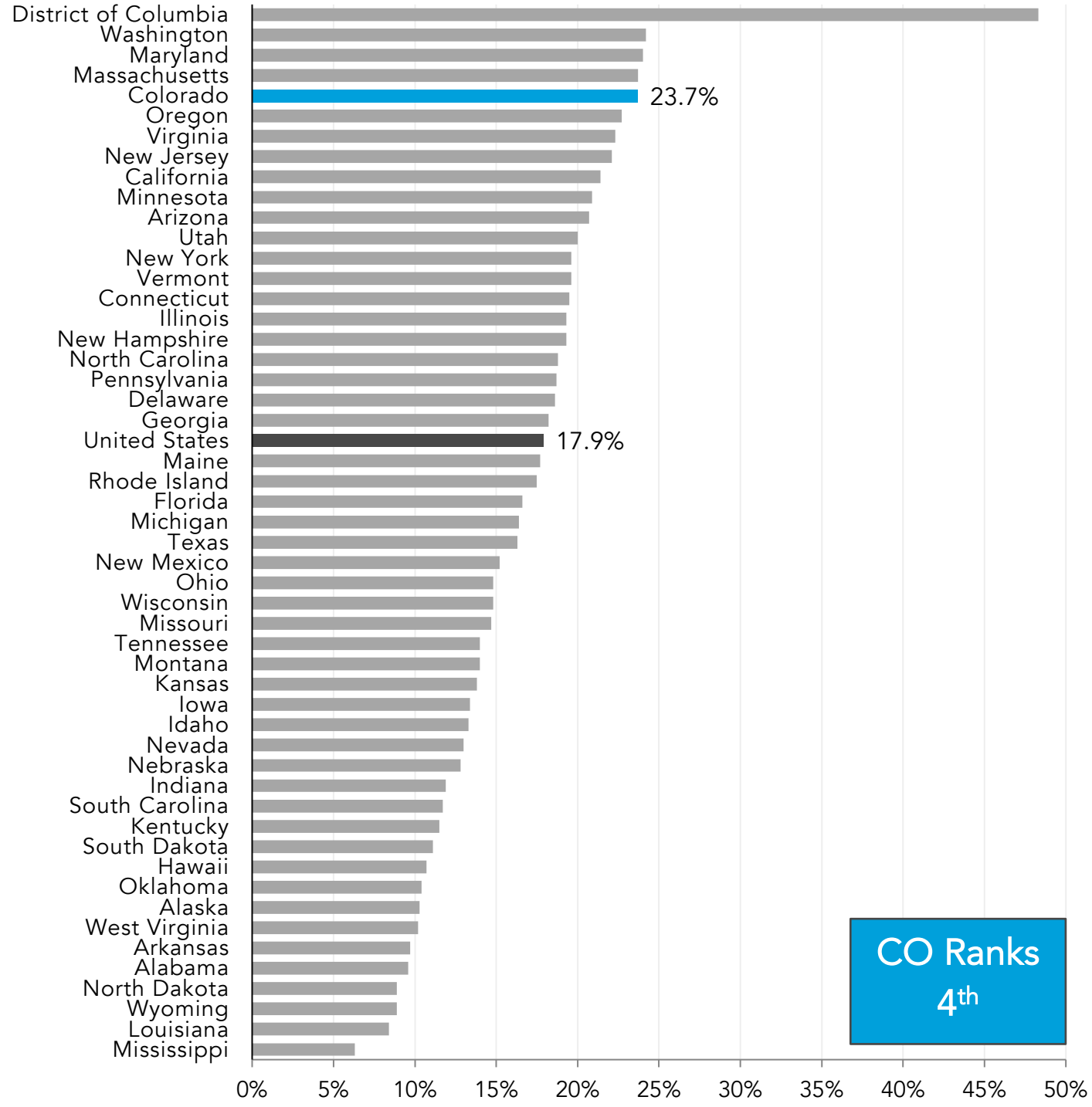
Source: Colorado Governor's Office of Information Technology (2022)

The expansion of remote work during the pandemic can also bring new talent to an area regardless of the local employment situation. According to Census surveying, Colorado had almost 24 percent of its workers who said they worked from home. This was the 4th highest state.

Many of the CTA members surveyed had embraced remote work to some degree permanently. While only 6 percent were entirely remote, another 86 percent were using a hybrid office/remote model. Many companies were using remote work as a recruiting tool. The future of remote work will likely offer a range of positive and negative impacts. Some see remote work to spread wealth beyond the Front Range in the state. One employer noted that some workers had relocated to the Western Slope once remote work became permanent.

However, remote work presents some threats to traditional economic development. Many of the emerging tech sectors before the pandemic were able to attract firms that were looking for lower costs in office space and wages from the traditional tech hubs. Now those companies may not need new headquarters and can just keep hiring remote workers. Some of the tech leaders interviewed noted they were much less concerned if the worker they hired lived in Colorado. This also means existing Colorado talent can be poached by companies outside the state, thus exacerbating the talent wars. If tech work is proven as completely location independent, more tech jobs could be moved offshore.

Percentage of Workers Working at Home, 2021

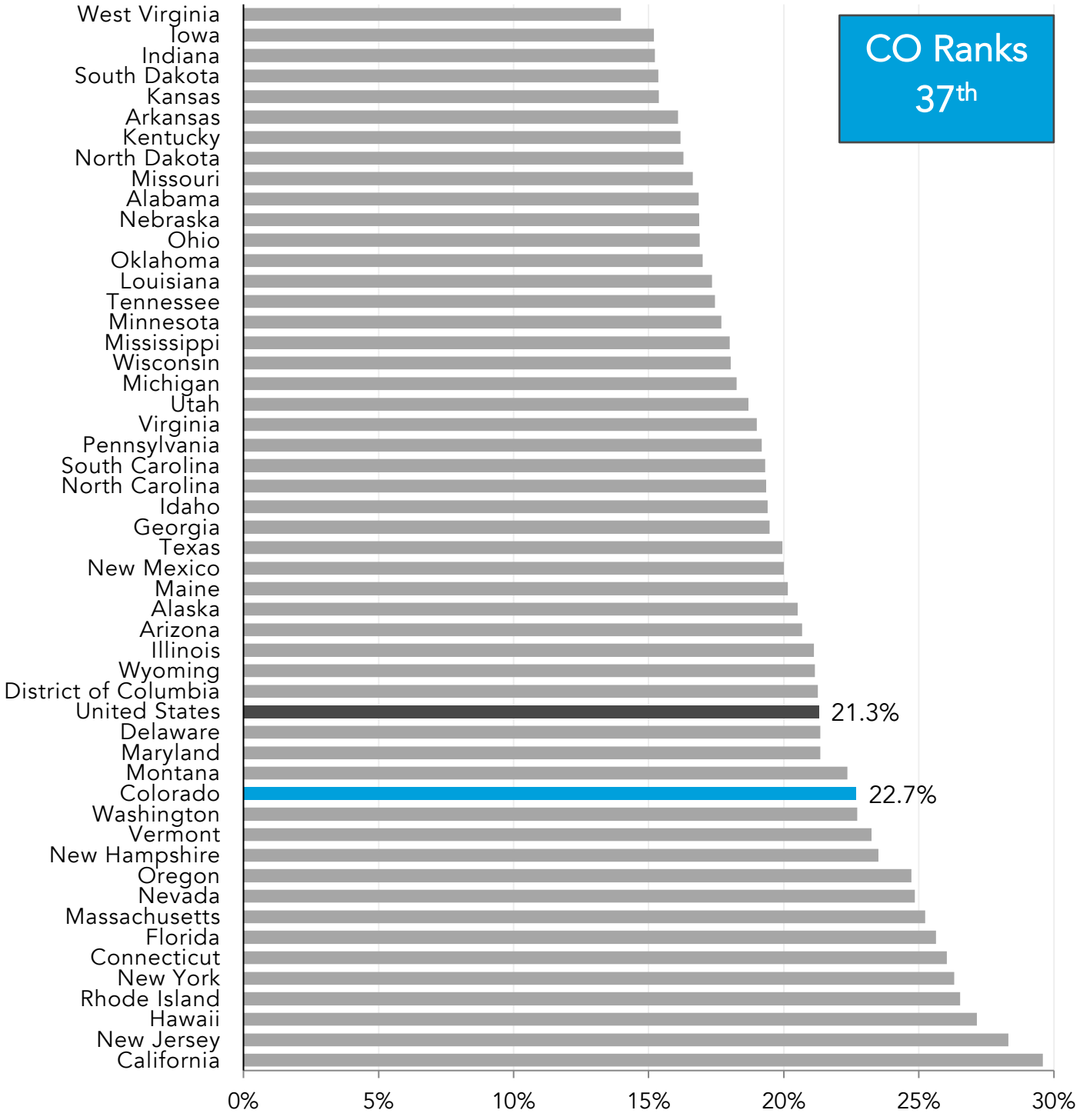


Source: US Census Bureau (2022)

The attractive quality of life in Colorado has brought many new people to the area in recent years. One downside of this growth is the impact to cost of living. Housing prices rose sharply in the

Mountain West in recent years, making affording housing more difficult. In 2020, almost 23 percent of households were considered housing burdened (paying more than 30 percent of household income on housing). This rate is higher than the national average and ranks Colorado in the bottom 15 states in the nation.

Share of Housing Burdened Households, 2020

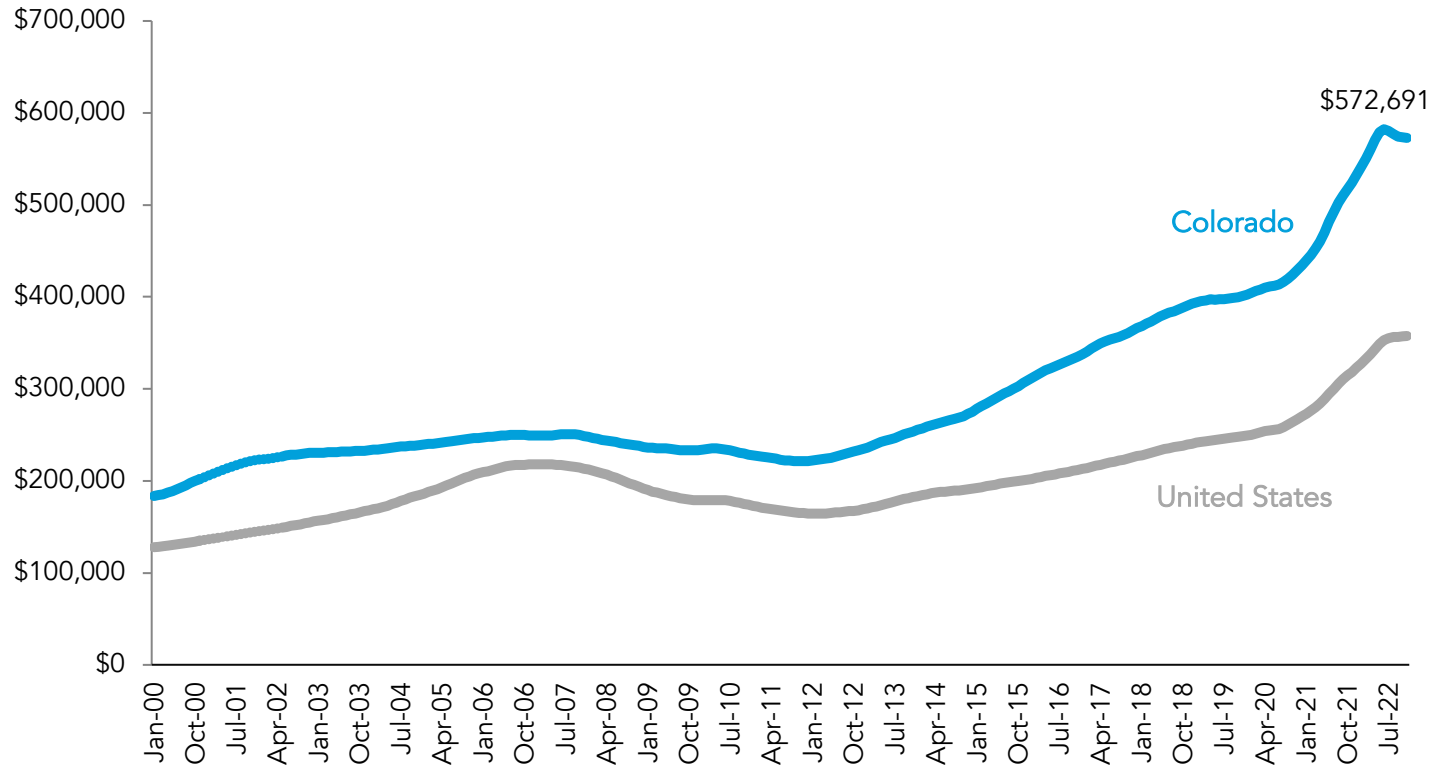


Source: Harvard Joint Center for Housing Studies (2022)

Colorado home prices had been rising relative to the national average before the pandemic. After the pandemic, this trend became even more pronounced. Since February 2020, the typical home in Colorado increased in price by 41 percent. This is much higher than any increases in wages during this time.

"All of the competitive advantages of the state don't matter if no one can afford to live here"

Typical Home Value, Jan 2000 – Nov 2022



Source: Zillow (2022)

SECTION 6. KEY TAKEAWAYS FOR TECH SECTOR

The following chart lists all the metrics we have measured for Colorado's tech sector and its corresponding ranking among the other states. Colorado ranks in the best 15 of all states for 20 out of the 34 indicators we evaluated. Colorado ranked in the bottom 15 states in tech industry diversity, education funding, affordable broadband, and housing cost burdens.

	Indicates a state ranking of 15th or higher
	Indicates a state ranking between 16th and 35th

	Indicates a state ranking of 35th or greater

Tech Industry		
Metric	Value	Rank
Technology Sector Location Quotient (2021)	1.48	2
Technology Sector Employment Growth (2016-2021)	16.4%	11
Expected Technology Sector Employment Growth (2022-2027)	9.6%	6
Average Annual Wage for Technology Sector Employees with Purchasing Power (2021)	$138,112	12
Percentage of Women in the Technology Workforce (2021)	31.7%	28
Tech Industry Diversity Index (2021)	66.1	42

IT Industry		
Metric	Value	Rank
IT Sector Location Quotient (2021)	1.56	6
IT (Tech Core) Employment Growth (2016-2021)	22.1%	7
Expected IT Sector Employment Growth (2022-2027)	12.4%	3
Average Annual Wage for IT Sector Employees with Purchasing Power (2021)	$149,371	10

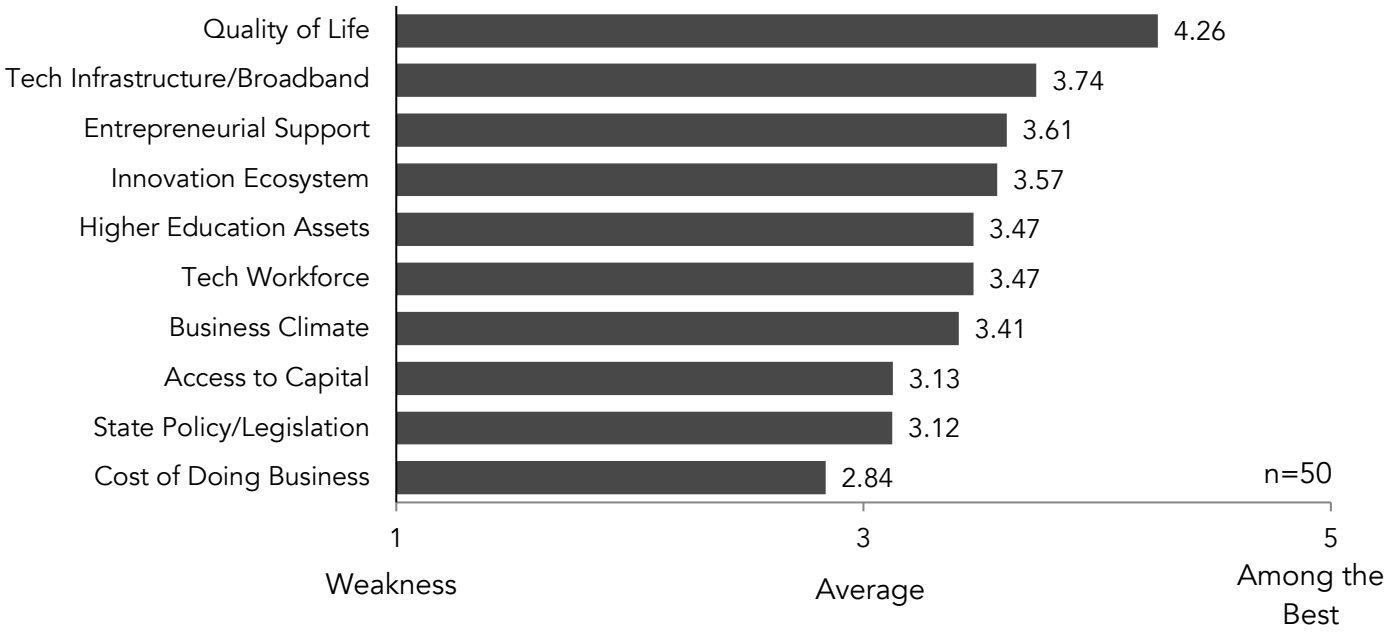
Tech Occupations		
Metric	Value	Rank
Tech Occupations Location Quotient (2021)	1.38	4
Tech Occupations Growth (2016-2021)	20.2%	11
Expected Tech Occupations Growth (2022-2027)	10.8%	6
Median Annual Earnings Adjusted for Purchasing Power (2021)	$84,569	13

Tech Infrastructure		
Metric	Value	Rank
Total R&D as a Percentage of GSP, 2019	2.5%	16
Business Performed R&D as a Percentage of Private Industry Output, 2020	2.1%	18
Higher Education R&D in Science & Engineering as a Percentage of GSP, 2020	0.31%	22
Patents Issued per 1,000 Science & Engineering Workers, 2020	16.9	22
Venture Capital Invested Per $1 Million of GSP, 2016-2021	$8,004	6
Technology Licenses and Options Executed from Universities, 2020	127	22
Start-Ups from Universities, 2020	29	13
SBIR and STTR Funding Per $1 Million of GSP, 2016-2021	$383	5
Rate of New Entrepreneurs, 2021	0.42%	8
Business Opening vs Closing Rate, 2020	0.07%	15
Start-Up Early Job Creation Rate, 2021	6.09	4
Start-Up Early Survival Rate, 2021	82.0%	17
Completed STEM Education Programs per 1,000 Enrolled Students, 2021	32.6	18
Percent Change in STEM Education Program Completions, 2016-2021	20.3%	15
Average In-State Tuition, 2022-2023	$12,103	34
State Spending on Higher Education Per FTE Student (2021)	$5,462	49
Percentage of Population with Access to High-Speed Broadband, 2021	80.4%	21
Percentage of Population with Access to Affordable High-Speed Broadband, 2021	10.5%	42
Percentage of Workers Working at Home, 2021	23.7%	4
Share of Housing Burdened Households, 2020	22.7%	37

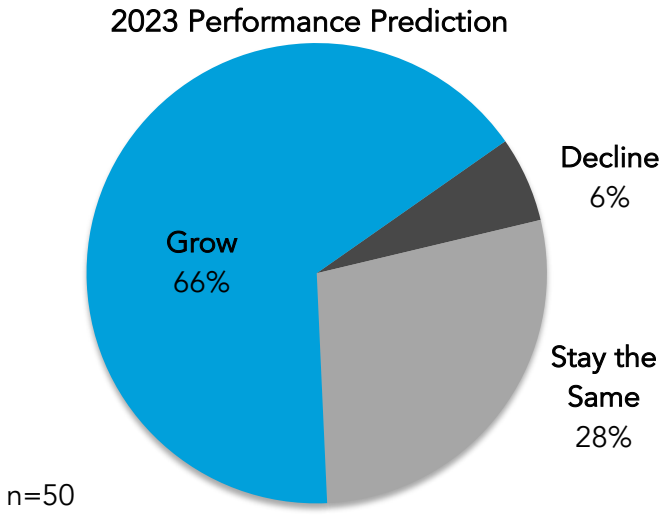
The tech industry added more net new jobs in Colorado's economy than any other industry group in the last five years. Growth trends for the state consistently rank in the top 15 states across the country. The data show that the tech sector was one of the most resilient parts of the post-pandemic economy and added jobs during one of the greatest economic disruptions of our time. Both tech companies and tech jobs are predicted to grow at fast rates into the future.

Colorado ranked in the top 15 states for eight of the twenty of the tech infrastructure metrics. This indicates the state has the essential components for supporting a knowledge-based economy into the future. Most of the data findings of this report match what CTA members think about the state's competitive advantages. Access to capital performs better in the nation than CTA members believe while broadband access is not as positive when the data is compared to other states.

Colorado's Competitive Position Ranked



Source: CTA Member Survey (2022)

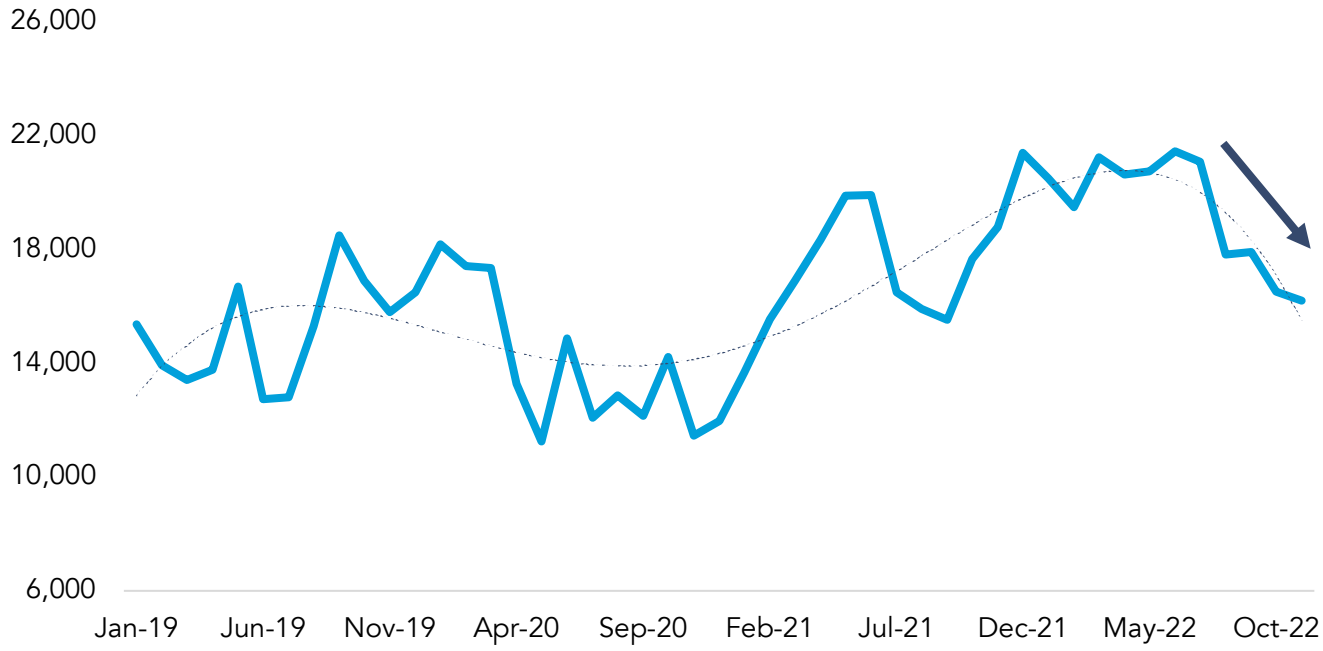


Source: CTA Member Survey (2022)

As of the writing of this report in the winter of 2023, the tech sector is beginning to show signs of cooling off nationally. Largely due to the inflation protection measures taken by the Federal Reserve. Many well-known tech companies like Meta and Tesla have announced worker layoffs. While in November of 2022, 66 percent of CTA members believed their company was going to continue to expand in 2023. In Colorado, the job postings data does indicate that the demand for new workers has slowed down in recent months.

One of the biggest challenges moving forward will be managing the cost of living, particularly housing and tuition, while maintaining the job gains of recent years. Affordability has moved to the top of list for people considering relocation. The exodus from the highest-cost cities since 2019 is well documented. Ensuring that a more diverse group of people can benefit from the high compensation of the sector is also an opportunity for improvement indicated by the data.

Colorado Unique Tech Job Postings by Month, Jan 2019 – Nov 2022



Source: Lightcast 2022.4

This preliminary report was written by Skylar Elliott Casey and Ted Abernathy in the winter of 2022.

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APPENDIX

Total Technology Industry 6-digit NAICS Code Breakdown

NAICS	Industry	Super Sub-Category	Sub-Category	Manufacturing or Services
325411	Medicinal and Botanical Manufacturing	Life Sciences Manufacturing	Life Sciences	Manufacturing
325412	Pharmaceutical Preparation Manufacturing	Life Sciences Manufacturing	Life Sciences	Manufacturing
325413	In-Vitro Diagnostic Substance Manufacturing	Life Sciences Manufacturing	Life Sciences	Manufacturing
325414	Biological Product (except Diagnostic) Manufacturing	Life Sciences Manufacturing	Life Sciences	Manufacturing
334510	Electromedical and Electrotherapeutic Apparatus Manufacturing	Life Sciences Manufacturing	Life Sciences	Manufacturing
334516	Analytical Laboratory Instrument Manufacturing	Life Sciences Manufacturing	Life Sciences	Manufacturing
334517	Irradiation Apparatus Manufacturing	Life Sciences Manufacturing	Life Sciences	Manufacturing
339112	Surgical and Medical Instrument Manufacturing	Life Sciences Manufacturing	Life Sciences	Manufacturing
339113	Surgical Appliance and Supplies Manufacturing	Life Sciences Manufacturing	Life Sciences	Manufacturing
339114	Dental Equipment and Supplies Manufacturing	Life Sciences Manufacturing	Life Sciences	Manufacturing
541330	Engineering Services	Engineering, Environmental, & Clean Tech	Life Sciences	Services
541380	Testing Laboratories	R&D and Testing	Life Sciences	Services
541690	Other Scientific and Technical Consulting Services	R&D and Testing	Life Sciences	Services
541713	Research and Development in Nanotechnology	R&D and Testing	Life Sciences	Services
541714	Research and Development in Biotechnology (except Nanobiotechnology)	R&D and Testing	Life Sciences	Services
541715	Research and Development in the Physical, Engineering, and Life Sciences (except Nanotechnology and Biotechnology)	R&D and Testing	Life Sciences	Services
333242	Semiconductor Machinery Manufacturing	Electronics Hardware	IT	Manufacturing
333314	Optical Instrument and Lens Manufacturing	Electronics Hardware	IT	Manufacturing
333316	Photographic and Photocopying Equipment Manufacturing	Electronics Hardware	IT	Manufacturing
334111	Electronic Computer Manufacturing	Electronics Hardware	IT	Manufacturing
334112	Computer Storage Device Manufacturing	Electronics Hardware	IT	Manufacturing

334118	Computer Terminal and Other Computer Peripheral Equipment Manufacturing	Electronics Hardware	IT	Manufacturing
334210	Telephone Apparatus Manufacturing	Electronics Hardware	IT	Manufacturing
334220	Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing	Electronics Hardware	IT	Manufacturing
334290	Other Communications Equipment Manufacturing	Electronics Hardware	IT	Manufacturing
334310	Audio and Video Equipment Manufacturing	Electronics Hardware	IT	Manufacturing
334412	Bare Printed Circuit Board Manufacturing	Electronics Hardware	IT	Manufacturing
334413	Semiconductor and Related Device Manufacturing	Electronics Hardware	IT	Manufacturing
334416	Capacitor, Resistor, Coil, Transformer, and Other Inductor Manufacturing	Electronics Hardware	IT	Manufacturing
334417	Electronic Connector Manufacturing	Electronics Hardware	IT	Manufacturing
334418	Printed Circuit Assembly (Electronic Assembly) Manufacturing	Electronics Hardware	IT	Manufacturing
334419	Other Electronic Component Manufacturing	Electronics Hardware	IT	Manufacturing
334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing	Electronics Hardware	IT	Manufacturing
334519	Other Measuring and Controlling Device Manufacturing	Electronics Hardware	IT	Manufacturing
335921	Fiber Optic Cable Manufacturing	Electronics Hardware	IT	Manufacturing
335999	All Other Miscellaneous Electrical Equipment and Component Manufacturing	Electronics Hardware	IT	Manufacturing
511210	Software Publishers	Software	IT	Services
517311	Wired Telecommunications Carriers	Internet & Telecommunications	IT	Services
517312	Wireless Telecommunications Carriers (except Satellite)	Internet & Telecommunications	IT	Services
517410	Satellite Telecommunications	Internet & Telecommunications	IT	Services
517911	Telecommunications Resellers	Internet & Telecommunications	IT	Services
517919	All Other Telecommunications	Internet & Telecommunications	IT	Services
518210	Data Processing, Hosting, and Related Services	Internet & Telecommunications	IT	Services
519130	Internet Publishing and Broadcasting and Web Search Portals	Internet & Telecommunications	IT	Services

541511	Custom Computer Programming Services	Software	IT	Services
541512	Computer Systems Design Services	Software	IT	Services
541513	Computer Facilities Management Services	Software	IT	Services
541519	Other Computer Related Services	Software	IT	Services
221310	Water Supply and Irrigation Systems	Engineering, Environmental, & Clean Tech	Environmental Technology	Services
221320	Sewage Treatment Facilities	Remediation and Waste Management	Environmental Technology	Services
221330	Steam and Air-Conditioning Supply	Engineering, Environmental, & Clean Tech	Environmental Technology	Services
334512	Automatic Environmental Control Manufacturing for Residential, Commercial, and Appliance Use	Engineering, Environmental, & Clean Tech	Environmental Technology	Manufacturing
334513	Instruments and Related Products Manufacturing for Measuring, Displaying, and Controlling Industrial Process Variables	Engineering, Environmental, & Clean Tech	Environmental Technology	Manufacturing
334514	Totalizing Fluid Meter and Counting Device Manufacturing	Engineering, Environmental, & Clean Tech	Environmental Technology	Manufacturing
334515	Instrument Manufacturing for Measuring and Testing Electricity and Electrical Signals	Engineering, Environmental, & Clean Tech	Environmental Technology	Manufacturing
335911	Storage Battery Manufacturing	Engineering, Environmental, & Clean Tech	Environmental Technology	Manufacturing
541620	Environmental Consulting Services	Engineering, Environmental, & Clean Tech	Environmental Technology	Services
562111	Solid Waste Collection	Remediation and Waste Management	Environmental Technology	Services
562112	Hazardous Waste Collection	Remediation and Waste Management	Environmental Technology	Services
562119	Other Waste Collection	Remediation and Waste Management	Environmental Technology	Services
562211	Hazardous Waste Treatment and Disposal	Remediation and Waste Management	Environmental Technology	Services
562212	Solid Waste Landfill	Remediation and Waste Management	Environmental Technology	Services
562213	Solid Waste Combustors and Incinerators	Remediation and Waste Management	Environmental Technology	Services
562219	Other Nonhazardous Waste Treatment and Disposal	Remediation and Waste Management	Environmental Technology	Services

562910	Remediation Services	Remediation and Waste Management	Environmental Technology	Services
562920	Materials Recovery Facilities	Remediation and Waste Management	Environmental Technology	Services
562991	Septic Tank and Related Services	Remediation and Waste Management	Environmental Technology	Services
562998	All Other Miscellaneous Waste Management Services	Remediation and Waste Management	Environmental Technology	Services
211120	Crude Petroleum Extraction	Other Energy and Power Generation	Energy Technology	Services
211130	Natural Gas Extraction	Other Energy and Power Generation	Energy Technology	Services
212111	Bituminous Coal and Lignite Surface Mining	Other Energy and Power Generation	Energy Technology	Services
212112	Bituminous Coal Underground Mining	Other Energy and Power Generation	Energy Technology	Services
212113	Anthracite Mining	Other Energy and Power Generation	Energy Technology	Services
213111	Drilling Oil and Gas Wells	Other Energy and Power Generation	Energy Technology	Services
213112	Support Activities for Oil and Gas Operations	Other Energy and Power Generation	Energy Technology	Services
213113	Support Activities for Coal Mining	Other Energy and Power Generation	Energy Technology	Services
221111	Hydroelectric Power Generation	Other Energy and Power Generation	Energy Technology	Services
221112	Fossil Fuel Electric Power Generation	Other Energy and Power Generation	Energy Technology	Services
221113	Nuclear Electric Power Generation	Other Energy and Power Generation	Energy Technology	Services
221114	Solar Electric Power Generation	Renewable Energy	Energy Technology	Services
221115	Wind Electric Power Generation	Renewable Energy	Energy Technology	Services
221116	Geothermal Electric Power Generation	Renewable Energy	Energy Technology	Services
221117	Biomass Electric Power Generation	Renewable Energy	Energy Technology	Services
221118	Other Electric Power Generation	Renewable Energy	Energy Technology	Services
221121	Electric Bulk Power Transmission and Control	Other Energy and Power Generation	Energy Technology	Services
221122	Electric Power Distribution	Other Energy and Power Generation	Energy Technology	Services
221210	Natural Gas Distribution	Other Energy and Power Generation	Energy Technology	Services

324110	Petroleum Refineries	Other Energy and Power Generation	Energy Technology	Services

Tech Occupations SOC Code Breakdown

Occupation SOC Code	Occupation Description
11-3021	Computer and Information Systems Managers
11-9041	Architectural and Engineering Managers
13-1081	Logisticians
13-1082	Project Management Specialists
13-1111	Management Analysts
13-1141	Compensation, Benefits, and Job Analysis Specialists
13-1161	Market Research Analysts and Marketing Specialists
13-1199	Business Operations Specialists, All Other
13-2031	Budget Analysts
13-2041	Credit Analysts
13-2051	Financial and Investment Analysts
13-2054	Financial Risk Specialists
13-2099	Financial Specialists, All Other
15-1211	Computer Systems Analysts
15-1212	Information Security Analysts
15-1221	Computer and Information Research Scientists
15-1231	Computer Network Support Specialists
15-1232	Computer User Support Specialists
15-1241	Computer Network Architects
15-1242	Database Administrators
15-1243	Database Architects
15-1244	Network and Computer Systems Administrators
15-1251	Computer Programmers
15-1252	Software Developers
15-1253	Software Quality Assurance Analysts and Testers
15-1254	Web Developers
15-1255	Web and Digital Interface Designers
15-1299	Computer Occupations, All Other
15-2011	Actuaries
15-2021	Mathematicians
15-2031	Operations Research Analysts
15-2041	Statisticians
15-2051	Data Scientists
15-2099	Mathematical Science Occupations, All Other
17-1021	Cartographers and Photogrammetrists
17-2011	Aerospace Engineers
17-2021	Agricultural Engineers
17-2031	Bioengineers and Biomedical Engineers

17-2041	Chemical Engineers
17-2051	Civil Engineers
17-2061	Computer Hardware Engineers
17-2071	Electrical Engineers
17-2072	Electronics Engineers, Except Computer
17-2081	Environmental Engineers
17-2111	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors
17-2112	Industrial Engineers
17-2121	Marine Engineers and Naval Architects
17-2131	Materials Engineers
17-2141	Mechanical Engineers
17-2151	Mining and Geological Engineers, Including Mining Safety Engineers
17-2161	Nuclear Engineers
17-2171	Petroleum Engineers
17-2199	Engineers, All Other
17-3021	Aerospace Engineering and Operations Technologists and Technicians
17-3022	Civil Engineering Technologists and Technicians
17-3023	Electrical and Electronic Engineering Technologists and Technicians
17-3024	Electro-Mechanical and Mechatronics Technologists and Technicians
17-3025	Environmental Engineering Technologists and Technicians
17-3026	Industrial Engineering Technologists and Technicians
17-3027	Mechanical Engineering Technologists and Technicians
17-3028	Calibration Technologists and Technicians
17-3029	Engineering Technologists and Technicians, Except Drafters, All Other
17-3031	Surveying and Mapping Technicians
19-1021	Biochemists and Biophysicists
19-1031	Conservation Scientists
19-1042	Medical Scientists, Except Epidemiologists
19-1099	Life Scientists, All Other
19-2021	Atmospheric and Space Scientists
19-2031	Chemists
19-2032	Materials Scientists
19-2041	Environmental Scientists and Specialists, Including Health
19-2042	Geoscientists, Except Hydrologists and Geographers
19-2043	Hydrologists
19-2099	Physical Scientists, All Other
19-4012	Agricultural Technicians
19-4013	Food Science Technicians
19-4021	Biological Technicians
19-4031	Chemical Technicians
19-4042	Environmental Science and Protection Technicians, Including Health
19-4043	Geological Technicians, Except Hydrologic Technicians
19-4044	Hydrologic Technicians
19-4051	Nuclear Technicians

43-9111	Statistical Assistants
49-2011	Computer, Automated Teller, and Office Machine Repairers
51-9141	Semiconductor Processing Technicians

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