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THE COLORADO SKILLS GAP: UNDERLYING CAUSES

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EXECUTIVE SUMMARY

This report identifies and explores possible grounds for, and consequences of, skills gaps in Colorado's labor market. Imbalances between job openings and job applicants are neither new nor largely unique to Colorado. Every state examined in this report [suffers](#) longstanding labor supply/demand imbalances, including gaps between the skill requirements of high-paying jobs and the skills of applicants actively seeking employment.¹ The pandemic made some gaps worse by changing the demand for and supply of many specific skills.²

The report begins with a Shift-Share Analysis (SSA), which identifies the Colorado industries most likely to have noteworthy skilled labor shortages. The SSA also helps pinpoint where industry-specific and regional factors are responsible for those shortages. The shift-share analysis of employment change by industry indicates which Colorado industries are out-performing or under-performing their counterparts nationwide. We also compare Colorado to its regional neighbors that have a mix of plains agriculture and mountainous terrain—Arizona, New Mexico, Utah, and Wyoming.

We then explore causes of the skills gaps common to Colorado's neighbors, and throughout the United States, alongside general causes that seem to be especially important in Colorado. Many of the common causes stem from shared practices and institutions, but that does not mean that Colorado policy cannot productively address them. For example, public school teacher pay policies are similar in significant, problematic ways throughout the country despite not being national policies. Colorado controls the pay policies for its public school teachers. We find that the central theme of the underlying causes is a price control—or central planning—cascade. Failure to allow market forces to deliver higher salaries to

STEM (Science, Technology, Engineering, and Math) teachers caused a huge reduction in the number of STEM-qualified graduates needed in the workforce. In addition, the combination of rough terrain, centrally-planned cities (e.g. zoning), and failures to apply pricing to infrastructure (esp. highways) use exacerbates the challenge of getting adequately trained workers to job sites or getting unskilled workers to job sites where they can receive training.

Likely important barriers to closing the skills gap include 1) rising housing costs, to some degree related to zoning restrictions, and commuter congestion; 2) insufficient training opportunities and other competitiveness challenges; and 3) occupational licensing. We examine state policies surrounding each of these to see whether they could be responsible for some of the persistence of numerous, often urgent-fill, high-skill job openings. Possible still-to-be-determined policy changes may also underlie some of Colorado's recent struggles to keep pace with neighboring states.

Key Findings

- Some of Colorado's industry-specific struggles in filling open positions appear related to skills gaps within the workforce.
- Out-of-field teaching is likely to be the most important systemic cause of skills gaps within Colorado's workforce, reducing the pipeline of young people going into certain skilled professions.
- Occupational licensing has created often unnecessary or unnecessarily high barriers to entering professions for which skills gaps exist.
- Population density and mobility challenges caused by a combination of Colorado's geography and policies lead to congestion issues and high housing costs, which add to the challenge of closing the skills gap.

OVERVIEW: SHIFT-SHARE ANALYSIS

Methodology

A Shift-Share Analysis (SSA) helps economists determine where industry mix and regional factors may be responsible for a region's economic growth or decline. SSA decomposes changes in employment within Colorado by industry into three components:

1. National share (NS) – the share of the change that might be expected based only on the aggregate national or regional (aggregated AZ, NM, UT, and WY for this report) change;
2. Industry mix share (IM) – the share due to the differences between the aggregate change (NS) and national or regional trends for specific industries; and
3. Regional share (RS) – for this report, the Colorado share for each industry, which is anything not accounted for by 1. and 2.

The analysis helps us to identify the Colorado industries in which the state may have experienced the most severe skills gaps and may continue to experience skills gaps. For example, suppose we want to find NS, IM, and RS for Colorado's Industry A. If Industry A's employment increased from 5000 to 6000 workers between 2010 and 2019, using the nation's trends as the basis for NS and IM, we can determine the regional contribution to the increase in employment using the following formula:

$$NS + IM + RS = 1000 \rightarrow RS = 1000 - NS - IM$$

If national employment grew 10% from 2010-2019 and 'A' grew 12%, nationally, from 2010-2019, we can surmise that 'A' is performing very well in Colorado relative to national trends in the industry: NS = 500 (10% of 5000); IM = 100 (an additional

2% [12-10] for this high-performing industry) $\rightarrow RS = 400$. Colorado factors, therefore, added 400, or 40%, of the 1000 new industry workers during that timeframe.

$$RS = 400 = 1000 - 500 - 100$$

The same formula can also identify when a region's employment growth in a particular industry suffered even when overall employment numbers grew within the industry. Suppose Colorado's Industry B grew from 8000 to 8600 from 2010-2019, and during that period, 'B' grew 8% nationally. For B, NS = 800 (10% of 8000), IM = -100 (2% slower [10-8] for this low-performing industry) $\rightarrow RS = -100$; based on the negative RS and the negative IM, 'B' would be said to be performing more poorly in Colorado than nationally.

$$RS = -100 = 600 - 800 - (-100)$$

SSA allows use of national or regional data as the basis for NS and IM. For this report, we determined RS from both ways to estimate NS and IM. For purposes of this report, the nation includes all fifty states plus Washington, D.C. We determined that Colorado's relevant regional comparison basis is AZ, NM, UT, and WY (close by with mountainous terrain and arid plains basis for agriculture).

We also examine the change for two time periods, 2007-2019 and 2013-2019. The first period serves to incorporate persistent effects of the financial crisis; the second focuses on the post-crisis, pre-pandemic period. It is important to compare relatively stable times—years that are not in the middle of a major disruption, such as a recession, or early in the recovery from a recession. We want to gauge the effect of permanent economic

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forces, not temporary adjustment pressures.

To account for both national and regional (i.e. AZ, NM, UT, and WY) trends in both time periods outlined above, the report describes four Shift-Share Analyses for Colorado:

- Colorado Versus the Nation, 2007-2019
- Colorado Versus the Region, 2007-2019
- Colorado Versus the Nation, 2013-2019
- Colorado Versus the Region, 2013-2019

We applied those to several major industry aggregates as reported by the Bureau of Economic Analysis and then disaggregated the whole industries in which skills gaps were especially likely to be evident. These include the following aggregated and disaggregated industries:

- Farm employment
- Forestry, fishing, and related activities
- Mining
 - Oil and gas extraction
 - Mining (except oil and gas)
 - Support activities for mining
- Utilities
- Construction
 - Construction of buildings
 - Heavy and civil engineering construction
 - Specialty trade contractors
- Manufacturing
 - Durable goods manufacturing
 - Other durable
 - Computer and electronic product manufacturing
 - Nondurable goods manufacturing
- Wholesale trade
- Retail trade
- Transportation and warehousing
- Information
 - Publishing industries (except Internet)
 - Other Information

- Finance and Insurance
 - Real estate and rental and leasing
 - Professional, scientific, and technical services
- Management of companies and enterprises
- Administrative and support and waste management and remediation services
- Educational services
- Health care and social assistance
- Arts, entertainment, and recreation
- Accommodation and food services
- Other services (except government and government enterprises)
- Federal civilian
- Military
- State government
- Local government

With the Colorado economy growing at about twice the national rate,³ our analyses found that most Colorado industries generally out-performed the state's region-wide and national counterparts. But Colorado still has several noteworthy industries that may be growing more slowly than their national or regional counterparts (indicated by negative RS values in our analyses), perhaps because of skilled labor shortages relative to national and regional trends:

- Mining (excluding oil and gas)
- Specialty Trade Contractors
- Durable Goods Manufacturing, except consumer and electronic goods
- Non-Durable Manufacturing
- Publishing, Except Internet
- Finance and Insurance
- Professional, Scientific, and Technical Services
- Administrative and Support and Waste Management and Remediation Services
- Health Care and Social Assistance
- Arts, Entertainment, and Recreation

The remainder of this section decomposes and dissects the results of our Shift-Share

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Analyses for major Colorado industries that may be experiencing skilled labor shortages.

Mining (Excluding Oil and Gas)

Colorado under-performed its national and regional counterparts (Arizona, New Mexico, Utah, and Wyoming) in both periods (2007-2019 and 2013-2019) for skill-intensive mining jobs—the ‘not oil and gas’ part of Colorado’s mining industry. The nation’s 2008-09 ‘Great Recession’ did not disrupt that trend. Rather, it may have accelerated it, as RS was larger, negative, for ‘not oil and gas’ mining employment from 2013-2019 than during the longer period:

	NS	+ IM	+ RS	= EmplΔ
Versus Nation, 2007-2019:	675	- 1662	- 312	= -1300
Versus Region, 2007-2019:	855	- 971	- 1184	= -1300
Versus Nation, 2013-2019:	796	- 1501	- 1107	= -1812
Versus Region, 2013-2019:	1146	- 1810	- 1148	= -1812

A general decline of an entire industry, such as the mining industry, could account for the decline in employment for that industry. Looking at actual job announcements of the non-oil-and-gas part of the Colorado mining industry, however, it does not appear that this is a withering industry, shedding employees to curtail production. On the contrary, Colorado’s mining industry appears to be expanding. Thus, an inadequate supply of needed skilled workers is likely limiting its expansion. Labor-saving technology improvements,⁴ probably driven in part by difficulty filling key jobs, appears to be another prime culprit in the faster-than-expected (RS<0) employment decline. For example, a 2015 article announced that hard-rock mining was a key driver of Colorado’s economic expansion, and a recent posting announced “[14 urgent openings](#)”⁵—a virtually sure sign of a sector being held back by expansion barriers.

Occupational licensing hurdles may also be a barrier. Both the [2012](#) and [2017](#) Institute for Justice Occupational Licensing assessment listed a 730-day experience/training requirement for earth drillers—an essential job for mining. That said, we did not discover any published ‘Earth Driller’ openings as of this writing, and Colorado’s neighbors (47 states in 2012; all states by 2017) also required earth drillers to be licensed, though with less onerous requirements. Furthermore, the much more extensive [occupational licensing database of Saint Francis University](#)⁶ did not list earth drillers.

Specialty Trade Contractors

Likely a posterchild for dependence on a diverse mix of special skills, the specialty trade contractors sector was a slow-growing sector for 2007-2019, but a fast-growing sector from 2013-2019, both nationally and regionally. For 2007-2019, Colorado’s specialty trade contractor sector slightly outperformed both its regional and national counterparts. From 2013-2019, the sector underperformed its regional counterparts.

	NS	+ IM	+ RS	= EmplΔ
Versus Region, 2013-2019:	20635	+28855	- 4235	= 45256

Again, this sector’s struggles do not signify withering. [87% of registered apprentices](#) are in the construction and extraction major occupational group.⁷ Still, while the sector grew a lot, it did not grow as fast as its region. This is an essential area for further investigation. Why did Colorado suddenly underperform its neighbors in this sector, especially when those neighbors decry skills gaps of their own?

Looking at [specific current job openings](#) in specialty construction,⁸ we see that there are at least 497 openings. Many pay well into six figures, and even

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basic laborer openings pay over twice Colorado’s \$12/hour Minimum wage. “Yard worker” fetches \$17 to \$25 an hour.

Connecting to the discussion of congestion and high housing cost later in the report, we can surmise that even seemingly well-paid, low-skill, entry-level jobs (front end of a skills development pipeline) may remain unfilled if potential employees would have to endure heavy road traffic every day to get from affordable housing to a job site. A lack of affordable housing near many job sites, therefore, may be a key reason why Colorado Specialty Construction businesses are not keeping up with the growth achieved in neighboring mountain states.

Manufacturing

In what is a recurrent outcome for several industries, in some areas of manufacturing Colorado also under-performed only its regional neighbors, and only for 2013-2019. One of those areas is ‘Durable Manufacturing, except for computer and electronic goods.’

$$\begin{array}{r} \text{NS} + \text{IM} + \text{RS} = \text{Empl}\Delta \\ \text{Versus Region, 2013-2019: } 10860 + 1949 - 4778 = 8031 \end{array}$$

Computer and electronic goods manufacturing employment did very well. Another lagging sector is non-durable manufacturing. Colorado gained 9877 non-durable manufacturing jobs from 2013 to 2019; 1188 fewer than expected from trends in Arizona, New Mexico, Utah, and Wyoming aggregated into a region. Job openings in manufacturing are also plentiful and well-paying. Someone with “beginner’s competency in the use of hand tools” can earn \$18.50 - \$24.50 per hour. A carpenter apprentice earns \$20/hour. About half of the openings are flagged as “urgently hiring.” A

“Manufacturing Supervisor” with 6 years of experience fetches at least \$90,000 per year.

Publishing (Excluding Internet)

“Publishing, except internet,” is another case of a 2013-2019 Colorado slump compared to its neighbors, even though, compared to the nation, Colorado did more poorly from 2007-2019 than in just the 2013-2019 period.

$$\begin{array}{r} \text{NS} + \text{IM} + \text{RS} = \text{Empl}\Delta \\ \text{Versus Nation, 2007-2019: } 2958 - 8176 - 373 = -5590 \\ \text{Versus Region, 2007-2019: } 3748 - 4671 - 4667 = -5590 \\ \text{Versus Region, 2013-2019: } 3643 + 1558 - 3642 = -1559 \end{array}$$

As suggested by the positive sign in the last row of the IM column, publishing, except internet, became a post-financial-crisis fast growing industry. Compared to its neighbors, Colorado didn’t catch the wave, losing jobs rather than gaining them in this industry. Indeed, the [Colorado Talent Pipeline Report](#) listed “Software Developers” as a top posted occupation.⁹ It was difficult to sort the ‘publishing, except internet’ job listings from others involved in “publishing;” for example, a water resources scientist—publish or perish—came up in the ‘publishing’ job openings search.

Finance and Insurance

In Finance and Insurance, Colorado out-performed the nation but under-performed its neighbors in the full 2007-2019 period and also just after the financial crisis, 2013-2019.

$$\begin{array}{r} \text{NS} + \text{IM} + \text{RS} = \text{Empl}\Delta \\ \text{Versus Region, 2007-2019: } 21032 + 34679 - 5735 = 49976 \\ \text{Versus Region, 2013-2019: } 30161 + 27725 - 33835 = 24051 \end{array}$$

Colorado missed out on some of the region-wide rapid employment growth in finance and insurance services. It does not appear that Colorado’s Finance and

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Insurance firms are seeking rapid growth. Indeed.com shows only 179 current openings—not many for a sector that, while falling far short of regional growth in that sector (negative RS), still increased its employment by 24,051 from 2013 to 2019. Still, many of the openings are high-paying. Policy changes, either within Colorado or by Colorado’s competitors, seem like the most likely culprit for this case and for the other instances in which Colorado did not keep up with its competitors from 2013 to 2019. Utah has had a #1-ranked economic outlook climate for 14 years in a row.¹⁰ Wyoming is #4; it was #2 in 2020. Arizona is #13; it was #11 in 2019. Colorado is ranked #20 now but was #18 in 2019, fallen from #16 in 2013 and #15 in 2017 and 2018.¹¹ Colorado fares better in [Forbes’ assessment](#) of “Business Climate.”¹² Colorado is #9. Utah is #3.

pandemic. Indeed.com indicated 63,148 current Colorado job listings matching “Professional, scientific, and technical services.” That’s nearly as many as the net change from 2013 to 2019. Breaking it down into the three categories, we see about 43,000 in professional, 1,000 in scientific, and 17,000 in technical services. It adds to less than 63,000, suggesting that disaggregated searches miss some that arise in broader searches, which is not surprising with this diverse field. In scrolling through the listings, Northrup-Grumman appeared quite often. Indeed, the Northrup-Grumman website has a ten-page list of high-pay openings; all on the front range (Aurora, Boulder, and Colorado Springs). Looking at the job types, the likely biggest factor in the persistence of such openings is the out-of-field teaching effects *cascade*, which we discuss later in this report under “Training, Attitude, and Competitiveness Challenges.” But the high and rapidly rising housing and commute costs (also, see below) on the front range are likely to be a key factor in the struggle to recruit and retain the top talent they seek.

Professional, scientific, and technical services is another rapidly growing area where Colorado under-performed.

Professional, Scientific, and Technical Services

Professional, scientific, and technical services is another rapidly growing area where Colorado under-performed, only relative to its neighbors and only after the financial crisis.

$$\text{NS} + \text{IM} + \text{RS} = \text{Empl}\Delta$$

Versus Region, 2013-2019: 43703 + 35020 - 5836 = 72887

Based on the aggregate performance of Arizona, New Mexico, Utah, and Wyoming, Colorado’s professional, scientific, and technical services employment should have grown even more than it did. Certainly, that is another potential symptom of inability to secure enough talented labor. Looking at current job openings, the [Colorado Talent Pipeline Report](#) (dated 12/2020) listed 76,729 unique openings.¹³ That December, the 2020 total was over 30% lower than in December 2019, prior to the

ASWMRS

Colorado’s administrative and support and waste management and remediation services (ASWMRS) floundered relative to the nation in both time periods. In 2007-2019, when ASWMRS was a slow-growing industry, Colorado outperformed its neighbors region-wide. In the latter half of 2007-2019, when ASWMRS became a fast-growing sector, Colorado’s ASWMRS employment growth fell well short of its neighbors’ ASWMRS job gains.

$$\text{NS} + \text{IM} + \text{RS} = \text{Empl}\Delta$$

Versus Nation, 2007-2019: 18469 + 4512 - 4485 = 18496
 Versus Region, 2007-2019: 23401 - 8614 + 3709 = 18496
 Versus Nation, 2013-2019: 20406 + 4061 - 6351 = 18116
 Versus Region, 2013-2019: 29369 + 2159 - 13411 = 18116

The Administrative support component shows 7296 current job openings, while waste management and remediation shows only 45 current job openings. In contrast, the [Colorado Talent Pipeline Report](#) showed ASWMRS as the top posted industry, with 107,798 unique openings in 12/2020—two-thirds of the level from the immediately preceding year.

Health Care and Social Assistance

Colorado’s employment growth in Health Care and Social Assistance outperformed the nation but under-performed its neighbors, though not for lack of demand for services (i.e. staff).

$$\begin{aligned} & NS + IM + RS = \text{Empl}\Delta \\ \text{Versus Region, 2007-2019: } & 30353 + 81179 - 13869 = 97662 \\ \text{Versus Region, 2013-2019: } & 44006 + 18216 - 5234 = 56989 \end{aligned}$$

The [Colorado Talent Pipeline Report](#) listed “registered nurses” as the #2 top posted occupation and listed “Health Care and Social Assistance” as a top-5 posted industry with 73,110 unique openings in December 2020. Colorado’s market for nurses—the often-seen classic example of near monopsony (not very competitive and a few major employers dominate the market), which will exist at least in areas with few major health care providers—should be more competitive than in its mostly more sparsely competitive neighbors. Consequently, the slower-than-expected employment growth seen in the negative RS values immediately above is more likely to reflect skills gaps unique to Colorado. In other words, since the widespread monopsony factor should impact Colorado less than its neighbors, on that basis alone, Colorado’s RS should be positive. Since Colorado’s Health Care RS is negative, other factors, perhaps a skills gap, are at work.

That said, perusing the openings of several health care categories gave the impression that there is not a strong determination to compete for talent. For example, there is a ‘Medical Assistant’ opening at \$16-\$20 per hour, demanding experience and certification, and promising a fast-paced work environment. For perspective, we looked at the Texas announcements of ‘Medical Assistant’ openings; \$20-\$35/hour and no mention of formal certification requirements. As the monopsony model predicts, employers would love to hire more highly qualified people at existing wage rates, but not if they have to adjust their pay scale. The Colorado market for nurses and medical assistants may be potentially more competitive because of front range population density. But that density, if poorly mitigated, can yield high housing costs and traffic congestion, which undermines potential competitiveness by shrinking labor market areas.

Arts, Entertainment, and Recreation

Employment change in Arts, Entertainment, and Recreation (AER) was another case of a 2013-2019 [minor] slump relative to its neighbors, but not the nation.

$$\begin{aligned} & NS + IM + RS = \text{Empl}\Delta \\ \text{Versus Region, 2013-2019: } & 13401 + 12998 - 2016 = 24834 \end{aligned}$$

While there was nothing remarkable about the arts, entertainment, and recreation job listings—not a sector likely to be held back by skills gaps—it is another troubling example of 2013-19 lost regional competitiveness.

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TRAINING, ATTITUDE, AND COMPETITIVENESS CHALLENGES

There's a lot to unpack in the challenges Colorado faces in connecting employers and skilled workers. For example, competitive markets for some firms' output—such as minerals with international markets—may literally keep those firms from paying enough for some skills. They cannot pay enough to fill some of their openings. So, such firms say there is a skills gap, when there is, in fact, a competitiveness or affordability gap within a globally competitive industry.

In other cases, such as with the aforementioned shortage of nurses, uncompetitive labor markets discourage employers from paying enough to fill all of the openings at the wage rates earned by existing employees. That is, to attract additional hires those uncompetitive circumstances would force much higher pay for existing employees. Specialized health care workers, especially the nurses needed in large numbers, are often in such a situation. The existence of few major employers of nurses leads those major employers to employ fewer people than they would like to hire at the low wage that will attract a tolerable staffing level and keep wage rates low.

The same situation often exists for teachers,¹⁴ which can create or exacerbate widespread shortages of teachers trained to teach the subjects necessary to close existing skills gaps. School districts employ the lion's share of public school teachers.¹⁵ Approximately 77% of Colorado's 5- to 17-year-old population was enrolled in public schools.¹⁶ Colorado's largest population center (Denver) has only one school district. It hires the vast majority of Denver-area teachers. It competes only with other areas, private schools, and public charter schools. The average Colorado county contains less

than three school districts ($179/64 = 2.8$).¹⁷ Such uncompetitive teacher labor market conditions exacerbate the effects of a longstanding national tendency toward (and inexplicable malaise about) out-of-field teaching. We can blame (NAS [2007] does) that mostly on prioritizing the appearance of fairness to teachers, and unions' interest in solidarity (Lieberman, 2007), over the talent needs of the economy and the fortunes of children that might find engagement and excitement in science and math classes taught by trained, enthusiastic science and math teachers.

The nearly nationally ubiquitous fairness-justified and union-preference based policy is called the single salary schedule (SSS). Since the underlying rationale of the SSS is that teachers' different subject content mastery is not a significant difference in teacher qualifications, teacher pay policies only rarely recognize skill differences as a basis for paying some teachers more than others. The SSS recognizes only increased formal training, and experience as a teacher, as a basis for differential base pay. As a result, the SSS yields shortages of teachers with high-demand skills.¹⁸ It also produces shortages of generally skilled, experienced teachers in hard-to-staff places such as rural areas and low-income urban areas. A huge source of inequity is that those places have even higher rates of out-of-field teaching. We find direct confirmation of teacher subject area skill supply-demand mismatch in a [Utah study](#):

*“The **teacher shortage** isn't spread evenly across subject matters or districts: We see far more **shortages** in the STEM [science, technology, engineering, and math] areas, particularly*

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science and math, than we do in other general content areas. Need is also highest in early childhood classes, special education, and rural areas.”¹⁹

The specific out-of-field teaching numbers in the quote below set the table for every difficulty in affordably matching labor market demand for many skills with supply, including self-reinforcing inertia:

“69% of US 5th- through 8th-grade students are being taught mathematics by teachers who do not possess a degree or certificate in mathematics. Fully 93% of students in those grades are being taught physical sciences by teachers with no degree or certificate in the physical sciences. Even in high school, the corresponding likelihoods are 31% for mathematics, 61% for chemistry, and 67% for physics. Many entire school districts do not have a single teacher with an academic degree in mathematics or science.”²⁰

Indeed, the search term, “Colorado, Teacher shortages” yields this list: Nursing, Math, and Psychotherapist; also ESL (English as a Second Language), Special Ed, and Social Work.

Colorado compounds that SSS effect with its many uncompetitive teacher labor markets. With low competitive pressure, districts in less competitive areas pay less than they otherwise would, which hits especially hard in the degree fields where lower pay matters the most: science, math, and special education. That will be especially important where rampant out-of-field teaching turns students off to teaching careers in the inherently difficult fields of science and mathematics. When, for example, schools lacking trained

math and science teachers hire physical education teachers to teach those subjects, students become disengaged in those classes. Lacking a sufficient pool of native-born students interested in STEM fields, science, technology, engineering, and math, university faculties rely on mostly foreign-born professors teaching mostly foreign-born students. It is a longstanding phenomenon, and near total dependence on foreigner-staffed STEM training, by any country, is very costly.

While the U.S. has the good fortune that many universities can attract foreign talent, the persistence of skills gaps and labor shortages across industries demonstrates the insufficiency of this solution. K-12er’s learned distaste for STEM courses compounds the problem by directly or indirectly²¹ diminishing the pipeline for training skilled workers for frontline businesses. Recall Northrup-Grumman’s ten pages of Colorado-based job openings as evidence of this phenomenon.

The insufficiency of STEM training by universities starts with many high school graduates never having taken a course from someone qualified to teach a math or science course, and no wonder, given how few teachers are trained to teach, for example, physics. “Brigham Young University, a private institution run by the Mormon Church, graduated roughly 5% of all the new physics teachers produced by all U.S. colleges and universities [in 2006](#). BYU’s 2006 class of 16 tops the production of any other university.”²² University of North Carolina (UNC), President Erskine Bowles lamented, “Think about this: in the past 4 years, UNC’s 15 schools of education turned out a grand total of three physics teachers.”²³ And such teachers are especially likely to be among the many that quickly exit teaching—a problem compounded (Merrifield, 2019) by the political imperative to

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deliver mainstream instruction to nearly everyone in the same way.

“About 46% of new teachers abandon the profession within 5 years. The attrition rate is even higher among science and mathematics teachers;” partly because of SSS and uncompetitive teacher labor market-induced lower pay.²⁴

Especially disheartening is that for all the pressure to appear fair to all, the United State’s 51 school systems yield severe inequities in student outcomes. As Thomas Jefferson observed over 200 years ago, “There is nothing more unequal than the equal treatment of unequal people.”²⁵ As Todd Rose (2016) points out in [The End of Average](#), only equal fit can produce equity. Equal fit for a diverse student population requires diverse instructional approaches (Merrifield, 2019) staffed by people trained to teach engagingly what students expect from course titles.

Another incredible aspect of the out-of-field teaching problem is the inattention to it, especially at the state level where the ability to address the problem lies. Nearly fifteen years after a [very prominent national study](#) (National Academy of Science, 2007) highlighted the extensiveness and importance of out-of-field teaching, a search for state-level responses yielded only a Tennessee PowerPoint alleging as still problematic a much lower out-of-field teaching rate than described above by the national study. Beware of creative accounting for teaching assignments. Sadly, [the prominent study](#) mostly produced misdirection and little useful insight.

The search term, “Out-of-Field Teaching, Colorado” yields no data or analysis; just definitions. The [statement below](#), backed by a 1985 reference, asserts that

out-of-field teaching was already a long-time, major problem 36 years ago, as we would expect from economic analysis of the long-time, widespread single salary schedule (SSS).

“The phenomenon of out-of-field teaching—teachers teaching subjects for which they have little education or training—has long been a crucial but relatively unrecognized problem in schools (Robinson, 1985). It is a crucial issue because highly qualified teachers may in actuality become highly unqualified if they are assigned to teach subjects for which they have little training or education. And unqualified teachers may negatively impact student achievement. There has been little national recognition of this problem, however, because of an absence of accurate data. This situation was remedied in the 1990s with the release of the Schools and Staffing Survey (SASS).”²⁶

The SASS addressed a data deficiency, but it did not correct the dearth of attention to the issue.

A price control at the post-secondary level probably exacerbates the problem. Tuition typically does not vary by major, which can yield shortages of faculty in majors where recruiting faculty is especially costly. The artificially low tuition in high cost fields does yield additional students in those fields, including some, foreign-born and home-grown, that will remain in the USA after graduation. But the larger enrollment numbers and price control-induced drop in faculty hiring for those fields yield engagement-undermining, attrition-inflating larger classes. Again, this price

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control is another appearance-of-fairness-driven state-level policy.

Since the market-based standard responds to a problem created by price control (The price of teacher labor = teacher salaries) may not be politically feasible in any existing state political setting, we need an urgent search for a

politically feasible policy to address this critical deficiency of Colorado's skills training process.

OCCUPATIONAL LICENSING

A main driver of the skills gap is the equal treatment of unequals (such as math and PE teachers) that results from the political process' appearance of fairness imperative. Another possible factor, excess [occupational licensing](#),²⁷ results from the greater political relevance of immediate, concentrated [real and imagined] benefits over larger, diffused, hidden, and sometimes deferred costs. [Legislators in all fifty states](#) have succumbed to pressure from organized occupation incumbent groups to create entry barriers into occupations where ill-informed consumers are not a serious risk to themselves or innocent third parties. Because organized interests can impact votes, much licensing typically survives evidence that it does not have the promised benefits,²⁸ though it does drive up prices.²⁹ Even where a strong case for some government oversight exists—where there should be licensing—the requirements imposed are often excessive; again, they largely benefit only the already licensed.

That's why, even though Colorado generally has much less extensive and intensive licensing requirements than its neighbors, other than Wyoming, still nearly a million Coloradans need a license to do their jobs, or 17.2% of the total workforce.³⁰ Licensing requirements have been rising nationwide, and Colorado went from [28/102 low/medium income](#)

[licensed occupations in 2012](#)³¹ to [34/102 in 2017](#).³²

At the very least, licensing impairs the flexibility of the labor force in responding to changing demands for particular skills, such as we've seen with Covid, where several industries may not quickly, or ever, return to pre-pandemic employment levels.³³ To fill in-demand jobs, some workers will have to abandon familiar routines and their investment in the license or licenses they already hold. Some may hesitate to do so. In addition, they may also have to pursue a new license, perhaps only because they are considering moving to Colorado.³⁴

Alongside an occupation-by-occupation re-examination of the justification for any licensing, or at the existing, perhaps excessive requirements, a possibly less politically challenging reform would be to recognize more licenses earned in other states. For example, as noted previously, in 2012, 47 states licensed earth drillers, and by 2017 it was all states.³⁵ So, with additional recognition reform, which is not unusual, including in Colorado, all states suddenly become places to recruit immediately available earth drillers. Without such reforms, the earth driller labor pool is limited to current state license holders. To increase that pool, non-Coloradans

[L]icensing impairs the flexibility of the labor force in responding to changing demands for particular skills.

already trained in the profession would nonetheless have to complete 730 days of approved training.

Some other Colorado licensing requirements are noteworthy for their seeming presumption that, without the license requirement, employers and supervisors will hire unqualified people for support positions and that those unqualified laborers will endanger the public. This argument cannot withstand basic logical scrutiny. Does a nurse aide, for example, not work directly with a nurse who will surely notice if requested or promised qualifications are not present? It seems that the only likely effect of licensing an aide is to slow the development of nurses. The same points apply to the licensing of Physical

Therapist Assistants and Occupational Therapist Assistants.³⁶ Likewise, the licensing of Dental Hygienists seems likely only to reduce their availability. Hygienists are under the regular supervision of dentists who will detect inadequate training, probably before the first patient is seen. An “Engineer in Training” must be a citizen. It is a seemingly innocuous requirement that, sadly, can significantly reduce STEM-qualified applicants. The requirement benefits existing engineers but impairs employers of engineers from recruiting a sufficient workforce. For reasons given previously, citizens can be scarce among entry-level STEM skill holders.

Not only does costly housing drive away or deter fully trained labor, it is especially likely to influence extensive job-site training—employers’ last-ditch end-run around inadequate education and training programs.

HOUSING COSTS AND CONGESTION

In *The Captured Economy*, Brink Lindsay and Steven Teles (2017) point out that a key cause of slower economic growth, nationwide, is congestion and housing costs that are causing out-migration where there should be in-migration to meet industry growth needs, mostly for skilled labor. Not only does costly housing drive away or deter fully trained labor, it is especially likely to influence extensive job-site training—employers’ last-ditch end-run around inadequate education and training programs. Someone that would accept a necessarily low-pay apprenticeship in normal circumstances might not do so if high-cost housing and or a long, annoying, costly commute eats up the lion’s share of an apprentice wage. Because newly-trained workers can accept competing offers, training-intensive apprenticeships are risky even at low wages. That makes it difficult to justify paying enough to overcome high housing and commute costs.

Still, Colorado appears to have an [extensive network of Apprenticeship programs](#),³⁷ though it is not possible to readily observe how active the individual programs are. That extensive network, by itself without knowing details, is likely a symptom of a widespread struggle to fill job openings. As noted above, that is so because it is very difficult for individual business firms to capture a large share of training investments. Newly trained employees can easily move to higher-paying competitors of the businesses that paid them while training them. That may be why (alongside high housing and commuting costs) the [Colorado Talent Pipeline Report](#) cited only 5894 US Department of Labor registered apprentices in active programs.

Where does Colorado stand with regard to those possible barriers between potential employees and job sites? Widely published data exist mostly

just for Denver, Boulder, and Colorado Springs. However, high housing costs and commuting challenges exist outside Colorado's major metro areas. For example, housing is very expensive in Aspen, Telluride, and Vail, to name a few places with similar constraints to the Front Range. Rough—albiet beautiful—terrain, distance, and weather complicate commuting there from places with lower housing costs. Mines (recall Colorado's underperformance in 'mining, not oil and gas'), for example, located near such towns likely struggle to afford, or stay competitive in meeting, their labor requirements.

Looking at Colorado's three top metro areas, we see that housing costs were high pre-Covid-19, and present trends are in the wrong direction.³⁸ Even before the recent price surges, housing was expensive. [Housing Affordability Index](#) numbers below 100 indicate that a median income is not sufficient to qualify a family for a loan sufficient to buy a median-priced home (see chart "Housing Affordability Index"). It means a lot of workers in those areas cannot afford to live near their jobs, and many jobs cannot exist in such high-housing-cost areas. Numbers way below 100 exist for places such as San Francisco and New York City.

The [most recent published numbers](#) are available for three Colorado metro areas for 2015-2018. Boulder's legendary expensive housing is reflected by the 2018 index value of 93.2, and getting less affordable. Denver is not far behind. The city registered a 21.3% year-over-year increase in home prices from July 2020 to July 2021, according to the [S&P CoreLogic Home Price Index](#), the highest 12-month increase on record.

	2015	2018
Boulder:	115	93.2
Co Springs	164.3	128.1
Denver	126.5	109.2

Source: National Association of Realtors: Affordability Index of Existing Single Family Homes for Metropolitan Areas: <https://cdn.nar.realtor/sites/default/files/documents/metro-affordability-2018-existing-single-family-2019-06-11.pdf>

Colorado Springs, though already also approaching 100 pre-Covid-19, still attained #14 on the [Emerging Markets Index](#),³⁹ which includes housing cost as a negative factor. Of course, Colorado's popularity is a key factor in driving up housing costs, but building challenges can, and widely do (Lindsay and Teles, 2017), prevent supply from keeping up with demand, except through higher prices. In *The Captured Economy*, Brink Lindsay and Steven Teles note that restrictive zoning is a major factor underlying the high housing costs that drive people away from places that need more skilled labor. Indeed, Ryan Keeney at *Colorado Politics* (March 26, 2021 print edition) cites zoning as a major factor in Denver's exploding housing costs:

"So why hasn't supply kept up in places where the demand is greatest? Here there is complexity, with many contributing factors, but one of the largest is restrictive zoning. In Denver and nearly every other American city, it is only legal to build detached single-family houses on most of their residential land. Multi-unit construction, from duplexes to high-rises, is only legal to build in very limited areas."

Because of a "[Transitional Gains Trap](#)" (Tullock, 1975),⁴⁰ zoning restrictions can be especially persistent and troublesome. The people that paid the prices inflated by those restrictions stand to suffer major losses if the restrictions are lifted. Despite that bias in favor of single-family units, we

[A] lot of workers in [Colorado's three top metro] areas cannot afford to live near their jobs, and many jobs cannot exist in such high-housing-cost areas.

see from the Housing Affordability Index that Denver single-family dwellings also became much more expensive.

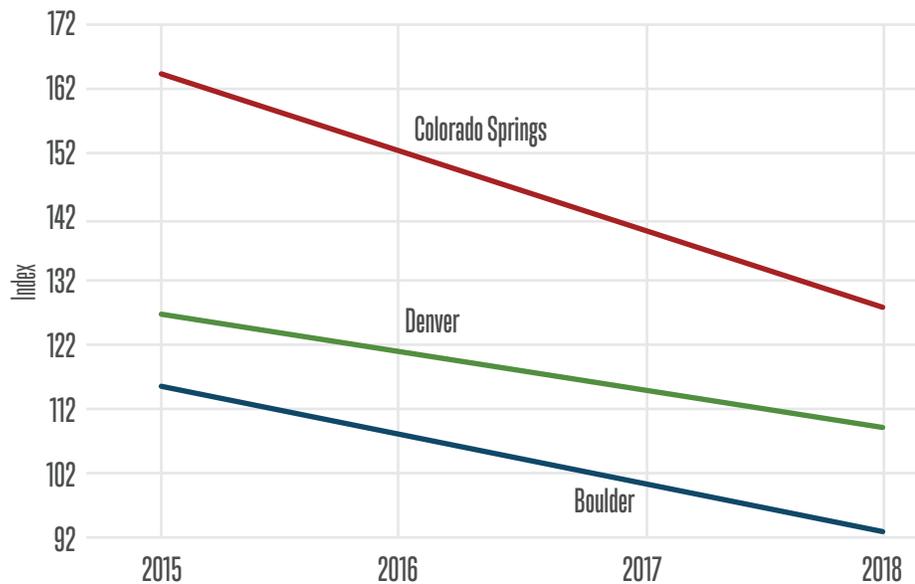
High-cost housing also forces longer commuting distances, adding to the traffic deterrent to reaching distant workplaces. Pre-Covid-19, Denver's commuting costs were 24th in the nation, and troublesome traffic exists far outside of Denver, especially northward. Just the Denver, Boulder, and Fort Collins metro areas account for 63.2% of Colorado's total population. Looking at the entire central front range area, including Pueblo, Colorado Springs, and Greeley, we find 84% of Colorado's growing population. The Boulder area is #1 in population density among mountain state metro areas. Denver, Colorado Springs, and Fort Collins are #3, #6, and #8, respectively, in density. Unpopular (until tried)

congestion fee approaches may be unavoidable alternatives to debilitating gridlock. It is very expensive to out-run (out-build) demand growth for 'free'-way capacity.

Colorado's combination of rough terrain, winter weather, expensive housing, traffic, and spots with zoning that slows building could very well contribute to difficulty connecting employers with an appropriate mix of skilled and low-skilled (or in-training) workers willing to work for an amount the employers can and will pay.

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Figure 1: Housing Affordability Index



Source: Natl Association of Realtors: Affordability Index of Existing Single Family Homes for Metropolitan Areas

UNIQUE TO COLORADO FACTORS AND COMBINATIONS OF FACTORS

Many of the factors discussed up to this point can apply to any state. Every state has zoning, a single salary schedule for K-12 teachers to a great extent (extensive out-of-field teaching), and largely fails to address infrastructure congestion through tolls or fees. To the extent that Colorado has larger skills gaps or lags in particular industries, therefore, there may exist within the state a combination of factors that cause unique effects. For example, the combination of terrain and high altitude winter weather challenges,

and beauty, may be a key to the high population density along the front range, which may make zoning restrictions and absence of congestion fees more important in Colorado, generally, or more important to certain industries. Offsetting inherent disadvantages may necessitate tackling the politics of conditions it shares with other states. Some policies unique to Colorado, or recent political churn, may be partly to blame.

NAVIGATING THE POLITICAL PROCESS

Likely, the policy reforms suggested by the description of longstanding causes are not politically feasible. They would include heavy lifts, politically, such as—

- market determination of individual teacher salaries;
- more competitive pressure in schooling markets to energize avoidance of out-of-field teaching;
- more competitive teacher labor markets, including more districts and significant expansion of genuine school choice (schools can differ significantly – few/no shortages of space);
- stop-gap measures to short-circuit some long-term solutions;
- varying college tuition rates by major;
- much-relaxed zoning restrictions; and
- rush-hour congestion tolling (revenues dedicated to tolled highway segments), and entry fees for congested areas.

A room full of people with sincere differences of perspective—but

committed to resolution of insidious causes—might be able to develop innovative policy that reduces opposition through informative experimentation or through a gradual phase-in. Of course, the key is to create such a group, perhaps a commission created by the Governor. Probably the closest Colorado has to this is the Colorado Workforce Development Council, the same entity which produced the Colorado Talent Pipeline Report. But the current political environment is not encouraging, and the Talent Pipeline Report seems to boil down to pursuing streamlining of state services and ‘More-of-the-Same-Harder’—a strategy co-author John Merrifield discovered repeatedly in his examination of *The School Choice Wars* (Merrifield, 2001), and the failure to progress on *School System Reform* (Merrifield, 2019).

The Talent Report Pipeline repeatedly cites the need to pursue equity—to address racial disparities in hiring outcomes—even though [disparities are quite often not the result of any](#)

[discrimination \(Sowell, 2018\)](#). This creates a cloud over hiring efforts while providing no new approaches to getting more talent into the pipeline. Much greater inequities lie in the persistence of funding and of governance policies for K-12 and Higher Education, which creates barriers to high-paying jobs. The Talent Pipeline Report does not mention any of those. To the authors' credit, it dares to call for a "re-envisioning of education," though without venturing to specify what that should mean or what the re-envisioning needs to accomplish to reduce skills gaps. The Talent Pipeline Report cites "Colorado Rising," a 2017 Colorado Higher Ed document⁴² that laments underfunding but confesses no lapses, failures, or needs for reform in how Colorado universities operate. A [more recent document](#) with nearly the same catchy title at least seeks ways to make higher education more affordable.⁴³

Experimentation is especially likely to be necessary and fruitful for traffic reduction and easing of zoning restrictions. Phase-

in is likely to be absolutely necessary for price decontrol in K-16 education.

Colorado's recurrent recent struggles to keep up with its neighbors suggests a possible policy change basis. A detailed comparison of Colorado's policy changes to its neighbors is beyond the scope of this assessment, but a suggestive overview can be a good starting point. As the data below demonstrate, during the last twenty-two years Colorado has gone from politically red (Republican dominated) to purple (very competitive) to blue, recently.

Because this might be a [divided government story](#),⁴⁴ we hasten to add that Democrat governors alongside GOP majority legislatures were common (Lamm – three terms) at the end of the 20th century. In our roles leading the Institute for Objective Policy Assessment, however, we would argue that governors such as Lamm would now struggle to win a Democratic nomination, a conclusion he implicitly endorsed by running for President under a third party banner.

	Governor	State House		State Senate	
		Republican	Democrat	Republican	Democrat
1999	R	42	23	21	14
2001	R	38	27	18	17
2003	R	38	27	18	17
2005	R	32	33	18	17
2007	D	26	39	16	19
2009	D	29	36	14	21
2011	D	33	32	15	20
2013	D	29	36	17	18
2015	D	32	33	18	17
2017	D	25	40	18	17
2019	D	24	41	16	19
2021	D	24	41	15	20

The divided government story, [supported by the likes of Milton Friedman](#),⁴⁵ is that widespread disagreement yields economically consequential policy stability, so that the recent shift away from politically competitive (purple) is to blame for Colorado lagging its neighbors in the industries identified earlier in this report under “Overview Through Shift-Share Analysis.” In the divided government story, disruption and uncertainty because of political churn is to blame, not the specifics of policy changes.

An alternate story is that the direction of change, from purple to blue, is partly to blame. Governor Polis’ [recent declaration](#) that the optimal income tax rate is zero⁴⁶ is a promising sign that Colorado will build on its history of fiscal conservatism. (Since 1992,⁴⁷ Colorado’s Taxpayer’s Bill of Rights has been the nation’s most stringent constitutional limit on [state and local government spending growth](#).) A move in this direction could offset possible disadvantages that exist because of policy inertia and geographic realities.

The circumstances of Colorado’s neighbors support the divided government story and the direction of change story. Utah and Wyoming are solid red. It has been quite a while since either has had a Democrat governor, and they have recently always had a Republican majority in both legislative chambers. Arizona and New Mexico are politically competitive.

Correction of systemic defects often produces positive results slowly, and sometimes only after a troublesome transition period. Subsidy of apprenticeships and worker investment in training are areas that, while costly on the front end, can deliver quicker results. Because employers of apprentices are wary of the easy loss of training investments to competitors, apprenticeship use may be especially sensitive to direct cost reduction through a subsidy.

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CONCLUSION

Concerns that skills gaps may be undermining economic growth and the building of profitable businesses and high-paying jobs led to this preliminary investigation. Several of Colorado’s industries appear to suffer inadequate access to the skilled workers needed for competitiveness and expansion.

A combination of common policies, perhaps some policies unique to Colorado, and geographic factors seem to underlie many businesses’ inadequate access to skilled labor. The pay structure for public school teachers exacerbates the shortage of teachers specialized in

teaching the subjects necessary to interest pupils in, and prepare them for, the jobs for which skills gaps persist. For those graduates who pursue these jobs despite the education systems’ insufficiencies, the state of Colorado and local governments across the state have created burdensome barriers to entry—especially occupational licensing—for certain career fields, further diminishing the likelihood of filling skills gaps. For those willing and able to overcome these hurdles, congestion and housing costs can deter workers from accepting in-demand jobs. If they do, Colorado’s infrastructure, traffic, and housing—already between struggling

and failing—probably cannot support the growth in workforce populations that would follow firms finding qualified applicants for all of their openings.

It is consequently very unlikely that any single policy reform would put a significant dent in the widespread skills gaps. While certain individual reforms may improve the situation, economics’ [“theory of the second best” might suggest that](#), in some instances, addressing only one of many barriers could make things worse.⁴⁸ For example, increasing the number of people with highly sought-after skills without addressing the key reasons for housing and traffic challenges could compound housing and congestion issues, thus making it more difficult to attract additional talent to that part of the state.

As indicated by the tepid recommendations of the [Colorado Talent Pipeline Report](#), the policy responses implied by the likely causes are mostly political heavy lifts that will also not quickly yield huge results. Because of the political challenges inherent in addressing longstanding causes, and despite the potential problems raised by the theory of the second best, Colorado policymakers should warm to the challenge by considering some possible quick, partial fixes such as boosting apprenticeship.

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