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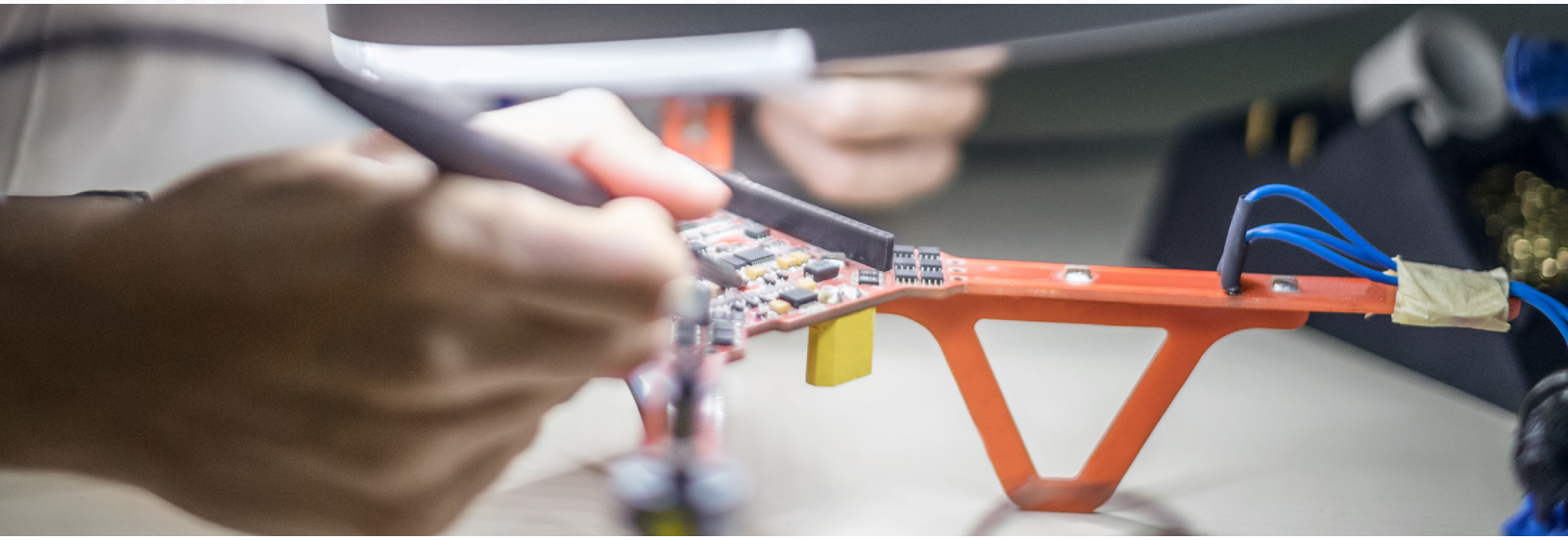

Strategies for Resilient Growth in the Knowledge Economy

A white paper based on the Milken Institute's "State Technology and Science Index"

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Introduction

The COVID-19 pandemic has revealed disparities in the national economic landscape that may have particularly adverse effects for specific regions of the United States. A critical component of economic recovery at the state level will be restoring a trajectory for resilient growth. Knowledge economies provide a foundation for the pursuit of that objective.

For state leaders, the challenge lies in strengthening education and training options and creating jobs to employ skilled workers. This requires directing investments toward higher education and employer engagement as well as linking these opportunities. Developing systems to provide core scientific competencies and new technical skills aligned to critical workforce needs is key to making recovery plans more resilient, and bolstering support for entrepreneurs and job creation establishes a foundation for broad-based economic growth.

What is the role of the knowledge economy?

This white paper uses the Milken Institute's "2020 State Technology and Science Index (STSI)" to identify best practices for resilient growth based on the relative strength of states' knowledge economies.[1] The top-ranking states not only have the capacity for groundbreaking discoveries, but they also nurture emerging technologies by helping new firms enter the market.

STSI is a composite of five sub-indexes that each measures a different dimension of the knowledge economy: Research and Development Inputs, Risk Capital and Entrepreneurial Infrastructure, Human Capital Investment, Technology and Science Workforce, and Technology Concentration and Dynamism. Because each state's overall ranking on STSI includes a mix of different measures across each of these dimensions, the highest-ranking states tend to demonstrate diverse forms of high-tech activity:

- **Massachusetts** has consistently been the No. 1 performer on STSI due to its strong research capacities and its business environment. The Bay State is home to more than 120 institutions of higher education, many of which have pursued breakthroughs in distance learning before and during the pandemic.[2] It is also home to numerous high-tech sectors that proved resilient during the sharpest economic downturn in a century.[3]
- **Colorado** ranked No. 2 on STSI 2020 thanks to dynamic growth and strong private-sector investment in sectors such as information technology[4] and aerospace.[5] These industries—and others—continued growing despite the economic turmoil of the past year. Together with more than 30 federally funded research laboratories in the Centennial State,[6] they can provide the foundation for knowledge-based growth well into the future.

While top-tier states have many advantages, they must act to maintain a high level of performance. As we discuss further, Tier 1 states such as Maryland and Utah have a vital opportunity to address specific issues that could present much broader challenges in the future. By supporting the growth of knowledge economies, all 50 states can keep workers employed while problem solving for key challenges to prosperity, making these efforts central to success in the post-pandemic period.[7]

What strategies can state leaders use to provide a foundation for resilient growth?

The best approaches to promoting resilient growth vary based on where states landed in the rankings of their knowledge economies. STSI 2020 provides a useful tool for states to benchmark their performance vis-à-vis peer states by dividing states into five tiers, based on their position relative to the top and bottom overall ranking scores.

This white paper identifies a handful of states from each of five tiers with characteristics that are broadly representative of states in that tier. In the highest-ranking (Tier 1) and lowest-ranking (Tier 5) states, there are more obvious similarities than one may find in the middle layers of the rankings. Tier 1 states tend to rank at or near the top of all five sub-indexes, whereas Tier 5 states tend to rank at or near the bottom of all five. Nonetheless, several key patterns emerge across each group.

High-ranking states can adjust to changing circumstances, including different needs for economic recovery after the pandemic. Supporting more robust pipelines for technology to move from concept (in university labs) to commercialization (at private companies) can ensure that these states remain attractive places to live, learn, and work.

Mid-ranking states have critical pieces of the foundation for knowledge-based growth. However, they need to improve coordination across their policy and business environments. Establishing stronger links between higher education and industry in these states can catalyze job creation in high-tech sectors.

Low-ranking states require broad-based investments to change their growth trajectory and protect against the effects of future economic downturns. Leveraging public funds to attract private-sector investment can generate more demand for high-skill workers.

The remainder of this white paper reviews the results of STSI 2020 and the implications of these rankings for state-level application and explores best practices for supporting resilient growth. Based on states' experiences in each tier, the white paper also presents a short set of strategies that others in the same tier might consider.

TABLE 1. STATE TECHNOLOGY AND SCIENCE INDEX 2020 RANKINGS

	Overall Ranking	R&D Inputs	Risk Capital	Human Capital	Tech Workforce	Tech Dynamism
TIER 1 STATES						
Massachusetts	1	1	3	1	3	4
Colorado	2	6	2	4	4	2
California	3	4	1	8	5	3
Maryland	4	2	18	2	1	10
Washington	5	10	5	14	1	4
Utah	6	19	4	3	10	1
TIER 2 STATES						
New Hampshire	7	5	11	16	6	13
Virginia	8	12	25	5	6	7
Delaware	9	3	12	12	15	15
Oregon	10	20	7	17	9	11
Minnesota	11	24	6	7	6	22
Connecticut	12	8	15	6	21	20
Pennsylvania	13	7	10	11	17	30
New Jersey	14	17	14	13	12	18
North Carolina	15	14	17	22	15	12
TIER 3 STATES						
Texas	16	25	9	35	17	8
Arizona	17	18	19	30	29	6
New Mexico	18	22	22	28	14	16
Michigan	19	9	28	29	12	23
Illinois	20	16	13	10	32	25
New York	21	11	8	9	43	27
Georgia	22	32	20	26	30	9
Rhode Island	23	13	36	15	23	35
Ohio	24	15	24	31	17	37
Wisconsin	25	21	27	23	20	35
Idaho	26	36	29	39	22	14
Indiana	27	27	26	21	36	29
Vermont	28	34	29	23	36	19

TABLE 1. STATE TECHNOLOGY AND SCIENCE INDEX 2020 RANKINGS (continued)

	Overall Ranking	R&D Inputs	Risk Capital	Human Capital	Tech Workforce	Tech Dynamism
TIER 4 STATES						
Montana	29	28	21	34	25	33
Kansas	30	38	35	26	26	26
Missouri	31	31	37	20	33	31
Alabama	32	23	46	36	24	28
Florida	33	39	16	42	47	16
Iowa	34	30	45	18	27	38
South Carolina	35	40	31	44	34	20
Alaska	36	26	49	37	11	46
Hawaii	37	29	33	38	41	32
Nebraska	38	33	42	19	31	49
Wyoming	39	37	40	32	27	45
Tennessee	40	35	23	40	45	33
North Dakota	41	41	39	23	39	46
TIER 5 STATES						
South Dakota	42	42	44	33	36	41
Maine	43	44	33	41	40	43
Kentucky	44	43	31	48	44	39
Oklahoma	45	48	43	50	35	40
Nevada	46	47	41	49	50	24
Louisiana	47	46	47	45	46	46
Arkansas	48	49	38	47	49	42
West Virginia	49	50	50	43	41	44
Mississippi	50	45	48	46	48	50

Source: Milken Institute (2020)

The Knowledge Economy as a Foundation for Resilient Growth

TIER 1 STATES:

MAINTAIN SUCCESSFUL INITIATIVES AND FOCUS ON THE LONG TERM

States in the top tier ranked highly across most—if not all—of the five sub-indexes in STSI. To maintain their ranking, they can improve efficiency through collaboration among public, private, and nonprofit entities in the technology pipeline. Given their diversity of knowledge economy assets, states in the top tier are generally well-positioned to recover from the COVID-19 pandemic recession. However, they must also ensure that these tools are coordinated to prevent technologies, businesses, or workers from falling behind.

TABLE 2. AREAS OF OPPORTUNITY AND IMPROVEMENT FOR SELECT TIER 1 STATES

	Overall Ranking	R&D Inputs	Risk Capital	Human Capital	Tech Workforce	Tech Dynamism
Maryland	4	2	18	2	1	10
Utah	6	19	4	3	10	1

Source: Milken Institute (2021)

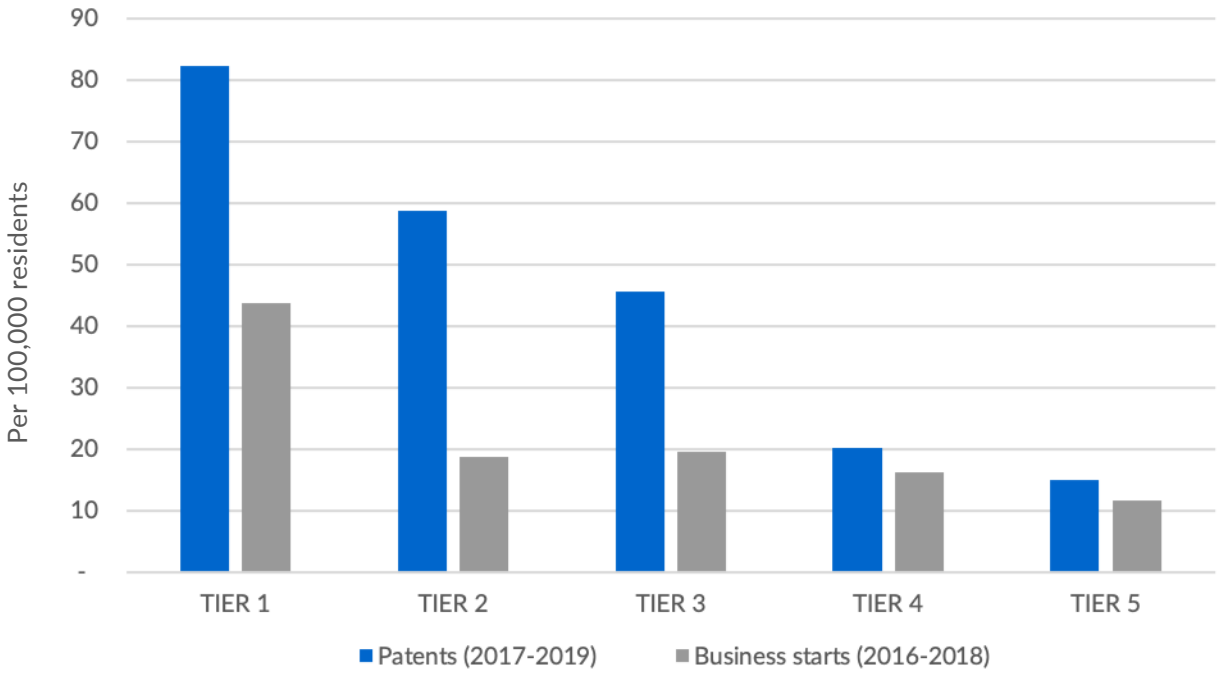
Maryland ranked No. 4 overall but No. 18 on the sub-index of Risk Capital

- Among Tier 1 states, the average number of patents (82 per 100,000 residents from 2017 to 2019) was over twice as high as it was in Maryland (36 per 100,000 residents).
- Among Tier 1 states, the average number of new business starts (44 per 100,000 residents from 2016 to 2018) was over five times as high as it was in Maryland (8 per 100,000 residents).

Maryland was a top performer in STSI 2020 but lagged in the development of infrastructure to help technologies reach the market, as shown in Figure 1. The Old Line State has steadily improved on the Thumbtack Small Business Friendliness

survey, rising from an overall B-minus grade in 2017 to an A grade in 2019. However, it received low marks for a complex tax code and licensing regulations, indicating a relatively high cost of doing business, particularly for entrepreneurs. Although the state's 8.25 percent corporate tax rate is relatively high, multiple Tier 1 states have similar rates (including California at 8.84 percent and Massachusetts at 8 percent) but higher business startup rates.[8]

FIGURE 1. AVERAGE OUTCOMES: PATENTS AND BUSINESS STARTS



Source: Milken Institute (2021)

Utah ranked No. 6 overall but No. 19 on the sub-index of R&D Inputs

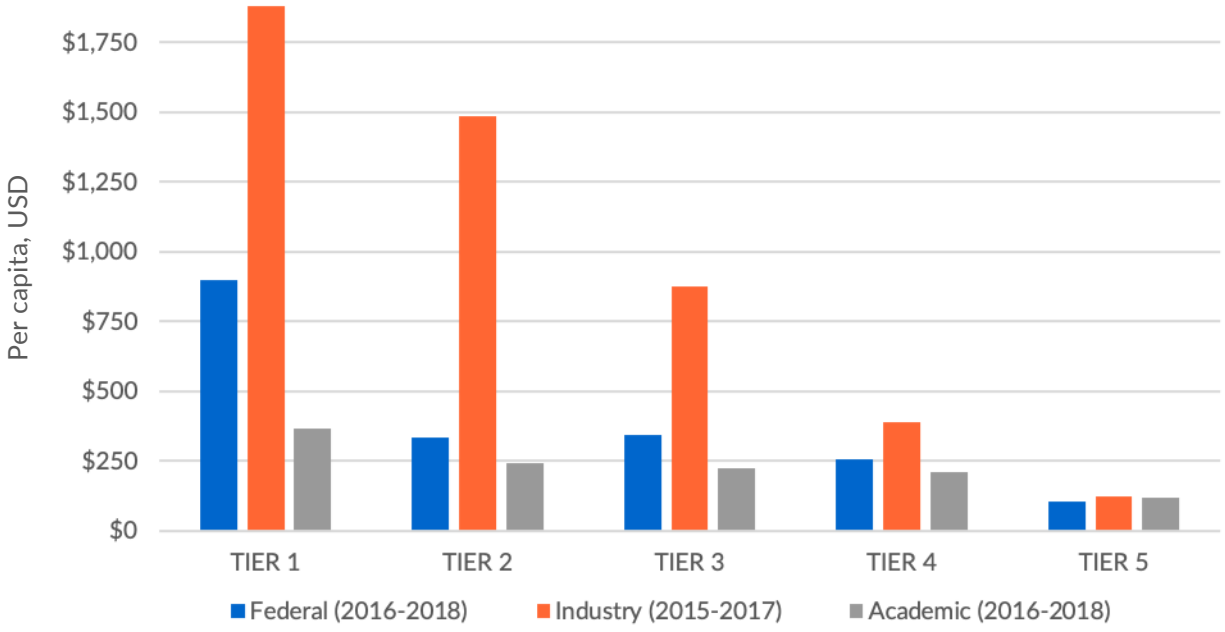
- Among Tier 1 states, average industry R&D funding ($1,880 per capita from 2015 to 2017) was six times as high as it was in Utah ($285 per capita).
- Among Tier 1 states, average National Science Foundation (NSF) funding ($61 per $1 million Gross State Product [GSP] from 2016 to 2018) was almost twice as high as it was in Utah ($33 per $1 million GSP).

Utah has an extraordinary level of tech dynamism, as evidenced by the fact that all of the state's major metro areas ranked in the top tier of our Best-Performing Cities Index for 2021.[9] However, the state does not yet provide as much support for original research as its Tier 1 peers, as shown in Figure 2. For example, while

NSF funding is a significant source of support for Academic R&D, the Beehive State only has three major universities: University of Utah in Salt Lake City, Utah State University in Logan, and Brigham Young University in Provo. Only the University of Utah is classified as an R1: university with "Very high" research activity. Utah State and Brigham Young are classified as R2 universities with "High" research activity. However, there were signs of an increase in NSF funding in 2020.[10] The University of Utah received a five-year, $20 million grant to fund Phase II development at the Center for Synthetic Organic Electrochemistry.[11] And Utah State University received a five-year, $26 million grant to establish an Engineering Research Center for the adoption of electric vehicles (Advancing Sustainability through Powered Infrastructure for Roadway Electrification, ASPIRE).[12]

More concerning was the state's 2019 decision to eliminate the Utah Science Technology and Research Initiative (USTAR), which managed competitive grant programs for local startups.[13] In its final year, funding for the program was cut from $22 million to $1.8 million, and management of the Small Business Innovation Research (SBIR) program was transferred to the Governor's Office of Economic Development.[14]

FIGURE 2. AVERAGE R&D SPENDING



Source: National Science Foundation Federal Funds for Research and Development (FY2016-FY2018), Business Research and Development Survey (2015-2017), and Survey of Federal Science and Engineering Support to Universities, Colleges, and Non-profit Institutions (FY2016-FY2018)

APPLYING BEST PRACTICES IN TIER 1 STATES

- **Strong R&D capabilities can be leveraged to promote commercial successes, but this requires developing innovations that can be commercialized.**

- **Technology incubators can identify ideas with potential for commercialization, but state governments must also support an increase in private investment across a variety of high-tech industries.**

TIER 2 STATES:

INVEST IN AREAS WHERE PERFORMANCE LAGS

Second-tier states tended to demonstrate very high rankings in most areas but often lagged behind their peers in specific sub-index rankings. Although these states have weak points in their knowledge economies, they are not beyond the reach of policy reforms—whether increasing R&D funding or eliminating barriers to market entry for startups. Without a focused effort to improve in key areas, Tier 2 states may face a longer path to recovery after the pandemic, particularly in sectors that are not resilient enough to weather major economic disruptions.

TABLE 3. AREAS OF OPPORTUNITY AND IMPROVEMENT FOR SELECT TIER 2 STATES

	Overall Ranking	R&D Inputs	Risk Capital	Human Capital	Tech Workforce	Tech Dynamism
Virginia	8	12	25	5	6	7
Minnesota	11	24	6	7	6	22
Pennsylvania	13	7	10	11	17	30

Source: Milken Institute (2021)

Virginia ranked No. 8 overall but ranked No. 25 on the sub-index of Risk Capital

- Among Tier 2 states, the average number of new patents awarded (59 per 100,000 residents from 2017 to 2019) was almost twice as high as it was in Virginia (30 per 100,000 residents).
- Among Tier 2 states, average venture capital biotech investment ($451 per $1 million GSP from 2017 to 2019) was almost three times higher than it was in Virginia ($159 per $1 million GSP).

Much like its neighbor Maryland, Virginia has substantial science and technology assets thanks to its proximity to the federal government and military institutions. However, it has also lagged in supporting institutions that facilitate high-tech growth using these assets. Despite the Old Dominion's strong business climate (it ranked No. 4 in the CNBC "Top States for Doing Business in 2018" and moved up to No. 1 in 2019[15]) its rankings for the cost of doing business fell substantially (No. 34 in 2018 and No. 35 in 2019). Programs such as the Technology Transfer Assistance Project could help lower the costs of translating the state's substantial resources in

R&D and human capital into growth at startup or spinoff firms creating products with commercial potential.[16]

Minnesota ranked No. 11 overall but No. 24 on the sub-index of R&D Inputs

- Among Tier 2 states, average federal R&D spending ($334 per capita from 2016 to 2018) was almost twice as high as it was in Minnesota ($172 per capita).

- Among Tier 2 states, average academic R&D spending ($245 per capita from 2016 to 2018) was 40 percent higher than it was in Minnesota ($175 per capita).

Minnesota has a strong technology pipeline but has not funded new research at the same rate as other Tier 2 states. Although R&D spending in the University of Minnesota system has been rising significantly over the past few years,[17] the vast majority of that activity (over 95 percent) is concentrated on the Twin Cities campus. The University of Minnesota's Duluth campus is a distant second, while other public universities and the state's liberal arts colleges account for much smaller amounts of research funding.[18] The North Star State's level of industry R&D per capita was relatively higher ($1,001 per capita average from 2015 to 2017), though still below the Tier 2 average of $1,485 per capita during that span.

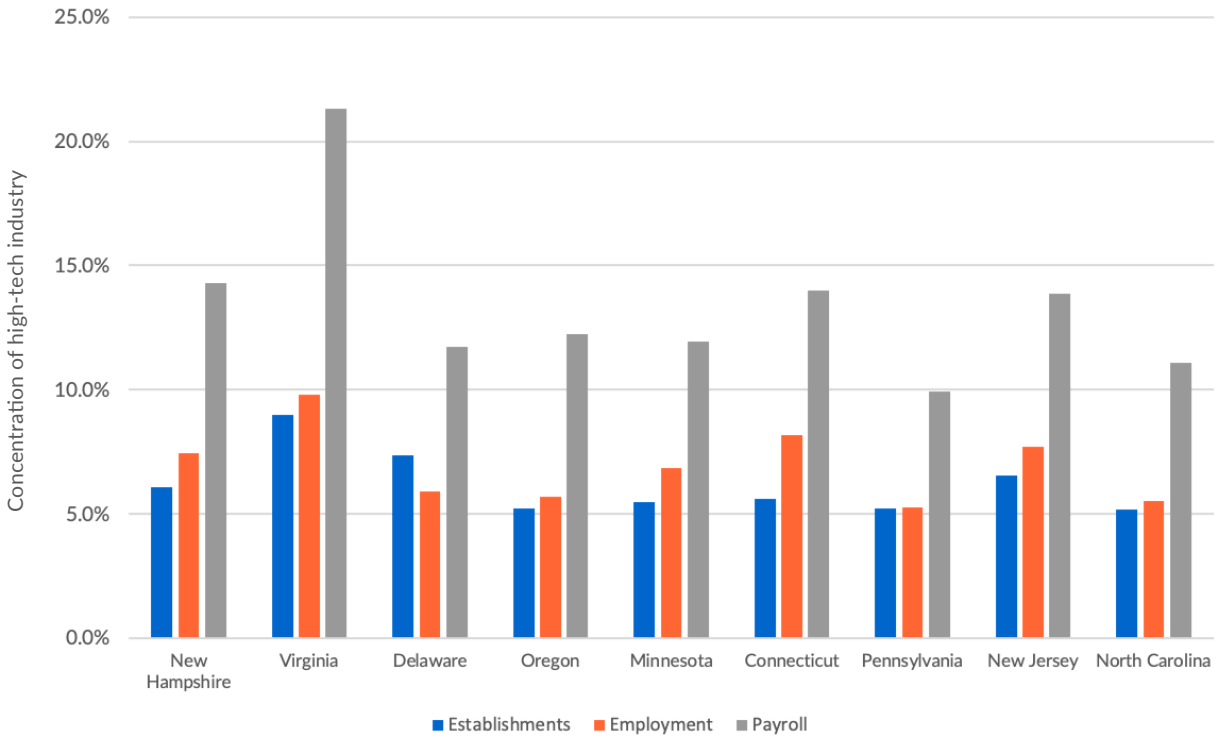
Pennsylvania ranked No. 13 overall but No. 30 on the sub-index of Tech Dynamism

- Pennsylvania had a low rate of job creation in high-tech industries (0.9 percent from 2016 to 2018). Among Tier 2 states, the average net employment growth in high tech was three times as high (2.7 percent).

- Average high-tech concentration from 2017 to 2019 was also higher among Tier 2 states than in Pennsylvania as a proportion of total businesses (6.2 percent to 5.2 percent), total employment (6.9 percent to 5.3 percent), and payroll (13.4 percent to 9.9 percent).

Pennsylvania's substantial research and workforce assets have not fostered robust growth in high-tech sectors, as shown in Figure 3. A Brookings Institution analysis of the Keystone State's innovation economy in 2019 noted that the state lacks a comprehensive statewide strategy for supporting startups.[19] The Ben Franklin Technology Development Authority, established to support entrepreneurship and innovation, has also received less support in recent years following the discontinuation of supplemental state funding from the Alternative Energy Development Program and the Innovate in PA initiative.[20]

FIGURE 3. AVERAGE HIGH-TECH INDUSTRY CONCENTRATION IN TIER 2 STATES



Source: US Census Bureau, County Business Patterns (2016-2018)

APPLYING BEST PRACTICES IN TIER 2 STATES

- **Developing comprehensive strategies that link research output and commercialization opportunities requires strong public-private coordination.**
- **A weak patent-to-product pipeline may be a sign that startups need more support; this can be generated by "de-risking" investments that attract venture capital or by taking additional steps to reduce their operating costs.**

TIER 3 STATES:

IDENTIFY OPPORTUNITIES TO IMPROVE CONSISTENCY

Tier 3 states unsurprisingly had the broadest range of results across the sub-index components of STSI. Nonetheless, this mix of high and low rankings demonstrates the importance of consistent performance across the pipeline from technology concept to commercialization. Efforts to promote resilient growth must provide more consistent access: for students to access educational opportunities, for small businesses to access capital, and for workers to access job opportunities in high-tech industries.

TABLE 4. AREAS OF OPPORTUNITY AND IMPROVEMENT FOR SELECT TIER 3 STATES

	Overall Ranking	R&D Inputs	Risk Capital	Human Capital	Tech Workforce	Tech Dynamism
Texas	16	25	9	35	17	8
New York	21	11	8	9	43	27
Rhode Island	23	13	36	15	23	35
Ohio	24	15	24	31	17	37

Source: Milken Institute (2021)

New York (No. 21 overall) ranked No. 9 on Human Capital and No. 43 on Tech Workforce

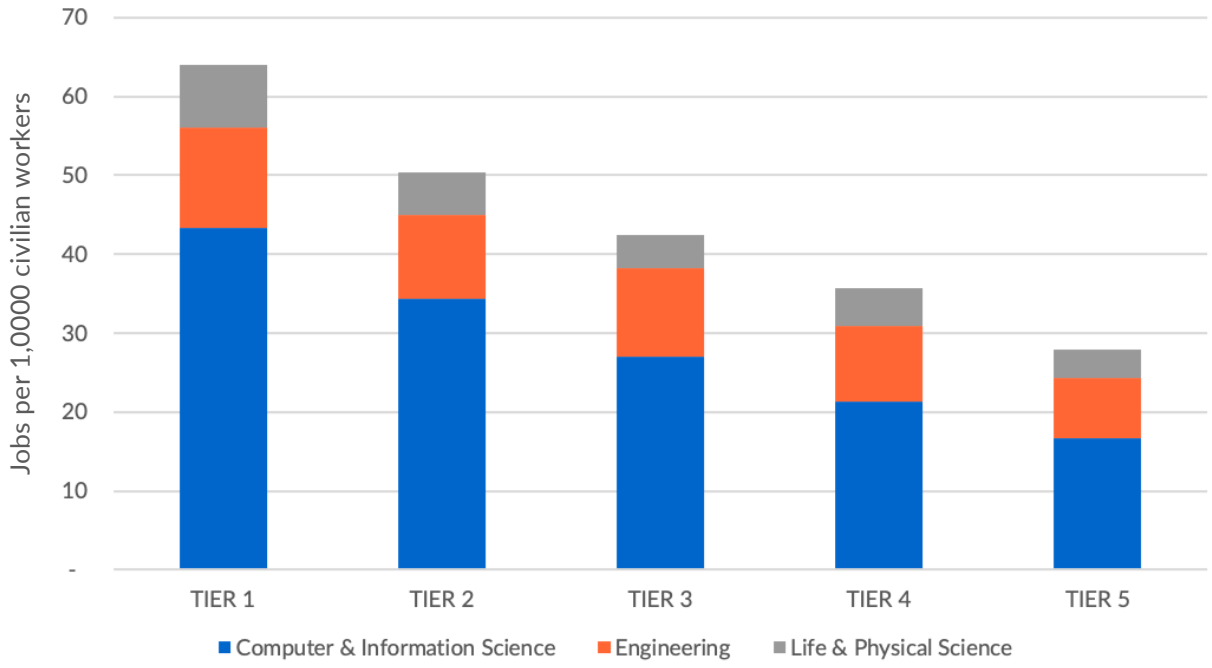
- Among Tier 3 states, the average concentrations of engineering jobs (11.2 per 100,000 workers in 2019) and life and physical sciences jobs (4.3 per 100,000 workers) were both substantially higher than the levels of concentration in New York (6.3 and 3.4 per 100,000 workers, respectively).[21]

- New York had a higher concentration of degree holders (37 percent with bachelor's degrees or higher and 16 percent with graduate degrees) than the average among Tier 3 states (32 percent with bachelor's degrees or higher and 12 percent with graduate degrees).[22]

As shown in Figure 4, there is a strong correlation between performance on STSI and the concentration of workers in high-tech jobs. However, New York demonstrated a mismatch between the capabilities of state residents and the quality of the jobs

available to them. The State Department of Labor showed that eight of 13 Upstate metro areas recorded job losses in the manufacturing sector between 2010 and 2016, reducing opportunities for graduates in fields such as engineering.[23] The Empire State has sought to address the gap between education and jobs by offering scholarships to graduates who agree to stay in the state.[24] However, longer-term solutions still require expanding the number of available positions in high-tech industries to provide those graduates with reasons to stay.

FIGURE 4. AVERAGE JOB INTENSITY IN HIGH-TECH OCCUPATIONS



Source: US Bureau of Labor Statistics, Occupational Employment Statistics (2019)

Ohio (No. 24 overall) ranked No. 17 on Tech Workforce and No. 37 on Tech Dynamism

- Among Tier 3 states, the average concentration of jobs in computer science (27.1 per 100,000 workers in 2019) and engineering (11.2 per 100,000 workers) was roughly equal to the concentration of similar jobs in Ohio (28.2 in computer science and 11.7 in engineering).

- Average high-tech concentration from 2017 to 2019 was significantly higher among Tier 3 states than in Ohio as a proportion of total businesses (5.1 percent to 4.7 percent), total employment (5.4 percent to 4.3 percent), and payroll (11 percent to 8 percent).

Ohio's strong industrial base has traditionally provided numerous job opportunities for state residents. However, even as US manufacturing employment rebounded before the pandemic, the Buckeye State's manufacturing jobs increased at only half the national growth rate.[25] Using the lessons from startups in Cincinnati[26] and Columbus,[27] the state could explore additional avenues to support similar growth across other metro areas. Other Midwest states that ranked low for technology dynamism despite high concentrations of engineering jobs may also benefit from similar approaches, including Michigan (No. 19 overall in STSI 2020), Wisconsin (No. 25), and Indiana (No. 27).[28]

Rhode Island (No. 23 overall) ranked No. 13 on R&D Inputs and No. 36 on Risk Capital

- Both federal and academic R&D spending were high ($601 per capita and $367 per capita averages from 2016 to 2018, respectively). Among Tier 3 states, average federal R&D spending ($344) and academic R&D spending ($223) were around 40 percent lower.[29]

- The number of new business starts was very low (3 per 100,000 residents on average from 2017 to 2019). Among Tier 3 states, average new business starts (20) were over six times as high.

Despite substantial research assets, Rhode Island has not supported local tech startup growth. The Ocean State ranked last nationwide for the fifth time in CNBC's "2019 Ranking of America's Top States for Business." Its tax code, regulations, and aging infrastructure contribute to the state's tepid business climate, and it has never finished higher than its No. 45 ranking (in 2017 and 2018) in the index's 13-year history.[30] Given its demonstrated capacity to fund R&D in new technology, the state has made efforts at promoting commercialization through its Innovation Voucher, granting small businesses awards up to $50,000.[31] From 2016 to 2019, the program provided 70 awards leading to nearly $10 million in follow-on funding, according to the state Commerce Department.[32]

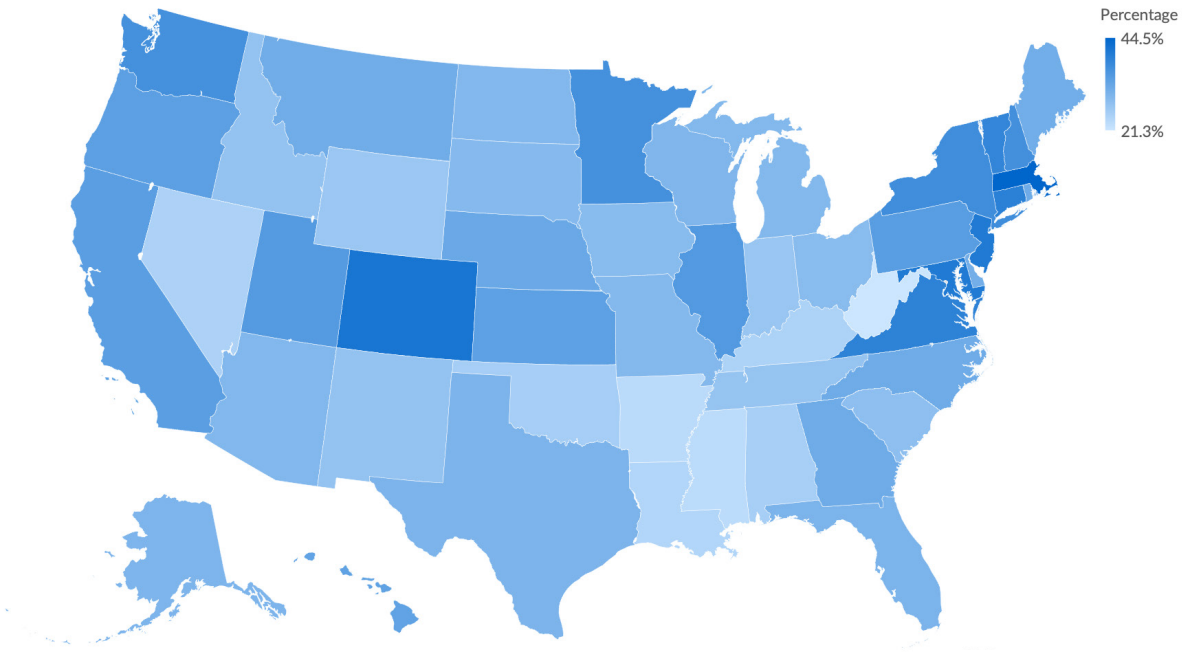
Texas (No. 16 overall) ranked No. 9 on Risk Capital and No. 35 on Human Capital

- The number of new business starts in Texas (38 per 100,000 residents on average from 2017 to 2019) was twice as high as the average among Tier 3 states (20 per 100,000 residents).

- The concentration of degree holders in Texas (30 percent with bachelor's degrees or higher and 11 percent with graduate degrees) was very similar to the average among Tier 3 states (32 percent with bachelor's degrees and 12 percent with advanced degrees).[33]

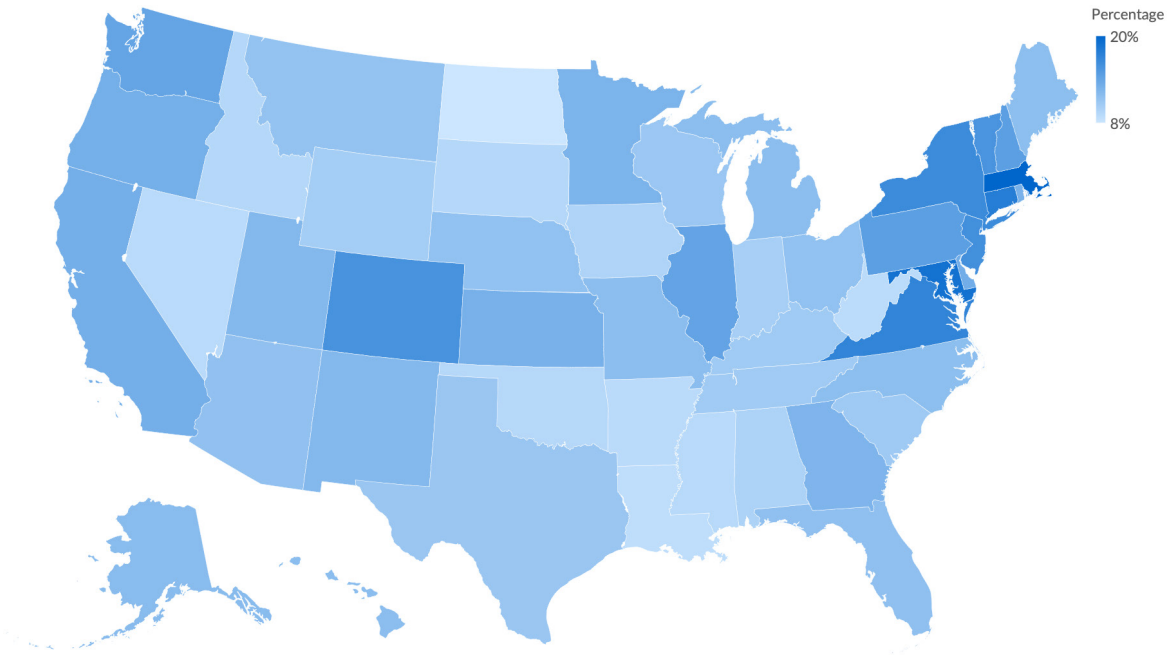
Texas illustrates the difference between creating high-tech jobs and providing the workers needed to fill those jobs, as shown in Figure 5 and Figure 6. The Lone Star State's Higher Education Coordinating Board aims to provide postsecondary education to 60 percent of residents ages 25 to 34 by 2030. However, Rice University researchers have shown the state is unlikely to meet that benchmark, leaving a large gap between the supply and demand of college-educated workers.[34] Another key constraint on local workforce development is the lack of funding for the state's K-12 education system, ranked No. 28 in the nation according to a 2020 WalletHub survey.[35] As a growing number of high-tech firms expand their presence in Texas,[36] the state may face additional pressure to overcome education funding obstacles and provide pathways for local graduates to compete for jobs.

FIGURE 5. PERCENTAGE OF POPULATION WITH BACHELOR'S DEGREE OR HIGHER



Source: American Community Survey, One-Year Estimates (2016-2018)

FIGURE 6. PERCENTAGE OF POPULATION WITH ADVANCED DEGREE



Source: American Community Survey, One-Year Estimates (2016-2018)

APPLYING BEST PRACTICES IN TIER 3 STATES

- **Public investment in a broader range of degree programs across high-tech industries can help stimulate expansion of the local skilled workforce available to fill job openings.**
- **Private investment in job creation can help generate career opportunities in science and technology for local graduates from higher education programs.**

TIER 4 STATES:

EXPLORE THE POTENTIAL FOR POSITIVE SPILLOVERS

Fourth-tier states tended to rank in the bottom half of states on most sub-index scores, though they occasionally posted higher rankings in a specific area (or areas). In many of these states, providing continued support to these components of their knowledge economies can offer the potential for positive externalities—including spillover effects. For example, increasing public investment in human capital can increase the supply of skilled workers to fill high-tech jobs. However, it may also specifically attract private investment in technologies developed by public and university labs.

TABLE 5. AREAS OF OPPORTUNITY AND IMPROVEMENT FOR SELECT TIER 4 STATES

	Overall Ranking	R&D Inputs	Risk Capital	Human Capital	Tech Workforce	Tech Dynamism
Alabama	32	23	46	36	24	28
Florida	33	39	16	42	47	16
South Carolina	35	40	31	44	34	20
Nebraska	38	33	42	19	31	49

Source: Milken Institute (2021)

Alabama (No. 32 overall) ranked No. 23 on the sub-index of R&D Inputs

- The level of federally funded R&D in Alabama ($1,232 per capita from 2016 to 2018) was 80 percent higher than the average among Tier 4 states ($258 per capita).
- Alabama's funding through the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs ($541 per $1 million GSP and $37 per $1 million GSP, respectively, from 2016 to 2018) was substantially higher than the average among Tier 4 states ($237 per $1 million GSP and $13 per $1 million GSP, respectively).

Alabama's strong performance in R&D is closely linked to federal research facilities, particularly in aerospace. In 2018, NASA selected 304 SBIR proposals and 44 STTR proposals to advance national small business research and technology transfer, totaling $43.5 million in awards. The Marshall Space Flight Center in Huntsville won 43 of these SBIR and STTR awards, totaling almost $5.4 million,[37] helping

the city rank in the top tier of our Best-Performing Cities Index in 2021.[38] The Yellowhammer State's research assets are capable of generating new technologies with significant potential for supporting long-term growth, but this requires increasing the number of patents, business formation rate, and amounts of venture capital investment in high-tech industries.

Florida (No. 33 overall) ranked No. 16 on the sub-index of Risk Capital

- Florida's level of business starts (49 per 100,000 residents on average from 2016 to 2018) was three times the average among Tier 4 states (16 per 100,000 residents).
- The level of Small Business Investment Company funds in Florida ($369 per $1 million GSP from 2016 to 2018) was one-third higher than the average among Tier 4 states ($223 per $1 million GSP).

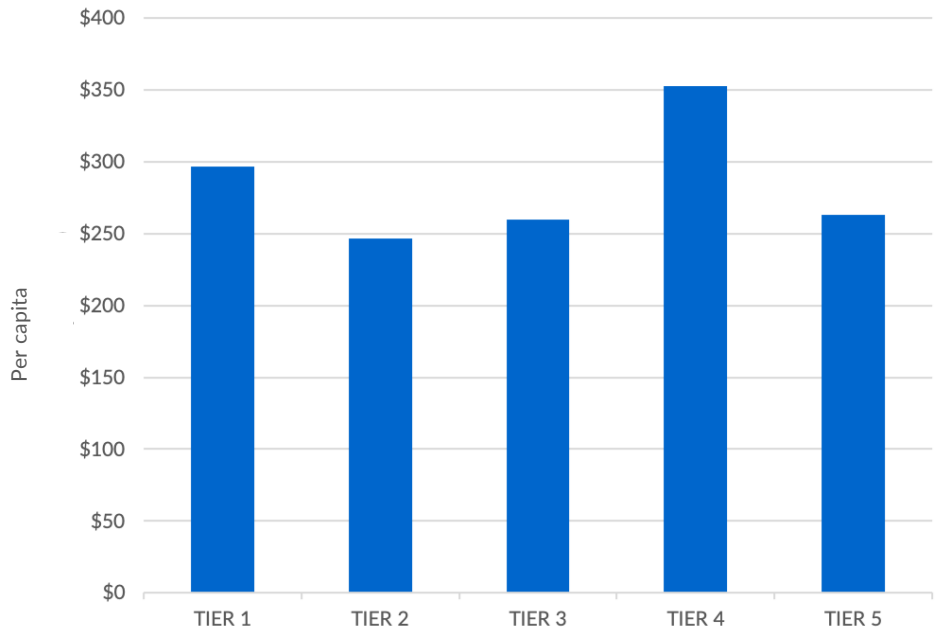
Florida's business environment fosters entrepreneurship through low tax rates, as shown by the Sunshine State's No. 4 ranking on the Tax Foundation "2019 State Business Tax Climate Index."[39] But it also has large technology hubs in areas such as the Space Coast.[40] The region's largest metro area, Palm Bay-Melbourne-Titusville, ranked No. 2 among large cities on the Milken Institute's 2021 "Best-Performing Cities Index."[41] As a next step, however, Florida must focus on translating strong overall growth rates into job creation in high-tech industries. Much of the state's job growth over the past decade has been concentrated in lower-wage work.[42] And even for better-paying jobs in the information and service economies, pay rates in cities like Miami tended to be lower than in other major metro areas around the country.[43]

Nebraska (No. 38 overall) ranked No. 19 on the sub-index of Human Capital

- Nebraska's state appropriations for higher education ($397 per capita from 2017 to 2019) were notably higher than the average among Tier 4 states ($352 per capita).
- However, Nebraska's level of high-tech business formation (6.2 net new establishments per 10,000 from 2016 to 2018) and high-tech job creation (0.5 percent average employment growth from 2016 to 2018) were notably lower than the averages among Tier 4 states (17.5 net new businesses per 10,000 and 1.6 percent average employment growth, respectively).

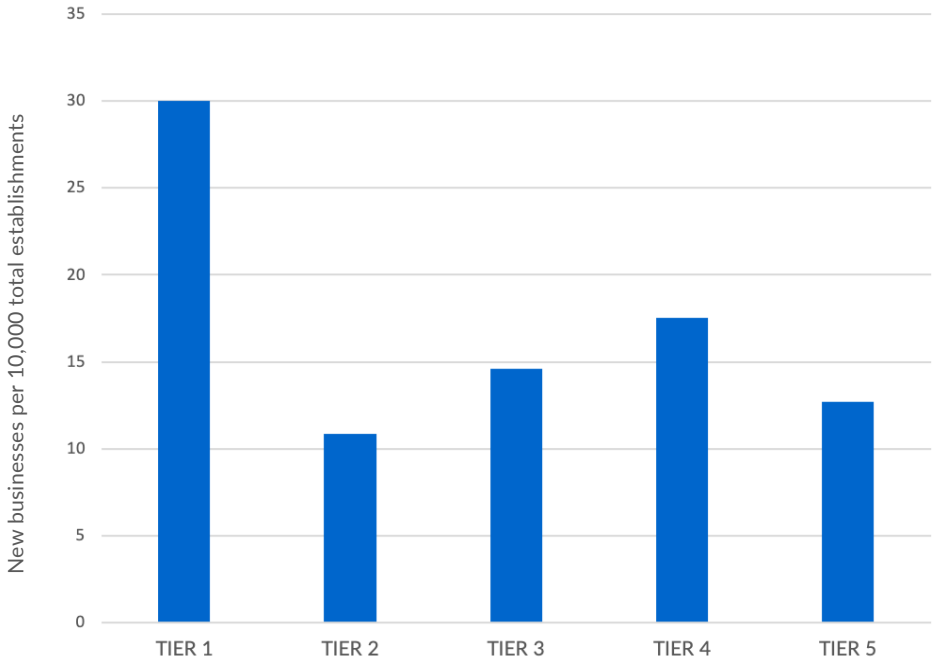
Nebraska's high level of per capita investment in higher education helps raise the average for Tier 4 states, as shown in Figure 7. Despite possessing the assets to produce an educated workforce, it has struggled to ensure that high-quality jobs are available to keep graduates in the state.[44] Those who leave the Cornhusker State for work tend to be better educated than those who stay,[45] so there are clear incentives to explore initiatives designed to stimulate the creation of new technology firms, such as the Innovation Campus at the University of Nebraska-Lincoln.[46]

FIGURE 7. AVERAGE STATE APPROPRIATIONS FOR HIGHER EDUCATION



Source: Illinois State University, Grapevine (2017-2019)

FIGURE 8. AVERAGE NET FORMATION OF HIGH-TECH BUSINESSES



Source: US Census Bureau, County Business Patterns (2016-2018)

South Carolina (No. 35 overall) ranked No. 20 on the sub-index of Tech Dynamism

- South Carolina's level of high-tech business formation (38 net new establishments per 10,000 from 2016 to 2018) was twice as high as the average for Tier 4 states, and the level of high-tech job creation (5 percent average employment growth on average from 2016 to 2018) was three times as high.
- However, South Carolina's state appropriations for higher education ($234 per capita from 2017 to 2019) were 40 percent lower than the average for Tier 4 states.

South Carolina needs to ensure a pipeline of local STEM graduates is available for employment at local tech firms, as shown in Figure 8. However, the Palmetto State faces a lack of teachers in these fields.[47] It spent less than the national average on secondary school students ($10,856 per pupil compared to $12,612 nationally) in 2018,[48] and the high school graduation rate of 84 percent was also lower than the national average (88 percent).[49] Standardized test nonprofit ACT reported that a lower percentage of graduates met the science and math benchmarks than the national average. And while 73 percent of ACT-tested graduates in South Carolina aspired to further education, in line with the national average, only 57 percent enrolled the following year, compared to 65 percent nationally.[50]

APPLYING BEST PRACTICES IN TIER 4 STATES

- **Business climate and startup culture may not sustain a long-term increase in the number of high-tech jobs without an increase in locally available talent. States also need to invest in research and train local workers to fill those jobs.**
- **Businesses won't automatically hire locally; higher wages can encourage educated residents to pursue local job opportunities, while increasing the number of residents with skills and training can lead firms to recruit more local workers.**

TIER 5 STATES:

BE BOLD AND EXPERIMENT WITH NEW IDEAS

States in Tier 5 consistently posted the lowest rankings nationwide for R&D inputs, with no state ranking higher than No. 42. Although this group also posted low rankings across other sub-index areas, several states did stand out for their strong performance on specific topics. These states may offer useful lessons to their peers regarding the value of public policies laying the foundation for future growth opportunities as the nation recovers from the COVID-19 pandemic.

TABLE 6. AREAS OF OPPORTUNITY AND IMPROVEMENT FOR SELECT TIER 5 STATES

	Overall Ranking	R&D Inputs	Risk Capital	Human Capital	Tech Workforce	Tech Dynamism
South Dakota	42	42	44	33	36	41
Kentucky	44	43	31	48	44	39
Nevada	46	47	41	49	50	24

Source: Milken Institute (2021)

Kentucky (No. 44 overall) ranked No. 31 on the sub-index of Risk Capital

- Venture capital investment in Kentucky cleantech ($206 per $1 million GSP from 2017 to 2019) was almost five times higher higher than the average for Tier 5 states ($43 per $1 million GSP).
- Venture capital investment in Kentucky biotech ($333 per $1 million GSP from 2017 to 2019) was over three times higher than the average for Tier 5 states ($104 per $1 million GSP).

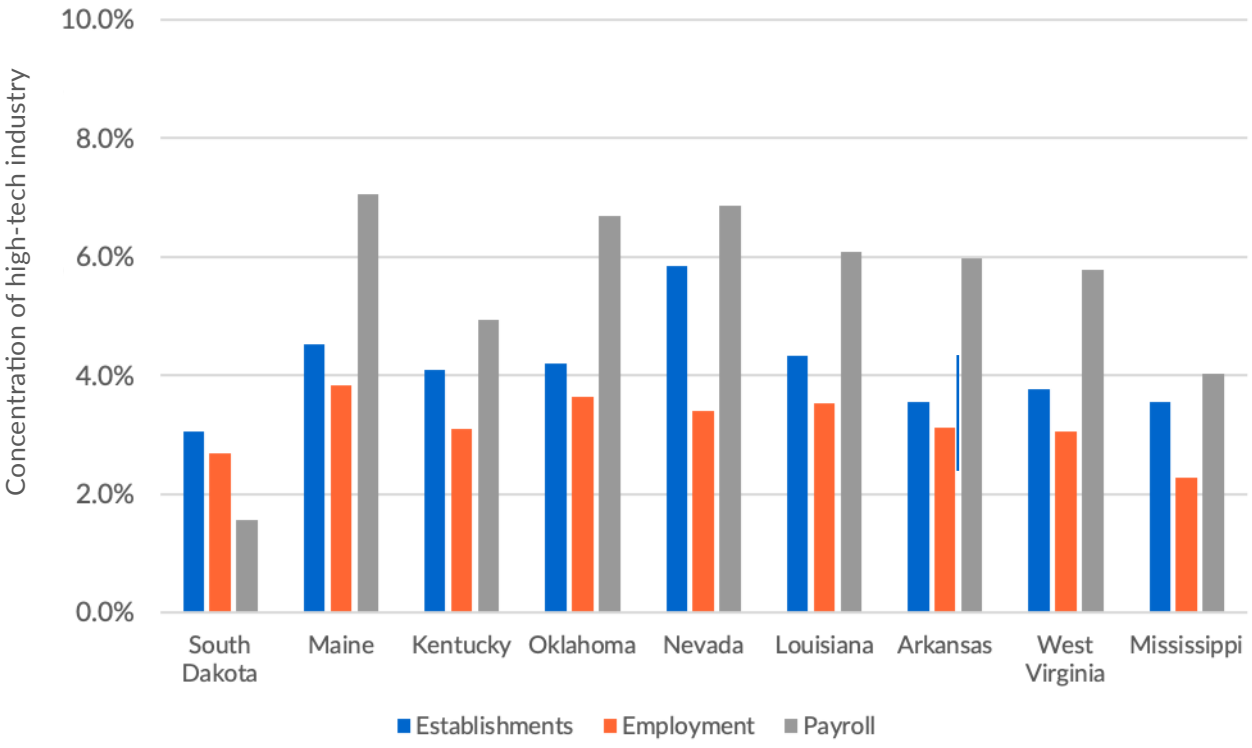
Although Kentucky's economy still relies largely on coal-fired electrical power, several initiatives have promoted additional investment in lower-emissions technology in the Bluegrass State. The nonprofit Kentucky Science and Technology Corporation operates several programs supported by public funding, including Kentucky New Energy Ventures, that offer grants, initial investments, or follow-on funding for firms providing alternative and renewable energy technologies.[51] In biotech, several companies have announced recent construction or expansion of research facilities near the University of Kentucky in Lexington.[52]

Nevada (No. 46 overall) ranked No. 24 on the sub-index of Tech Dynamism

- The rate of business formation in Nevada's high-tech industries (31.8 new establishments per 10,000 from 2016 to 2018) was 60 percent higher than the average among Tier 5 states (12.7 net new establishments per 10,000).
- Nevada's rate of employment growth in high-tech industries (5.8 percent annual growth from 2016 to 2018) was twice as high as the average among Tier 5 states (2.9 percent).

Nevada's tech industry is experiencing strong growth,[53] as shown in Figure 9. Several state institutions have sought to aid in its success, including nonprofit statewide business incubator StartupNV,[54] the University of Nevada-Reno "Innevation Center,"[55] and the Nevada Center for Entrepreneurship and Technology.[56] However, the Silver State remains highly dependent on tourism and hospitality, which experienced tremendous job losses throughout the pandemic.[57] Charting a path to more resilient job growth will require further improvements in educational opportunities for state residents so that they receive the skills and training to perform jobs in other industries.

FIGURE 9. AVERAGE HIGH-TECH INDUSTRY CONCENTRATION IN TIER 5 STATES



Source: US Census Bureau, County Business Patterns (2016-2018)

South Dakota (No. 42 overall) ranked No. 33 on the sub-index of Human Capital

- The proportion of total undergraduate degrees awarded in science and engineering fields in South Dakota (42 percent from 2016 to 2017) was substantially higher than the average among Tier 5 states (30 percent).

The 2020 South Dakota Science and Innovation Strategy[58] is an important step toward leveraging the scientific and technological skills available among state residents. The same committee that developed the strategy also manages a $20 million NSF Research Infrastructure grant to improve education systems, research capacity, and science-based economic development. Nonetheless, the Mount Rushmore State could do more to take advantage of this program by incentivizing private investment in the same areas and encouraging firms to prioritize hiring a locally educated and trained workforce.

APPLYING BEST PRACTICES IN TIER 5 STATES

- **Attracting private investment does not guarantee that states will have the human capital or skilled workforce necessary to sustain growth in business formation or job creation.**
- **Nonetheless, private investment activity can provide a valuable guide to potential matching opportunities for workforce development programs, particularly those that produce skilled manufacturing professionals and technicians**

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