MILKEN INSTITUTE

STATE TECHNOLOGY AND SCIENCE INDEX

2020

By Kevin Klowden, Aaron Melaas, Charlotte Kesteven, and Sam Hanigan

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The Milken Institute Center for Regional Economics produces research, programs, and events designed to inform and activate innovative economic and policy solutions to drive job creation and industry expansion.

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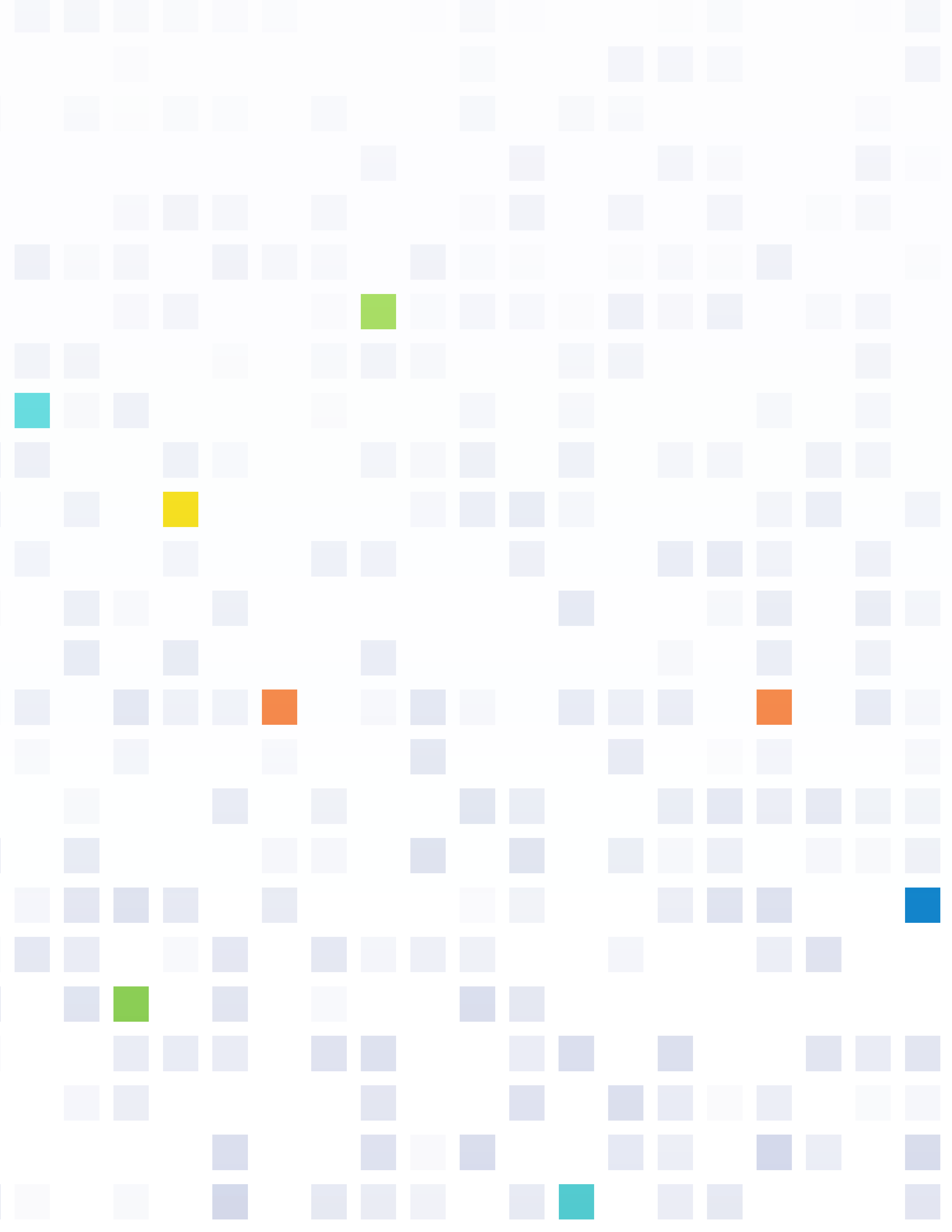


Executive Summary

The State Technology and Science Index (STSI) provides a benchmark for evaluating the knowledge economies of all 50 US states. The index compares each state's capacity for achieving prosperity through scientific discovery and technological innovation, by performing a cross-sectional analysis of their rankings on key indicators using the latest available data from US federal government and private-sector sources.

The index is a composite of five sub-indexes, which cover a diverse range of topics: research and development (R&D) inputs, risk capital and entrepreneurial infrastructure, human capital investment, technology and science workforce, and technology concentration and dynamism. By comparing how states rank in these areas, the index assesses their capacities for generating new scientific ideas, as well as for commercializing technologies that contribute to firm expansion, high-skills job creation, and broad-based economic growth.

This index provides a useful guide to understanding how and why states face different challenges. It presents a snapshot of how state-level science and technology economies compare to one another at a specific time, rather than a long-term study of how individual states have changed over time. And because the index scores are based on rankings, differences in state scores reflect the overall differences among states' knowledge economies, rather than their performance in a particular area. Within these parameters, the overall index rankings—as well as the rankings on each sub-index—help states evaluate the foundation for further development of their knowledge economies and enact policies to help businesses and workers adapt to economic change.

During 2020, the COVID-19 pandemic has shown clear disparities in our national economic landscape, with particularly adverse effects for certain regions. As such, a critical component of economic recovery at the state level will be ensuring the presence of a robust, technologically skilled workforce. For state leaders, the challenge lies not only in directing investments toward higher education and employer engagement but also in enhancing access to these opportunities for vulnerable populations and under-served communities. Developing systems to provide core scientific competencies and new technological skills aligned to critical workforce needs—while bolstering support for entrepreneurs and businesses—is key to making recovery plans more resilient and laying a foundation for broad-based economic growth.

As we do with each edition of the index, we have reviewed the combination of indicators used to calculate the rankings in prior years and made updates to this list based on the latest available data. We have also computed scores on each sub-index and used these scores to benchmark state rankings across five tiers.

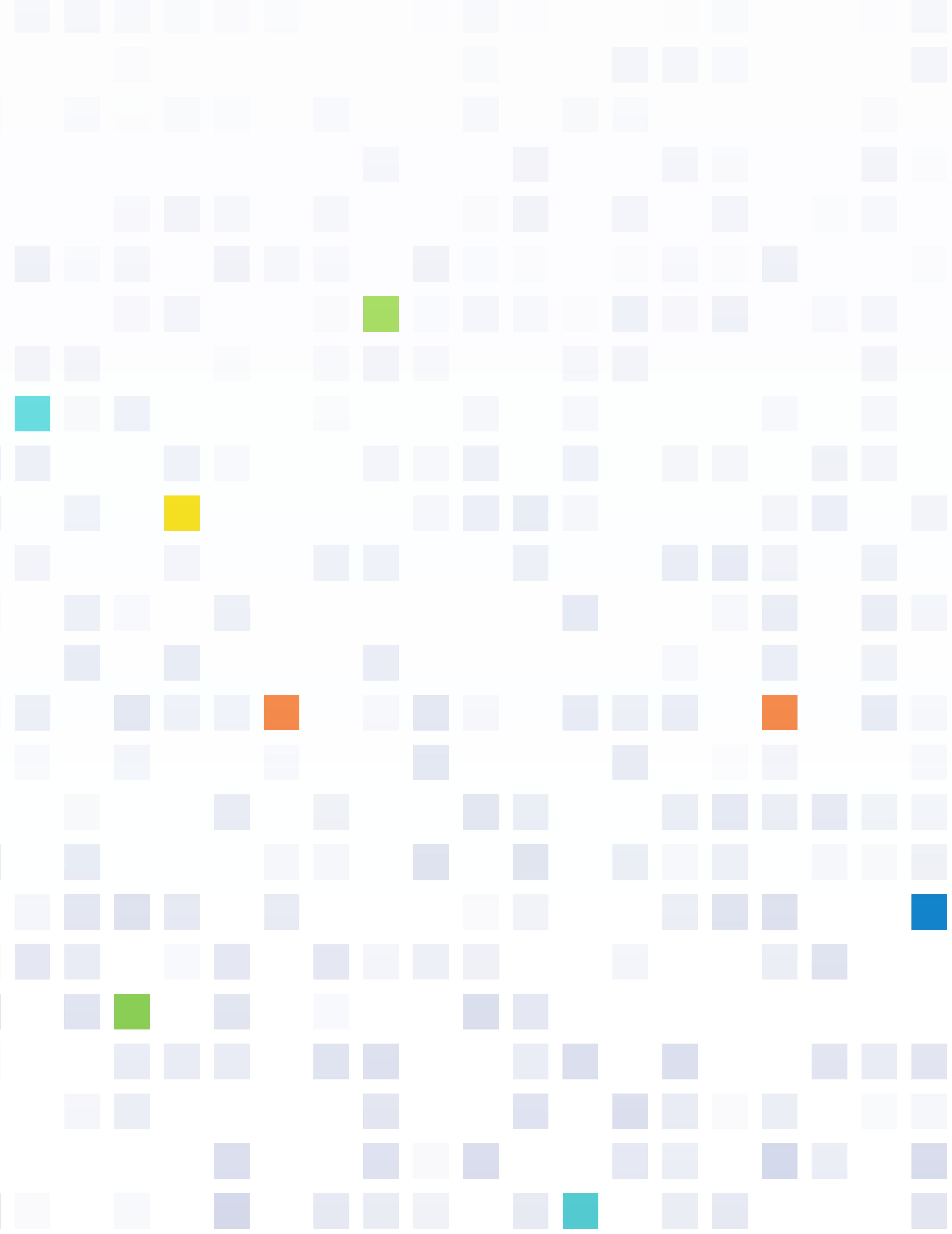
This year, the top tier of the overall index rankings included the same six states that ranked atop the previous edition of the index: Massachusetts, Colorado, California, Maryland, Utah, and Washington. The next page displays the overall rankings for STSI 2020.

TABLE 1: 2020 STATE TECHNOLOGY AND SCIENCE INDEX: OVERALL RANKINGS

State	2020 Rank	2018 Rank	2020 Score	2020 Tier
Massachusetts	1	1	86.57	1
Colorado	2	2	82.27	1
California	3	4	80.12	1
Maryland	4	3	77.93	1
Washington	5	6	74.73	1
Utah	6	5	74.20	1
New Hampshire	7	9	67.27	2
Virginia	8	12	67.20	2
Delaware	9	7	66.01	2
Oregon	10	10	64.23	2
Minnesota	11	8	64.13	2
Connecticut	12	13	64.11	2
Pennsylvania	13	14	61.74	2
New Jersey	14	20	61.50	2
North Carolina	15	11	60.42	2
Texas	16	19	59.71	3
Arizona	17	16	57.79	3
New Mexico	18	24	57.78	3
Michigan	19	18	57.69	3
Illinois	20	15	56.36	3
New York	21	17	56.15	3
Georgia	22	22	54.45	3
Rhode Island	23	21	51.86	3
Ohio	24	28	51.50	3
Wisconsin	25	25	51.45	3

State	2020 Rank	2018 Rank	2020 Score	2020 Tier
Idaho	26	26	48.84	3
Indiana	27	31	47.79	3
Vermont	28	23	47.38	3
Montana	29	27	46.22	4
Kansas	30	30	46.08	4
Missouri	31	29	45.17	4
Alabama	32	32	45.08	4
Florida	33	33	41.62	4
Iowa	34	36	41.62	4
South Carolina	35	37	41.29	4
Alaska	36	41	40.62	4
Hawaii	37	35	40.17	4
Nebraska	38	34	39.45	4
Wyoming	39	42	38.53	4
Tennessee	40	39	38.32	4
North Dakota	41	40	36.57	4
South Dakota	42	43	33.99	5
Maine	43	38	33.15	5
Kentucky	44	45	31.29	5
Oklahoma	45	46	28.75	5
Nevada	46	44	28.64	5
Louisiana	47	47	25.50	5
Arkansas	48	48	25.09	5
West Virginia	49	49	22.00	5
Mississippi	50	50	20.91	5

Source: Milken Institute (2020)



Introduction

For nearly two decades, the Milken Institute State Technology and Science Index (STSI) has systematically evaluated the knowledge economies of all 50 US states,[1] providing insights into key components of sustainable growth and development. The index helps to show why some states are more effective than others at supporting job creation and wage growth in high-tech industries and how different states can achieve similar levels of success—or struggle in the same areas. Through this index, state governments have a template for evaluating their pursuit of economic growth as well as for analyzing similar efforts in peer states.

As it does every other year, STSI 2020 outlines several success stories: states that have successfully built and maintained ecosystems of knowledge-based growth. Just as importantly, it also identifies areas where states' rankings on certain indicators have declined, making them less attractive as places for businesses to operate or for workers to live. By providing a benchmark for performance, STSI stimulates conversation amongst state and regional policymakers on how to promote innovation and economic development more effectively.

A state's knowledge economy is tied not only to its educational systems—primary and secondary schools, colleges, and universities—but also to private-sector activity. Important activities range from designing and marketing new ideas, products, and processes to providing venture capital and seed funding for the growth of new firms. The link between innovation on one hand and job and wage growth on the other, though not always well-understood by policymakers and the public, remains a vital component of the US' competitive advantage in the global knowledge economy. As a result, STSI specifically focuses on the pathways from new ideas to their commercialization.

The index identifies five critical components of each state's innovation ecosystem: research and development (R&D) inputs, risk capital and entrepreneurial infrastructure, human capital investment, technology and science workforce, and technology concentration and dynamism. States are ranked on these sub-indexes, which are then combined to produce an overall STSI ranking of all 50 states. These rankings are not intended to evaluate how states have been performing in a particular industry or activity over time but instead show a cross-section of key differences in each state's science and technology capabilities.

Knowledge-based economic development is a core pillar of the research and policy agenda at the Milken Institute Center for Regional Economics (CRE). Through our engagement, we encourage policymakers to develop effective, actionable plans to sustain development and growth. CRE also focuses on other key aspects of regional competitiveness, including maintaining a built environment that provides adequate and affordable housing, health, and transit options, facilitating access to capital and exports for small businesses, and trade finance.

STSI complements other CRE research products, including the annual Best-Performing Cities Index. Publishing the STSI every other year allows it to account for longer-term development in critical areas, such as the evolution of a skilled workforce, improvements to education and training, and strategies for attracting additional research funding or venture capital investments. Taken together, these two indexes show how metropolitan area growth contributes to state-level trends and how states' policies and regulations influence local communities.

Pandemic and Recovery

The COVID-19 pandemic has presented a unique challenge to assessing knowledge economies this year, particularly due to the resulting economic downturn and the need to move a wide swath of in-person education and work online. All 50 states have been challenged by enacting adequate health and safety measures to limit growth in the number of cases while facing pressure from businesses and other interest groups to enable operations to continue—or for financial assistance to businesses that have been subject to closures.

However, the pandemic also illustrates how and why the knowledge economy is a cornerstone of a prosperous society. Scientific progress and technological innovation are vital for designing treatments to alleviate suffering as well as vaccines and other therapies for preventing the spread of disease. Furthermore, technological advancements allow people to access critical resources during institutional and regional shutdowns, as well as to remain connected with one another through work, education, and personal relationships.

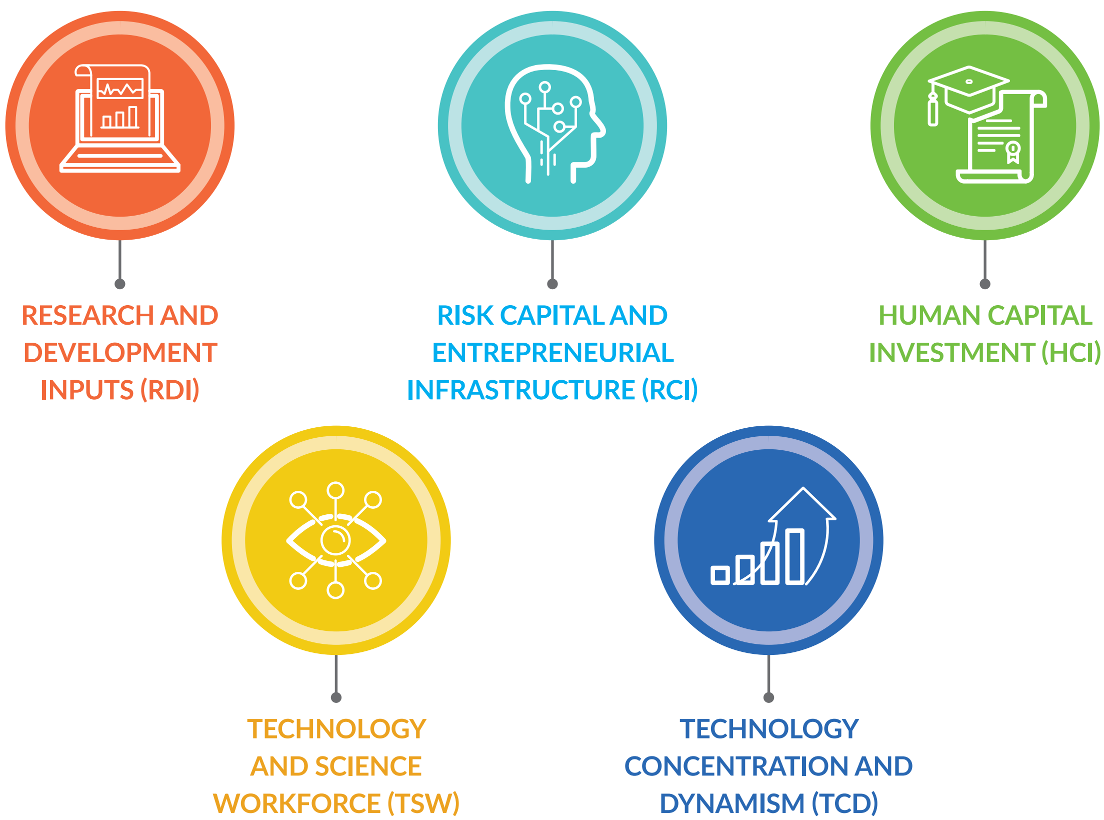
Given the unique challenges for states to support economic recovery, CRE will use the results of STSI 2020 to prepare an additional policy brief covering specific policy and business recommendations to support knowledge-based economic development.

Outline of the Index

The State Technology and Science Index provides a benchmark for states to assess their science and technology capabilities as well as the broader ecosystem that contributes to job and wealth creation. The index computes and measures 105 individual indicators relative to population, gross state product (GSP), number of business establishments, or degree of change during a specific period.[2]

SUB-INDEX COMPONENTS

The STSI is a composite of five sub-indexes that each measures a different dimension of states' science and technology economies. The overall index rankings are calculated by taking the average of state scores on all five of these sub-indexes:



RESEARCH AND DEVELOPMENT INPUTS (RDI): The index examines a state's R&D capacity to see if it has facilities that can attract funding and create innovative technologies that can be commercialized. We evaluate state rankings for academic, industry, and federal government R&D funding; National Science Foundation activity; and small business innovation research awards.

RISK CAPITAL AND ENTREPRENEURIAL INFRASTRUCTURE (RCI): States' entrepreneurial capacity and risk capital infrastructure are ingredients that determine their success in converting research into commercially viable technology services and products. We include measures of venture capital as well as patents, business formation, and initial public offerings.

HUMAN CAPITAL INVESTMENT (HCI): Education and training are crucial assets for any state to develop its knowledge economy. We look at indicators that suggest how these activities influence the skill levels of each state's current and future workforce. Examples include numbers of bachelor's, master's, and PhD degrees and measures specific to science, engineering, and health education.

TECHNOLOGY AND SCIENCE WORKFORCE (TSW): The intensity of the technology and science workforce indicates whether states have sufficient depth of high-caliber technical talent, represented by the share of workers in a particular field relative to total state employment. We look at 49 occupations spread across three categories: computer and information sciences, engineering, and life and physical sciences.

TECHNOLOGY CONCENTRATION AND DYNAMISM (TCD): By measuring high-tech industry growth, we can assess how effective policymakers and other stakeholders have been at transforming assets into prosperity. Our measures of concentration and dynamism include the proportion of establishments, employment, and payrolls in high-tech categories, as well as the employment location quotient, which quantifies each state's industry concentration relative to the entire country.

TABLE 2: 2020 STATE TECHNOLOGY AND SCIENCE INDEX: OVERALL AND SUB-INDEX RANKINGS

State	2020 Rank	2020 Tier	RESEARCH AND DEVELOPMENT INPUTS RANK	RISK CAPITAL AND ENTREPRENEURIAL INFRASTRUCTURE RANK	HUMAN CAPITAL INVESTMENT RANK	TECHNOLOGY AND SCIENCE WORKFORCE RANK	TECHNOLOGY CONCENTRATION AND DYNAMISM RANK
Massachusetts	1	1	1	3	1	3	4
Colorado	2	1	6	2	4	4	2
California	3	1	4	1	8	5	3
Maryland	4	1	2	18	2	1	10
Washington	5	1	10	5	14	1	4
Utah	6	1	19	4	3	10	1
New Hampshire	7	2	5	11	16	6	13
Virginia	8	2	12	25	5	6	7
Delaware	9	2	3	12	12	15	15
Oregon	10	2	20	7	17	9	11
Minnesota	11	2	24	6	7	6	22
Connecticut	12	2	8	15	6	21	20
Pennsylvania	13	2	7	10	11	17	30
New Jersey	14	2	17	14	13	12	18
North Carolina	15	2	14	17	22	15	12
Texas	16	3	25	9	35	17	8
Arizona	17	3	18	19	30	29	6
New Mexico	18	3	22	22	28	14	16
Michigan	19	3	9	28	29	12	23
Illinois	20	3	16	13	10	32	25
New York	21	3	11	8	9	43	27
Georgia	22	3	32	20	26	30	9
Rhode Island	23	3	13	36	15	23	35
Ohio	24	3	15	24	31	17	37
Wisconsin	25	3	21	27	23	20	35

TABLE 2: 2020 STATE TECHNOLOGY AND SCIENCE INDEX: OVERALL AND SUB-INDEX RANKINGS (continued)

State	2020 Rank	2020 Tier	RESEARCH AND DEVELOPMENT INPUTS RANK	RISK CAPITAL AND ENTREPRENEURIAL INFRASTRUCTURE RANK	HUMAN CAPITAL INVESTMENT RANK	TECHNOLOGY AND SCIENCE WORKFORCE RANK	TECHNOLOGY CONCENTRATION AND DYNAMISM RANK
Idaho	26	3	36	29	39	22	14
Indiana	27	3	27	26	21	36	29
Vermont	28	3	34	29	23	36	19
Montana	29	4	28	21	34	25	33
Kansas	30	4	38	35	26	26	26
Missouri	31	4	31	37	20	33	31
Alabama	32	4	23	46	36	24	28
Florida	33	4	39	16	42	47	16
Iowa	34	4	30	45	18	27	38
South Carolina	35	4	40	31	44	34	20
Alaska	36	4	26	49	37	11	46
Hawaii	37	4	29	33	38	41	32
Nebraska	38	4	33	42	19	31	49
Wyoming	39	4	37	40	32	27	45
Tennessee	40	4	35	23	40	45	33
North Dakota	41	4	41	39	23	39	46
South Dakota	42	5	42	44	33	36	41
Maine	43	5	44	33	41	40	43
Kentucky	44	5	43	31	48	44	39
Oklahoma	45	5	48	43	50	35	40
Nevada	46	5	47	41	49	50	24
Louisiana	47	5	46	47	45	46	46
Arkansas	48	5	49	38	47	49	42
West Virginia	49	5	50	50	43	41	44
Mississippi	50	5	45	48	46	48	50

Source: Milken Institute (2020)

METHODOLOGY AND ADJUSTMENTS

We calculate scores for each sub-index by averaging state rankings for each indicator in that sub-index. (Data for these indicators come from a combination of federal government and private sources. Please consult the Appendix for a comprehensive list.) States are ranked in descending order on each indicator and then assigned scores based on those rankings; the state ranked first receives a score of 100 and the state ranked fiftieth gets a score of two.

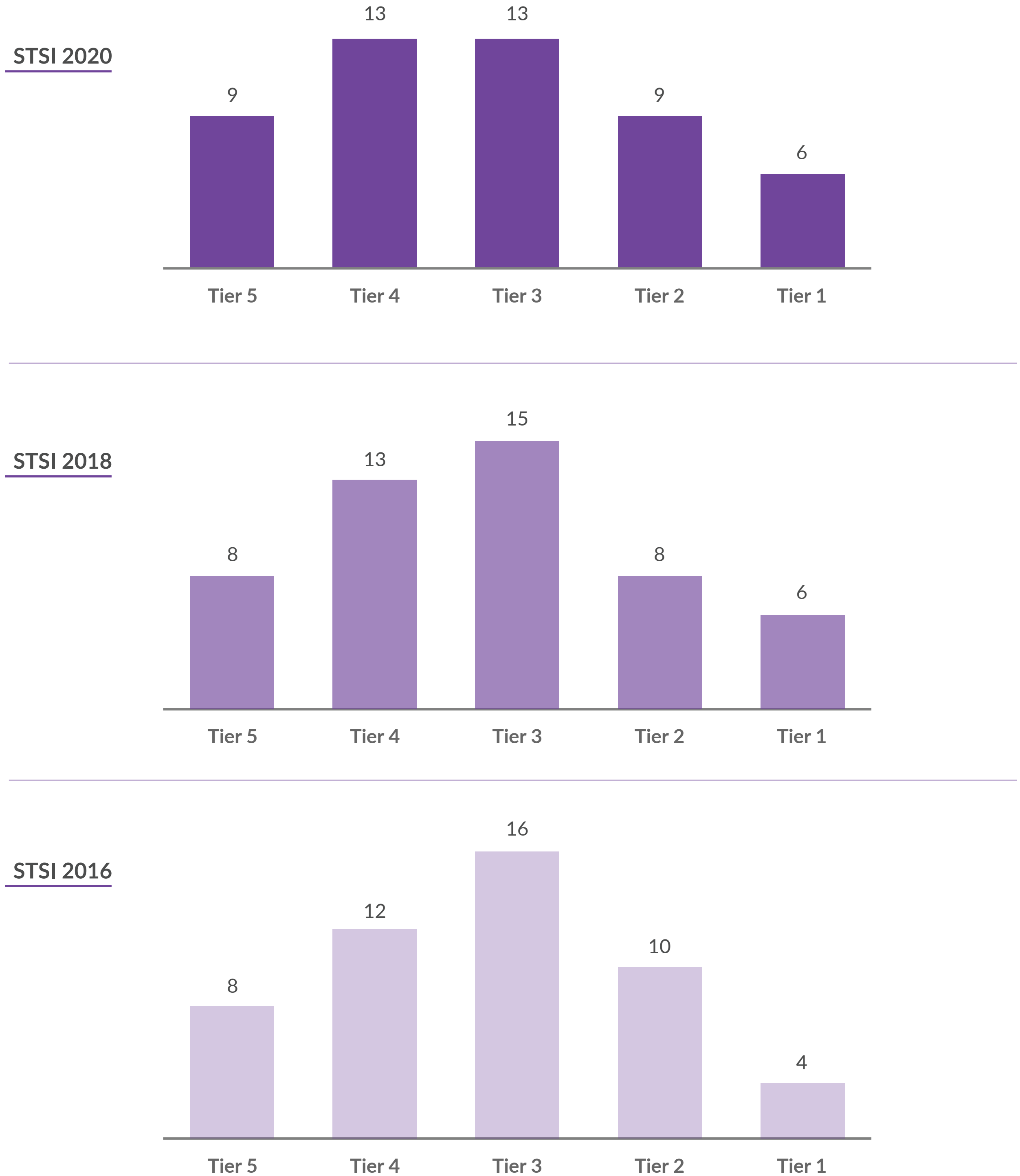
The RDI sub-index also uses a partially weighted ranking of relevant indicators to account for the proportion of total R&D funding that comes from different sources in private industry (around two-thirds), the federal government (roughly one-fifth), and academic institutions of higher education (around one-eighth).

The TSW sub-index does not assign a score for each indicator used to denote the job intensity of a unique occupation code. Instead, it takes the sum of job intensity for all occupation codes in each of three categories (Computer and Information Scientists, Engineers, and Life and Physical Scientists) to calculate—and rank—the overall level of job intensity within each category. It then uses the average of those three rankings to determine each state's sub-index ranking. This method ensures that each job within a particular type is weighted equally and that less common (lower intensity) occupations are not weighted more.

For the first time, STSI 2020 also divides the rankings on the overall index and each sub-index into five tiers, providing a new set of benchmarks for states to compare their science and technology capabilities with others that have similar characteristics. The range of scores on each ranking—or the difference between the top- and bottom-ranked states—determines the size of these tiers. After finding the top and bottom scores, the difference between these two scores is divided into five tiers that each span an equal proportion (20 percent). States are placed into tiers based on whether they fall above or below the index scores representing 20 percent, 40 percent, 60 percent, or 80 percent of the gap between the top and bottom scores.

When applying this method to evaluate the overall index rankings in previous years, the distribution across all five tiers shows a slightly flatter curve in 2020 than in the previous rankings for 2018 and 2016, as shown in Figure 1. This pattern does not necessarily indicate any specific trend in the broad characteristics that define science and technology economies at the state level. However, it does demonstrate states' potential to move up toward the top tiers or down toward the bottom ones. A state is thus not guaranteed steady improvement in the index rankings without making careful policy choices to support the growth of its knowledge economy.

FIGURE 1: RECENT STSI OVERALL RANKINGS:
NUMBER OF STATES PER TIER



Notes: States per tier are listed at the top of each column. Boundaries for each tier are defined in 20 percent increments between the top and bottom scores on the index rankings for each year.
Source: Milken Institute (2020)

STSI 2020: Overall Index Rankings

TOP-TIER STATES

Massachusetts ranks first in the 2020 edition of the STSI, as it has each year since 2002. The Bay State ranked in the top tier of states on all five sub-indexes, as well as No. 1 on two sub-indexes (research and development inputs and human capital investment). It demonstrated high levels of investment in R&D funded by the government, industry, and academic institutions. Firms in the state were also particularly competitive in programs designed to encourage small businesses to engage R&D with the potential for commercialization.

Colorado ranks second in this year's STSI, maintaining its rank from 2018. The Centennial State increased its ranking on the sub-index of technology concentration and dynamism (up from No. 5 in 2018 to No. 3 in 2020), though it ranked lower on the sub-index of research and development inputs (down from No. 3 in 2018 to No. 6 in 2020). Its economy also featured a strong No. 2 ranking on the risk capital and entrepreneurial infrastructure sub-index, based mostly on its vibrant venture capital sector.

California ranks third in this year's edition of the STSI, rising one spot from its fourth-place rank in 2018. The Golden State climbed three places from No. 4 to No. 1 in the sub-index of risk capital and entrepreneurial infrastructure, thanks to a strong venture capital sector and a large number of patents. It also rose two places (from No. 10 to No. 8) in the human capital investment sub-index due to a notable increase in state appropriations for higher education from 2018 to 2019. California's knowledge economy remains remarkably diverse, with a higher level of concentration than the national average in 19 of 20 high-tech industries.

Maryland ranks fourth in this year's edition of the STSI, falling one spot from its prior third-place rank. The Old Line State ranked No. 1 in the technology and science workforce sub-index, demonstrating high levels of concentration among workers in computer and information science (No. 1 in the nation), engineering (No. 1), and life and physical science (No. 3). It also ranked No. 2 on the sub-index of research and development inputs, with the highest levels of federal government and academic funding for R&D out of any state.

Washington ranks fifth in this year's edition of the STSI, rising one place in the rankings. The Evergreen State tied for No. 1

on the sub-index ranking for technology and science workforce, with the No. 2 concentration of computer and information scientists and No. 4 concentration of engineers in the nation. It also registered a No. 3 ranking on the technology concentration and dynamism sub-index, with the highest rates of high-tech employment and payroll of any state.

Utah ranks sixth in this year's STSI, dropping one rank from 2018. The Beehive State ranked No. 1 on the index of technology concentration and dynamism, placing in the top 10 on measures of all but one indicator of high-tech industry performance. It also rose two spots in the human capital investment sub-index (from No. 5 in 2018 to No. 3 in 2020). Still, Utah fell eight spots (from No. 11 to No. 19) on the research and development inputs sub-index, due partly to lower levels of funding from the National Science Foundation (NSF).

SECOND-TIER STATES

The second tier of states demonstrated a variety of rankings across the five sub-indexes of STSI, frequently registering very high marks in two to three and generally ranking in the top half of states in others.

New Hampshire rose to seventh overall—up from ninth—primarily on the strength of its No. 5 ranking on the sub-index of R&D inputs, also recording sizable awards from Small Business Administration (SBA) innovation funding programs. **Virginia** continues to benefit from its proximity to Washington, DC, as its high scores for human capital (No. 5) and extensive technology and science workforce (No. 6) helped it move up four places in the overall rankings, from 12th in 2018 to seventh in 2020. **Delaware** dropped two spots from seventh to ninth overall. Still, it registered high marks for R&D inputs (ranking No. 3) on the strength of its industry-funded R&D as well as a high level of small business innovation funding support relative to the size of the state's economy.

Oregon ranked 10th for the second consecutive time, **Minnesota** dropped three spots in the overall rankings to 11th, and **Connecticut** and **Pennsylvania** each rose one place, to 12th and 13th, respectively. Oregon substantially improved its ranking on the sub-index of risk capital, rising from No. 16 in 2018 to No. 7 this year, but also recorded a lower position on the R&D inputs sub-index in 2020, dropping from No. 13 to No. 20. Minnesota's most impressive areas of performance were in risk capital and entrepreneurial infrastructure as well as human capital investment (No. 6 on each). Still, it ranked much lower for R&D inputs (No. 24) due mainly to a lack of academic funding. Connecticut ranked No. 6 on the sub-index of human capital investment, with large proportions of the state's population holding degrees and high ratios of both doctoral scientists and engineers relative to its population. Pennsylvania once again performed well in the area of R&D inputs, as its No. 7 ranking put it in the top 10 for the third consecutive time. However, it ranked much lower (No. 30) in technology concentration and dynamism.

New Jersey tied for the most significant rise in the rankings (six spots) to 14th and moved up to the second tier for the first time. New Jersey demonstrated remarkably similar scores across all five sub-indexes, ranking consistently between No. 12 (for technology and science workforce) and No. 18 (for technology concentration and dynamism). Meanwhile, **North Carolina** dropped four spots to 15th overall, due mainly to an eight-place drop to No. 17 in risk capital and entrepreneurial infrastructure.

THIRD-TIER STATES

As mentioned previously, the results of STSI 2020 demonstrated the capability of states to move either up or down in the overall rankings. States in Tier Three experienced a mix of moves up and down from 2018, so there were few consistent trends across this group. Several states ranked highly for technology concentration and dynamism, while others ranked in the bottom third nationwide. A third group posted mid-level rankings on most of the five sub-indexes.

Third-tier states that climbed significantly in the overall rankings were **Texas**, rising three spots to 16th, and **New Mexico**, ranked 18th, rising six places—tied for highest in the nation—as well as **Ohio** and **Indiana**, which both rose four places to 24th and 27th, respectively. Indiana's rise brought it into the Third Tier for the first time. Meanwhile, another group dropped significantly: **Illinois** (20th) and **Vermont** (28th) both fell five places, tied for the largest overall fall, while **New York** (21st) dropped four places. Texas and New York were indicative of this group's diversity, posting a wide range of rankings across different sub-indexes. The former ranked No. 8 in technology concentration and dynamism and No. 9 for risk capital, while it ranked No. 35 for human capital. The latter scored high for risk capital (No. 8) and human capital (No. 9) but also ranked No. 43 for its technology and science workforce. **Arizona** ranked 17th overall, dropping one spot from 2018. Like Texas, it showed a combination of low human capital investment (No. 30) and high technology concentration and dynamism (No. 6).

Other states recorded more consistent results. **Georgia** (22nd), **Wisconsin** (25th), and **Idaho** (26th) all held steady in the rankings, while **Michigan** dropped one spot to 19th, and **Rhode Island** dropped two places to 23rd. Michigan ranked No. 9 for R&D inputs due to a potent combination of industry and academic research funding and No. 12 for tech and science workforce due to a large contingent of engineers. However, it dropped to No. 28 in risk capital due to limited venture capital investments in key high-tech sectors.

FOURTH-TIER STATES

Fourth-tier states tended to rank in the bottom half on most sub-index scores, though they occasionally posted higher rankings in a specific area.

Montana and **Missouri** both dropped two places in 2020 and fell into the Fourth Tier of the overall STSI rankings at 29th and 31st, respectively. Both states ranked lower for technology concentration and dynamism in 2020; Missouri dropped four places to No. 31, and Montana dropped seven spots to No. 33. **Kansas** (30th), **Alabama** (32nd), and **Florida** (33rd) all saw their rankings hold steady, with Kansas rising seven places to No. 26 on the sub-index of human capital investment while dropping 11 places to No. 26 in technology concentration and dynamism. Florida ranked highly (No. 16) for both risk capital and technology concentration and dynamism but near the bottom nationwide (No. 47) for the relative size of its tech and science workforce.

Several other states saw their rankings improve in this year's edition of the index. **Iowa** rose two places to 34th, **Alaska** climbed five places to 36th, and **Wyoming** gained three places to 39th. Alaska's ranking for tech and science workforce (No. 11) was notably high due to a high proportion of engineers and scientists. Still, it also ranked No. 49 for risk capital and entrepreneurial infrastructure thanks to minimal venture capital investment.

Meanwhile, **South Carolina** at 35th and **Hawaii** at 37th traded places from their rankings in 2018. **Tennessee** ranked 40th, and **North Dakota** ranked 41st, each dropping one spot. And **Nebraska** saw its ranking drop four places in 2020 to 38th. Several of the Upper Midwest states boasted strong performances in human capital, including Iowa (No. 18), Nebraska (No. 19), and North Dakota (No. 23), thanks to strong average test scores and relatively large numbers of graduate students in science, engineering, and health. Iowa also experienced the second-largest rise of any state (up 17 places to No. 27) in the tech and science workforce sub-index.

FIFTH-TIER STATES

The bottom tier of states in the STSI overall rankings increased by one in number this year, as **Maine** dropped five spots in the rankings to 43rd in 2020, with its lowest sub-index ranking in R&D inputs (No. 44). **Nevada** dropped two places overall to 46th. Despite ranking No. 24 for technology concentration and dynamism, it also ranked No. 50 for technology and science workforce.

Although **South Dakota** (42nd), **Kentucky** (44th), and **Oklahoma** (45th) each rose one spot in the rankings from 2018, they did not manage to break out of Tier Five. South Dakota's highest result was in human capital investment (No. 33), Kentucky's was in risk capital and entrepreneurial infrastructure (No. 31), and Oklahoma's was in technology and science workforce (No. 35). The bottom four states in the rankings all held steady: **Louisiana** at 47th, **Arkansas** at 48th, **Mississippi** at 49th, and **West Virginia** at 50th. West Virginia ranked last on two sub-indexes—R&D inputs and risk capital—but finished above Mississippi in the overall rankings due to its more extensive tech and science workforce (No. 41).

Overall, states in Tier Five consistently posted the lowest rankings nationwide for R&D inputs, with no state ranking higher than No. 42. This pattern marked a continuation of the trend from the 2018 rankings when none of the bottom-tier states ranked higher than No. 41 for research funding.

LARGEST GAINS

New Jersey rose six places, going from 20th in 2018 to 14th in 2020 and climbing from Tier Three to Tier Two. The state rose eight places in the R&D input sub-index rankings, from No. 25 to No. 17, based primarily on the strength of industry funding for R&D (which rose from No. 8 to No. 4). The state is particularly well-known for its large life sciences industry; as of 2019, 13 of 20 top pharmaceutical companies and 12 of 20 top medical technology companies maintain a presence there.[3] **New Mexico** also rose six spots to reach 18th in the overall rankings but remained in the third tier. It ranked highest for its technology and science workforce (No. 14), due in large part to a high concentration of life and physical scientists, and technology concentration (No. 16), with high-tech industries accounting for a significant proportion of total employment and payroll.

LARGEST DROPS

Three states each dropped five places in the overall rankings this year. **Illinois** at 20th and **Vermont** at 28th both retained their positions in Tier Two, while **Maine**'s drop to 38th took it from Tier Four down to Tier Five. Illinois dropped three places in the risk capital sub-index, and four spots in the human capital investment sub-index—the latter due partly to a steady decline in average SAT scores.[4] Vermont dropped 20 places in the tech and science workforce ranking, partly owing to its relatively large number of workers in industries with relatively low job intensity as a proportion of the overall economy. And Maine dropped four places on each of three different sub-index rankings: risk capital and entrepreneurial infrastructure (to No. 33), human capital investment (to No. 41), and technology concentration and dynamism (to No. 43). The state still lags behind its neighbors in New England on measures of research funding and patenting activity.[5]

Research and Development Inputs

BACKGROUND

The Research and Development Inputs (RDI) sub-index measures the ability of institutions in each state to generate new knowledge, emphasizing science and technology that may have commercial value. Innovation is a cornerstone of knowledge-based economic development and can provide a key competitive advantage for states' long-term economic growth trajectory. A robust R&D infrastructure can create opportunities for innovative discoveries, so the RDI sub-index helps benchmark states' abilities to attract research funding from different sources and establish a pipeline to develop innovative products and processes.

While a significant portion of spending on research—particularly basic research, often in university labs—may not have an immediate economic impact, it can yield substantial returns in the long term. Private industry generally funds applied research, which has the potential to facilitate job creation and wage growth in high-tech sectors.[6]

SUB-INDEX COMPONENTS

Federal R&D expenditures: This captures investments in all basic and applied research in such areas as national defense, health, space research and technology, energy, and general science. As a principal source of nationwide R&D spending—just under 20 percent—state rankings in federal R&D receive additional weight when calculating state scores.

Industry R&D expenditures: This is the total that corporations spent on basic and applied research, including funds spent at federally funded R&D centers. Industry R&D rankings are heavily weighted when calculating state scores on the sub-index because industry represents by far the largest share of spending on R&D activities nationwide, at around 67 percent.

Academic R&D expenditures: This is the total that a state's colleges and universities spent on R&D. All research performed by colleges and universities, basic and applied, is funded by a combination of federal, industry, and academic sources, but more than 60 percent of R&D funding at universities originates from the federal government. Academic spending on R&D represents around 13 percent of national expenditures.

National Science Foundation (NSF) funding: The National Science Foundation supports research and education in science and engineering through grants, contracts, and cooperative agreements. Because the NSF is a critical source of funding for R&D in higher education, we track the organization's support for research in the physical sciences, geosciences, computer science, life sciences, and math and statistics. Rates of competitive NSF project proposals also measure R&D inputs.

Small business research funding: Small Business Technology Transfer (STTR) and Small Business Innovation Research (SBIR) programs provide federal funding for innovation by small businesses. The STTR and SBIR programs support collaboration with nonprofit research institutes and research with commercial potential, respectively. Phase I programs provide six months of support for feasibility studies or prototypes, while Phase II programs offer two years of funding support for R&D.

TOP-TIER STATES

Massachusetts once again maintains its No. 1 position on the Research and Development Inputs sub-index in 2020. This is the sixth consecutive time that Massachusetts has topped the rankings. Massachusetts ranks first in the nation on six of 19 variables that compose the RDI sub-index. The state has an additional 10 indicators ranked in the top five. The state's perennial high ranking is largely due to the presence of excellent research universities, which are also playing a leading role in pushing for greater equity and inclusion in scientific research.[7]

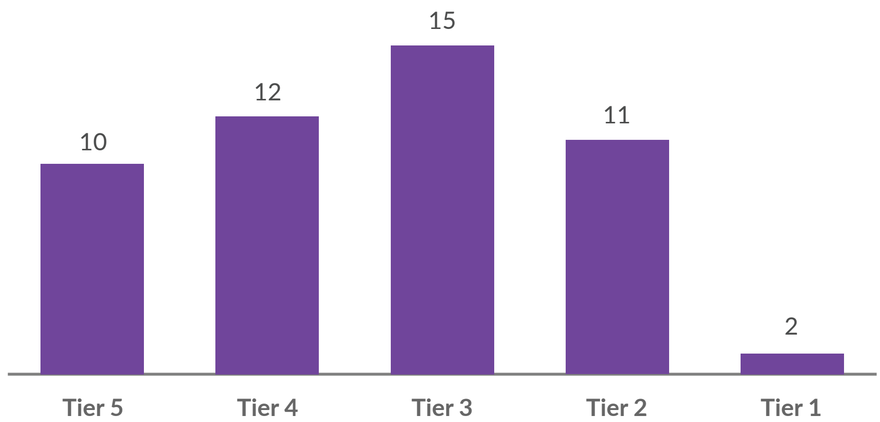
Maryland maintains its No. 2 position on the RDI sub-index rankings for the sixth consecutive time. It ranked in the top five states for funding academic R&D across a range of fields and also recorded by far the highest level of federal R&D funding per capita at over $2,700—two-thirds higher than the rate in the next-highest recipient of federal funds, New Mexico. Much like Massachusetts, Maryland's high rankings for R&D inputs are also due to the presence of top-tier research universities. The University of Maryland has attracted significant federal funding for research, raising $570 million in 2019 for research across a range of fields that included quantum physics and artificial intelligence.[8]

BOTTOM-TIER STATES

Arkansas dropped one place to No. 49 on the RDI sub-index in 2020. Arkansas dropped in six of 18 indicators, with significant declines in Phase I STTR awards (−6), Phase I SBIR awards (−9), and industry R&D spending (−6). It also ranked in the bottom five overall on eight indicators, including federal R&D spending (No. 47), academic R&D spending (No. 47), NSF funding (No. 46), and higher education R&D in five of six major fields.

West Virginia maintained its No. 50 position on the RDI sub-index for the second consecutive time. It declined in rank on seven indicators, including higher education R&D in life sciences (−9), geosciences (−5), and math and statistics (−4). It also ranked near the bottom for overall R&D spending in both industry (No. 49) and academia (No. 46) as well as STTR awards (No. 49 for Phase I and No. 44 for Phase II) and the overall amount of funding (No. 49). To address the latter deficiency, TechConnect West Virginia had scheduled a series of STTR boot camps before the pandemic as part of its "Bridging the Ecosystem in Science & Technology (BEST) in West Virginia" program.[9]

FIGURE 2: RESEARCH AND DEVELOPMENT INPUTS (RDI) SUB-INDEX: NUMBER OF STATES PER TIER



Source: Milken Institute (2020)

LARGEST GAINS

Ohio rose 11 positions to No. 15 on the RDI sub-index for 2020. The increase is due largely to rankings on two indicators improving by double digits: industry R&D spending (to No. 14) and higher education R&D in math and statistics (No. 17). Ohio's rankings rose on 11 of 18 indicators, with the state's most notable increase in federal funding for R&D activities (from No. 20 to No. 17). **Alaska** rose nine spots to No. 26 on the RDI sub-index for 2020. This increase is mainly due to its double-digit improvements in its rankings for industry R&D per capita (+13) and STTR award dollars (+14). Alaska is also a key recipient of NSF funding, ranking No. 1 for NSF funding and NSF research funding relative to the size of the state economy and No. 2 for its NSF proposal funding rate.

LARGEST DROPS

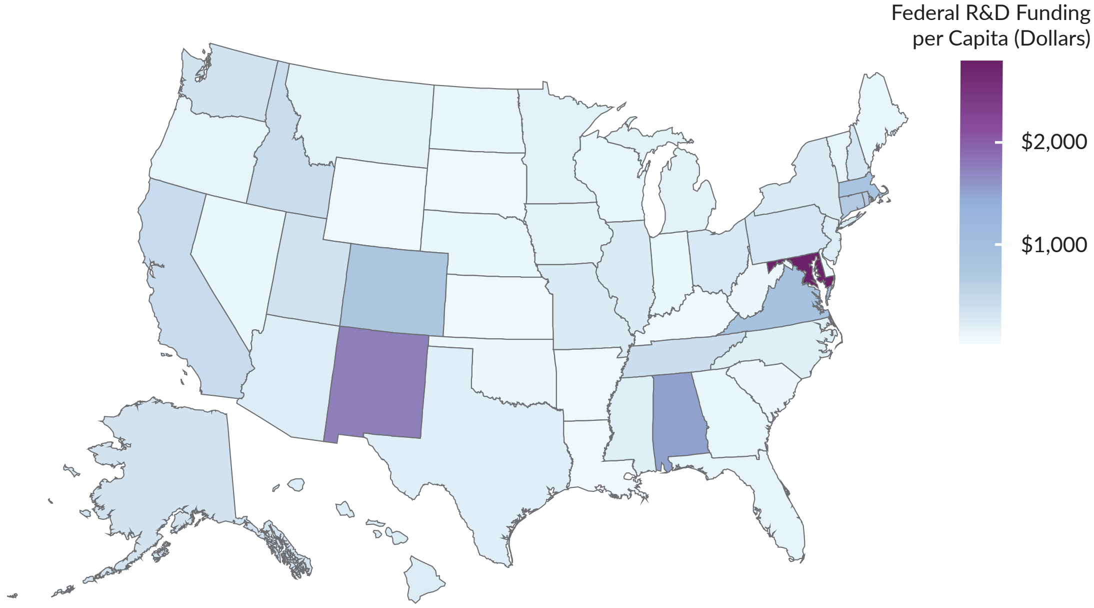
Utah dropped eight places to No. 19 in the RDI sub-index rankings, due mainly to a sharp decline (from No. 10 to No. 34) in per capita funding of R&D by industry sources. According to NSF data, industry R&D fell by more than $600 million overall between 2016 and 2017.[10] **Oregon** dropped seven ranks to No. 20 for 2020's RDI, and its rankings declined in 12 of the 18 indicators. It dropped 23 places in higher education R&D in math and statistics, 18 places in STTR awards (Phase 1), nine places in STTR awards (Phase II), and a noteworthy 24 places in STTR awards as a proportion of GSP. Although the state received a sizable amount of NSF funding, much of this was not dedicated to research but instead earmarked for Oregon State University to lead the design of a Regional Class Research Vessel designated for marine science studies.[11]

TABLE 3: RESEARCH AND DEVELOPMENT INPUTS (RDI) SUB-INDEX: STATE RANKINGS

State	2020 Rank	2018 Rank	2020 Score	2020 Tier
Massachusetts	1	1	97.10	1
Maryland	2	2	91.68	1
Delaware	3	9	80.03	2
California	4	4	79.17	2
New Hampshire	5	5	78.83	2
Colorado	6	3	76.21	2
Pennsylvania	7	8	74.14	2
Connecticut	8	6	70.86	2
Michigan	9	12	68.52	2
Washington	10	10	67.25	2
New York	11	18	65.24	2
Virginia	12	16	64.70	2
Rhode Island	13	7	64.62	2
North Carolina	14	14	63.19	3
Ohio	15	26	62.74	3
Illinois	16	15	62.42	3
New Jersey	17	25	60.27	3
Arizona	18	17	60.04	3
Utah	19	11	59.97	3
Oregon	20	13	59.28	3
Wisconsin	21	19	58.28	3
New Mexico	22	20	58.27	3
Alabama	23	24	55.56	3
Minnesota	24	21	55.22	3
Texas	25	28	53.22	3
Alaska	26	35	52.19	3
Indiana	27	22	51.54	3
Montana	28	23	48.20	3
Hawaii	29	29	47.34	4
Iowa	30	27	47.25	4
Missouri	31	36	46.20	4
Georgia	32	32	45.91	4
Nebraska	33	33	42.37	4
Vermont	34	30	42.03	4
Tennessee	35	39	38.73	4
Idaho	36	31	38.63	4
Wyoming	37	34	35.91	4
Kansas	38	38	35.86	4
Florida	39	42	33.77	4
South Carolina	40	40	31.52	4
North Dakota	41	37	29.55	5
South Dakota	42	41	26.48	5
Kentucky	43	44	25.98	5
Maine	44	43	25.54	5
Mississippi	45	46	21.75	5
Louisiana	46	47	21.58	5
Nevada	47	49	21.30	5
Oklahoma	48	45	19.07	5
Arkansas	49	48	17.73	5
West Virginia	50	50	15.12	5

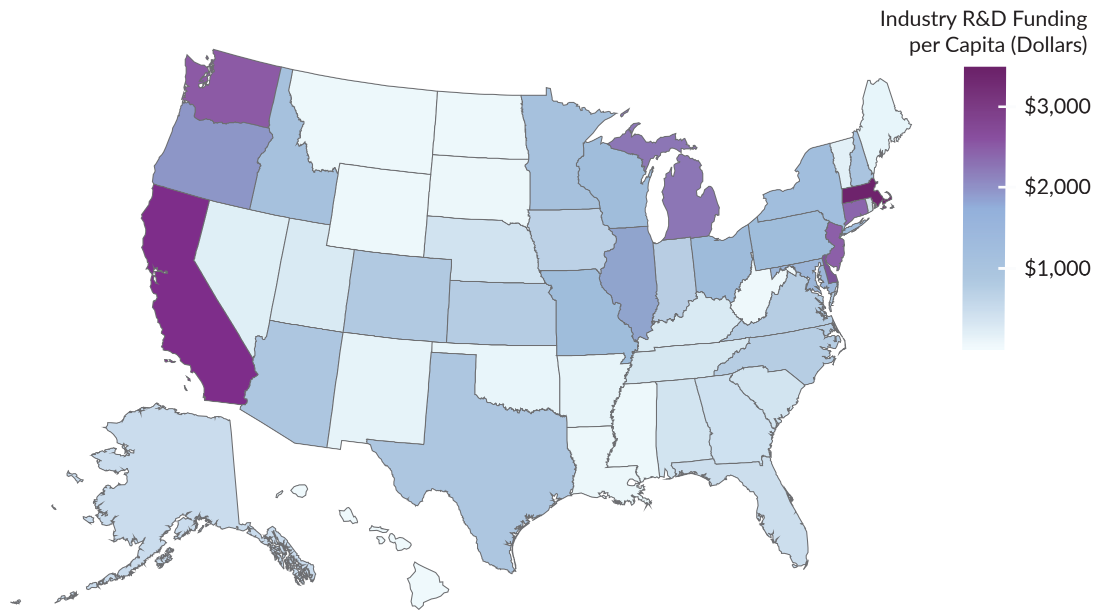
Source: Milken Institute (2020)

FIGURE 3: FEDERAL R&D FUNDING PER CAPITA: THREE-YEAR AVERAGE (2016-2018)



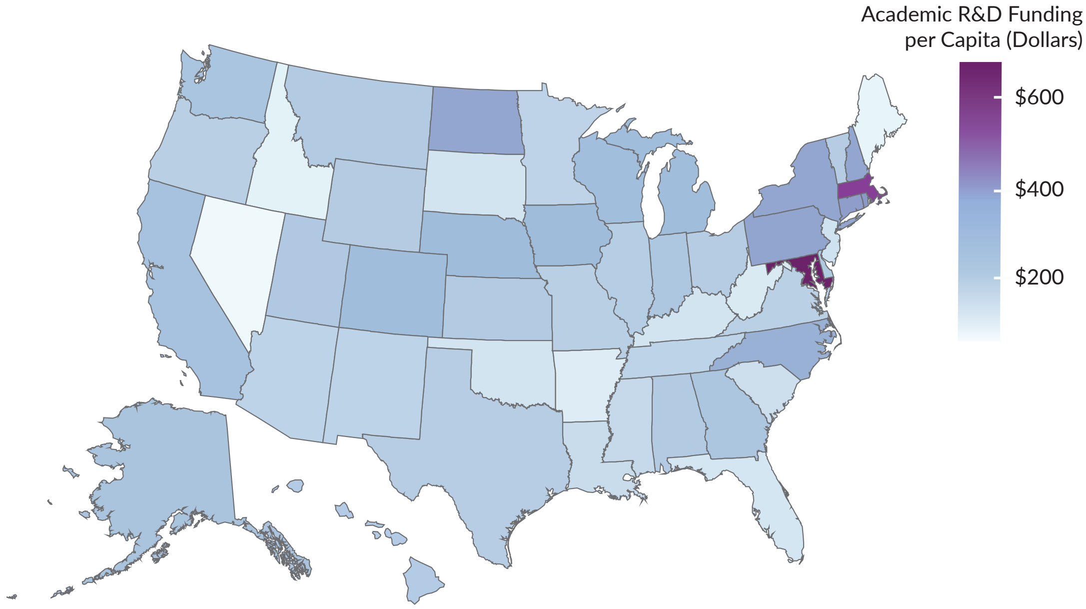
Source: Milken Institute analysis of National Science Foundation data (2020)

FIGURE 4: INDUSTRY R&D FUNDING PER CAPITA: THREE-YEAR AVERAGE (2015-2017)



Source: Milken Institute analysis of National Science Foundation data (2020)

FIGURE 5: ACADEMIC R&D FUNDING PER CAPITA:
THREE-YEAR AVERAGE (2016-2018)



Source: Milken Institute analysis of National Science Foundation data (2020)

Risk Capital and Entrepreneurial Infrastructure

BACKGROUND

The Risk Capital and Entrepreneurial Infrastructure (RCI) sub-index measures the environment for attracting investment to help bring innovations to the market. The ability of entrepreneurs not only to recognize the economic value in their ideas but also to successfully pursue their commercialization is a core asset of any state's knowledge economy.[12] Rather than a leading indicator, venture capital is a key measure of states' ability to attract investment through innovative activity, as early-stage investors engage in scrutinizing firms' strengths and weaknesses and monitor their performance over time.[13]

SUB-INDEX COMPONENTS

Venture capital activity: To assess a region's potential for entrepreneurship in science and technology, we look at indicators such as growth in total venture capital (VC) investment, the number of VC deals, the size of these investment flows as a percentage of the state's economy, and the proportion of deals to the number of businesses operating in the state.

Small Business Investment Company (SBIC) funding: An SBIC is an incubator-type establishment that uses its capital, plus loans guaranteed by the US Small Business Administration, to make equity and debt investments in qualifying small businesses. Like venture capitalists, the SBIC identifies profit potential and makes funding decisions aiming for high returns on investment.

Patents: Patents indicate a strong state-level culture of scientific inquiry and represent opportunities to commercialize new technologies. While the costs and time spent registering a patent are significant, completing the process may offer enormous potential for long-term job creation and wage increases.

Business formation: Business starts and initial public stock offerings (IPOs) reflect entrepreneurship and optimism. Often, companies that engage in IPOs have proven revenues.

Nanotechnology, clean technology, and biotechnology investments: As three sectors at the forefront of technological innovation, investment in these fields represents a strong culture of entrepreneurship and serves as a measure of investors' willingness to take risks in that state.

TOP-TIER STATES

California reclaims the top ranking on the RCI sub-index in 2020, mainly due to its large, diverse economy of venture capital firms. It ranked highly on several indicators, including the level of VC investment relative to the size of the state's overall economy (No. 1 at 1.9 percent) and deals relative to the number of businesses (No. 2 at 27.8 per 100,000). California also demonstrated particularly strong levels of investment in both clean technology and biotechnology. In 2018, then-Governor Jerry Brown signed into law an increase in the state's Renewable Portfolio Standard (RPS) program, establishing a strong incentive for further private-sector investment in the clean energy sector. The new law required that renewable resources provide 60 percent of retail electricity sales by 2030 and that carbon-free resources produce all the state's electricity by 2045.[14]

Colorado also has a vibrant venture capital economy, remaining in the No. 2 ranking for RCI for the second consecutive time. It ranked No. 5 for investment flows relative to GSP and No. 4 for deals relative to the number of businesses in the state, as well as No. 6 for specific investments in the area of clean technology. Colorado was the nation's first state to enact an RPS by ballot initiative in November 2004, leading to particularly strong growth in the solar power sector.[15] The state also ranked highly for several indicators of entrepreneurship, including No. 3 for both the ratio of business starts to state population and IPO investments as a percentage of GSP.

Massachusetts dropped two spots to No. 3 in the RCI sub-index rankings. The state narrowly edged out California for the No. 1 ranking in patents relative to state population. It ranked in the top three for measures of venture capital investment in all three fields measured in the RCI sub-index: nanotechnology (No. 3), clean technology (No. 2), and biotechnology (No. 1). However, Massachusetts also dropped seven places to No. 23 in the ranking of business startups at 19.5 per 100,000 residents, likely due to its relatively high labor costs and tough competition for skilled workers.[16]

Utah ranked No. 4, dropping one place from 2018. As with the other states in the top tier, it has one of the largest venture capital sectors in the nation as measured by a proportion of the state's total economy,[17] measured both by total investment (No. 4) and by the number of deals (No. 6). Utah also ranked No. 2 for both SBIC funding relative to the size of the economy and business starts relative to the state population, down one spot from its ranking for both indicators in 2018. The outlook for entrepreneurship support in the state remains unclear after Governor Gary Herbert signed a bill in March 2019, eliminating the Utah Science, Technology and Research Initiative (USTAR). The USTAR program was created in 2006 to support entrepreneurs and operated a technology incubation facility in addition to running competitive grant programs.[18]

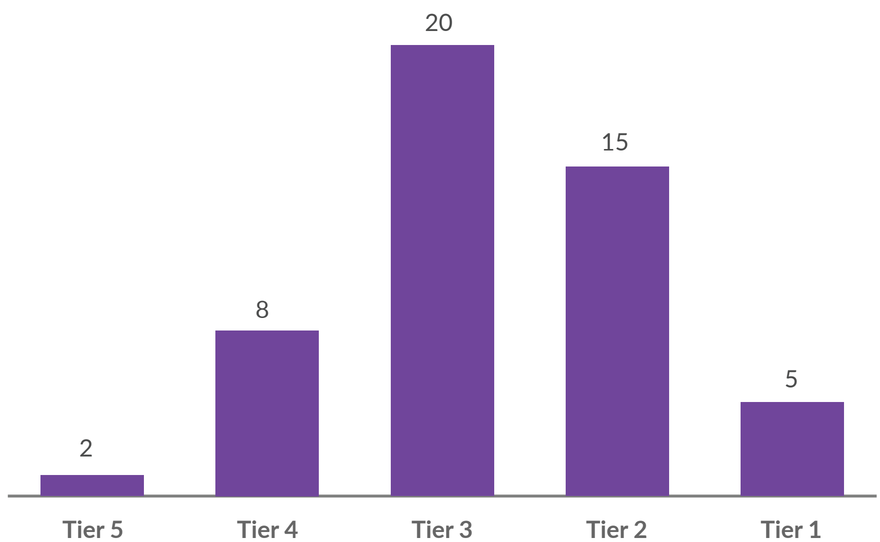
Washington remained steady at No. 5 in the sub-index rankings for RCI. It ranked No. 5 for the ratio of VC deals to the number of businesses in the state and No. 6 for the ratio of VC investment to total GSP. The state rose four spots to No. 5 for the number of business startups from 2016 to 2018 and was expected to record strong venture capital investment numbers through 2019. Three firms—contract management platform Icertis, identity authentication platform Auth0, and sales software maker Outreach—obtained "unicorn" status, becoming privately held startups with a total value of over $1 billion.[19] Washington also demonstrated a strong culture of technological innovation as one of just three states to record more than 100 patents per 100,000 state residents, ranking No. 3 behind Massachusetts and California, and the state's clean technology (No. 4) and biotechnology (No. 6) sectors received large investment flows.

BOTTOM-TIER STATES

Alaska ranked No. 49 for risk capital and entrepreneurial infrastructure in 2020, dropping one spot from its ranking in 2018. It had the smallest venture capital economy of any state, ranking at the bottom of the sub-index on six of 11 indicators, including VC investment and deals relative to the population of the state, IPOs, and investment in biotechnology, clean technology, and nanotechnology. Due to its small population, however, it did rank much higher (No. 2) for VC investment growth.

West Virginia ranked No. 50 on the RCI sub-index for the second consecutive time. It ranked at the bottom of the sub-index on six of 11 indicators and second from the bottom on three more. The trend has not gone unnoticed by state leaders, however. The Advantage Valley economic development organization announced a new program in June 2020, Fostering Advantages for Startups for Entrepreneurial Resurgence (FASTER WV). The program aims to increase funding opportunities for new business startups through collaboration among community colleges, foundations, and state government agencies.[20]

FIGURE 6: RISK CAPITAL AND ENTREPRENEURIAL INFRASTRUCTURE (RCI) SUB-INDEX: NUMBER OF STATES PER TIER



Source: Milken Institute (2020)

LARGEST GAINS

Minnesota (No. 6) and **Tennessee** (No. 23) both rose 15 places in the 2020 RCI sub-index rankings. Although Minnesota didn't experience a similar rise in the rankings in any specific indicator, it improved in several measures, including VC investment (+4), VC deals (+7), and VC investment in nanotechnology (+7). Tennessee rose substantially in the rankings for VC investment growth (+36), VC investment (+13), IPO investments (+10), and SBIC funding (+7). The health-care sector was a particularly frequent target for venture capital in both states. In Minnesota, Medical Alley is a premier center of health-care innovation, and the renowned Mayo Clinic also operates a venture capital arm investing in biopharmaceuticals, diagnostics, and medical devices.[21] According to the Nashville Capital Network, health care represented the largest portion (40 percent) of venture capital funding in middle Tennessee through 2018. However, the technology sector (30 percent) continued to attract increased venture capital flows.[22]

LARGEST DROPS

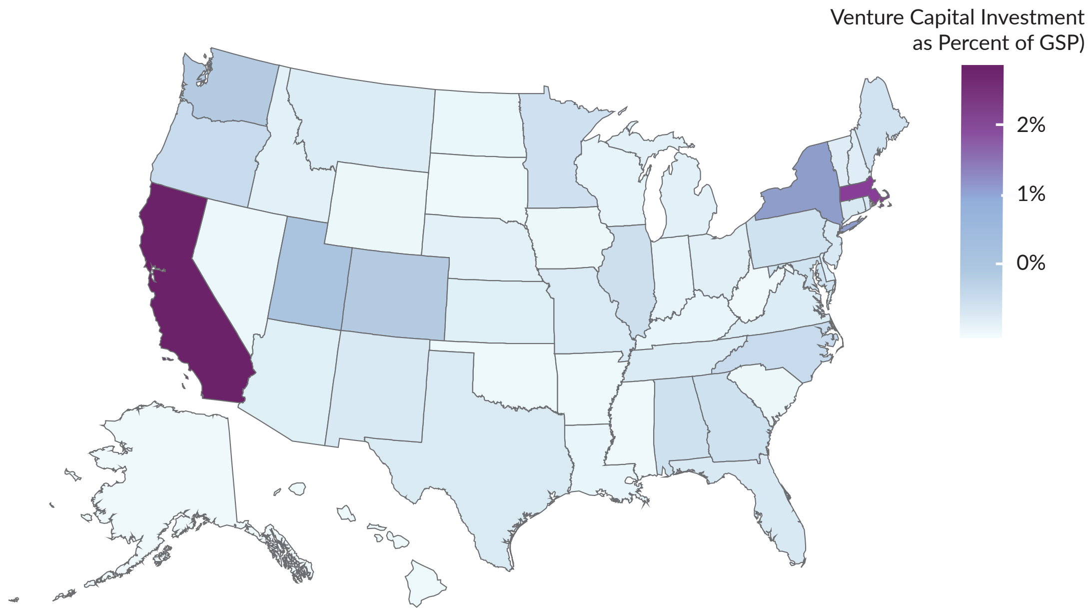
Rhode Island dropped 23 places in the RCI sub-index in 2020, ranking No. 36. The change was due primarily to sharp declines in both the amount of venture capital investment (−7) and the number of venture capital deals (−6), as well as a contraction of approximately 70 percent in both indicators (−45 places in the VC investment growth rankings and −10 places in VC deal growth). It also experienced much weaker growth in business starts, dropping 19 spots to rank No. 41 with just under three new enterprises per 100,000 state residents created from 2016 to 2018.

TABLE 4: RISK CAPITAL AND ENTREPRENEURIAL INFRASTRUCTURE (RCI) SUB-INDEX: STATE RANKINGS

State	2020 Rank	2018 Rank	2020 Score	2020 Tier
California	1	4	85.82	1
Colorado	2	2	84.00	1
Massachusetts	3	1	83.45	1
Utah	4	3	74.18	1
Washington	5	5	73.64	1
Minnesota	6	21	69.09	2
Oregon	7	16	68.73	2
New York	8	6	68.18	2
Texas	9	11	65.45	2
Pennsylvania	10	14	63.82	2
New Hampshire	11	23	63.27	2
Delaware	12	15	62.00	2
Illinois	13	10	61.27	2
New Jersey	14	20	60.18	2
Connecticut	15	25	59.82	2
Florida	16	8	58.36	2
North Carolina	17	9	57.82	2
Maryland	18	6	56.91	2
Arizona	19	30	55.45	2
Georgia	20	19	54.73	2
Montana	21	32	52.73	3
New Mexico	22	18	52.55	3
Tennessee	23	38	52.18	3
Ohio	24	24	52.00	3
Virginia	25	34	50.91	3
Indiana	26	21	50.73	3
Wisconsin	27	16	48.00	3
Michigan	28	12	47.82	3
Idaho	29T	28	46.73	3
Vermont	29T	31	46.73	3
South Carolina	31T	26	46.00	3
Kentucky	31T	42	46.00	3
Maine	33T	29	44.73	3
Hawaii	33T	47	44.73	3
Kansas	35	37	44.55	3
Rhode Island	36	13	43.64	3
Missouri	37	27	42.91	3
Arkansas	38	36	42.55	3
North Dakota	39	44	39.64	3
Wyoming	40	46	39.45	3
Nevada	41	34	36.18	4
Nebraska	42	33	34.00	4
Oklahoma	43	43	33.09	4
South Dakota	44	45	32.18	4
Iowa	45	41	28.00	4
Alabama	46	39	27.64	4
Louisiana	47	40	26.18	4
Mississippi	48	49	24.73	4
Alaska	49	48	18.55	5
West Virginia	50	50	5.27	5

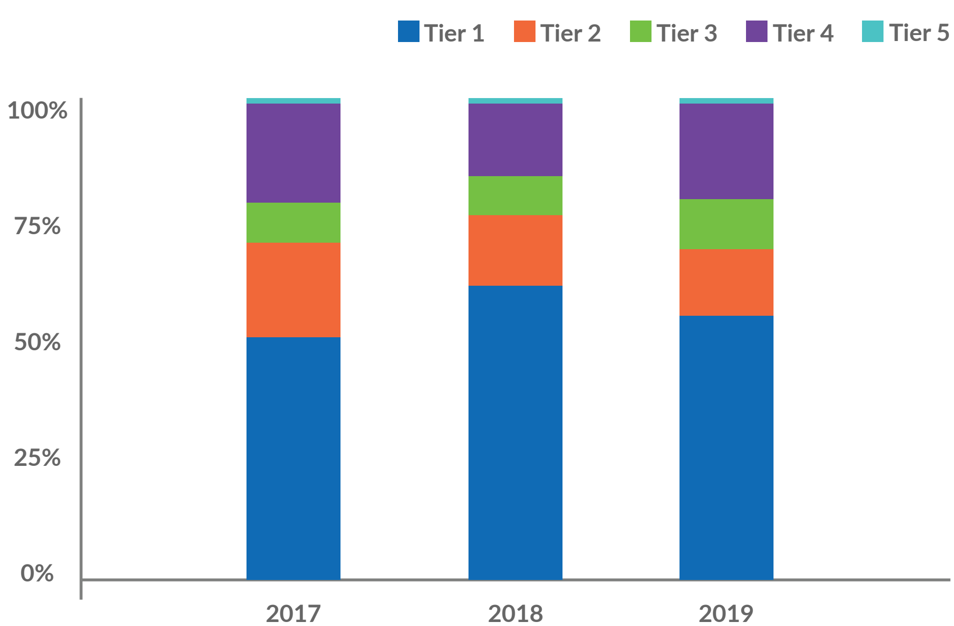
Source: Milken Institute (2020)

FIGURE 7: VENTURE CAPITAL INVESTMENT AS PERCENT OF GSP: THREE-YEAR AVERAGE (2017-2019)



Source: Milken Institute analysis of PwC MoneyTree report (2020)

FIGURE 8: VENTURE CAPITAL FUNDING TO STATES BY RCI SUB-INDEX TIER: PERCENT OF TOTAL



Note: Tier 5 states received less than 1 percent of total venture capital each year.
Source: Milken Institute analysis of PwC MoneyTree report (2020)

Human Capital Investment

BACKGROUND

Investment in human capital is essential to the competitiveness of each state's knowledge economy, where success often depends more on training and talent than on the availability of specific resources. Education in the fields of science, technology, engineering, and mathematics (STEM) can enhance a region's ability to innovate as well as giving workers greater ability to adapt to economic shifts. As a result, higher levels of education frequently correlate with higher-wage job opportunities.[23]

Generating growth in jobs and wages also requires balancing investments in higher education with those in primary and secondary educational systems. And workforce development programs at community colleges and technical and vocational training facilities increase a region's appeal to potential employers by promising a steady flow of skilled local graduates and trainees.[24]

SUB-INDEX COMPONENTS

Higher education graduates: The proportion of a state's population holding four-year university degrees—as well as graduate and PhD degrees—are key measures of skills and capacity for research and development, both within institutions of higher education as well as in the private sector. Relevant indicators also focus specifically on degrees in science, engineering, and health, which improve a state's ability to attract federal grants and other research funding in these fields.

State spending on students: Overall expenditures on student aid and changes in appropriations for higher education indicate the state government's commitment to producing a scientifically literate labor force and improving its potential for helping create new jobs and raising wages through workforce development programming.

Computer penetration and broadband access: These components illustrate technological connectivity across the state's population, representing an essential dimension of residents' ability to access critical business opportunities and educational resources without needing to travel.

Test scores: This includes average scores on the Scholastic Aptitude Test (SAT) and American College Testing Assessment (ACT) among high school students. Both the SAT Math section and ACT (which has sections on math and science) measure the effectiveness of the state curriculum in secondary schools.

TOP-TIER STATES

Massachusetts is again at the top of the ranking for the Human Capital sub-index, ranking first or second in 11 of 20 indicators. Massachusetts has ranked No. 1 every year but one since 2012. Massachusetts is the highest-scoring state in the nation for the percentage of adults with bachelor's, master's, and PhD degrees, as well as ACT scores, graduate students in science and engineering fields, and doctoral scientists per capita. Massachusetts is also home to a robust high-tech industry with firms in areas such as robotics, nanotechnology, and software that have strong links with labs at the top universities, such as the UMass Laboratory for Advanced Software Engineering Research (LASER).[25] The state government has also consistently supported high-tech industry growth, as evidenced by The Massachusetts Cybersecurity Innovation Fund, founded in 2018 to support the cybersecurity industry,[26] and the Scientific and Technology Research and Development Matching Grant Fund.[27]

Maryland ranks No. 2 behind Massachusetts on the sub-index for the total proportion of adult residents with bachelor's, master's, or PhD degrees. It also scores highly for the number of per capita doctoral scientists and graduate students in science, engineering, and health. It also has a strong high-tech industry, supported by the Maryland Technology Development Corporation (TEDCO), which provides resources, funding, and industry connections to help new companies develop and grow.[28] And it has a particularly strong life sciences sector, hosting several federal government agencies, most notably the National Institutes of Health, as well as one of the country's top hospital and medical research systems at Johns Hopkins University.[29]

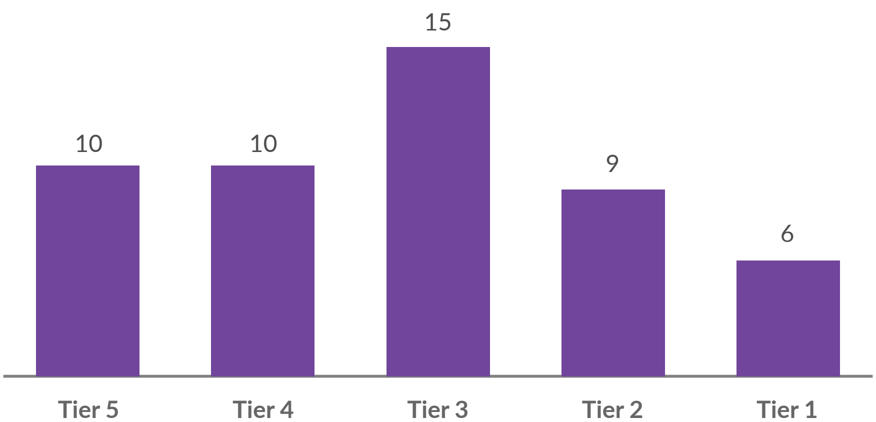
Utah ranks No. 3 due to growth in higher education funding (No. 2 for change in state appropriations) and the proportion of residents with bachelor's degrees in science and engineering (No. 1). Universities in Utah's higher education system continue to receive increased state funding, have relatively low tuition compared to the rest of the US, and produce graduates in critical fields.[30] There is a fast-growing high-tech sector in Provo, which has helped Utah develop a reputation as a hub for startups. A hub of larger tech companies such as Adobe supports the local industry, while a high number of graduates in science and technology fields provide workers for the industry. The state also performs well on measures of connectivity, ranking No. 1 in computer penetration and No. 4 in broadband access.

Colorado (No. 4) also scores well on the education variables and access to computers and broadband. Colorado's success in these indicators is partially attributed to a flourishing IT sector, which has grown rapidly in the last decade. Several tech giants have opened campuses in Colorado, including Google, which invested $131 million building a campus to house 1,500 employees.[31] Colorado has been attractive to tech companies due to its quality of life and its business environment. The state government offers tax incentives for job creation and business expansion, with specific benefits for companies investing in biotechnology, renewable energy, medical technology, and other high-tech industries.[32] These measures have helped the state become home to thousands of high-tech companies across the Front Range region, stretching from Fort Collins south through Boulder, Denver, and Colorado Springs.[33]

Virginia rose three places in the sub-index rankings to No. 5 in 2020. Its highest rankings were for the percentage of the state population with degrees—including bachelor's (No. 6), master's (No. 4), and PhD (No. 4)—as well as per capita state spending on student aid (No. 1 for the second consecutive time). It also scored highly (No. 9) in the growth of state appropriations for higher education and recent degree recipients in science and engineering (No. 10). A consortium of public universities in the state, including George Mason University, James Madison University, the University of Virginia, Virginia Commonwealth University, and Virginia Tech, began working together in 2019 to create an inventory of STEM programming and host a summit of state education leaders.[34]

Connecticut ranked No. 6, mainly due to the quality of its educational system. Connecticut scored highly for the percentage of adults with a bachelor's degree or higher (No. 4), rate of adults with a master's degree (No. 3), and for doctoral engineers and scientists. It also had the No. 2 average ACT scores of any state. Although funding for higher education has fallen somewhat,[35] the state still ranks highly in terms of per-student support. Higher education enrollment rates as a share of the young adult population have been rising, and graduation rates from four-year colleges are also higher than the nation's average.

FIGURE 9: HUMAN CAPITAL INVESTMENT (HCI) SUB-INDEX: NUMBER OF STATES PER TIER



Source: Milken Institute (2020)

BOTTOM-TIER STATES

Nevada ranked No. 49 in the HCI sub-index. The state ranked near the bottom for degree holders (bachelor's degrees No. 45, graduate degrees No. 46, and PhD degrees No. 49) as well as for the number of doctoral scientists (No. 50) and engineers (No. 48). These deficiencies are due principally to the lack of renowned research universities within the state. However, the University of Nevada-Las Vegas achieved its goal of classification as an R1 institution with "very high research activity" in 2018.[36]

Oklahoma (No. 50) falls in the bottom half of most indicators in the sub-index. Over the last 10 years, it has cut higher education funding by over 25 percent, and as a result, the state's public universities have raised tuition. These cuts have reduced graduation rates significantly, especially in the state's more disadvantaged areas.[37] This situation appears unlikely to improve in the immediate future, as COVID-19 related cuts to education funding have brought the total level to its lowest level in two decades.[38]

LARGEST GAINS

Missouri saw its ranking rise nine places to No. 20, and New Jersey rose eight spots to No. 13. Missouri increased the number of degrees awarded in science and engineering fields at the bachelor's degree (+7) and master's degree (+4) levels, ranking No. 20 and No. 4, respectively, and also substantially increased the proportion of recent bachelor's degrees awarded in science, engineering, and health (+11 to No. 27). New Jersey experienced a considerable rise in the growth of state appropriations for higher education (+28), ranking No. 5, as well as recent degrees in science and engineering as a proportion of the total labor force (+18), ranking No. 24.

LARGEST DROPS

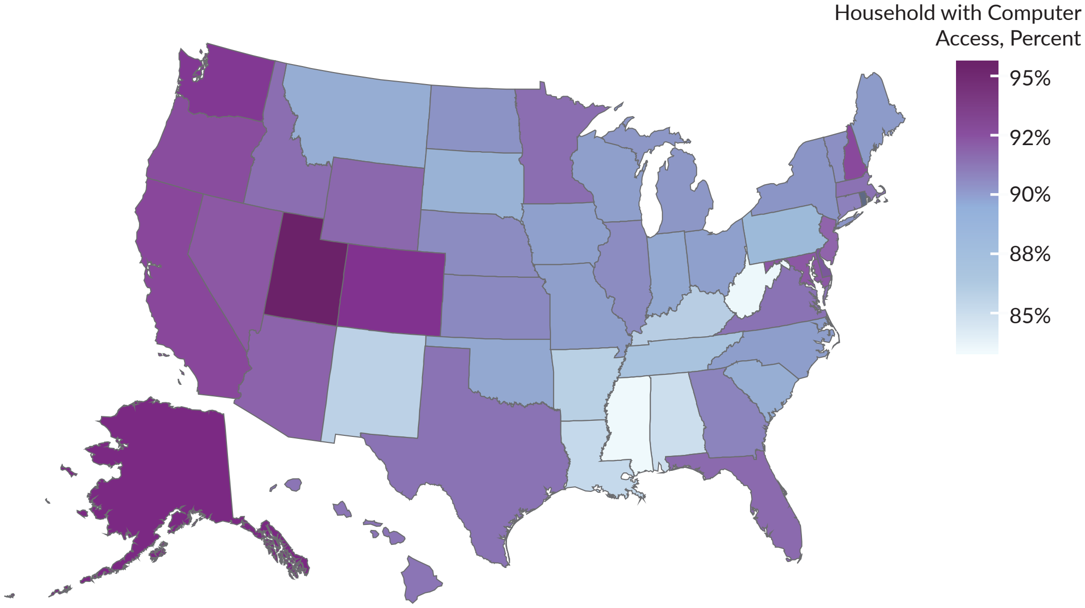
Vermont dropped seven places into a tie for No. 23 in the 2020 sub-index for HCI. Its ranking fell eight places for master's degrees in science and engineering to No. 28, though it continued to rank highly (No. 3) for bachelor's degrees. Its ranking for broadband penetration also dropped substantially (−17) to No. 33 overall. However, that measure could potentially see improvement following Governor Phil Scott's decision to sign a 2019 law investing an additional $1.5 million in expanding connectivity to rural communities.[39]

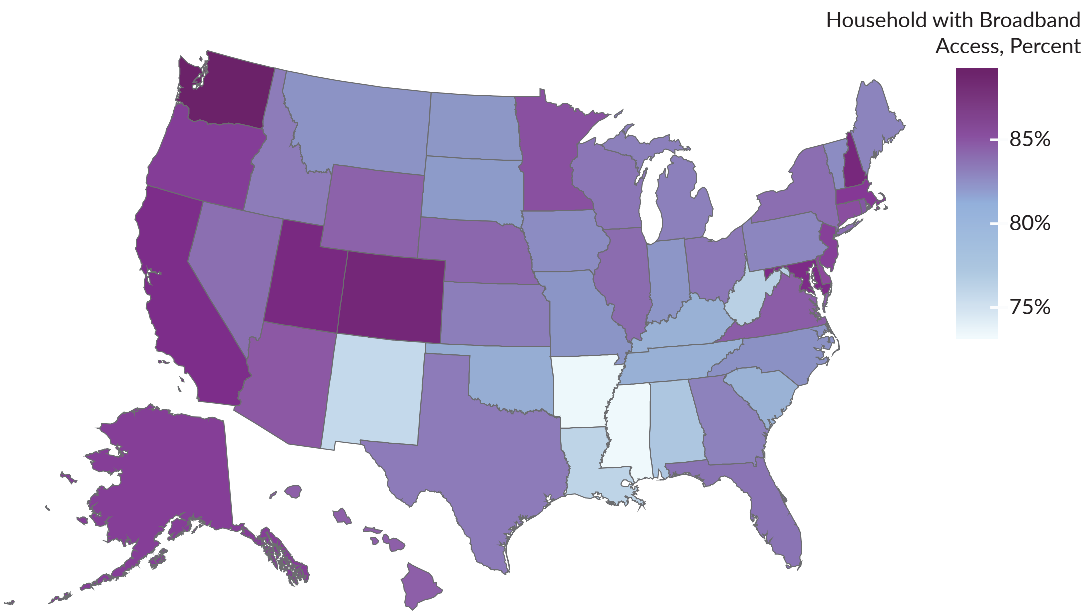
TABLE 5: HUMAN CAPITAL INVESTMENT (HCI) SUB-INDEX: STATE RANKINGS

State	2020 Rank	2018 Rank	2020 Score	2020 Tier
Massachusetts	1	1	82.50	1
Maryland	2	2	78.30	1
Utah	3	5	75.30	1
Colorado	4	3	73.50	1
Virginia	5	8	72.50	1
Connecticut	6	7	71.50	1
Minnesota	7	4	69.60	2
California	8	10	68.30	2
New York	9	9	67.60	2
Illinois	10	6	64.10	2
Pennsylvania	11	13	63.00	2
Delaware	12	12	62.10	2
New Jersey	13	21	60.40	2
Washington	14	14	60.30	2
Rhode Island	15	11	59.90	2
New Hampshire	16	15	58.90	3
Oregon	17	20	57.80	3
Iowa	18	18	55.60	3
Nebraska	19	19	54.90	3
Missouri	20	29	53.10	3
Indiana	21	24	52.80	3
North Carolina	22	22	52.60	3
Vermont	23T	16	52.50	3
North Dakota	23T	17	52.50	3
Wisconsin	23T	25	52.50	3
Kansas	26T	33	52.40	3
Georgia	26T	30	52.40	3
New Mexico	28	31	51.90	3
Michigan	29	23	50.60	3
Arizona	30	27	50.40	3
Ohio	31	26	45.90	4
Wyoming	32	34	45.20	4
South Dakota	33	28	44.80	4
Montana	34	35	43.80	4
Texas	35	36	43.00	4
Alabama	36	38	42.80	4
Alaska	37	39	39.90	4
Hawaii	38	32	38.90	4
Idaho	39	41	37.70	4
Tennessee	40	40	37.00	4
Maine	41	37	34.90	5
Florida	42	43	33.10	5
West Virginia	43	42	32.30	5
South Carolina	44	47	31.20	5
Louisiana	45	44	30.60	5
Mississippi	46	45	29.10	5
Arkansas	47	48	29.00	5
Kentucky	48	45	27.50	5
Nevada	49	49	26.10	5
Oklahoma	50	50	23.60	5

Source: Milken Institute (2020)

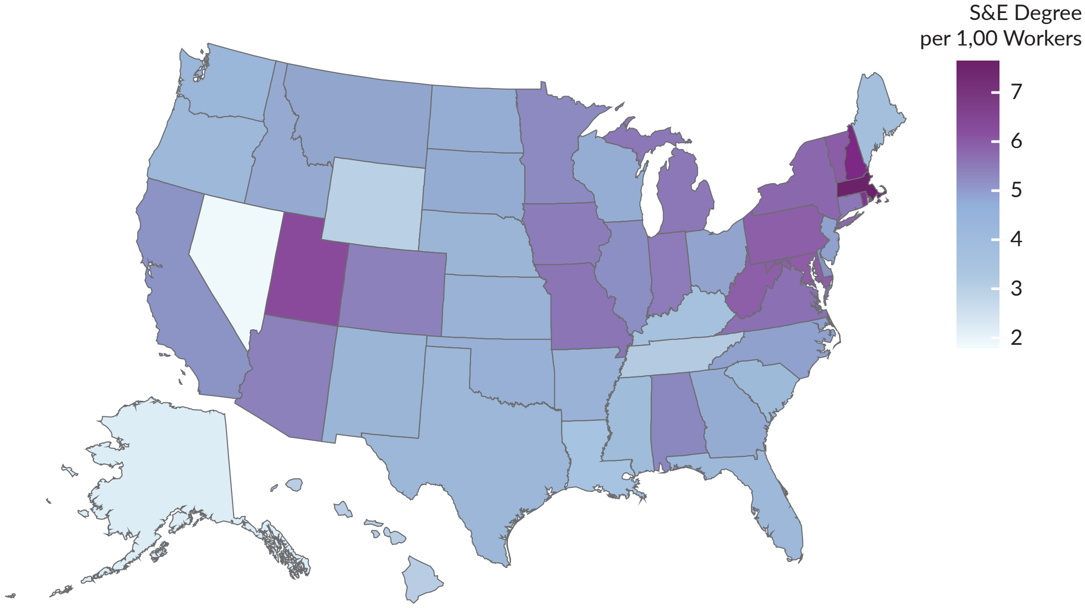
FIGURE 10: PERCENTAGE OF HOUSEHOLDS WITH COMPUTER AND BROADBAND ACCESS: THREE-YEAR AVERAGES (2016-2018)





Source: Milken Institute analysis of IPEDS Completion Survey (2020)

FIGURE 11: DEGREES IN SCIENCE AND ENGINEERING (S&E) PER 1,000 CIVILIAN WORKERS: THREE-YEAR AVERAGE (2016-2018)



Source: Milken Institute analysis of IPEDS Completion Survey (2020)

Technology and Science Workforce

BACKGROUND

The Technology and Science Workforce (TSW) sub-index shows the intensity of each state's technologically proficient workforce, based on the prevalence of jobs in key fields relative to total state employment. The rising complexity of new technologies leads many firms to seek a large pool of potential employees with the needed experience and skills to install, maintain, and operate advanced programs and processes. While some occupations—such as engineers and research scientists—require credentials in higher education, a state's tech and science workforce also includes many skilled technicians who do not necessarily have four-year degrees. Regardless of their educational background, these workers play vital roles in the knowledge economy.

In addition to attracting and staffing innovative firms, a large science and technology workforce creates knowledge spillovers and agglomeration effects. Information spreads through informal networks of professionals and researchers, aiding the adoption of discoveries. Workers in science, engineering, and health degrees frequently prefer to live and work in clusters,[40] and the concentration of related opportunities also enables more frequent switches from one firm to another, further speeding the dissemination of knowledge.[41]

SUB-INDEX COMPONENTS

Intensity of computer and information science experts: This category includes the following jobs: Computer Systems Analysts, Information Security Analysts, Information Research Scientists, Network Support Specialists, User Support Specialists, Network Architects, Systems Administrators, Database Administrators, Computer Programmers, Software Developers, Web Developers, Operations Research Analysts, Statisticians, and other types of computer and information scientists.

Intensity of engineers: This group includes the following occupations: Aerospace Engineers, Bioengineers and Biomedical Engineers, Chemical Engineers, Civil Engineers, Computer Hardware Engineers, Electrical Engineers, Environmental Engineers, Industrial Engineers, Materials Engineers, Mechanical Engineers, Mining and Geological Engineers, Nuclear Engineers, Petroleum Engineers, and other types of engineers.

Intensity of life and physical scientists: This category includes the following occupations: Soil and Plant Scientists, Biochemists and Biophysicists, Microbiologists, Zoologists and Wildlife Biologists, Medical Scientists, Epidemiologists, Physicists, Atmospheric and Space Scientists, Chemists, Materials Scientists, Environmental Scientists and Specialists, Geoscientists, Agricultural and Food Science Technicians, Biological Technicians, Chemical Technicians, Environmental Science and Protection Technicians, Nuclear Technicians, and other types of life and physical scientists.

TOP-TIER STATES

Maryland tied with Washington for the No. 1 spot in TSW for this edition of the STSI. The state ranks No. 3 in the concentration of computer and information science experts and No. 2 in the concentration of life and physical scientists. Maryland also boasts the country's second-highest concentration of high-tech business establishments. Proximity to federal agencies that employ workers in technology and a robust private sector combine to boost the state in the sub-index rankings. Additionally, the diverse nature of their workforce is evident as it ranks highly in all three relevant occupation groups. Recent statewide initiatives such as Employment Advancement Right Now (EARN) contributed to Maryland's development of a robust technology workforce by working with private companies to provide education and career paths for people to enter the workforce, and the program's funding has almost doubled since 2018.[42]

Washington moved into a tie with Maryland for the No. 1 rank in 2020. It ranked No. 2 in the concentration of computer and information science experts and No. 4 in the concentration of engineers. The state boasts an impressive cluster of software and web developers employed at technology giants such as Microsoft and Amazon but also within the thriving start-up environment. Moreover, Washington has a high concentration of aerospace engineers as a center of manufacturing for Boeing.[43] In addition to the University of Washington's ability to attract robust research funding,[44] the state's community college system recently ranked second-best in the country,[45] helping it sustain the highest levels of employment and payroll in high-tech industries nationwide.

Massachusetts ranks No. 3 in TSW. The state ranks No. 6 in the concentration of computer and information science experts and No. 1 in the concentration of life and physical sciences workers. It also has a booming biotech sector and a healthy university system that have produced one of the country's highest concentrations of biological and medical scientists. The state has numerous well-funded and prestigious private universities, and the University of Massachusetts system attracted $684 million in research and development funding. This system contributed to over 1,000 patent applications and the formation of at least 50 spinoff companies, attracting and retaining highly skilled workers.[46]

Colorado ranked No. 4 on the TSW sub-index ranking, coming in at No. 4 for its concentration of computer and information science experts and No. 5 for its concentration of engineers. The recently formed Colorado Space Coalition promotes and bolsters Colorado's position as a hub for aerospace companies. Nine major aerospace companies have significant operations in the state and contribute to a highly skilled technology workforce. As a result, Colorado has one of the highest concentrations of businesses in high-tech industries nationwide. The University of Colorado system has some of the leading programs in aerospace engineering and attracted over $1.2 billion in funding in fiscal year 2018, facilitating research in areas such as climate science, genetics, and molecular biology.[47]

California is the only new addition to the top tier at No. 5, with some of the highest concentrations of high-tech companies and an employment LQ higher than the national average for 19 high-tech industries. The state's vibrant technology economy is a result of major centers of innovation such as Silicon Valley and Pasadena that attract highly skilled workers from around the world. The well-funded University of California system and numerous notable private institutions such as Stanford also contribute to the skilled workforce in California. As an established haven for technology companies, California continues to attract startups, and regions such as Silicon Valley keep the state at the forefront of the national rankings for technology and science workforce. The state government also proposed an 11 percent increase in its workforce development budget for fiscal year 2020, putting almost $100 million into various programs.[48]

BOTTOM-TIER STATES

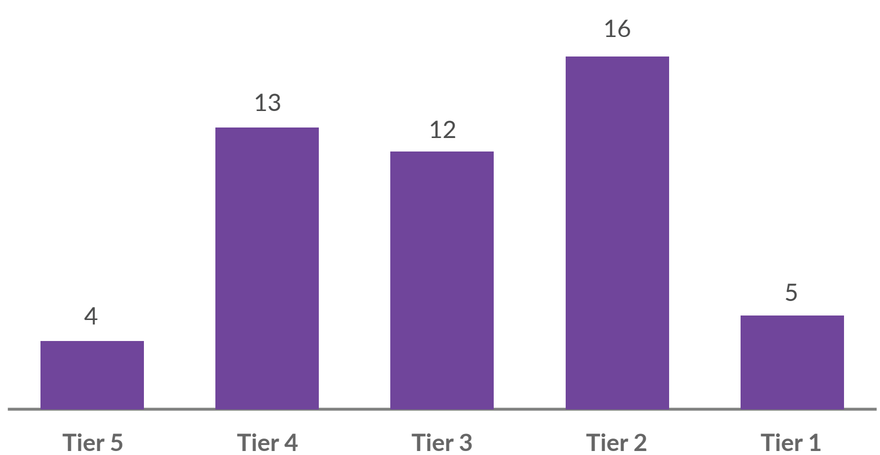
Arkansas dropped to No. 49 in TSW from No. 46 in the previous edition of the STSI. The state was held back by ranking second to last in the concentration of engineers and last in the concentration of life and physical scientists. The University of Arkansas has a low graduation rate and has largely relied on the Walton Family Foundation for research funding.[49] In 2018, Walmart began rounds of job cuts at its corporate headquarters,[50] but the newly announced construction of a modern headquarters may attract a large skilled workforce. Despite those factors, Arkansas ranked No. 12 in the net formation of high-tech establishments, which suggests promising growth in the tech-startup ecosystem.

Nevada ranks last in TSW, ranking in the bottom five in all three categories of technology and science workers. Outside of some startup growth in the Reno area, the state has not attracted a skilled workforce of substantial size, as reflected by the spike in the state unemployment rate to 30.1 percent in April 2020 due to the COVID-19 pandemic.[51] The University of Nevada system currently shows growth towards higher research expenditures but lacks a healthy retention rate for students.

LARGEST GAINS

Michigan increased 19 spots in the rankings, moving from No. 31 to No. 12. The state saw an increase in the concentration of life and physical scientists (+14) and moved up in the concentration of engineers (+14) to claim the No. 1 spot. The

FIGURE 12: TECHNOLOGY AND SCIENCE WORKFORCE (TSW) SUB-INDEX: NUMBER OF STATES PER TIER



Source: Milken Institute analysis of PwC MoneyTree report (2020) robust engineering programs at the University of Michigan and the automobile industry give Michigan the country's highest number of engineers per capita. However, salaries in the auto industry vary widely between the assembly line and management offices.[52] Further expansion could result from the state's $3 million campaign to add skilled trades jobs by 2026 and compensate for lagging growth in recent years.[53]

LARGEST DROPS

Vermont faced the most significant drop in rankings from No. 16 to No. 36. The state saw a decline in the concentration of engineers (–11) and a major decrease in its concentration of life and physical scientists (–24). Vermont tended to rank higher within occupations that were not represented in all the states but lower in professions with higher nationwide intensity, reflecting a shrinking job market.[54]

TABLE 6: TECHNOLOGY AND SCIENCE WORKFORCE (TSW) SUB-INDEX: STATE RANKINGS

State	2020 Rank	2018 Rank	2020 Score	2020 Tier
Maryland	1T	1	93.33	1
Washington	1T	2	93.33	1
Massachusetts	3	3	90.67	1
Colorado	4	4	89.33	1
California	5	6	81.33	1
Virginia	6T	8	71.33	2
Minnesota	6T	7	71.33	2
New Hampshire	6T	11	71.33	2
Oregon	9	10	69.33	2
Utah	10	9	68.67	2
Alaska	11	13	67.33	2
New Jersey	12T	20	66.67	2
Michigan	12T	31	66.67	2
New Mexico	14	22	65.33	2
North Carolina	15T	19	63.33	2
Delaware	15T	5	63.33	2
Texas	17T	17	62.00	2
Pennsylvania	17T	15	62.00	2
Ohio	17T	23	62.00	2
Wisconsin	20	30	61.33	2
Connecticut	21	18	60.67	2
Idaho	22	12	58.00	3
Rhode Island	23	21	54.00	3
Alabama	24	33	50.00	3
Montana	25	24	48.67	3
Kansas	26	32	47.33	3
Iowa	27T	44	46.67	3
Wyoming	27T	25	46.67	3
Arizona	29	14	45.33	3
Georgia	30	28	44.67	3
Nebraska	31	29	44.00	3
Illinois	32	26	42.00	3
Missouri	33	27	41.33	3
South Carolina	34	36	40.00	4
Oklahoma	35	40	38.00	4
Indiana	36T	41	37.33	4
Vermont	36T	16	37.33	4
South Dakota	36T	37	37.33	4
North Dakota	39	35	36.00	4
Maine	40	39	34.00	4
West Virginia	41T	43	31.33	4
Hawaii	41T	34	31.33	4
New York	43	38	30.00	4
Kentucky	44	47	26.67	4
Tennessee	45	42	26.00	4
Louisiana	46	49	24.00	4
Florida	47	45	22.00	5
Mississippi	48	48	14.67	5
Arkansas	49	46	9.33	5
Nevada	50	50	5.33	5

Source: Milken Institute (2020)

Technology Concentration and Dynamism

BACKGROUND

The Technology Concentration and Dynamism (TCD) sub-index measures the intensity and expansion of high-tech businesses. It captures several critical components of a state's ability to transform small entrepreneurial firms into large, growing companies. Measures of high-tech dynamism, including high levels of employment and payroll growth in high-tech industries, correlate with robust economies that are less vulnerable to external economic shocks or gradual obsolescence. Moreover, they often correlate with the development of high-tech clusters that generate positive spillover effects through the growth of supplier networks and local wages.[55]

By measuring outcomes—not just science and technology inputs—this sub-index also captures other influences on the business climate that complement the STSI's core analytical insights regarding factors that facilitate knowledge-based economic growth. These factors include taxes, regulations, growth in non-high-tech sectors, proximity to other dynamic regions, and overall quality of life. These influence not only where firms choose to locate but where their workers choose to live.

SUB-INDEX COMPONENTS

Industry concentration: These industries are key drivers of both job creation and wage growth, so the sub-index measures the concentration of establishments, employment, and payroll in high-tech sectors to determine the quality of new jobs in each state economy. It also measures growth in high-tech startups and the number of high-tech jobs.

Geographic concentration: The sub-index counts the number of high-tech industries in each state with a location quotient (LQ) higher than 1.0, which indicates that the average concentration of that industry is higher than the national average. This indicator reveals which states have been most successful in stimulating the growth of particular industries and which sectors have been most successful in specific regions.

High-performing tech companies: The number of companies named in Deloitte's Technology Fast 500—an index that identifies the fastest-growing private tech companies—reflects the level of growth in states' high-tech economies. We also consider the Inc. 500 rankings for a general snapshot of all companies. Taken together, they measure how well tech firms are performing against a wider field.

The following high-tech industries, defined at the four-digit industry group level by the North American Industry Classification System (NAICS), are measured by the indicators used for the TCD sub-index: Pharmaceutical Manufacturing; Commercial and Service Industry Machinery Manufacturing; Computer Equipment Manufacturing; Communications Equipment Manufacturing; Audio and Video Equipment Manufacturing; Semiconductor and Electronic Component Manufacturing; Navigational and Control Instruments Manufacturing; Magnetic and Optical Media Manufacturing; Aerospace Manufacturing; Medical Equipment Manufacturing; Software Publication; Motion Picture, Video, and Sound Recording; Wired and Wireless Telecommunications; Satellite Communications; Data Processing, Hosting, and Related Services; Architectural and Engineering Services; Computer Systems Design; Scientific Research and Development; and Medical and Diagnostic Laboratories.

TOP-TIER STATES

Utah ranked No. 1 on the TCD sub-index, driven by strong job growth in technology industries, particularly in the Silicon Slopes region. However, some experts anticipate that nearby Salt Lake City could soon become the state's tech hub.[56] The state ranked No. 1 on two of eight indicators, including high-tech business formation and the number of firms in the Inc. magazine list of Fastest Growing Companies in America. Utah also ranked No. 2 for employment growth in high-tech industries and No. 3 for the greatest number of sectors with a location quotient greater than 1. Provo (No. 2), Ogden (No. 22), and Salt Lake City (No. 25) were all listed on the Milken Institute's Best-Performing Cities (BPC) Index in 2020.[57]

Colorado rose three spots to No. 2 in 2020. It ranked near the top of the sub-index for the percentage of businesses (No. 3), jobs (No. 8), and wages (No. 8) in high-tech industries, as well as No. 4 for the number of high-tech industries with employment LQs higher than 1. Denver (No. 18), Greeley (No. 20), Fort Collins (No. 21), and Boulder (No. 28) all ranked near the top of the Milken Institute's Best-Performing Cities Index in 2020.[58] Meanwhile, both Fort Collins (No. 12) and Boulder (No. 1) were listed on Bloomberg's 2019 Brain Concentration Index, a ranking of cities with high densities of STEM professionals.[59] Denver is also likely to remain a driver of high-tech employment growth with the relocation of analytics software company Palantir Technologies, announced in August 2020.[60]

California dropped one spot from its 2018 ranking to No. 3. It once again registered unprecedented diversity in its high-tech economy, ranking No. 1 with a higher LQ than the national average in 19 of 20 high-tech industries. And this diversity was also reflected in its ranking for the percentage of total establishments (No. 4), percentage of employment (No. 3), and share of payroll (No. 2) in high-tech sectors. The Milken Institute's BPC 2020 also highlighted exceptionally robust industry-led growth in San Francisco (No. 1), San Jose (No. 4), Oakland (No. 17), and Riverside (No. 25), demonstrating that high-tech industries in the state extend far beyond Silicon Valley.[61]

Washington maintained its No. 4 ranking, with a score identical to Massachusetts. It topped the sub-index rankings at No. 1 for both the proportion of total jobs (more than one in ten) and the proportion of total pay (around one-quarter) concentrated in high-technology industries. The latter trend appears particularly likely to continue given extraordinarily high average salaries in the Seattle information technology sector, where workers took home an average of over $5,000 in weekly pay in 2019.[62] With respect to regional tech hubs, both Seattle (No. 8) and Olympia (No. 19) ranked high on the Milken Institute's Best-Performing Cities Index in 2020.[63]

Massachusetts dropped from No. 3 to tie with Washington for No. 4. It recorded the No. 2 highest number of high-tech industries with LQs greater than 1.0 as well as the No. 1 concentration of Deloitte Technology Fast 500 companies. However, the state lagged slightly in 2020 in high-tech employment growth, dropping 14 places in the rankings to No. 29. The city of Cambridge has become a particular hotbed for job and wage growth in its biotech industry cluster. However, it has also generated concerns about the effects of limited infrastructure and rising rents on future startups.[64]

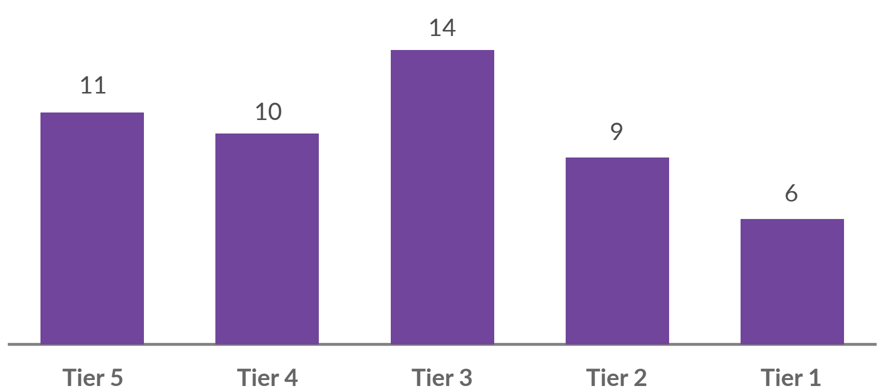
Arizona rose three places to No. 6 in the TCD sub-index rankings. The state demonstrated high levels of business formation in high-tech industries (No. 8), as well as a diverse range of high-tech industries with LQs greater than 1 (No. 10). Arizona's Technology and Research Initiative Fund (TRIF) has proven an incredibly important tool for attracting firms in the technology industry, including funds for technology transfer at the state's public universities.[65]

BOTTOM-TIER STATES

Nebraska ranked No. 49, dropping six spots from its previous ranking. The state recorded high-tech employment growth of just one-half of 1 percent from 2016 to 2018, ranking No. 46 and dropping 17 places from its prior ranking. The state's high-tech economy also showed little diversity (No. 39), as just two high-tech industries had LQs higher than 1: medical equipment manufacturing and data processing.

Mississippi was at the bottom of the TCD sub-index rankings, three places below 2018. The state ranked no higher than No. 34 on any relevant indicators, registering its highest ranking for net high-tech business formation. It also ranked at or near the bottom for measures of industry concentration in terms of businesses (No. 48), jobs (No. 50), and payroll (No. 48).

FIGURE 13: TECHNOLOGY CONCENTRATION AND DYNAMISM (TCD) SUB-INDEX: NUMBER OF STATES PER TIER



Source: Milken Institute (2020)

LARGEST GAINS

New Mexico rose 19 places to rank No. 16, and **South Carolina** jumped 12 places into a tie for No. 20. The latter state registered a notable increase (+24 to No. 7) in net high-tech business formation as well as the percentage of payroll in high-tech industries (+12). Greenville, Charleston, and Columbia are all centers of startup growth, with Greenville hosting a particularly dynamic business-to-business software industry.[66]

LARGEST DROPS

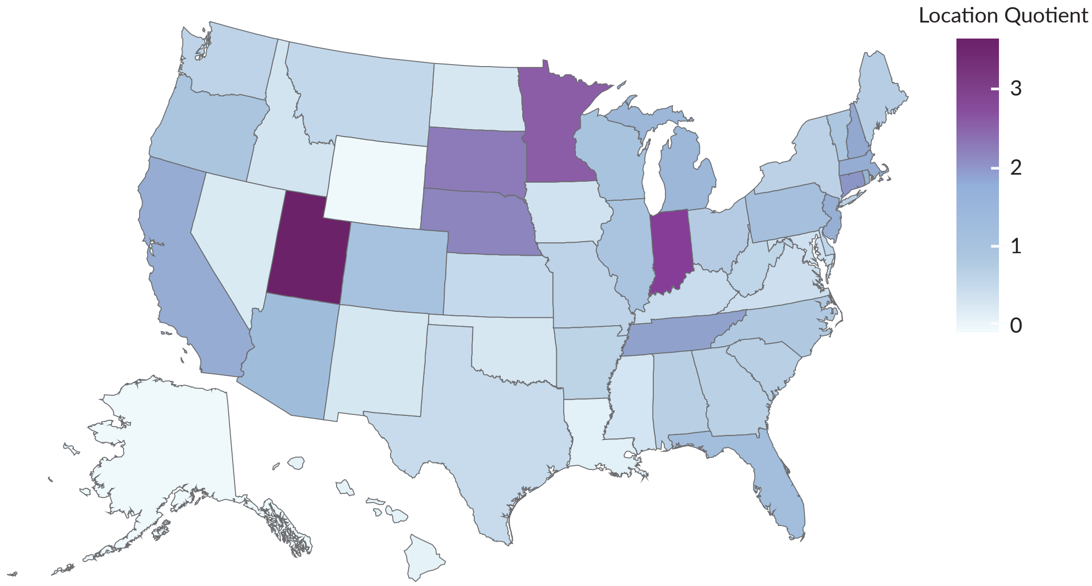
Kansas (No. 26) and **New York** (No. 27) both dropped 11 places in the rankings in 2020. Kansas experienced a sharp drop (to No. 43) in high-tech business formation as well as a steep decline (to No. 47) in high-tech employment growth. Meanwhile, New York's ranking for percentage of total payroll in high-tech industries dropped substantially (to No. 29) as did its rate of net high-tech business formation (to No. 45).

TABLE 7: 2018 TECHNOLOGY CONCENTRATION AND DYNAMISM (TCD) SUB-INDEX: STATE RANKINGS

State	2020 Rank	2018 Rank	2020 Score	2020 Tier
Utah	1	1	92.86	1
Colorado	2	5	88.29	1
California	3	2	86.00	1
Washington	4T	4	79.14	1
Massachusetts	4T	3	79.14	1
Arizona	6	9	77.71	1
Virginia	7	7	76.57	2
Texas	8	8	74.86	2
Georgia	9	6	74.57	2
Maryland	10	11	69.43	2
Oregon	11	13	66.00	2
North Carolina	12	10	65.14	2
New Hampshire	13	19	64.00	2
Idaho	14	17	63.14	2
Delaware	15	21	62.57	2
Florida	16T	12	60.86	3
New Mexico	16T	35	60.86	3
New Jersey	18	14	60.00	3
Vermont	19	23	58.29	3
Connecticut	20T	25	57.71	3
South Carolina	20T	32	57.71	3
Minnesota	22	18	55.43	3
Michigan	23	20	54.86	3
Nevada	24	22	54.29	3
Illinois	25	24	52.00	3
Kansas	26	15	50.29	3
New York	27	16	49.71	3
Alabama	28	29	49.43	3
Indiana	29	34	46.57	3
Pennsylvania	30	31	45.71	4
Missouri	31	27	42.29	4
Hawaii	32	36	38.57	4
Montana	33T	26	37.71	4
Tennessee	33T	29	37.71	4
Wisconsin	35T	28	37.14	4
Rhode Island	35T	38	37.14	4
Ohio	37	33	34.86	4
Iowa	38	41	30.57	4
Kentucky	39	37	30.29	4
Oklahoma	40	41	30.00	5
South Dakota	41	44	29.14	5
Arkansas	42	49	26.86	5
Maine	43	39	26.57	5
West Virginia	44	50	26.00	5
Wyoming	45	46	25.43	5
Alaska	46T	45	25.14	5
Louisiana	46T	40	25.14	5
North Dakota	46T	47	25.14	5
Nebraska	49	43	22.00	5
Mississippi	50	47	14.29	5

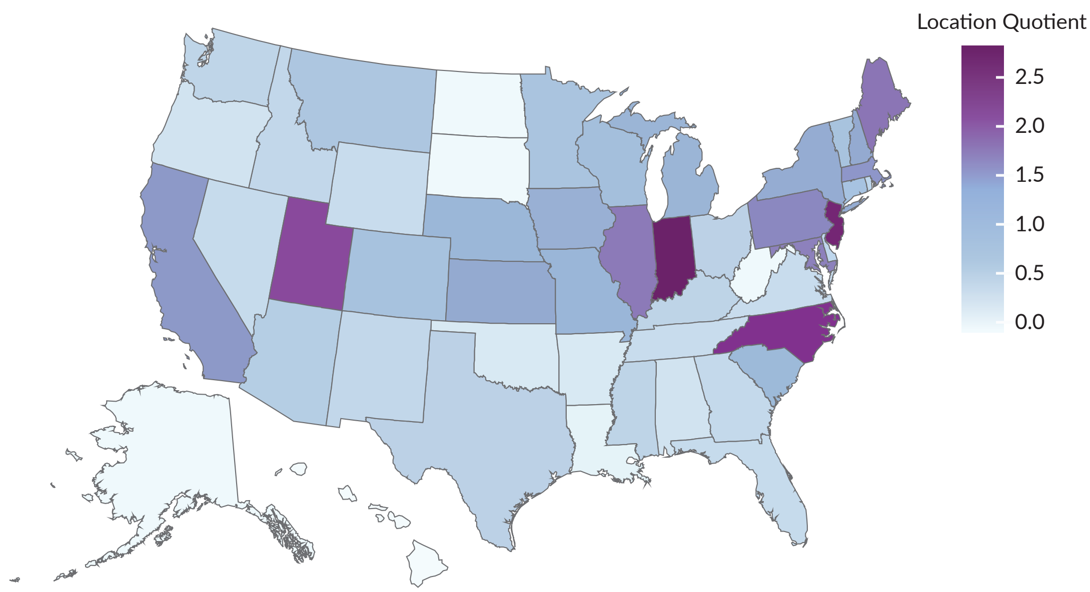
Source: Milken Institute (2020)

FIGURE 14: MEDICAL EQUIPMENT MANUFACTURING LOCATION QUOTIENTS: MEASURED IN 2018



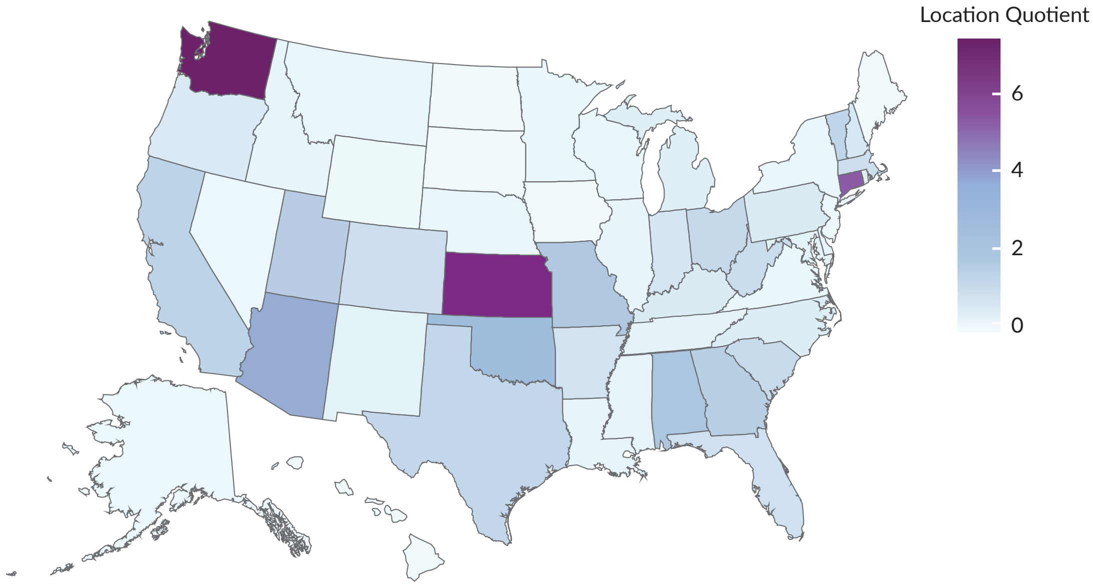
Note: Medical Equipment Manufacturing reflects NAICS Industry Code 3391.
Source: Milken Institute analysis of BLS Quarterly Census of Wages and Employment (2020)

FIGURE 15: PHARMACEUTICAL AND MEDICINE MANUFACTURING LOCATION QUOTIENTS: MEASURED IN 2018



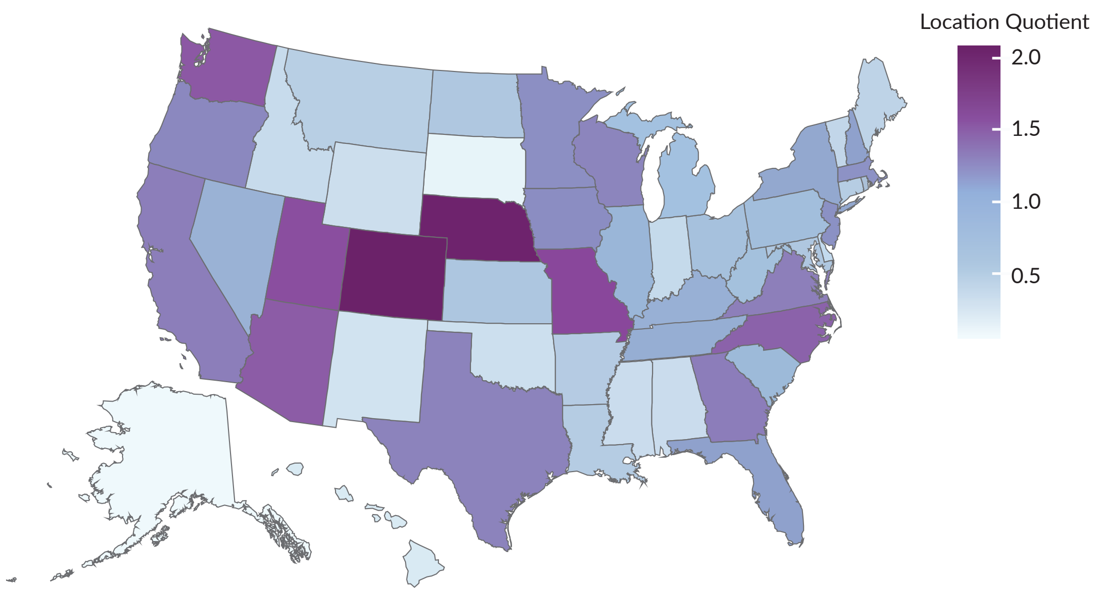
Note: Pharmaceutical and Medical Manufacturing reflects NAICS Industry Code 3254.
Source: Milken Institute analysis of BLS Quarterly Census of Wages and Employment (2020)

FIGURE 16: AEROSPACE MANUFACTURING LOCATION QUOTIENTS: MEASURED IN 2018



Note: Aerospace Manufacturing reflects NAICS Industry Code 3364.
Source: Milken Institute analysis of BLS Quarterly Census of Wages and Employment (2020)

FIGURE 17: DATA PROCESSING, HOSTING, AND RELATED SERVICES LOCATION QUOTIENTS: MEASURED IN 2018



Note: Data Processing, Hosting, and Related Services reflect NAICS Industry Code 5182.
Source: Milken Institute analysis of BLS Quarterly Census of Wages and Employment (2020)

Appendix

Research and Development Inputs (RDI)	Source	Year
Federal R&D Funding (per capita)	NSF, National Patterns of R&D Resources, Survey of Federal Funds for Research and Development	2016-18
Industry R&D Funding (per capita)	NSF, National Patterns of R&D Resources, Business Research and Development and Innovation Survey	2015-17
Academic R&D Funding (per capita)	NSF, National Patterns of R&D Resources, Higher Education Research and Development Survey	2016-18
National Science Foundation Funding per $100,000 of GSP	NSF, Budget Internet Information System	2017-19
National Science Foundation Research Funding per $100,000 of GSP	NSF, Budget Internet Information System	2017-19
Higher Ed R&D Expenditures on Engineering (per capita)	NSF, Survey of Research and Development Expenditures at Universities and Colleges/Higher Education Research and Development Survey	2016-18
Higher Ed R&D Expenditures on Physical Sciences (per capita)	NSF, Survey of Research and Development Expenditures at Universities and Colleges/Higher Education Research and Development Survey	2016-18
Higher Ed R&D Expenditures on Geosciences, Atmospheric Sciences, and Ocean Sciences (per capita)	NSF, Survey of Research and Development Expenditures at Universities and Colleges/Higher Education Research and Development Survey	2016-18
Higher Ed R&D Expenditures on Computer and Information Sciences (per capita)	NSF, Survey of Research and Development Expenditures at Universities and Colleges/Higher Education Research and Development Survey	2016-18
Higher Ed R&D Expenditures on Life Sciences (per capita)	NSF, Survey of Research and Development Expenditures at Universities and Colleges/Higher Education Research and Development Survey	2016-18
Higher Ed R&D Expenditures on Math and Statistics (per capita)	NSF, Survey of Research and Development Expenditures at Universities and Colleges/Higher Education Research and Development Survey	2016-18
STTR Awards per 10,000 Business Establishments (Phase I)	SBA, STTR	2016-18
STTR Awards per 10,000 Business Establishments (Phase II)	SBA, STTR	2016-18
STTR Award Amounts per $1 Million of GSP	SBA, STTR	2017-19
SBIR Awards per 10,000 Business Establishments (Phase I)	SBA, SBIR	2016-18
SBIR Awards per 10,000 Business Establishments (Phase II)	SBA, SBIR	2016-18
SBIR Award Amounts per $1 Million of GSP	SBA, SBIR	2017-19
Competitive NSF Proposal Funding Rate	NSF, Budget Internet Information System	2017-19

Risk Capital and Entrepreneurial Infrastructure (RCI)	Source	Year
Venture Capital Investment Growth	PwC, Moneytree Report	2017-19
Venture Capital Investment as Percentage of GSP	PwC, Moneytree Report	2017-19
Venture Capital Deal Growth	PwC, Moneytree Report	2016-18
Venture Capital Deals per 10,000 Business Establishments	PwC, Moneytree Report	2016-18

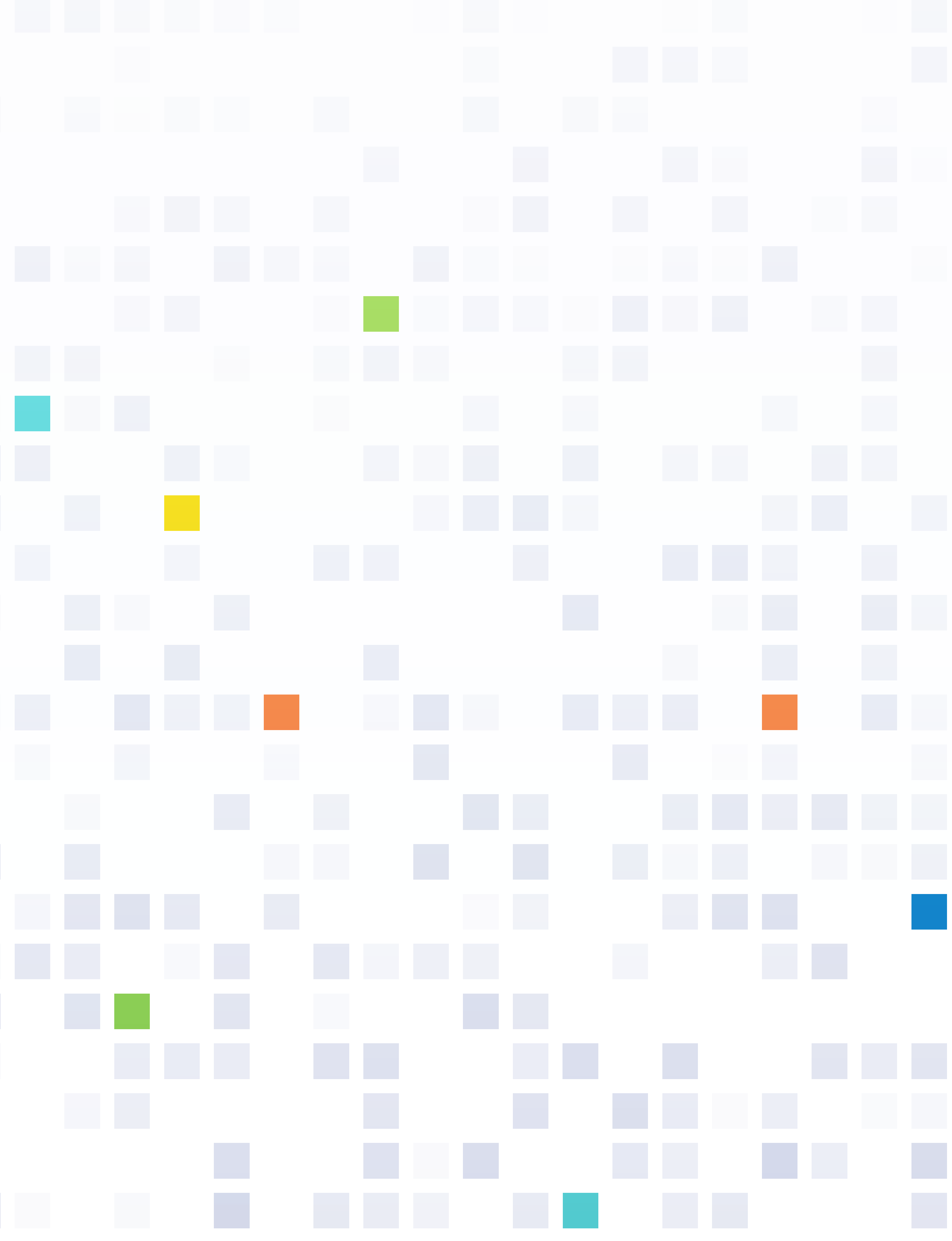
RCI (continued)	Source	Year
SBIC Funding per $1,000 of GSP	Congressional Research Service, University of North Texas, SBA SBIC	2016-18
Patents Issued per 100,000 People	USPTO, Performance and Accountability Report	2017-19
Business Starts per 100,000 People	US Census Bureau, County Business Patterns	2016-18
IPO Investment as Percent of GSP	Pitchbook	2017-19
Venture Capital Investment in Nanotechnology per $1,000 of GSP	Pitchbook	2017-19
Venture Capital Investment in Clean Technology per $1,000 of GSP	Pitchbook	2017-19
Average Venture Capital in Biotechnology per $1,000 of GSP	Pitchbook	2017-19

Human Capital Investment (HCI)	Source	Year
Percentage of Population Age 25+ with Bachelor's Degree or Higher	American Community Survey 1-year estimates	2016-18
Percentage of Population Age 25+ with Advanced Degree	American Community Survey 1-year estimates	2016-18
Percentage of Population Age 25+ with PhD	American Community Survey 1-year estimates	2016-18
Per Capita State Spending on Student Aid	National Association of State Student Grant & Aid Programs Annual Fiscal Report	2016-18
Average Reading and Writing SAT Scores	College Board	2017-19
Average Math SAT Scores	College Board	2017-19
Average ACT Scores	ACT	2017-19
State Appropriations for Higher Education (per capita)	Illinois State University, Grapevine	2017-19
Percent Change in State Appropriations for Higher Education	Illinois State University, Grapevine	2018-19
Doctoral Scientists per 100,000 People	NSF, Survey of Doctorate Recipients	2017
Doctoral Engineers per 100,000 People	NSF, Survey of Doctorate Recipients	2017
PhDs awarded in Science, Engineering, and Health per 100,000 People	NSF, Survey of Earned Doctorates	2016-18
Graduate Students in Science & Engineering & Health per 100,000 People	NSF-NIH, Survey of Graduate Students & Post Doctorates in Science and Engineering	2016-18
Percentage of Bachelor's Degrees in Science, Engineering, and Health	IPEDS, Completions Survey	2016-17
Recent Bachelor's Degrees in Science and Engineering per 1,000 Workers	IPEDS, Completions Survey	2016-18
Recent Master's Degrees in Science and Engineering per 1,000 Workers	IPEDS, Completions Survey	2016-17
Recent PhD Degrees in Science and Engineering per 1,000 Workers	NSF, Survey of Earned Doctorates	2016-18
Recent Degrees in Science and Engineering per 1,000 Workers	IPEDS, Completions Survey	2016-18
Percentage of Households with Computers	American Community Survey 1-year estimates	2016-18
Percentage of Households with Broadband Access	American Community Survey 1-year estimates	2016-18

Tech and Science Workforce (TSW)	Source	Year
Computer and Information Science		
Intensity of Computer Systems Analysts per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Information Security Analysts per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Computer and Information Research Scientists per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Computer Network Support Specialists per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Computer User Support Specialists per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Computer Network Architects per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Network and Computer Systems Administrators per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Database Administrators per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Computer Programmers per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Software Developers, Applications per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Web Developers per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Computer Occupations, All Other per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Operations Research Analysts per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Statisticians per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Data Scientists and Mathematical Science Occupations, All Other per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Engineering		
Intensity of Aerospace Engineers per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Bioengineers and Biomedical Engineers per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Chemical Engineers per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Civil Engineersper 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Computer Hardware Engineers per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Electrical Engineers per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Environmental Engineers per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Industrial Engineers per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Materials Engineers per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019

TSW (continued)	Source	Year
Intensity of Mechanical Engineers per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Mining and Geological Engineers, Including Mining Safety Engineers per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Nuclear Engineers per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Petroleum Engineers per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Engineers, All Other per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Life and Physical Science		
Intensity of Soil and Plant Scientists per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Biochemists and Biophysicists per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Microbiologists per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Zoologists and Wildlife Biologists per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Biological Scientists, All Other per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Epidemiologists per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Medical Scientists, Except Epidemiologists per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Life Scientists, All Other per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Physicists per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Atmospheric and Space Scientists per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Chemists per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Materials Scientists per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Environmental Scientists and Specialists, Including Health per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Geoscientists, Except Hydrologists and Geographers per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Physical Scientists, All Other per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Agricultural and Food Science Technicians per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Biological Technicians per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Chemical Technicians per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Environmental Science and Protection Technicians, Including Health per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019
Intensity of Nuclear Technicians per 1,000 Workers	Bureau of Labor Statistics, Occupational Employment Statistics	2019

Technology Concentration and Dynamism (TCD)	Source	Year
Percentage of Employment in High-Tech Industries	US Census Bureau, Country Business Patterns	2016-18
Percentage of Payroll in High-Tech Industries	US Census Bureau, Country Business Patterns	2016-18
Percentage of Establishments in High-Tech Industries	US Census Bureau, Country Business Patterns	2016-18
Net Formation of High-Tech Firms per 10,000 Business Establishments	US Census Bureau, Country Business Patterns	2016-18
Employment Growth of High-Tech Industries	US Census Bureau, Country Business Patterns	2016-18
Number of High-Tech Industries with LQ Higher Than 1.0	Bureau of Labor Statistics, Quarterly Census of Wages and Employment	2016-18
Number of Inc. 500 Companies per 10,000 Business Establishments	Inc. Magazine	2016-18
Number of Technology Fast 500 Companies per 10,000 Business Establishments	Deloitte Fast 500 Technology	2016-18



Endnotes

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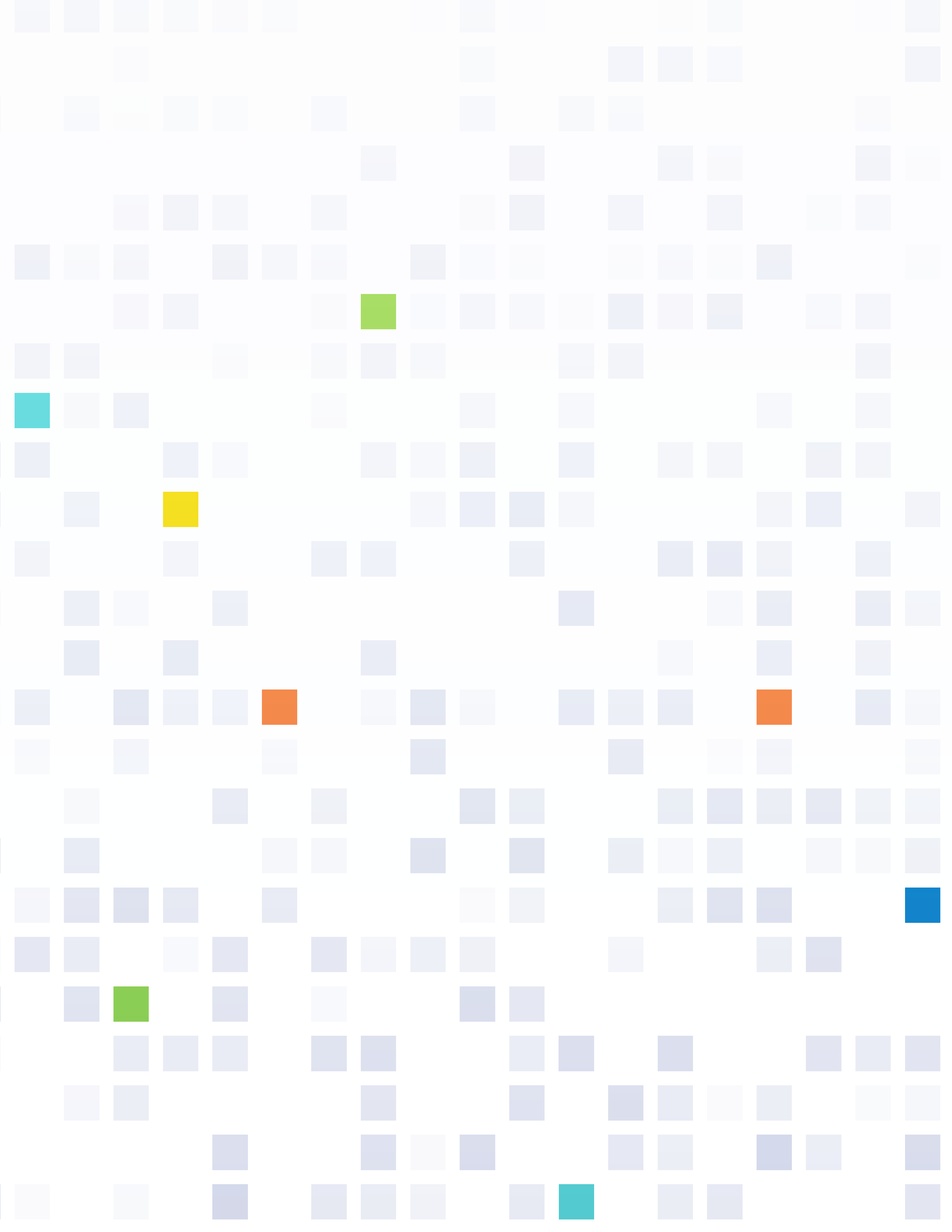

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