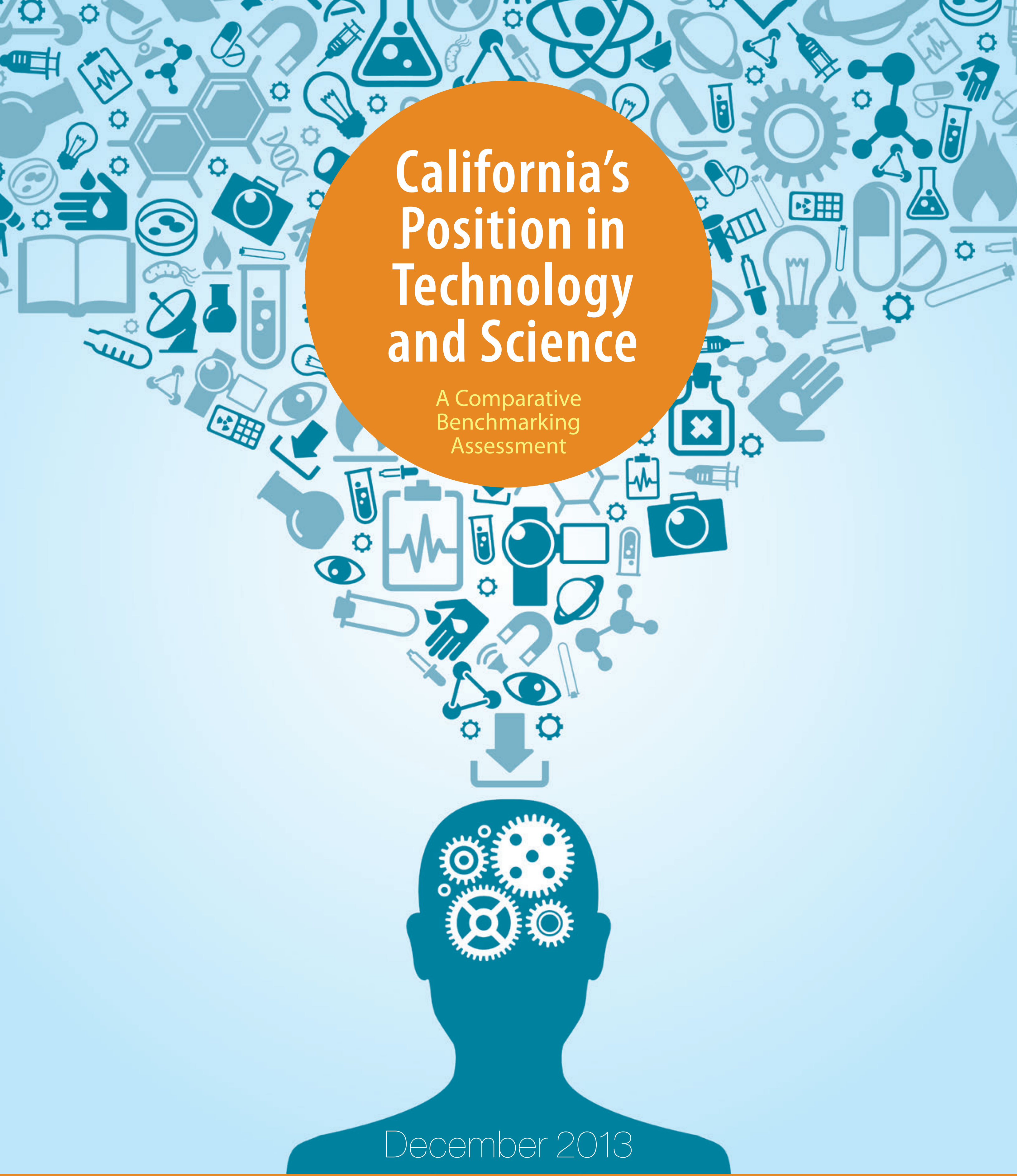

California's Position in Technology and Science

A Comparative Benchmarking Assessment

December 2013

Kevin Klowden and Kristen Keough

Milken Institute

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For more information

An interactive website with data for each state can be found at

www.milkeninstitute.org

Acknowledgments

The authors would like to acknowledge Ross Devol for envisioning the first Science and Technology Index in 2002 and helping to preserve it for over a decade.

About the Milken Institute

A nonprofit, nonpartisan economic think tank, the Milken Institute works to improve lives around the world by advancing innovative economic and policy solutions that create jobs, widen access to capital, and enhance health. We produce rigorous, independent economic research—and maximize its impact by convening global leaders from the worlds of business, finance, government, and philanthropy. By fostering collaboration between the public and private sectors, we transform great ideas into action.

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Data for each state can be found at
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Executive Summary

When it comes to California's performance in technology and science, in many ways it's back to the future, as troubles in education funding bring California back to its 2010 ranking. The state dropped from third in 2012 to fourth in our latest national State Technology and Science Index, and this California-specific report investigates the factors behind this decline.

This 2013 analysis provides a thorough examination of a California that has found its greatest opportunities for rebounding from the Great Recession in the fields of high-tech and knowledge-based industries. This study updates the data from the 2012 national State Technology and Science Index to provide tangible evidence of California's current strengths and prospects for growth.

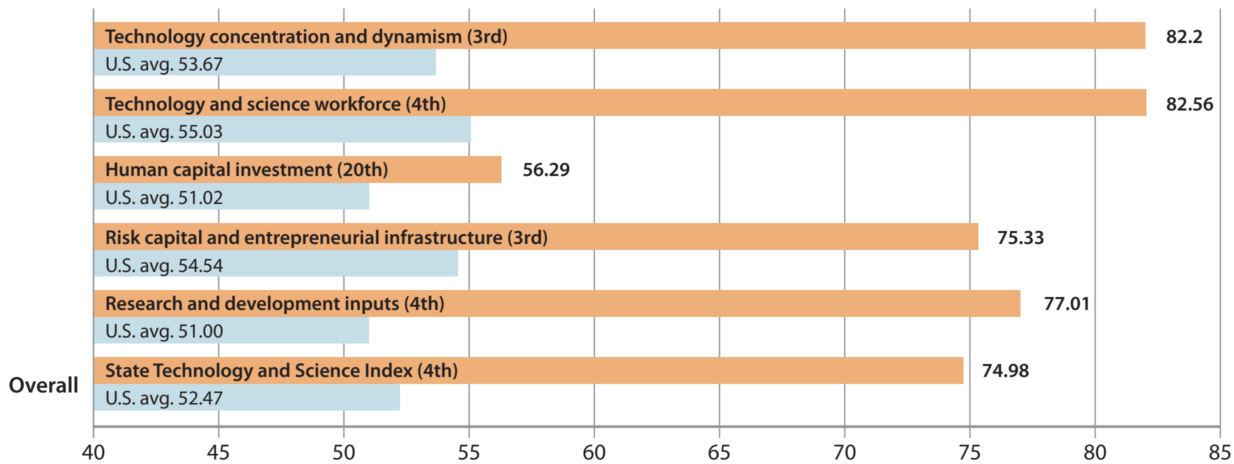
California's score in the State Technology and Science Index declined to 74.98 from 75.70 in 2012. This is only marginally better than its score of 73.85 in 2010, when the state also ranked fourth overall. A key factor behind the decline in the state's overall ranking is its performance in human capital investment. California's position in this category has been on a slow decline since the state began cutting appropriations for higher education in 2008.

The overall State Technology and Science Index ranking consists of five composite indexes, themselves comprising 79 indicators. The performance of California in the five composites is as follows:

- The most significant story for California is told by the **Human Capital Investment Composite Index**. The state's score of 56.29 is a nearly 10-point drop from 65.05 in the 2012 national index, and California lost eight positions to place 20th in the rankings. As mentioned above, this decline is largely driven by budget cuts in higher education.
- The state's brightest spot is the **Technology Concentration and Dynamism Composite Index**. California inched up one spot to third place and improved its score slightly to 82.20 from 82.00. The continued success of the Bay Area's tech industry is directly reflected in the improvement, though the state's score is still far from the lofty heights in the 2002 index, when the dot-com bubble buoyed California's score to 86.20.
- California climbed to fourth in the **Technology and Science Workforce Composite Index** from fifth in 2012 and seventh in 2010. Its score followed the same trajectory, soaring to 82.56 in 2013 from 79.89 in 2012 and 74.67 in 2010.
- The state's performance was mixed in the **Risk Capital and Entrepreneurial Infrastructure Composite Index**. California climbed from fourth to third in the rankings, but its score declined to 75.33 in 2013 from 76.00 in 2012. Going back to 2010, the state ranked second with a score of 75.45.
- California maintained its fourth-place ranking in the **Research and Development Inputs Composite Index** with a score of 77.01. The state's score has been gradually declining from a peak of 80.32 in 2004.

California's performance in the State Technology and Science Index

California, 2013



Examining the Five Composite Indexes

In the following analysis, we examine California's performance in the five composite indexes, comparing it to previous years and other leading states in each of the component indicators.

Research and Development Inputs Composite Index

The Research and Development Inputs Composite Index measures each state's R&D and innovation capacities—the building blocks of technology-based economic development. The composite gauges a state's ability to attract federal, industry, and academic funding. Along with the Human Capital Investment Index, this composite provides the clearest picture of a state's long-term ability to maintain its competitiveness in high-technology and science, particularly through internally generated means.

California's fourth-place finish in the 2013 index marks at first glance a degree of stability in the rankings. The state held the same place in the 2010 index, and more than half of the indicators (10 out of 18) stayed the same. At the same time, the state's score has declined to 77.01 from 79.06, with only one indicator showing an improved ranking compared with seven that declined. Meanwhile, the gap between California and third-place Colorado has grown, as Colorado's score has risen from 79.96 to 81.33, creating a lead of more than four points. New Hampshire, which had fallen in the 2012 index to 11th, has rebounded over the past year to fifth place. Meanwhile, Massachusetts has widened its lead, with its score reaching a record 94.10—a total gap of over 14 points.

While California remains sixth in federal and industry R&D per capita and 15th in academic R&D dollars per capita, its National Science Foundation research funding comes in at an uncompetitive 23rd place.

R&D expenditures on engineering have fallen from 19th place in 2008 to 25th in 2012 to 28th in this year's index, reinforcing the sector as an underperformer for the state. California continued to perform below average in environmental science and agricultural sciences, despite the state's reputation as a leader in green practices and status as the nation's largest food-producing state by cash receipts.

Research and Development Inputs Composite Index

State	Rank 2013	Rank 2012	Rank 2010
Massachusetts	1	1	1
Maryland	2	2	2
Colorado	3	3	5
California	**4**	**4**	**4**
New Hampshire	5	11	3
Delaware	6	5	11
Washington	7	10	6
Rhode Island	8	9	12
Connecticut	9	7	7
Pennsylvania	10	8	9

Risk Capital and Entrepreneurial Infrastructure Composite Index

This index serves as a key measure of California's ability to support and grow new companies, particularly in high-technology. As is evidenced by the strength and reputation of Silicon Valley, this composite has long been an area of comparative advantage for the state, and California consistently held a first- or second-place ranking in every index through 2010 before falling to fourth place in 2012. Although the state's score declined in 2013 from 76.00 to 75.33, California did move up to third place in the composite. This is attributable largely to New Hampshire, whose brief jump in risk capital to third place for 2012 has not proven to be sustainable, falling back down to 16th place in 2013. Of greater concern is New York's second-place finish, which it has maintained since 2012. This is evidence of New York City's ability to tap its monetary reserves for the kinds of investments that used to flow to California or Massachusetts.

Although California remains formidable from a structural standpoint, finishing second in companies receiving venture capital per 10,000 establishments and second in venture capital as a percentage of gross state product (remarkable given the state's size), the state saw a decline of 1 percent in venture capital investment growth from 2011 to 2012 (with a 21st-place ranking), at the same time as New York's VC grew by 823 percent. Overall, California remained stable, gaining in two indicators, dropping in two, and remaining flat in eight.

Of great concern is the overall confidence in California's economy. While California has historically done well in terms of business starts per 10,000 residents, it fell to 23rd in the 2012 national index and tumbled even further to 29th in 2013. At the same time, New York and Texas finished in second and third place, respectively. This, combined with an unusually low level of IPO proceeds as a percent of GSP with a 15th-place ranking, suggests that the state is finally seeing the toll of the recession on the health of its companies. The fact that the number of business incubators per 10,000 business establishments fell even further to 0.25 and a 47th-place ranking is also of concern.

Risk Capital and Entrepreneurial Infrastructure Composite Index

State	Rank 2013	Rank 2012	Rank 2010
Massachusetts	1	1	1
New York	2	2	16
California	**3**	**4**	**2**
Colorado	4	5	6
New Jersey	5	9	4
Maryland	6	13	14
Connecticut	7	6	3
Pennsylvania	8	14	21
North Carolina	9	25	8
Illinois	10	8	17

Human Capital Investment Composite Index

As noted previously, the amount a state invests in human capital to produce and retain educated workers is one of the most important factors in its long-term ability to foster knowledge-based industries. For California, a state with a high cost of living and difficulty attracting workers from other parts of the United States, a strong supply of locally educated workers is even more important. The Human Capital Investment Composite measures the availability of skilled human capital, particularly recent science and engineering graduates, and a state's level of investment in higher education.

As was demonstrated in the Milken Institute 2011 publication "What Brain Drain?," California's problem is not the flight of skilled workers from the state's highly regarded public university system. In fact, California has the second-highest retention rate of high-skilled natives of any state in the country after Texas, while at the same time facing clear difficulties in attracting talent from outside the state. This hindrance places a higher burden on California's high schools and universities than schools face in other leading tech-driven states, making this composite and its recent drop more significant rather than less. This talent shortfall has caught the attention of employers throughout the state.

Overall, California, after having moved up to 12th place in the national rankings in 2012, saw a drop to 20th place in human capital investment for 2013. Of the 21 indicators, four increased, eight stayed even, and nine decreased. California ranked in the top 10 in four indicators and below the national average in nine. California's score of 56.29 was 35 points behind leader Massachusetts (81.52), although the gap with fifth-place Connecticut (69.81) was smaller.

California's low ranking can largely be attributed to cuts in funding for higher education in the wake of the state's budget crisis. The state's ranking in appropriations for higher education per capita fell from 11th in 2012 to 22nd in 2013, and the percent change in appropriations for higher education (-5.7 percent) resulted in a fall from seventh place to 48th in 2013. This, combined with ongoing low rankings of 40th in recent science and engineering degrees per 1,000 civilian workers and 39th in percentage of graduate students in science, engineering, and health, served to undercut the state's ranking in the composite. One piece of good news is that the passage of Proposition 30 in 2012 restored some stability to higher education funding for the next six to seven years. However, the dangers of the low ranking remain.

Human Capital Investment Composite Index

State	Rank 2013	Rank 2012	Rank 2010
Massachusetts	1	1	2
Maryland	2	2	1
Minnesota	3	4	4
Utah	4	6	8
Connecticut	5	3	5

State	Rank 2013	Rank 2012	Rank 2010
New York	6	8	9
Virginia	7	9	16
Colorado	8	5	3
Pennsylvania	9	9	11
North Dakota	10	15	7

Technology and Science Workforce Composite Index

While the human capital investment composite provides a view of future prospects, the Technology and Science Workforce Composite highlights present trends in tech-based and knowledge-based industries for the state as a whole. The state has been performing well, with the San Jose metro topping the Milken Institute Best Performing Cities index in 2012. It appears from the results of this composite that employment growth has been consistent in tech and science for the state as a whole.

In this composite for 2013, California saw gains from 2012, rising to fourth place from fifth place as its score rose to 82.56 from 79.79. This ranking is the highest California has held in this composite. All of the states formerly ranked in the top 10 continued to perform well, with all states remaining in the top 10 from 2012. Few components saw a major change for California, which improved in 10 indicators, stayed the same in six, and decreased in two of the 18 indicators. There were no significant changes, but the small improvements in half of the indicators contributed to the overall improvement.

California ranked seventh in overall concentration of computer and I.S. experts, second in overall concentration of engineers, and fourth in overall concentration of life and physical scientists. Some of the top indicators include second in electronics engineers, second in computer hardware engineers, fifth in microbiologists, second in medical scientists, and third in biomedical engineers.

Technology and Science Workforce Composite Index

State	Rank 2013	Rank 2012	Rank 2010
Massachusetts	1	1	1
Maryland	2	2	2
Washington	3	3	4
California	**4**	**5**	**7**
Delaware	5	4	3
Virginia	6	6	6
Colorado	7	8	5
Rhode Island	8	9	21
Minnesota	9	10	11
Texas	10	7	10

Technology Concentration and Dynamism Composite Index

This composite index may be the key positive story for California in the 2013 index. It measures growth and positive change in tech-based economic sectors and how well states are able to encourage growth in tech-based companies and jobs. After improving from seventh to fifth in 2010 and fourth in 2012, California rose again in 2013 to third place, tying with Colorado. This demonstrates that even while the overall state employment and business figures may be lagging, the tech sector continues to grow. Although the tale from the indicators is flat, with two increases, two decreases, and six staying the same, the two improvements allowed California to catch up with Colorado and separate itself from Maryland.

The strength of the sector in California's economy is reflected in the fourth-place ranking in percent of businesses in high-tech (6.83 percent), third in the percent of employment in high-tech (9.40 percent), and second in the percent of payroll in high-tech (17.80 percent). The latter figure shows how important the high-paying jobs in the tech sector remain for the health of the California economy. Although California's ranking of 10th in number of high-tech industries growing faster than the U.S. average does not appear strong at first glance, it is a remarkable recovery from the 2012 index, which used older data and had California ranked 36th.

California fell to 42nd in net formation of high-tech establishments per 10,000 businesses. One reason for this is data from 2008, when California's tech sector saw the brunt of the recession earlier than many other parts of the economy did. The good news is that this should reverse in the next index. Although California did rank fifth in the number of Technology Fast 500 companies per 10,000 business establishments, its score of 1.97 was dwarfed by New York's 13.41, which set the national pace.

Technology Concentration Dynamism Composite Index

State	Rank 2013	Rank 2012	Rank 2010
Utah	1	1	1
Washington	2	2	2
California	**3**	**4**	**5**
Colorado	3	3	2
Maryland	5	4	5
Massachusetts	6	6	7
Texas	7	7	9
Virginia	8	9	4
Delaware	9	8	24
North Carolina	10	10	11

Conclusions

California remains the most important state in the country for science and technology, when one considers the size of the state economy, the risk capital infrastructure, a culture that embraces risk and entrepreneurship, and the best-regarded public university system in the world. The state ranks in the top three in the country in the composites for risk capital and entrepreneurial infrastructure as well as technology concentration and dynamism. It holds a fourth-place ranking in research and development inputs and technology and science workforce. Despite falling to fourth place in the overall rankings, California remains a force to be reckoned with. But the sharp decline in human capital investment is troubling. For a state that is so dependent on its own university system, the consistent underfunding combined with rapidly rising tuition and fees could be the greatest long-term threat to the state's continued strength in science and technology.

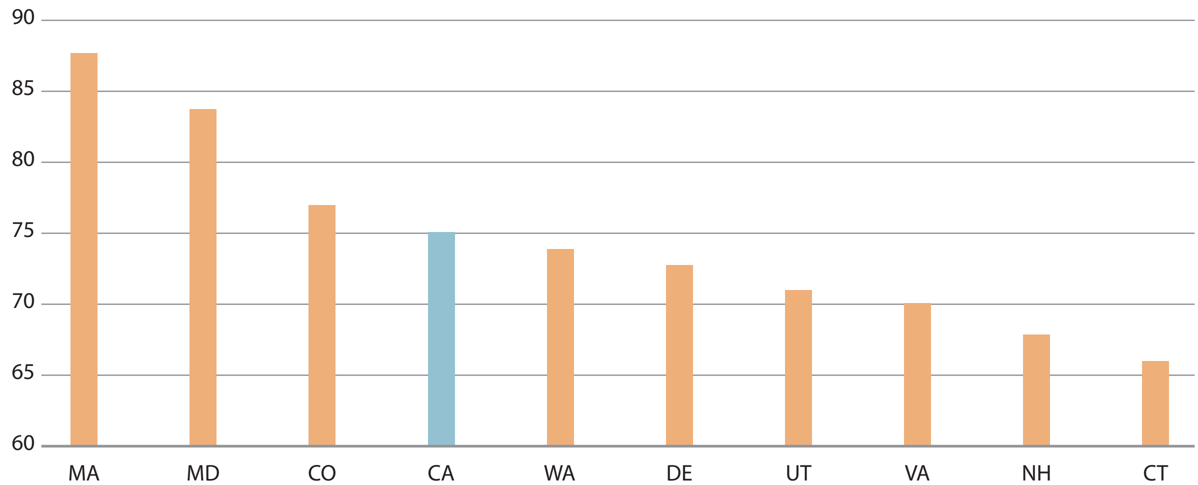
As noted in previous versions of "California's Position in Technology and Science," threats to the state's university system as well as K-12 education present a consistent structural risk to California's ability to supply high-technology startups and growing establishments with skilled workers. When combined with the high cost of living in California's major metropolises and the cost of recruiting out-of-state workers, the reason for many growing tech firms choosing to expand (not relocate) in places such as Texas, Arizona, Colorado, and North Carolina becomes clear. To improve California's long-term prospects in technology and science, these actions are required:

- Establish a long-term structural mechanism for maintaining and growing university funding while at the same time determining effective steps for controlling rapid rises in student costs. There is a danger of pricing the lower and middle classes out of university educations.
- Determine mechanisms for stability in educational funding over a multiyear period. The passage of Proposition 30, backed by Gov. Jerry Brown, brought a brief respite in the state's budgetary struggles, but the new revenue is subject to the same cyclical fluctuations as the taxes already in place. Although an overhaul of the state's tax code would be ideal, a more feasible step would be to implement long-term budget planning for education, especially the state's two- and four-year colleges.
- Increase the focus at two- and four-year institutions on applied technical degrees and training that can directly serve the state's tech and science industries. California consistently suffers from a shortage of undergraduate engineering students and technical workers needed for many smaller and specialized high-tech firms. Whether through targeted scholarships or tuition breaks for in-demand majors, the state should strive to steer students into those fields.
- Improve the perception and practice of the state's business and regulatory environment. California is a front-runner in environmental practices and implementation of green technology, but the benefits to the state's entrepreneurs seem limited. Restrictions on small businesses in particular can stymie the growth of high-tech firms. The most recent numbers for business starts lend credence to this concern.
- Push for comprehensive immigration reform at the national level. California is more dependent on skilled immigration than most high-tech centers—in the U.S. and globally. The state must maintain access to talent from overseas. Furthermore, many lower-skilled immigrants are denied opportunities to improve their own educations and incomes.

Despite all the attention paid to Texas, the states with proportionately greater access to talent, research, and investment capital—such as Massachusetts, Maryland, Washington, Utah, and even New York—present the biggest competitive threat to California when it comes to high-technology jobs. California's greatest advantage remains its strong system of public higher education. Just before the completion of this study, California's Little Hoover Commission, which advises the governor on policy issues, released a full report emphasizing the need for a master plan for the state's higher education system and highlighting the importance of the state's two- and four-year schools in maintaining competitiveness.

Furthermore, unlike many smaller states, California has a larger, more economically diverse population. Rapidly growing communities with lower educational attainment such as Bakersfield must have access to talent. California needs statewide strategies to boost rational investment in science and technology. It is clear that the state's tech sector has been leading California out of the recession.

State Technology and Science Index Top 10 States



ON THE WEB

Data for each state can be found at

www.statetechandscience.org

Introduction

Since 2002, the Milken Institute's State Technology and Science Index has examined each state's technology and science capabilities and their impact on regional economic growth. The index is a method for comparing states' performance, but it also helps states see trends that will affect their economies. Since 2004, we have provided a companion piece focusing on California and the issues affecting the state. For the first time, in 2013, we are using data that have been updated from the 2012 national index. We examine, discuss, and compare all 79 indicators as they pertain to California.

In 2012, California relied on the technology sector to help lead the state out of the recession, which carried into 2013. The continued innovation in Silicon Valley moved California to the third position in technology concentration and dynamism. This movement in 2012 saw California briefly return to the third position in the overall rankings. However, as we will note below, the state fell back to fourth position in 2013, largely due to a decline in investment in human capital. Other states with strong technology sectors, such as Massachusetts, are also seeing tech-driven recoveries.

In every composite index except human capital investment, California ranked in the top five. In human capital investment, the state fell from the top 10 to 20th. This is a six-spot decline from California's performance in 2010, and although investment in education increased in 2012 to land California in 12th, it did not carry over to the 2013 index.

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 79 indicators relative to population, gross state product (GSP), number of establishments, number of businesses, and other factors. Data sources include government agencies, foundations, and private entities. The states are ranked in descending order with the top state being assigned a score of 100, the runner-up a score of 98, and the 50th state a score of 2. The indicators are then combined to create these five composite rankings:

Research and development inputs:

We examine a state's R&D capacity to see if it has facilities that can attract funding and create innovations that can be commercialized. The category includes measures such as industrial, academic, and federal R&D; Small Business Innovation Research awards; and the Small Business Technology Transfer program.

Risk capital and entrepreneurial infrastructure:

The entrepreneurial capacity and risk capital infrastructure are factors that determine how successful a state will be in converting research into commercially viable technology services and products. We include several measures of venture capital activity as well as entrepreneurial pursuits, including patenting activity, business formations, and initial public offerings.

Human capital investment:

Human capital is the most important intangible asset of a regional or state economy. We look at indicators that suggest the skill levels of the current and future workforce. Examples include the number of bachelor's, master's, and doctorate degrees relative to a state's population, and measures specific to science, engineering, and technology degrees.

Technology and science workforce:

The intensity of the technology and science workforce indicates whether states have sufficient depth of high-end technical talent. Intensity is derived from the share of employment in a particular field relative to total state employment. We look at 18 occupation categories in three main areas of employment: computer and information sciences, life and physical sciences, and engineering.

Technology concentration and dynamism:

By measuring technology growth, we are able to assess how effective policymakers and other stakeholders have been at transforming regional assets into regional prosperity. This includes measures such as the percent of establishments, employment and payrolls that are in high-tech categories. It also measures growth in a number of technology categories.

Research and Development Inputs

Background and Relevance

The Research and Development Inputs Composite Index measures each state's ability to attract federal, industry, and academic funding.

R&D funding supports and strengthens the research labs, universities, and innovative companies that educate the workforce and lead to new technologies. It encourages the commercialization that takes inventions from minds to markets. The resulting exchange of ideas and innovations draws new companies, especially technology-intensive firms. World-renowned innovators such as Microsoft, Apple, Google, Genentech, and Amgen were launched from the springboard of the country's R&D landscape.

Largely because of its advocacy and support of cutting-edge R&D, the United States is a world leader in science and engineering.[1]

California and Other State Rankings

Since the 2010 index, California has remained in fourth place in Research and Development Inputs with a score of 77.01. Despite the state's unchanged ranking, California's score in R&D is slowly declining, finishing about one point less than in the 2012 index. Colorado was able to edge California out of the top three in the 2012 index and remains third, scoring 81.33, four points higher than California. The state will need to improve to remain in fourth as New Hampshire moves to fifth, only half a point behind California. Massachusetts, with the score 94.10, and Maryland, with a score of 87.00, remain in the top two spots for the fourth consecutive index, improving their scores from the 2010 index. The remaining states in the top 10 start with sixth-place Delaware (74.72 points), Washington (73.03 points), Rhode Island (70.86 points), Connecticut (69.73 points), and Pennsylvania (69.30 points).

Figure 1. Research and Development Inputs Composite Index

Top 10 states, 2013

Source: Milken Institute

1. Crescenzi, Riccardo, Andre Rodriguez-Pose, and Michael Storper. "The Territorial Dynamics of Innovation: A Europe-United States Comparative Analysis." *Journal of Economic Geography* 7, no. 6 (2007): 673-709.

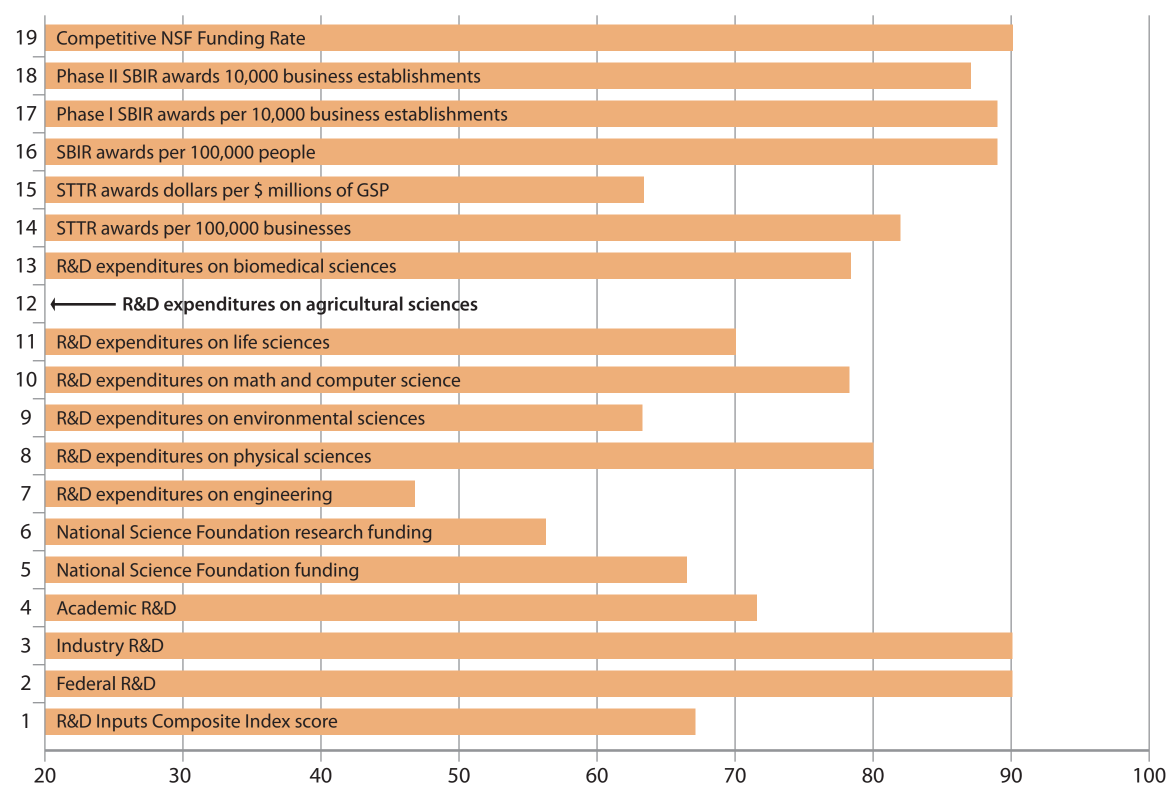
R&D funding predominantly comes from three sources: the federal government, private industry, and academia. All three of these sources are included in the composite R&D, and awards won are reflected in the state's score.

The index's measure of federal R&D expenditures captures the sum of all basic and applied research in federally supported projects, including work pertaining to national defense, health, space research and technology, energy, and general science. The industry R&D measure totals all the money corporations spent on basic and applied research, including expenditures at federally funded R&D centers. Industry R&D receives great weight in the composite index because of its large share of overall R&D. All research, basic and applied, performed by colleges and universities 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.

The National Science Foundation (NSF) is an independent federal agency that funds R&D in science and engineering through grants, contracts, and cooperative agreements. Its R&D expenditures on engineering are a key source of funding at doctorate-granting institutions for basic and applied engineering programs. It also supports physical sciences, environmental sciences, math, computer sciences, and life sciences.

Small Business Technology Transfer (STTR) awards are federal grants to small businesses and nonprofit institutes to support the technology commercialization efforts of innovative small businesses. The Small Business Innovation Research program (SBIR) funds the often-costly startup and development stages, and encourages commercialization of research findings. To be eligible, firms must be for-profit, American-owned, independently operated, and must employ a principal researcher and fewer than 500 workers. The funding rates of competitive NSF project proposals for basic research are crucial for generating momentum in the formative stages of R&D at universities.

Figure 2. California's performance in R&D components



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California's statistics, 2013

	1	2	3	4	5	6	7	8	9	10
California	77.01	730.85	1742.47	200.37	52.54	6.69	14.78	16.21	5.91	6.69
U.S. Avg.	51.00	392.25	684.71	175.17	48.21	7.153	21.85	11.22	11.02	5.28

	11	12	13	14	15	16	17	18	19
California	82.21	1.95	78.57	1.29	21.55	1.88	19.38	8.37	0.28
U.S. Avg.	68.43	5.52	58.51	0.93	21.42	1.12	10.18	4.54	0.22

California's Performance by Indicator

California maintains its top spot in the State Technology and Science Index because the state's leaders in business and government recognize the importance of research and development. California remained in the top 10 in federal and industry R&D per capita, despite its large population. In academic R&D, California continued to improve from the 2010 index, moving up three rankings to 15th from $185.08 to $200.37 per capita.

California performed well in almost all of the categories, but fell below the national average in R&D expenditures on engineering, on environmental science, and on agricultural sciences—the same categories that scored below the national averages in the 2010 index. In National Science Foundation research funding, the state dropped six places from 2012 and fell below the national average to receive $6.69 per $100,000 of GSP, ranking 23rd. California remained 18th in overall National Science Foundation funding, even with the decline.

The SBIR-related measures made no changes in ranking from 2010 and 2012. California once again ranked seventh in number of SBIR awards per 100,000 residents, seventh in Phase I, and eighth in Phase II SBIR awards per 100,000 people.

California's Competitive NSF Proposal Funding Rate score improved from 2012 to 27.7 percent, but competition in this measure has increased, and California fell two places to finish eighth.

Risk Capital and Entrepreneurial Infrastructure

Background and Relevance

Entrepreneurs are prime drivers of growth and job creation. They create businesses and use technology to increase productivity, and their new products increase competition, forcing established players to innovate or risk losing market share. This competition drives down prices and gives rise to better products.

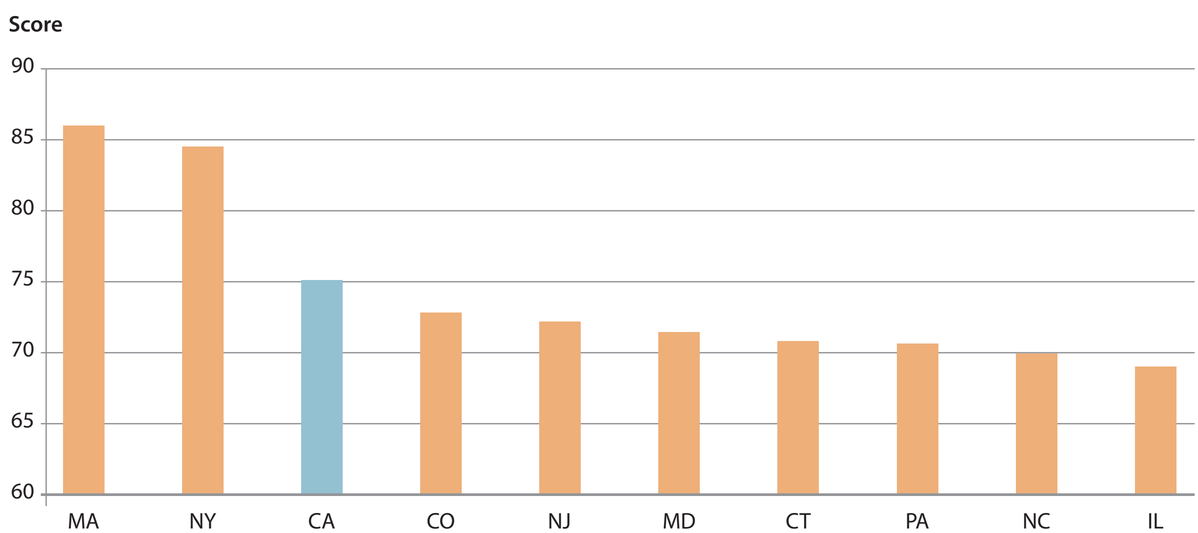
Over the past few decades, an explosion of available capital has helped entrepreneurs bring their products to market. Intel, Microsoft, Apple, Cisco, Genentech, and Amazon were all venture-backed enterprises. Studying venture capital activity is an excellent way to assess the level of confidence in the new ideas and entrepreneurial infrastructure in a region.

California and Other State Rankings

California jumps around in Risk Capital and Entrepreneurial Infrastructure. The state finishes the 2013 index ranked third with a score of 75.33, one spot down from the second-place finish in 2010, but one spot up from the fourth-place finish in 2012. California is almost 10 points behind second-place New York, which scored 84.33. First-place Massachusetts scored 86.50. The Golden State was second in VC investment as a percent of GSP, second in the number of companies receiving venture capital, first in clean-tech investment, third in nanotechnology investment, and third in patents issued. This is a strong performance, but California lags far behind Massachusetts, which placed first in three indicators.

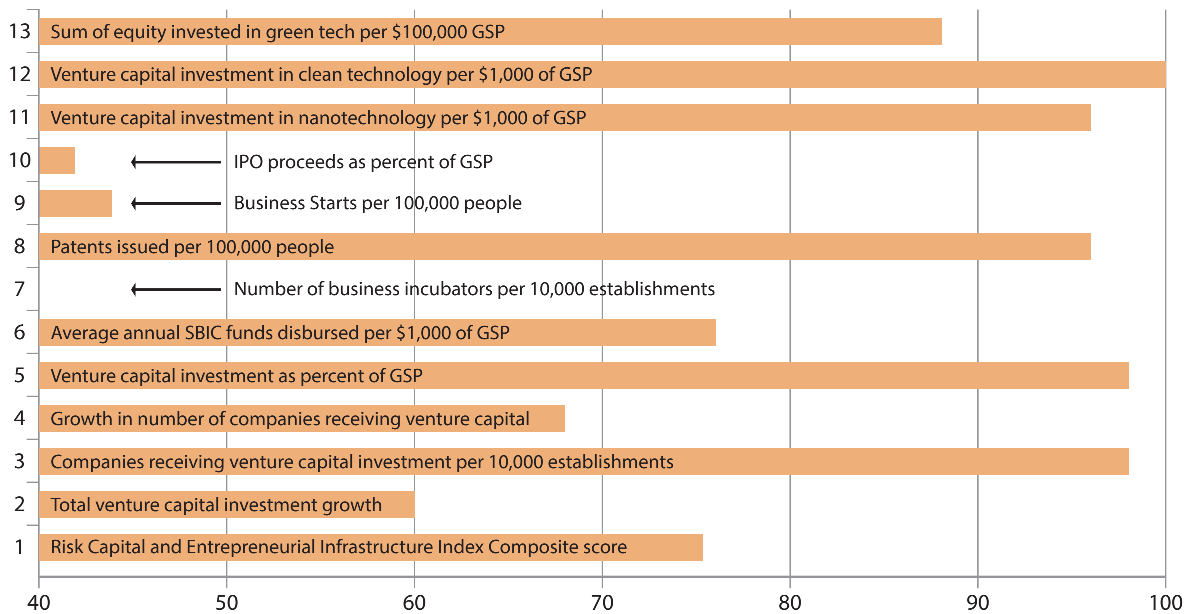
Figure 3. Risk Capital and Entrepreneurial Infrastructure Composite Index

Top 10 states, 2013



Source: Milken Institute

Figure 4. California's scores in Risk Capital and Entrepreneurial Infrastructure components



California Statistics, 2013

	1	2	3	4	5	6	7	8	9	10	11	12	13
CA	75.33	-.01	17.97	0.06	0.01	0.15	0.25	74.68	-17.7	0.00	0.12	0.97	59.64
U.S.	54.54	2.11	3.16	1.80	0.00	0.12	0.73	28.97	-13.7	0.00	0.04	0.14	58.16

The Risk Capital and Entrepreneurial Infrastructure Composite Index is calculated by totaling the scores (which are based on state rankings in each indicator) and dividing by the total number of indicators. Several venture capital indicators are included to reflect which states are witnessing rapid gains. A high growth rate in VC placements indicates that a state is experiencing early success in building technology-based firms for future economic development and job creation and is closing the gap with more advanced states. Growth in total venture capital funding and in the number of companies receiving VC investment captures this element.

We include the number of companies receiving venture capital investment per 10,000 firms and VC investment as a percentage of gross state product (GSP) to measure the flow and strength of each state's venture capital activity relative to its total economy. Venture capital's share of a state's economy is important because of the strong relationship between higher venture capital investment and entrepreneurial success, job creation, wealth creation, and higher standards of living. The numbers represent where the states rank in terms of size for each indicator. The growth indicators demonstrate the continued vitality of the indicators within each state. So both combined give a more complete picture of how states are performing.

California's Performance by Indicator

California ranked in the top five in five indicators. Massachusetts and California were dominant in venture capital investment as a percentage of GSP, ranking first and second: Massachusetts had 0.89 percent, and California had 0.81 percent. The national average is drastically less at 0.10 percent, and Utah, which ranks third, scored 0.29 percent. These rankings are similar to those of 2010, but Massachusetts increased the spread between itself, California, and the remaining states.

Although California performs well in the overall risk capital and entrepreneurial infrastructure, two components could indicate future problems. First, the Business Incubators per 10,000 Business Establishments continues to fall. California ranked 47th with 0.25 incubator compared to the national average of 0.73. In fact, California has declined in this indicator every year since the index began in 2002. In 2010, the state ranked 45th, with 0.66 incubators compared with the national average of 1.27. It ranked fourth with 2.56 in 2002, slipping to 13th and 1.68 incubators in 2004, and declining further to 33rd and 1.29 incubators in 2008. The continuing slide suggests entrepreneurship in California may be oriented toward startups managed by experienced officers. Also, in the number of business starts per 100,000 people, California lost ground with a decline of 17.75 businesses per 100,000 people, falling to 29th from its second-place finish in 2010.

California topped the rankings in Venture Capital Investment in Clean Technology, investing $0.97 per $1,000 of GSP and outperforming the U.S. average of $0.14. California outspent second-place Connecticut ($0.82) by $0.15 per $1,000 GSP, and third-place Oklahoma ($0.63) by $0.34 per $1,000 of GSP. California placed in the top 10 in nanotechnology and green tech investment, ranking third and seventh, respectively.

Human Capital Investment

Background and Relevance

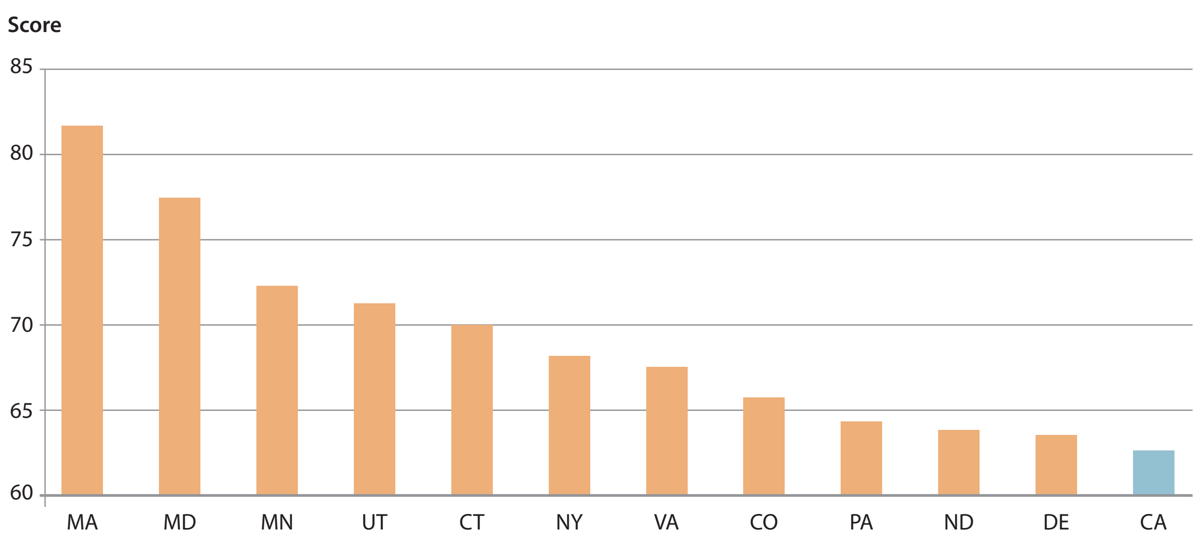
Capital and land used to be key productive forces, but talent is the driving force in today's knowledge-based economy. Regions with the educational institutions to produce highly skilled workers benefit from a virtuous cycle: Their human capital attracts cutting-edge companies and innovative startups, which draw skilled labor from outside the region, which draws more companies, and so on. Because education determines the quality of a region's workforce, this composite index looks at educational attainment and state funding for schools

California and Other State Rankings

California again fails to make the top 10 in the Human Capital Investment Composite Index. California was able to climb one spot to 12th in 2012 after finishing 13th in 2010, making the fall to 20th in 2013, an eight-ranking decline. Twenty factors make up the Human Capital Investment Composite Index. California ranked in the top 10 in four, and scored below the national average in nine factors. The top five spots belong to Massachusetts (81.52), Maryland (77.24), Minnesota (72.19), Utah (71.14), and Connecticut (69.81). Utah was the only state to join the top five from 2012. Colorado fell to eighth after ranking in the top five in 2010 and 2012.

Figure 5. Human Capital Investment Composite Index

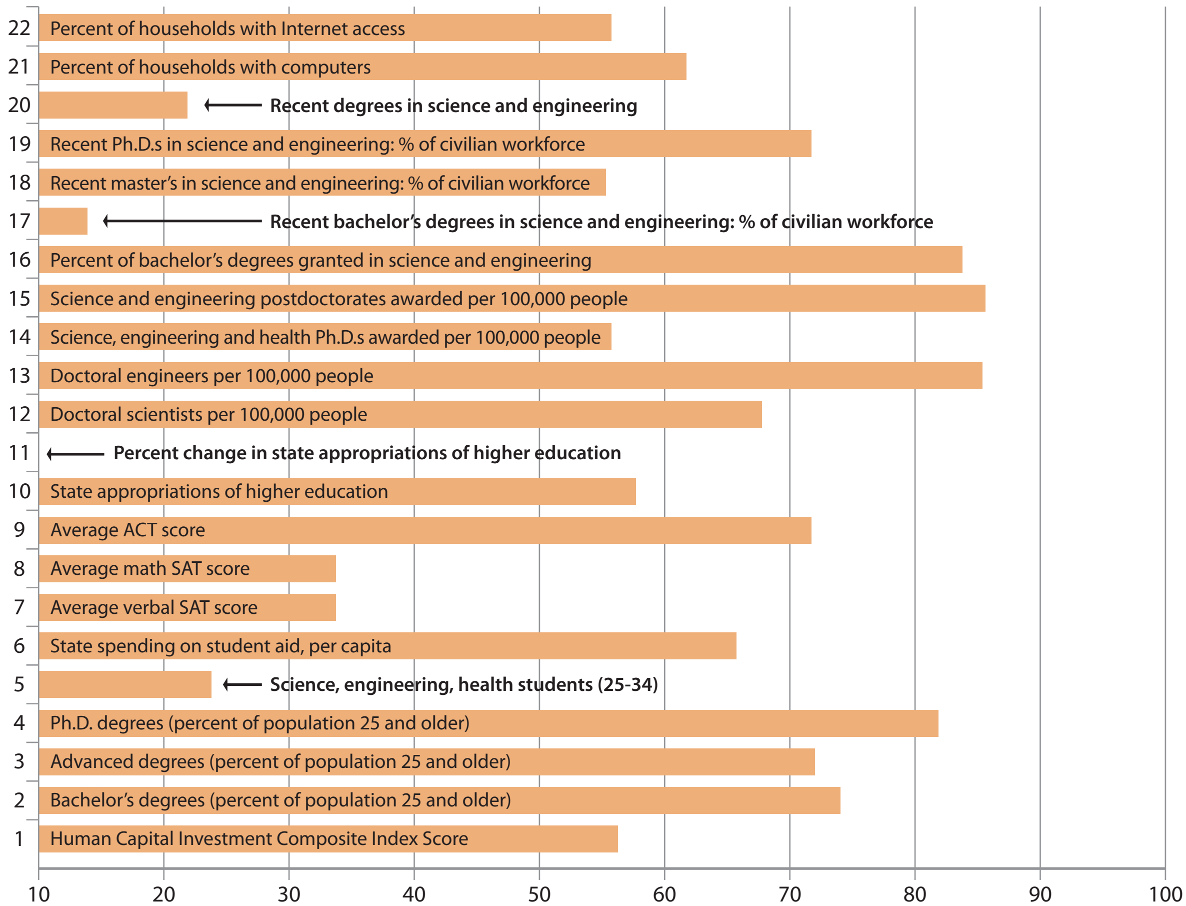
Top states and California, 2013



Source: Milken Institute

*California tied with Washington, ranked 20th

Figure 6. California's scores in human capital investment components



California's statistics, 2013

	1	2	3	4	5	6	7	8	9	10	11
CA	56.3	0.31	0.11	0.015	0.01	39.3	496.0	512.0	22.2	246.6	-0.06
U.S.	51.0	0.28	0.10	0.012	0.01	31.3	517.9	538.6	21.4	247.6	0.01

	12	13	14	15	16	17	18	19	20	21	22
CA	142.6	43.7	63.7	184.2	0.18	2.31	0.93	0.20	3.44	83.60	0.44
U.S.	124.1	24.9	65.8	136.2	0.16	3.18	1.00	0.18	4.36	81.76	0.44

The Human Capital Investment Composite Index attempts to measure the stock of human capital and rate of investment (flow) between states by gauging the concentration and momentum of science and engineering fields. It also tries to capture how well R&D investments are being utilized by analyzing student scores. These indicators are meant to give a snapshot of how adequately the state is prepared to sustain employment in science and technology. Scores are calculated by totaling the state's rankings in each indicator and dividing it by the number of indicators. The accompanying table highlights California's position in each of the 21 indicators that make up the composite index, plus its overall score.

California's Performance by Indicator

California finished 20th, tied with Washington, dropping eight places since 2012. California performed below the national average in nine of the 21 Human Capital Investment indicators, had four indicators in the top 10, and no indicators in the top five. California finished 10th with 1.47 percent of population over 25 having a Ph.D., ninth with 17.64 percent of all bachelor's degrees granted in science and engineering, eighth with 43.71 doctoral engineers per 100,000 people, and eighth with 184.24 science, engineering, and health postdoctorates awarded per 100,000 residents ages 25-34.

California continues to underperform in verbal and math SAT testing, ranking 34th and scoring about 20 points lower than the national average.

After improving from 15th in 2010 to 11th in 2012, California fell 11 places to finish 22nd in state appropriations for higher education per capita. The change in state appropriations for higher education was negative 5.7 percent, while the overall national average rose 1 percent. This negative growth moved California from seventh in 2012 to 48th in 2013. Funding for higher education in California is dependent on the state's budget, which can fluctuate year to year. The decreased spending is one of the main reasons for California's poor performance in the Human Capital Composite Index.

California remained on the bottom in recent degrees in science and engineering, ranked 40th with 3.44 recent degrees in science and engineering per 1,000 civilian workers, about one percentage point less than the national average of 4.36. This could also be related to cutbacks in education funding. The thin supply of science and engineering graduates could lead to lower scores in future state indexes.

Technology and Science Workforce

Background and Relevance

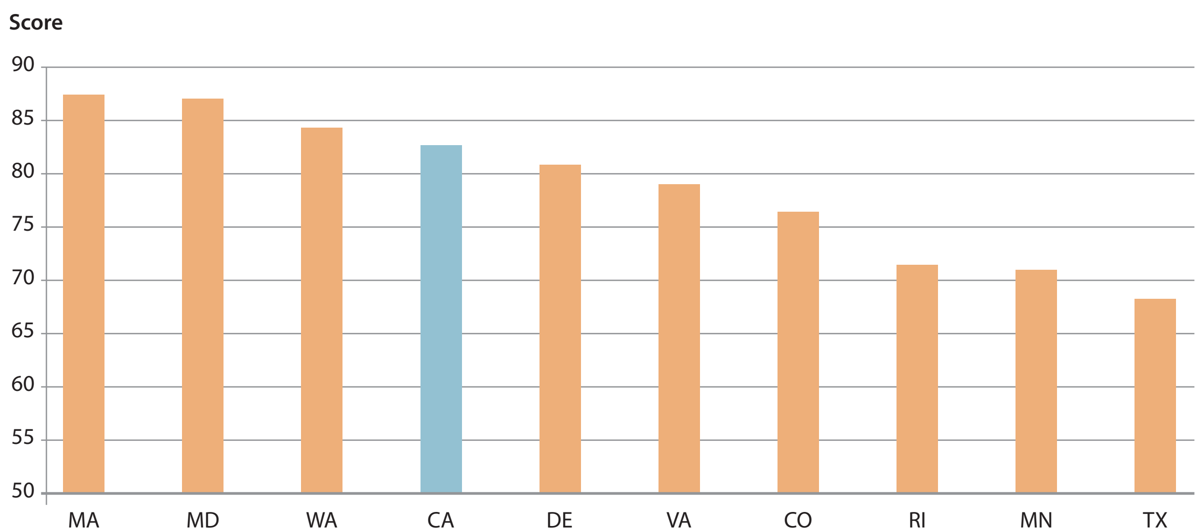
Transforming innovation into commercial products and services requires a skilled tech and science workforce. Regions with these skilled workers are better positioned for economic growth and for sustaining high-tech firms as they mature. Although these workers constitute a small percentage of the workforce on average, their outsized influence on regional economies belies their modest numbers.[2]

California and Other State Rankings

There was hope of improvement when California halted its decline in technology and science workforce in the 2012 index–finishing fifth after its all-time low of seventh in 2010. California delivered in the 2013 index, finishing fourth in the Technology and Science Workforce Composite, the state's best finish since 2004. Few indicators saw a major change, but California made small improvements in 10 indicators, remained the same in six, and decreased in only two of the 18 indicators. California's biggest improvements occurred in intensity of computer systems analysts and intensity of computer programmers, both moving up five places in the rankings.

Figure 7. Technology and Science Workforce Composite Index

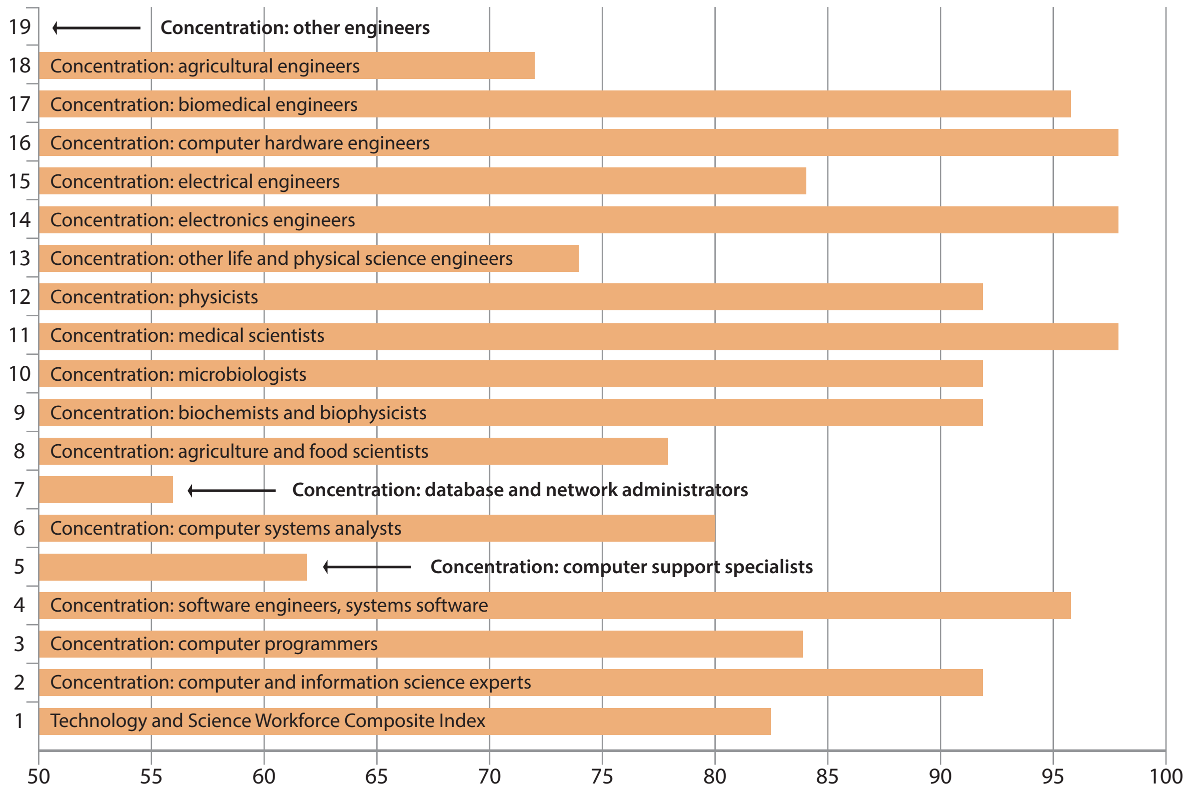
Top 10 states, 2013



Source: Milken Institute

2. Jarle Moen, "Is Mobility of Technical Personnel a Source of R&D Spillover?," NBER Working Paper, No. 7834 (2000).

Figure 8. California's scores in technology and science workforce components



California's statistics, 2013

	1	2	3	4	5	6	7	8	9	10
California	82.56	45.16	290.42	560.21	122.42	429.47	353.69	18.53	41.81	25.03
U.S. Avg	55.03	21.41	214.60	236.80	123.68	310.47	335.35	18.85	13.87	13.81

	11	12	13	14	15	16	17	18	19
California	181.56	26.08	15.87	210.72	168.56	156.32	37.82	1.26	204.84
U.S. Avg	58.07	14.48	15.90	89.94	115.68	47.01	13.32	4.57	248.02

The Technology and Science Workforce component measures each state's concentration of workers in high-tech jobs to determine a region's innovation capacity, ability to supply research, and support for high-tech entrepreneurial activity.

The Technology and Science Workforce component was divided into three fields for analysis: computer and information science, life and physical science, and engineering. This allows us to paint an overall picture of the high-tech workforce in California in comparison with the other states.

The intensity of computer and information science experts was obtained by computing the percentage of these workers relative to total state employment. This category includes computer and information scientists, computer programmers, software engineers, computer support specialists, systems analysts, and database and network administrators.

Similarly, the intensity of life and physical scientists indicator was obtained by computing the percentage of six types of life and physical science-related jobs relative to total state employment. This category includes agricultural and food scientists, biochemists and biophysicists, microbiologists, medical scientists, physicists, and miscellaneous life and physical scientists.

The intensity of engineers was calculated by computing the percentage of six types of engineering-related jobs relative to total state employment. This category includes electronics engineers, electrical engineers, computer hardware engineers, biomedical engineers, architectural engineers, and other engineers.

California's Performance by Category and Indicator

In 2010, California ranked seventh, with only two indicators falling below the national average in tech and science workforce, agricultural engineers and other engineers. In the 2013 index California ranked below the national average in four indicators: 20th in intensity of computer support specialists; 12th in intensity of agricultural and food scientists; 15th in intensity of agricultural engineers; and 30th in intensity of other engineers.

California scored below the national average in four indicators, but it scored in the top 10 in 11 of the 18 indicators. These were fifth in intensity of computer and information scientists; ninth in intensity of computer programmers; third in intensity of software engineers, systems software and computer systems analysts; fifth in intensity of biochemists and biophysicists; fifth in intensity of microbiologists; second in intensity of medical scientists; fifth in intensity of physicists; second in intensity of electronics engineers; ninth in intensity of electrical engineers; second in intensity of computer hardware engineers; and third in intensity of biomedical engineers.

From 2010 to 2012, California improved in 16 of the 18 indicators in the tech and science workforce composite. From 2012 to 2013, California continued its improvement in 11 of the 18 indicators. California declined only in intensity of software engineers and systems software and computer systems analysts, and remained the same in intensity of physicists, intensity of biomedical engineers, and intensity of other engineers.

California declined in only two rankings: intensity of biochemists and biophysicists moved from third to fifth, and intensity of database and network administrators moved from 21st to 23rd.

Technology Concentration and Dynamism

Background and Relevance

High-tech industries are critical to a region's economic development; it is where new companies are formed and innovations emerge. States with strong high-tech clusters grow faster than those without them. The technology concentration and dynamism component applies several metrics to ascertain the intensity and prevalence of high-tech businesses by state and whether the sector is expanding.

California and Other State Rankings

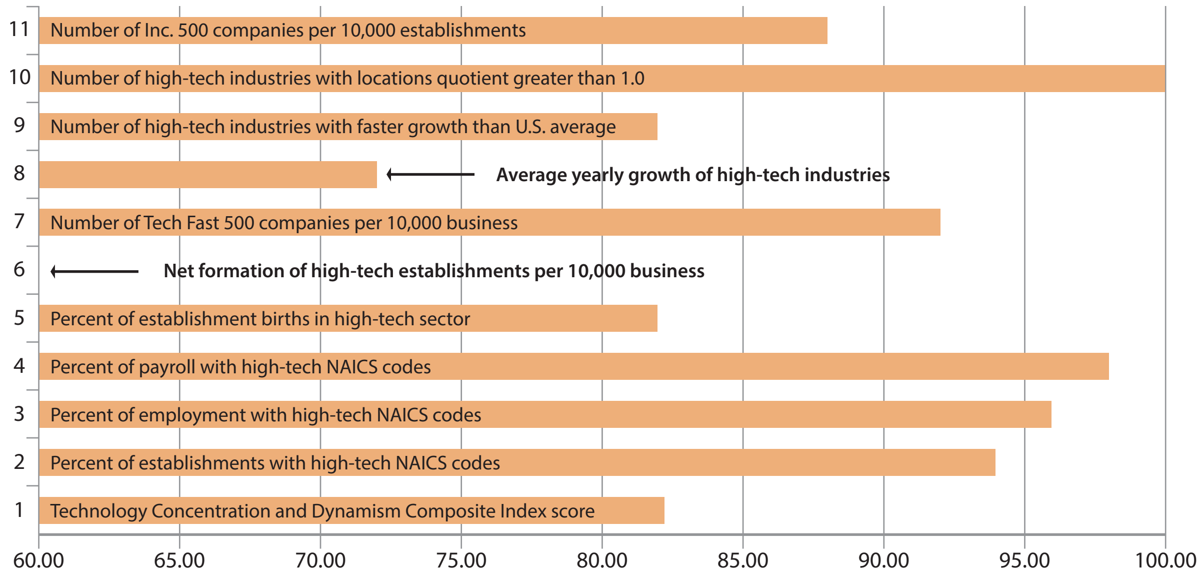
California is making slow improvements in technology concentration and dynamism, finishing fifth in 2010, fourth in 2012, and tied for third with Colorado in the current index with a score of 82.20. California ranked in the top 10 in eight of the 10 indicators. The state absolutely dominated in the number of high-tech industries, with a location quotient above 1.0 (17 industries vs. 13 for next-ranked Massachusetts). California scored below the national average only in net formation of high-tech establishments per 100,000 business establishments, ranking 42nd. The other states in the top five were Utah (score of 86), followed by Washington (82.40), and Maryland in fifth (80.40).

Figure 9. Technology Concentration and Dynamism Composite Index

Top 10 states, 2013

Source: Milken Institute

Figure 10. California's scores in technology concentration and dynamism components



California's statistics, 2013

	1	2	3	4	5	6	7	8	9	10	11
California	82.20	0.07	0.09	0.18	0.11	-11.0	1.97	0.00	12.00	17.00	1.04
U.S. Avg	53.67	0.05	0.05	0.09	0.09	-1.78	1.01	-0.01	9.56	4.86	0.57

The figure above shows California's overall performance and the national average in each of the 10 indicators in the Tech Concentration and Dynamism Composite Index. This component departs from the preceding ones, focusing instead on payroll, business formation, and growth in high-tech industries. The four preceding components—R&D inputs, risk capital, human capital, and tech and science workforce—act as fuel for the Technology Concentration and Dynamism component, which reflects each state's success in its high-tech sector.

California's Performance by Indicator

California finished third in this composite. It ranked second in percent of payroll in high-tech NAICS codes, third in percent of employment in high-tech NAICS codes, and fourth in percent of establishments in high-tech NAICS codes.

California finished first for the fourth time since 2008 with 17 high-tech industries with LQs higher than 1.0. This is consistent with previous findings, given the Golden State's dominant high-tech clusters, particularly in San Jose. Massachusetts tied with Utah, trailing California with 13 industries, followed by Colorado (10) and New Hampshire (nine).

California fell from second in 2012 to fifth in 2013 with 1.97 Technology Fast 500 companies per 10,000 business establishments. New York jumped from 13th in 2012 to first in 2013 with 13.41 Fast 500 companies, surpassing Massachusetts, which had held the first spot since 2010. The remaining states in the top five were Massachusetts (11.21), Virginia (8.97), and New Jersey (3.65).

The most drastic change occurred in Net Formation of High-Tech Establishments. In 2010 California outperformed the national average (17) with 30 establishments. In 2012 and 2013 (same data due to lack of updates) California posted a net loss high-tech establishments, as did the U.S. average. The U.S. average in 2013 was a decline of 1.8 in high-tech business establishments. California fell all the way to a negative 11, pulling the state down to a ranking of 42nd, by far the worst-performing indicator in the composite. The top five states in this measure were Wyoming (26), Montana (21), North Dakota (20), Arkansas (20), and South Dakota (16).

California's average yearly growth in high-tech industries is a little better than the national average, which fell 0.85 percent. The state posted a drop of 0.38 percent, ranking 15th. California ranked 10th in the number of high-tech industries growing faster than the U.S. average.

Overall Findings and California's Performance

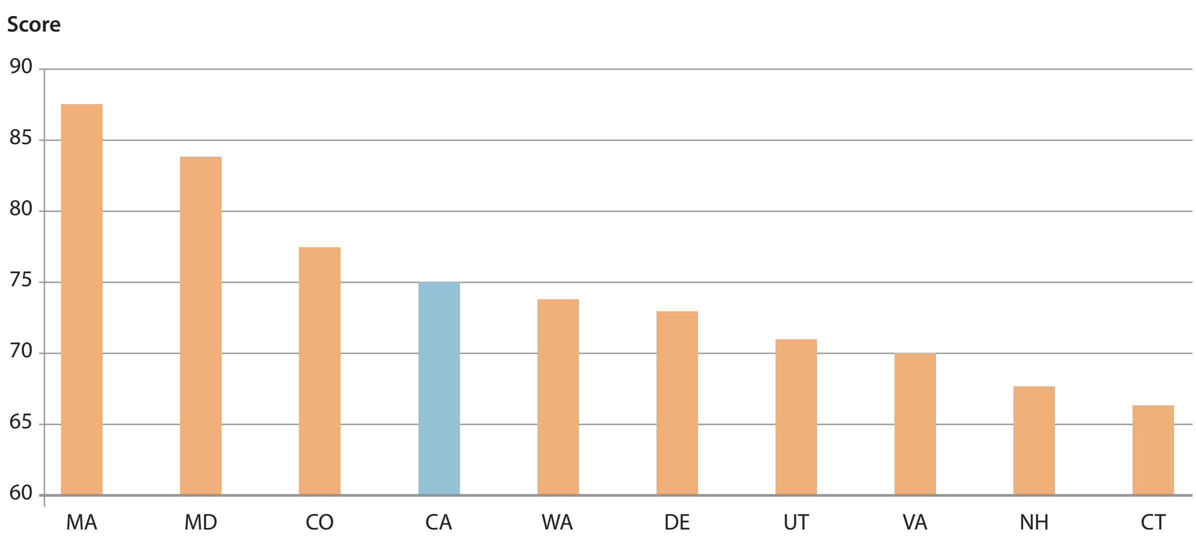
California found itself once again stuck in fourth, after its third-place finish in 2012. The state scored 74.98, far from its pinnacle of 80.37 in 2002. California had a mixed performance, moving up one place in risk capital and entrepreneurial infrastructure and technology concentration and dynamism, remaining in fourth in research and development inputs and technology and science workforce, and plummeting eight places in human capital investment.

California was outpaced by Massachusetts (87.46), Maryland (83.75), and Colorado (77.38). The remaining states in the top 10 were Washington (73.78), Delaware (72.89), Utah (70.96), Virginia (69.97), New Hampshire (67.61), and Connecticut (66.34). Massachusetts remains the overwhelming leader, ranking first in four of the five composite indexes: technology and science workforce, human capital investment, risk capital and entrepreneurial infrastructure, and research and development inputs.

Since the 2010 index, Jerry Brown has replaced Arnold Schwarzenegger as governor, taking office amid economic turmoil and budgetary uncertainty. Although Brown has taken steps to address the state's fiscal woes, it is too soon to tell how they will affect California's science and tech performance. There are positive developments, including support for innovations such as high-speed rail and renewable energies[3] and the governor's intention to create a foreign trade office in China[4] (after our last index lamented California's lack of foreign trade offices). However, the decline of state appropriations for higher education by 5.7 percent from 2012-2013–and an overall drop of 23.9 percent from 2008-2013—place the state's score far outside the top 10 in human capital investment. Investment in human capital creates a foundation for the future of California and its residents.

Figure 11. State Technology and Science Index

Top 10 states, 2013

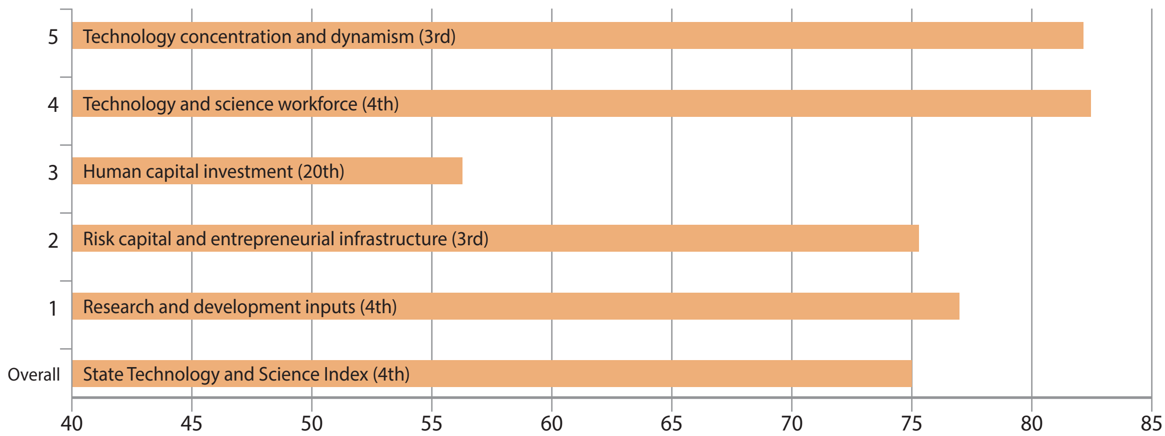


Source: Milken Institute

3. "Brown Lauds Job Creation at World's Largest Solar Energy Project." Office of Governor Edmund G. Brown Jr.. http://gov.ca.gov/news.php?id=17090 (accessed September 12, 2012).

4. "Governor Brown to Open New Trade and Investment Office in China." Office of Governor Edmund G. Brown Jr. http://gov.ca.gov/news.php?id=17423 (accessed September 10, 2012).

Figure 12. California's overall performance



California Statistics, 2013

	1	2	3	4	5	Overall
California	77.012	75.33	56.29	82.56	82.2	74.98
U.S. Avg	51.003	54.54	51.02	53.67	53.67	52.47

State Technology and Science Index: Components

California's Position in Technology and Science

Definition

California's overall position in technology and science is derived from its performance in five major composite indexes: Research and Development Inputs, Risk Capital and Entrepreneurial Infrastructure, Human Capital Investment, Technology and Science Workforce, and Technology Concentration and Dynamism. Each component that goes into these indexes is described in detail in the following pages. The five indexes are weighted equally in determining each state's overall performance. The data were collected from governmental agencies, foundations, and private sources, and have been compiled and analyzed by the Milken Institute.

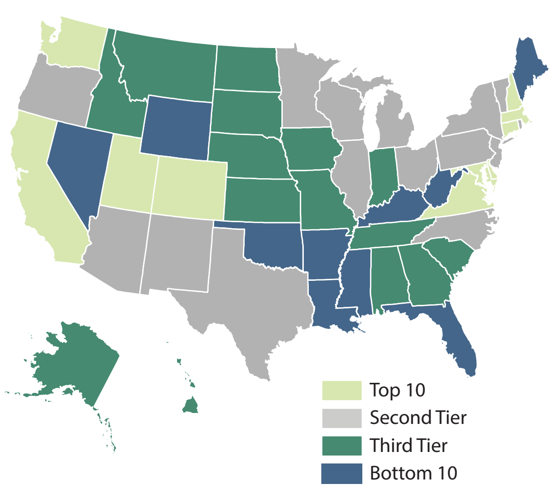
Why Is It Important?

This overall ranking represents an inventory of each state's technology and science assets. Its value lies in the breadth, depth, and relevance of the indicators. The first set of indicators calculated, research and development inputs, draws a relationship between levels of R&D spending and which fields of research are hotbeds for technological innovation. The Risk Capital and Entrepreneurial Infrastructure index reveals a state's capabilities for supporting entrepreneurial activity and its comparative success in risk capital funding. The indicators for Human Capital Investment show how each state is positioned to attract and sustain high-tech industries based on the educational preparedness of its residents and its financial commitment to higher education. The Technology and Science Workforce Composite Index drills down further to show whether each state has a sufficient base of high-end technical talent. The final set of indicators on Technology Concentration and Dynamism essentially measures technology outcomes—that is, how successfully the other sets of indicators produced tangible results by creating a sizable population of high-tech firms and workers.

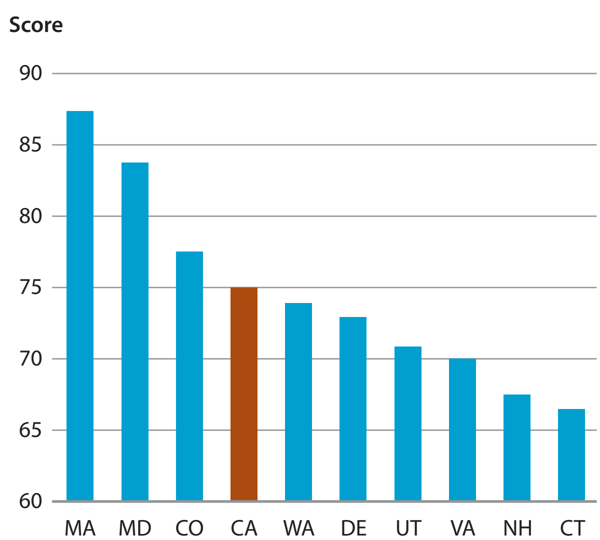
The Index and California

California climbed to third place in the 2012 Index. The score was so close between Colorado and California in 2012 that California fell one place to fourth in the 2013 Index, scoring 74.98. The Golden State is almost 13 points behind the leader, Massachusetts, which continues to dominate the index year after year. California's score is 22 points higher than the U.S. average of 52.47. The following sub-sections provide a complete and detailed account of California's strengths and weaknesses.

State Technology and Science Index: 2013



State Technology and Science Index Top 10: 2013



Sources: Milken Institute

Research and Development Inputs Composite Index

Definition

The Milken Institute's assessment of California's position in technology and science is based on the state's performance in five composite indexes, the first of which is Research and Development Inputs (RDI). The RDI Composite Index score is derived by averaging each state's performance in 18 indicators. The three basic types of R&D funding (academic, industry, and federal) are assigned weights of 1.15, 6.04, and 2.81, respectively. This adjustment is necessary to appropriately capture the differences in funding levels among the three sources. The component data are collected from various agencies and compiled by the Milken Institute.

Why Is It Important?

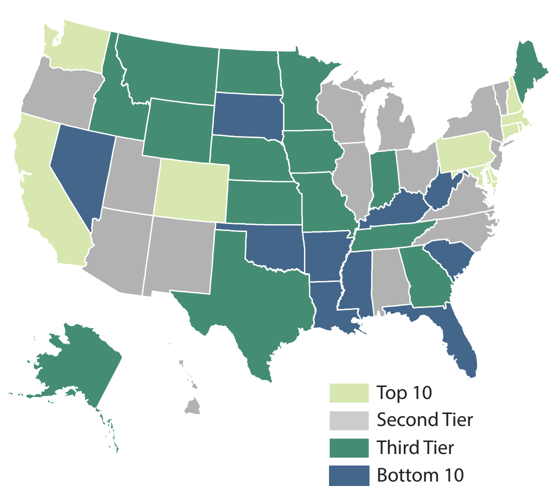
Investments in R&D fuel scientific discoveries that lead to regional economic growth in the form of new companies and new products. R&D is carried out in the federal, industry, and academic sectors. Each type has the ability to spark technological progress, either at the company level by encouraging infant business starts or by targeting universities that excel in scientific fields. The magnitude of the impact varies, according to the number of nodes and linkages the recipient has to the region. The more links, the more the effect on the economy.

The RDI helps assess each state's research and development legacy as well as opportunities for future technological success.

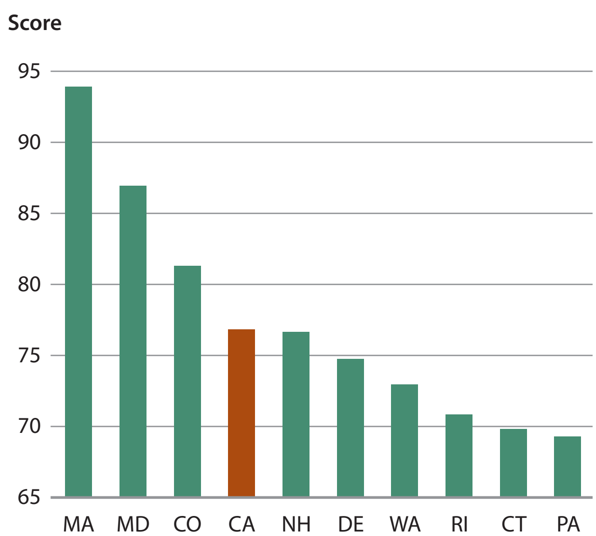
R&D Inputs and California

In this component, California scored 77.01 points, more than two points less than in 2010. California remained in fourth place behind Colorado, which moved up two rankings from fifth in the last index. Once again, Massachusetts (94.1) and Maryland (87.0) led the pack. California scored below the national average in R&D on engineering, environmental science, and agriculture sciences, but improved its amount of National Science Foundation (NSF) funding, keeping the state in fourth place.

Research and Development Inputs: Composite Index



Research and Development Inputs: Top 10 states



Source: Milken Institute

Federal R&D Dollars per Capita

Definition

The indicator for federal research and development dollars per capita is calculated by dividing each state's federal R&D total by its population. Federal R&D is the sum of all spending for basic and applied research in projects pertaining to national defense, health, space, technology, energy, and general science. The National Science Foundation collects the data. Population figures come from the U.S. Census Bureau.

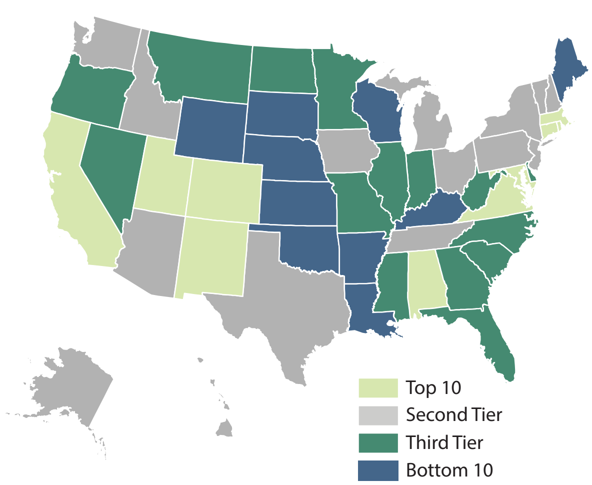
Why Is It Important?

As with financial support of scientific research in general, the real value of federally funded R&D is not only in its dollar amount but also in its ability to foster and sustain a state's pool of skilled human capital. The latest figures show that federal R&D for all 50 states totaled $138.2 billion, an average of $392.25 per capita. Maryland and New Mexico have held the top two positions since the 2004 index. Maryland received more than $2,300 per resident, while New Mexico received nearly $1,700 per resident in 2010, the most recent figures available. The leading recipients of federal R&D dollars have heavy concentrations of health and national security research. Maryland, New Mexico, Virginia, and Massachusetts all serve as bases for major government research programs. Federal R&D spending supports stand-alone research institutions such as Maryland's National Institutes of Health and New Mexico's Los Alamos National Laboratory, as well as the work of research universities. Government research programs can plant the seeds for new technology ventures.

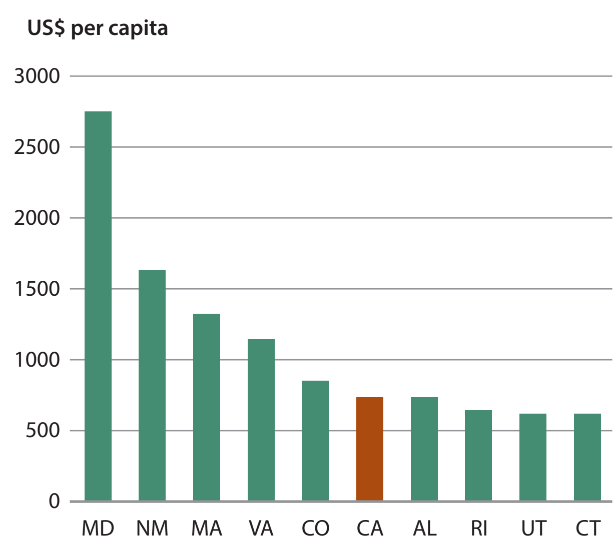
Federal R&D and California

California was able to gain two spots between 2012 and 2013, ending in sixth–the same ranking as the 2010 index. California surpassed Rhode Island and Alabama in the 2013 index by attracting more funding. In the latest index, the state received $730.84 per capita, compared to $534 in the 2012 index. The top state, Maryland, was able to increase federal funding per capita to $2,750.30 from $231.00 in 2012. California garnered $27.2 billion in federal R&D, the highest amount received by any state averaged out per person. Still, the Golden State lags far behind even fifth-place Colorado, with $864.61 in funding per capita.

Federal R&D spending: Dollars per capita, 2010



Federal R&D spending: Top 10 states, 2010



Sources: Milken Institute, National Science Foundation, U.S. Census Bureau

Industry R&D Dollars per Capita

Definition

This indicator measures each state's level of commercial industry financial support for R&D adjusted for total population. The indicator is calculated by totaling the amount each state's nonfarm industry sector spends on R&D and dividing the sum by population. Industry R&D is the sum of all amounts spent by corporations on basic and applied research, including money spent by corporations on federally funded R&D centers. The National Science Foundation provides spending data. Population data comes from the U.S. Census Bureau.

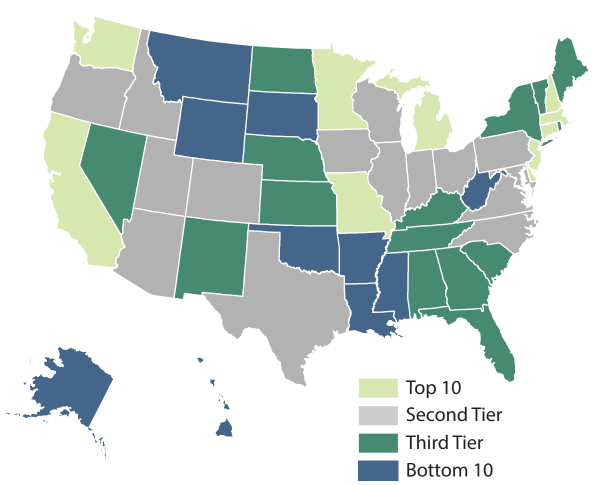
Why Is It Important?

This indicator illustrates the role of industry R&D in a state's economy. Latest figures indicate that total industry R&D for all 50 states exceeds $278 billion, for an average of $684 per capita. Industry R&D is by far the largest of the three R&D types (federal, industry, and academic), representing slightly more than 65 percent of total spending. As a result, its weight in the Research and Development Inputs Composite Index is roughly six times that of academic R&D and three times that of federal R&D. Corporate R&D is a strong indicator of how companies are investing in their future. Businesses spend their R&D dollars primarily in states with talented and educated workforces. The fruits of R&D often take years to materialize, but without this investment, companies eventually lose their competitive edge.

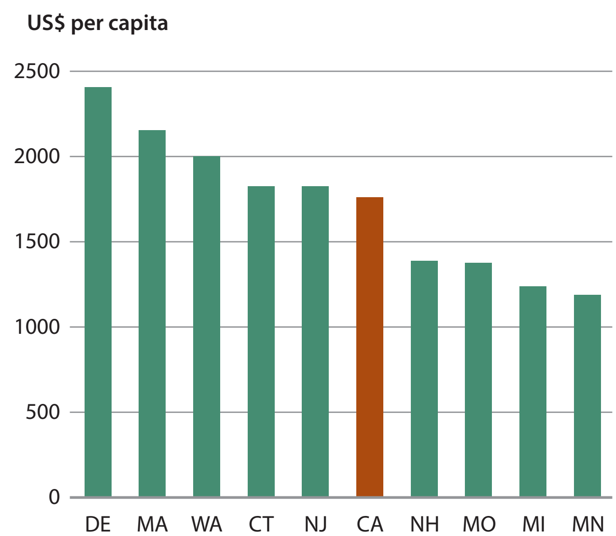
Industry R&D and California

California received $1,742 per capita in industry R&D funding, slightly less than the 2010 and 2012 index figures, but more than twice what it received from the federal government. California's slight drop kept it in sixth. The top five states were Delaware, Massachusetts, Washington, Connecticut, and New Jersey. Delaware jumped into first after being pushed out of the top five in the 2010 and 2008 indexes. Thanks to Silicon Valley, it is no surprise that California continues to perform well in this measure, even with the state's large population.

Industry R&D spending: Dollars per capita, 2010



Industry R&D spending: Top 10 states, 2010



Sources: Milken Institute, National Science Foundation, U.S. Census Bureau

Academic R&D Dollars per Capita

Definition

Academic research and development dollars per capita is calculated by totaling the amount of money spent on R&D by each state's colleges and universities and dividing that sum by the state's population. All research, basic and applied, performed by colleges and universities may be funded by a combination of federal, industry, and academic sources; that data are collected by the National Science Foundation. The U.S. Census Bureau collects population statistics. R&D figures reported by academic institutions from federal sources will differ from those reported by the federal government for academic institutions because the funds are not necessarily spent in the same year they are awarded.

Why Is It Important?

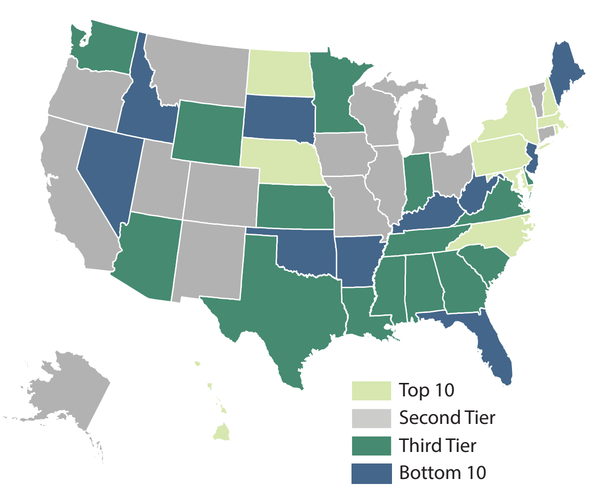
This indicator illustrates the importance of university research as well as the strength and competence of each state's university system. In contrast to R&D performed by the private sector, academic R&D tends to focus on basic rather than applied research. The latest figures indicate that the nation's total academic R&D spending exceeds $54 billion, or an average of $175 per U.S. resident.

R&D performed by colleges and universities differs from government and industry R&D because it typically focuses on fundamental scientific questions rather than product or technology development. Although academic research has traditionally been somewhat divorced from the marketplace, academic R&D can serve as a magnet for knowledge-intensive businesses that seek to hire academic researchers and benefit from their discoveries.

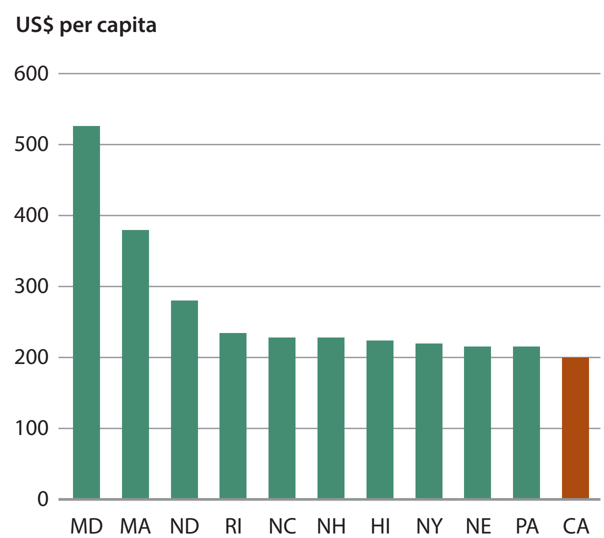
Academic R&D and California

California spends considerably less on academic R&D compared to federal and industry R&D funding. At a slightly improved $200 per capita, the state gained three spots to rank 15th, placing it in the second tier of states in this measure. Maryland and Massachusetts again led the pack, spending $527 and $377 per capita on Academic R&D. Alaska, which placed in the top five in the 2010 and 2008 indexes, dropped to 17th.

Academic R&D spending: Dollars per capita, 2009



Academic research and development spending: Top 10 states and California, 2009; California ranked 15th



Sources: Milken Institute, National Science Foundation, U.S. Census Bureau

National Science Foundation Funding

Definition

This indicator shows the dollar amount of funding awarded by the National Science Foundation (NSF) per $100,000 of each state's gross state product (GSP). The NSF is an independent agency of the U.S. government that funds research and education in science and engineering through grants, contracts, and cooperative agreements. The largest beneficiaries of NSF awards are universities and nonprofit nonacademic institutions, such as museums and research laboratories. Data on NSF funding comes from the NSF itself. The Bureau of Economic Analysis in the U.S. Department of Commerce provides GSP figures.

Why Is It Important?

This indicator measures the impact of NSF funding on a state's economy. The NSF is the second-largest source of federal funding, to the tune of $6.7 billion in 2012.

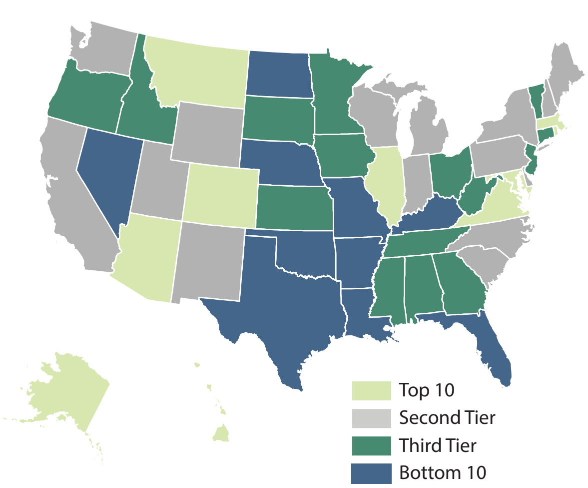
Since 1950, the NSF has invested in the key driver of technological progress: intellectually creative people. Its financial support of research and education has led to breakthroughs in science, engineering, and other fields. NSF-supported researchers have been awarded more than 100 Nobel Prizes in physics, chemistry, physiology, and economics.

NSF Funding and California

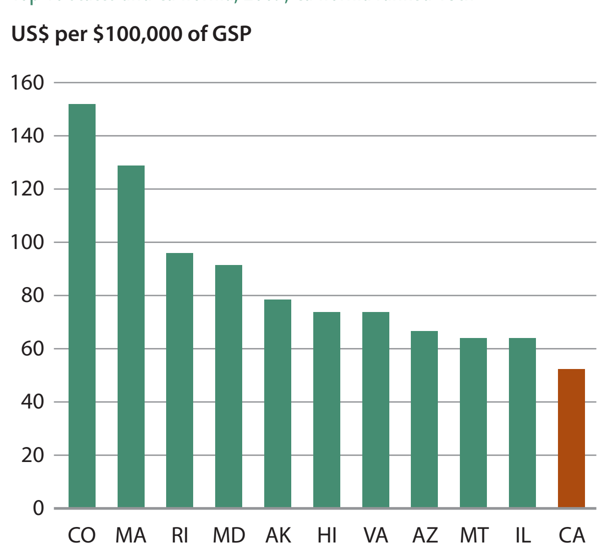
California jumped two rankings to 16th in the 2012 index, but dropped back two spots to end in 18th for the 2013 index. California went from receiving almost $47 in 2012 to $52 in 2013. California's performance improved, but so did the national average, rising from about $42 to $48 and moving California down in the rankings.

The top three states all saw an increase in NSF funding from 2012: Colorado ($129 to $152), Massachusetts ($116 to $129), and Rhode Island, which moved up from fifth ($73 to $96). Alaska gained ground, having fallen from first to eighth in 2012, but ending 2013 in fifth with $78. California will need improvement to break into the top 10 and attract more NSF funding to support leading-edge research.

National Science Foundation funding: Per $100,000 of GSP, 2009



National Science Foundation funding:
Top 10 states and California, 2009; California ranked 18th



Sources: National Science Foundation, U.S. Bureau of Economic Analysis

National Science Foundation Research Funding

Definition

This indicator is calculated by deriving the dollar amount of funds awarded by the NSF specifically for research for every $100,000 of GSP. As discussed, the NSF is an independent agency of the U.S. government that funds research and education in science and engineering through grants, contracts, and cooperative agreements. The largest beneficiaries are universities and nonprofit nonacademic institutions, such as museums and research laboratories. The data are provided by the NSF. GSP data are collected by the Bureau of Economic Analysis in the U.S. Department of Commerce.

The difference between NSF funding, described on the previous page, and NSF research funding is that the former is more inclusive, representing funds awarded for research and education, while this component isolates funding for research only.

Why Is It Important?

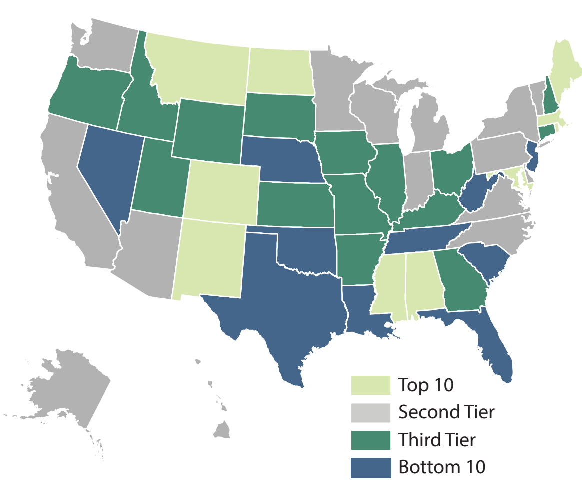
The indicator measures the impact of NSF funding on a state's economy. In 2012, NSF research awards exceeded $5.6 billion.

Through their work, recipients of NSF research funding develop and expand a state's R&D record of accomplishment and future capacity—elements that heighten recognition of a state's science and technology capabilities and attract more support for R&D activities. The NSF acts on the premise that institutions and their science and engineering experts are valuable resources that can influence a state's development.

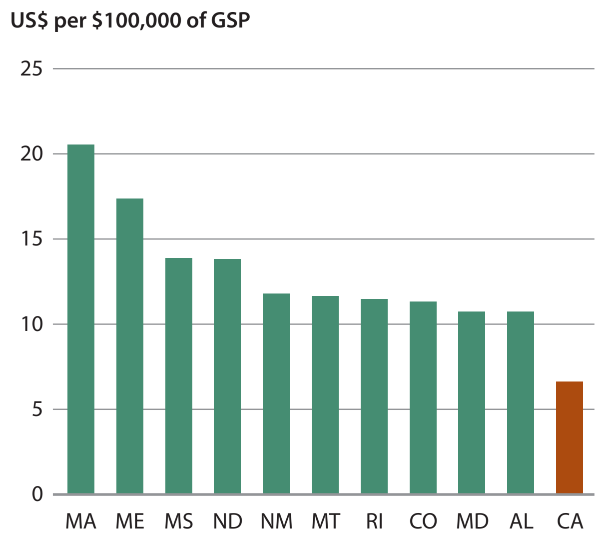
NSF Research Funding and California

California remains in the middle of the pack, ranking 23rd in NSF Research Funding. In the 2013 index, California's $6.69 per $100,000 GSP ranked below the national average of $7.15. This is not a great performance, but all the top states received much less research funding. The top five states in this measure are Massachusetts ($20.57), Maine ($17.50), Mississippi ($13.91), North Dakota ($13.83), and New Mexico ($11.90). Mississippi moved up 40 places to gain a spot in the top five.

National Science Foundation research funding: Per $100,000 of GSP, 2012



National Science Foundation research funding: Top 10 states and California, 2012; California ranked 23rd



Sources: National Science Foundation, U.S. Bureau of Economic Analysis

R&D Expenditures on Engineering

Definition

R&D expenditures on engineering are shown in dollars per capita. It is calculated by totaling the funds spent at doctorate-granting institutions on basic and applied engineering programs and dividing the sum by each state's population. All recognized engineering programs that spend funds on research are accounted for here. The data are collected by the Division of Science Resources Studies of the National Science Foundation. Population statistics are recorded by the U.S. Census Bureau.

Why Is It Important?

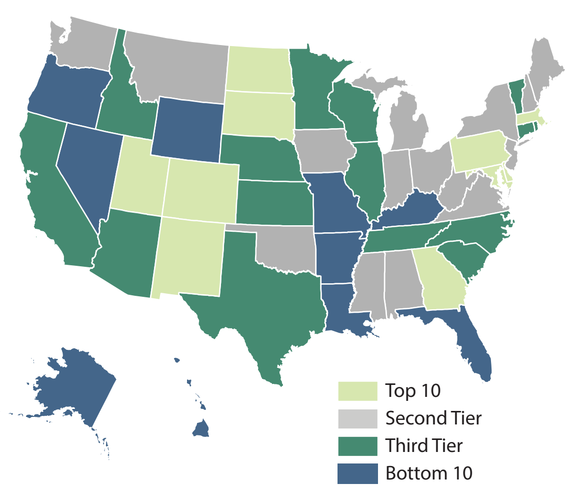
This indicator illustrates each state's relative level of institutional R&D spending on engineering research projects. More than $6.2 billion of all R&D funding at doctorate-granting institutions was spent on engineering research in 2011, for a national average of $21.84 per capita. While R&D expenditures on life sciences dominate at doctorate-granting universities, accounting for 75 percent of all R&D funding, engineering research was the second-highest priority, accounting for 11 percent.[5]

Advances and discoveries in engineering—especially in areas such as computer science and nanotechnology—are important drivers of a state's high-tech economy, not to mention contributors to improving national security capabilities. Universities in states with world-class engineering programs will continue to be well-positioned to attract research funding and produce a highly educated labor force.

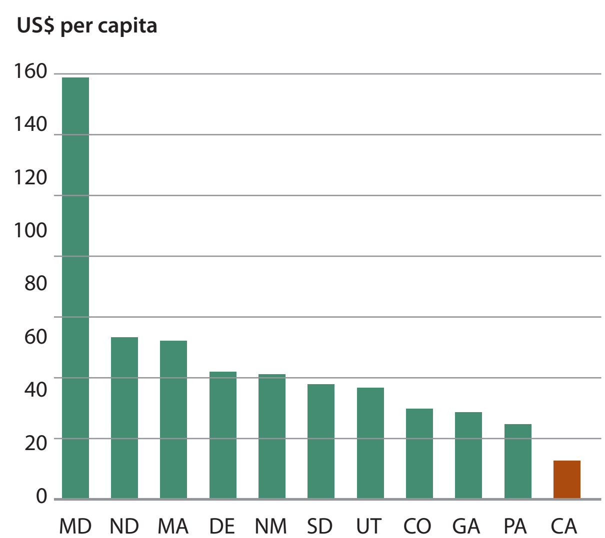
Engineering R&D and California

California continues its steady decline in engineering R&D, falling to 28th place and spending $14.78 per capita. California's position in this measure has continued to fall since its 12th-place finish in the first index in 2002, dropping to 21st in the 2004 edition, recovering slightly to 19th in 2008, falling again to 23rd in 2010. The top five states remain the same, though the order has changed since 2012. Maryland ($158.48) remained first, followed by North Dakota ($59.97), Massachusetts ($58.95), Delaware ($47.82), and New Mexico ($46.33).

R&D expenditures on engineering: Per Capita, 2011



R&D expenditures on engineering:
Top 10 states and California, 2011; California ranked 28th



Sources: National Science Foundation, U.S. Census Bureau

5. National Science Foundation/Division of Science Resources Studies Statistics, Survey of Research and Development Expenditures at Universities and Colleges, FY 2007.

R&D Expenditures on Physical Sciences

Definition

The indicator for R&D expenditures on physical sciences is measured in dollars per capita. It is calculated by dividing the statewide funds spent at doctorate-granting universities on basic and applied physical sciences programs by each state's respective population. All physical science research programs, from mathematics and physics to astronomy and materials research, are accounted for here. The Division of Science Resources Studies of the National Science Foundation collects this data. The U.S. Census Bureau collects the population statistics.

Why Is It Important?

Some $3.5 billion of all R&D at doctorate-granting universities was spent on research relating to the physical sciences in 2011 (the most recent data available), for an average per capita of $11.22. Almost 6 percent of institutional R&D at doctorate-granting universities was spent on research in the physical sciences, making it the third-best-funded category of R&D expenditures.

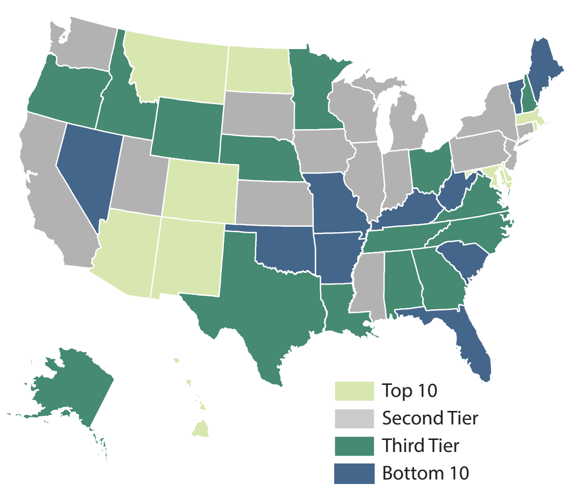
Advances in physical sciences, such as the discovery of planets that exhibit similar characteristics to Earth's and the finding that pressurized nitrogen can act as a semiconductor, continue to open new frontiers for science and technology. University-based research expenditures in this area help attract and retain highly qualified individuals who contribute to the innovative dynamics of a state's economy. Even when carrying out basic research, they may eventually have an immense impact on advances in commercial technology.

Physical Science R&D and California

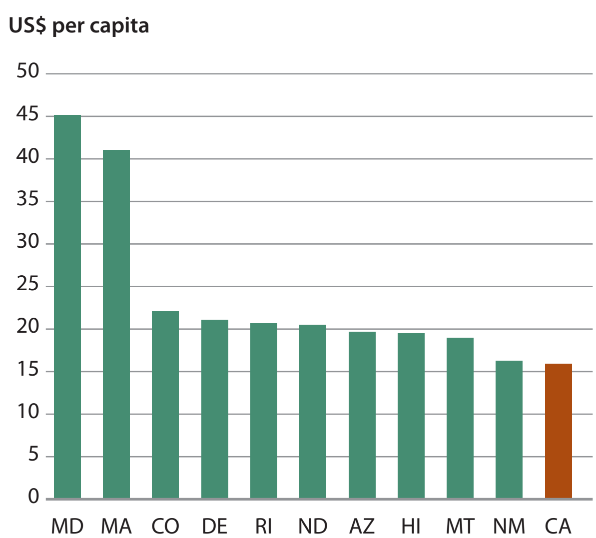
California decreased per capita spending on Physical Science R&D by almost $5 from $21.02 in 2012 to $16.21 in 2013. The Golden State falls one spot to 11th. The national average also decreased from 2012 by almost $3 from $14.99 per capita to $11.22 in 2013.

The top five states in this measure are Maryland ($44.89), Massachusetts ($40.90), Colorado ($22.14), Delaware ($20.82), and Rhode Island ($20.65). California has not been able to gain any ground on Maryland or Massachusetts. The top two knowledge-intensive states, with world renowned R&D assets, have spent more than twice as much as California on physical science R&D since 2008.

R&D expenditures on physical sciences: Per capita, 2011



R&D expenditures on physical sciences:
Top 10 states and California, 2011; California ranked 11th



Sources: National Science Foundation, U.S. Census Bureau

R&D Expenditures on Environmental Sciences

Definition

R&D expenditures on environmental sciences are measured in dollars per capita. Figures are calculated by dividing the statewide funding at doctorate-granting universities on basic and applied environmental science programs by each state's respective population. All funded research programs, from studies on environmental complexity to analysis of climate change, are captured in the data, collected by the Division of Science Resources Studies of the National Science Foundation. The U.S. Census Bureau provides the population statistics.

Why Is It Important?

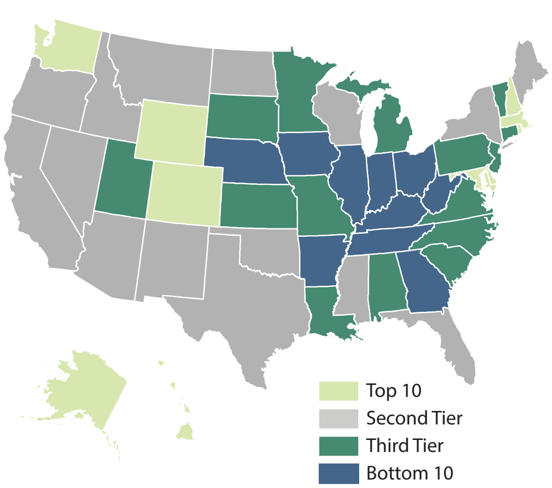
This indicator measures relative spending levels for institutional R&D in the environmental sciences. More than $2.1 billion of all R&D at doctorate-granting universities was spent on research in this field in 2011, an average of $11.02 per capita, accounting for 3.7 percent of all institutional R&D.

Environmental science supports such highly valued commercial fields as environmental technologies and genomics. Regarding the latter, projects are exploring genomic approaches to environmental problems, gaining understanding of how organisms interact with or adjust to their environment. Further discoveries in environmental sciences will potentially heighten attention to the field, allowing it to obtain more funding.

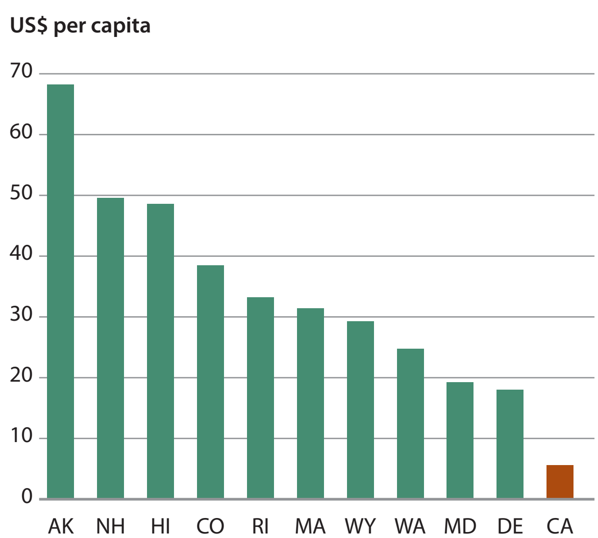
Environmental Science R&D and California

At 19th, California continued to rank among the top 20 in R&D spending on environmental science. The state spent $5.91 per capita, significantly less than the national average of $11.02. The top five states in this measure were Alaska ($67.87), New Hampshire ($49.70), Hawaii ($48.54), Colorado ($38.51), and Rhode Island ($33.55). Although these states are not generally regarded as knowledge-intensive powerhouses, they all spend more than five times what California does on environmental science R&D. In fact, the top 12 states all spend at least twice as much as California in this regard.

R&D expenditures on environmental sciences: Per capita, 2011



R&D expenditures on environmental sciences:
Top 10 states and California, 2011; California ranked 19th



Sources: National Science Foundation, U.S. Census Bureau

R&D Expenditures on Math and Computer Science

Definition

The indicator for R&D expenditures on math and computer science is expressed in dollars per capita. It is calculated by dividing statewide funding at doctorate-granting universities on basic and applied math and computer science programs by each state's respective population. All math and computer science programs are included here, as determined by the Division of Science Resources Studies of the National Science Foundation. The U.S. Census Bureau collects population statistics.

Why Is It Important?

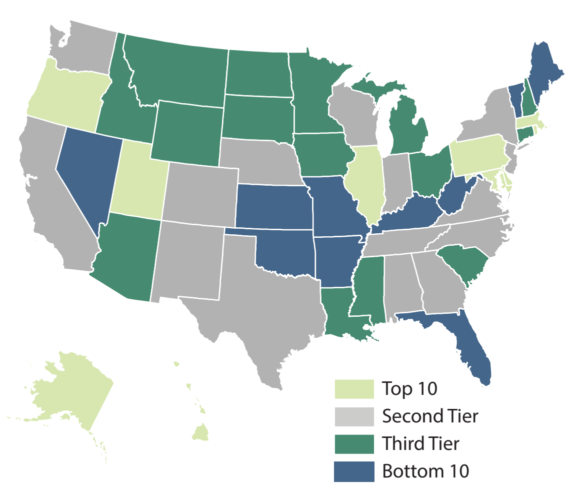
This indicator shows institutional R&D dollars spent on math and computer science projects. In 2011, nearly $1.7 billion of all R&D at doctorate-granting universities was spent on research relating to these fields, for an average per capita total of $5.28. Three percent of all institutional R&D funding was spent on math and computer science-related projects, making this the least-funded area of research.

Mathematics forms the basis of all quantitative science and is the "core language" of high-tech development. Computer science represents the chief component of what we associate with high-tech today: information technologies. Because advanced computer technologies are influenced by other disciplines (engineering, physics, and even life sciences), figures in this category may underreport the amount of research spending.

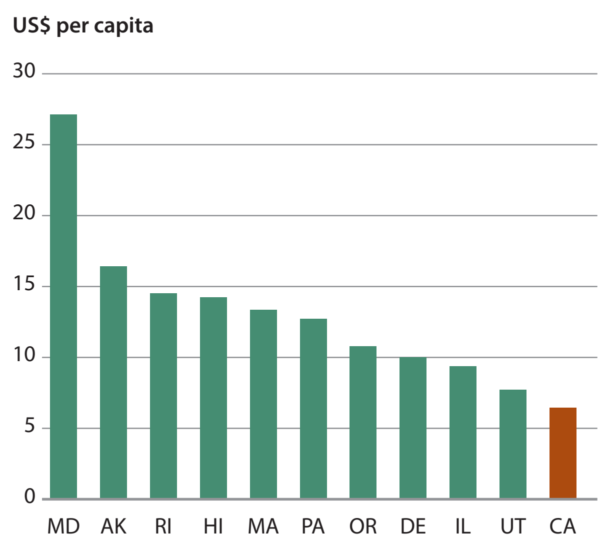
Math and Computer Science R&D and California

California slipped from eighth in 2010 to 10th in 2012, then to 12th in 2013, in Math and Computer Science R&D. California spends $6.69 per capita vs. the national average of $5.28. Research institutions such as the University of California Berkeley's Mathematical Sciences Research Institute, Caltech's Applied and Computational Mathematics Department, the San Diego Supercomputer Center, and Stanford University are among the top spenders in this regard. The top five in this measure were Maryland ($27.27), Alaska ($16.56), Rhode Island ($14.67), Hawaii ($14.55), and Massachusetts ($13.52).

R&D expenditures on math and computer science:
Per capita, 2011



R&D expenditures on math and computer science:
Top 10 states and California, 2011; California ranked 12th



Sources: National Science Foundation, U.S. Census Bureau

R&D Expenditures on Life Sciences

Definition

The indicator for R&D expenditures on life sciences is measured in dollars per capita. It is calculated by dividing the statewide funding spent at doctorate-granting universities on basic and applied life sciences programs by each state's respective population. All funded life science research programs, be they in biology, physical anthropology, oceanography, or horticulture, are accounted for here. The Division of Science Resources Studies of the National Science Foundation collects the data. The U.S. Census Bureau provides state population statistics.

Why Is It Important?

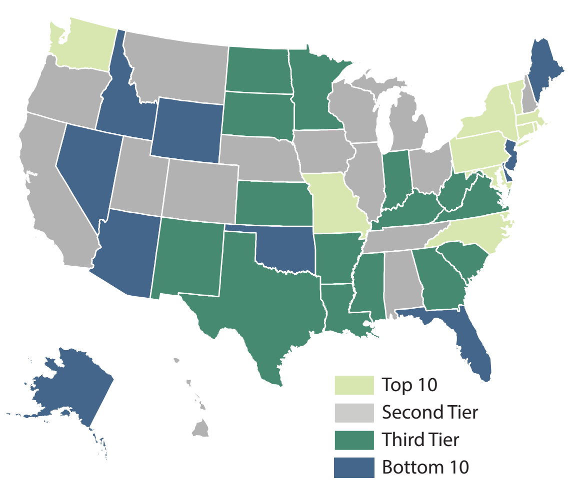
This indicator measures the funding each state received for institutional R&D in the life sciences. Nationally, $23.7 billion of all R&D at doctorate-granting universities was spent on research relating to the life sciences, for an average of $68.43 per capita. About 75 percent of all institutional R&D was spent on life science projects, making programs in this category by far the largest recipients of R&D funds.

The concept of high-technology originated with advanced electronics, a field that has historically been most directly influenced by such disciplines as engineering, physics, and computer science. Since the field of biotechnology emerged in the 1970s, however, the life sciences have become a growing force in the high-tech economy. The disproportionately high level of R&D funding for life sciences is reflective of this. Among the life science disciplines that show particular economic promise are genomics, bio pharmacology, virology, and agronomy.

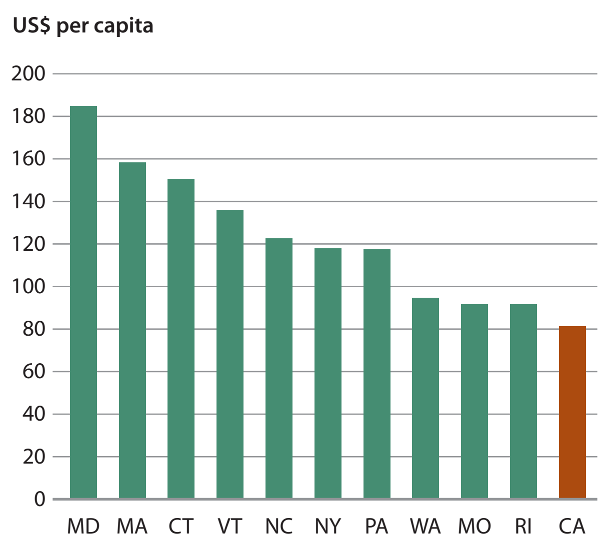
Life Sciences R&D and California

Ranking 16th, California fell from its place at 15th in the previous three indexes. California spent $82.21 per capita on R&D in life sciences, a sharp drop from $132.30 in 2012, however the decrease was consistent nationwide. East Coast states dominated this measure, with the top five being Maryland ($185.63), Massachusetts ($159.35), Connecticut ($151.21), Vermont ($137.61), and North Carolina ($123.11). Even with a strong life sciences cluster in San Diego, California will need to improve in biomedical science to break into the top 10.

R&D expenditures on life sciences: Per capita, 2011



R&D expenditures on life sciences:
Top 10 states and California, 2011; California ranked 16th



Sources: National Science Foundation, U.S. Census Bureau

R&D Expenditures on Agricultural Sciences

Definition

The indicator for R&D expenditures on agricultural sciences is measured in dollars per capita. It is calculated by dividing the statewide funding spent at doctorate-granting universities on basic and applied agricultural science programs by each state's respective population. According to NSF classifications, 12 scientific disciplines make up agricultural sciences, including animal sciences, plant sciences, soil sciences, and forestry. The data are collected by the National Center for Science and Engineering Statistics (formerly the Division of Science Resources Studies) of the National Science Foundation. The U.S. Census Bureau collects state population statistics.

Why Is It Important?

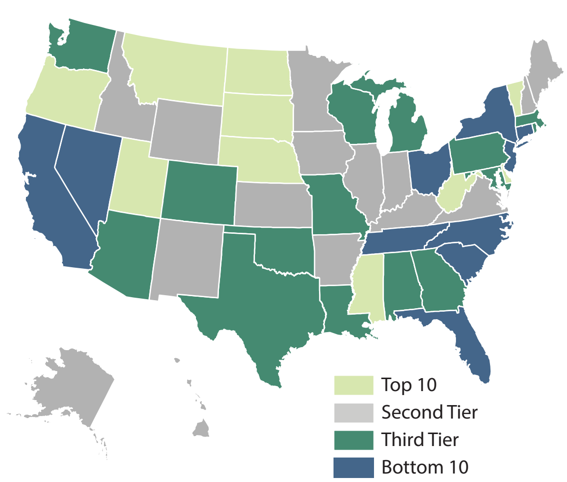
This indicator shows institutional R&D spending on agricultural science projects. Some $1.04 billion goes to R&D at doctorate-granting universities for research relating to agriculture—about 2 percent of the total $29.7 billion spent on life science R&D in 2011. Nationally, the average expenditure for this category of R&D was $5.52 per person in the latest index.

Although agricultural research has something of a low-tech image, agriculture-related studies have long been—and remain—an important component of scientific advancement. Today it is imperative to find innovative solutions to such problems as world hunger and forest degradation, and agricultural R&D is at the forefront of efforts to address these challenges. Agricultural science R&D blends old and new technologies, such as innovations in genetically modified crops, which demonstrates how the field is radically modernizing.

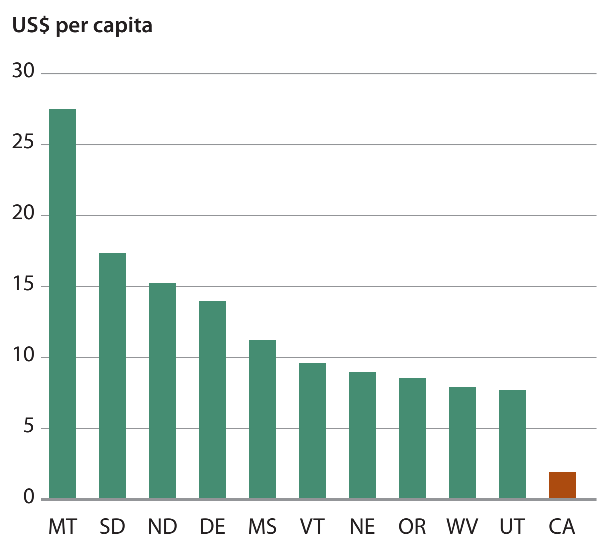
Agricultural Sciences R&D and California

California continues to rank in the bottom 10 in agricultural R&D. It slid two spots to 46th, and its per capita expenditures were $1.95, less than half the U.S. average and far short of spending levels in the top five states: Montana ($27.51), South Dakota ($17.32), North Dakota ($15.32), Delaware ($13.96), and Mississippi ($11.30). These top states are heavily dependent on the agricultural industry, including bio-agriculture and biofuels, while California has a more diversified economy. However, as a leading source and exporter of many agricultural products, the state could benefit from more investment in agricultural R&D.

R&D expenditures on agricultural sciences: Per capita, 2011



R&D expenditures on agricultural sciences:
Top 10 states and California, 2011; California ranked 46th



Sources: National Science Foundation, U.S. Census Bureau

R&D Expenditures on Biomedical Sciences

Definition

The indicator for R&D expenditures on biomedical sciences is measured in dollars per capita. It is calculated by dividing the statewide funding spent at doctorate-granting universities on basic and applied biology and medical science programs by each state's population. Research fields in this category include biochemistry, molecular biology, genetics, immunology, clinical medicine, and pharmacy. The data are collected by the National Center for Science and Engineering Statistics (formerly the Division of Science Resources Studies) of the National Science Foundation. The U.S. Census Bureau provides the population statistics.

Why Is It Important?

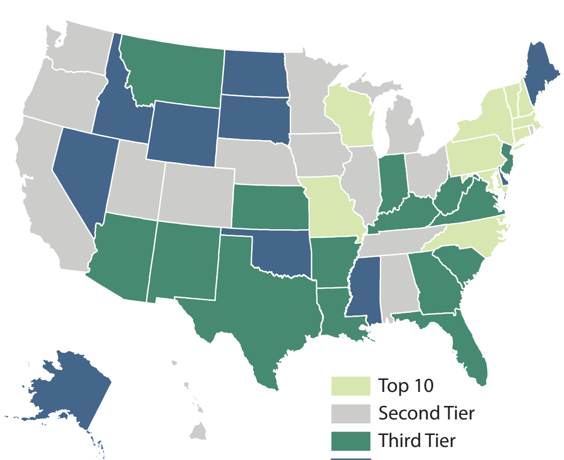
This indicator shows the institutional R&D dollars spent on biological and medical science projects. Nationally, $21.4 billion went to R&D at doctorate-granting universities for research relating to this field in 2011. This figure represents 48 percent of funding for life science research and more than 35 percent of all university R&D expenditures. The average expenditure in the United States for biomedical R&D is $58.51 per person.

As reflected in their disproportionately large share of university R&D funding, the biomedical sciences comprise some of the most promising areas for research. Demand for technologies that deliver better health is virtually unlimited. Moreover, there are enormous attendant benefits, economic and otherwise. Adequate biomedical R&D funding is vital to a well-rounded, knowledge-based economic strategy.

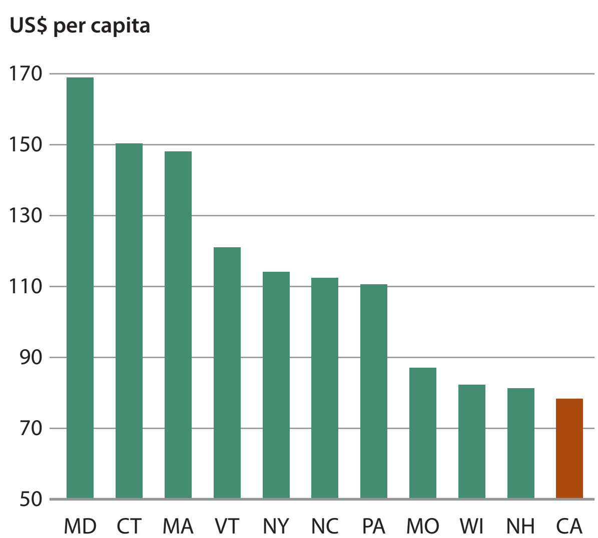
Biomedical Sciences R&D and California

California ranked 12th in this measure, spending $78.57 per capita. California fell directly behind New Hampshire and Ohio. California's performance in this measure is better than the national average of $58.51 per capita. The top three states remain the same: Maryland ($168.34), Connecticut ($149.89), and Massachusetts ($148.53). Rounding out the top five are Vermont ($120.97) and New York ($114.78).

R&D expenditures on biomedical sciences: Per capita, 2011



R&D expenditures on biomedical sciences:
Top 10 states and California, 2011; California ranked 12th



Sources: National Science Foundation, U.S. Census Bureau

STTR Awards per 10,000 Business Establishments

Definition

Here and on the following five pages, R&D inputs are not evaluated on a per capita basis, but according to larger base figures. The indicator for Small Business Technology Transfer (STTR) awards per 10,000 businesses is calculated by taking the average of the number of STTR awards in each state for the years 2008, 2009, and 2010, and dividing the result by the average number of business establishments in each state for those three years, times 10,000.

STTR awards are the total of Phase I and Phase II federally funded research grants to small businesses and nonprofit research institutions with fewer than 500 employees. The Small Business Administration (SBA) collects STTR award data, and the U.S. Census Bureau collects data on the number of establishments.

Why Is It Important?

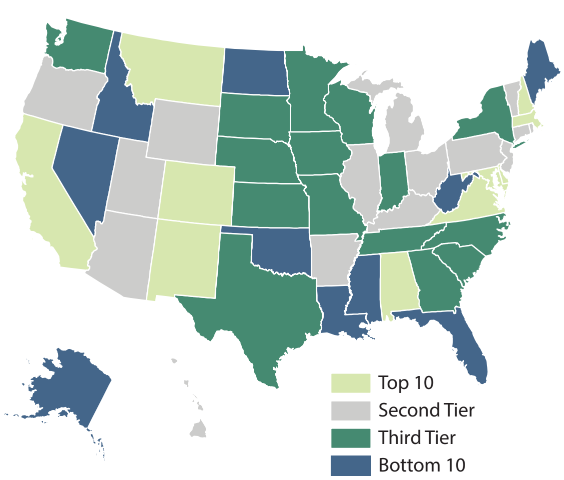
This indicator illustrates the synergy between small businesses or nonprofit research institutions and federally funded R&D resources. The latest figures indicate that the average annual number of STTR awards granted in the United States from 2008 through 2010 was 44.

The STTR program seeks to increase the participation of small businesses in federally funded R&D and to increase private-sector commercialization of technology. Many newly chartered firms play an increasingly instrumental role in the commercialization of technology innovations. Unencumbered by other core technology assets, small enterprises can bring new products and services to market quickly. One of the unique features of the STTR program is its requirement for participating small businesses to formally collaborate with a research institution in Phase I and Phase II. STTR awards play a significant role in supporting the innovation of small firms and research organizations while helping to bolster the nation's scientific and technological capabilities.

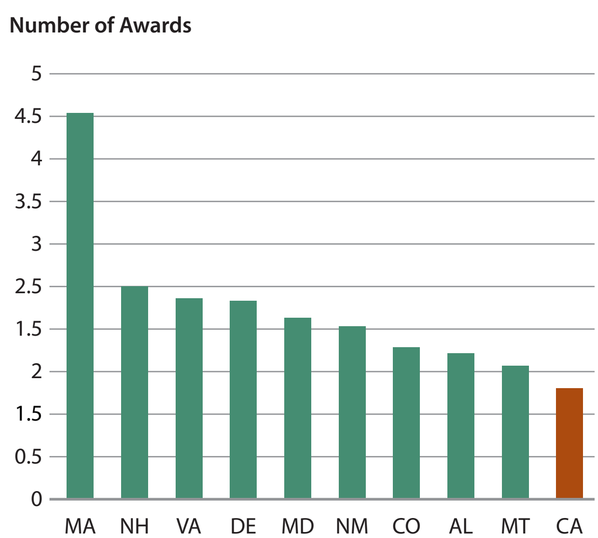
STTR Awards and California

California received 1.29 STTR awards per 10,000 businesses to remain ranked at 10th since the 2008 index. With its research universities, supply of venture capital, and number of startups, California should fare better in this measure. However, California has not been able to move from the 10th ranking, despite continuing to receive more than the national average of 0.92. The top five states were Massachusetts (4.56), New Hampshire (2.45), Virginia (2.34), Delaware (2.29), and Maryland (2.12).

Average annual STTR awards: Per 10,000 business establishments, 2008–2010



Average annual STTR awards per 10,000 business establishments: Top 10 states, 2008–2010



Sources: Small Business Administration, U.S. Census Bureau

STTR Award Dollars per $1 Million of GSP

Definition

The indicator for Small Business Technology Transfer (STTR) award dollars per $1 million of GSP is calculated by taking the average amount of STTR awards won during the years 2008, 2009, and 2010 (the latest data available when our calculations were completed), and dividing the result by each state's respective average GSP for those three years. STTR awards are the total of Phase I and Phase II federally funded research awards granted to small businesses and nonprofit research institutions with fewer than 500 employees. The Small Business Administration (SBA) collects STTR award data. The U.S. Department of Commerce collects GSP data.

Why Is It Important?

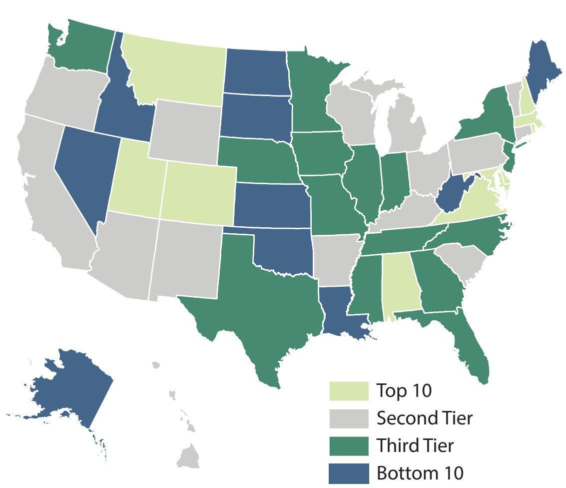
This indicator quantifies the magnitude of federal investment in the country's small businesses and research institutions. Each year, five federal departments are required to reserve part of their R&D funds for STTR awards. Latest figures indicate that average annual total for federal funds spent on R&D in the small-business and nonprofit institution sectors was $249.2 million during the three years, or $21.42 for every $1 million of GSP.

Small businesses have long been drivers of entrepreneurial dynamism and innovation capacity. However, the risk and expense of undertaking R&D efforts is beyond the means of many small commercial operations. This applies even more so to small nonprofit research laboratories. STTR awards bolster these components of a state's economy and can help support a state's overall innovation infrastructure.

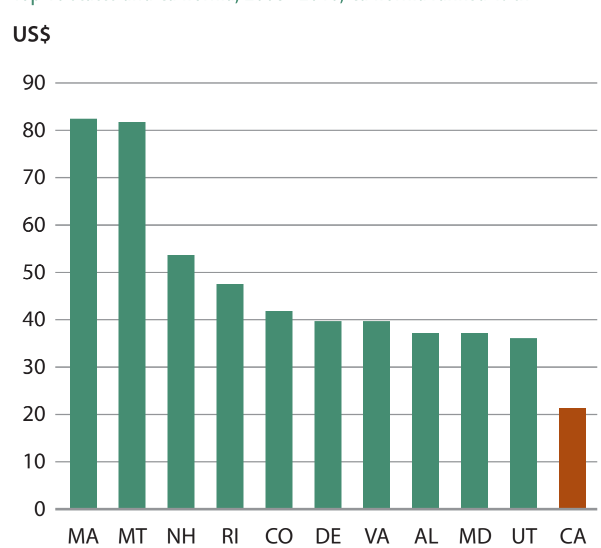
STTR Awards and California

California had a big drop, down six places to 19th, receiving $21.55 in STTR awards per $1 million of GSP, $4 less than in 2010. The top five states were Massachusetts ($83.24), Montana ($82.28), New Hampshire ($53.79), Rhode Island ($47.72), and Colorado ($42.37). These five states received at least $20 more in STTR awards per $1 million GSP than California did. Although California has a large technology base, its performance was simply adequate in this measure. Small businesses tend to use more traditional financing from banks, angel investors, and venture capital; many are unaware of STTR awards. California has abundant infrastructure for private funding, but training for small-business owners and heightened awareness may help increase the visibility of STTR awards and encourage businesses to apply.

Average annual STTR award dollars per $1 million of GSP:
2008–2010



Average annual STTR awards per $1 million of GSP:
Top 10 states and California, 2008–2010; California ranked 19th



Sources: Small Business Administration, U.S. Bureau of Economic Analysis

SBIR Awards per 100,000 People

Definition

The indicator for Small Business Innovation Research (SBIR) awards per 100,000 residents is derived by taking the average number of annual awards received by each state from 2009 through 2011 and dividing that by the average state population for those three years, times 100,000. Like STTR awards, SBIR awards are split into Phase I and Phase II, and this component pools both phases. SBIR awards fund a small enterprise's often costly startup and development stages as well as encouraging the commercialization of research findings. The Small Business Administration (SBA) collects SBIR awards data. The U.S. Census Bureau collects population figures.

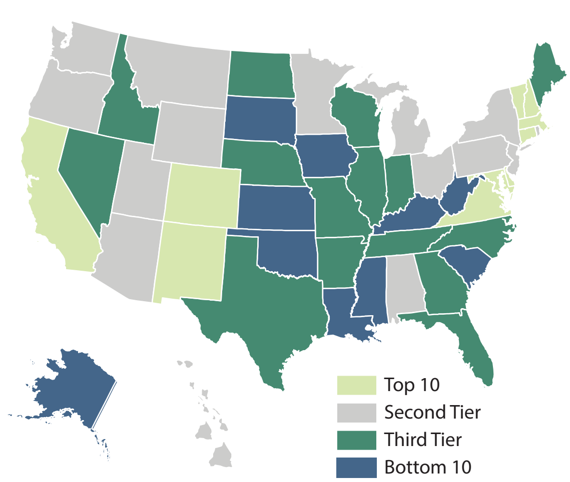
Why Is It Important?

SBIR awards are granted on the basis of need and creative ideas that have commercialization potential, so this indicator partially illustrates each state's level of entrepreneurial creativity. For a business to qualify for an SBIR award, it must be a for-profit entity; it must be American-owned and independently operated; it must employ the principal researcher; and it must have no more than 500 employees. Funding for the program comes from the federal government's 10 largest departments and agencies.

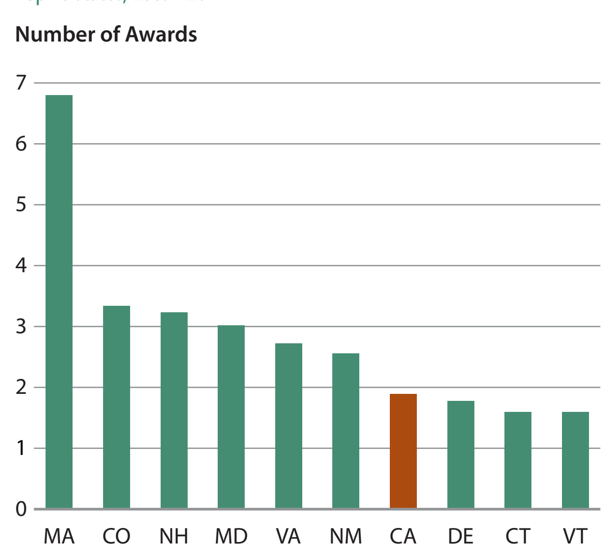
SBIR Awards and California

With 1.88 SBIR awards received per 100,000 people, California has placed seventh in this measure since the 2008 rankings, when the state racked up 3.54 SBIR awards per 100,000 residents. The top state in this measure was Massachusetts, which earned 6.77 SBIR awards per 100,000 people—twice as many awards as second-place Colorado, with 3.38 awards. Rounding out the top five were New Hampshire (3.27), Maryland (3.01), and Virginia (2.72). The national average was 1.12 awards. More details about SBIR awards are given in the following sections as we look at Phase I and II SBIR awards.

Average annual SBIR awards per 100,000 people: 2009–2011



Average annual SBIR awards per 100,000 people:
Top 10 states, 2009–2011



Sources: Small Business Administration, U.S. Census Bureau

Phase I SBIR Awards per 10,000 Business Establishments

Definition

The indicator for Phase I SBIR awards per 10,000 businesses is calculated by adding the number of Phase I awards per state and dividing them by units of 10,000 business establishments active in the state. This calculation allows us to derive a standard measurement. Phase I SBIR awards data are collected by the NSF's Experimental Program to Stimulate Competitive Research (EPSCoR). The U.S. Census Bureau collects data on the number of business establishments.

Why Is It Important?

SBIR programs fund high-risk R&D efforts that have commercialization potential. Through funding, the program seeks to stimulate technological innovation, use small businesses to meet federal R&D demand, and encourage R&D participation by minority-owned or otherwise potentially disadvantaged firms.

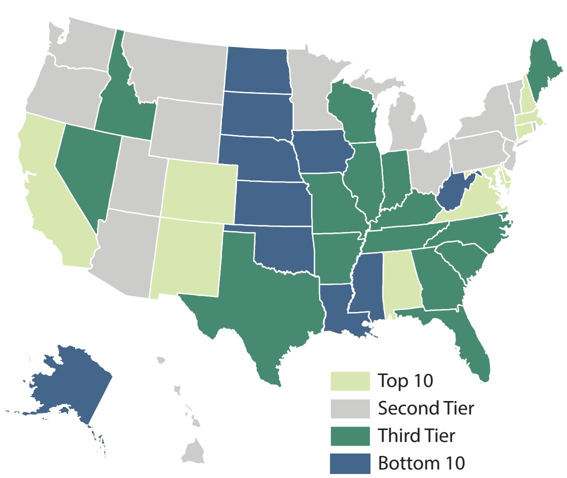
Phase I awards are granted on the basis of research capability. A typical Phase I award funds about six months of research and does not exceed $100,000.

During these six months, the researching firm must establish the technical feasibility of the project as well as justify reasons for further federal, and sometimes private, financing. Not all Phase I SBIR awards lead to further funding; however, obtaining one creates the opportunity to initiate research and helps firms market themselves to potential investors.

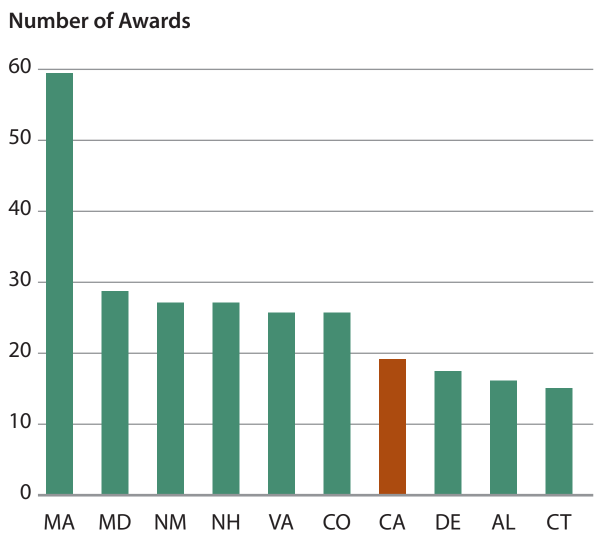
Phase I SBIR Awards and California

California remains in the top 10, ranked seventh with 19.38 Phase I SBIR awards per 10,000 business establishments. The national average is 10.18. California ranked seventh in the 2010 index and the 2012 index. The top five states in this measure were Massachusetts (59.36), Maryland (28.74), New Mexico (27.35), New Hampshire (27.27), and Virginia (26.06).

Phase I SBIR awards per 10,000 business establishments:
2011



Phase I SBIR awards per 10,000 business establishments:
Top 10 states, 2011



Sources: EPSCoR, U.S. Census Bureau

Phase II SBIR Awards per 10,000 Business Establishments

Definition

This indicator is calculated by totaling the number of Phase II awards per state and dividing them by units of 10,000 business establishments active in the state. This calculation allows us to derive a standard measurement. Phase II SBIR awards data are collected by the NSF's Experimental Program to Stimulate Competitive Research (EPSCoR). Data on the number of business establishments are collected by the U.S. Census Bureau.

Why Is It Important?

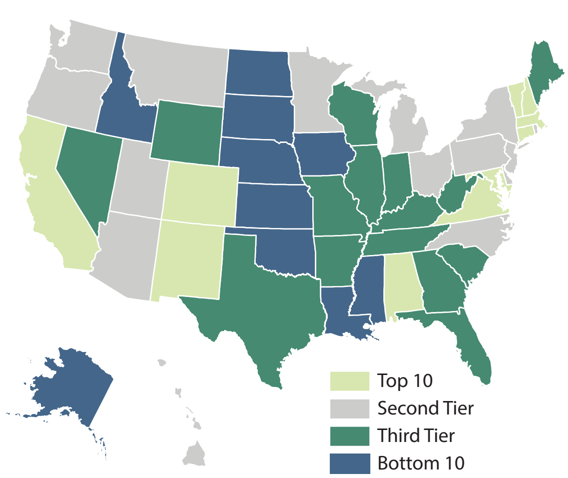
To be eligible for a Phase II award, a firm must have secured a Phase I award. Phase II awards are granted on the basis of findings from Phase I research and are meant to continue the R&D launched in the initial stage. Typically, Phase II awards fund two years of research and do not exceed $750,000. Phase II awards are fewer and harder to come by than are Phase I awards. On average, 4.5 Phase II SBIR awards per 10,000 businesses were granted in 2011 (the latest data available) compared to 10 Phase I awards.

As the statistics indicate, Phase II is highly competitive. The purpose of a Phase II award is to facilitate advanced R&D efforts moving closer to the stage of commercialization than would be the case in most Phase I projects. A Phase II award allows a small business to reach a higher level in its innovation efforts. Without such funding, many small firms would lack the means to carry out promising research.

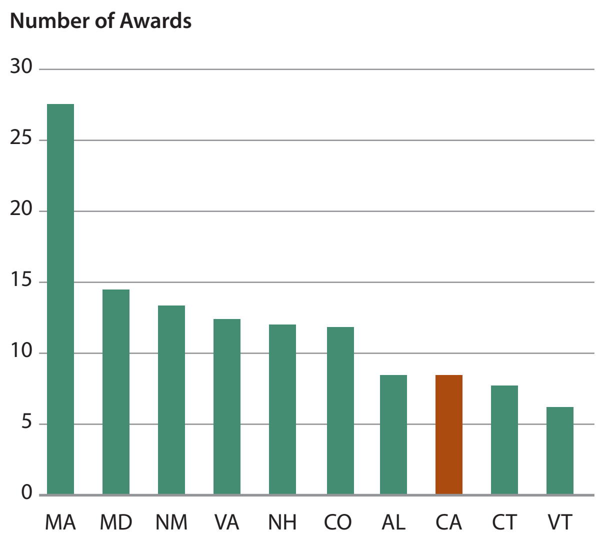
Phase II SBIR Awards and California

California maintained its eighth-place ranking from the 2010 index. The state received 8.37 Phase II SBIR awards per 10,000 business establishments in this index. Still, its SBIR awards numbered almost twice the national average of 4.54 awards per 10,000 business establishments. Phase II SBIR awards increased for all states. The top five states were Massachusetts (27.61), Maryland (14.33), New Mexico (13.22), Virginia (12.35), and New Hampshire (11.88). California could improve its rankings in the SBIR-related measures by creating more awareness among small businesses about these forms of support. Other kinds of support such as application assistance could also be helpful in boosting the state's rankings.

Phase II SBIR awards per 10,000 business establishments:
2011



Phase II SBIR awards per 10,000 business establishments:
Top 10 states, 2011



Sources: EPSCoR, U.S. Census Bureau

Competitive NSF Proposal Funding Rate

Definition

This indicator is calculated by taking the total number of competitive NSF awards granted in 2009 and dividing it by the total number of competitive NSF proposals submitted. Most NSF funding opportunities are in the areas of biology, computer sciences, education, engineering, geosciences, physical sciences, and social and behavioral sciences. Data on competitive NSF proposals and awards are collected by the Experimental Program to Stimulate Competitive Research (EPSCoR), a division of the NSF.

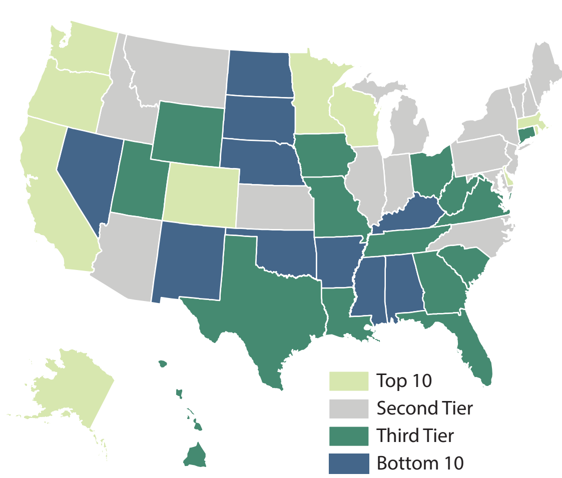
Why Is It Important?

The NSF accounts for approximately one-quarter of total federal funds awarded for basic research to all U.S. colleges and universities. The average national funding rate for competitive NSF proposals in 2012 was 22.4 percent. Without support from organizations such as the NSF, the range and quality of research in colleges and universities would be severely limited. In addition, funding often supports highly theoretical "basic" or "blue-sky" research, the sort of R&D that private industry is reluctant to undertake due to its high risks and limited immediate payoff. Awards and grants such as those provided by the NSF thus help support the bedrock of American scientific research and knowledge.

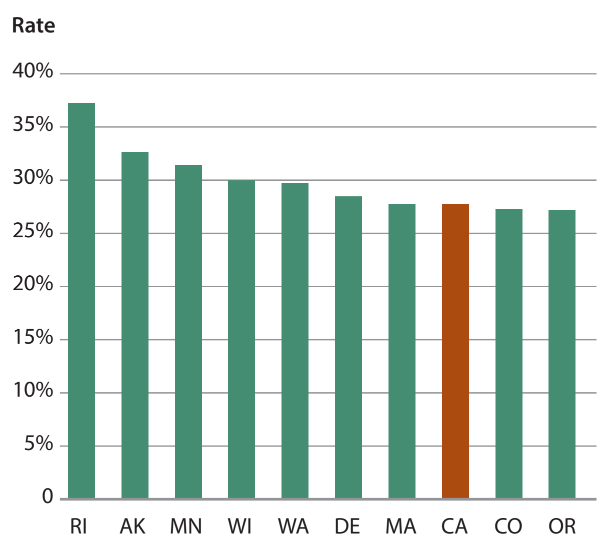
NSF Proposal Funding and California

California fell two places to rank eighth with a success rate in NSF funding of 27.7 percent. For some historical perspective, the state enjoyed a 38 percent success rate in the first index in 2002, placing fifth in this measure. In this index, even top-ranking Rhode Island's score of 37.1 percent did not match California's former success rate. This means that while California has maintained its ability to attract NSF funding due to its renowned research institutions, other states are progressing in this measure, making funding more competitive. The remaining states that make up the top five are Alaska (32.7 percent), Minnesota (31.2), Wisconsin (29.9), and Washington (29.7 percent).

Competitive NSF proposal funding rate: 2012



Competitive NSF proposal funding rate: Top 10 states, 2012



Source: EPSCoR

Risk Capital and Entrepreneurial Infrastructure Composite Index

Definition

The Risk Capital and Entrepreneurial Infrastructure (RCEI) Composite Index is the second major component of the State Technology and Science Index. The RCEI measures each state's entrepreneurial capacity by examining such indicators as venture capital investment, IPO activity, business starts, and patent issuance. VC investment in the cutting-edge fields of clean technology and nanotechnology was first included in the 2008 index. This year, sum of equity invested in green technologies was added to reflect the current shift in the high-tech industry toward clean tech. A state's score on the RCEI Composite Index is calculated by totaling its score on each individual RCEI indicator and dividing it by the number of indicators. (Scores are based on state rankings.) In the pages that follow, we will describe the individual components that make up the RCEI and discuss California's performance in each category.

Why Is It Important?

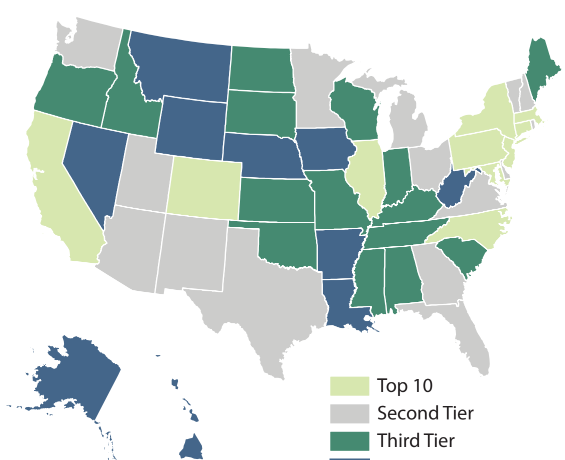
The Research and Development Inputs Composite Index, described in the previous section, measures the raw material of knowledge-based economic growth. The RCEI index adds technological commercialization and entrepreneurial activity to the mix, analyzing marketplace funding mechanisms (such as VC flows) and government funding disbursed by the Small Business Investment Company program.

We have measured items relating to that facilitating infrastructure such as the number of business incubators in each state, patents issued, and business starts. A state's level of risk capital funding and its entrepreneurial infrastructure work in tandem to provide an environment conducive to growth.

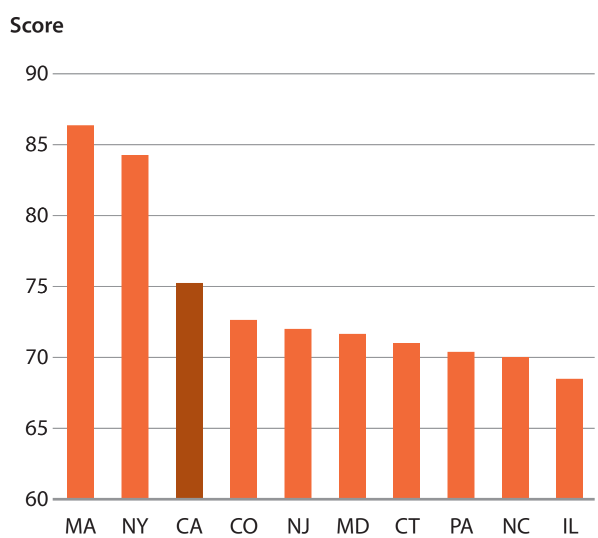
Risk Capital and California

With a score of 75.33, California continues its slide down the index, finishing third behind New York and Massachusetts. California slipped to second in the 2010 composite index after surpassing Massachusetts to take first in 2008. Massachusetts remains on top with a score of 86.50, followed by New York with 84.33. Rounding out the top 10 are Colorado (72.83), New Jersey (72.17), Maryland (71.67), Connecticut (71.00), Pennsylvania (70.60), North Carolina (70.00), and Illinois (68.67). California needs to maintain its ability to draw investment to its universities as well as its open policy toward cultivating new technologies in computers, biotechnology, and green technology. California performs well in VC investment, whether measured by its percentage of GSP or by the number of companies receiving VC investment.

RCEI Composite Index: 2013



RCEI Composite Index, Top 10 states: 2013



Source: Milken Institute

Total Venture Capital Investment Growth

Definition

The indicator for total venture capital investment growth is calculated by taking total VC investment for each state in 2012, dividing it by total VC investment for the previous year, and multiplying the result by 100. (VC refers to specially accumulated funds invested in or available for investment in a new or unproven business endeavor. Venture capital is also referred to as "risk capital" in recognition of its high risk coefficient.) VC data used in this report is from the PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report, based on data from Thomson Reuters.

Why Is It Important?

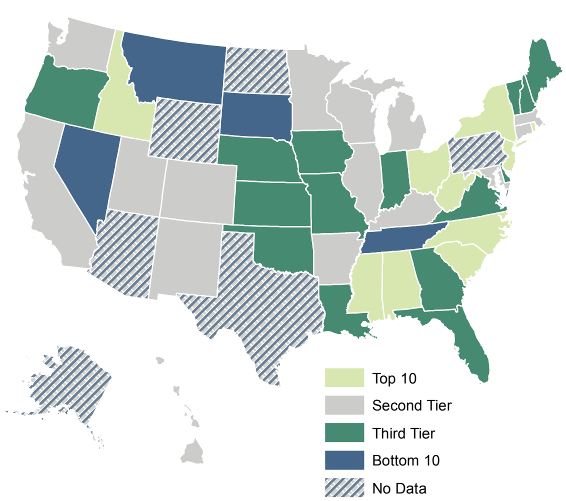
The goal for venture capitalists is to invest in young, fast-growing businesses that exhibit potential for high growth and high return on investment. VC has assumed greater importance as a source of equity funding for startups as public funding has faltered in recent years.

On the national level, the Great Recession has dampened the risk appetite of venture capitalists; total VC funding decreased by 5 percent from 2011 to 2012. Still, more than $27 billion was up for grabs in 2012, with California claiming by far the largest share with more than 50 percent of all VC funding. Venture capital financing remains highly important to a new firm's formation and growth. Digital Equipment Corporation, Sun Microsystems, Apple, Microsoft, Intel, Compaq, Federal Express, and Genentech are examples of companies that benefited from early-stage venture capital investment.

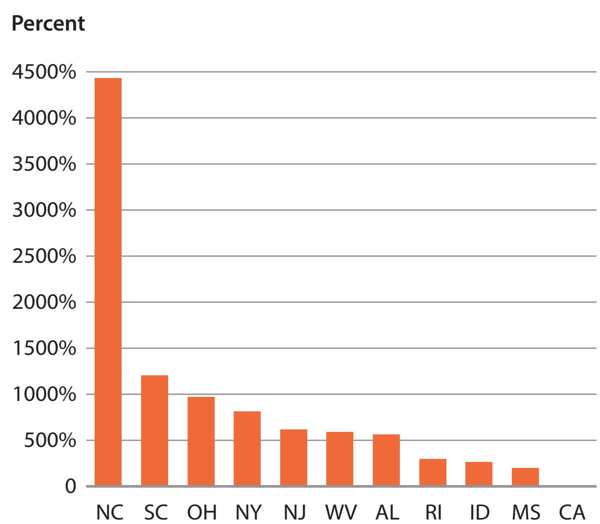
VC Investment and California

California was able to increase growth in VC investment by 24 percent in the 2012 index. However, that level was not met in the 2013 index; VC investment dropped by 1 percent, leaving California ranked 21st. In the current economy, it is difficult to have continued large year-on-year growth. For example, Maine ranked first in the 2012 index with VC investment growth at 1,673 percent, but in the 2013 index Maine dropped to 37th with negative growth of 67 percent. California should continue to leverage its innovative high-tech clusters to attract more venture capital. The top five states in this measure were North Carolina (4,440 percent), South Carolina (1,197 percent), Ohio (963 percent), New York (823 percent), and New Jersey (611 percent). These large growth rates are not sustainable.

Total venture capital investment growth: 2011–2012



Total venture capital investment growth:
Top 10 states and California, 2011–2012; California ranked 21st



Sources: PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report on data from Thomson Reuters

Number of Companies Receiving Venture Capital per 10,000 Firms

Definition

The indicator represents the number of companies that received venture capital funding between 2000 and 2012 in each state, normalized by increments of 10,000 business establishments of all kinds. Data on the number of companies receiving VC funding were provided by PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report, based on data from Thomson Reuters; data on the total number of business establishments came from the U.S. Census Bureau.

Why Is It Important?

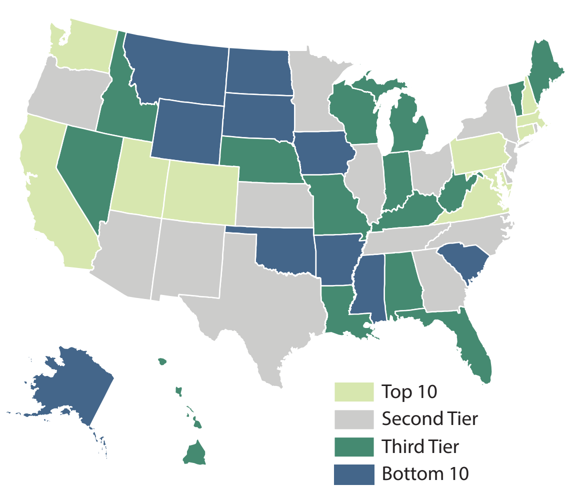
Most new business formation and job creation in the United States comes from the small-business sector. Financing for new business ventures has historically come from family endowments and inheritances. Over the past few decades, however, more and more small enterprises have begun turning to structured credit and private equity opportunities as a source of financial capital.

Venture capital funding reached its peak at the height of the tech bubble. Since the bubble burst in 2000, VC has slowly gained traction, even after its progress was interrupted by the Great Recession. It remains a vital source of funding for new firms, especially those that operate in knowledge-intensive sectors. Because it is disbursed in stages, venture capital not only plays a crucial role in getting a firm started but also in supporting its early years of operation before revenue or the sale of shares can sustain it.

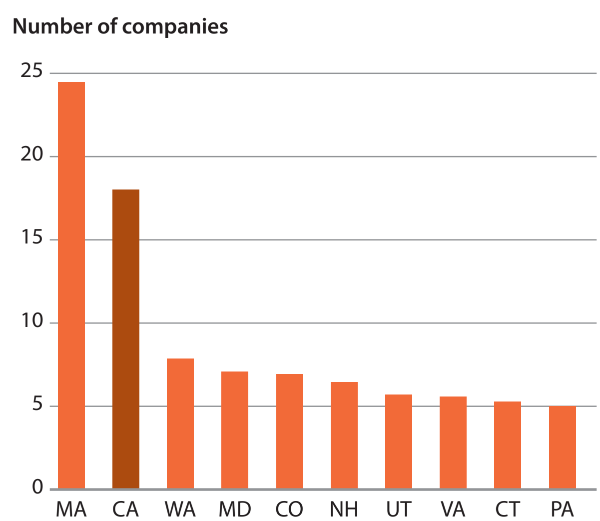
Number of Companies Receiving Venture Capital and California

California once again ranked second, with 17.97 companies receiving VC investments per 10,000 business establishments, the same ranking since the 2008 index. California lags far behind first place Massachusetts with 24.52 companies receiving VC investments per 10,000 business establishments. California greatly outpaced the other three states in the top five, Washington (7.81), Maryland (7.01), and Colorado (6.78).

Companies receiving VC per 10,000 firms: 2000–2012



Companies receiving venture:
Capital investment per 10,000 firms, Top 10 states, 2000–2012



Sources: PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report on data from Thomson Reuters

Increase in Number of Companies Receiving VC Investment

Definition

Growth in the number of companies receiving venture capital investment was calculated by comparing the number of companies that received VC funding in 2011 to the number in 2012. This variable takes into consideration all firms, small and large, that received any VC funding. Data is provided by the PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report, based on data from Thomson Reuters.

Why Is It Important?

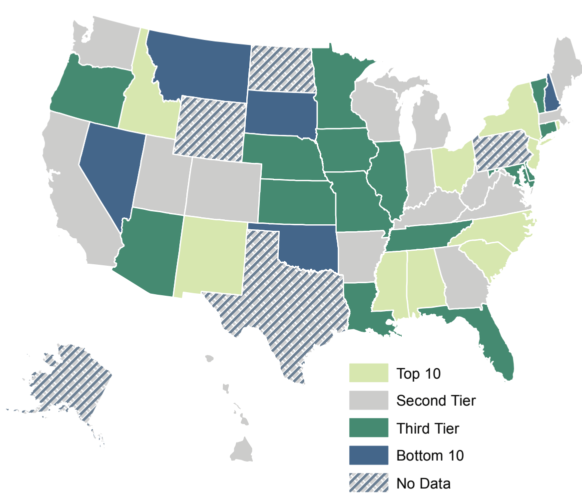
This component allows stakeholders to measure the momentum of this form of risk capital flowing to companies. Growth trends reflect how those companies' prospects are perceived by the leading class of risk capitalists. In this latest index, the number of companies receiving venture capital investment in the United States increased by 180 percent from 2011 to 2012.

This indicator differs from that for Total VC Investment Growth. Instead of measuring the amount of venture capital disbursed, it looks at the level of participation among a given state's firms in the competition for VC investment and whether its momentum is increasing or decreasing. This indicator illustrates the relative level of potential that the marketplace has assigned to that state's businesses as measured by investors' willingness to take risks there.

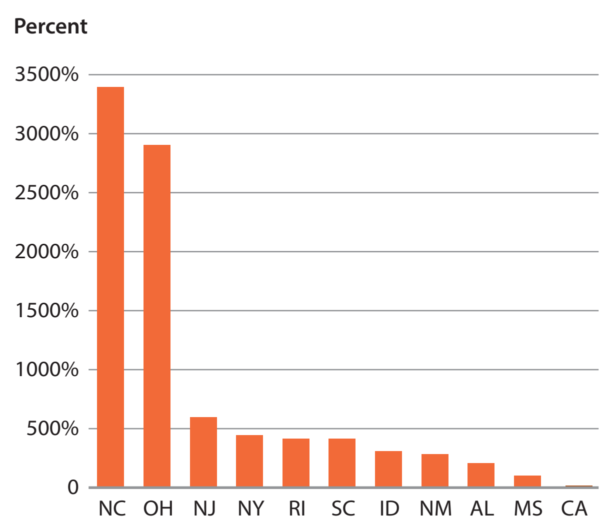
Increase in Number of Companies Receiving VC Investment and California

California experienced a 6 percent increase in the number of companies receiving VC investments, jumping six places to rank 17th. In the 2010 index, only the top nine states experienced growth in this measure as the economic downturn wreaked havoc across the country. In the 2013 index, the top five states had explosive growth because of their previously low numbers—even small increases registered as large growth rates. The top five were North Carolina (3,400 percent growth), Ohio (2,900 percent), New Jersey (600 percent), New York (458 percent), and Rhode Island tied with South Carolina (both 400 percent). These spikes prove that as the economy improves, venture capitalists will look for new investments.

Increase in number of companies receiving VC: 2011–2012



Increase in number of companies receiving VC investment:
Top 10 states and California, 2011–2012; California ranked 17th



Sources: PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report on data from Thomson Reuters

Venture Capital Investment as Percent of GSP

Definition

The indicator for venture capital investment as a percentage of gross state product is calculated by dividing the dollar amount of each state's venture capital investments by its respective GSP. Monitoring VC investment as a percentage of GSP allows us to analyze VC's flow and strength in terms of the total state economy. VC data are from PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report based on data from Thomson Reuters. GSP data are collected by the U.S. Department of Commerce.

Why Is It Important?

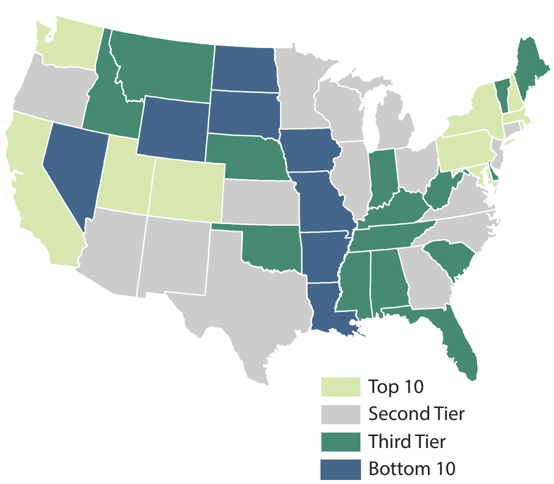
The proportion of a state's GSP that comes from VC investment reflects the degree to which risk capital figures into the value of a state's overall economic output. The indicator is a proxy of how adventuresome a state's economy is. In 2012, venture capital's share of the nation's GDP was 0.1 percent, based on a total of $27 billion in VC investments made across all the states. This percentage was heavily skewed by the top three states, which scored above the average by wide margins. This VC concentration may stem from the riskiness of the projects themselves as well as speculative investment being reined in due to economic uncertainty.

Massachusetts and California attract a disproportionate share of VC investment relative to their GSP, serving as a reminder that states eager to foster dynamic high-tech economies should carefully consider the catalytic role of risk capital finance.

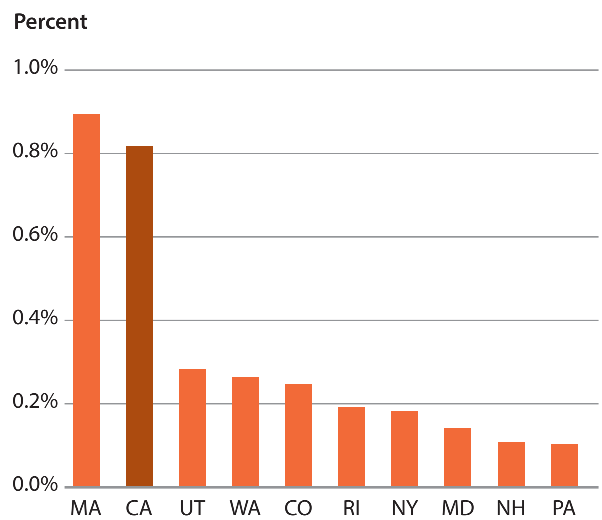
VC Investment and California

California performed well in this measure, with VC investment making up 0.82 percent of GSP. California's performance continues to improve from 0.59 percent in the 2010 index. California ranked second after Massachusetts, where venture capital made up 0.89 percent of GSP. The remaining three states in the top five lag far behind the leaders, with Utah at 0.29 percent of GSP, Washington at 0.26 percent, and Colorado at 0.247 percent. As venture capitalists turn to emerging markets in Europe and Asia, Massachusetts and California may have to work harder to continue attracting venture capital.

Venture capital investment as percent of GSP: 2012



Venture capital investment as percent of GSP:
Top 10 states, 2012



Sources: PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report on data from Thomson Reuters

SBIC Funds Disbursed per $1,000 of GSP

Definition

The indicator for the average annual Small Business Investment Company program funds disbursed per $1,000 of GSP is calculated by taking the annual average of all SBIC funds invested in 2008, 2009, and 2010, and dividing that amount by each state's GSP times 1,000. Program data are collected by the Small Business Administration (SBA). GSP figures are collected by the U.S. Department of Commerce. The SBIC program was created in 1958 by Congress as a facilitating agency between lenders and borrowers.

Why Is It Important?

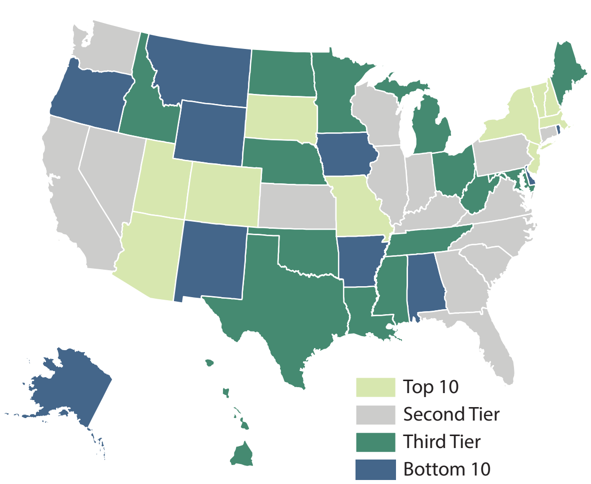
SBICs are business incubators that provide services to small businesses such as financial capital or management consulting. Backed by the SBA, the incubators operate like venture capitalists; their goal is to identify profit potential in small businesses and fund those companies in hopes of high returns on investment. While almost 70 percent of venture capital dollars go to high-tech and life science industries, this program invested heavily in small-business manufacturing. More than half of VC investments are made in California and Massachusetts, but the SBIC program invested more than 70 percent in other states that are often starved for investment capital.[6] On average, 12 cents in SBIC funds are disbursed for every $1,000 of GDP—about a third less than a decade ago.

SBIC funding represents a bridge between government and the private sector. First, it provides government funding to support small enterprises. Second, this funding fills a gap in access to capital, since small businesses may not be able to tap into financial markets on their own. Although some may debate the proper role of government in these contexts, the fact remains that small businesses are supported by the SBIC program and in return contribute to state and national economies.

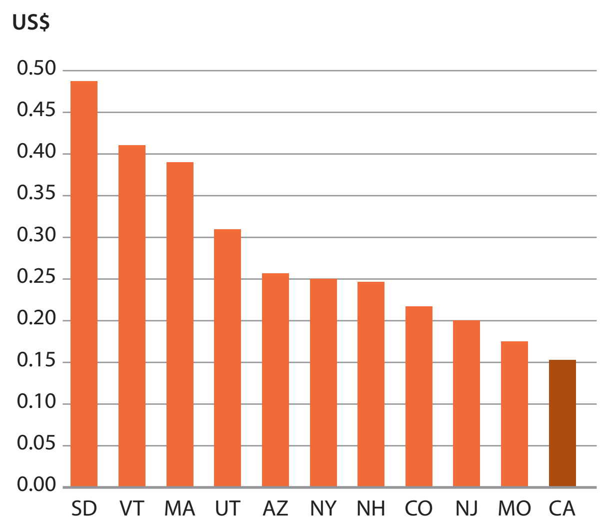
SBIC Funds and California

With $0.15 of SBIC funds disbursed per $1,000 of GSP, California ranked 13th in this measure, losing ground since the index in 2008 when California ranked eighth. California did climb one spot from 14th in the 2010 index. The top states in this measure were South Dakota ($0.49), Vermont ($0.41), Massachusetts ($0.39), Utah ($0.31) and Arizona ($0.26).

Average annual SBIC funds disbursed per $1,000 of GSP:
2008–2010



Average annual SBIC funds disbursed per $1,000 of GSP:
Top 10 states, 2008–2010; California ranked 13th



Sources: PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report on data from Thomson Reuters

6. Hollis A. Huels, National Association of Small Business Investment Companies, June 10, 2009, http://www.nasbic.org/resource/resmgr/files/holly__huels-small_business.pdf (accessed March 9, 2011).

Business Incubators per 10,000 Establishments

Definition

The number of business incubators per 10,000 business establishments is calculated by determining the total number of incubators in each state and dividing by that state's population of business establishments, tallied in increments of 10,000. Data on the number of incubators are provided by the National Business Incubation Association (NBIA). Although the NBIA data set is the most accurate, the association estimates that it may account for only half of all U.S. incubators, so the reported figures are likely conservative. Data on the number of business establishments by state are collected by the U.S. Census Bureau.

Why Is It Important?

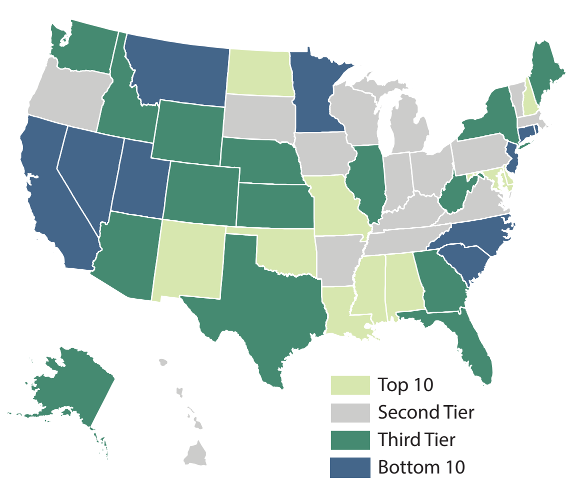
Business incubators provide embryonic businesses with guidance and resources that assist company formation and growth. They provide "hard" assets, such as office facilities and equipment, as well as "soft" assets, such as assistance services, and financial and management consulting. The right incubator aid can make a critical difference to companies that otherwise would not survive on their own.

According to the latest NBIA statistics, nearly 454 business incubators were operating in the United States in 2013, or an average of roughly 0.73 incubator per 10,000 business establishments. States with increasing numbers of business formations should appreciate the importance of incubators.

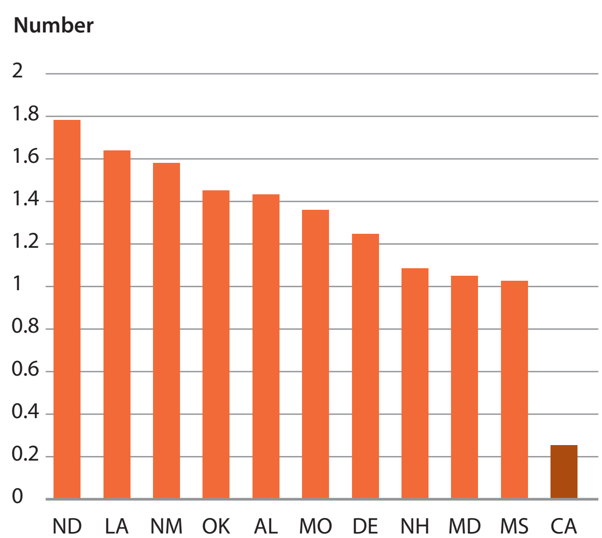
Business Incubators and California

California remains in the bottom 10 states, ranking 47th with 0.24 incubator per 10,000 business establishments, about one-third of the national average of 0.72. California has fallen drastically since the 2002 index, when the state ranked fourth with 2.56 incubators per 10,000 establishments. The top five states in this measure are North Dakota (1.78), Louisiana (1.65), New Mexico (1.60), Oklahoma (1.45), and Alabama (1.43). Interestingly, the top five are not knowledge-intensive states. A possible explanation is that these states are increasingly showing support for innovative businesses, while states with more mature tech sectors such as California and Washington use incubators less.

Business incubators per 10,000 business establishments: 2013



Number of business incubators per 10,000 business establishments: Top 10 states and California, 2013; California ranked 47th



Sources: National Business Incubation Association, U.S. Census Bureau

Patents Issued per 100,000 People

Definition

This indicator is calculated by determining the number of patents, assigned and unassigned, issued to individuals in a state and then dividing that sum by the respective state's population (in increments of 100,000 residents). Patent documents included in this indicator are utility, design, plant, and reissue patents; defensive publications; and statutory invention registrations. Most patents granted in the United States are utility patents, or patents for invention. The U.S. Patent and Trademark Office collects patent data, while state population figures are collected by the U.S. Census Bureau.

Why Is It Important?

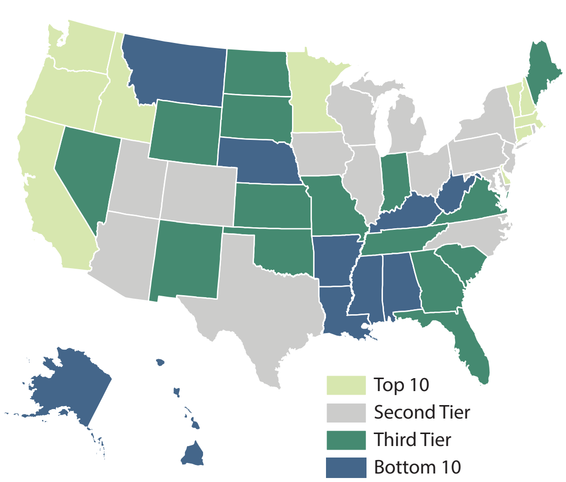
Patents are granted by the Patent and Trademark Office (PTO), a division of the U.S. Department of Commerce. Innovation and scientific advancement are protected through patents by prohibiting others from making, using, or selling the invention. The term of a new patent is 20 years from the time the application was filed.

When averaged out for a state's population, the number of patents issued serves as a measure for how innovative and commercially prepared the residents of a given state are. About 108,500 patents were issued in the United States in 2011; on a national basis, that comes out to 29 patents for every 100,000 people.

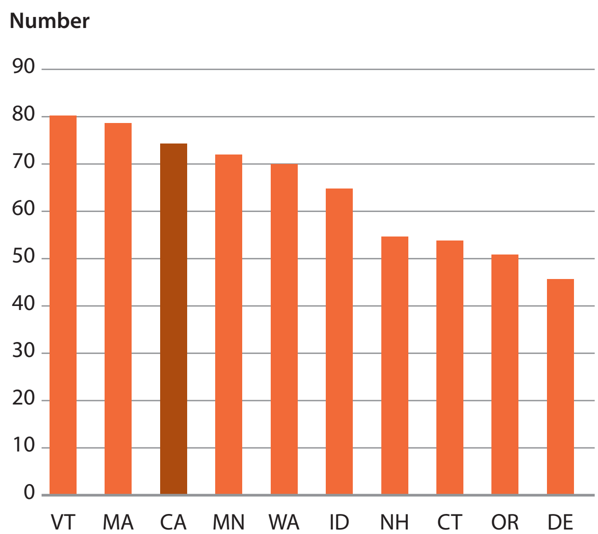
Patents Issued and California

California is again in the top three in this category, moving back to third after a fifth-place finish in the 2010 index. With a score of 74.68, California more than doubles the national average. Vermont (80.46) took first place followed by Massachusetts (78.80), California, Minnesota (72.22), and Washington (69.79).

Figure 1. Patents issued per 100,000 people: 2011



Number of patents issued per 100,000 people:
Top 10 states, 2011



Source: U.S. Patent and Trademark Office

Net Business Starts per 100,000 People

Definition

This indicator is calculated by finding the difference between employers recorded by the U.S. Census Bureau, Small Business Administration, and U.S. Department of Labor at the end of fiscal year 2010 and those recorded at the end of FY 2011. The totals for each state are then divided by 100,000 increments of the state's population. The figure encompasses businesses with at least one employee that began operation during the time period evaluated. The U.S. Census Bureau collects the states' population figures.

Why Is It Important?

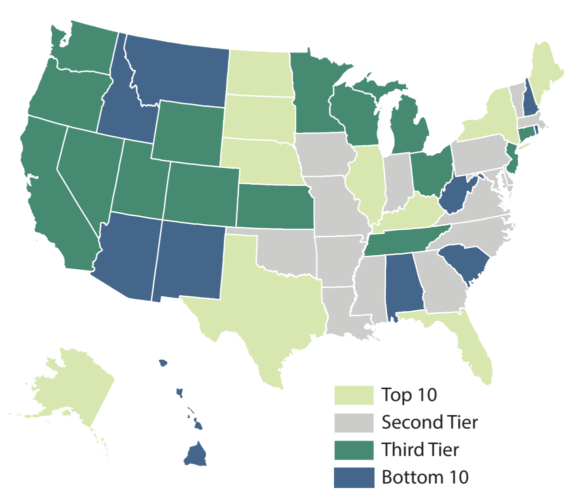
Net business starts represent one of the clearest measures of a state's entrepreneurial dynamism. When considered in relation to a state's population, additional layers of meaning concerning a state's overall economic creativity emerge, including factors such as a population's commercially adventuresome spirit and optimistic expectations. A state's performance in new firm formation also reflects on its ability to attract financial resources, tolerate risk, and create new jobs.

From 2009 to 2010, there were 65,486 fewer business starts in the United States, for an average decline of 13.67 per 100,000 people. This number continues to plummet since the 2004 State Technology and Science Index, when the average was around 300.

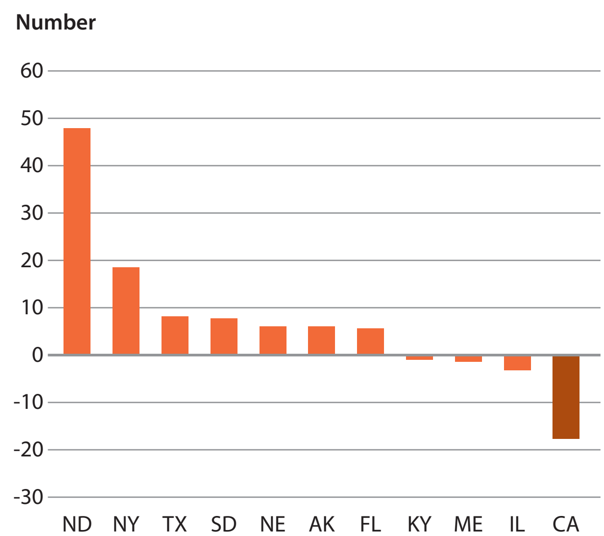
Net Business Starts and California

California has seen a precipitous drop in business starts, falling from second place in 2010 to 23rd in 2012 and 29th in 2013. In 2012, the state posted an average of -17.21 starts per 100,000 people, and in 2013 an average of -17.75. This suggests that high unemployment and a sluggish economy prompted many Californians to start their own businesses, adding competition that some companies, new or old, could not survive. The leaders in this measure are North Dakota (48.03), New York (18.84), Texas (7.98), South Dakota (7.84), and Nebraska (6.17).

Net number of business starts per 100,000 people: 2010-2011



Net number of business starts per 100,000 people:
Top 10 states and California, 2010-2011; California ranked 29th



Source: Small Business Administration, U.S. Census Bureau

IPO Proceeds as Percent of GSP

Definition

The indicator for initial public offering (IPO) proceeds as a percentage of gross state product is calculated by totaling the dollar amount raised in each state by companies that issued publicly traded shares in an initial offering in 2009–2011. These figures are then divided by the corresponding state's GSP. An IPO is a company's first sale of stock to the public. Selling shares to the public allows companies to raise capital to meet corporate goals and for risk capitalists to cash in on their investment. IPO data are provided by the Securities Data Corporation and Thomson Financial. GSP figures are collected by the U.S. Department of Commerce.

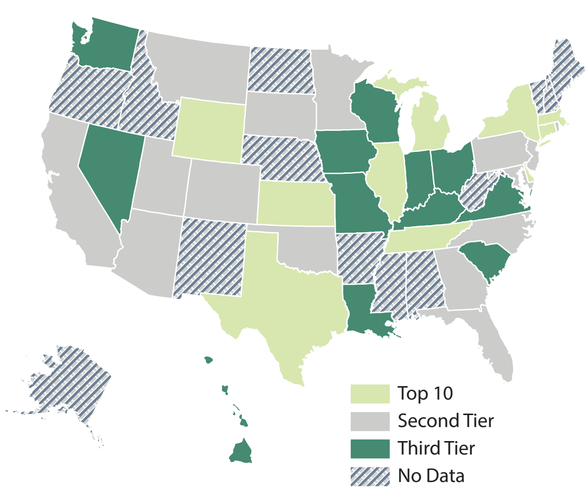
Why Is It Important?

An IPO occurs when a company decides to sell shares of its common stock to the public. Companies that go public typically demonstrate a proven record of revenue or sales and, as is increasingly the case, exciting new technologies. For 2010–2011, average IPO proceeds represented 0.22 percent of the national gross domestic product, and total IPO proceeds were more than $106 billion.

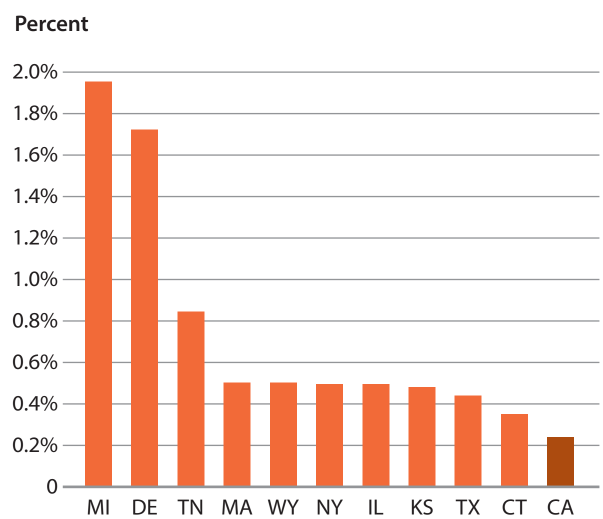
IPO Proceeds and California

California's IPO proceeds represent 0.23 percent of its GSP for a ranking of 15th. In 2010's index, the state ranked 16th with IPO proceeds at 0.18 percent of GSP. Although California is home to many leading high-tech firms, its position has consistently weakened in this measure since the index began in 2002, when the state ranked fourth with IPO proceeds at 0.90 percent of GSP. The top five states in this measure were Michigan (1.86 percent), Delaware (1.64), Tennessee (0.81), Massachusetts (0.48), and Wyoming (0.48)

IPO proceeds as percent of GSP: 2009–2011



IPO proceeds as percent of GSP:
Top 10 states and California, 2009–2011; California ranked 15th



Sources: Security Data Corporation, Thomson Financial, Milken Institute, U.S. Bureau of Economic Analysis

VC Investment in Nanotechnology per $1,000 of GSP

Definition

This is calculated by adding up the dollar amount of investment in each state by all companies that fit Thomson Financial's nanotechnology definition from 2009 to 2011. (Nanotechnology concerns the design and manufacturing of electronic circuit and mechanical devices at the molecular level. These are often measured in atomic units and have the potential to revolutionize engineering and biomedical sciences.) The three-year total is divided by each state's GSP for the same period, and then multiplied by 1,000. The U.S. Department of Commerce provides GSP figures.

Why Is It Important?

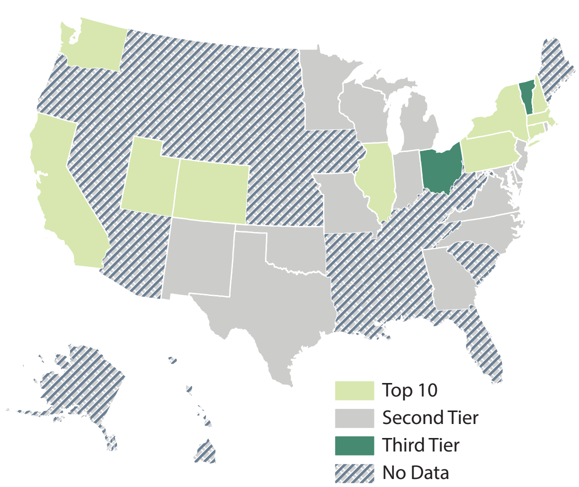
Nanotechnology enables greater utility and portability of computers and other electronics. Total venture capital invested in this area amounted to some $2.6 billion for 2009–2011. California captured the lion's share—about 24 percent, or $621 million.

Private funds for nanotechnology were added to the State Technology and Science Index in 2008. This component serves to highlight and complement academic R&D in engineering, including nanotechnology. The federal government is highly involved in nanotechnology because of the potential for environmental, medical, and military applications.

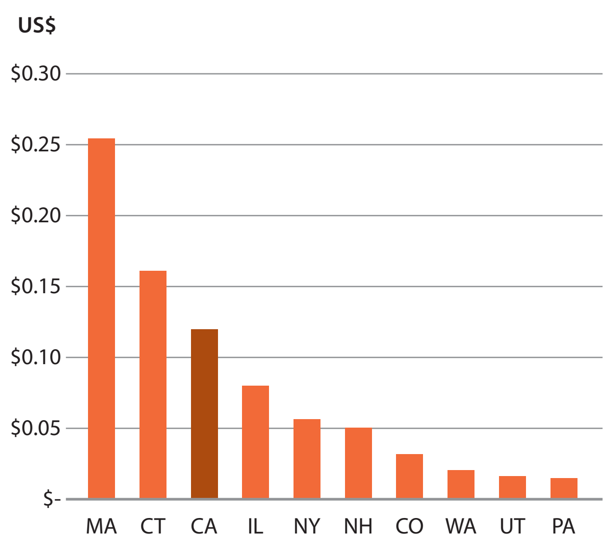
VC in Nanotechnology and California

California maintained its third-place ranking, with $0.12 of VC investment in nanotechnology per $1,000 of GSP. The data were not available for the 2010 index, but in the 2008 index California ranked third in the measure, with $0.37 of VC investments in nanotechnology per $1,000 of GSP. Massachusetts was the leader, with $0.26, followed by Connecticut ($0.16), California, Illinois ($0.08), and New York ($0.06). California has universities and research institutions that can be leveraged for innovative research in nanotechnology.

VC investment in nanotechnology per $1,000 of GSP:
2009–2011



VC investment in nanotechnology per $1,000 of GSP:
Top 10 states, 2009–2011



Sources: Thomson Financial, U.S. Bureau of Economic Analysis

VC Investment in Clean Technology per $1,000 of GSP

Definition

Clean tech seeks to minimize environmental damage from human activity and energy use and to improve the productivity and responsible use of natural resources. Clean technology refers to renewable energy sources like wind turbines, solar panels, and waste-to-energy enclosures, as well as improving conventional methods with techniques like coal gasification.

This indicator is calculated by totaling the dollar amount of venture capital investment in clean technology over the period 2009–2011, and then dividing by the corresponding GSPs. VC data are provided by Thomson Financial in its One Banker product. The U.S. Department of Commerce collects GSP figures.

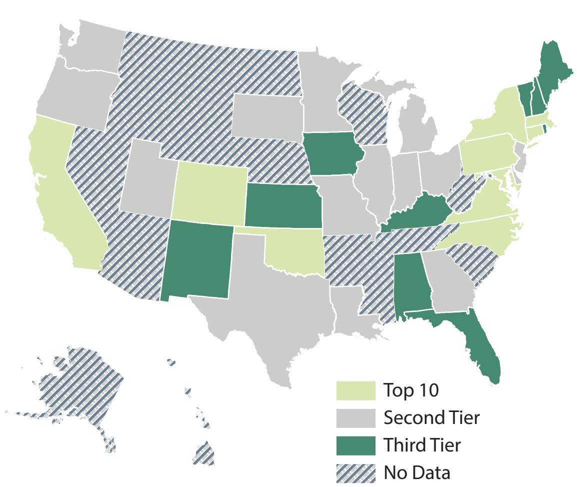
Why Is It Important?

Investments in clean technology and nanotechnology are indications of a state's openness to new ideas. They represent a cutting-edge mentality and serve as a measure of each state's willingness to accept risks and take new ideas to commercialization. The strength of a state's clean-technology policy is also indicative of a progressive mind-set.

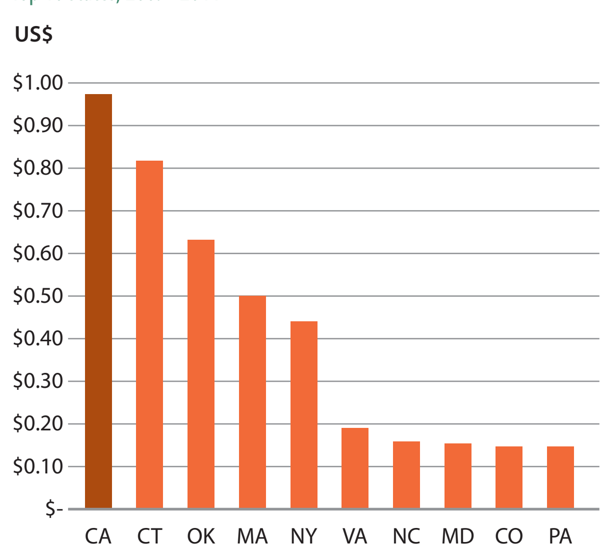
VC in Clean Technology and California

California ranked first with $0.97 in VC investment in clean technology per $1,000 of GSP, over six times the national average of $0.14. California placed third in VC investment in clean technology with $0.31 per $1,000 of GSP in the 2008 index; 2010 was not updated due to data release dates. The other states in the top five were Connecticut ($0.82), Oklahoma ($0.63), Massachusetts ($0.51), and New York ($0.44). In contrast to the 2008 index, when several states ranked at the top because of their abundant wide-open spaces for wind turbines and solar paneling, the 2013 index has more urban states dominating the top rankings.

VC investment in clean technology per $1,000 of GSP:
2009–2011



VC investment in clean technology per $1,000 of GSP:
Top 10 states, 2009–2011



Sources: Thomson Financial, U.S. Bureau of Economic Analysis

Sum of equity invested in green technology per $100,000 of GSP

Definition

This indicator was first included in the 2010 State Technology and Science Index. Green technology seeks to improve methods, techniques, and use of materials that are environmentally friendly to conserve natural resources, increase efficiencies, and reduce waste and pollution from production and consumption. Green technology refers to investments in sustainable products and processes; alternative fuels and new means of generating energy and increasing energy efficiency are examples.

This indicator is calculated by totaling the dollar amount of venture capital investment in green technology in 2011, then dividing by the corresponding GSPs. VC data are provided by Thomson Financial in its One Banker product, while the U.S. Department of Commerce collects GSP figures.

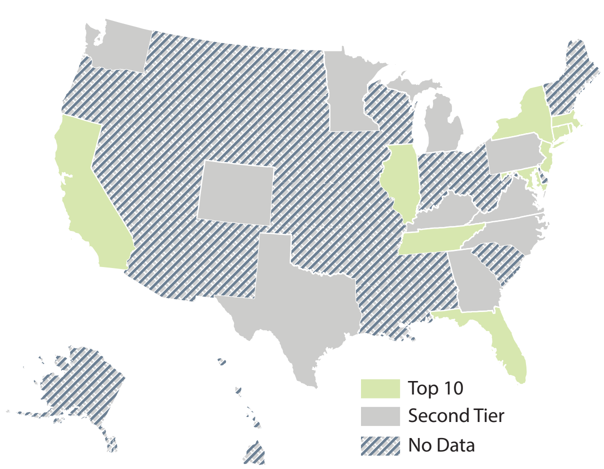
Why Is It Important?

Investments in green technology indicate that a state is open to new ideas and innovation and willing to take the risks involved in creating environmentally friendly products. These investments also reveal an awareness that depletion of natural resources and unsustainable practices harm society as well as the environment. The technology is uncertain and untested, and the state and federal tax credits that subsidize it are volatile. A state that encourages green technology through policies and incentives is able to attract larger amounts of VC investment.

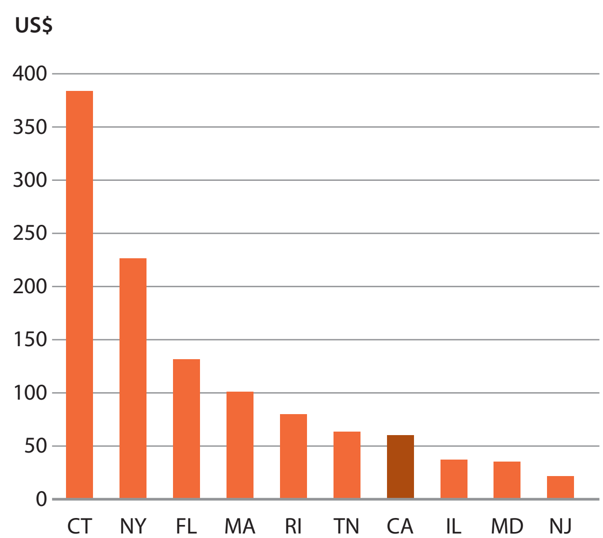
Investment in Green Technology and California

California fell five places from second in 2010 to seventh in the 2013 index. California invested $59.64 in green technology per $100,000 of GSP, half of what was spent in the 2010 index and equivalent to the national average of $58.16. The other states in the top 10 are Connecticut ($382.23), New York ($225.14), Florida ($132.24), Massachusetts ($100.89), Rhode Island ($79.03), Tennessee ($64.10), Illinois ($37.38), Maryland ($34.51), and New Jersey ($20.74). Most of these top states have aggressive policies such as credits and funding that attract investments and innovation in this field.

Sum of equity investments in green technology per $100,000 of GSP: 2011



Sum of equity investments in green technology per $100,000 of GSP, Top 10 states: 2011



Sources: Thomson Financial, U.S. Bureau of Economic Analysis

Human Capital Investment Composite Index

Definition

The third major index measuring each state's position in technology and science is the Human Capital Investment Composite Index. This composite is made up of 18 indicators that comprehensively assess a state's human capital attainments, especially in science and engineering fields. The composite index is calculated by totaling each state's scores (which are based on rankings) and dividing by the number of indicators. Data are collected from a variety of sources and compiled by the Milken Institute.

Why Is It Important?

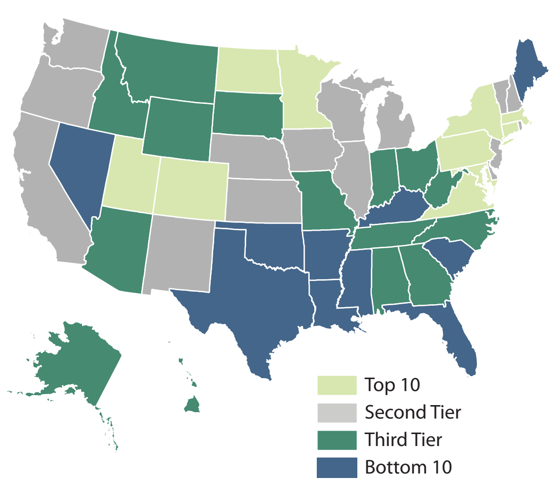
Human capital is arguably the most critical intangible asset of a knowledge-based economy. A state's depth of talent attracts and retains commercial firms, financing, and research organizations. Human capital offers a state the latent creative capacity to build and grow firms indigenously as well. In the high-technology sector, workers educated in science and engineering are especially in demand.

This index assesses such factors as the percentage of the population with advanced degrees, the percentage educated in science and engineering, state support of higher education, average college entrance exam performance, and the diffusion of key information technologies among the population at large. States that score well in this index have succeeded by nurturing a proportionally large base of highly trained people.

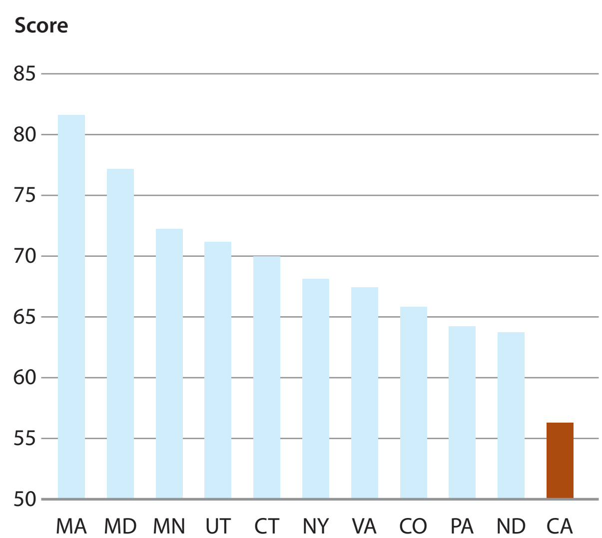
Human Capital Capacity and California

California has dropped six places from 2010, when it posted a score of 60.67 and 14th ranking overall. In this index, the state scored 56.29 and fell to 20th. This continues a downtrend that dates to the start of the index. If funding for higher education rebounds from recent budget cuts, the state could leverage its world-renowned universities to improve its performance in this measure. The following sections break down this component in more detail. The states that make up the top five in this component are Massachusetts (81.52), Maryland (77.24), Minnesota (72.19), Utah (71.14), and Connecticut (69.81).

Human Capital Investment Composite Index: 2013



Human Capital Investment Composite Index:
Top 10 states and California, 2013; California ranked 20th



Source: Milken Institute

Percentage of Population with Bachelor's Degrees

Definition

This indicator provides a broad measure of higher educational attainment by a state's population. It is calculated by adding up the number of residents 25 and older with qualifying degrees and dividing that figure by the state's entire population in that age group. This demographic cohort was selected because current trends show that people are either starting college at a later age or taking longer than the traditional four years to complete a bachelor's degree. The U.S. Department of Education provides bachelor's degree data. The U.S. Census Bureau provides population numbers.

Why Is It Important?

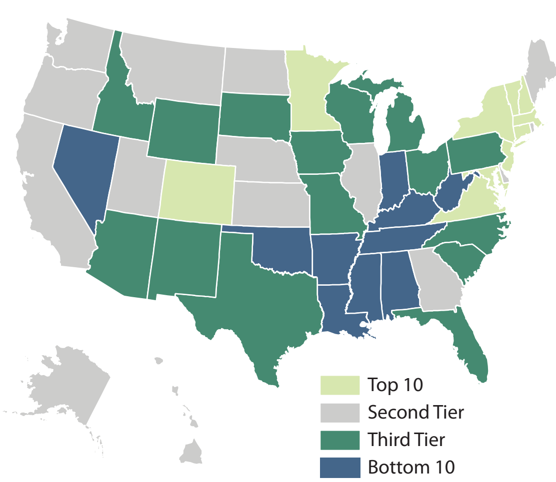
A well-educated population is vital for supporting a state's science and technology assets. There are additional benefits as well: Better-educated workers tend to earn higher wages that support state finances and feed into the marketplace. A bachelor's degree represents the first rung on the ladder of advanced learning that is required for much of the high-end work in a knowledge-based economy.

The latest available figures indicate that a quarter of all people in the United States 25 and older have bachelor's degrees. Twenty-two states meet or exceed the national average. The need for suitable human capital can be addressed by providing an adequate education to state residents or importing talent from outside. All states engage in both approaches to some extent.

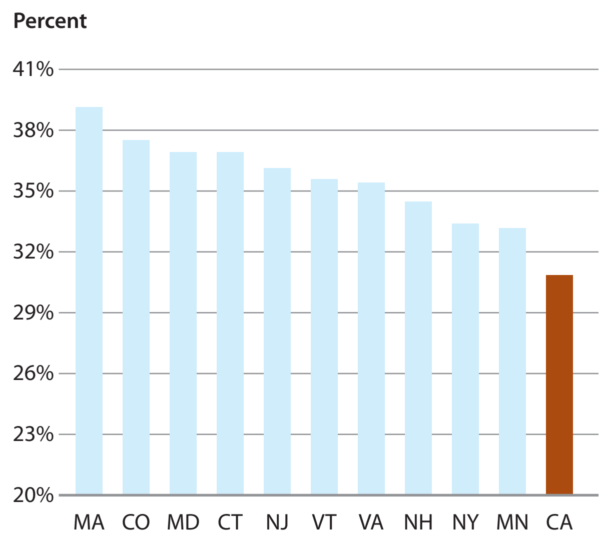
Bachelor's Degrees and California

California was able to increase its score slightly after hitting an all-time low in the index in 2010. With 26.46 percent of California's population 25 and older holding at least a bachelor's degree, the state ranked 16th overall in 2010. In the 2013 index, California improved its score to 30.84 percent, ranking 14th overall. California is slightly above the national average, 28.44 percent. Since 2008, the soft job market has encouraged more students to seek higher education in hopes of improving their prospects for employment. California could benefit by encouraging more high school students to take advantage of the state's strong university system. The top five states are Massachusetts (39.20 percent), Colorado (37.54 percent), Maryland (37.04 percent), Connecticut (36.99 percent), and New Jersey (36.26 percent).

Percentage of population age 25+ with bachelor's degree or higher: 2012



Population age 25+ with bachelor's degree or higher: Top 10 states and California, 2012; California ranked 14th



Sources: U.S. Census Bureau, Department of Education

Percentage of Population with Advanced Degrees

Definition

This indicator measures the percentage of the population with a master's degree or higher, including professional degrees and doctorates. It is calculated by totaling the number of people 25 and older with an advanced degree, and then dividing by the total population 25 and older. That age cohort was selected because Americans are taking longer than four years to complete a bachelor's degree and taking more time between completing their bachelor's and starting their advanced degrees. Advanced-degree data come from the U.S. Department of Education. Population numbers are provided by the U.S. Census Bureau.

Why Is It Important?

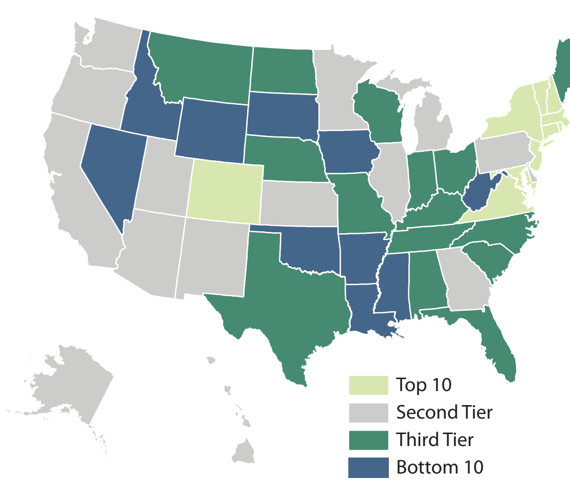
The percentage of the population with advanced degrees is a reliable indicator of a state's capacity to support a knowledge-based economy. Advanced degrees are often an important qualifier for upper-management positions, especially in high-tech fields.

The cost of education is a factor, however, and states eager to cultivate a high-tech economy must consider the impact of student aid and general appropriations for higher education (which we analyzed separately as components of human capital investment). Some 20.2 million Americans hold advanced degrees, for an average of 10.49 percent of all U.S. residents 25 and older. Twenty states exceed the national average.

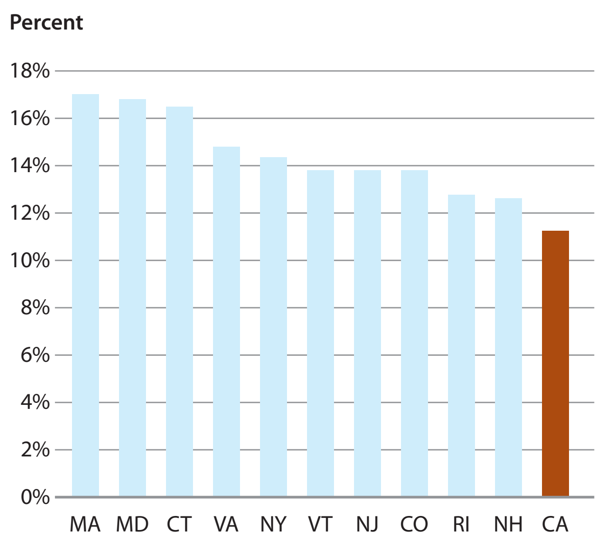
Advanced Degrees and California

California remained ranked at 15th in the 2008, 2010, 2012, and 2013 indexes. In California, 11.25 percent of those 25 and older have an advanced degree, an increase from 9.62 percent in the 2010 index. An outreach program that promotes the state's universities and lucrative job market for advanced degree-holders could help attract talent from around the world. The top five states in this measure remained Massachusetts (17.04 percent), Maryland (16.94 percent), Connecticut (16.55 percent), Virginia (14.87 percent), and New York (14.39 percent).

Percentage of population age 25+ with advanced degrees:
2012



Population age 25+ with advanced degrees:
Top 10 states and California, 2012; California ranked 15th



Sources: U.S. Census Bureau, Department of Education

Percentage of Population with Ph.D.s

Definition

This indicator is calculated by determining the number of residents age 25 and older who have attained a Ph.D., then dividing it by the total population 25 and older. This age cohort was selected because Americans are taking longer than four years to complete bachelor's degrees and taking more time between completing their bachelor's and starting an advanced degree. Ph.D. data come from the U.S. Department of Education. The U.S. Census Bureau provides population numbers.

Why Is It Important?

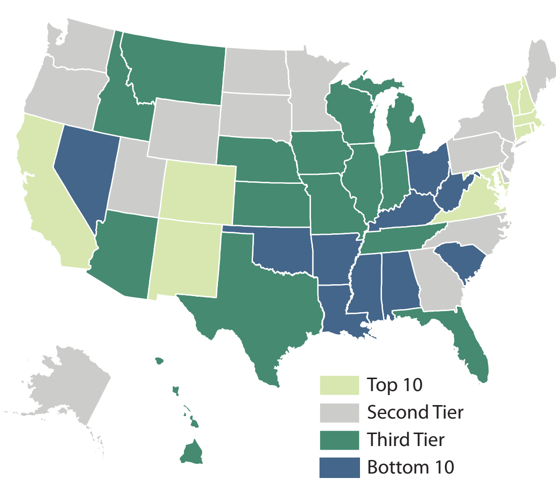
The percentage of a state's population with Ph.D. degrees is another reliable indicator of that state's capacity to support a knowledge-based economy. States with highly educated populations such as Massachusetts and Maryland are well known for their knowledge-intensive economies. Although doctorates are not in wide demand, some jobs in high-technology R&D do require this level of education.

As mentioned, Americans are taking longer to complete degrees than in the past. Part of the reason is systemic, but cost is also a factor. States eager to cultivate a high-tech economy must consider the impact of student aid and appropriations for higher education (also analyzed here as components of human capital investment). About 2.6 million U.S. residents hold Ph.D.s, an average of 1.23 percent of the population age 25 and older. Eighteen states meet or exceed the average percentage.

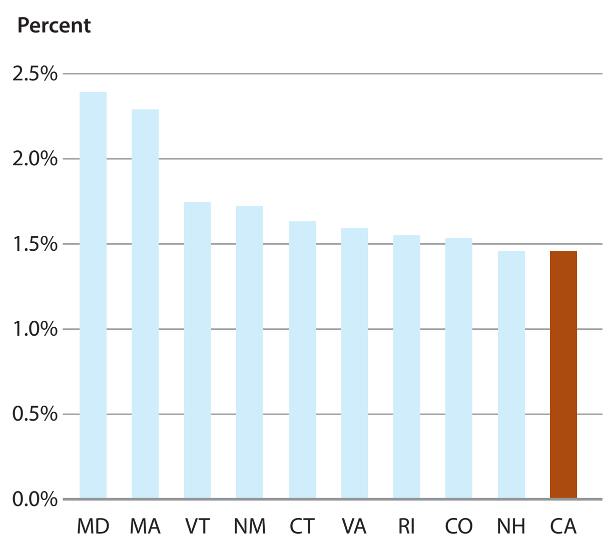
Ph.D.s and California

California was able to crack the top 10 in this measure, performing much better than in bachelor's and advanced degrees. In California, 1.47 percent of those 25 and older hold a Ph.D., placing the state in 10th. California's performance improved from the 2010 index when 1.28 percent of those 25 and older held a Ph.D., but California dropped three places from seventh in 2010 due to increased competition from all of the states. The top five in this measure were Maryland (2.40 percent), Massachusetts (2.29 percent), Vermont (1.76 percent), New Mexico (1.73 percent), and Connecticut (1.63 percent).

Percentage of population age 25+ with Ph.D.s: 2012



Population age 25+ with Ph.D.s: Top 10 states, 2012



Sources: U.S. Census Bureau, Department of Education

Graduate Students in Science, Engineering, and Health

Definition

This indicator quantifies the percentage of graduate students ages 25 to 34 in science, engineering, and health. It measures the degree to which a state is training people with skills specific to those fields. The indicator is calculated by taking the number of individuals in that age cohort enrolled in each state's science, engineering, and health graduate studies programs and dividing that number by each state's population of 25- to 34-year-olds. Graduate students have a bachelor's degree and are pursuing a master's or Ph.D. Data on the number of students in graduate schools in those fields are collected by the NSF's Experimental Program to Stimulate Competitive Research. Population numbers are from the U.S. Census Bureau.

Why Is It Important?

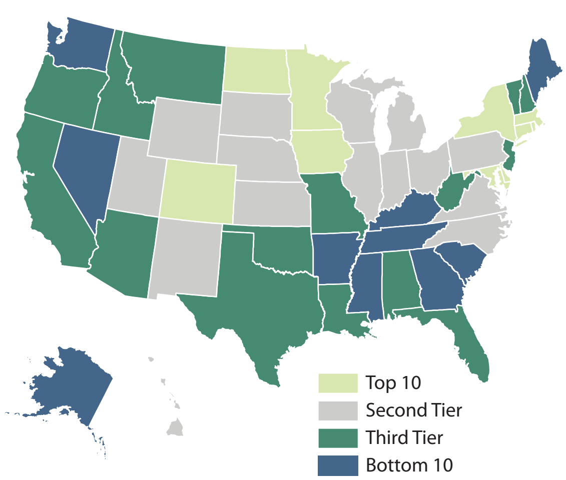
Counting graduate students in science, engineering, and health provides one of the more direct indicators of how well a state is preparing its population to work in the high-tech economy. Strong graduate programs are one of the most effective means of attracting high-tech companies to a state.

In 2010 (the most recent data available), 1.38 percent was the national average for percentage of 25- to 34-year-olds in science, engineering, and health. Twenty-one states exceeded the national average. Wyoming, at 1.46 percent, came closest to the average among these higher-performing states.

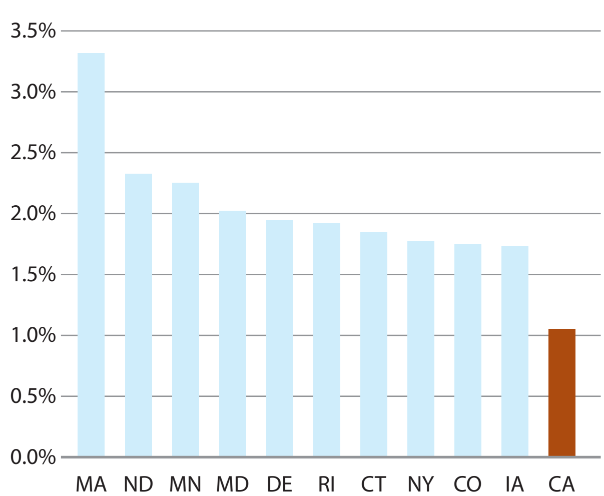
Science, Engineering, and Health and California

California came in below the national average, with 1.07 percent of 25- to 34-year-olds enrolled in science, engineering, and health programs compared with 1.01 percent in the 2010 index. Despite the improved score, the state slid two spots to 39th in the latest calculation. The states that make up the top five are Massachusetts (3.31 percent), North Dakota (2.32 percent), Minnesota (2.24 percent), Maryland (2.02 percent), and Delaware (1.95 percent). Science, engineering, and health programs form the foundation for high-tech development, so stable growth in workers educated in these areas is necessary for a state to be competitive.

Percentage of graduate students in science, engineering, and health, ages 25–34: 2010



Percent of graduate students in science, engineering, and health, 25-34 age cohort: Top 10 states and California, 2010
California ranked 39th



Sources: EPSCoR, U.S. Census Bureau

Per Capita State Spending on Student Aid

Definition

Per capita state spending on student aid is calculated by taking the total amount spent by each state on student aid and dividing by the state's total population. Student aid is defined as funds spent by a state on any form of financial assistance for a student to attend its colleges, universities, or research institutions. Data on student aid come from the National Science Foundation's EPSCoR division. The U.S. Census Bureau collects population figures.

Why Is It Important?

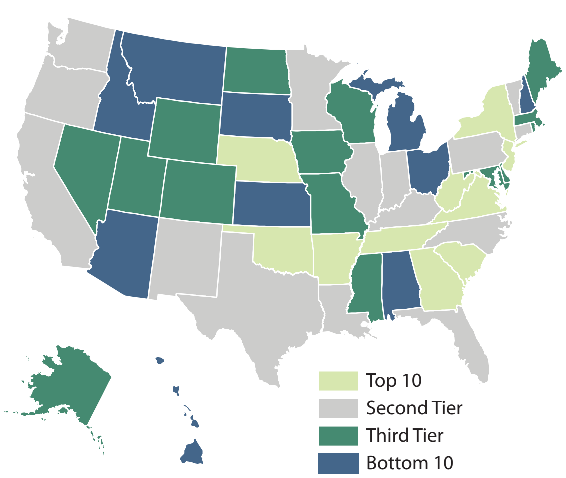
State-sponsored financial aid can open the door to higher education. State student aid typically complements federal forms of financial assistance. As with any human capital resource, states must compete with one another for talent. State-sponsored student aid is one of many factors that can encourage advanced learning and attract out-of-state talent to contribute to a knowledge economy.

State spending on student aid per capita can provide a useful gauge of commitment to facilitating access to higher education. In 2012, $11 billion was spent by the 50 states on student aid, for an average of $31.27 per U.S. resident. Twenty-four states provide aid that tops the national average.

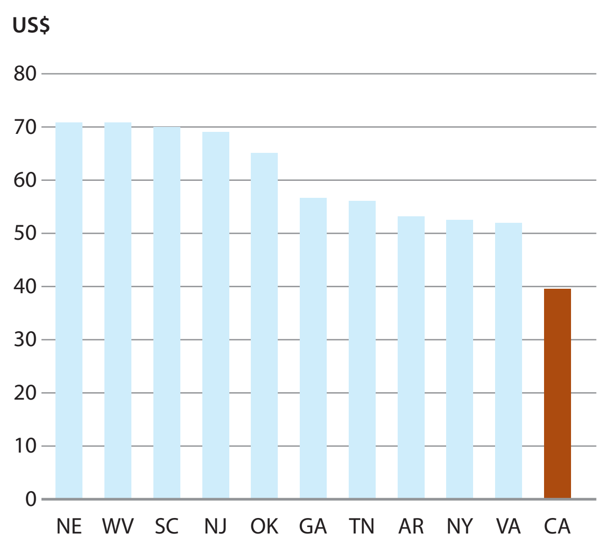
Student Aid Spending and California

California spends $39.31 per capita on state sponsored student aid, an increase of nearly 60 percent since the 2010 index. This increase helped California jump seven places to rank 18th, up from 25th in the 2010 index. If funding levels for student aid do not increase to match tuition increases, the state could suffer major declines in human capital components like standardized test scores and recent university graduates per capita. The top five states in this measure were Nebraska ($70.93), West Virginia ($70.91), South Carolina ($70.29), New Jersey ($68.91), and Oklahoma ($65.41).

Per capita state spending on student aid: 2011-2012



Per capita state spending on student aid:
Top 10 states and California, 2011-2012; California ranked 18th



Sources: EPSCoR, U.S. Census Bureau

Average Verbal SAT Scores

Definition

This indicator measures each state's average verbal scores on the Scholastic Aptitude Test (SAT), the most widely used form of college admissions testing. The indicator is calculated by averaging the verbal scores reported by each high school in each state. The SAT is composed of three sections, covering verbal (critical reading), math, and writing skills. We focus on the first two sections because of their historical usage. Individually, verbal and math are worth 800 points each, for a maximum combined score of 1,600. SAT data are collected by the Experimental Program to Stimulate Competitive Research at the NSF.

Why Is It Important?

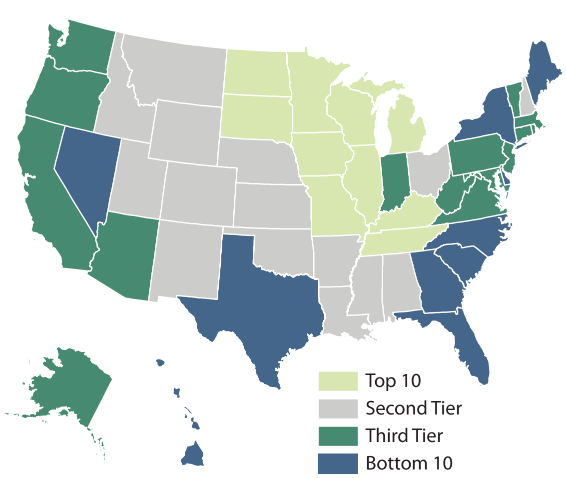
Verbal SAT scores reflect how well a state's high school students are prepared for competitive college admission in terms of reading comprehension and language skills. In states with large university systems—such as California, Florida, and New York—generally 50 percent or more of high school graduates have taken the SAT. Because so many students, including a significant number of first-generation immigrants, take the test, scores tend to be lower in those states. In states such as Iowa, North Dakota, and Wisconsin, where less than 10 percent of all graduates take the SAT, students tend to score higher because of "selection bias" because only high-performing students tend to take the test.

Although the verbal portion of the SAT is not as directly relevant to science and technology fields as the math portion, verbal scores testify to the effectiveness of high school instruction and learning. Verbal skills also relate to an individual's communication and analytical abilities. In 2012, the average verbal SAT score in the United States was 518.

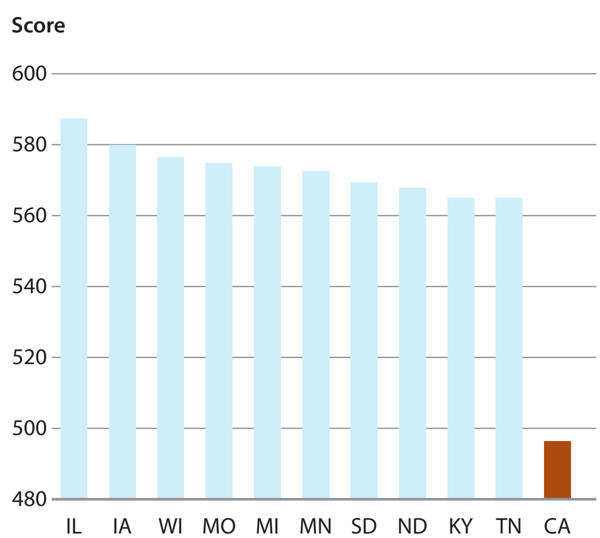
SAT Verbal Scores and California

High school students in California continue to score below the national average, scoring 496 points on the verbal section of the SAT exam. California moved up two rankings to 34th from the 2010 index, and has made great improvements since finishing 46th in the 2004 index. One explanation for its relatively weak performance is its large pool of immigrant test-takers. However, other states such as Arizona and New Mexico with large immigrant test-takers outperform California. Occupying the top five positions were Illinois (587 points), Iowa (580 points), Wisconsin (577 points), Missouri (575 points), and Michigan (574 points).

Average verbal SAT scores: 2012



Average verbal SAT scores:
Top 10 states and California, 2012; California ranked 34th



Source: EPSCoR

Average Math SAT Scores

Definition

This indicator measures how well each state's high school students perform on the math portion of the SAT, the most widely used form of college admissions testing. The indicator is calculated by averaging the math scores reported by each high school in each state. The SAT math section is worth a possible 800 points. Data on SAT scores are collected by EPSCoR, a division of the National Science Foundation.

Why Is It Important?

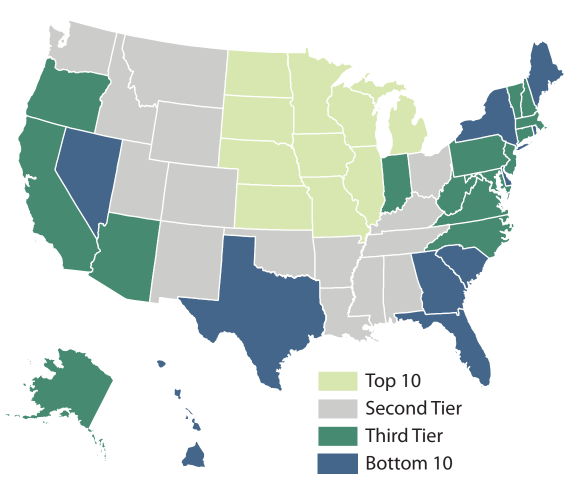
Math SAT scores reflect how well a state's high school students are prepared for competitive college admission in regard to mathematical problem-solving and analysis. High math SAT scores are indicative, to some degree, of the quality and the intensity of algebra, geometry, and general quantitative analysis instruction in each particular state and the ability of its students to master this material. States with large populations and university systems generally don't score as well in this indicator as less populous states do because a more select group of students take the exam in smaller states, although disparities are not as clear-cut as those in the verbal scores.

The aptitudes tested in the math portion of the SAT are directly relevant to science and technology fields. Students anticipating study in any scientific or quantitatively based discipline must possess the fundamental mathematical ability the SAT is designed to measure. The national average for the math SAT score is 539. Twenty-one states meet or exceed this average.

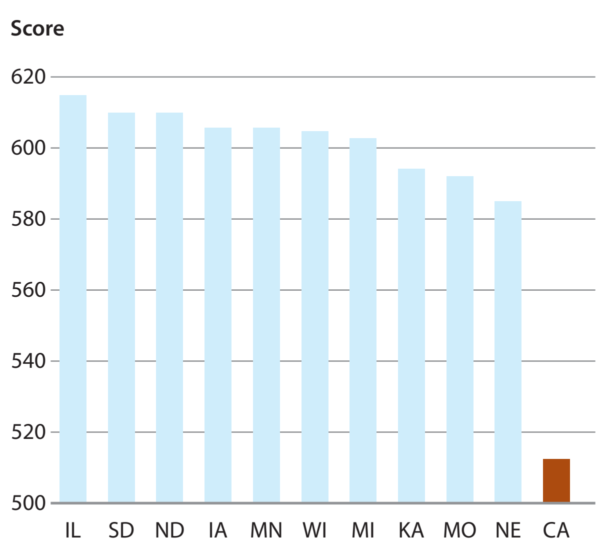
SAT Math Scores and California

California remained ranked 32nd from the 2004 until the 2010 index, but has fallen two positions to 34th in the 2012 and 2013 index. For the first time since 2004, California did not perform better on the SAT math portion but tied its ranking with the SAT verbal portion. California continues to score lower than the national average (539 points) by averaging 512 points. The top five states were Illinois (615 points), South Dakota (610 points), North Dakota (610 points), Iowa (606 points), and Minnesota (606 points).

Average math SAT scores: 2012



Average math SAT scores:
Top 10 states and California, 2012; California ranked 34th



Source: EPSCoR

Average ACT Scores

Definition

The indicator for the average American College Testing Assessment (ACT) scores measures state-based performance in this college admissions test. The indicator is calculated by averaging the composite ACT scores reported by each high school in each state. The ACT is composed of four sections: English, mathematics, reading, and science reasoning. The test is scored on a scale of 1 to 36, with 36 being the highest possible score. ACT score data are provided by EPSCoR.

Why Is It Important?

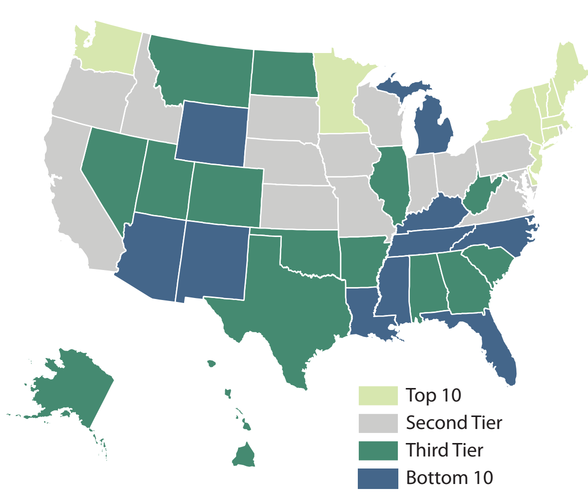
ACT scores, like SAT scores, provide colleges and universities with a means of measuring students' aptitude as well as an instrument to predict academic performance during the student's first year in college. ACT scores provide high schools with a tool to gauge the effectiveness of their curricula in preparing teens for higher education.

Unlike the SAT, the ACT is a curriculum-based exam rather than a psychometric (IQ-type) test. That is, it tests students on their knowledge of specific subjects, not on their aptitude for more broadly defined verbal and quantitative problem-solving. Twenty-five states scored at or above the 2013 national average of 21.4, with Nevada, Montana, Oregon and Nebraska coming closest to the U.S. average.

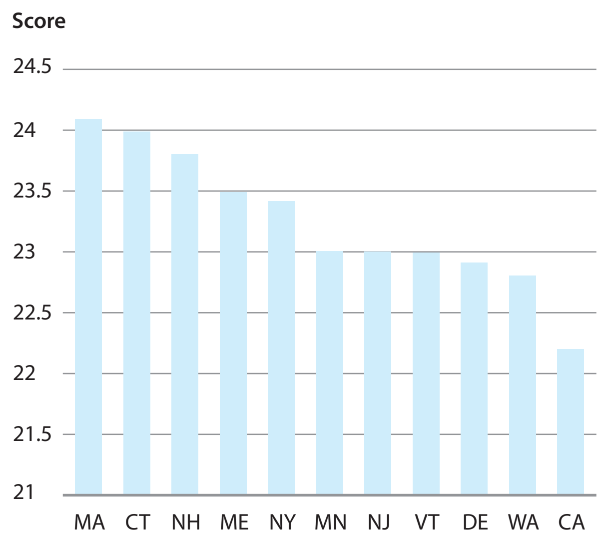
ACT Scores and California

California notched the same ACT average it posted in the 2010 index, 22.2 points. Other states' improved performances pushed California down one place to rank 15th. The ACT is taken less frequently by California students than the SAT, meaning those who take the ACT are a more selective and better-performing group. The top five states in this measure are Massachusetts (24.1 points), Connecticut (24 points), New Hampshire (23.8 points), Maine (23.5 points), and New York (23.4 points).

Average ACT scores: 2013



Average ACT scores:
Top 10 states and California, 2013; California ranked 15th



Source: EPSCoR

State Appropriations for Higher Education

Definition

This indicator is calculated by taking the amount each state spends on higher education and dividing it by state population. Appropriations for higher education include the money spent on faculty and staff wages, building maintenance, athletic programs, and other allocations for the day-to-day operations of colleges and universities. EPSCoR provides state appropriations data, and population numbers come from the U.S. Census Bureau.

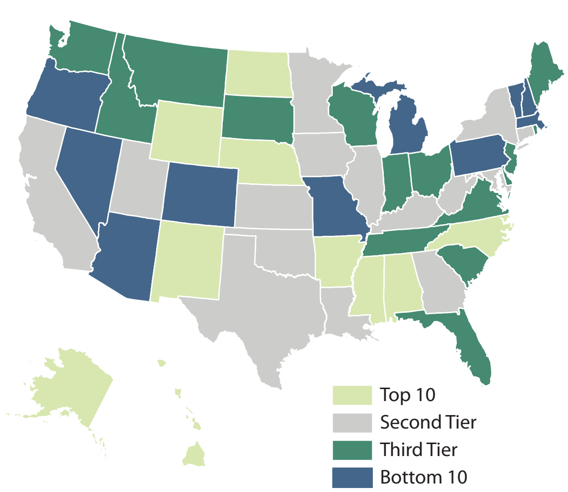
Why Is It Important?

When averaged out on a per capita basis, spending on higher education reveals the extent of each state government's commitment to providing the infrastructure for higher learning. Somewhat similar to an earlier indicator showing state spending on student financial aid per capita, this component focuses on money provided directly to institutions of higher learning. These two measures, taken together, plus an additional indicator for percent change in appropriations for higher education (found on the following page), offer a composite picture of how well a state's government supports higher education. In fiscal year 2012, state appropriations for higher education throughout the United States totaled $72.2 billion, or an average of about $248 per U.S. resident.

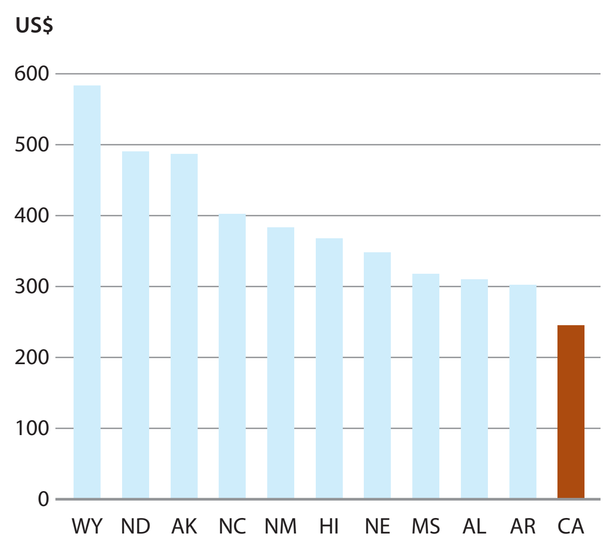
State Appropriations and California

California continues to fall in this ranking, dropping 11 places from the 2012 index to 22nd and spending $246.55 per capita on higher education in 2013. In the 2010 index, the state devoted $295.14 per capita. The state continues to fall behind other states in this measure, perhaps in part because of its budget deficit. The top five states in this measure were Wyoming ($586.37 per capita), North Dakota ($491.64), Alaska ($488.11), North Carolina ($401.41), and New Mexico ($383.10).

State appropriations for higher education: Per capita, 2012



Per capita state appropriations for higher education: Top 10 states and California, 2012; California ranked 22nd



Sources: EPSCoR, U.S. Census Bureau

Percent Change in Appropriations for Higher Education

Definition

This indicator measures increases or decreases in per capita state spending on higher education. The indicator is calculated by taking the amount each state set aside for higher education in 2011 and 2012 and determining upward or downward changes. Appropriations for higher education include the money spent on faculty and staff wages, building maintenance, athletic programs, and various other allocations that pay for the day-to-day operations of a state's colleges and universities. State appropriations data are provided by EPSCoR, and population numbers come from the U.S. Census Bureau.

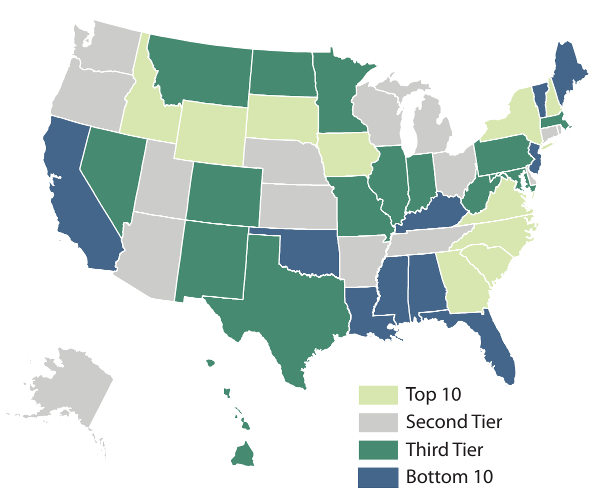
Why Is It Important?

As noted in the previous indicator, appropriations for higher education reveal how much a state's government is committing to providing the infrastructure for higher learning. While the previous indicator gives a static picture of appropriations for a given year, this indicator compares appropriations over the most recent two-year period. Taken in conjunction with the two related indicators (state spending on student aid per capita and state appropriations for higher education per capita), this indicator provides a composite picture of a state's financial commitment to providing advanced education. From 2011 to 2012, the average state increased appropriations for higher education by a bleak 1 percent.

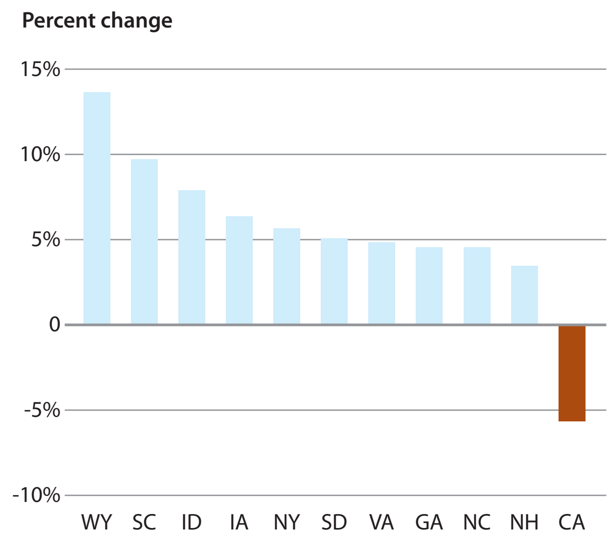
Growth in State Appropriations and California

In the 2012 index California increased appropriations for higher education by 8.45 percent from 2010-2011, ranking seventh. The growth from the 2012 index was not maintainable, and California dropped to rank 48th, decreasing appropriations for higher education by 5.7 percent. For California to preserve a high ranking in this indicator it will need to create sustainable growth slowly over time, but California's budget deficit will continue to challenge the state's commitment to higher education. The top five states in this measure were Wyoming (13.7 percent), South Carolina (9.7 percent), Idaho (7.9 percent), Iowa (6.4 percent), and New York (5.7 percent).

Growth in state appropriations for higher education:
2011-2012



Growth in state appropriations for higher education:
Top 10 states and California, 2011–2012; California ranked 48th



Sources: EPSCoR, U.S. Census Bureau

Doctoral Scientists per 100,000 People

Definition

This indicator measures a state's intensity of scientists who have attained the highest level of formal academic training. It is calculated by totaling the number of doctoral scientists in each state and then normalizing it per 100,000 of each state's respective population. Doctoral scientists are professionals with advanced degrees in such fields as biology, chemistry, physiology, astronomy, physics, and the life sciences. Data come from the Division of Science Resources Studies of the National Science Foundation. Population figures are provided by the U.S. Census Bureau.

Why Is It Important?

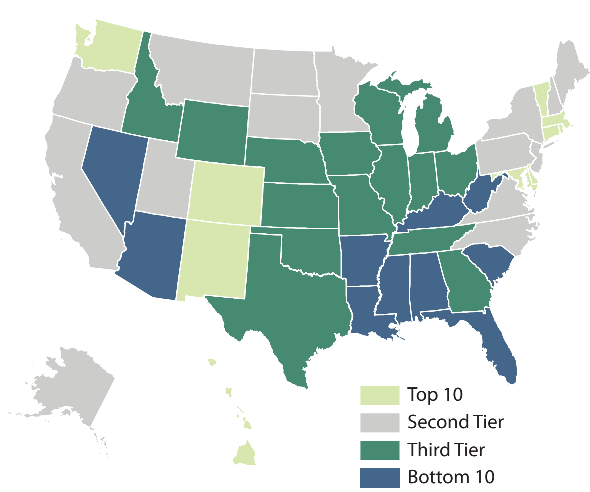
Doctoral scientists operate at the upper end of creative and managerial work in scientific and technological fields. A noticeable presence of such individuals tends to be conducive to high-tech industry innovation, new firm formation, and growth. A labor pool with a sizable number of such highly skilled workers is also attractive to technology firms when they evaluate locations for their high-end operations.

There were about 380,500 doctoral scientists in the United States in 2008 (the most recent statistics available). This represents an average of 124 doctoral scientists for every 100,000 U.S. residents. Twenty-one states exceeded the national average, including California.

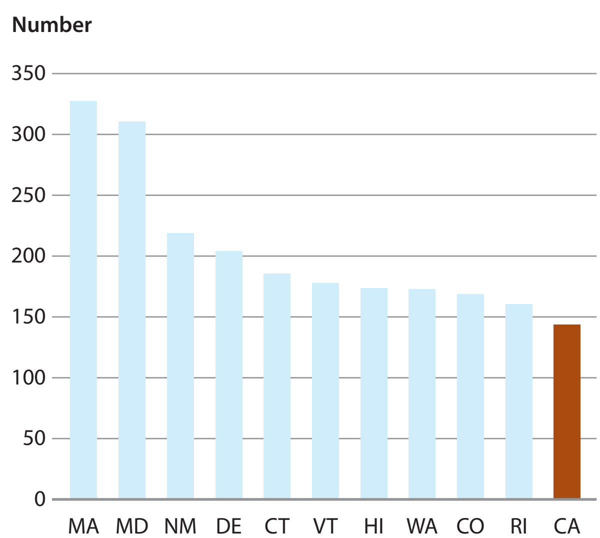
Doctoral Scientists and California

California ranked 17th, with 142.61 doctoral scientists per 100,000 population, in the 2013 index, using 2008 data. In the 2010 index, with 133.74 doctoral scientists per 100,000 population, California ranked 18th, using 2006 data. The top four states remained the same from the 2010 index: Massachusetts (327.72), Maryland (311.35), New Mexico (218.83), and Delaware (203.65), with Connecticut (186.15) joining the top five.

Doctoral scientists per 100,000 people: 2008



Doctoral scientists per 100,000 people:
Top 10 states and California, 2008; California ranked 17th



Sources: National Science Foundation, U.S. Census Bureau

Doctoral Engineers per 100,000 People

Definition

This indicator is calculated by totaling the number of doctoral engineers in each state and normalizing it per 100,000 state residents. Doctoral engineers specialize in a variety of fields, including electrical, nuclear, molecular, and chemical engineering. Data come from the Division of Science Resources Studies of the NSF. Population figures are provided by the U.S. Census Bureau.

Why Is It Important?

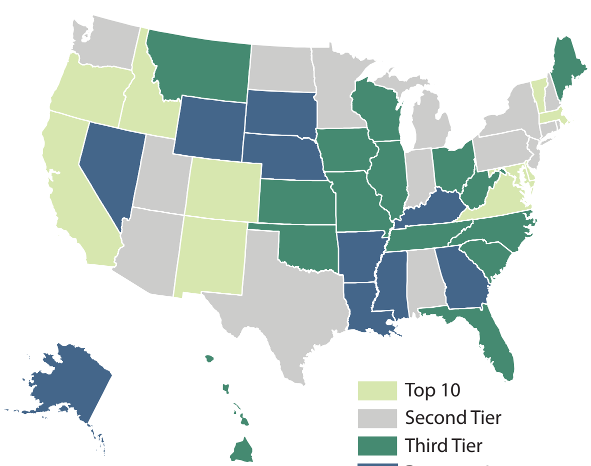
Like doctoral scientists, doctoral engineers operate at the upper end of creative and managerial work in scientific and technological fields. Engineering disciplines tend to be more applied and technologically oriented than scientific ones, although both are relevant to a high-tech economy. A noticeable presence of such individuals tends to be conducive to high-tech industry innovation, new company formation, and growth. A labor pool with a sizable number of highly skilled doctoral engineers is also attractive to technology firms when they evaluate locations for their high-end operations.

There are some 84,500 doctoral engineers in the nation, for an average of 24.94 doctoral engineers for every 100,000 U.S. residents. Twenty-four states meet or exceed the national average. Washington is one of them, with 25.91 doctoral engineers per 100,000 population, coming closest to the national average.

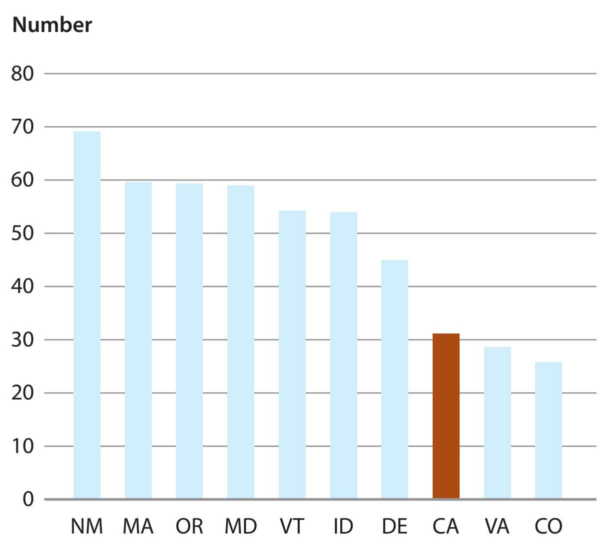
Doctoral Engineers and California

California ranked eighth in this index (using 2008 data), the same ranking that the state scored in the 2010 index (2006 data). California scored 43.71 doctoral engineers per 100,000 population in 2013 vs. 41.00 doctoral engineers per 100,000 population in 2010. The top five states were New Mexico (74.60), Massachusetts (54.10), Oregon (50.41), Maryland (49.25), and Vermont (45.15).

Doctoral engineers per 100,000 people: 2008



Doctoral engineers per 100,000 people: Top 10 states, 2008



Sources: National Science Foundation, U.S. Census Bureau

Science, Engineering, and Health Ph.D.s Awarded

Definition

The indicator for the number of science, engineering, and health Ph.D.s awarded measures how many doctorate degree-holders a state produces in those disciplines. The indicator is calculated by taking the number of Ph.D.s awarded in the 25- to 34-year-old age cohort and normalizing it per 100,000 people in that demographic. Data on doctoral scientists and engineers include all graduate-degree candidates and recipients in science, engineering, and health fields. They were compiled by the Division of Science Resources Studies of the National Science Foundation. The U.S. Census Bureau provided population figures.

Why Is It Important?

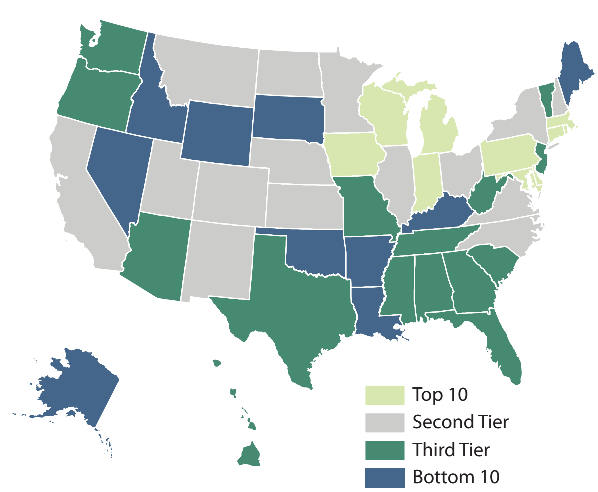
While the previous two indicators measured the number of doctoral scientists and engineers in a state, this indicator assesses how many doctoral scientists and engineers a state's higher education system produces. In this sense, the indicator measures a state's capacity to generate and train highly skilled knowledge workers. Producing such specialized individuals can be conducive to high-tech industry innovation, new business formation, and growth. Producing a critical mass of science and engineering doctorate degree-holders also attracts technology firms to a state.

Possessing an education system that produces a sufficient quantity of science and engineering doctoral candidates and degree-holders indicates a state's capacity for upper-tier knowledge-based economic activity. There were close to 28,105 science, engineering, and health degrees awarded in the United States in 2011, for a national average of 65.82 science, engineering, and health Ph.D.s for every 100,000 residents ages 25 to 34. Twenty states met or exceeded the national average; Utah comes closest with 67.17.

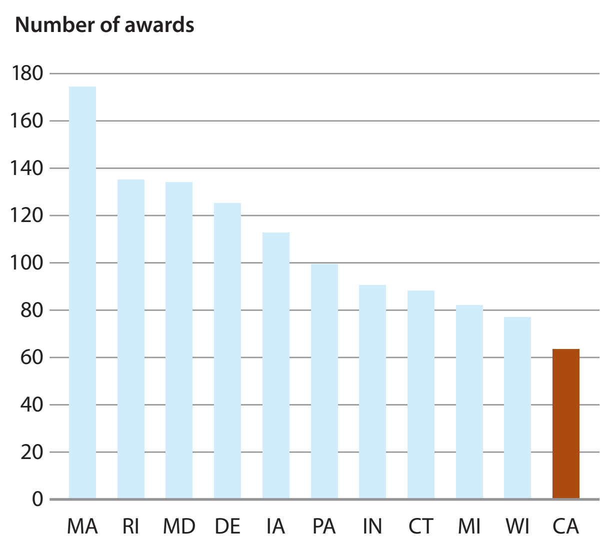
Science, Engineering, and Health Ph.D.s and California

California fell back to levels similar to those of the 2008 index, after jumping to 16th with 82.70 Ph.D. holders in science, engineering, and health for every 100,000 residents age 25 to 34 in the 2010 index. In the 2013 index, California fell to 23rd, one spot below the 2008 finish in 22nd. California produces 63.69 Ph.D. holders in science, engineering, and health for every 100,000 residents age 25 to 34. California lags far behind the leaders: Massachusetts (175.10 Ph.D. holders), Rhode Island (135.08), Maryland (134.74), Delaware (125.10), and Iowa (113.33).

Science, engineering, and health Ph.D.s awarded per 100,000 people: 25–34 age cohort, 2011



Science, engineering, and health Ph.D.s awarded: Top 10 states and California, 2011; California ranked 23rd



Sources: National Science Foundation, U.S. Census Bureau

Science, Engineering, and Health Postdoctorates Awarded

Definition

This indicator measures the number of positions granted in a state for advanced academic or professional work immediately after a student's completion of doctoral degree studies. The indicator is calculated by taking the number of Ph.D. holders ages 25 to 34 conducting postdoctoral work and normalizing it per 100,000 state residents in that demographic. Science, engineering and health (SEH) postdoctoral awards data are provided by the Division of Science Resources Studies of the National Science Foundation. Population figures come from the U.S. Census Bureau.

Why Is It Important?

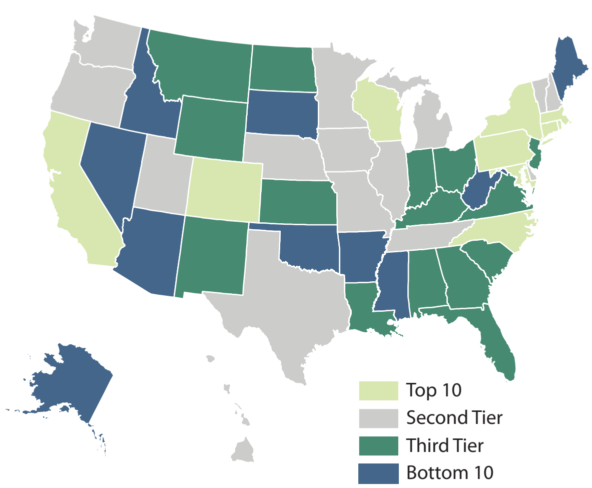
This indicator relates to a state's ability to attract and produce highly trained knowledge workers. Postdoctoral work is important to Ph.D. holders and institutions alike because such programs allow newly minted Ph.D.s to further their knowledge in their field. Postdoctoral opportunities are predominantly awarded by universities, so participants often teach in addition to performing postdoctoral research.

Data on postdoctoral awards include all graduate degree candidates and recipients in SEH fields. There were 43,305 SEH postdoctorates awarded in the United States to people ages 25 to 34 in 2010, for a national average of 136 per 100,000 members of this age group. Fifteen states exceeded the national average.

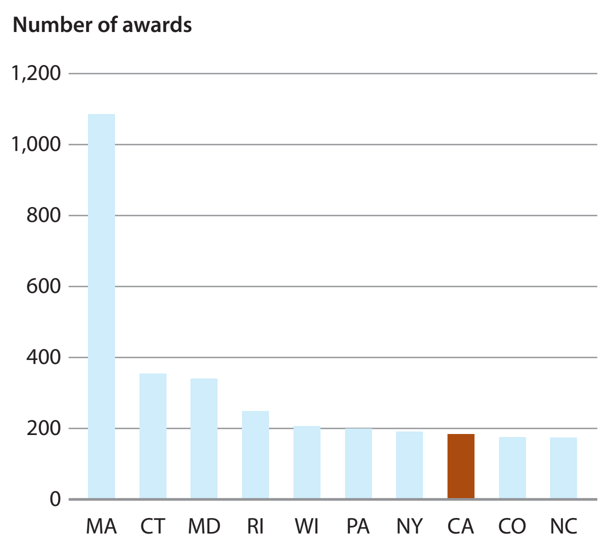
Postdoctorates and California

California is making improvements, awarding 184.24 postdoctoral positions in science, engineering, and health programs for every 100,000 people ages 25 to 34, ranking eighth, up four spots from the 2010 index. Massachusetts, with 1,083.19 positions, is the clear leader having 5.8 times as many postdoctoral positions per 100,000 young adults as California. The remaining top five are Connecticut (359.29), Maryland (345.47), Rhode Island (249.47), and Wisconsin (212.68).

Science, engineering, and health postdoctorates awarded per 100,000 people: 25–34 age cohort, 2010



Science, engineering, and health postdoctorates awarded per 100,000 people: Top 10 states, 2010



Sources: National Science Foundation, U.S. Census Bureau

Percentage of Bachelor's Degrees in Science and Engineering

Definition

This indicator is calculated by taking the number of bachelor degrees granted in a state for science- or engineering-related fields and dividing it by the total number of bachelor degrees granted in all disciplines. The indicator includes degrees conferred by Title IV-eligible, degree-granting institutions. Data are provided by the National Center for Education Statistics, a division of the U.S. Department of Education.

Why Is It Important?

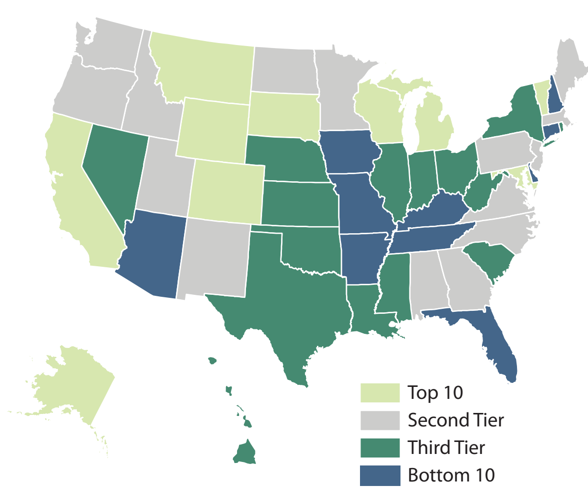
A large share of degrees granted in science or engineering suggests correspondingly high interest in science- and engineering-related professions, but it does not automatically correlate with a flourishing high-tech economy.

Many high-scoring states such as Wyoming and Montana likely attract a much higher percentage of science and engineering majors than recognizably high-tech states like California and Massachusetts because the university curricula of the former are comparatively more limited. Nevertheless, a large percentage of science and engineering graduates can undeniably help feed a high-tech labor pool. The national average for science and engineering bachelor's degrees was 15.9 percent in 2009. Twenty-two states met or exceeded the average; Alabama most closely matched the national average with 16.1 percent.

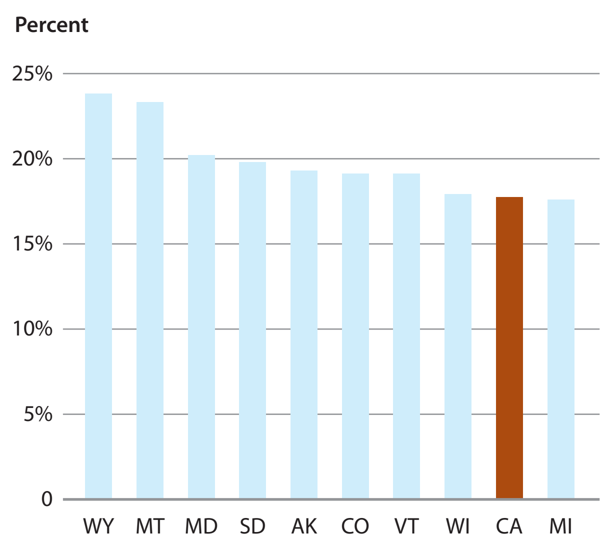
Science and Engineering Bachelor's Degrees and California

California ranked ninth. About 17.64 percent of university graduates in California received bachelor's degrees in science or engineering. California has been in the top 10 since the 2008 index. The continued pursuit of science and engineering degrees indicates a strong focus on high-tech jobs. In this measure, the top five performers were Wyoming (23.85 percent), Montana (23.29 percent), Maryland (20.31 percent), South Dakota (19.80 percent), and Alaska (19.25 percent).

Percentage of bachelor's degrees granted in science and engineering: 2009



Percentage of bachelor's degrees granted in science and engineering: Top 10 states, 2009



Source: National Center for Education Statistics

Recent Degrees in Science and Engineering

Definition

The indicator for recent degrees in science and engineering measures the proportion of people in a state's workforce who recently graduated from a higher-education program in science or engineering. The indicator is derived by totaling the number of workers who earned bachelor's, master's, or Ph.D. degrees in science or engineering in 2011 and dividing that figure by the total number of civilian workers in a state. Data on degrees earned came from the National Science Foundation's Division of Science Resources Studies. Civilian labor force figures were collected by the Bureau of Labor Statistics, a division of the U.S. Department of Labor.

Why Is It Important?

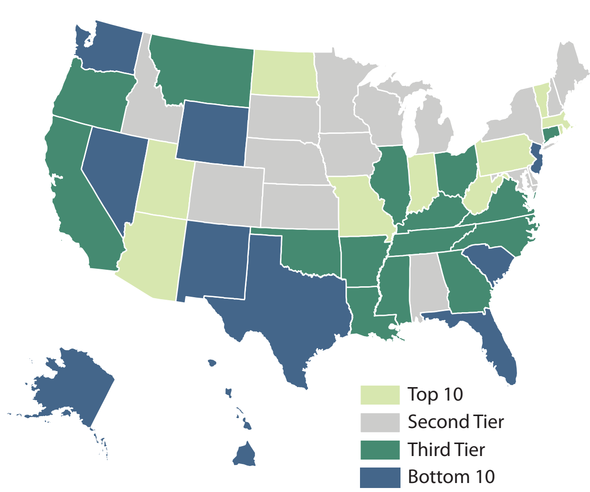
This figure offers a proxy for the extent to which a state's labor pool is being infused with new talent that could directly contribute to high-tech industries. As a group, recent graduates in science and engineering fields tend to gravitate to those states that offer the most promising job opportunities. States that combine a high-tech industrial base with a large proportion of new science and engineering degree-holders in their workforce are well-positioned to benefit disproportionately from a cohort that is characterized by intellectual curiosity and eagerness to develop a high-tech career.

During 2011, more than 651,000 U.S. workers had recently obtained degrees in science or engineering disciplines. Twenty-too states met or exceeded the national average of 4.36 per 1,000 civilian workers in this category. Idaho roughly matched the average.

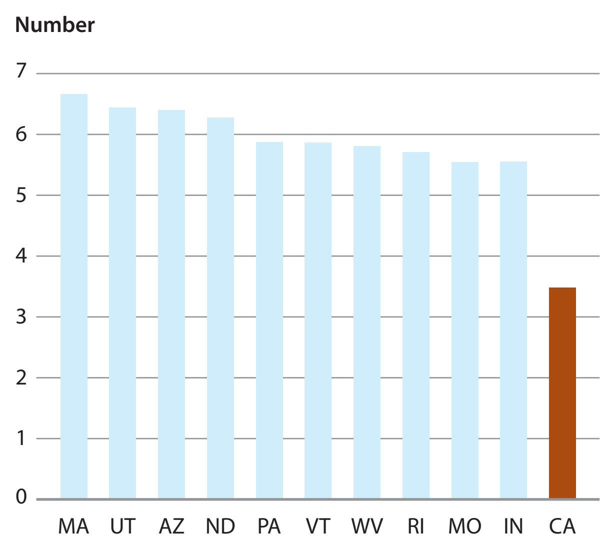
Recent Degrees and California

California remains in the bottom 10 with 3.44 per 1,000 civilian workers having recently received a degree in science and engineering. The state ranks 40th among its peers, almost one below the national average. The top five states in this measure are Massachusetts (6.60), Utah (6.37), Arizona (6.30), North Dakota (6.20), and Pennsylvania (5.78).

Recent degrees in science and engineering:
Per 1,000 civilian workers, 2011



Recent degrees in science and engineering:
Top 10 states and California, 2011; California ranked 40th



Sources: National Science Foundation, Bureau of Labor Statistics

Percentage of Households with Computers

Definition

This indicator measures each state's computer penetration rate. It is calculated by taking the number of households with computers and dividing by the number of households in each state. Historically, computer ownership is highest among the most educated and wealthiest segments of the population. However, with falling prices and bundling schemes, computer ownership among lower-income and less-educated consumers has risen steadily over the past 10 years. The data were provided by the U.S. Department of Commerce, but new figures have not been collected since 2010.

Why Is It Important?

Having computers in the home helps children and adults become technically proficient and take advantage of knowledge and resources that would otherwise be difficult to attain. While the digital divide is narrowing, it still exists. Black and Hispanic communities remain the largest racial/ethnic populations with the lowest computer-ownership rates.

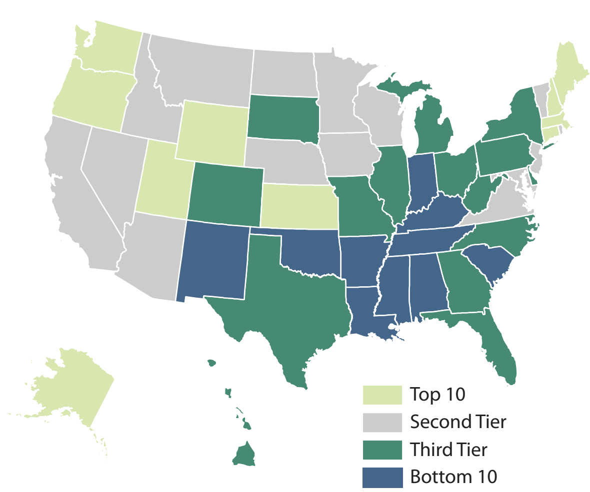
Computer ownership does not immediately correlate with high-tech industrialization. A more accurate assessment might be a statistic combining computer penetration within households with the number of computers per household, which would delve into the level of usage and proficiency. Nevertheless, a high degree of computer access and literacy among a population is an important component of any modern economy that aspires to equitable economic participation for the members of its society.

As of 2010, the latest year for which figures are available, 81.76 percent of all U.S. households were equipped with a computer.

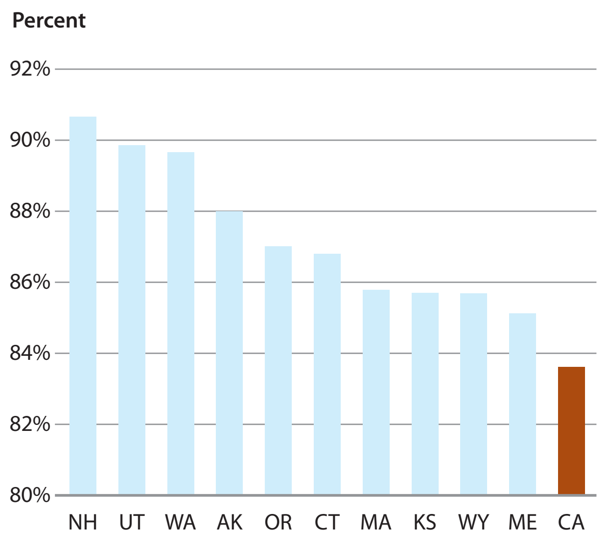
Computer Households and California

California improved its performance by almost 20 percentage points from the 2008 index, with 83.6 percent of households equipped with a computer vs. 66.3 percent in the 2008 index (most updated due to data restrictions). California's score greatly improved, but its ranking slipped from 12th to 20th due to the increase in household computers across all states. The top five states are New Hampshire (90.7 percent), Utah (89.9 percent), Washington (89.6 percent), Alaska (88 percent), and Oregon (87 percent).

Percentage of households with computers: 2012



Percentage of households with computers:
Top 10 states and California, 2012; California ranked 20th



Source: U.S. Department of Commerce

Percentage of Households with Broadband Access

Definition

This indicator measures each state's Internet penetration rate. The indicator is calculated by taking the number of households with Internet service and dividing that figure by the total number of households in each state. Since the predominant form of Internet access is via computer, this component is essentially a subset of the previous indicator on households with computers and is influenced by similar factors. The U.S. Department of Commerce provides the data.

Why Is It Important?

The Internet connects people with resources in a manner that is efficient, fast, and geographically unencumbered. It enables people to retrieve and share data, communicate, shop, study, be entertained, and perform other tasks.

As with computer ownership, Internet access does not automatically correlate with high-tech industrialization, but it is a good gauge of the diffusion of modern information technologies among a state's population. High Internet penetration is harder to achieve than computer usage because of the added cost of Internet service and the need for telecommunications infrastructure.

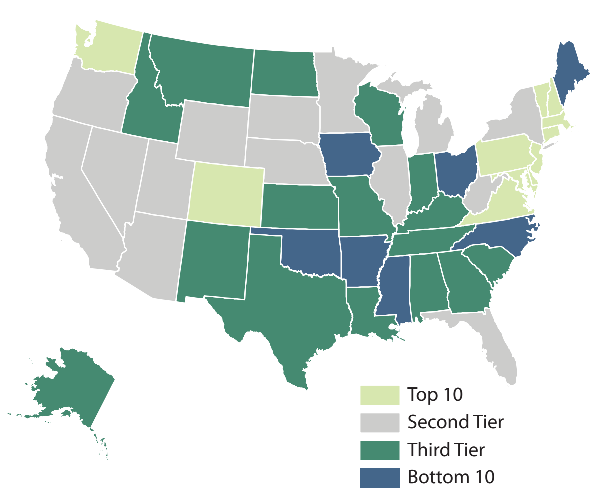
This indicator may become less reliable in the future. Given the widespread use of (increasingly free) Wi-Fi hot spots in many public areas, tech-savvy consumers and employees with Internet-equipped mobile units may not need to pay for Internet access at home.

As of 2012, 95.1 percent of all U.S. households had Internet access at home, with 44 percent using broadband. Twenty-six states exceeded this penetration rate, with California, Illinois, and Wyoming tying the national average at 44 percent broadband.

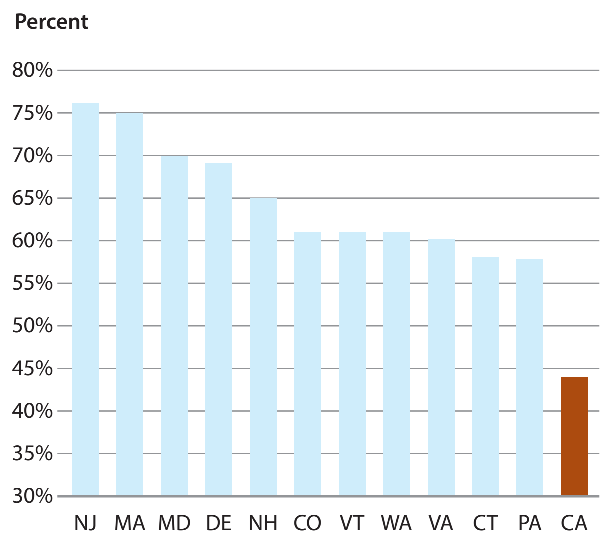
Internet Access and California

California ranked 23rd in this measure, with 44 percent of households having broadband access. The top five states were New Jersey (76 percent), Massachusetts (75 percent), Maryland (70 percent), Delaware (69 percent), and New Hampshire (65 percent). In the 2010 index, Internet access was measured instead of broadband access, and California ranked 17th in that category.

Percentage of households with broadband access: 2012



Percentage of households with broadband access:
Top states and California, 2012; California ranked 23rd



Source: U.S. Department of Commerce

Technology and Science Workforce Composite Index

Definition

The Technology and Science Workforce Composite Index encompasses three primary occupational areas: computer and information science experts, life and physical scientists, and engineers. Each category is made up of six components that measure employment intensity in science and technology. The composite index is then calculated by averaging the intensity scores of the three occupational areas so that 18 individual components feed into the overall score. "Intensity" is the percent share of employment in a particular industry or occupation as it relates to total state employment. Technology and science occupational data are collected by the Bureau of Labor Statistics and compiled by the Milken Institute.

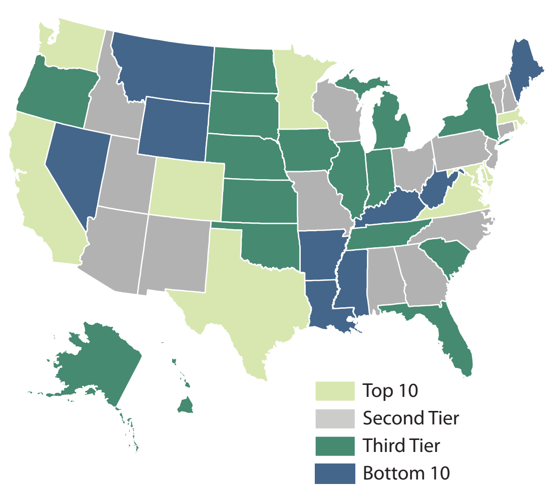
Why Is It Important?

The intensity of the technology and science workforce reveals the sophistication and technological competency of a state's labor pool. It reflects a state's capacity for technological innovation and its attractiveness to high-tech employers that need to locate near large talent pools. Strength across all three primary occupational areas will bolster a state's performance in the index. Conversely, states that excel in the fewest of the 18 scientific or technical specialties comprising the index will not do well. A high score bodes well because it is a proxy of a state's human capital potential. Combining that potential with simulating factors such as R&D funding and risk and human capital investments is integral to a state's high-tech development capacity.

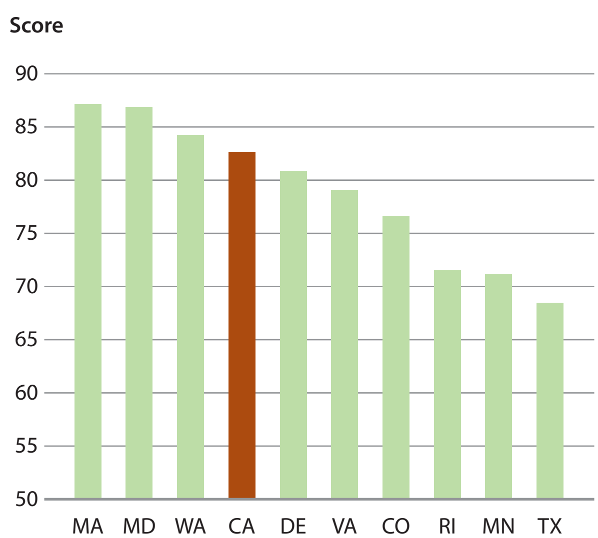
Tech Workers and California

At fourth, California remains a leader in science and technology workforce, with a score of 82.56. Its performance continued to improve, from seventh in 2010 (with a score of 74.64) and fifth in 2012 (with a score of 79.89), although still not reaching its peak of second place in 2002. The state remained in the top five in nine categories including computer and information scientists, software engineers, biochemists and biophysicists, microbiologists, medical scientists, physicists, electronics engineers, computer hardware engineers, and biomedical engineers. The top 10 states in this composite component were Massachusetts (87.29), Maryland (86.94), Washington (84.22), California (82.56), Delaware (80.83), Virginia (79.11), Colorado (76.44), Rhode Island (71.50), Minnesota (71.00), and Texas (68.44).

Technology and Science Workforce Composite Index:
2013



Technology and Science Workforce Composite Index:
Top 10 states, 2013



Source: Milken Institute

Intensity of Computer and Information Science Experts

Definition

The intensity of computer and information science (I.S.) experts is calculated by averaging the intensity scores of six types of computer and information science-related occupations: computer and information scientists, computer programmers, software engineers, computer support specialists, systems analysts, and database and network administrators. "Intensity" is the percent share of employment in a particular industry or occupation as it relates to total state employment. To determine this measurement, we combine total employment in the above fields and divide by increments of 100,000 workers in the state. These figures are then ranked, and the state rankings are converted into scores. Computer and IS occupational data and state employment data are collected by the Bureau of Labor Statistics and compiled by the Milken Institute.

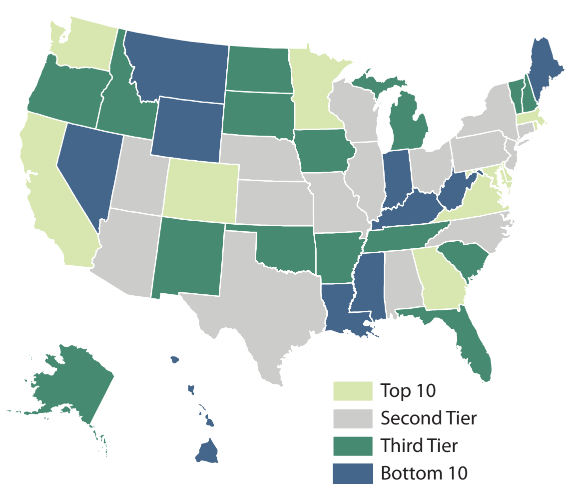
Why Is It Important?

Computer and IS professions are important to a state's economic vitality. They represent high value-added occupations, and there is a further strategic value in having skilled knowledge workers in these fields because so much in high-technology and other advanced sectors of a modern economy functions on an information-technology platform. Some 1.6 million computer and IS experts reside in the United States. That translates to a national average of about 1,210 computer and IS experts per 100,000 U.S. workers.

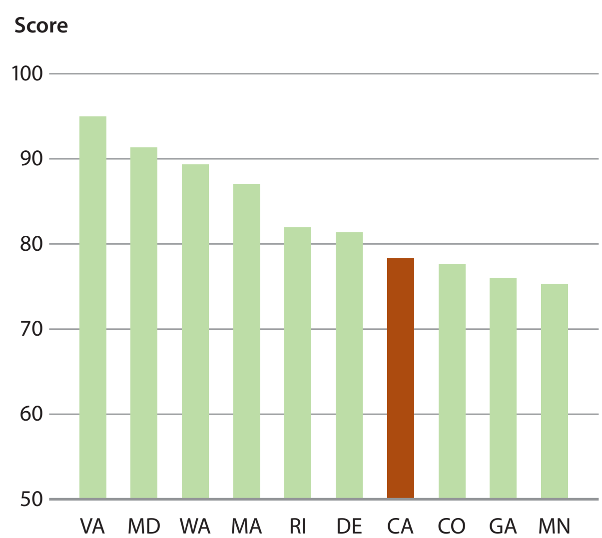
Computer and Information Science Experts and California

California remained in the top 10, moving up two places from the 2012 index. With a score of 78.33 combined computer and IS experts per 100,000 workers, the state finished in seventh in this measure. This is the state's best finish since eighth in the 2004 index. The improvement shows that computer and IS experts continued to be important and employable in California despite outsourcing to states and countries with lower operating costs. The top five states are Virginia (95.00), Maryland (91.33), Washington (89.33), Massachusetts (87.00), and Rhode Island (82.00)

Intensity of computer and IS experts: 2012



Intensity of computer and IS experts:
Top 10 states, 2012



Sources: Milken Institute, Bureau of Labor Statistics

Intensity of Life and Physical Scientists

Definition

The intensity of life and physical scientists is calculated by averaging the intensity scores of six types of related occupations: agricultural and food scientists, biochemists and biophysicists, microbiologists, medical scientists, physicists, and miscellaneous life and physical scientists. "Intensity" is the percent share of employment in a particular industry or occupation as it relates to total state employment. To determine this measurement, we combine employment in the above fields and divide it by increments of 100,000 state workers. These figures are then ranked, and state rankings are converted into scores. Life and physical science occupational data are collected by the Bureau of Labor Statistics (BLS) and compiled by the Milken Institute. However, many states do not report employment statistics to the BLS in these occupations.

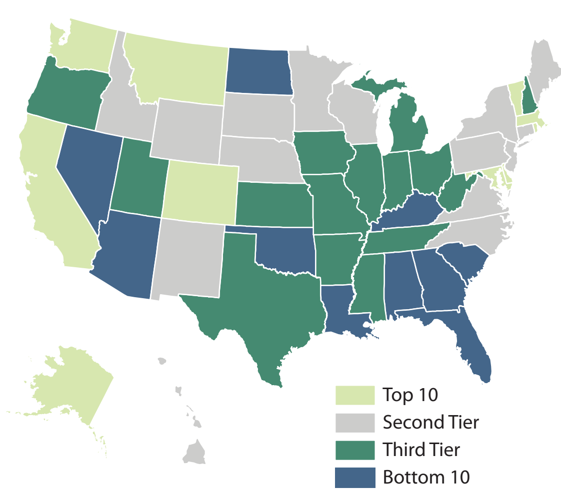
Why Is It Important?

Life and physical scientists are leading developments in some of the most promising and fastest-growing high-tech sectors. These sectors include biotech and medical devices and related fields that require in-depth knowledge of biochemistry, biophysics, microbiology, and medical science. Because these industries are growing and have a propensity toward innovation, these knowledge workers can disproportionately contribute to a region's techno-entrepreneurial dynamism. A strong concentration of life and physical scientists also helps promote a region to potential investors and corporations, and in turn stimulates an additional inflow of such scientists. There were a reported 185,460 life and physical scientists in the United States in 2012, or an average of 143 per 100,000 workers nationwide.

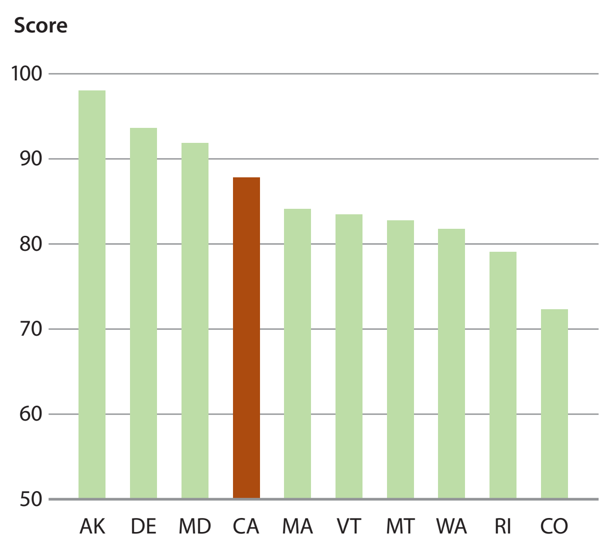
Life and Physical Scientists and California

California remained in the top 10, finishing fourth with a score of 87.67. California moved up three places from 2010 and one place from 2012. The improvements mirror the overall rankings in the tech and science workforce composite. The remaining states in the top five are Alaska (98.00), Delaware (93.50), Maryland (91.67), and fifth place Massachusetts (84.00).

Intensity of life and physical scientists: 2012



Intensity of life and physical scientists:
Top 10 states, 2012; California and Washington tied for 8th



Sources: Milken Institute, Bureau of Labor Statistics

Intensity of Engineers

Definition

This indicator is calculated by averaging the intensity scores of six categories of engineering-related occupations: electronics engineers, electrical engineers, computer hardware engineers, biomedical engineers, agricultural engineers, and other types of engineers. "Intensity" is the percent share of employment in a particular industry or occupation as it relates to total state employment. To determine this measurement, we combine total employment in the above fields and divide it by increments of 100,000 state workers. These figures are then ranked, and state rankings are converted into scores. Occupational data are collected by the Bureau of Labor Statistics and compiled by the Milken Institute.

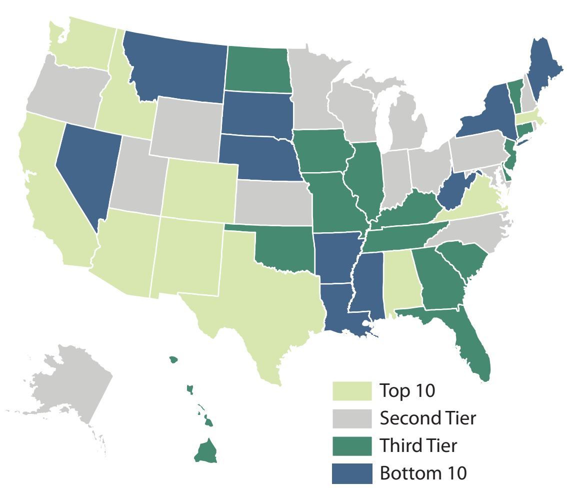
Why Is It Important?

Engineering is the mainstay of a technology-based economy. This applied discipline draws on a range of scientific knowledge to turn theories and concepts into reality. Engineering is especially important in such high-tech sectors as electronics, computers, and medical devices. Apart from their contributions to technology sectors, engineers also serve as all-around innovators and problem-solvers in areas such as workplace productivity and building construction. As of 2012, the United States had nearly 630,130 engineers or an average of 486 engineers for every 100,000 workers nationwide, based on the data available. Since engineering functions can range widely in degree of specialization, the presence of engineers in a state's economy is a reasonable indicator of the breadth and depth of its high-tech capacity.

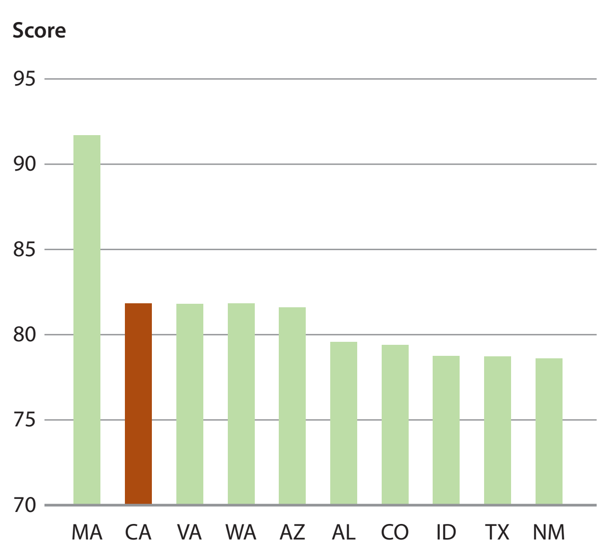
Engineers and California

California broke into the top three, with a score of 81.67. Once again this is California's highest ranking since 2008 due to small continued improvements. California gained second place through a three-way tie with Virginia and Washington. To remain in the top three, California will need to continue to make improvements so that it is not passed by states that score similarly in the measure. The state is still almost 10 points behind Massachusetts, which once again finishes in first with a score of 91.60. Arizona finished fifth, close behind the states tied in second with a score of 81.60.

Intensity of engineers: 2012



Intensity of engineers: Top 10 states, 2012



Sources: Milken Institute, Bureau of Labor Statistics

Technology Concentration and Dynamism Composite Index

Definition

The fifth set of indicators determining each state's position in technology and science is the Technology Concentration and Dynamism Composite Index, which measures the degree to which each state's economy is fueled by the technology sector. As such, it is a measurement of technology outcomes. The indicators that make up this composite focus on entrepreneurial dynamism and growth in high-tech industries. The following indicators explore such factors as high-technology employment, business formation, industry growth, and industry concentration. The data used in these indicators were collected from various sources, and compiled, modeled, and interpreted by the Milken Institute.

Why Is It Important?

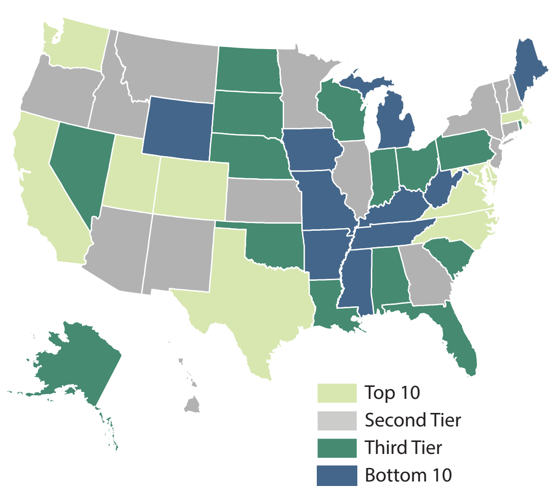
The concentration and dynamism of a high-technology industry is presented last in this study because it is bolstered by the performances of the previous four areas of research and development, risk capital, human capital, and science and technology workforce. This index measures the degree of success in not just aggregating similar professions, but also creating regional hubs of high-technology industries that benefit from aggregation and economies of scale.

Technology Concentration and California

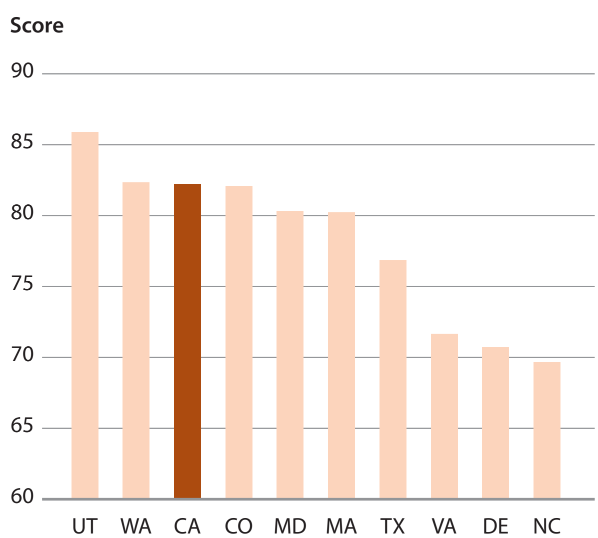
Thanks to Silicon Valley, California finally broke into the top three after continued movement up the ranks. California finished third with a score of 82.20. California ranked fifth in technology concentration and dynamism in the 2010 index with an overall score of 79.40 points. In 2008 rankings, California occupied seventh with a score of 72.60 points. California performed particularly well in number of high-tech industries with location quotients above 1.0. It topped the states with 17 industries, while Massachusetts took second with 13. California's weakest performance was 44th in high-tech industries average yearly growth. These findings suggest that California's growth in the high-tech area may be approaching saturation.

The top 10 were Utah (86.00 points), Washington (82.40 points), California, Colorado, Maryland (80.40 points), Massachusetts (80.20 points), Texas (77.00 points), Virginia (71.60 points), Delaware (70.67 points), and North Carolina (69.78 points).

Technology Concentration and Dynamism Composite Index: 2013



Technology Concentration and Dynamism Composite Index: Top 10 states, 2013



Source: Milken Institute

Percent of Business Establishments in High-Tech NAICS Codes

Definition

The indicator for percentage of businesses in the high-technology North American Industry Classification System (NAICS) codes is determined by totaling the number of business establishments in 25 technology-intensive NAICS code industries. These particular NAICS codes represent industries that spend an above-average amount of revenue on R&D and employ an above-industry-average number of technology-using occupations. The Milken Institute's definition of high-technology is coupled with business data from the Bureau of Labor Statistics. This figure is then divided by the total number of state business establishments as collected by the U.S. Census Bureau.

Why Is It Important?

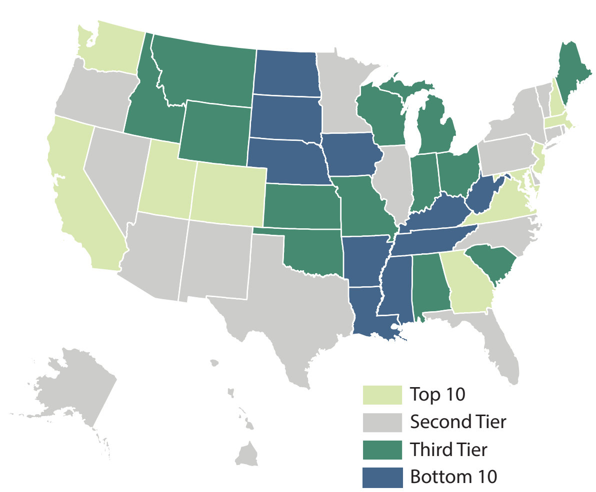
This indicator measures the high-tech business intensity of a state. Given that its determining factors are R&D expenditures and technology-oriented occupations at businesses, the indicator sheds light on a state's high-tech business population as well as the high-tech orientation of the population. Scoring well in this category is one indication of a state possessing an advanced industrial base as well as a skilled and technologically proficient workforce.

Roughly 395,050 U.S. establishments qualify as high-tech, according to the Milken Institute's high-technology classification standards. When measured as a portion of all U.S. business establishments, the national average for percentage of businesses with high-tech NAICS codes was 4.92 percent. Pennsylvania, ranked 25th, most closely matches the national average with 4.95 percent.

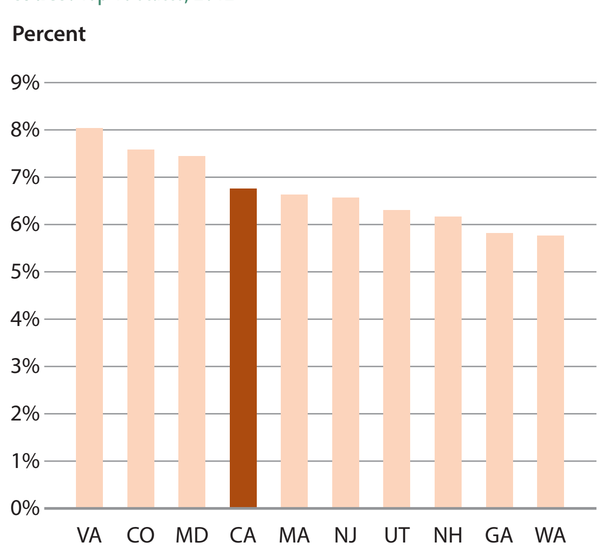
High-Tech Business Establishments and California

The national average in the 2010 index was 6.27 percent of business establishments. There was over a 1 percent decrease in the 2013 index, averaging 4.92 percent of business establishments in the current measure. California also had a decline in average percentage of business establishments from 6.98 percent in the 2010 index to 6.83 percent in the 2013 index. California's lower score pushed the state up the ranking from 16th to fourth because of the decline of other states. The remaining top five states are Virginia (8.08 percent), Colorado (7.61 percent), Maryland (7.51 percent), and Massachusetts (6.71 percent).

Percent of businesses in high-tech NAICS codes: 2012



Percent of business establishments in high-tech NAICS codes: Top 10 states, 2012



Sources: U.S. Census Bureau, Bureau of Labor Statistics, Milken Institute

Percent of Employment in High-Tech NAICS Codes

Definition

The indicator for percent share of employment in high-technology North American Industry Classification System (NAICS) codes is calculated by dividing the total number of employees within 25 high-tech industries (defined by the Milken Institute) by the total employment base in a state. This is a change in methodology from previous editions, incorporating sectors that we deem to be representative of industries that spend an above-average amount of revenue on R&D and that employ an above-industry-average number of technology-heavy occupations. It defines high-technology more narrowly than the Bureau of Labor Statistics' definition, which leans toward heavy manufacturing. The U.S. Census Bureau collected the employment data.

Why Is It Important?

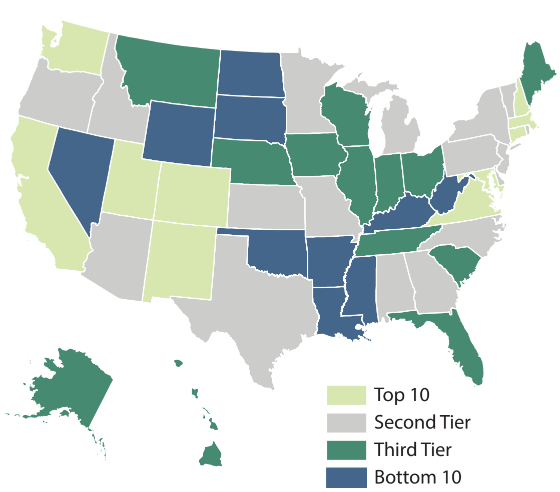
From an industrial perspective, states benefit from having a significant percentage of employment in technology-related fields because such workers tend to contribute disproportionately to the overall economy. States benefit from their above-average salaries and pay packages. A concentration of high-tech employment attracts out-of-state companies and encourages established businesses to stay.

As of 2012, 5.17 percent of U.S. workers held jobs in a high-tech industry. For a state to score well in this category requires not only sources of high-tech employment but also sources of training, such as universities.

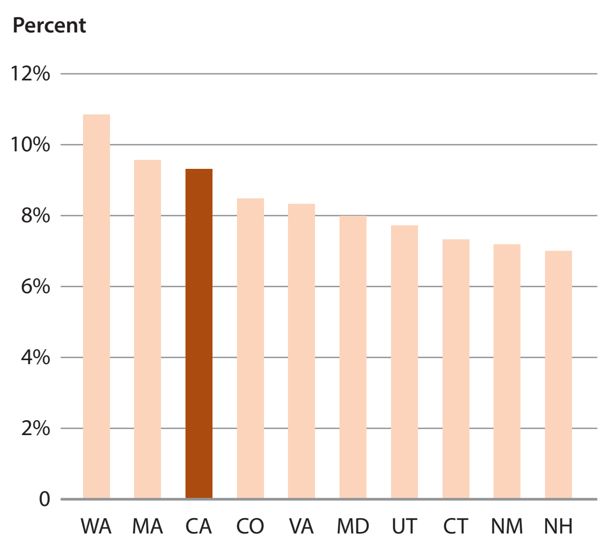
High-Tech Employment and California

With 9.40 percent of the state's workforce engaged in the high-tech industry, California ranks third in the nation, improving one ranking from the 2010 index. Only Washington (10.90 percent) and Massachusetts (9.60 percent) perform better than California. The remaining states in the top five are Colorado (8.50 percent), and Virginia (8.40 percent).

Percent of employment in high-tech NAICS codes: 2012



Percent of employment in high-tech NAICS codes:
Top 10 states, 2012



Sources: U.S. Census Bureau, Bureau of Labor Statistics, Milken Institute

Percent of Payroll in High-Tech NAICS Codes

Definition

The indicator for percentage of total payroll for workers in high-technology North American Industry Classification System (NAICS) code industries is calculated by dividing the dollar amount paid to high-tech workers by the total amount of wages and salary disbursements paid to all workers in each state. High-tech industries are narrowly defined by the Milken Institute. High-technology employment data are collected by the U.S. Census Bureau under contract with Taratec Corporation.

Why Is It Important?

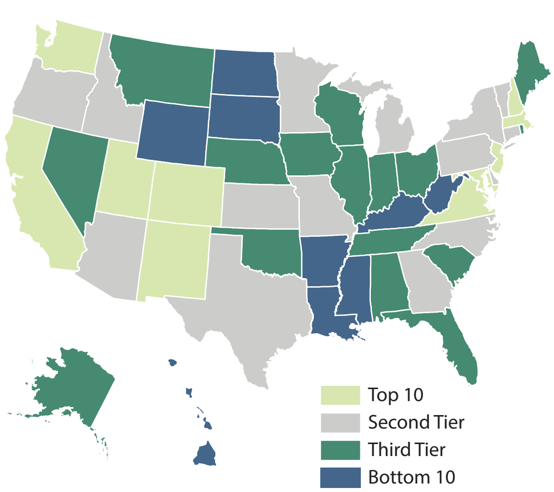
As noted, states benefit from having a relatively high percentage of employment in technology-related fields for several reasons: The industries have long-term growth potential and tend to contribute disproportionately to an economy, and high-technology employees tend to have above-average salaries and pay packages. This indicator augments and expands on the previous indicator—percentage share of high-tech employment—by showing how much of total payroll income is generated by high-tech employment.

The data clearly indicate that high-tech jobs pay disproportionately high salaries. The high-tech employment in the United States represents 8.9 percent of all payroll dollars in the nation.

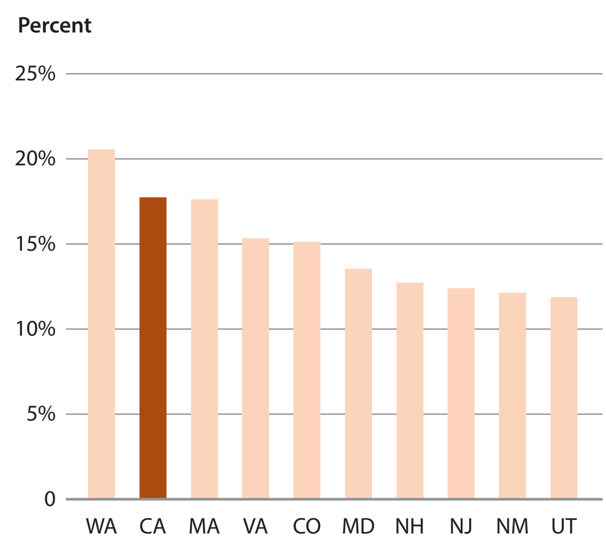
High-Tech Payroll and California

California is slowly making progress in this measure, ranking third in the 2010 index, third in the 2012 index, and second in the 2013 index. With 17.80 percent of California's total wages in the high-tech industry, the state was finally able to surpass Massachusetts to place second. This suggests the state has a relatively high proportion of high-tech in its industry. The top five states are Washington (20.60 percent), California, Massachusetts (17.70 percent), Virginia (15.40 percent), and Colorado (15.10 percent).

Percent of payroll in high-tech NAICS codes: 2012



Percent of payroll in high-tech NAICS codes:
Top 10 states, 2012



Sources: U.S. Census Bureau, Bureau of Labor Statistics, Milken Institute

Percent of Business Births in the High-Tech Sector

Definition

This indicator is calculated by dividing the number of new high-tech business establishments born in the year for which the most recent data are available and dividing that by the total number of new business establishments created during the same year. A business establishment, as defined by the U.S. Census Bureau, is a "single physical location at which business is conducted." The distinction is worth noting because an establishment is not interchangeable with a company. A company can have more than one establishment, so business establishment data include branches. Nevertheless, the data are an accurate measure of high-tech business presence. The Census Bureau's Statistics of U.S. Businesses (SUSB) program compiles data on new high-tech firms and total business establishments.

Why Is It Important?

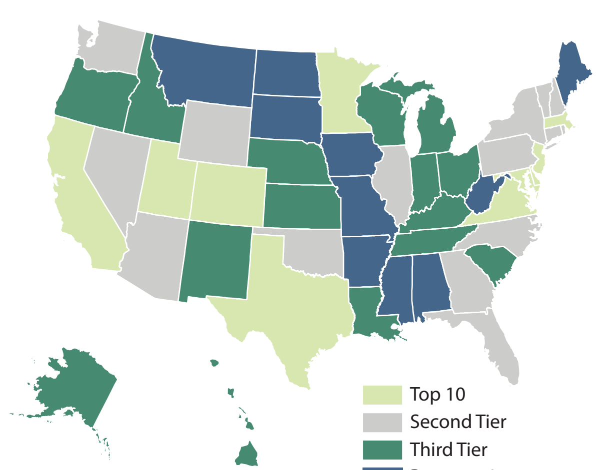
Business births are important to a state because growth is a sign of economic dynamism, prosperity, and optimism. Business births in the high-technology sector are particularly important because of such additional benefits as the sector's high wages, knowledge intensity, and long-term growth prospects.

The latest data available (for 2007) indicate that an average of 9.05 percent of all new business establishments formed in the United States were in the 25 industries categorized as high-tech by the Milken Institute definition. Vermont, ranked 24th with 9.18 percent, most closely matched the national average.

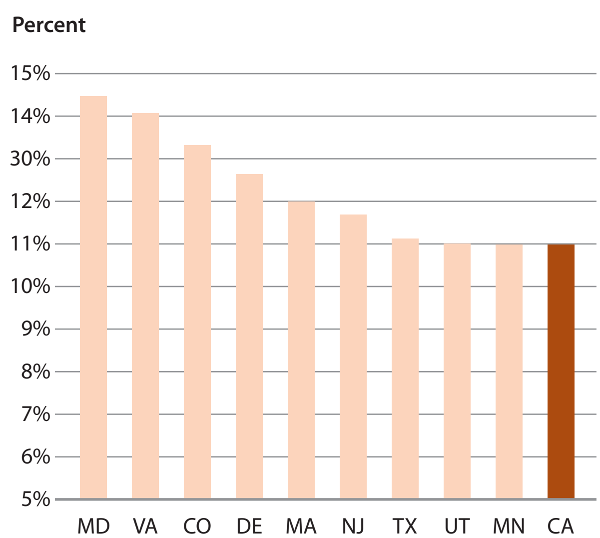
High-Tech Business Births and California

Based on the latest available data, 11.00 percent of California's new business establishments fell into the high-tech sector, keeping California barely in the top 10. California fell three places from the 2010 index, but coupled with the state's strong performance in high-tech industry payroll, this finding confirms the high-tech sector constitutes an important part of California's industry mix. The top five states are Maryland (14.49 percent), Virginia (14.07 percent), Colorado (13.37 percent), Delaware (12.62 percent), and Massachusetts (12.04 percent).

Business births in high-tech NAICS codes:
Percent of all establishment births, 2008



Establishment births in high-tech NAICS codes:
Top 10 states, 2008



Source: U.S. Census Bureau

Net Formation of High-Tech Establishments

Definition

This indicator measures the number of high-tech establishment births minus the number of high-tech business establishment deaths during a one-year period. This figure is then divided by increments of 10,000 business establishments in each state. A business establishment is considered in this indicator only if it has an Employer Identification Number (EIN) issued by the U.S. Census Bureau. High-technology and total establishments' birth data are compiled by the U.S. Census Bureau under contract with Taratec Corporation.

Why Is It Important?

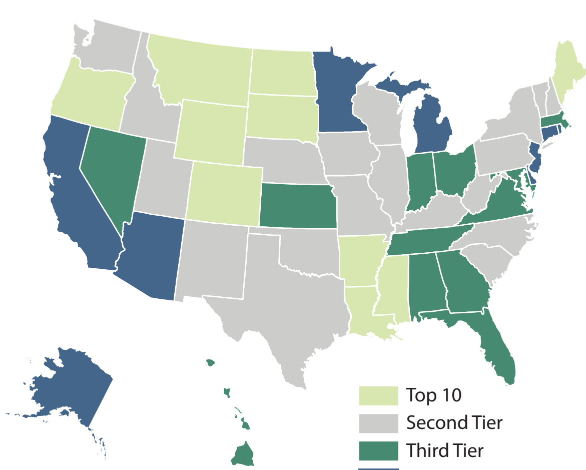
The previous indicator is a comparative absolute measure of business births: It looks at the total number of new high-tech firm formations as a percentage of all business births. This indicator for net formation is more specific in ascertaining the "balance sheet" of high-tech firm births versus deaths. By basing the indicator statistic on the population of all businesses (in units of 10,000 establishments), we get a clearer picture of how this high-tech industrial life cycle plays out. Net high-tech firm formation reveals high-tech entrepreneurial dynamism.

For the year measured (2008), the U.S. posted a net loss across all 50 states, with 2,768 high tech businesses closing. This simply means business failures outnumbered business creations. This represents a net formation of -1.78 high-tech companies per 10,000 business establishments. Over half of the states showed negative growth, and four showed no change at all. In the 2010 index, only two states showed negative growth (Delaware and West Virginia). This suggests a contraction in the economy after the previous growth in American businesses.

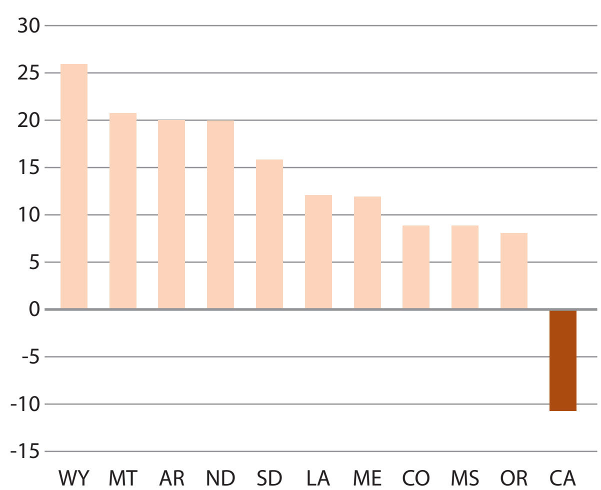
Net High-Tech Formation and California

California dropped in the index, consistent with the decline in the national average. California occupies 44th place, with a closure of 11 high-tech companies per 10,000 business establishments. In comparison, the state finished 11th in the 2010 index, with a net formation of 30 high-tech companies per 10,000 business establishments. The data were last updated in 2008, so these results may be showing the effects of the beginning of the Great Recession. The top five states were Wyoming (26), Montana (21), Arkansas (20), North Dakota (20), and South Dakota (16).

Net formation of high-tech establishments per 10,000 establishments: 2008



Net formation of high-tech establishments:
Top 10 states and California, 2008; California ranked 44th



Source: U.S. Census Bureau

Number of Technology Fast 500 Companies

Definition

This indicator measures a state's relative performance in generating fast-growing high-tech enterprises. The list of Technology Fast 500 companies is compiled annually by Deloitte & Touche, which ranks the fastest-growing technology companies in the United States and Canada over the most recent five-year period. In our indicator, the relevant Technology Fast 500 figures are averaged out by increments of 10,000 business establishments in each state. Deloitte & Touche considers a company to be high-tech if it produces technology or technology-related products, uses extensive technology, or allocates a large percentage of revenue to R&D. The U.S. Census Bureau collects the business establishment data.

Why Is It Important?

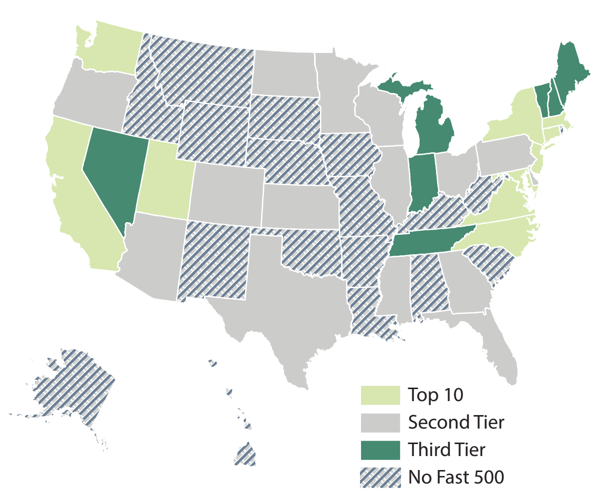
The Deloitte & Touche list of North America's 500 fastest-growing high-technology firms relies on a combination of quantitative and qualitative data to identify innovative, rapidly expanding firms that demonstrate strong promise for long-term technological and economic impact.

The combination of factors used as evaluation criteria means the list is unavoidably subjective. Nevertheless, it is helpful for identifying new technology companies that demonstrate high growth and potential. Our measure provides an indication of how rapidly a state's high-tech base is expanding by accounting for the state's business population. A total of 434 companies made the Technology Fast 500 list in the United States. Averaged out per 10,000 businesses nationwide, this leads to a ratio of 1:1. Only 33 states are home to Technology Fast 500 companies, an indication of the relatively exclusive nature of the list.

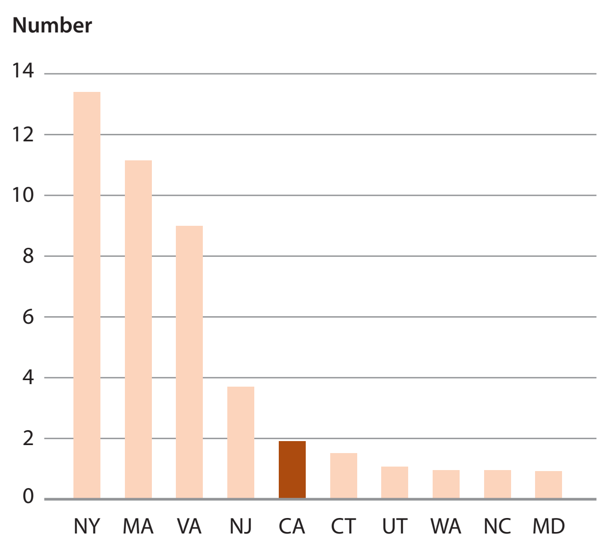
Tech Fast 500 Companies and California

California ranked fifth with 1.97 Tech Fast 500 companies per 10,000 business establishments. This represents a decline from the 2010 index, when California finished third, though the score did improve from 1.5 in that index. The lower rank but higher score suggests there is more competition among the top 10 states. California has a more diversified high-tech sector, which makes the state's high-tech concentration more sustainable. The states that scored in the top five were New York (13.41), Massachusetts (11.22), Virginia (8.97), and New Jersey (3.65).

Number of Technology Fast 500 companies per 10,000 establishments: 2012



Number of Technology Fast 500 companies:
Top 10 states, 2012



Sources: Deloitte & Touche, U.S. Census Bureau

Average Yearly Growth of High-Tech Industries

Definition

The indicator for average yearly growth of high-technology industries measures expansion in high-tech employment. It is calculated using the average yearly growth in high-tech sectors for a state during the most recent five-year period on record. The Milken Institute's definition of high-technology is utilized for this indicator. Data for this indicator were provided by Moody's Analytics and compiled by the Milken Institute.

Why Is It Important?

Where technology is prevalent does not necessarily correlate to where technology is growing. This indicator aims to find where technology has grown at the fastest rate during the past five years, regardless of industry base. This allows stakeholders to identify where new technology opportunities are arising throughout the United States.

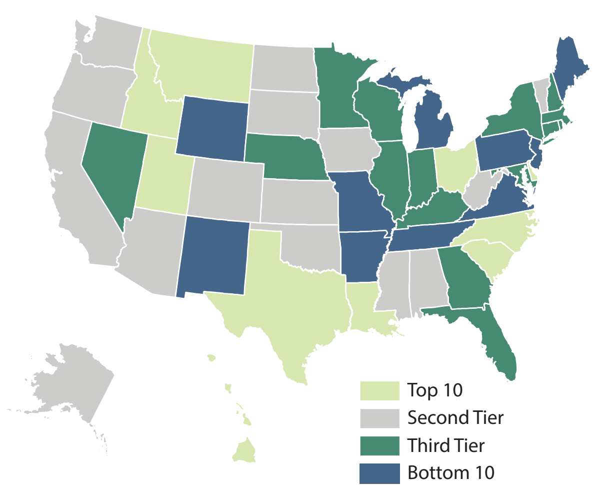
It also allows stakeholders to assess the health of their current investment and enables states to estimate the ramifications of their policies. Stringent laws governing taxes and business practices, coupled with skyrocketing electricity costs from deregulation, for example, could force firms to move to other states, or worse, to other countries.

Average yearly technology employment growth was -0.85 percent for the United States as a whole during the five years measured (2007-2011). High-tech industries as a whole declined in this period, with the largest decline, over 10 percent, in computer and electronic product manufacturing. Because states with a small technology industry base will register disproportionately strong growth rates with even a small industrial expansion, this indicator is easily dominated by states with relatively limited high-tech industrialization.

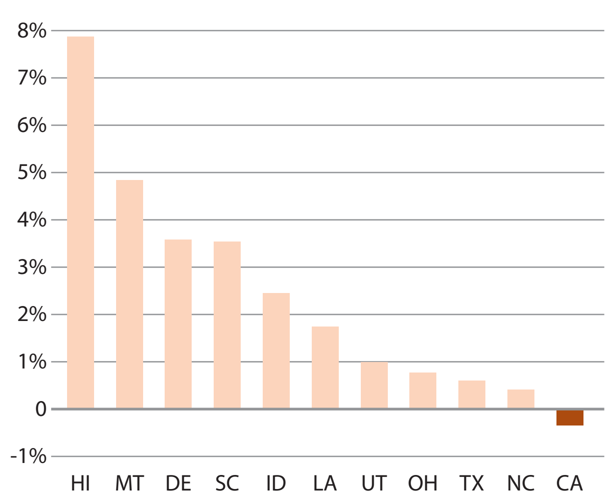
High-Tech Growth and California

California saw a 0.38 percent decline in high-tech employment. Regardless of the negative growth, California was able to score above the national average and move into the top half of states, ranking 15th. California's decline doubled from 0.19 percent in the 2010 index, but the poor performance of other states allowed California to move up 21 spots from its previous 36th place finish. The following two measures provide a more detailed picture of California's high-tech industry growth. The top five states were Hawaii (7.85 percent), Montana (4.82 percent), Delaware (3.55 percent), South Carolina (3.52 percent), and Idaho (2.41 percent).

Average yearly growth of high-tech industries Employment: 2007–2011



Average yearly growth of high-tech industries:
Top 10 states and California, 2007–2011; California ranked 15th



Sources: Moody's Analytics, Milken Institute

High-Tech Industries Growing Faster Than U.S. Average

Definition

This indicator measures the number of high-technology industries whose employment is growing faster than the national average for the overall economy. Growth rates are based on the most recent five-year period. The Milken Institute definition of high-tech is applied for this indicator. These particular high-tech NAICS codes represent industries that spend an above-average amount of revenue on R&D and employ an above-industry-average number of technology-dependent occupations. The data were furnished by Moody's Analytics and compiled by the Milken Institute.

Why Is It Important?

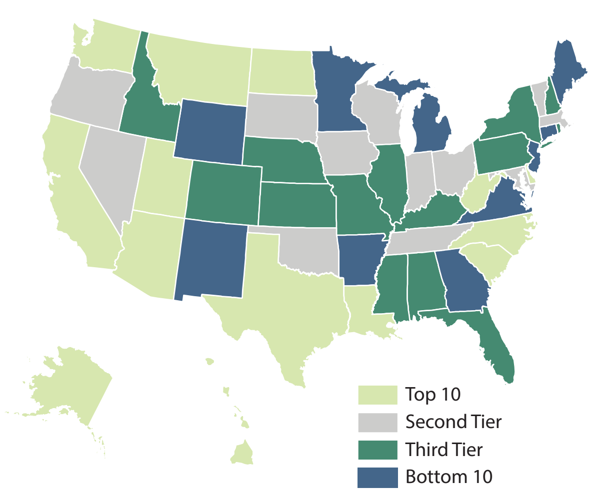
High-tech industries tend to expand rapidly, although growth rates can be influenced by many factors and, depending on the constituents in a state's high-tech sector, can accelerate or slow down at various periods. In this indicator, the highest possible score is 25, the maximum number of high-tech industries that could register growth above the U.S. average.

The years measured, 2007-2011, were characterized by a period of consolidation for many high-technology industries, especially those related to information technology. During this period, no state had the maximum number of industries outperforming U.S. employment growth. The closest were Montana and North Carolina with 15 high-tech industries.

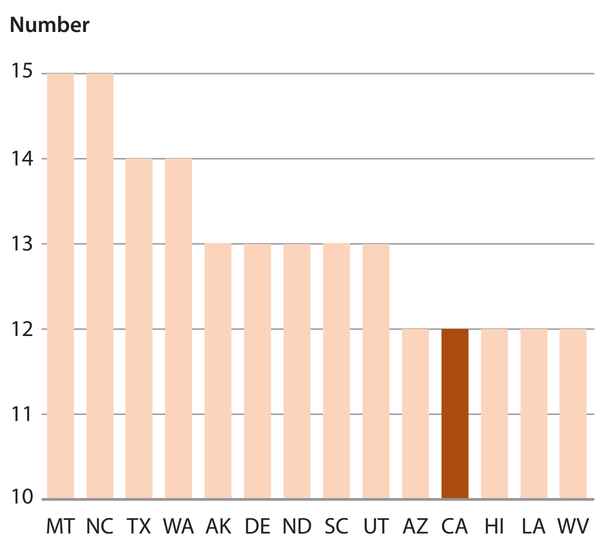
High-Tech Growth and California

California continues to improve its ranking from the 2010 index (26th place), as it has in the other indicators in the technology concentration composite. With 12 high-tech industries growing faster than the U.S. average, California tied with Arizona, Hawaii, Louisiana, and West Virginia for 10th. California's performance helps alleviate some of the concern about possible saturation of its high-tech sector. The top five states in this measure were Montana and North Carolina (tied with 15), Texas, Washington (tied with 14), Alaska, Delaware, North Dakota, South Carolina, and Utah (tied with 13).

Number of high-tech industries growing faster than U.S. average: Employment, 2007–2011



Number of high-tech industries growing faster than U.S. average: Top states, 2007–2011



Sources: Moody's Analytics, Milken Institute

High-Tech Industries with LQ Higher Than 1.0

Definition

The indicator for the number of high-technology industries with location quotient (LQ) higher than 1.0 measures how many high-tech industries are densely concentrated in a state. It is calculated by counting the number of high-tech industries (out of 14) that have an above-average location quotient in employment. An industry's location quotient measures a location's (in this case, a state's) level of employment concentration relative to the industry average across the United States. A high-tech industry in a state with an employment LQ higher than 1.0 is more densely concentrated in that state than in the nation on average. Industry output numbers used in this indicator were provided by Moody's Analytics and compiled by the Milken Institute.

Why Is It Important?

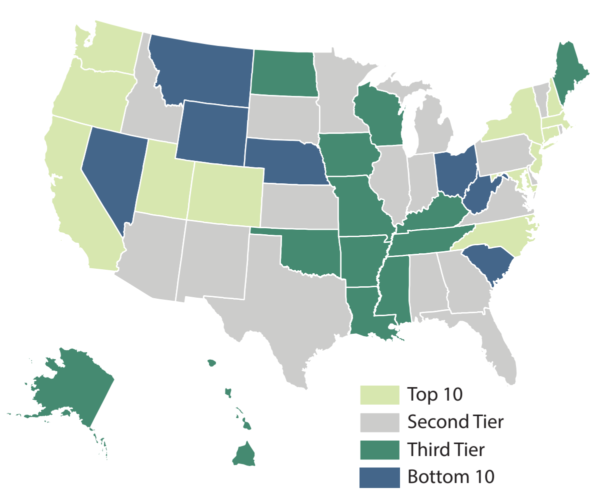
This indicator reveals whether a state has attracted an above-average mass of high-tech industries. States that exceed the national average in high-tech industry LQs have an edge in attracting and retaining high-tech firms due to their dense employment bases and other positive agglomeration factors.

Compared to above-average growth in employment (shown in the previous indicator), which measures industry momentum, this indicator on high-tech location quotients measures a more static but also critical factor: density. Taken together, the two indicators give a perspective on how well a spectrum of industries from the high-tech sector is anchored to and growing within a state. As with the previous indicator, no state has the maximum number of 25 industries outperforming the national average.

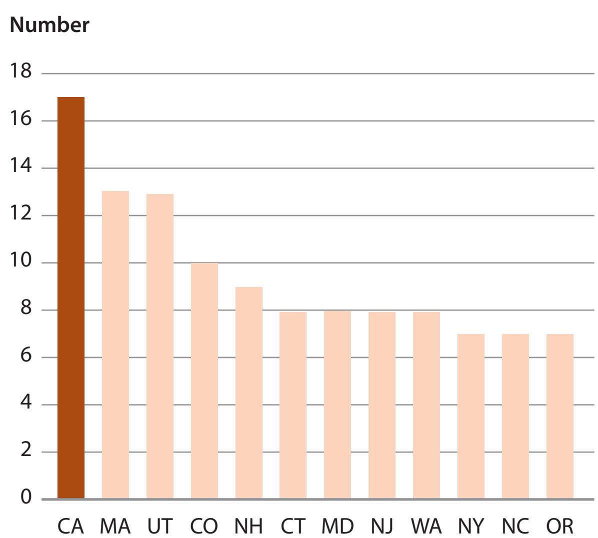
High-Tech Concentration and California

California continues to dominate this measure, topping the list for the sixth consecutive index. California holds on to the first spot with 17 industries whose employment concentrations are higher than the U.S. average. The remaining top five states were Massachusetts (13 industries), Utah (13), Colorado (10), and New Hampshire (9).

Number of high-tech industries with LQ higher than 1.0:
2012



Number of high-tech industries with LQ higher than 1.0:
Top states, 2012



Sources: Moody's Analytics, Milken Institute

Number of Inc. 500 Companies

Definition

The indicator for the number of Inc. 500 companies per 10,000 business establishments measures how many companies on Inc. magazine's top 500 list are located in each state. Inc.'s list ranks firms that apply to be on the list and can demonstrate that total net revenue (or, for financial companies, total net income) has more than tripled in the most recent five years. Our indicator is calculated by totaling the number of Inc. 500 companies in a state and normalizing the figures by increments of 10,000 business establishments in that state. The U.S. Census Bureau provides the business establishment data.

Why Is It Important?

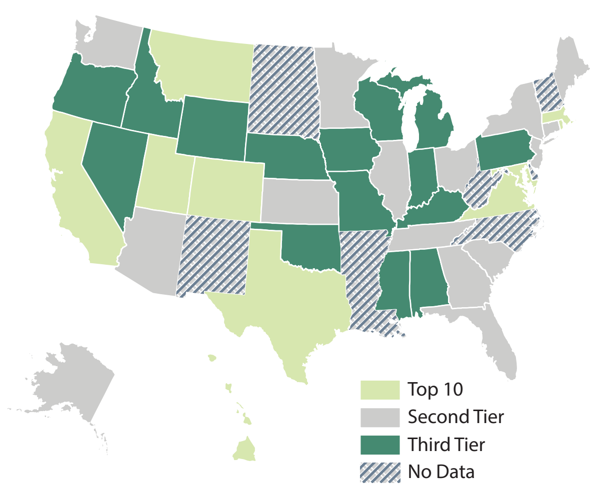
The Inc. 500 has a nearly three-decade history and is recognized as a chief barometer of entrepreneurial venture growth in the United States. Although it is not specific to technologically or otherwise knowledge-intensive enterprise, it offers a window into the national landscape for fast-growing, entrepreneurially dynamic firms. When its rankings are assessed on a normalized state-by-state basis and considered in the context of other indicators, it provides a useful comparative measure of economic vibrancy and dynamism throughout the United States.

Forty states are home to at least one company on the Inc. 500 list. This reflects the broader nature of this indicator (as opposed to the Technology Fast 500 rankings, in which just 29 states have companies that qualify). The U.S. average for Inc. 500 companies per 10,000 businesses is 0.57. New York was closest to the national average, with 0.56 Inc. 500 companies.

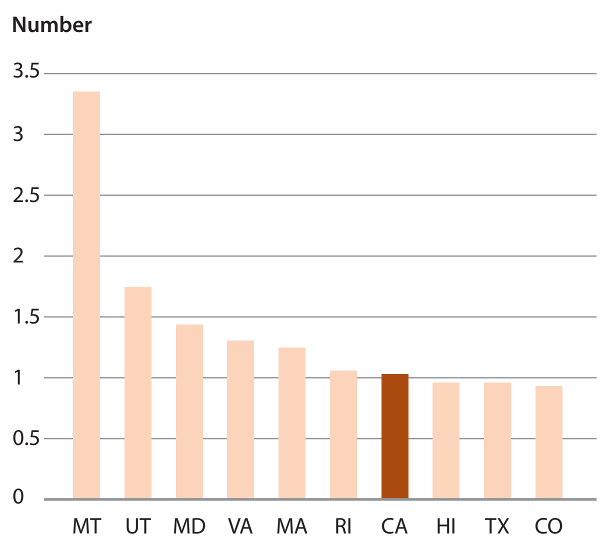
Inc. 500 Companies and California

With 1.04 Inc. 500 companies for every 10,000 business establishments, California ranked seventh. The state ranked 10th in the 2012 index. The top five states were Montana (3.4 companies), Utah (1.7 companies), Maryland (1.4 companies), Virginia (1.3 companies), and Massachusetts (1.24 companies).

Number of Inc. 500 companies per 10,000 establishments: 2013



Number of Inc. 500 companies: Top 10 states, 2013



Sources: Inc. magazine, U.S. Census Bureau

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Data for each state can be found at

www.statetechandscience.org

Appendix: List of Components in Each Composite Index

Research and Development Inputs	
Federal R&D Dollars per Capita	National Science Foundation (NSF)
Industry R&D Dollars per Capita	NSF
Academic R&D Dollars per Capita	NSF, Academic R&D Expenditure
National Science Foundation Funding	NSF, Experimental Program to Stimulate Competitive Research
National Science Foundation Research Funding	NSF, Experimental Program to Stimulate Competitive Research
R&D Expenditures on Engineering	NSF, Academic R&D Expenditure
R&D Expenditures on Physical Sciences	NSF, Academic R&D Expenditure
R&D Expenditures on Environmental Sciences	NSF, Academic R&D Expenditure
R&D Expenditures on Math and Computer Science	NSF, Academic R&D Expenditure
R&D Expenditures on Life Sciences	NSF, Academic R&D Expenditure
R&D Expenditures on Agricultural Sciences	NSF, WebCASPAR
R&D Expenditures on Biomedical Sciences	NSF, WebCASPAR
STTR Awards per 10,000 Businesses	Small Business Administration, U.S. Census Bureau
STTR Award Dollars	Small Business Administration
SBIR Awards per 100,000 People	Small Business Administration
SBIR Awards per 10,000 Businesses (Phase I)	NSF, Experimental Program to Stimulate Competitive Research (EPSCoR)
State Establishment Counts	County Business Patterns (data release in June for 2 years prior - i.e. 2010 data released June 2012)
SBIR Awards per 10,000 Businesses (Phase II)	NSF, EPSCoR
State Establishment Counts	County Business Patterns (data release in June for 2 years prior - i.e. 2010 data released June 2012)
Competitive NSF Proposal Funding Rate	NSF, EPSCoR
Risk Capital and Entrepreneurial Infrastructure	
Total Venture Capital Investment Growth	PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report, Thomson Financial
Number of Companies Receiving VC per 10,000 Firms	PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report, Thomson Financial
Growth in Number of Companies Receiving VC	PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report, Thomson Financial
Venture Capital Investment as Percent of GSP	PricewaterhouseCoopers/National Venture Capital Association MoneyTree™ Report, Thomson Financial
SBIC Funds Disbursed per $1,000 of GSP	Small Business Administration
Business Incubators per 10,000 Establishments	National Business Incubation Association, U.S. Census Bureau
Patents Issued per 100,000 People	U.S. Patent and Trademark Office
Business Starts per 100,000 People	U.S. Census Bureau
IPO Proceeds as Percent of GSP	Securities Data Corporation, Thomson Financial
VC Investment in Nanotechnology as Percent of GSP	Thomson Financial
VC Investment in Clean Technology as Percent of GSP	Thomson Financial
Sum of Equity Invested in Green Tech per $100,000 GSP	Thomson Financial

Human Capital Investment	
Percentage of Population with Bachelor's Degrees or Higher	U.S. Department of Education
Percentage of Population with Advanced Degrees	U.S. Department of Education
Percentage of Population with Ph.D.s	U.S. Department of Education
Graduate Students in Science and Engineering	NSF, EPSCoR
Per Capita State Spending on Student Aid	NSF, EPSCoR
Average Verbal SAT Scores	NSF, EPSCoR
Average Math SAT Scores	NSF, EPSCoR
Average ACT Scores	NSF, EPSCoR
State Appropriations for Higher Education (per capita)	NSF, EPSCoR
Percent Change in State Appropriations for Higher Education	NSF, EPSCoR
Doctoral Scientists per 100,000 People	NSF, Division of Science Resources Studies
Doctoral Engineers per 100,000 People	NSF, Division of Science Resources Studies
Science, Engineering, and Health Ph.D.s Awarded	NSF, Division of Science Resources Studies
Science, Engineering, and Health Ph.D.s Awarded	NSF, Division of Science Resources Studies
Percentage of Bachelor's Degrees in Science and Engineering	National Center for Education Statistics, U.S. Department of Education
Recent Bachelor's Degrees in Science and Engineering	NSF, Division of Science Resources Studies
Recent Master's Degrees in Science and Engineering	NSF, Division of Science Resources Studies
Recent Ph.D.s in Science and Engineering	NSF, Division of Science Resources Studies
Recent Degrees in Science and Engineering	NSF, Division of Science Resources Studies
Percentage of Households with Computers	U.S. Department of Commerce
Percentage of Households with Internet Access	U.S. Department of Commerce
Technology and Science Workforce	
Intensity of Computer and Information Scientists	Bureau of Labor Statistics, Milken Institute
Intensity of Computer Programmers	Bureau of Labor Statistics, Milken Institute
Intensity of Software Engineers	Bureau of Labor Statistics, Milken Institute
Intensity of Computer Support Specialists	Bureau of Labor Statistics, Milken Institute
Intensity of Computer Systems Analysts	Bureau of Labor Statistics, Milken Institute
Intensity of Database and Network Administrators	Bureau of Labor Statistics, Milken Institute
Intensity of Agricultural and Food Scientists	Bureau of Labor Statistics, Milken Institute
Intensity of Biochemists and Biophysicists	Bureau of Labor Statistics, Milken Institute
Intensity of Microbiologists	Bureau of Labor Statistics, Milken Institute
Intensity of Medical Scientists	Bureau of Labor Statistics, Milken Institute
Intensity of Physicists	Bureau of Labor Statistics, Milken Institute
Intensity of Other Life and Physical Science Occupations	Bureau of Labor Statistics, Milken Institute
Intensity of Electronics Engineers	Bureau of Labor Statistics, Milken Institute

Intensity of Electrical Engineers	Bureau of Labor Statistics, Milken Institute
Intensity of Computer Hardware Engineers	Bureau of Labor Statistics, Milken Institute
Intensity of Biomedical Engineers	Bureau of Labor Statistics, Milken Institute
Intensity of Agricultural Engineers	Bureau of Labor Statistics, Milken Institute
Intensity of Other Engineers	Bureau of Labor Statistics, Milken Institute
Technology Concentration and Dynamism	
Percent of Businesses in High-Tech NAICS Codes	Bureau of Labor Statistics, Milken Institute, U.S. Census Bureau
Percent of Employment in High-Tech NAICS Codes	Bureau of Labor Statistics, Milken Institute, U.S. Census Bureau
Percent of Payroll in High-Tech NAICS Codes	Milken Institute, U.S. Census Bureau
Percent of Business Births in the High-Tech Sector	U.S. Census Bureau
Net Formation of High-Tech Establishments	U.S. Census Bureau, NSF Science and Engineering Indicators
Number of Technology Fast 500 Companies	Deloitte & Touche, U.S. Census Bureau
Average Yearly Growth of High-Tech Industries	Moody's Economy.com, Milken Institute
High-Tech Industries Growing Faster Than U.S. Average	Moody's Economy.com, Milken Institute
High-Tech Industries With LQs Higher Than 1.0	Moody's Economy.com, Milken Institute
Number of Inc. 500 Companies	Inc. Magazine, U.S. Census Bureau
* All population statistics are from the U.S. Census Bureau. All Gross State Product figures are from the U.S. Department of Commerce.	

About the Authors

KEVIN KLOWDEN is director of the California Center at the Milken Institute, where he also serves as managing economist in the research group. He specializes in the study of demographic and spatial factors (the distribution of resources, business locations, and labor), how these are influenced by public policy, and how they in turn affect regional economies. Klowden has addressed the role of technology-based development in publications such as "North America's High-Tech Economy" and in location-specific studies on Arkansas and Arizona. In addition, he oversaw the yearlong Los Angeles Economy project, which examined key workforce and economic development issues in Los Angeles. Klowden was the lead author of "Film Flight: Lost Production and Its Economic Impact in California" and "The Writers' Strike of 2007–2008: The Economic Impact of Digital Distribution," both of which analyze the changing dynamics of the entertainment industry. He has also written on the role of transportation infrastructure in economic growth and job creation in reports such as "California's Highway Infrastructure: Traffic's Looming Cost" and "Jobs for America: Investments and Policies for Economic Growth and Competitiveness," as well as in several publications including *The Wall Street Journal*. Klowden earned an M.A. in economic geography from the University of Chicago and an M.S. in politics of the world economy from the London School of Economics.

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