GOLDEN GOOSE

THE PRESENT AND FUTURE OF CALIFORNIA'S TECHNOLOGY AND INNOVATION ECOSYSTEM

An In-Depth Analysis of the Facts, Origins and Trends of Advanced Technology and Basic Research in California

CALIFORNIA 100

VISION & STRATEGY FOR THE NEXT CENTURY

ABOUT CALIFORNIA 100

The California 100 Initiative envisions a future that is innovative, sustainable, and equitable for all. Our mission is to strengthen California's ability to collectively solve problems and shape our long-term future over the next 100 years.

California 100 is organized around 15 policy domains and driven by interrelated stages of work: research, policy innovation and engagement with Californians. California 100's work is guided by an expert and intergenerational Commission. Through various projects and activities, California 100 seeks to move California towards an aspirational vision—changing policies and practices, attitudes and mindsets, to inspire a more vibrant future.

This California 100 Report on Policies and Future Scenarios was produced as part of California 100's research stream of work, in partnership with 20 research institutions across the state. California 100 sponsored grants for data-driven and future-oriented research focused on understanding today and planning for tomorrow. This research, anchored in California 100's 15 core policy domains, forms the foundation for the initiative's subsequent work by considering how California has gotten to where it is and by exploring scenarios and policy alternatives for what California can become over the next 100 years.

The California 100 initiative is incubated through the University of California and Stanford.

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READ MORE ABOUT ADVANCED TECHNOLOGY AND BASIC RESEARCH IN CALIFORNIA

For additional information, read the related report at California100.org.

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Bay Area Council Economic Institute
California Center for Innovation

CALIFORNIA 100 RESEARCH PARTNERS

This Report is one of 15 reports that will be released in 2022 as part of the California 100 Initiative. We are proud to partner with the following research centers and institutes across California on our work:

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ABOUT THE BAY AREA COUNCIL ECONOMIC INSTITUTE

The Bay Area Council Economic Institute is the leading think tank focusing on the economy of the San Francisco/Silicon Valley Bay Area, one of the most dynamic regions in the United States and the world's leading center for technology, innovation and entrepreneurial activity. Much of its work also addresses economic issues in California. A forum for stakeholder engagement and a respected source of information and fact-based analysis, the Institute is a trusted partner to business leaders, government agencies, and educational institutions. Through its economic and policy research and its many partnerships, the Institute addresses critical issues impacting the competitiveness, growth, and quality of life in the Bay Area and California, including housing, infrastructure, healthcare, international trade, manufacturing, science and technology, innovation and global business. It is guided by a board of advisers drawn from leaders in the corporate, university, non-profit and government sectors. The Institute is part of the Bay Area Council, a business-supported public policy organization that engages more than 350 of the region's largest employers. It also supports and manages the Bay Area Science and Innovation Consortium (BASIC), a partnership of Northern California's leading scientific research laboratories and thinkers.

ABOUT THE CALIFORNIA CENTER FOR INNOVATION

The California Center for Innovation was created to generate and disseminate ideas related to technology & innovation in order to help policymakers and business leaders make decisions in the interests of the Common Good. The Center was founded as California's first think tank focused on innovation in our state – how it drives economic growth and helps solve society's problems, and how it gives rise to new challenges that we solve together. The California Center for Innovation was formed as an initiative of the Silicon Valley Leadership Group Foundation, which works to build community in the region, provides funds to support the needy, and serves as a forum for non-partisan research and analysis of public policy issues affecting Silicon Valley.

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INTRODUCTION

California is globally recognized as the world's leading center for technology, innovation and entrepreneurial opportunity. It is also the world's largest, most productive and most impactful innovation hub. While most concentrated in the San Francisco/Silicon Valley Bay Area, innovation assets are spread throughout the state. The economic strength that flows from this unique capacity has produced high-value jobs and world-leading companies and puts California at the leading edge of current and emerging technologies that will transform the world's economy in coming decades.

The income that this activity generates is also a critical source of revenue for the state through the personal income tax (PIT) and in particular taxation of IPOs and capital gains. In the state's 2019-2020 fiscal year PIT accounted for 66.19% of California's General Fund revenues. PIT revenues for the 2020-21 fiscal year totaled $98.13 billion, 18.9% higher than estimated in the Governor's budget proposal - a surge that is largely attributable to taxation on technology IPOs and stock gains. [1] The California Legislative Analyst's Office attributes growth in 2019-20 withholding levels to gains in sectors such as professional/technical services, computer equipment, web search and software, and vehicular companies such as Tesla. [2]

As the influence of technology and innovation on the broader economy expands to touch virtually every sector of the economy, awareness has grown of the need to enable more Californians to meaningfully participate in the innovation economy. Returns on investment in skills are continuing to grow, deepening digital divides shaped by region, race, language ability, gender, and other systemic factors. Governments across the globe are implementing policies to sup-

[1] Office of California State Controller Betty Yee, May 2021 California Personal Income Tax Daily Revenue Tracker.

[2] Justin Garosi and Brian Uhler, Examining California's Income Tax Withholding Growth by Sector, Office of the Legislative Analyst, June 9, 2021. https://lao.ca.gov/LAOEconTax/Article/Detail/662.

port innovation because of its positive externalities, but opinion polls show Californians more attuned to negative externalities associated with the technology economy – from global issues concerning privacy and misinformation to local housing and traffic dynamics. [3] [4]

The worldwide perception of California's leadership in technology and innovation has for decades attracted scientists and technologists to its universities and research laboratories, and investors and startups to its cities. This concentration of activity has created a positive cycle where more discovery, more funding and more startups have been drawn to California in search of technology, venture capital, and business opportunity. While California's economy is diverse – spanning agriculture, finance, entertainment, tourism and many other fields – its strength in science, technology and innovation uniquely defines its leadership on the national and global stage. California's success in maintaining and expanding its technological edge holds the key to its future competitiveness and its ability to generate jobs, wealth and taxes through the growth of existing companies and the creation of new ones.

This remarkable level of success stems from the confluence of a number of drivers that together create a self-reinforcing ecosystem and critical mass of activity that nowhere else in the United States or the world can currently replicate. This report assesses those drivers from the standpoint of California's capacity in basic research and advanced technology, key trends and issues that could impact the state's long-term leadership. Because technology moves quickly and other cities, states and nations are working to replicate California's success, its advantages require investment and should not be taken for granted.

[3] Brenan, Megan. 2021. "Views of Big Tech Worsen; Public Wants More Regulation." Gallup. February 18, 2021. Retrieved September 30, 2021 https://news.gallup.com/poll/329666/views-big-tech-worsen-public-wants-regulation.aspx

[4] Matas, Nour and Rob Copeland, 2020. "Google Wants to Pour Money Into San Jose. The City has a Few Demands." The Wallstreet Journal, January 28, 2021. Retrieved September 30, 2021.

FACTS | CALIFORNIA'S TECHNOLOGY & INNOVATION ECOSYSTEM

"Being deeply engaged in San Diego's innovation ecosystem and seeing what happens across the state, I'm inspired every day by Patrick Soon-Shiong's observation when he assumed ownership of the LA Times that "California is where the world comes to see the future."

- Mary Walshok, Co-Founder, UCSD Connect

"What makes California special and different are its universities and funding resources, but also the fact that California is a land where people come from somewhere else seeking something. They come to be part of the ecosystem. California is a place that lets you in, no matter where you come from, and people have a chance even if their resume isn't perfect. And the world has poured in – nearly every company with a major interest in tech has a presence."

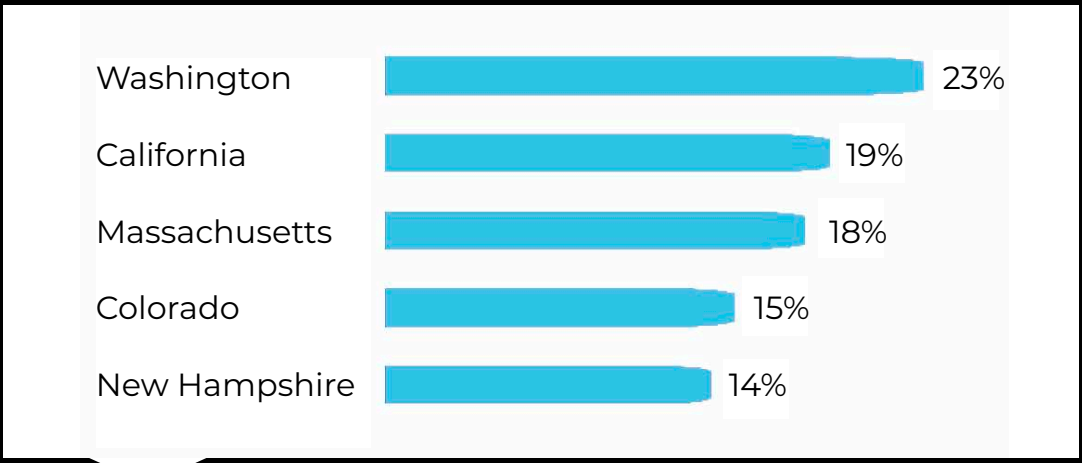
- Bill Reichert, Partner, Pegasus Ventures

California's advanced technology ecosystem is composed of a complex of public and private institutions and companies that conduct basic and applied research and commercialize and deploy advanced technologies and new business models, particularly through the creation of new companies. Over time technological change will impact every industry and company, and can enable solutions to many of our most pressing public challenges. This puts technology squarely at the heart of the economy. The ecosystem that supports it includes universities that generate intellectual property and talent; public, private and non-profit research laboratories; startup incubators and accelerators; venture and angel investors; and intangible assets such as an openness to collaboration and to risk and new ideas that pervades Silicon Valley but is not as easily found elsewhere. Though the innovation process isn't driven by government, government plays an important supporting role as an investor in education, by creating markets (for example, in renewable energy), and through the regulations that can positively or negatively influence the environment within which innovation takes place.

CALIFORNIA AS THE CENTER OF THE GLOBAL TECHNOLOGY ECONOMY

California dominates the nation's technology landscape. According to CompTIA's 2021 Cyberstates report, California leads the nation in overall economic impact and net technology jobs. The $519B its tech sector contributes to the economy represents more than a quarter of total US technology output, and more than the next four states combined. [5] Despite the size and diversity of the California economy, tech now accounts for nearly one-fifth of the economic value produced in the state. From an employment standpoint, California leads the nation in tech job postings by a wide margin. With 12% of the nation's population, its 1,882,167 technology jobs in 2020 accounted for 15% of the nation's tech workforce. [6] Jobs in tech are expected to grow 16 percent between 2020 and 2030 – above the 15 percent national average but tied for 10th among U.S. states behind key competitor Texas (21% expected growth) and smaller surging states (Utah – 29%; Nevada – 24%; Idaho – 23%). [7] Jobs in the

Figure 1 **Top 5 States - Tech's Economic Value (% of GDP) (2020)**



DATA SOURCE: CompTIA

[5] Computer Technology Industry Association. 2021. CompTIA Cyberstates 2021: The Definitive Guide to the U.S. Tech Industry and Tech Workforce. Downers Grove, IL: COMPTIA. Retrieved September 17, 2021. (https://www.cyberstates.org/pdf/CompTIA_Cyberstates_2021.pdf).

[6] Ibid.

[7] Ibid.

Table 1 **Largest Global Technology Companies Headquarters Location**

1	Apple	California, USA	11	Cisco Systems	California, USA
2	Samsung Electronics	South Korea	12	Dell Technologies	Texas, USA
3	Alphabet	California, USA	13	Hon Hai Precision Industry Co.	Taiwan
4	Microsoft Corp.	Washington, USA			
5	Tencent Holdings	China	14	SAP AG	Germany
6	Facebook	California, USA	15	Broadcom Limited	California, USA
7	Intel Corp.	California, USA	16	Salesforce.com	California, USA
8	IBM	New York, USA	17	Accenture Pic	Ireland
9	TSMC	Taiwan	18	SK Hynix	South Korea
10	Oracle Corporation	California, USA	19	Qualcomm	California, USA

DATA SOURCE: Forbes

tech sector are important by themselves but also have a multiplier effect: A study conducted by the Bay Area Council Economic Institute found that one job in the high-tech sector supports 3.6 additional non-tech jobs in the local goods and services economy.[8]

California's technology job growth has been driven by a combination of early-stage companies and mature firms. The state leads the nation in tech business establishments and dominates the IPO pipeline with 56% of the nation's private companies valued at more than $1B.[9] California is also headquarters to 11 of the 20 largest global technology firms. [10] No other U.S. state has more than a single Headquarters in the top 20, and Taiwan and South Korea are the only nations outside of the United States with more than 2 global headquarters.

California fares well in many of the indices developed for evaluating innovation regions. The Startup Genome Global Startup Ecosystem Report 2020 ranks Silicon Valley at the top, with

[8] Bay Area Council Economic Institute, "Technology Works: High-Tech Employment and Wages in the United States", December 2012.

[9] Bay Area Council Economic Institute, Unicorn Companies in the Bay Area, 2021

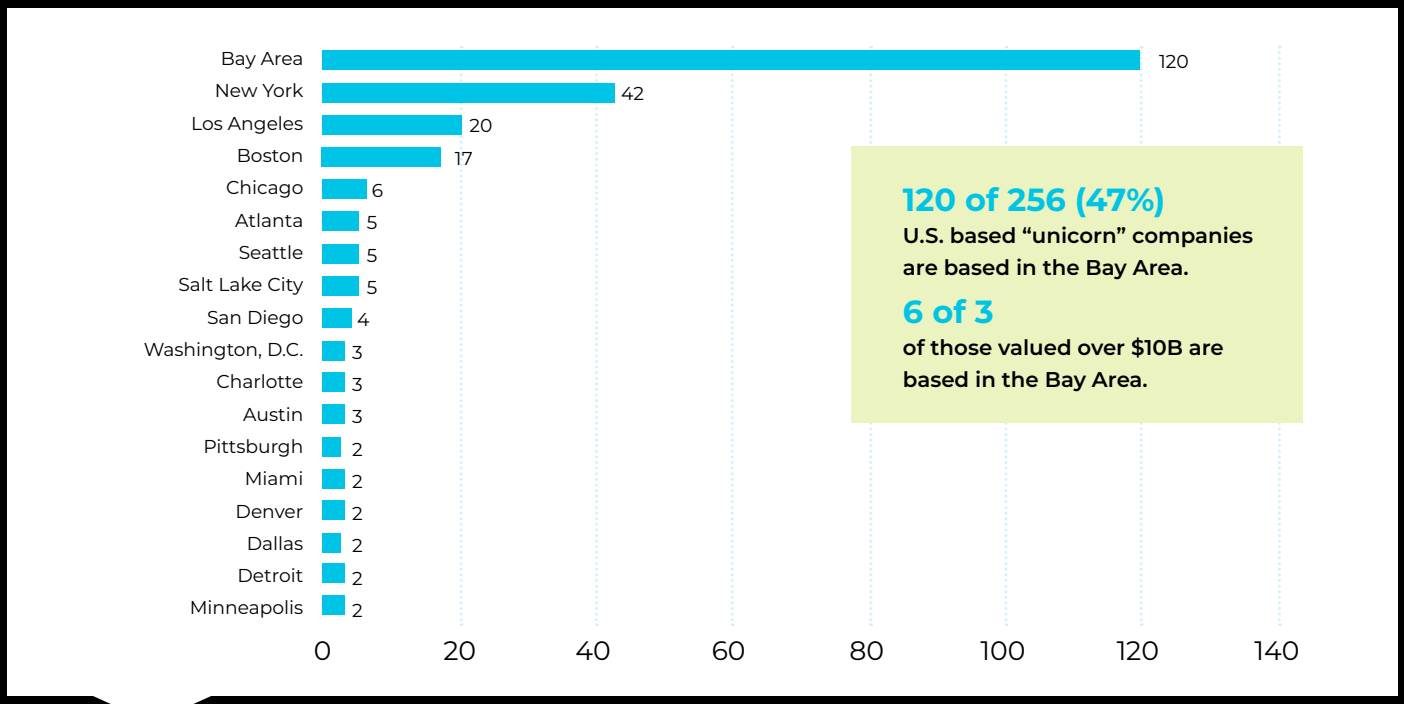
[10] Ponciano, Jonathan. 2021. "The World's Largest Technology Companies In 2021: Apple's Lead Widens As Coinbase, DoorDash Storm Into Ranks." Forbes, May 13. Retrieved September 30, 2021. (https://www.forbes.com/sites/jonathanponciano/2021/05/13/worlds-largest-tech-companies-2021/?sh=4fe7e81169bc).

Los Angeles tied for 6th and San Diego at #21.[11] The US, China and Canada are the only nations with more than one ecosystem in the top 30; no other US state has more than one. The picture is more mixed for the nation as a whole. The U.S. slid down two slots year-over-year to number 11 in Bloomberg's 2021 Innovation Index, after occupying the top spot since 2013. [12]

Figure 2

Private Companies in IPO Pipeline with Valuations Over $1B

(as of January 26, 2021)



DATA SOURCE: CB Insights, **ANALYSIS:** Bay Area Council Economic Institute.

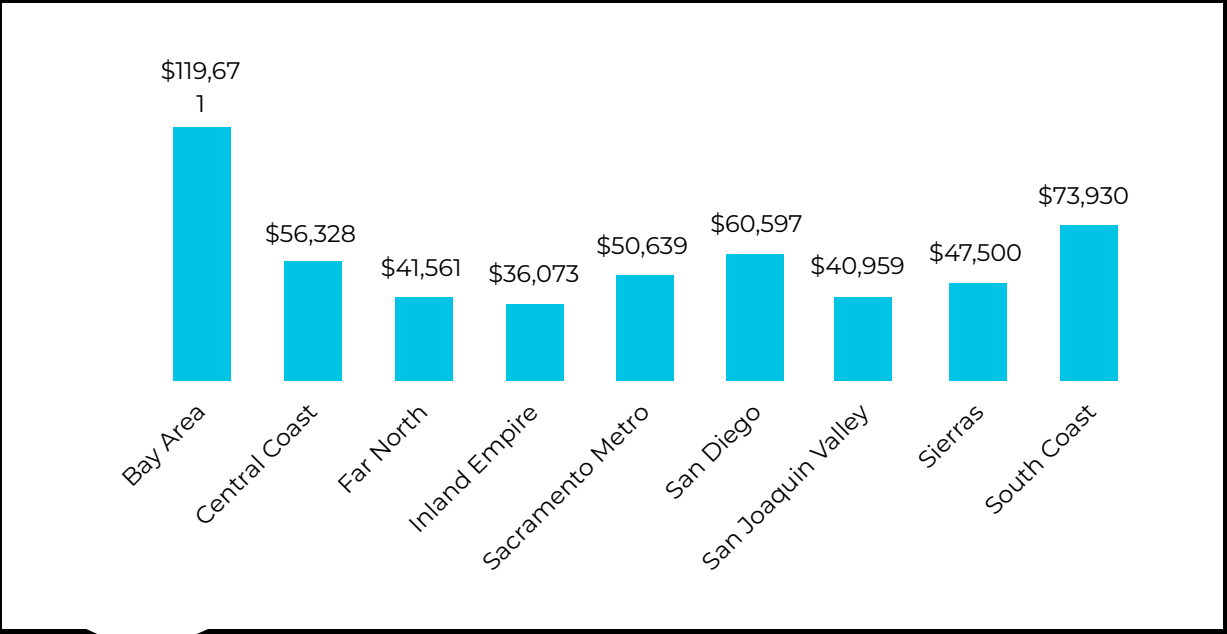
NOTE: There is one unicorn company located in each of the following locations: Buffalo, Columbus, Houston, Jacksonville, Kansas City, Milwaukee, Philadelphia, Portland, Raleigh-Durham, Santa Barbara, and Stamford.

[11] Computer Technology Industry Association. 2021. CompTIA Cyberstates 2021: The Definitive Guide to the U.S. Tech Industry and Tech Workforce. Downers Grove, IL: COMPTIA. Retrieved September 17, 2021. (https://www.cyberstates.org/pdf/CompTIA_Cyberstates_2021.pdf).

[12] Jamrisko, Michelle, Wei Lu and Alexandre Tanzi. 2021. "South Korea Leads World in Innovation as U.S. Exits Top Ten." Bloomberg, February 2. Retrieved September 30, 2021 (https://www.bloomberg.com/news/articles/2021-02-03/south-korea-leads-world-in-innovation-u-s-drops-out-of-top-10).

Across the globe, the technology economy is concentrated in a relatively small number of dynamic metropolitan regions. In California, technology jobs are heavily concentrated in three regions: nearly half are in the Bay Area (home to 19% of the state's population), 32% in Los Angeles and Orange Counties, and 11% in the San Diego area. The San Francisco Bay Area has the largest pool of technology talent in the United States with 373,430 tech workers, a 16.4% increase from 2015; technology accounts for 10.9% of all jobs in the region, or nearly triple the 3.9% national average. In the San Jose Metropolitan Area, technology jobs make up 33.7% of total employment. [13] The Greater Los Angeles region in Southern California has also become a significant technology center, which with 228,720 employees has the fifth largest tech pool of tech talent nationally, following an 18.6% increase from 2015-2020. [14]

Figure 3 **GDP Per Capita - 2019**



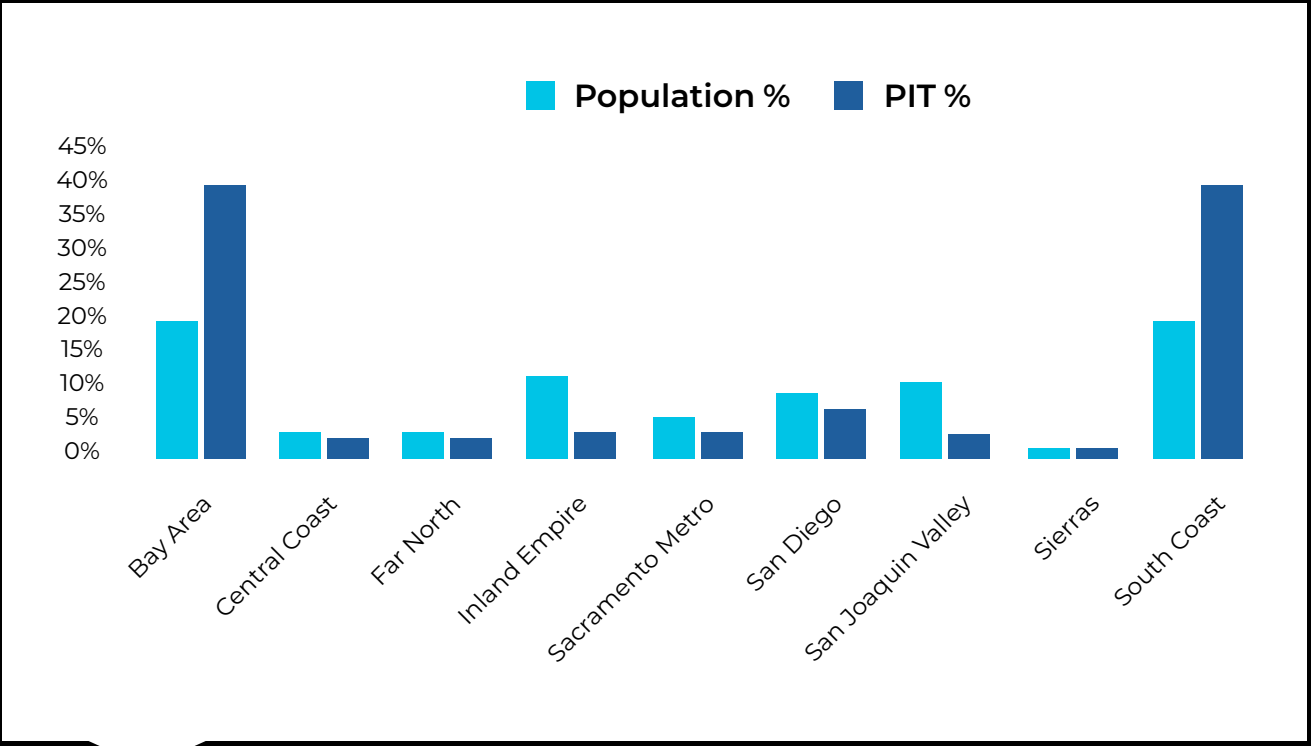
SOURCE: Bureau of Economic Analysis

[13] Computer Technology Industry Association. 2021. CompTIA Cyberstates 2021: The Definitive Guide to the U.S. Tech Industry and Tech Workforce. Downers Grove, IL: COMPTIA. Retrieved September 17, 2021. (https://www.cyberstates.org/pdf/CompTIA_Cyberstates_2021.pdf).

[14] CBRE Research. 2021. Scoring Tech Talent Report Scoring Tech Talent: How Tech Labor Trends Inform Workforce Decisions & Influence Real Estate in 50 U.S. & Canadian Markets. Retrieved September 30, 2021. (https://www.cbre.us/-/media/cbre/countryunitedstates/us-research/major-reports/2021/scoring-tech-talent-media-folder/2021-scoring-tech-talent.pdf).

Concentration in the tech sector drives per capita GDP, which in the Bay Area is nearly $50,000 higher than any other region of the state. Reflecting this, the personal income tax paid in the Bay Area is double the state's per capita average – a figure so high that PIT assessment is below the state's average in every other region.

Figure 4 **Personal Income Tax (PIT) Paid by Region - 2018**



SOURCE: Bureau of Economic Analysis

FACTS | REGIONAL TECHNOLOGY AND INNOVATION CLUSTERS

THE SAN FRANCISCO/SILICON VALLEY BAY AREA

The technology revolution led by Silicon Valley has its roots in universities such as Stanford and Berkeley that for decades have served as anchors that generate both technology and company founders. The space race launched by Sputnik and the Cold War that followed it played an important role in Silicon Valley's development, with federal research and defense funding flowing heavily to universities, federal research laboratories, and private companies in the aerospace and IT sectors. For the most part, however, Silicon Valley has grown spontaneously and without a government plan, driven by a confluence of university research, visionary business leaders who created industry-leading companies such as Intel and Hewlett Packard, venture capital and an entrepreneurial mindset where successful technology leaders support and invest in the generations of startups that have followed.

The Bay Area's innovation system today builds on a complex and highly networked web of technology companies, including the largest concentration of IT and biotech companies in the nation; five major research universities including four campuses of the University of California and Stanford; numerous independent and non-profit research laboratories; five national research laboratories; the world's largest pool of venture capital; the largest community of startups and early stage growth companies in the United States; an array of incubators and accelerators; and a large complex of research and innovation centers representing U.S. and globally headquartered corporations. Underlying this presence is a shared philosophy of open innovation that enables people and ideas to flow with relative ease across companies and between companies and institutions.

The region is characterized not only by its density of scientists, technology companies and startups, but by the diversity of the technologies that it produces, from semiconductors to IT, biotechnology, nanotechnology, AI, and a broad array of applications (cleantech, fintech, insuretech, agtech, etc.), with digitalization a common theme. This enables cross-disciplinary innovation (bioinformatics being one example). Large companies such as Google and Facebook acquire and invest in startups on a large scale and attract other companies from around the world whose business models depend on their platforms.

A distinctive quality of Silicon Valley's rise as a global technology center has been its capacity to create, incubate and accelerate transformative technologies. As those technologies have matured and spread the region has successfully pivoted to new technologies that launch further waves of innovation. This capacity for reinvention has enabled the region to define and lead successive phases of the technology revolution, keeping it at the leading edge of innovation.

Table 2 **Silicon Valley: Waves of New Industries Each with World-Leading Companies**

	Key Silicon Valley Industry	Major technology Innovation	Rising world leaders
Early 1970s	Silicon wafer manufacturing	Silicon crystal growth	
Late 1970s	(Highly) integrated microelectronics	Microprocessor	Intel, others
Early 1980s	New computer systems	RISC chip, new OS	SUN, Silicon Graphics
Late 1980s	Software	Relational databases, graphic user interface	Oracle
Mid 1990s	Internet	Hypertext	Netscape
Late 1990s	E-commerce	DSL, business enablers	Yahoo, eBay
Early 2000s	Web 2.0	Search engines	Google
Late 2000s	Social networking	New business models	Facebook, Twitter
2010 - 20	Intelligent mobility	Cloud & mobile client integration	Tesla, Uber

SOURCE: Richard Dasher, Stanford University

"Between the universities, national laboratories and the resources of Silicon Valley there are only a handful of places in the world that come anywhere close to the Bay Area for the amount of technical expertise that's concentrated in one place"

– Andy McIlroy, Associate Director, Sandia National Laboratory - California

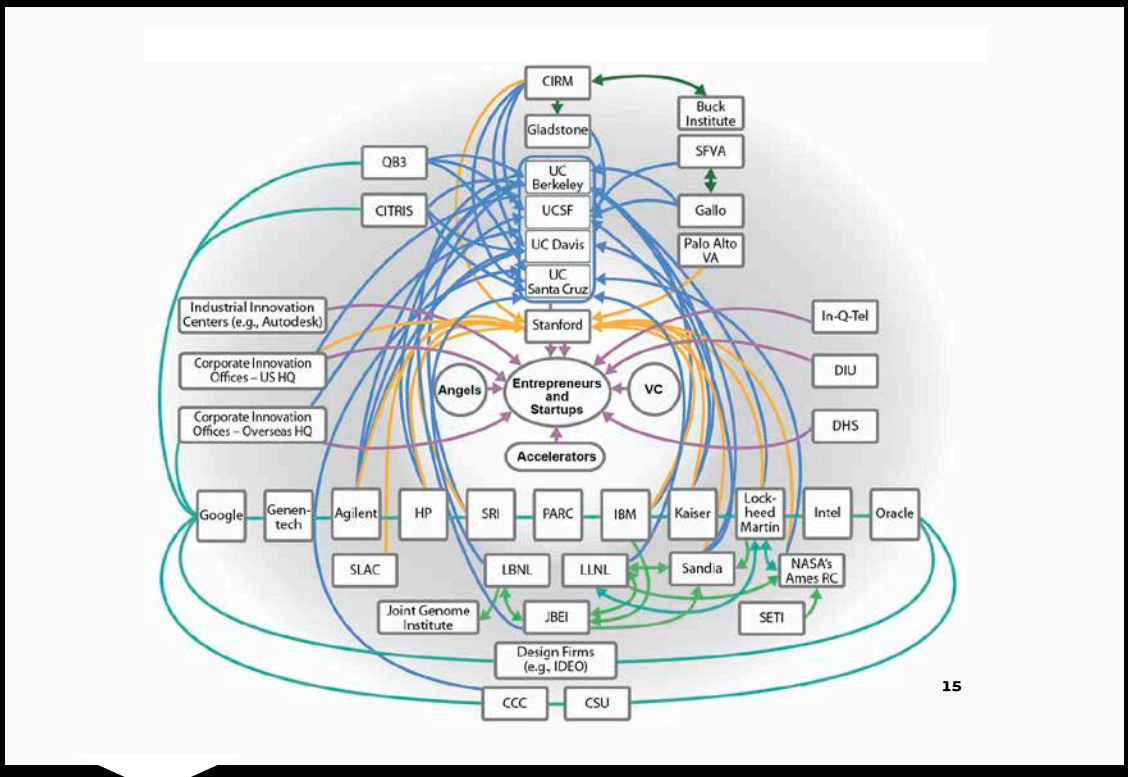
"The Bay Area offers an embarrassment of riches for innovation. The major players are well established, and the environment is dynamic. There are four national laboratories and when you add in Stanford and Berkeley you have a significant fraction of the basic research being done in the country being done within easy reach."

- Kim Budil, Director, Lawrence Livermore National Laboratory

"Being in Silicon Valley has been critical to the success of 500 Startups. Nowhere else in the United States or the world has a unique connection to startups, founders and capital."

- Vijay Rajendran, Director of Innovation and Partnerships, 500 Global

Figure 5 **Representative Collaborative Patterns in the Bay Area Innovation System**



SOURCE: Bay Area Council Economic Institute.

THE GREATER LOS ANGELES REGION OF SOUTHERN CALIFORNIA

The Greater Los Angeles region of Southern California encompasses a range of jurisdictions: Los Angeles County, Riverside County, Orange County, Ventura County and Santa Barbara County. Like other California regions it builds on a strong base of research universities, including four campuses of the University of California (UCLA, UC Riverside, UC Irvine and UC Santa Barbara), Caltech and USC. UCLA and UC Santa Barbara are linked by the California Nanosystems Institute, one of four California Institutes of Science and Innovation that facilitate joint research by UC campuses on shared technology priorities. CalTech manages NASA's Jet Propulsion Lab (JPL) in Pasadena, which generates technologies in fields including quantum computing, life science, materials science, machine learning and AI. The region is also home to leading non-profit research centers such as the Lundquist Institute for Biomedical Innovation which is associated with UCLA, and the Saban Research Institute at Children's Hospital Los Angeles.

Southern California's technology economy initially grew out of the aerospace industry that developed during World War II. Attracting heavy federal investment during that war and the Cold War that followed, the industry peaked in the late 1960s at 14% of the state's economy. Federal defense spending in California declined after that, with a sharp drop in the 1970s after the Vietnam War and the moon program ended, and despite a rebound in the 1980s at the end of the Cold War now accounts for a much smaller share of the state's economy. [16] Aerospace remains an important sector in Southern California but with a diminished base as many companies have moved activity out of state. The region's aerospace experience provides a cautionary note for the future: that technologies and economies evolve, and long-term dominance in any sector for any state or region is not guaranteed.

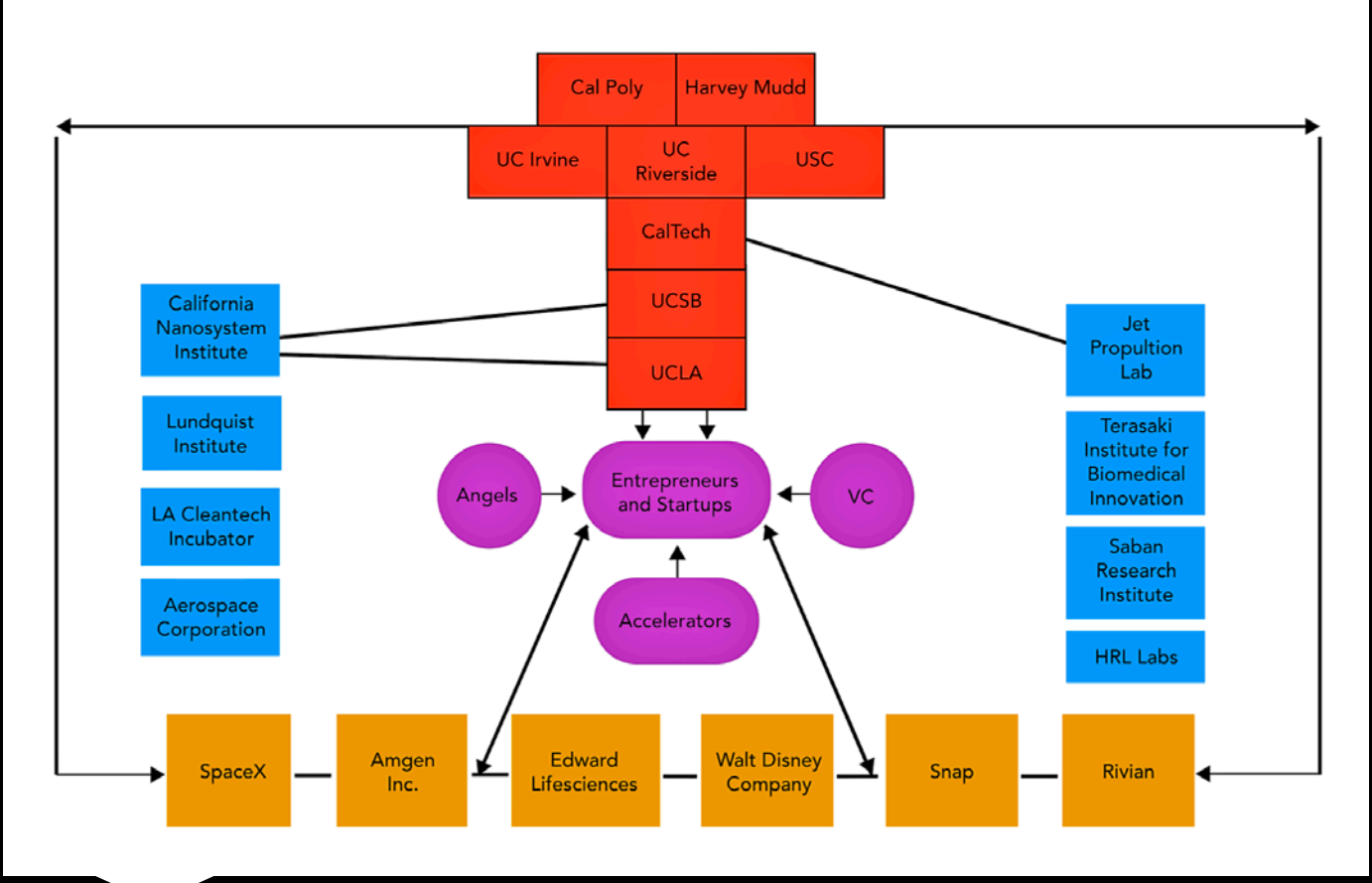
Today Southern California's technology economy is more diverse, spanning space and aerospace but also bioscience, medical devices, semiconductors, photonics, mobility, cleantech, consumer tech and digital entertainment. Companies such as Amgen (biopharma), Edwards Life Science (medical devices), Activision Blizzard (gaming), Snap (social media) and Broadcom (semiconductors) are indicative of the region's technology business base. Its space sector has evolved to focus on the commercialization of space, through companies such as SpaceX, Virgin Galactic, Virgin Orbit, Relativity Space and Rocket Labs, with a growing cluster developing in

[16] California Legislative Analyst's Office. 1995. "Cal Guide: A Program of State Programs and Finances." Sacramento: Legislative Analyst's Office. (Retrieved 9.27.2021) (https://lao.ca.gov/1995/010195_calguide/cgep1.html).

Long Beach. In mobility, the region is home to Elon Musk's Hyperloop and Boring Company. The biotech, life science and medical devices sectors are strong in Los Angeles and Orange County, with important links to UC Irvine, UCLA's School of Medicine, and USC. USC has close ties to the entertainment industry and in addition to hosting the USC School of Cinematic Arts offers the world's first degree in video gaming.

The Inland Empire (Riverside and San Bernardino Counties), has a distinct economy anchored by logistics and warehousing as well as agriculture. Though the region is not a major tech center or home to large tech or biotech companies, research and innovation activity is growing around UC Riverside, which hosts $300 million in research activity, a medical school, a life science incubator, a venture fund and the newly-created Oasis (Opportunities to Advance Sustain-

Figure 6 **Although Less Complex Than the Bay Area's Network, Los Angeles Also Relies on Strong Institutions for It's Innovation Economy**



SOURCE: Bay Area Council Economic Institute

ability, Innovation and Social Inclusion) Project. Oasis is an initiative to leverage the university's expertise in greenhouse gas emissions, air quality, clean energy, intelligent transportation, agriculture, natural resources management, and health to support an innovation community and facilitate technology transfer. Phase 1 of the project will leverage the recently-announced plan by the California Air Resources Board (CARB) to build a $419 million research laboratory adjacent to the university.

At a smaller scale than in the Bay Area, the region generates a growing number of startups and access to venture capital is growing, as seen in more later stage (B and C) rounds. The Alliance for SoCal Innovation reports that late-stage funding now accounts for 39% of venture investment in Southern California (including greater Los Angeles, Orange County and San Diego) vs. 60% in the Bay Area.

SAN DIEGO

San Diego's ecosystem is built around three core industries: aerospace, telecommunications, and life science.

As in Los Angeles, aerospace was a key driver during World War II and through the 1970s. Though it remains an important sector for the region and has evolved to include technologies such as drones, it is less central to the region's economy today as the importance of telecom and life science has grown.

San Diego's ICT and telephony network developed around Qualcomm, one of the world's top 20 technology companies and a leading producer of semiconductors, software and services for wireless communication. Qualcomm itself emerged from an earlier company that is considered the cornerstone of the industry in San Diego: Linkabit. [17] Andrew Viterbi was an Italian immigrant who had moved from New England in 1957 to take a job at the Jet Propulsion Lab at CalTech and Irwin Jacobs was a member of the engineering faculty at MIT who joined him at JPL in 1964. Drawn by the opportunity to build a new program at UC San Diego – and by the weather [18] – Jacobs moved there in 1965 where he, Viterbi and UCLA professor Lawrence Klein-

[17] West, Joel. 2009. "Before Qualcomm: Linkabit and the Origins of San Diego's Telecom Industry." Journal of San Diego History: Winter/Spring 2009, Volume 55, Numbers 1 & 2. Retrieved October 1, 2021 (https://sandiego-history.org/journal/v55-1/pdf/v55-1west.pdf).

[18] Daniel S. Morrow, "Irwin Mark Jacobs Oral History," interview transcript, Computerworld Honors Program International Archives, March 24, 1999.

rock founded Linkabit four years later. The Linkabit story entered a new phase in 1978, when the company merged with M/A-COM. Jacobs and Viterbi left a few years after that and were followed by a core of experienced managers and engineers, many of which went on to form the core of approximately two hundred wireless communications startups created in the San Diego region between 1980 and 2003, including Qualcomm in 1985. [19]

San Diego's biotech cluster developed in a similar way, building on a symbiotic relationship between academia and industry. The Scripps Research Institute, the Salk Institute, and UCSD each cultivated relationships between their researchers and private industry. If Linkabit was the cornerstone of San Diego's technology industry, Hybritech was the foundation of the region's biotech cluster. Established in 1978 by UCSD professors Ivor Royston, an immigrant from the UK, and Howard Birndorf, Hybritech alumni would go on to found more than 50 companies in the region, including at least 8 firms in the first two years after Hybritech was sold to Eli Lilly in 1986. [20] That sale created a cadre of local investors deeply embedded in biotech. By 2008, Biocom estimates, more than 150 San Diego companies – nearly a quarter of the region's biotech industry, had roots in Hybritech. [21] Major companies today include Illumina, an industry leader in the field of life science tools and systems.

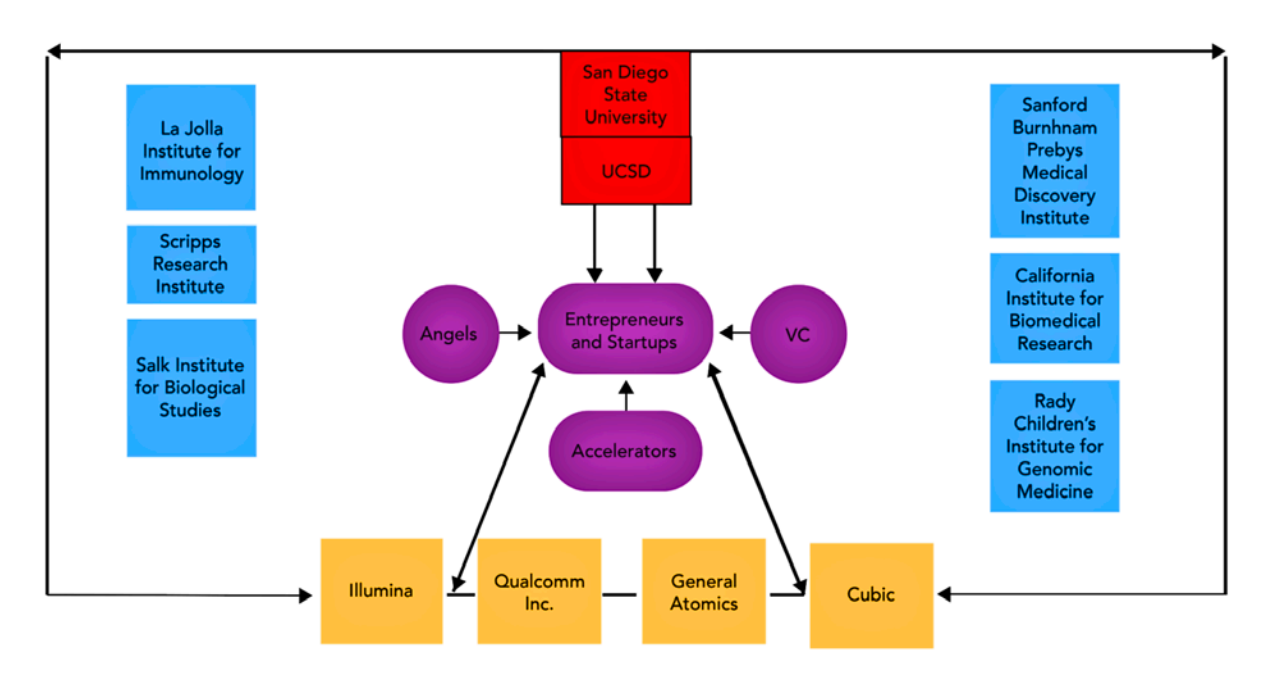
UC San Diego has played a catalytic role in this wave of technology innovation, connecting on-campus research with the region's economy and business community through innovative programs such as CONNECT. To deepen those connections, the university will open a UCSD Urban Center in downtown San Diego that will offer programming on both tech and culture. The California Institute for Telecom and Information Technology (CalIT2), a California Institute for Science and Innovation that partners UCSD with UC Irvine, provides a foundation for telecommunications research. In the life science sector, the region is home to the UC San Diego School of Medicine and leading research institutes such as the Sanford Consortium for Regenerative Medicine, the Sanford Burnham Prebys Medical Discovery Institute, the California Institute for Biomedical Research, the Scripps Research Institute, and the Salk Institute.

[19] Simard, Caroline. 2004. From Weapons to Cell-Phones: Knowledge Networks in the Creation of San Diego's Wireless Valley. (PhD dissertation, Stanford University, 2004).

[20] Porter, Michael E. 2001. Clusters of Innovation Initiative: San Diego. Washington DC: Council on Competitiveness (https://www.hbs.edu/ris/Publication%20Files/COI_SanDiego_0077428b-c9b2-4527-abcf-4a9769e530c8.pdf).

[21] Bennett, Darryn. 2008. How San Diego Biotech Started and Where It's Going. Voice of San Diego, August 4. Retrieved on October 1, 2021. (https://www.voiceofsandiego.org/topics/news/how-san-diego-biotech-started-and-where-its-going/)

Figure 7 **San Diego Also Has A Strong Innovation Ecosystem**



SOURCE: Bay Area Council Economic Institute

The Alliance for SoCal Innovation, which promotes innovation in the region that extends from San Diego to Ventura County, provides these comparative metrics for innovation activity in Southern California:

Table 3 **Comparative Metrics for Innovation in Southern California**

	Bay Area	Los Angeles	San Diego	Orange County	Ventura
Startups	6,800	3,000	650	60	30
Unicorns	96	11	2	-	-
Unicorn Exits	41	8	1	-	1
Tech Talent	380,000	14,000	77,000	74,000	TBD

SOURCE: Alliance for SoCal Innovation

THE CENTRAL VALLEY AND SACRAMENTO METRO

The Central Valley's economy is led by agriculture but is more diverse in Greater Sacramento, which hosts facilities of technology companies such as Intel and Micron. Because of its proximity and relative affordability, the Sacramento region has benefitted from the expansion of Bay Area companies.

Historically the Central Valley has not enjoyed the same level of prosperity as the coastal urban centers, with lower salaries and levels of education. This makes economic development and diversification a priority for both government and business leaders. Universities are playing a central role in that transition, anchoring research and entrepreneurial support and prioritizing higher education for historically underserved communities. UC Davis is the top agricultural research campus in the nation and a global leader in plant science and biological engineering and plays a pivotal role in California's wine industry. Research and innovation span agtech (which relates to the front-end process of growing food) and foodtech (the production of food products, including alternatives to animal-based proteins). University-sponsored innovation competitions and an array of public/private accelerators support startups and push food and other technologies to the market.

UC Merced, the newest of the University of California's ten campuses, has risen rapidly in the national ranks of research universities, with strength in agricultural technology, sustainability and data science. Initiatives include a new Experimental Smart Farm, which brings technological innovation to agriculture, and its engineering program was critical to the decision to locate the Autonomous Vehicle Test Drive Center at neighboring Castle Air Force Base. With its focus on serving low-income students, Merced is ranked fourth in the nation in its support for social mobility and eighth for the diversity of its undergraduate population. [22] Seventy-one percent of undergraduates are first generation, and Merced is the only public university and only research university in the nation with a Pell Grant eligible population over 60% and a graduation rate over 60%. [23] W-STEM (Women in Science, Technology, Engineering and Math) works to advance women in STEM fields through interdisciplinary research and training.

[22] US News & World Report. 2022. "US News & World Report Best Colleges." (https://www.usnews.com/best-colleges/university-of-california-merced-4127/overall-rankings).

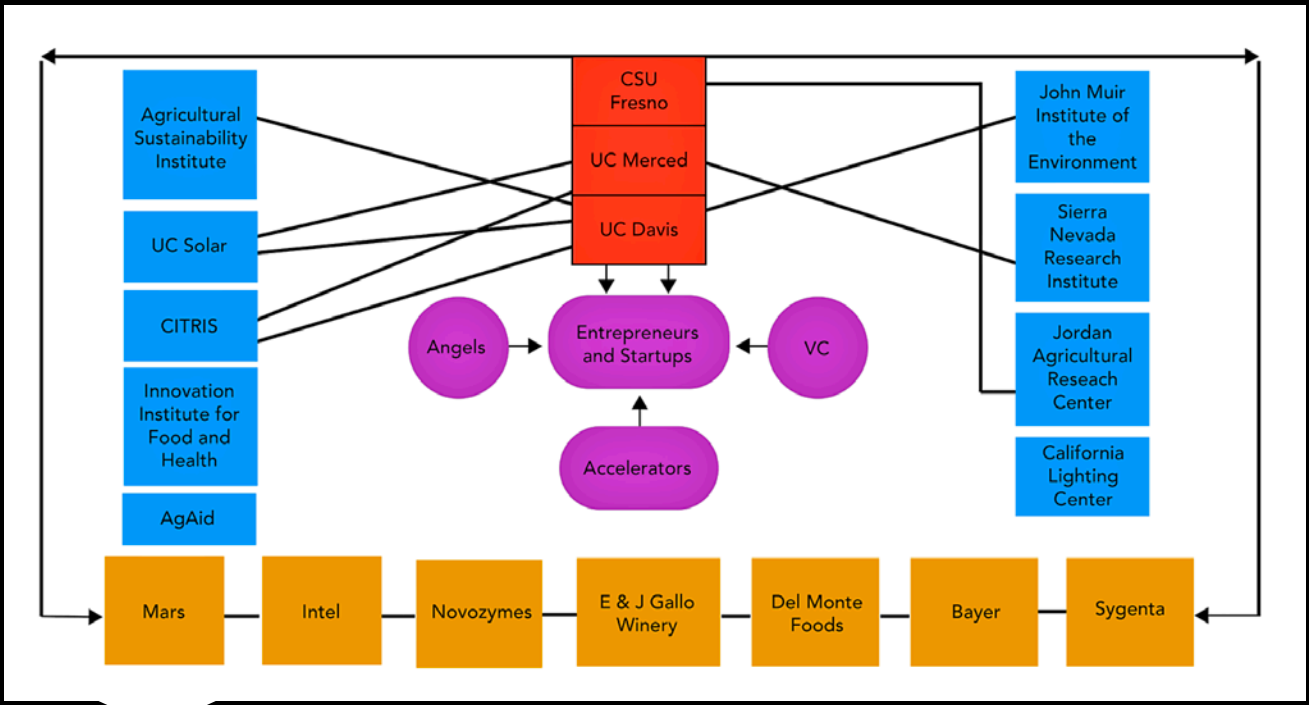
[23] University of California Merced, Diversity@Merced, Fall 2021.

Key research programs in the Central Valley, predominantly associated with universities, include the Food and Innovation Institute for Food and Health (UC Davis), the AI Institute for Next Generation Food and Health (UC Davis), the Agricultural Sustainability Institute (UC Davis), the California Lighting Technology Center (UC Davis), the John Muir Institute of the Environment (UC Davis), UC Solar (a systemwide partnership of 9 UC campuses based at UC Merced), the Sierra Nevada Research Institute (UC Merced), the AgAID Institute (UC Merced) and the Jordan Agricultural Research Center (CSU Fresno). Reflecting cross-system collaboration, a new $30 million Fresno-Merced Food Innovation Corridor approved in 2021 will stimulate research and development, commercialization and innovation in sustainable agricultural production. The application of advanced technology to the challenge of agricultural sustainability is a shared focus. Both UC Davis and UC Merced also participate in the multi-campus Center for Information Technology in the Interest of Society (CITRIS), one of the four California Institutes for Science and Innovation, which also includes UC Berkeley and UC Santa Cruz.

Beyond universities, state agencies such as the California Air Resources Board and the California Energy Commission support energy and environmental research and drive public policies that help to shape markets. A public-private partnership, the Sacramento-based California Mobility Center supports the commercialization of advanced mobility technologies.

Compared to the coastal centers, the Central Valley lacks headquartered companies that are deeply engaged in basic research, though agricultural companies work actively with campuses such as Davis and Merced on applied research. Significantly, however, a wide array of national and global food and agtech companies have an active presence in the Sacramento region through R&D and innovation offices, in order to engage research at UC Davis, and through Davis with the University of California's agtech and foodtech network. Leading companies with an active presence include Mars, Novozymes, Turtletree, BASF, Bayer and Sygenta.

Figure 8 **The Innovation Ecosystem in the Sacramento Metro Region**



SOURCE: Bay Area Council Economic Institute

"The University of California Davis is at the heart of the world's most powerful innovation cluster focusing on the future of the multi-trillion dollar food sector. Essentially every major player from the agriculture, ingredients and consumer products sectors has significant connections to Davis including several who have world-class R&D and innovation hubs either on or near the campus."

- Harold Schmitz, General Partner March Capital and former Chief Science Officer Mars Inc.

When thinking about the technology future it is important to understand the key environmental factors – in science, education, finance, and public policy - that enable innovation in California at scale. California's place in the global innovation economy is driven by many factors, but in discussions with experts across business, government and academia, three drivers emerge repeatedly as being critical to the past, present and future success of the state's technology ecosystem: university infrastructure/basic research, venture funding and talent.

ORIGINS | UNIVERSITIES AND BASIC RESEARCH

CALIFORNIA TODAY

California is a national and global center for scientific research. This activity is primarily centered at its research universities (in particular the ten campuses of the University of California, Stanford, and CalTech). It is also home to federal research laboratories (Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, Sandia National Laboratory – California, NASA Ames Research Center, and the Stanford Linear Accelerator Center in Northern California and the Jet Propulsion Laboratory in Southern California), and a wide array of independent non-profit laboratories, many with university affiliations. These centers attract large amounts of federal research funding and generate patents and licenses through which research flows to the economy.

Together with Stanford and Caltech, the University of California dominates the composite rankings of colleges and universities nationwide. With that base, California attracts a large share of the nation's R&D spending. In 2019, the state brought nearly $3 of every $10 in R&D spending nationwide. Business R&D spending in California was even more intense, making up more than a third of the U.S. total.

From a public policy standpoint the University of California is particularly important. From 2013-2018, UC was awarded the most utility patents of the top 100 research institutions globally, with 4,923 active patents not including those produced by Lawrence Berkeley National Laboratory. The Association of University Technology Managers (AUTM) 2019 annual survey finds a close relationship between research funding and invention. In 2019, 25,392 research disclosures were reported from 179 institutions nationally, for an average of 142 per reporting institution.[24] California had seven universities above that average, including Stanford (564), UCLA (426) and UCSD (413). This productivity of invention at California's universities supports the generation of large numbers of startups that commercialize research originating from their campuses. [25]

[24] Association of Technology Managers, 2019

[25] University of California "Technology Commercialization Report", 2018 (https://www.ucop.edu/knowledge-transfer-office/innovation/innovation-impact/technology-commercialization-report.html)

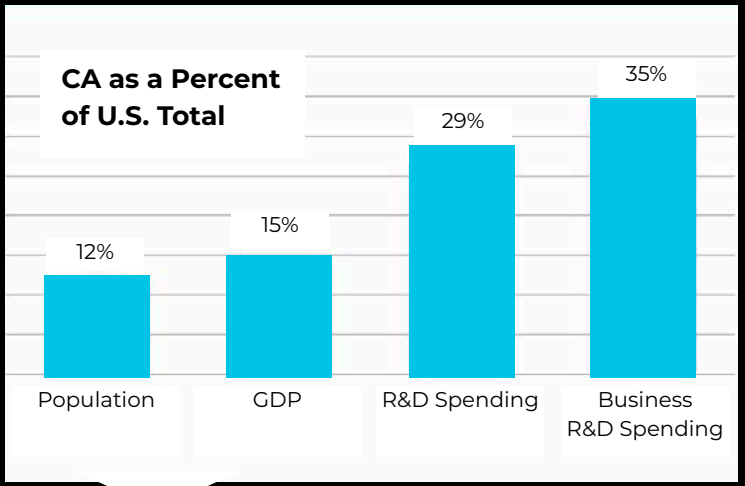
Table 4 **UC Campuses College Rankings in the United States (2021)**

Sub-Industry	Ranking
UCLA	1
UC Berkeley	2
UC Santa Barbara	6
UC Irvine	8*
UC San Diego	8*
UC Davis	11
UC Riverside	34
UC Merced	40*
UC Santa Cruz	40*

SOURCE: U.S. News & World Report 2021

NOTES: Findings do not account for the COVID-19 academic year, *denotes a tie with another university.

Figure 9 **California Earns a Substantial Portion of R&D Spending in the United States**

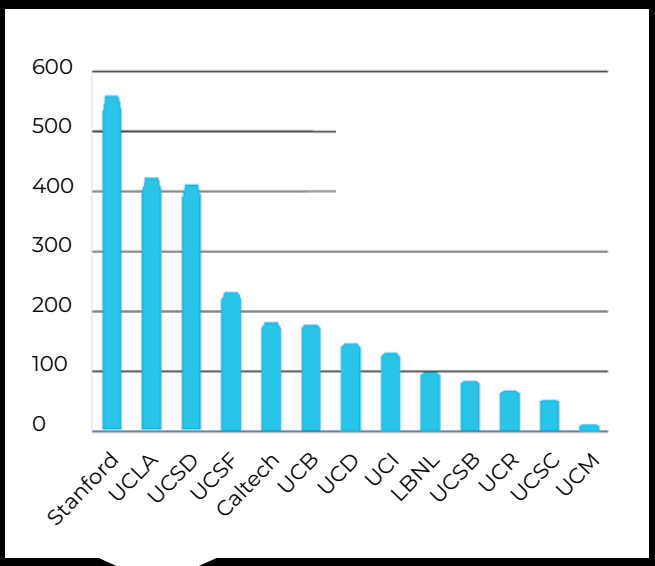


SOURCE: U.S. Census Bureau; U.S. Bureau of Economic Analysis; National Science Board Science & Engineering Indicators

"Federal funding for research is a sine qua non."

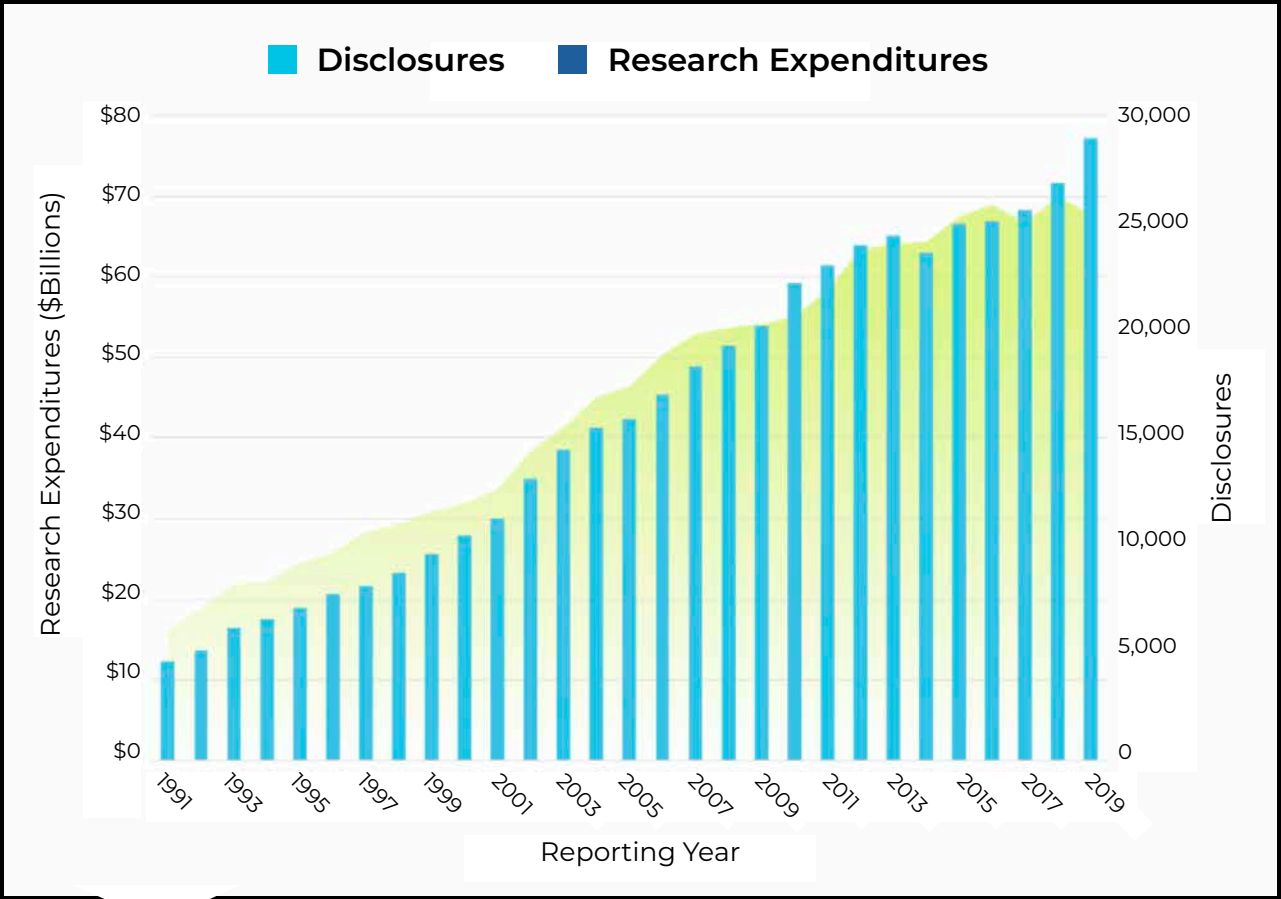
- Michael Borrus, Founding General Partner, XSeed Capita

Figure 10 **Inventions Disclosed 2019**



SOURCE: UC, Standford, Caltech

Figure 11 **Research Funding vs. Disclosures**



SOURCE: Association of Technology Managers, 2019

LONG-TERM PERSPECTIVES

While investment by private companies in scientific research is larger than investment by government, the funding provided by government plays a critical role. This is because companies primarily invest in technologies with the near-term potential to become products (applied research), while universities and their affiliates invest primarily in research that advances knowledge but has no near-term commercial goal (basic research). While most basic research is theoretical and designed to generate knowledge, it generates patents and licenses that often leads to new products, companies and industries. Basic research is also more likely than applied

research to lead to game-changing technology breakthroughs. Because this research primarily takes place at universities, government or non-profit laboratories and is federally funded, federal support for science is critical to California's research and innovation system.

While stable, federal support for science – through agencies such as the National Science Foundation (NSF) and the National Institutes of Health (NIH) – has declined over the last two decades as a share of the federal budget and of GDP. From 2016-2020 the President's budget each year proposed sharp cuts to science funding, which Congress chose not to act on. Bipartisan bills passed by the Senate (USICA) and House (America COMPETES) in 2021 and 2022 sharply increased funding for scientific research—both basic and applied—in key technology fields such as semiconductors. This bipartisan recognition of the importance of science to national security and economic competitiveness suggests that federal investment in science will be sustained in the coming years. While the federal government is likely to distribute those funds more broadly than in the past (away from the coasts and toward the country's interior), California institutions are likely to remain major beneficiaries. California's will also continue to benefit from sustained funding by the state that supports key priorities such as stem cell research and the development of renewable energy and energy efficiency to address climate change.

While optimistic about science funding overall, several research leaders interviewed for this report expressed their concern that the public has little understanding of the benefits of science – particularly compared to the days of the Cold War and the space race when national goals were clear. If combined with recent trends toward increased political populism and the questioning of scientific expertise on issues ranging from vaccines to climate change, public support for science could erode further. More public education and engagement on the benefits and impacts of scientific research may be needed to sustain investment at a high level.

"Federal funding for science has been fairly steady. I'm more concerned with a weakening recognition by the public that science benefits society. Support for science has frayed and there's less of a consensus that it's important. We're seeing this now in science skepticism."

- Horst Simon, Former Deputy Director for Research, Lawrence Berkeley National Laboratory

ORIGINS | VENTURE CAPITAL

CALIFORNIA TODAY

California is the center of the national and global venture capital industry. In the venture capital model funds are raised to invest in high-risk but potentially high-growth entrepreneur-led companies. Beyond providing funding in return for equity, investors also offer strategic guidance. Venture investment has been critical to the early development of many of California's leading companies such as Facebook, Apple, Amazon, Netflix, Microsoft, Google, Tesla and Uber.

Venture capital as a modern industry is generally traced to the founding of American Research and Development Corporation (ARD) in 1946 by French immigrant and Harvard Business School professor Georges Doriot and colleagues. [26] ARD's successful investment in Digital Equipment Corporation (DEC) generated impressive returns and served as a proof point for the venture capital industry's technology investment model. [27]

After that the center of gravity in venture capital shifted rapidly to the San Francisco Bay Area, where a pattern of more active engagement between venture firms and entrepreneurs took hold, led by investors such as Tom Perkins of Kleiner, Perkins, Caufield & Byers. In explaining why venture took root so deeply on the West Coast but not in the East scholars point to business culture. Writing about Silicon Valley, Annalee Saxenian observed that "...the conservatism of the east coast venture capital community makes it very difficult for companies that boldly define new markets to gain funding: entrepreneurs with good ideas on Route 128 are either forced to scale down their vision quickly or hook up with venture capital from the west and are convinced to move to the Valley." [28] Reflecting this risk-reward mindset, successful entrepreneurs in Silicon Valley chose to reinvest their new wealth in generations of new companies, either as investors or by starting new companies themselves.

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[26] Ante, Spencer E. 2008. Creative Capital: Georges Doriot and the Birth of Venture Capital. Boston: Harvard Business Press.

[27] Nicholas, Tom. 2016. "The Origins of High-Tech Venture Investing in America." In Financial Market History: Reflections on the Past for Investors Today, edited by David Chambers and Elroy Dimson, 227–241. CFA Institute Research Foundation.

[28] Saxenian, AnnaLee. 1994. Regional Advantage: Culture and Competition in Silicon Valley and Route 128. Cambridge: Harvard University Press.

Venture capital's emergence in Silicon Valley in the 1970s came at an important time in the region's development, as defense spending was starting to decline. While Southern California struggled to fill the gap created by a shrinking aerospace sector, the region's semiconductor industry was expanding to markets beyond national defense. The growth of the semiconductor sector, which was centered in Silicon Valley, drove the region's early growth, spawning both spinoff companies and new investors, and set the stage for the region to dominate the industry to the present day. The high concentration of firms on Menlo Park's Sand Hill Road and more recently in San Francisco acts as a powerful magnet for entrepreneurs from across the nation and around the world, who also feed the regional ecosystem by anchoring investment the Bay Area, by growing their companies in the state, and in many cases by becoming investors themselves. In recent years California has attracted close to half of all venture investment in the United States, and the Bay Area has consistently captured one-third or more.

Figure 12

47%

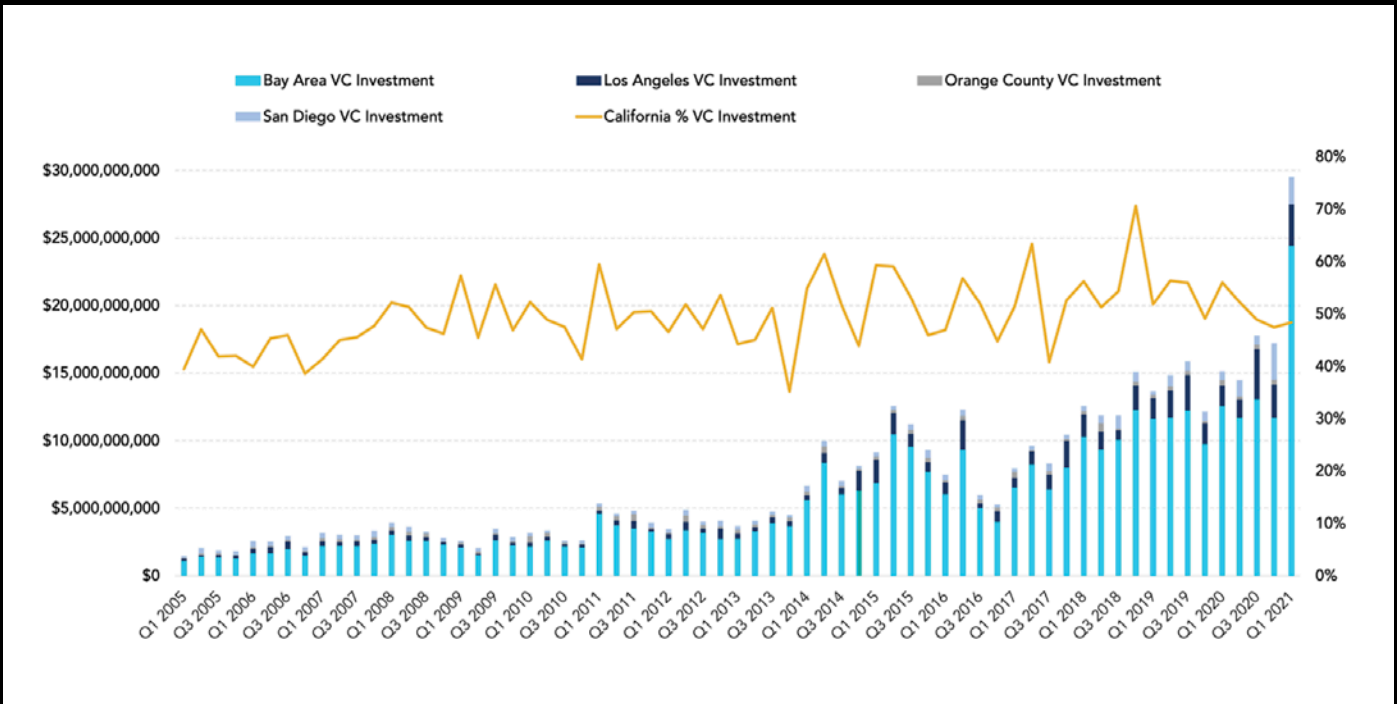
California companies capture 47% of total U.S. venture capital investment

(Q1 2021)

Source: PwC/CBI Insights Money Tree Analysis: BACEI

While angel, seed and early-stage investment funding are becoming more available in other countries, in most regions of the world and elsewhere in the U.S. later stage (growth) capital is in comparatively short supply. This particularly draws successful, growing companies from across the world to the Bay Area and California, which offers the world's largest pool of risk capital. U.S. and global startups and scaleups (growth companies) are also attracted to the region by the access it provides to experienced team members and advisers (often serial entrepreneurs with experience growing companies) and by access to platform companies such as Facebook and Google that often acquire smaller companies or offer platforms on which other companies' business models can build.

Figure 13 **California Share of Venture Capital Investment by Regions**



SOURCE: PwC/CBI Insights MoneyTree
ANALYSIS: Bay Area Council Economic Institute
NOTE: Data for Orange County VC investment is unavailable for Q1 2021

LONG-TERM PERSPECTIVES

Over 2020-21 the Bay Area has generated almost half of the IPOs and unicorns (privately held startups valued at more than $1 billion) in the United States. As of Q1 2021, 47% of U.S. unicorns and six of the thirteen unicorns valued at over $10 billion were headquartered in the Bay Area. The Greater Los Angeles area is home to an additional 21 unicorns.

In recent years funding has flowed in larger volumes but to fewer deals, as venture investors have reduced their risk by investing in later stage companies that are nearer to an exit or have

[29] CB Insights, State of Venture Report, Q2 2021. July 8, 2021. https://www.cbinsights.com/research/report/venture-trends-q2-2021/

re-invested in existing portfolios. The emphasis of investment has also shifted toward high payout investments in apps and software, and away from higher risk, longer term investments in hardware. Biotechnology, however, which is both high-risk and long-term, has seen strong investment. Some technology leaders interviewed for this report expressed concern that this trend toward software investment and later stage deals has come at the expense of entrepreneurial early-stage companies that focus on foundational hardware technologies.

Other long-term concerns regarding investment include what has been termed the "Valley of Death", the vulnerable stage in an early company's development where a technology has been developed but doesn't have a commercially proven product to attract investors. Creative approaches may be needed, particularly at universities, to ensure that innovative early-stage companies are supported in this period.

"The cost of being in Silicon Valley is a challenge, but that's been true forever and until now hasn't been a significant drag. If necessary, you can always build teams elsewhere. What matters is where the IP is coming from, and nobody has dented the California advantage."

- Bill Reichert, Partner, Pegasus Ventures

A newer trend with uncertain implications for startup activity in California is the shift toward remote work that emerged from the pandemic, leading to the move of technology workers and in some cases technology companies to cities out of California. As venture investors - who have historically conducted in-person meetings with prospective portfolio companies - become more comfortable conducting interviews and making decisions by Zoom, the companies they invest in may be more dispersed nationally. If this occurs, fewer startups may move to California than in the past, eroding the concentration of startup activity that until now has benefitted the Bay Area. While it is unclear if this will impact the venture model or the centrality of the Bay Area as the nation's leading center for startup activity, it is likely that for the foreseeable future the venture capital industry itself and the decisions regarding where venture capital is invested will continue to be predominantly made in California.

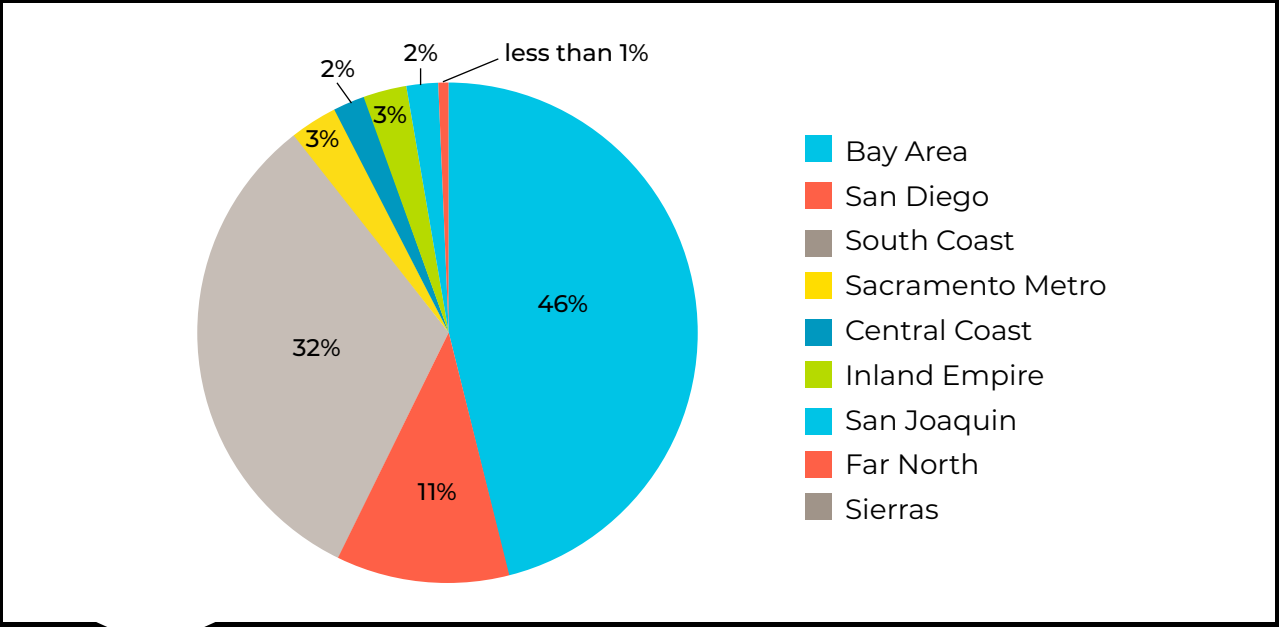
ORIGINS | TALENT

CALIFORNIA TODAY

California's competitiveness in technology is closely linked to its extraordinary base of talent.

Technology jobs are heavily concentrated in three regions: nearly half are in the Bay Area (home to 19% of the state's population), 32% in Los Angeles and Orange Counties, and 11% in the San Diego region. The San Francisco Bay Area has the largest pool of technology talent in the United States with 373,430 tech workers, a 16.4% increase from 2015; technology accounts for 10.9% of all jobs, or nearly triple the 3.9% national average. In the San Jose Metro Area, technology jobs make up 33.7% of overall employment. [30] The Greater Los Angeles region in Southern California has also

Figure 14 **Nearly 90% of CA Tech Jobs Concentrated in 3 Regions**



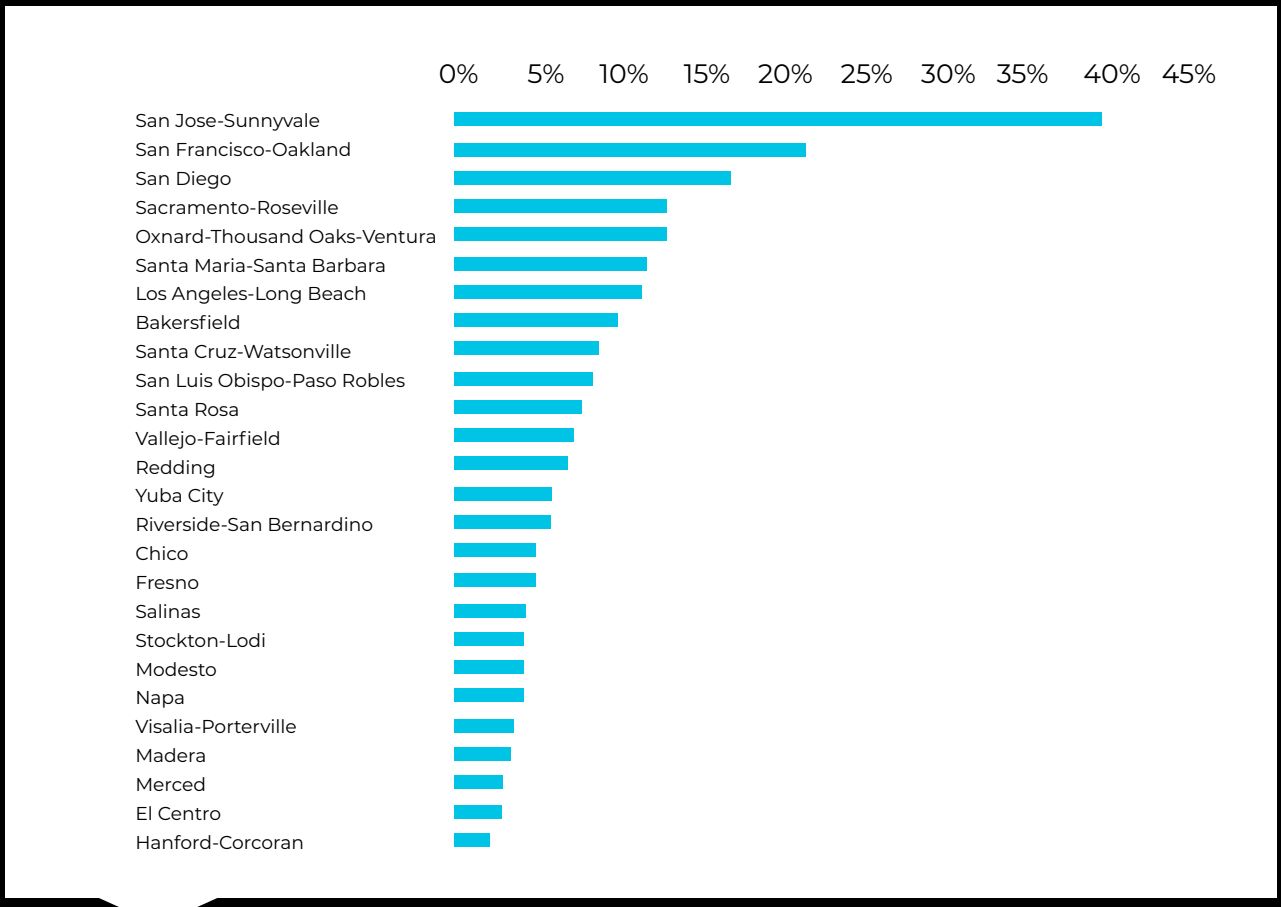
SOURCE: Same source as footnote 30 (below)

[30] Computer Technology Industry Association. 2021. CompTIA Cyberstates 2021: The Definitive Guide to the U.S. Tech Industry and Tech Workforce. Downers Grove, IL: COMPTIA. Retrieved September 17, 2021. (https://www.cyberstates.org/pdf/CompTIA_Cyberstates_2021.pdf)

become a significant technology center, which with 228,720 employees is the fifth largest pool of tech talent nationally, having experienced 18.6% increase from 2015-2020. [31]

That talent comes primarily from three places: home-grown talent produced by the state's community college, California State University and University of California systems; talent from across the university that is drawn to the state by its universities and innovation economy; and talent from overseas that is also attracted by California's universities and innovation economy.

Figure 15 **Core S&E Occupations as % of Total Employment by MSA 2019**



SOURCE: Bureau of Labor Statistics, *https://www.bls.gov/oes/tables.htm

ANALYSIS: California Center for Innovation

[31] CBRE 2021 Scoring Tech Talent Report, 2021 https://www.cbre.us/research-and-reports/scoring-tech-talent-in-north-america-2021

Universities are a leading source of company founders. This includes both faculty and students, with faculty founders being most prominent in life science. A recent report by the Bay Area Council Economic Institute found that most founders who start companies while at a university or soon after graduation choose to locate those companies within a short distance of their campus of origin. This points to the important role that universities play in local economic development. Distinct technology strengths on different campuses influence the composition of the technology and business communities of the cities that surround them. With its strong engineering programs, for example, Stanford has played a critical role in the development of Silicon Valley. Other university-anchored regional economic clusters include agricultural technology near UC Davis, software and electronic systems near Berkeley, medical therapeutics and devices near UC San Francisco, and medical therapeutics and software near UC San Diego. Recognizing these impacts, University of California campuses have developed entrepreneurial and startup support programs to magnify their economic impact in surrounding communities. [32]

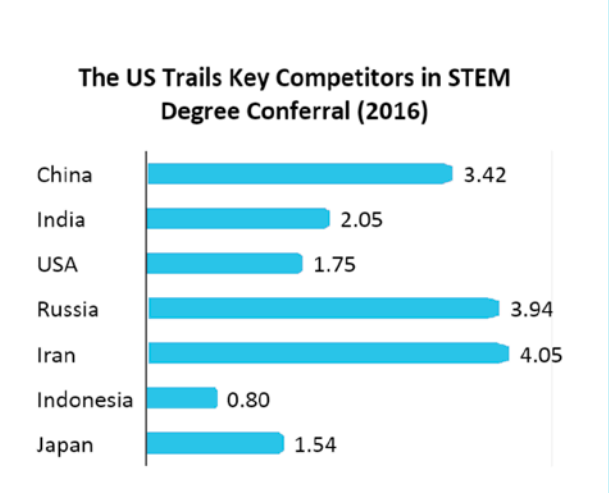
While most science & engineering jobs are concentrated in the Bay Area, the South Coast and San Diego, several other regions depend on technology jobs, which account for more than 10% of jobs in Sacramento, the San Fernando Valley and Ventura County, and Santa Maria-Santa Barbara, and just under 10% in Bakersfield.

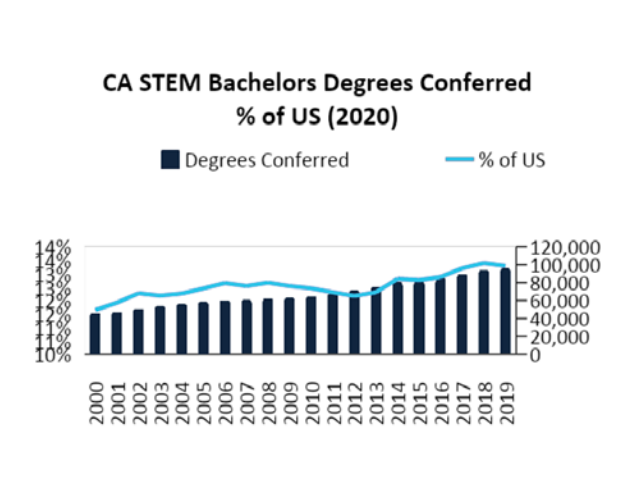
California's science and engineering sectors are more reliant on foreign-born talent than any other state in the nation – fully seven percent higher than the second most reliant Washington). Key competitors New York, Texas and Massachusetts are all in the top seven, however, underscoring the synergies between the foreign-born workforce and the innovation ecosystem. [33] International talent is particularly important to Silicon Valley, where nearly 45% of technology startups are led by founders who have come from other countries.

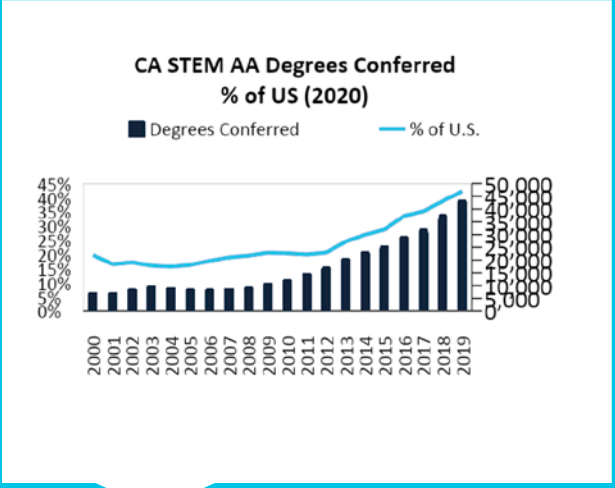
[32] Bay Area Council Economic Institute, "Entrepreneurs, Startups and Innovation at the University of California", August 2016. http://www.bayareaeconomy.org/report/entrepreneurs-startups-innovation-at-uc/

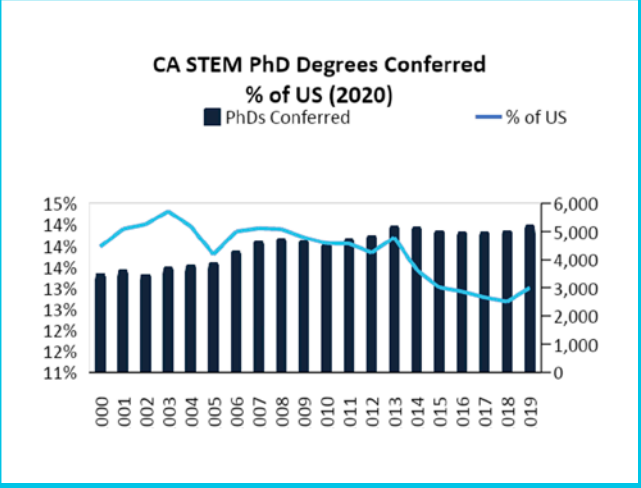
[33] National Science Board. "Foreign-Born Workers as a Percentage of Individuals in Science and Engineering Occupations." Science and Engineering Indicators: State Indicators. Alexandria, VA: National Science Foundation. https://ncses.nsf.gov/indicators/states/indicator/foreign-born-workers-to-se-occupations.

Figure 16 **Core S&E Occupations as % of Total Employment by MSA 2019**



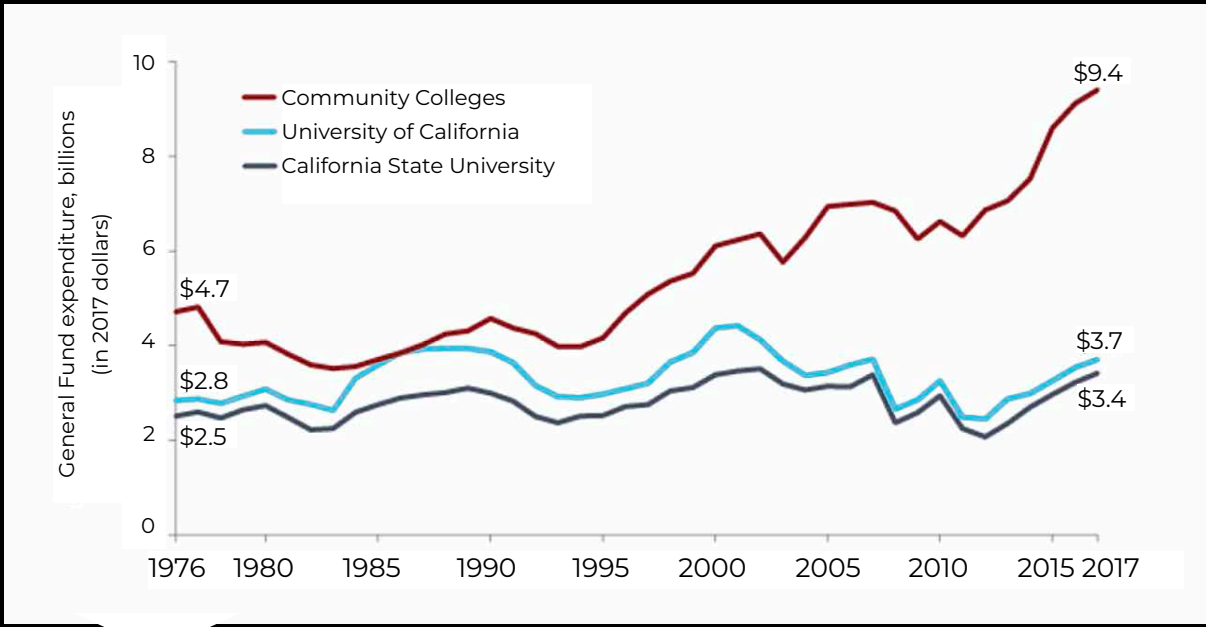






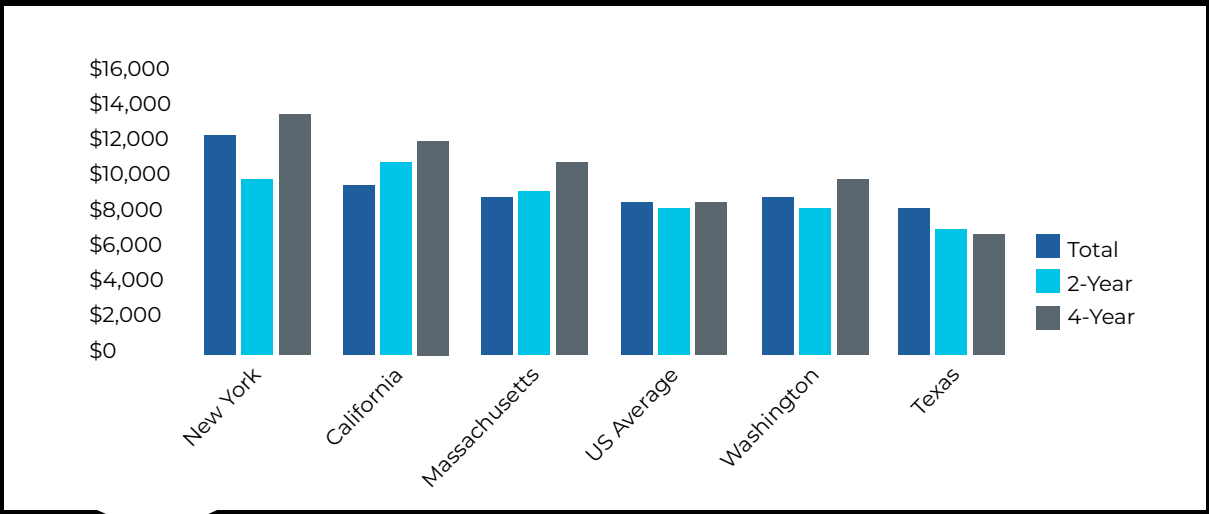
SOURCE: CA STEM degrees: National Science Board. Science and Engineering Indicators: State Indicators. Alexandria, VA: National Science Foundation. https://ncses.nsf.gov/indicators/states/indicator/se-bachelors-degrees-per-1000-18-24-year-olds. Accessed on [Sept 12,2021].

Figure 17 **California's Higher Education Spending Has Increased Most For Commmunity Colleges**



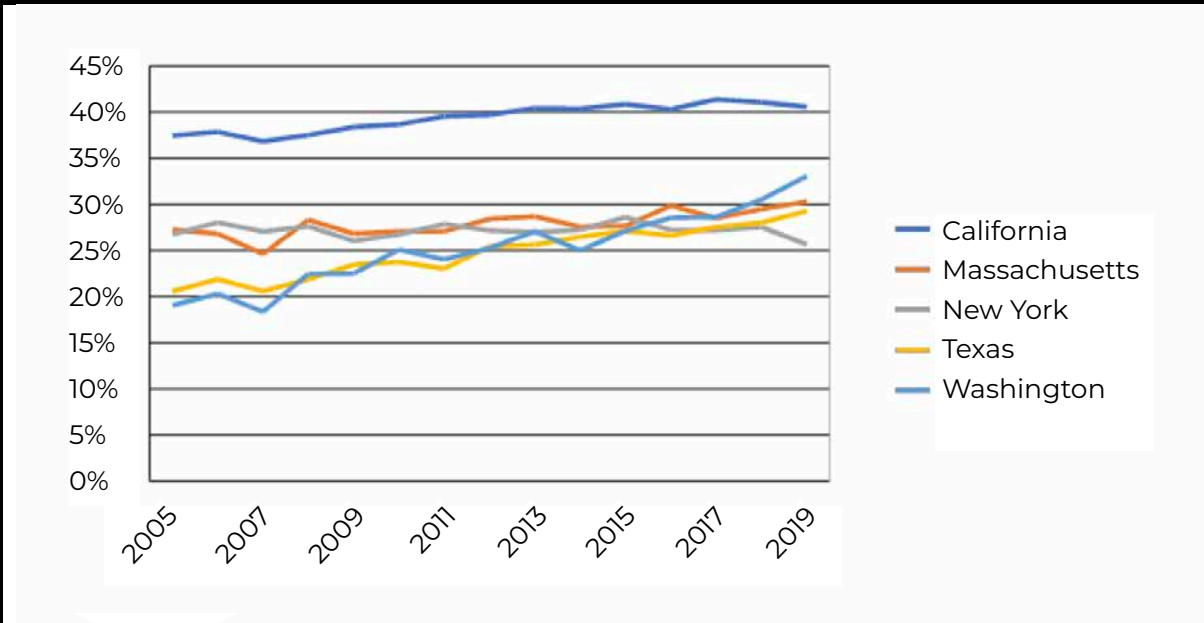
SOURCE: Author's calculations based on Department of Finance historical budget data.

Figure 18 **Public Higher Ed Appropriations Per Student, FY 2020**



SOURCE: CA STEM degrees: National Science Board. Science and Engineering Indicators: State Indicators. Alexandria, VA: National Science Foundation. https://ncses.nsf.gov/indicators/states/indicator/se-bachelors-degrees-per-1000-18-24-year-olds. Accessed on [Sept 12,2021].

Figure 19 **Foreign-Born Workers as % of Science & Engineering Workers 2005-19**



SOURCE: National Science Board Science & Engineering State Indicators: U.S. Census Bureau, special tabulations of the American Community Survey (various years), data available as of January 2021 (Accessed 9.21.2021)

LONG-TERM PERSPECTIVES

The University of California is a unique asset for the state. All nine of its undergraduate campuses (UC San Francisco is a graduate campus) rank in the top 40 in the nation among public universities and in the top 100 of all universities in the U.S. They also rank in the top tier nationally for their contributions to social mobility, claiming three of the top five slots: Riverside (1), Irvine (2), and Merced (4). [34] Despite the key roles that it plays, the level of investment by the state of California in the University of California system has fallen by nearly half since 2000 and has only recently begun to recover. [35] To compensate, UC campuses have expanded the admission of out-of-state students who pay the full cost of tuition.

[34] US News & World Report. 2021. "US News & World Report Best Colleges." Retrieved 9.28.2021. (https://www.usnews.com/best-colleges/university-of-california-merced-4127/overall-rankings).

[35] Bay Area Council Economic Institute, "The Bay Area Innovation System: Science and the Impact of Public Investment", April 2019.

Investment per student in higher education is also less than impressive. California was 14th overall in per full-time equivalent student appropriations (at $9,531) in FY 2020 – well below leaders Wyoming ($21,802) and Washington DC ($21,308) and behind #7 New York ($12,252), but above the national average of $8,636 and competitors Massachusetts ($8,728), Washington ($8,610) and Texas ($8,147).

All levels of the state's higher education system are important to its technological leadership: the University of California for research and startup founders, CSU for bachelors and masters level engineers, and community colleges for technicians. While Stanford, for example, is a major source of scientists and company founders in Silicon Valley, San Jose State University produces more engineers who staff Silicon Valley companies. The state's tiered higher education system also provides a ladder that enables students from community colleges to advance to degree programs at CSU and UC. At a deeper level, the K-12 pipeline that feeds the UC and CSU systems is critical to the supply of domestic talent in California but is at best uneven, ranking 40 out of 50 among U.S. states. [36]

California's other main source of technology talent, skilled immigration, is also vulnerable. For many years California has relied on immigration to offset falling birthrates and the out-migration of Californians to other states. With immigration falling since 2017, however, the state's demographic challenge has deepened. High-skilled immigration, which faces systemic bottlenecks due to visa limitations, limitations on green cards, and chronic delays in visa processing, is of particular concern to the tech community. From 2016-2020 the perception among many immigrants that the United States was not a welcoming place colored their decisions on whether to come or remain. [37]

Those that do come face formidable technical hurdles. The annual quota for H1B visas, which opens for applications each year in April each year, is normally filled within days. Immigrants from India, who fill a wide range of technology positions in Silicon Valley, can wait as long as ten years for their green card applications to be considered due to a 7000 per country cap on green cards (which assigns the same number to smaller countries that are not technology centers as it does to large ones.) Also, unlike countries such as Canada which actively competes with the U.S. for talent, the United States lacks a special-purpose visa for startup founders who could build their companies here.

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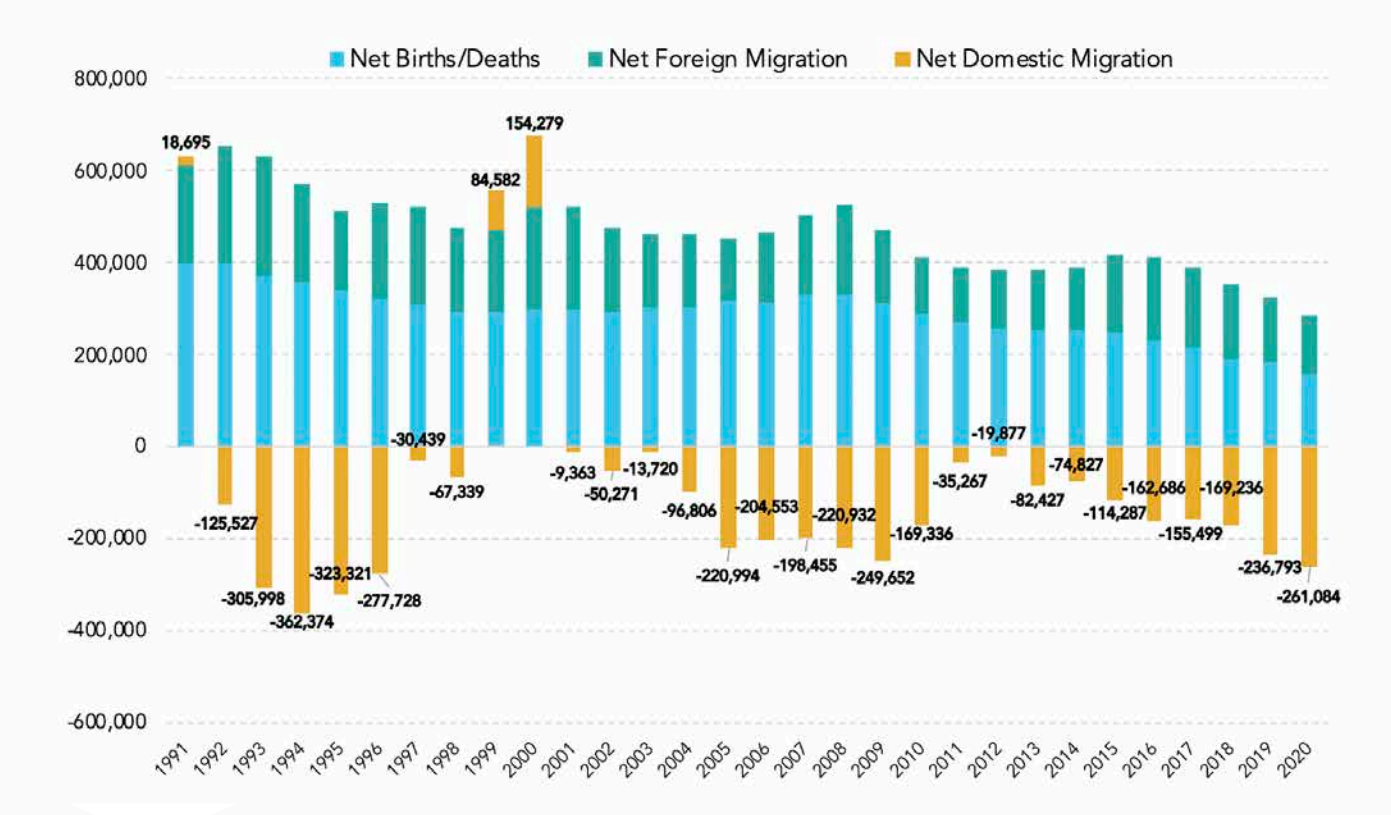
[36] U.S. News and World Report, "Education Rankings: Measuring How Well States are Educating Their Students", 2021.

[37] Pew Research Center, Key findings about U.S. immigrants, August 2020, https://www.pewresearch.org/fact-tank/2020/08/20/key-findings-about-u-s-immigrants/

Figure 20 **California Population Components of Change. Mid-year Estimates (July 1)**



DATA: California Department of Finance

ANALYSIS: Bay Area Council Economic Institute

Research by the Ewing Marion Kauffman Foundation finds that one in four new entrepreneurs is an immigrant and that immigrants are twice as likely as native born citizens to become entrepreneurs. [38] Other research by the National Foundation for American Policy has examined data for 91 unicorns. [39] More than half (50) - including California companies such as Tesla, Slack and Uber - had at least one immigrant founder and a collective value at the time the research was conducted of $248 billion. On average they had created 1200 jobs per company, the vast majority in the United States. Thirty-three of those companies were headquartered in California. The

[38] Ewing Marion Kauffman Foundation, Trends in Entrepreneurship Series, 2020, No.9.

[39] National Foundation for American Policy, More Than Half of America's Billion-Dollar Startups Have an Immigrant Founder, October 24,2018, https://nfap.com/wp-content/uploads/2018/10/Billion-Dollar-Startups.DAY-OF-RELEASE.October-2018.pdf retrieved [September 15,2021]

contributions of immigrants to the technology community go beyond company founders: 75 of the 91 companies surveyed (82%) had at least one immigrant filling key management and product development roles, the most common being CEO, CTO or Vice President for Engineering.

California's future competitiveness in basic research and advanced technology ultimately depends on the depth and quality of its talent. This will require both the development of a stronger and more diverse domestic technology workforce through investment in STEM education at all levels, and an open door to high quality talent from abroad.

Student debt is a significant obstacle that discourages domestic students and particularly minorities from going on to higher education in STEM fields, a challenge aggravated by the comparatively low salaries for academic graduates in many hard sciences compared to graduates in engineering or other professional fields. This is reflected in minority participation in the technology workforce, which is low and confronts structural challenges. In October 2019, Black, Hispanic, and Indigenous populations accounted for only 5% of the technology workforce in Silicon Valley. [40] For the IT sector overall the three groups account for 16% of the workforce. [41] Women are also underrepresented in the tech sector, making up only 28.8% of the tech workforce in 2020 – up from 26.2% in 2019 and 25.9% in 2018, but still much less than their share of the population. [42] Underrepresented women of color only make up 4% of the tech workforce despite making up 16% of the general population. [43]

"The talent here isn't intrinsic to California. It comes from everywhere. Risk takers and many of the brightest come here, which is a special breed. This brings a powerful combination of talent, skills and mindset and it's largely coming from outside California."

- Mathieu Augesse, CEO Schoolab-San Francisco

[40] Five years of Tech Diversity Reports – and Little Progress – Wired.com

[41] U.S. Census Bureau 2019 estimates, and U.S. Equal Economic Opportunity Commission's Diversity in Tech Report.

[42] Top Companies for Women Technologists – Building a More Inclusive Future – AnitaB.org

[43] Using CSR and Philanthropy to Close the Gender Gap in Tech – McKinsey&Company

"There's a global competition for tech talent, and the Bay Area has been a draw. With the number of unfilled positions today in the labor market, immigration is becoming even more important, and the chronic crisis in immigration policy means missed opportunities for everyone."

- Vijay Rajendran, Director of Innovation and Partnerships, 500 Global

"Faculty and graduate students born outside the US are fundamental to UC Berkeley's vitality and always have been."

- Richard Lyons, Chief Innovation and Entrepreneurship Officer, UC Berkeley

TRENDS | THE COMPETITIVE LANDSCAPE

CALIFORNIA TODAY

California's position as a global technology leader is for the moment secure due to the scale and depth of its innovation assets. Across the domestic and international technology landscape Silicon Valley continues to dominate, but as other technology centers rise its long-term leadership is not guaranteed.

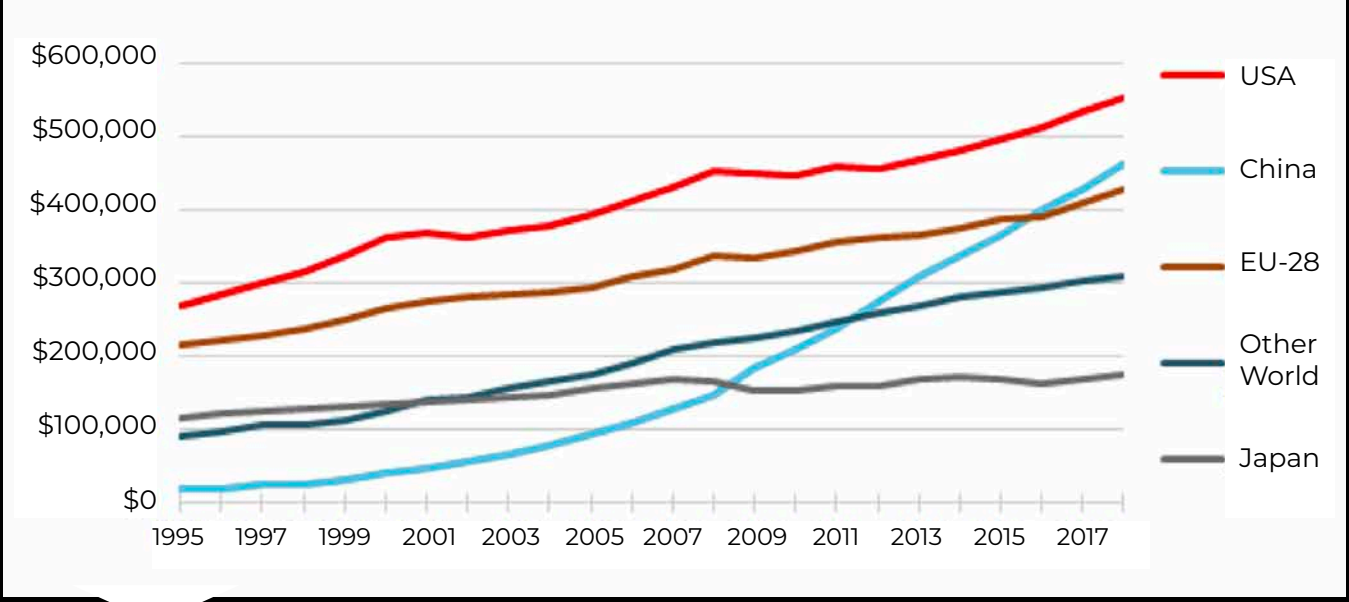
LONG-TERM PERSPECTIVES

Competition is growing both globally and domestically.

The most significant global challenge comes from China, whose policies aim for global leadership in a wide range of critical technologies. Its policy goals are supported by sustained, large-scale investment in scientific research and in strategically important sectors such as semiconductors. China is estimated to have accounted for 23% of world R&D expenditures in 2017. [44] In 2020 R&D spending

[44] OECD Main Science and Technology Indicators, R&D Highlights in the February 2020 Publication

Figure 21 **World R&D by Country / Region**
(millions of constant dollars adjusted for purchasing power parity)



SOURCE: Includes public and private sources. OECD Main S&T Indicators, October 2020 | AAAS

reached $378 billion, and in 2021 China committed to increasing its R&D spending by 7% per year through 2025, further increasing its share of GDP above the current 2.4%. [45]

AI is a major focus of competition. The volume of scientific research produced in China on AI has grown dramatically, and while most observers believe that the U.S. is still in the lead China is close behind. It is also strong in cloud computing, quantum computing, IoT, robotics, ICT and space technology. At the commercial level, the large-scale infusion of government funds into venture capital has enabled China to emerge within a short period of time as the number two country in the world for venture investment and for emerging billion-dollar companies (unicorns). As of July 2021, China was home to 155 unicorns spread across a wide range of industries including fintech, artificial intelligence, and health. [46]

[45] CNBC, China's Spending on Research and Development Hits a Record $378 billion", March 1, 2021; CNBC, "China Spending on Research and Development to Rise 7% per Year in Push for Major Tech Breakthroughs", March 4, 2021.

[46] CB Insights, "The Complete List of Unicorn Companies", July 2021

Though not yet an exodus, from January 2018 through June 2021, 265 companies relocated their headquarters out of state. [47] While some companies have always left the state and many have been replaced by new companies, the pace of departures is accelerating. In the first six months of 2021 alone, 74 companies relocated out of California, double the rate of the previous years. [48] Most have left for Texas. Economic factors that have contributed to these departures include high costs but also tax and regulatory policies and quality of life issues such as housing. California can retain its technology leadership even as other national and global centers grow but must continue to invest in its innovation infrastructure, address business climate issues that may discourage companies from growing in the state, and address systemic issues such as housing that could erode its appeal to talent and long-term competitiveness.

TRENDS | QUALITY OF LIFE

CALIFORNIA TODAY

Quality of life remains a strength for California but also a vulnerability. Its core weakness is the high cost of living in coastal cities, driven principally by the lack of affordable housing. In April 2021 the median sales price of a single-family home in California topped the $800,000 mark. [49] In San Diego the median was $825,120, in Los Angeles $725,000, and in the Bay Area $1,328,440. [50] For decades cities have failed to permit the housing needed to meet demand, creating a cumulative deficit that has worsened as the state's booming technology economy has drawn more workers to its urban centers. As an extreme case, the Bay Area is currently underbuilt by over 100,000 housing units. [51] Rental rates have also increased dramatically, and cities such as San Francisco, San Jose and Oakland have some of the highest average rental rates in the U.S. The median rental for a two bedroom apartment in San Francisco in January 2022 was $3,930 a month, surpassing Manhattan. In San Jose the rate was $2,870, and in Oakland $2,770.

[47] Hoover Institution, Why Company Headquarters Are Leaving California in Unprecedented Numbers, August 2021

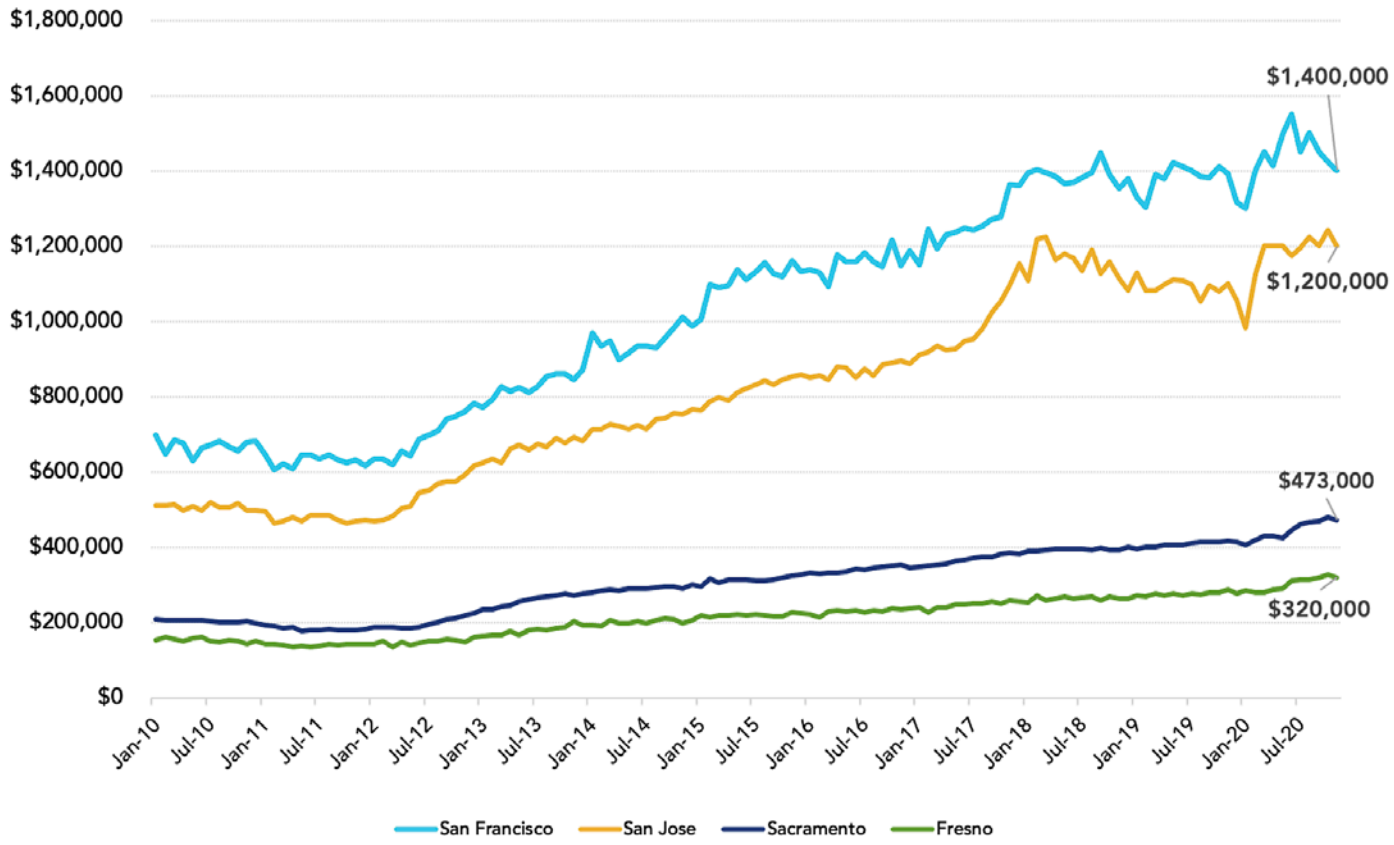
[48] Ibid

[49] California Association of Realtors. 2021. "April Home Sales & Price Report." Retrieved September 28, 2021 (https://www.car.org/aboutus/mediacenter/newsreleases/2021releases/apr2021sales).

[50] April 2021 Resale Housing Report - California Association of Realtors

[51] State Gives Bay Area Much Bigger Mandatory Housing Targets, Spurring Call to Action – Bay Area Council, April 2019

Figure 22 **Median Sale Price by Metro (2010-2020)**

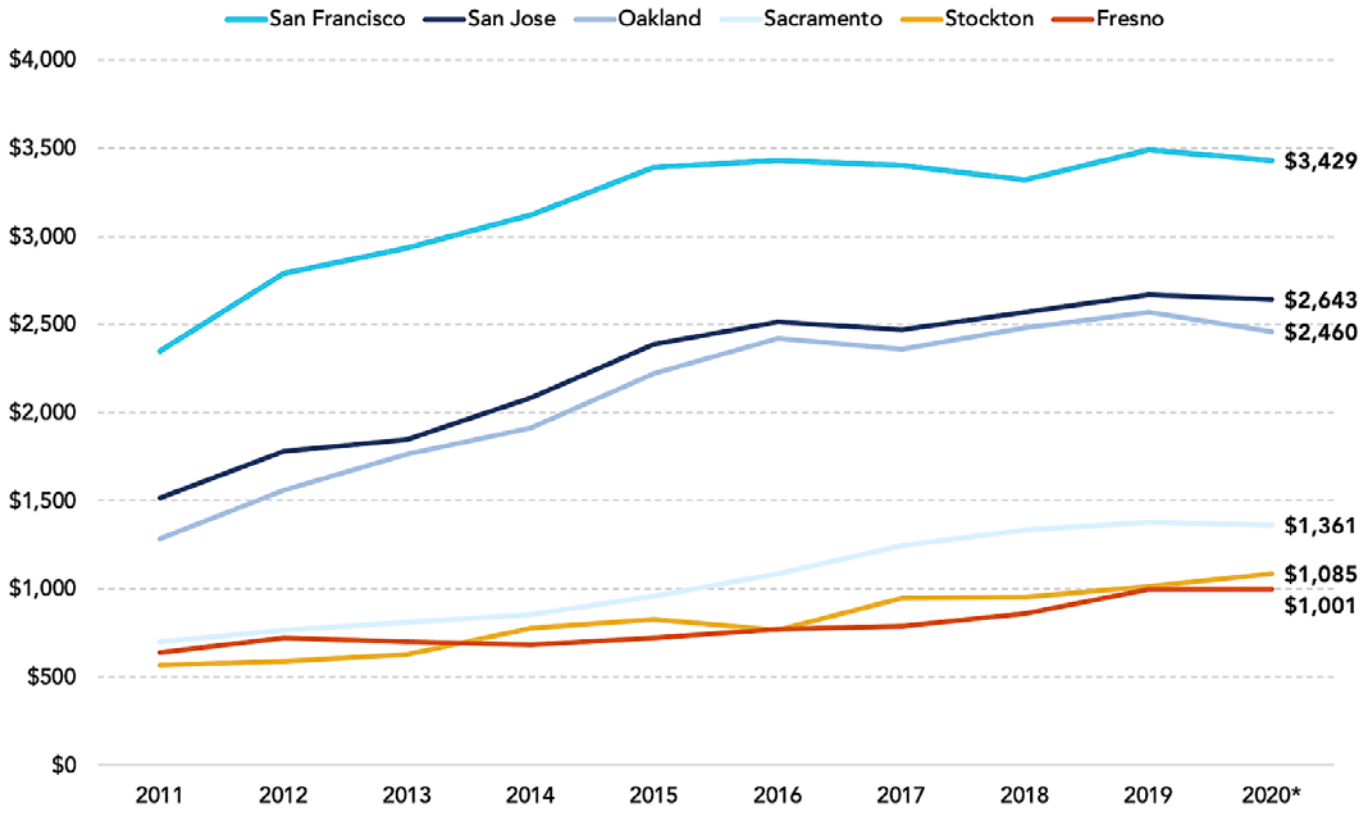


SOURCE: Redfin

ANALYSIS: Bay Area Council Economic Institute

NOTE: 2020 data does not include the month of December.

Figure 23 **Average Rental Rates for 1-Bedroom Apartment, 2011-2020***



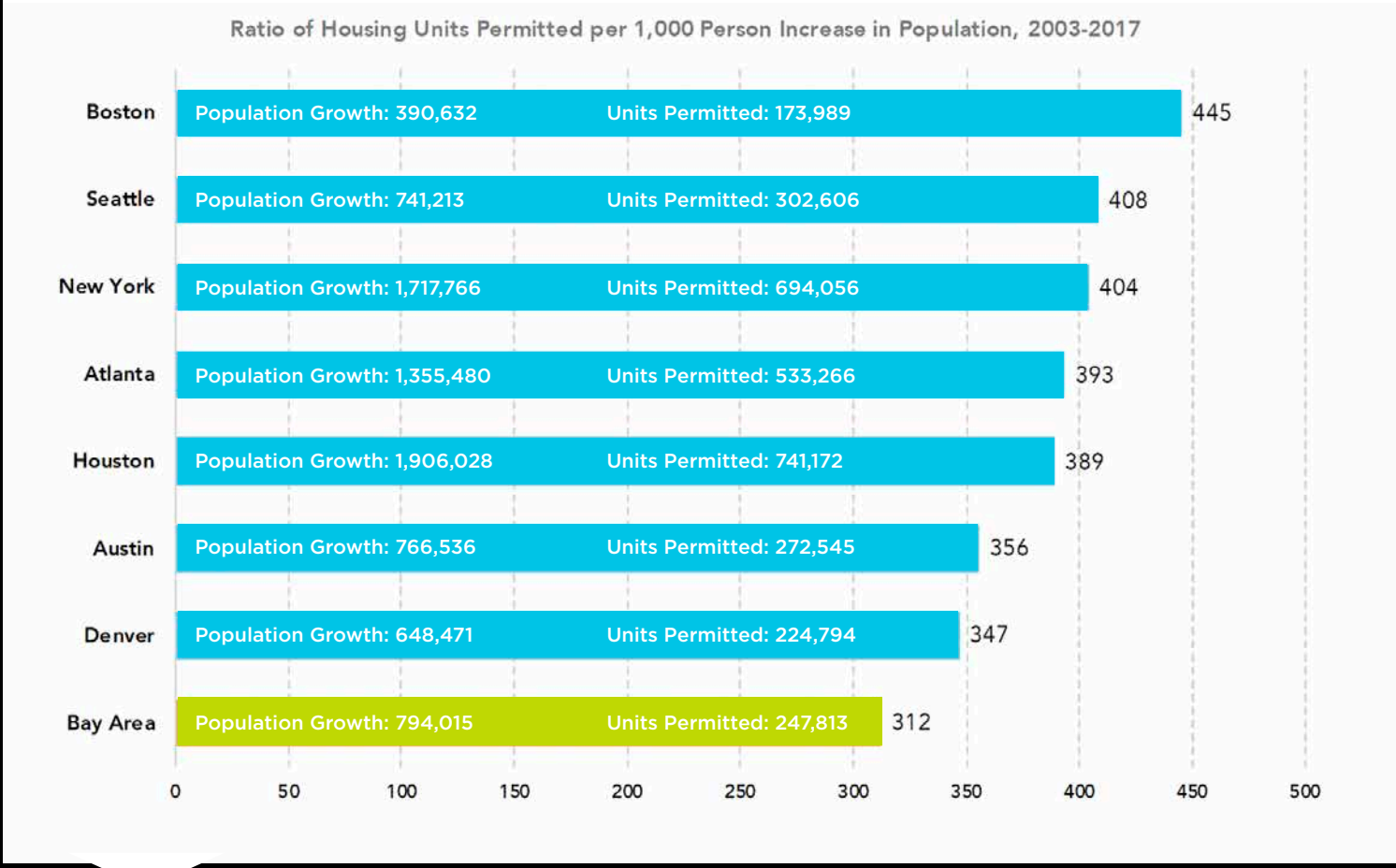
SOURCE: Red Jungle

ANALYSIS: Bay Area Council Economic Institute

NOTE: 2020 data does not include the months of January through May.

Figure 24

The Bay Area Builds Fewer Homes Per Population Added than Other Metros

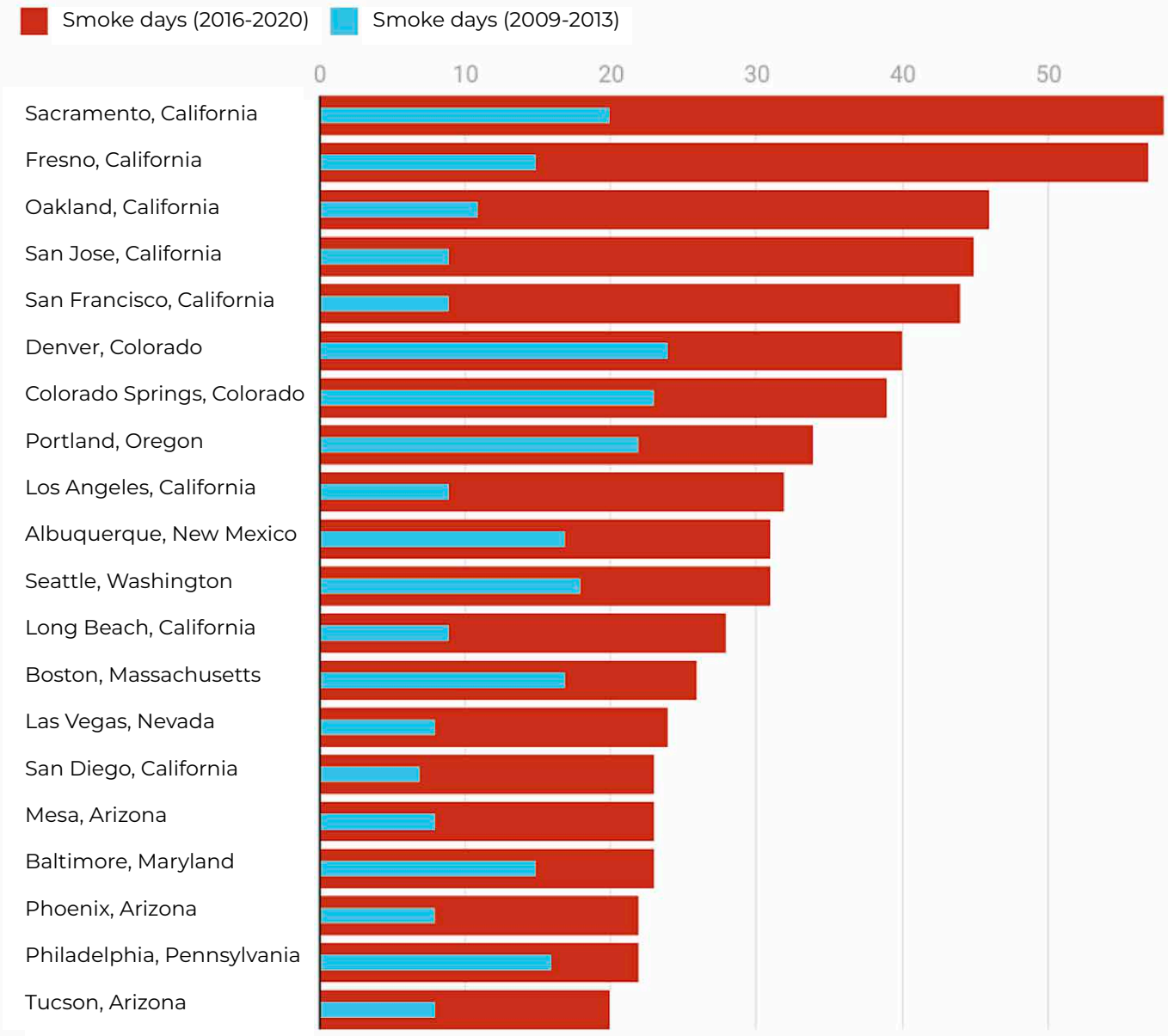


SOURCE: U.S. Census Bureau Building Permits Survey; U.S. Census Bureau Metropolitan and Micropolitan Statistical Area Datasets.

ANALYSIS: Bay Area Council Economic Institute.

NOTE: "Bay Area" data represents only Alameda, Contra Costa, Marin, San Francisco, San Mateo, and Santa Clara counties. All other locations are metropolitan areas.

Figure 25 **Major cities with significant increases in smoke days**



SOURCE: Analysis of National Oceanic and Atmospheric Administration satellite imagery by NPR's California Newsroom and Stanford University's Environmental Change and Human Outcomes Lab.

CHART: Alison Saldanha. Created with Datawrapper.

Extended periods of smoke from wildfires, a growing concern as the number and intensity of wildfires in California has increased, is another quality-of-life issue that may cause some technology workers to leave and others not to come. The period from 2013 to 2020 has seen the annual amount of acreage burned in California grow from 601,635 acres to 4,257,863 acres and the fire season extended year-round. [52] Poor air quality – on days the worst in the world - and health concerns stemming from airborne particulate matter from fires are compounding concerns regarding California's livability.

LONG-TERM PERSPECTIVES

While California's technology leadership is unquestioned, companies have alternatives for where to locate research manufacturing and management, and employees now have more alternatives for where to live. This became clear during the pandemic, which saw many California technology workers and the companies that employ them leave, enabled by the shift to remote work. While most tech workers who moved from core cities such as San Francisco only went as far as the inland counties of California that offer more space and where housing is cheaper, others left the state entirely for cities such as Austin, Dallas, Phoenix, Denver and Miami, and for smaller cities such as Bend. [53] Some technology companies have closed their California headquarters, shifting to a "no headquarters" model, while others have moved their headquarters or selected functions out of state. The relocation to other states of leading technology companies such as HP Enterprise, Oracle, Palantir and Tesla has drawn particular attention.

In the pandemic's wake most technology companies are likely to adopt a hybrid office model, where workers come to an office when needed but more often work from home. While each company will choose its own policies, the shift to more remote and hybrid work is permanent. As a consequence, the need for technology workers to concentrate in California urban centers such as San Francisco or San Jose will be reduced, and hybrid work will give companies more options for where to operate based on where the housing for their employees is affordable. In this scenario, most R&D activity is likely to remain in California, but the intensity of the state's technology leadership could diminish as workers and the companies that employ them are dispersed more widely.

[52] Cal Fire Incident Reports (2013 and 2020)

[53] Karlamangla, Soumya. 2021. "Texas? Idaho? Where Californians are Moving." *Silicon Valley Business Journal*, September 10. *San Francisco Business Times*.

The deepest challenge to California's long-term scientific and technology leadership may therefore not be external but stems instead from intrinsic failures in the state's basic infrastructure, and in particular its failure to build the housing required to support its workforce. California technology research and business leaders interviewed for this report were consistent in their view that the state's inherent ability to lead the technology field will remain strong for the foreseeable future, but that its elevated cost of living – driven largely by housing – may cause talent to leave the state or perhaps to never come, a trend that if realized would compromise California's future competitiveness. Because of the density of its assets California has over the last two decades continued to attract and retain talent despite its high costs. The uncertainty for the future is whether a tipping point may be reached where the inward flow of talent is reversed.

"Silicon Valley has a wealth of assets that support growth and innovation: R&D, great universities, national laboratories, access to startups and venture capital, and networks. The talent here is 10 on a scale of 10, although the fierce competition for talent can be challenging. The region's biggest liability is its cost of living – particularly for housing, which is significantly more than even the other high-cost areas we operate in globally. If those costs continue to increase it could deter people from wanting to live here, and ultimately impact the availability of talent that is the region's strength today."

- Jeff Welser, COO, IBM Research

"In the long-term we have to look at the sustainability of our environment here, particularly in terms of water and climate. With drought, wildfires and poor air quality will these issues scare people away?"

- Bill Diamond, President, SETI Institute

"As people feel more mobile some things that have been tolerated in the past – such as high housing costs and the impacts of climate change - might be less tolerable in the future."

- Darlene Solomon, CTO, Agilent Technologies

“The challenges to the innovation system are mostly external: the political climate, cost of living, and cost of doing business. It’s not surprising if companies who want their employees to live close to them are leaving. It’s a wakeup call where we need to pay attention and nurture the system. You can only squeeze the cost for business until it doesn’t work, at which point you start breaking the bonds that hold it all together.”

- Kim Budil, Director, Lawrence Livermore National Laboratory

“The cost of living is becoming dangerously high, and we’re crossing into a space that’s unaffordable for people who are young and innovators. Young professionals are in real danger of being priced out of the market. It’s an issue, because most real innovations come from early career people. It strikes at the future of innovation.”

- Andy McIlroy, Associate Director, Sandia National Laboratories - California

FUTURE | THE CHALLENGE AND OPPORTUNITY OF DEMOGRAPHICS

California today is a majority minority state, with an increasingly diverse racial mix led by a growing Hispanic community. Hispanic residents and other residents of color are underrepresented in the state’s heady mix of scientists and entrepreneurs, which poses the question of who is participating in and benefitting from the state’s innovation economy. Failure to more effectively engage Hispanic and other minorities will over time lead to a widening socio-economic gap in the state, while deeper engagement can energize California’s economy with a new and heretofore untapped resource for innovation. In the UC system, innovations at UC Merced offer a model for what a 21st public university could look like.

FUTURE | REBUILDING ADVANCED MANUFACTURING

Experience in the last two decades, when much of the state's manufacturing base moved overseas but most R&D remained centered in California, has shown that the two aren't easily separated. While high-value R&D continues to be a California strength, in the long term much of R&D is tied to markets and to the manufacturing process where research and production teams collaborate, suggesting that in the long term the loss of manufacturing capacity will also impact R&D.

Manufacturing itself is increasingly technical, with a growing proportion of jobs requiring advanced digital skills. Rebuilding advanced manufacturing in the state will require the development of a digitally capable workforce, supported by California's state universities and community colleges as well as industry. It will also require recognition and support by state leaders, who many in industry describe as indifferent to the role of manufacturing and to the need to compete for and support it.

The semiconductor sector offers an immediate opportunity and a test case. The large-scale expenditures on semiconductor manufacturing foreseen by the CHIPS Act now before Congress will flow to the states that choose to compete and can capitalize on federal interest in the sector. California has the embedded expertise in both hardware and software to lead the next revolution in semiconductor production, as well as in key fields such as biomanufacturing and battery production.

FUTURE | REIMAGINING THE ROLE OF UNIVERSITIES

California and the nation are at a pivotal point in the evolution of technology. Hardware and software are increasingly integrated, and the strategic nature of technology is becoming clearer. The decline in public funding for research universities, a national phenomenon that is not limited to California, is unlikely to be dramatically reversed. In these circumstances and given the catalytic role they play across the state, the role of public universities in advancing innovation and economic growth should be revisited. The University of California is a particularly powerful asset, not only for the state's economy but also for its ability to meet broader policy goals – in-

cluding solutions to the challenge of climate change and addressing economic development and the disparities between California's regions.

Focal points should include how to increase industry partnerships and non-state funding for research, how to maximize the economic development impact of public universities in the regions where they are located, how to support entrepreneurs and new companies emerging from the campuses, and how to incentivize faculty to engage more deeply with the broader economic community (for example, tenure decisions are made based largely on publications and don't account for how that research is applied or disseminated to benefit the wider community). More creative ways are also needed to enable public universities to benefit from the wealth they create, in particular by participating in the growth of startups they help to generate. Put differently, the boundary for what that defines the role of a research university will need to change.

FUTURE | CLIMATE AND ENERGY

Policies and technologies that support decarbonization will grow in importance as climate change accelerates. In Executive Order B-55-18 (September 2018), Governor Gavin Newsom set a statewide goal of achieving carbon neutrality by 2045, suggesting that by then 100% of the state's energy will come from renewable sources. As it has since the 1970s when California first set ambitious targets for energy efficiency in appliances, the state continues to advance energy policies and standards designed to increase energy efficiency and reduce greenhouse gas emissions: the Renewable Portfolio Standard (RPS) for energy generation, progressively higher targets for greenhouse gas reduction under AB 32, the reduction of petroleum use by 45% by 2030, the goal of 5 million zero emission vehicles on the road by 2030, reduction in the carbon intensity of fuels through the Low Carbon Fuel Standard by 2030, a requirement to double the rate of energy efficiency in buildings, and extension of the state's cap-and-trade program.

These initiatives drive markets, making California a leading laboratory for technology advances, and when coupled with California's technology base and innovative capacity they have supported the state's development as a national and global leader in renewable energy. Meeting ambitious targets that are also realistic, and continued investment in renewable energy research, can ensure that California further strengthens its position in high impact climate and energy technologies, with benefits across its regions.

FUTURE I INCENTIVIZING R&D

R&D, which moves the product of technology research into the marketplace, is at the heart of California's technology ecosystem. California's R&D tax credit dates from 1987, providing firms conducting qualified research with a 15% credit on overall expenses and a 24% credit on basic research. R&D tax credits are particularly valuable for smaller firms, helping to offset high local costs in California and reducing the risk of investment in long-term research.

At the start of the pandemic, when the state was projecting a deep budget deficit, business incentives including the R&D credit were placed under a three-year cap. While prudent in the circumstances, this had the effect of increasing cost uncertainty for many businesses and disrupted their ability to undertake long-term planning. These uncertainties may ultimately affect innovation and technology-led business growth.

Full restoration of the R&D tax credit can enhance California's competitiveness by supporting in-state R&D as well as high-wage jobs, patents and licenses. State leaders should also consider how the R&D tax credit can better support startups, newer firms at the pre-revenue stage, and companies that haven't yet turned a profit so don't face a large enough tax bill to benefit from a credit. Options include a net operating loss provision, a tradeable credit, and allowing a refund of any credit that exceeds a company's tax liabilities. To stimulate R&D while also supporting California's universities, a tax credit could be offered for investment from private companies in basic research conducted at universities. [54]

"The climate won't wait until 2045 for us to address the energy challenge. We need to make both the grid and our economy more resilient. The right investments can drive growth across the state in fields such as battery production, electromobility, and grow industrial capacity through large volumes of inexpensive renewable energy."

- Danny Kennedy, Chief Energy Officer, New Energy Nexus

[54] Milken Institute, *Sustaining California's R&D Economy Through Investments in R&D*, November 2021.

FUTURE | ADVANCING NEW TECHNOLOGIES

Over many decades Silicon Valley and other California regions have defined the frontier of where technology was moving, creating successive generations of transformative technologies. This capacity to advance the frontiers of science has assured California's technology leadership. It is imperative that California continue to lead.

"The state just assumes that it's a high-tech leader and will win out. We may be strong, but even if you succeed in keeping most of what you have you can lose out on the new things. In the case of semiconductors it's not about California doubling down on a mature business. Tomorrow will bring a new generation of semiconductor technologies that will reset the clock, stimulating activity not seen since the early days of Silicon Valley. Silicon Valley has the pole position for now but unless it steps up in 10-20 years that leadership could be lost."

- Dan Armbrust, Co-Founder and Director, Silicon Catalyst

New technologies are emerging or advancing that will continue to transform industries and how we live. AI has at least another decade of groundbreaking development ahead. Synthetic biotechnology and bioinformatics are advancing rapidly to include predictive medicine, gene therapy and the applications of CRISPR (gene editing) technology, MRNA technology (which has enabled the current generation of covid vaccines and is poised for more advances), and agtech and foodtech (which are improving sustainability while revolutionizing agricultural production and consumer markets.) Fields that are early in their development but are potentially transformative include materials science (materials for energy storage being one example), photonic computing, neuromorphic computing (which emulates how the brain works), and quantum computing. Quantum technology is likely to revolutionize both computing and materials science.

FUTURE | GROWING REGIONAL INNOVATION CLUSTERS

Technology innovation tends to be concentrated and highly localized, based on the unique competitive assets in different regions and cities. Technology and innovation clusters in turn drive economic development. Besides Silicon Valley there are at least three technology ecosystems in the state: in the greater Los Angeles region of Southern California, in San Diego, and the Central Valley. Each is based in distinct industries and is often connected to a university campus.

"Silicon Valley can drive the next wave of computing and semiconductor technology."

- Norbert Holtcamp, Deputy Laboratory Director, Stanford Linear Accelerator Center

The California Institutes of Science and Innovation, created in the early 2000s to leverage the resources of the University of California and accelerate growth in key technologies, has been a strategic success. Each of the four CISIs – in telecommunications, nanotechnology, bioinformatics and IT – has participation from at least two campuses, has attracted large scale government and private research funding, and has stimulated economic development and startup activity in their surrounding regions. The catalytic role of universities extends to California State University system. Humboldt State University, for example, has recently been designated a polytechnic campus, increasing its potential to play a more important role in the economy of the state's far north. This points to the long-term importance of spreading economic development and opportunity beyond the major coastal centers to include less developed regions of the state such as the North Coast and the Central Valley. Strategic partnerships that leverage public and private assets can spur the development of innovation clusters in target regions, spreading participation in the technology economy more evenly across the state.

FUTURE: A CALIFORNIA SCIENCE AND INNOVATION STRATEGY

Because California is a global leader in science and technology, state leaders should consider including these and other topics in a clearly articulated California science and technology strategy.

INTERVIEWS

To support the analysis in this report 44 interviews were conducted with leaders in the California's technology and innovation economy. Interviews included university research leaders, senior research executives at federal and independent research laboratories, venture capitalists and angel investors, executives from leading startup accelerators, and senior corporate executives. Each was asked to share their views on California's competitiveness in basic research and advanced technology, assess its underlying assets and long-term vulnerabilities, comment on the drivers of innovation in the state, and discuss emerging technologies that will be critical in the future. Their perspectives as practitioners provided valuable insights into how decisionmakers view the state's technology future and the issues that will shape it.

Bill Allen, President & CEO, Los Angeles Economic Development Commission

Daniel Armbrust, President Silicon Catalyst, former President SEMATECH

Mathieu Augesse, CEO Schoolab-San Francisco

Greg Becker, CEO, Silicon Valley Bank

Arthur Binenenstock, Special Assistant to the President for Federal Research, Stanford University

Kelly Born, Director, Cyber Initiative, Hewlett Foundation

Michael Borrus, Founding General Partner, XSeed Capital

Mark Bregman, General Partner Quidnet Ventures, former CTO Symantec, former chair of BASIC

Barry Broome, President & CEO, Greater Sacramento Economic Council

Nathan Brostrom, Executive Vice President, University of California Office of the President

Kim Budil, Director, Lawrence Livermore National Laboratory

Alan Chiu, CEO, Enya.ai & Co-President, Stanford Angels & Entrepreneurs

Richard Dasher, Director, US-Asia technology Management Center, Stanford

Mark Davis, Senior Director, Autodesk Research

William Diamond, President, SETI Institute

Eric Eide, Director of Ecosystem Development, Alliance for SoCal Innovation

Brian Green, Director of Technology Ethics, Santa Clara University Markkula Center for Applied Ethics

Gary Guthart, CEO, Intuitive Surgical

Stefan Heck, CEO, Nauto

Norbert Holtcamp, Deputy Laboratory Director, Stanford Linear Accelerator Center

Matt Horton, Director, Center for Regional Economics and California Center, Milken Institute

The Hon. Jacqui Irwin, Co-Chair, California Assembly Tech Caucus

Nidhi Kalra, Senior Scientist, RAND Corporation

Regis Kelly, Executive Director, QB3 Institute

Danny Kennedy, Chief Energy Officer, New Energy Nexus

Edward Klotzbier, Vice Chancellor and President UC Merced Foundation, UC Merced

Richard Lyons, Chief Innovation and Entrepreneurship Officer, UC Berkeley

Amber Mace, Executive Director California Council on Science and Technology

Theresa Maldonado, Vice President for Research and Innovation, University of California Office of the President

Andrew McIlroy, Associate Director, Sandia National Laboratory - California

Lenny Mendonca, former Chief Business & Economic Advisor, Office of Governor Gavin Newsom

Matthew Miller, Vice President – Research & Strategy, Greater Sacramento Economic Council

Prasant Mohapatra, Vice Chancellor for Research, University of California Davis

Rosibel Ochoa, Executive Director, Von Liebig Center, University of California Riverside

David Pearson, Managing Director, Entrepreneurial Programs, UC Riverside

Bill Reichert, Partner, Pegasus Ventures

Vijay Rajendran, Director of Innovation and Partnerships, 500 Startups

Harold Schmitz, General Partner, March Capital and former Chief Science Officer, Mars Inc.

Horst Simon, Deputy Director for Research, Lawrence Berkeley National Laboratory

Darlene Solomon, CTO Agilent Technologies

Evan Spiegel, CEO, Snapchat

Wallace Walrod, Chief Economic Advisor, Orange County Business Council

Mary Walshok, Associate Vice-Chancellor for Public Programs & Co-Founder CONNECT, UCSD

Dan Warmenhoven, former CEO, NetApp

Jeff Welser, COO IBM Research

Andy Wilson, Executive Director, Alliance for SoCal Innovation

Marjorie Zatz, Interim Vice Chancellor for Research, UC Merced

"CORE SCIENCE & ENGINEERING" DEFINED TO INCLUDE THE FOLLOWING BLS OCCUPATIONS:

Aerospace Engineering and Operations Technologists and Technicians, Aerospace Engineers, Agricultural Engineers, Architectural and Engineering Managers, Architecture and Engineering Occupations, Astronomers, Atmospheric and Space Scientists, Biochemists and Biophysicists, Bioengineers and Biomedical Engineers, Biological Scientists, All Other, Biological Technicians, Calibration Technologists and Technicians and Engineering Technologists and Technicians, Except Drafters, All Other, Chemical Engineers, Chemical Technicians, Chemists, Civil Engineering Technologists and Technicians, Civil Engineers, Computer and Information Research Scientists, Computer and Information Systems Managers, Computer and Mathematical Occupations, Computer Hardware Engineers, Computer Network Architects, Computer Network Support Specialists, Computer Numerically Controlled Tool Operators, Computer Numerically Controlled Tool Programmers, Computer Occupations, All Other, Computer Programmers, Computer Systems Analysts, Computer User Support Specialists, Conservation Scientists, Data Scientists and Mathematical Science Occupations, All Other, Database Administrators and Architects, Desktop Publishers, Electrical and Electronic Engineering Technologists and Technicians, Electrical and Electronics Drafters, Electrical Engineers, Electro-Mechanical and Mechatronics Technologists and Technicians, Electronics Engineers, Except Computer, Engineers, All Other, Environmental Engineering Technologists and Technicians, Environmental Engineers, Environmental Science and Protection Technicians, Including Health, Environmental Scientists and Specialists, Including Health, Epidemiologists, Food Scientists and Technologists, Forensic Science Technicians, Geological and Hydrologic Technicians, Geoscientists, Except Hydrologists and Geographers, Health and Safety Engineers, Except Mining Safety Engineers and Inspectors, Hydrologists, Industrial Engineering Technologists and Technicians, Industrial Engineers, Information Security Analysts, Life Scientists, All Other, Life, Physical, and Social Science Occupations, Life, Physical, and Social Science Technicians, All Other, Marine Engineers and Naval Architects, Materials Engineers, Materials Scientists, Mathematicians, Mechanical Engineering Technologists and Technicians, Mechanical Engineers, Medical Scientists, Except Epidemiologists, Microbiologists, Mining and Geological Engineers, Including Mining Safety Engineers, Natural Sciences Managers, Network and Computer Systems Administrators, Nuclear Engineers, Petroleum Engineers, Physical Scientists, All Other, Physicists, Semiconductor Processing Technicians, Software Developers and Software Quality Assurance Analysts and Testers, Soil and Plant Scientists, Web Developers and Digital Interface Designers, Zoologists and Wildlife Biologists

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