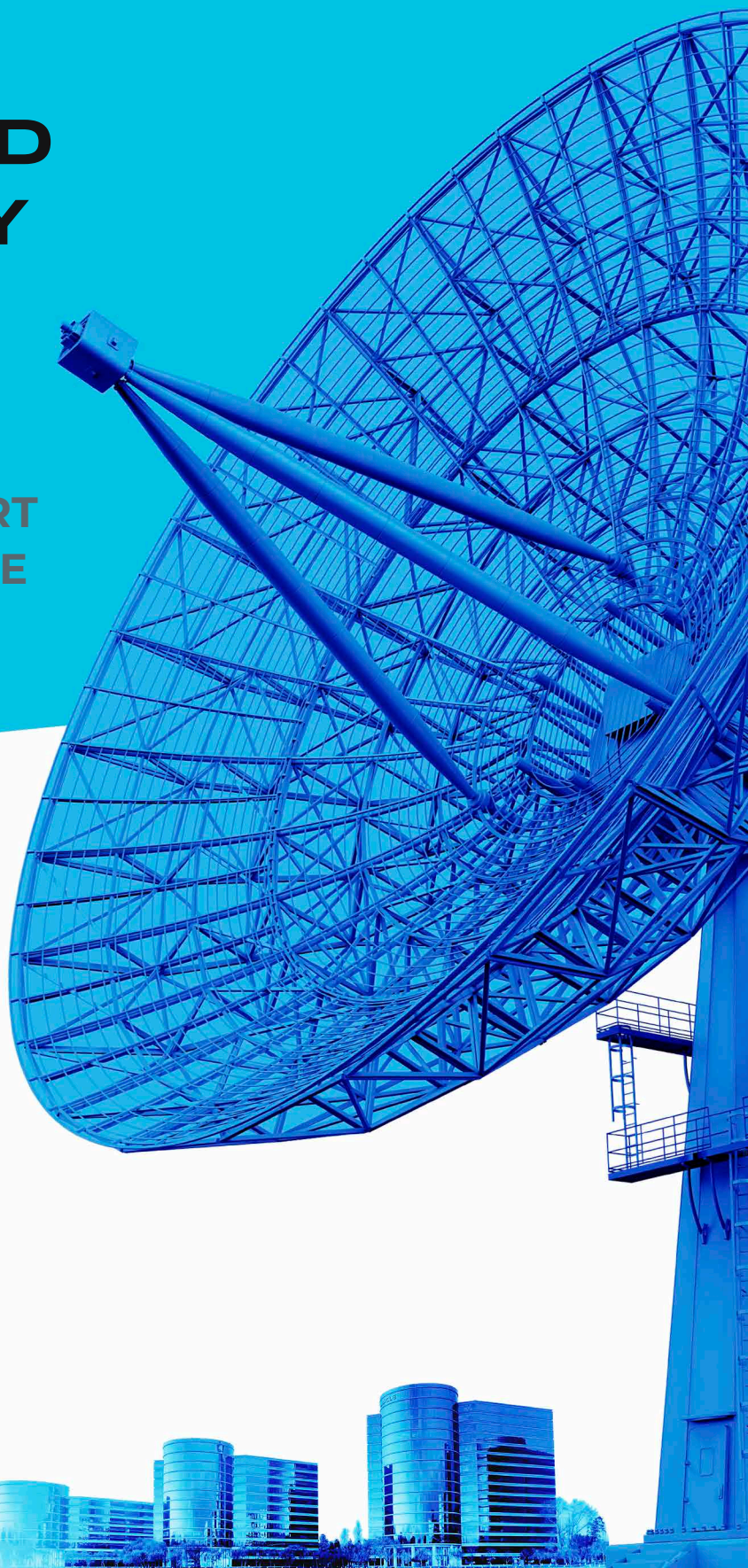
THE FUTURE OF ADVANCED TECHNOLOGY AND BASIC RESEARCH

A CALIFORNIA 100 REPORT ON POLICIES AND FUTURE SCENARIOS



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 THE FUTURE OF ADVANCED TECHNOLOGY AND BASIC RESEARCH IN CALIFORNIA

For additional background information, read the related Facts-Origins-Trends report at California100.org. The Facts-Origins-Trends report contains all of the references and citations to support the content of this report.

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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:

ADVANCED TECHNOLOGY AND BASIC RESEARCH

- Bay Area Council Economic Institute/Bay Area Science and Innovation Consortium
- Silicon Valley Leadership Group Foundation's California Center for Innovation

AGRICULTURE AND FOOD SYSTEMS

- California Polytechnic State University, San Luis Obispo, Natural Resources Management and Environmental Sciences

ARTS, CULTURE, AND ENTERTAINMENT

- Allosphere at the University of California, Santa Barbara

BUSINESS CLIMATE, CORPORATE GOVERNANCE, AND ASSET FORMATION

- Loyola Marymount University, College of Business Administration

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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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Focused Insight and perspectives provided by board members of the Bay Area Science and Innovation Consortium (BASIC)

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FOREWORD

"As California Goes, So Goes the Nation, Alas." That was a headline from a *Los Angeles Times* opinion column on April 30, 1989, which noted that, even though "Californians have long considered their state the cutting edge of social and political change… [it] no longer seems the vanguard of political innovation. Other states rarely look to California for policy initiatives."

Fast-forward to 2022, and few would proclaim that California lacks in policy innovation. Quite the contrary. The state has enacted a variety of policies ranging from expansions in immigrant rights and voting rights to health care and higher education, and from large-scale experiments in guaranteed income to ambitious moves towards net-zero emissions in a variety of sectors. And despite the periodic waves of "doom and gloom" reporting about the state, California's economic output over the last 25 years has grown faster than the national average, and on par with GDP growth for the state of Texas.

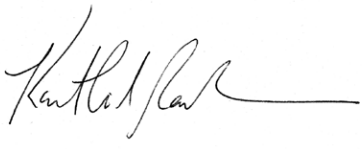
Even so, much remains to be done. While the state has embraced diversity in many ways, the California Dream has been marred by periods of intense racial exclusion. And the Dream remains out of reach for millions in the state today—whether measured by health outcomes, unaffordable housing, or massive disparities in income and wealth. California also recognizes that future progress depends on recognizing and correcting historical wrongs. Its Truth and Healing Council, for example, will provide recommendations aimed at prevention, restoration, and reparation involving California Native Americans and the State. If California's racial diversity represents America's demographic reality by 2100, our work is essential—not only for the long-term success of the state, but also for our country's innovative and equitable future.

This future-focused work is especially pressing today. The COVID-19 pandemic has scrambled a state and nation already undergoing significant changes in economics, politics, and society. The harmful consequences of climate change are at our doorstep,

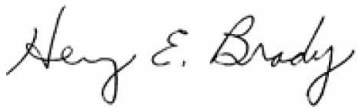
with forest fires and droughts that grow in frequency and intensity each year. The weakening of local media and the growth of disinformation threaten both our civic health and our public health. And staggering inequities in income and wealth, home-ownership and health, threaten the state's reputation as a haven for migrants, domestic and international alike.

In addition to immediate threats that affect our long-term future, we also see plenty of opportunity. Record increases in federal and state spending mean that billions of additional dollars are flowing to state, local, and tribal governments in California. Many jurisdictions are looking to invest in infrastructure that meets the long-term needs of their communities. Philanthropic institutions and individual donors are also looking to make transformative investments that have enduring impact. We have an opportunity to inform and enrich all of these plans and conversations.

Most institutions and organizations in California are focused on immediate challenges, and don't have the luxury of time, dedicated talent, and resources to focus on long-term futures. California 100 is grateful for the opportunity to provide added value at this critical time, with actionable research, demonstration projects, and compelling scenarios that help Californians—government agencies, stakeholder groups, and residents alike— to envision, strategize, and act collectively to build a more innovative and equitable future.



Karthick Ramakrishnan, Ph.D.
Executive Director



Henry E. Brady, Ph.D.
Director of Research

ADVANCED TECHNOLOGY AND BASIC RESEARCH IN CALIFORNIA

California is globally recognized as the world's leading center for technology, innovation, and entrepreneurial opportunity. While most concentrated in the San Francisco and Silicon Valley Bay Area, technology 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 personal income taxes (PIT) due to the substantial workforce dedicated to advancing technology in California. In the state's 2019-2020 fiscal year, PIT accounted for 66.19 percent of California's General Fund revenues, much of which are driven by taxation on technology initial public offerings (IPOs) and stock gains.

The worldwide perception of California's leadership in technology and innovation has attracted scientists and technologists to its universities and research laboratories for decades.

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 support 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.

The worldwide perception of California's leadership in technology and innovation has attracted scientists and technologists to its universities and research laboratories for decades, as well as 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 innovation, 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.

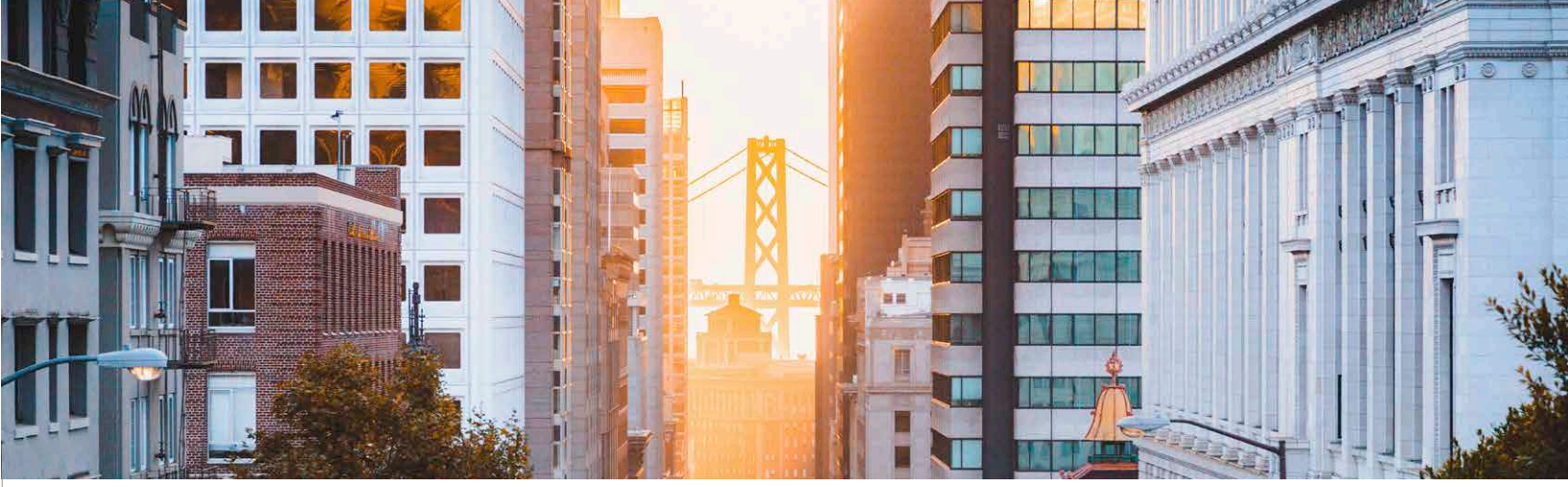
This remarkable level of success stems from the confluence of several drivers that together create a self-reinforcing ecosystem and critical mass of activity that is currently replicated nowhere else in the United States or the world. This report assesses California's capacity in basic research and advanced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

California's advanced technology ecosystem is composed of a complex of public and private institutions working in conjunction to commercialize and deploy new technologies and business models. This puts technology squarely at the heart of the state's economy. In this ecosystem, universities generate intellectual property and talent; public, private and non-profit research laboratories contribute to basic and applied research; startup incubators and accelerators support new companies; and venture and angel investors provide much of the finance. Though the innovation process isn't driven by government, government plays an important role as an investor in higher 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.

The $519 billion its tech sector contributed to the economy is more than a quarter of overall U.S. tech output, and more than the next four states combined. Although California's economy is large and diverse, the tech sector alone now accounts for nearly one-fifth of the economic value produced in the state. With 12 percent of the nation's population, California's nearly 2 million technology jobs in 2020 accounted for 15 percent of the nation's tech workforce. Jobs in the 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.

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 percent of the nation's private companies valued at more than $1 billion. The state is also headquarters to 11 of the 20 largest global technology firms. The Startup Genome Global Startup Ecosystem Report 2020 ranks Silicon Valley at the top of the new startup ecosystem, with Los Angeles tied for 6th and San Diego at 21st.

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 percent of the state's population), with 32 percent in Los Angeles and Orange Counties, and 11 percent in the San Diego region. The San Francisco Bay Area has the largest pool of technology talent in the United States with more than 370,000 tech workers. Technology accounts for 10.9 percent of all Bay Area jobs, or nearly triple the 3.9 percent national average. The Greater Los Angeles region in Southern California has also become a significant technology center—the fifth largest pool of tech talent nationally—with nearly 230,000 employees. The tech sector drives California's per capita gross domestic product, which is nearly $50,000 higher in the Bay Area than any other region of the state.

UNEQUAL ACCESS TO THE TECH SECTOR FOR COMMUNITIES OF COLOR

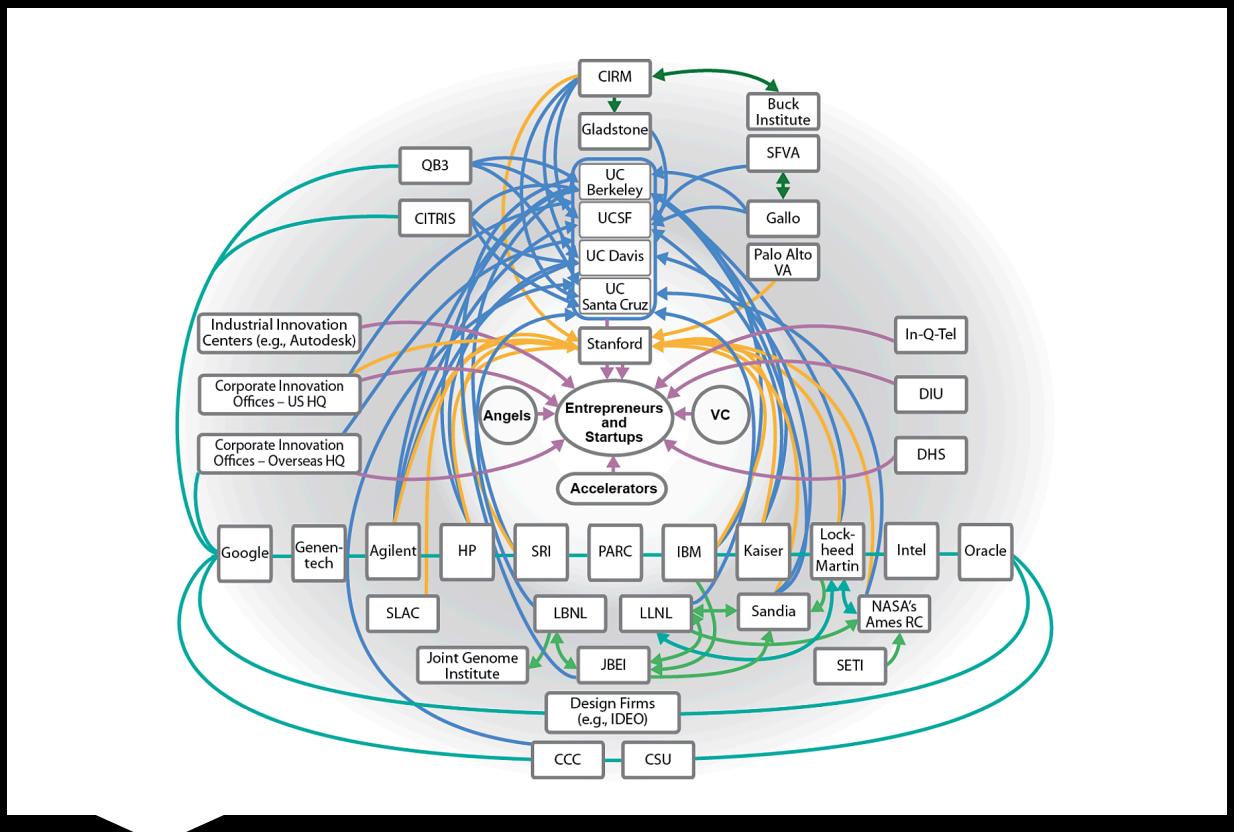
Student debt is a significant obstacle that discourages domestic students and particularly students of color from going on to higher education in STEM fields, a challenge aggravated by the comparatively low salaries for academic graduates in many hard sciences compared to graduates in engineering or other professional fields. This is reflected in participation of communities of color in the technology workforce, which is low and demonstrates structural challenges. In October 2019, Black, Latino, and Indigenous populations accounted for only 5 percent of the technology workforce in Silicon Valley. For the IT sector overall the three groups account for 16 percent of the workforce. Women are also underrepresented in the tech sector, making up only 28.8 percent of the tech workforce in 2020 – up from 26.2 percent in 2019 – but still much less than their share of the population.

CALIFORNIA HAS UNIQUE REGIONAL TECHNOLOGY AND INNOVATION CLUSTERS

THE SAN FRANCISCO BAY AREA AND SILICON VALLEY

The technology revolution led by Silicon Valley has its roots in world-leading universities, such as Stanford and UC Berkeley, that have served as anchors generating both technology innovations and company founders for decades. Federal dollars flowed into the region during the Cold

Figure 1 **The Bay Area's Unique Innovation Systems Relies on Collaborative Connections**



SOURCE: Bay Area Council Economic Institute.

War, but for the most part Silicon Valley has grown spontaneously and without a government plan, driven by a confluence of university research, visionary business leaders who created new industries and industry-leading companies, and an entrepreneurial mindset.

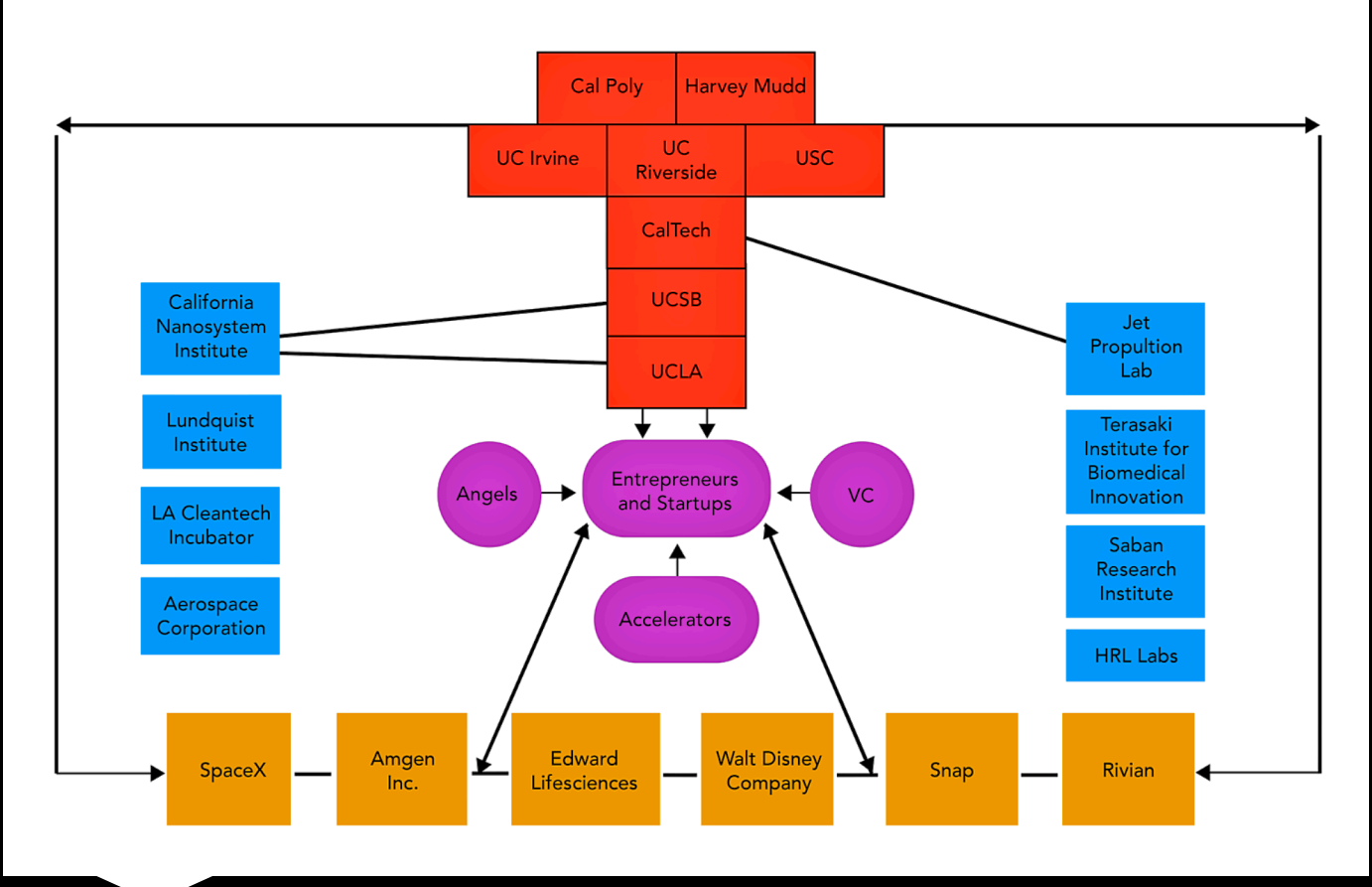
The Bay Area's innovation system today builds on a complex and highly networked web of technology companies, including the largest concentration of information technology (IT) and biotech companies in the nation; five major research universities, including four campuses of the University of California 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 world; an array of incubators and accelerators; and a large complex of research and innovation centers representing U.S. and globally-headquartered corporations. One key to the region's success over time lies in its ability to define and lead successive phases of the technology revolution. This flexibility and the capacity for reinvention has kept it at the leading edge of innovation. Over the past few decades, Silicon Valley has incubated the biggest names in cutting-edge technology companies, including Google, Apple, and Facebook.

THE GREATER LOS ANGELES REGION OF SOUTHERN CALIFORNIA

The Greater Los Angeles region of Southern California encompasses Los Angeles County, Riverside County, Orange County, Ventura County and Santa Barbara County. It builds on a strong base of research universities, including four campuses of the University of California, CalTech, and the University of Southern California. CalTech manages NASA's Jet Propulsion Lab in Pasadena.

Southern California's technology economy initially grew out of the aerospace industry following World War II. Aerospace remains an important sector in Southern California, but

Figure 2 **Although Less Complex Than the Bay Area's Network, Los Angeles Also Relies on Strong Institutions for Its Innovation Economy**



SOURCE: Bay Area Council Economic Institute

with a diminished base as a more diverse tech economy has developed. Today that economy spans bioscience, medical devices, photonics, semiconductors, mobility, cleantech, consumer tech, and digital entertainment, with agtech strong in the Inland Empire. The aerospace sector has evolved with a strong focus on the commercialization of space. Though at a smaller scale than in the Bay Area, the region generates a growing number of startups and access to venture capital is increasing.

SAN DIEGO

As in Los Angeles, aerospace was a key technology driver in San Diego 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 telecommunications and life science has grown.

San Diego's information and communication technologies (ICT) and telephony network first developed around Qualcomm, one of the world's top 20 technology companies and a leading producer of semiconductors, software, and services for wireless communication. San Diego's biotech cluster also developed through a symbiotic relationship between academia and industry. Major life science companies include Illumina, an industry leader in the field of life science tools and systems. UC San Diego has played a catalytic role in this new wave of technology innovation, attracting talent and connecting on-campus research with the region's business community through programs such as CONNECT, an economic development initiative launched in the 1980s designed to link campus research and local businesses, and which today supports tech and life science entrepreneurs by providing access to capital and mentorship.

Unicorn ***Describes a private startup company with a value of over $1 billion***

Table 1 **Southern California Is Home to a Large Pool of Technology Talent and a Growing Number of Startups and Unicorns**

	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 REGION

The Central Valley's economy is led by agriculture but is more diverse in the Greater Sacramento region, which hosts facilities of technology companies, such as Intel and Micron, as well as research and development in biotechnology, mobility and CleanTech. Because of its relative affordability and proximity to San Francisco and Silicon Valley, the Sacramento region has benefitted from the expansion of Bay Area companies, particularly as they seek more affordable locations as well as proximity to policymakers.

The Central Valley and Sacramento Metro regions are home to a range of top research facilities. UC Davis is the leading agricultural research campus in the nation and has played a critical role in the development of California's wine industry. Innovation activity spans both AgTech (which relates to the front-end process of growing food) and FoodTech (the production of food products, such as alternatives to animal-based proteins). 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. With its focus on serving low-income students from across the state, Merced is ranked fourth in the nation for supporting social mobility and number eight for the diversity of its undergraduate population.

A range of research institutes in the Central Valley, predominantly associated with universities, focus on AgTech, FoodTech and sustainability. While the Central Valley lacks headquartered companies that are engaged in basic research, many national and global food and AgTech companies have an active presence in the Sacramento region through research and development and innovation offices that engage with UC Davis and with the University of California's broader AgTech and FoodTech network.

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: universities that enable basic research, talent to translate research into innovation, and venture funding to fuel the effort to commercialize.

CALIFORNIA'S LEADERSHIP IN ADVANCED TECHNOLOGY STEMS FROM WORLD-CLASS UNIVERSITIES AND BASIC RESEARCH

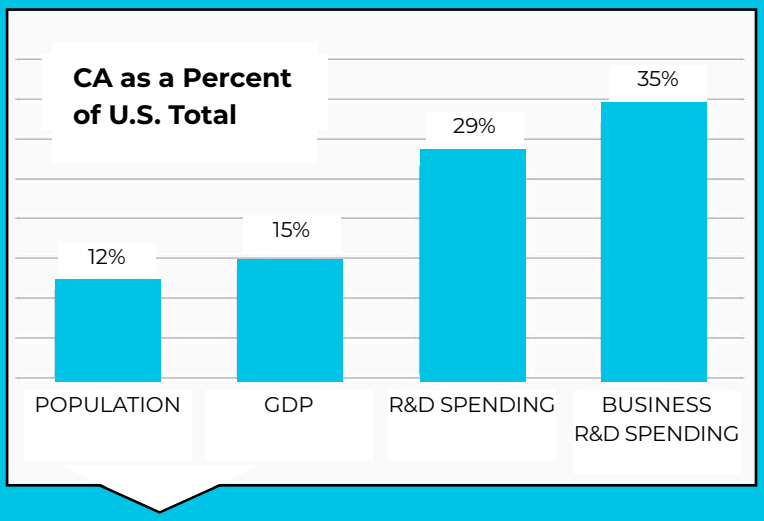
California is a national and global center for scientific research.

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 six federal research laboratories and an array of independent laboratories. These centers attract federal research funding and generate patents and licenses that channel research to the economy. From 2013 to 2018, the University of California was awarded the most utility patents of the top 100 research institutions globally, with nearly 5,000 active patents. This total does not include those additional patents produced by Lawrence Berkeley National Laboratory.

CALIFORNIA ATTRACTS MUCH OF THE NATION'S R&D SPENDING

California attracts a large share of the nation's research and development (R&D) spending. As Figure 3 shows, 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 one-third of the U.S. total.

Figure 3 **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

Together with Stanford and CalTech, the University of California dominates the composite rankings of colleges and universities nationwide.

Basic research, principally conducted at universities, typically has no immediate commercial application and requires government funding. This foundational research, however, provides an essential base for technological and commercial breakthroughs. The State of California enables this research through funding for the State's public research universities.

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 lead 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.

Federal support for science – through agencies such as the National Science Foundation (NSF) and the National Institutes of Health (NIH) – has significantly declined over the last two decades as a percentage of the federal budget and of GDP. 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 is needed to sustain investment at a high level.

CALIFORNIA'S DOMINANCE IN ADVANCED TECHNOLOGY IS SUPPORTED BY HIGH LEVELS OF VENTURE CAPITAL

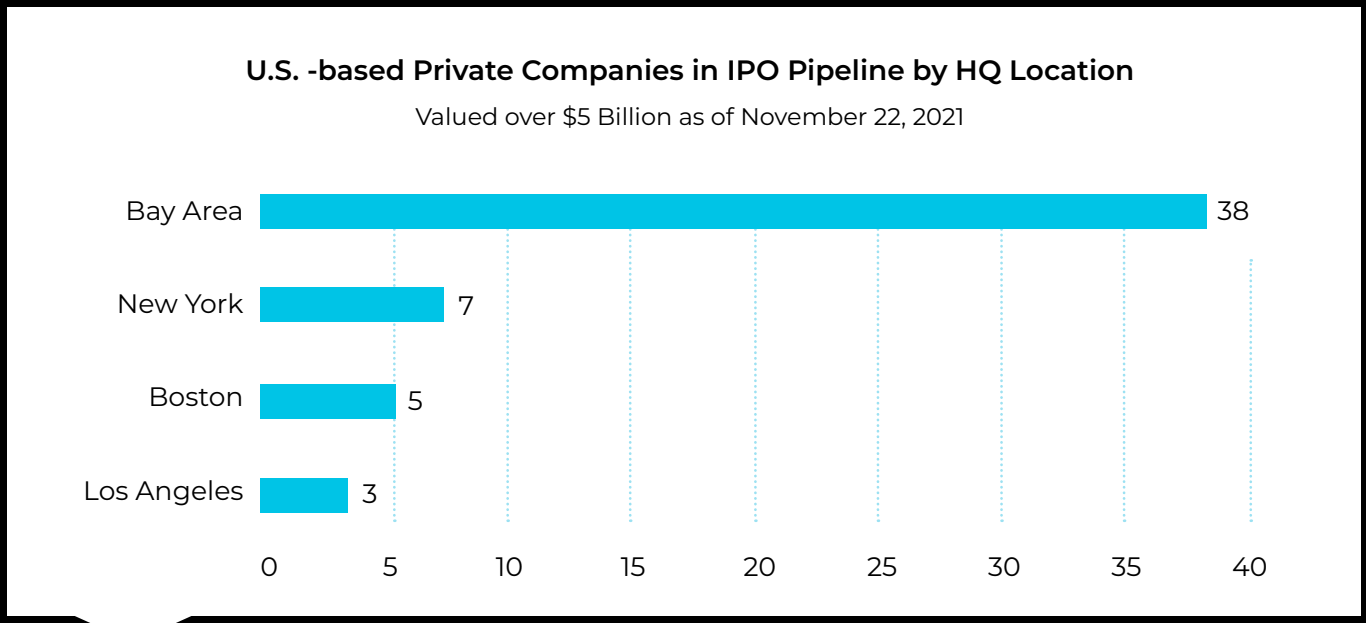
With investors concentrated in Silicon Valley, California attracts nearly half of all venture investment in the United States, with the Bay Area historically attracting approximately one-third of total venture investments. This capital, together with angel and other investment, provides funding that supports technology commercialization and attracts startup founders from across the United States and around the world; in many cases, those founders choose to move and grow their companies in the state.

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, Silicon Valley's semiconductor industry was expanding to markets beyond national defense. Growth in the semiconductor sector drove tech growth more broadly, spawning both spinoff companies and new investors, and set the stage for the region's present technology leadership. The high concentration of firms in Silicon Valley 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 often by becoming investors themselves.

During 2020-21, the Bay Area generated almost half of the IPOs and unicorn start-ups—or privately held startups valued at more than $1 billion—in the United States. In the first quarter of 2021, 47 percent of U.S. unicorn start-ups, and six of the thirteen unicorn start-ups valued over $10 billion, were based in the Bay Area. The greater Los Angeles area is home to an additional 21 unicorns. Figure 4 below shows how California dominates the IPO and unicorn pipeline across the country with evidence that this dominance continued through the end of 2021. A comparably strong pipeline is expected in 2022.

As venture investors—those who have historically conducted in-person meetings with prospective portfolio companies—become more comfortable conducting interviews and making decisions through virtual teleconferences, the companies they invest in may become dispersed nationally. If this occurs, fewer startups may come to California than in the past, eroding the concentration of startup activity that has benefitted the Bay Area. Nonetheless, while the implications for the Bay Area as the nation's leading center for startup activity are unclear, 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 the Bay Area and California, as we discuss in our Trends analysis below.

Figure 4 **California Dominates the IPO and Unicorn Pipeline Throughout the U.S.**



NOTE: There are 63 total companies valued over $5 billion in the IPO pipeline. Atlanta, Chicago, Dallas, Jacksonville, Philadelphia, Pittsburgh, Raleigh, Sacramento, San Diego, and Seattle have one company headquartered in each.

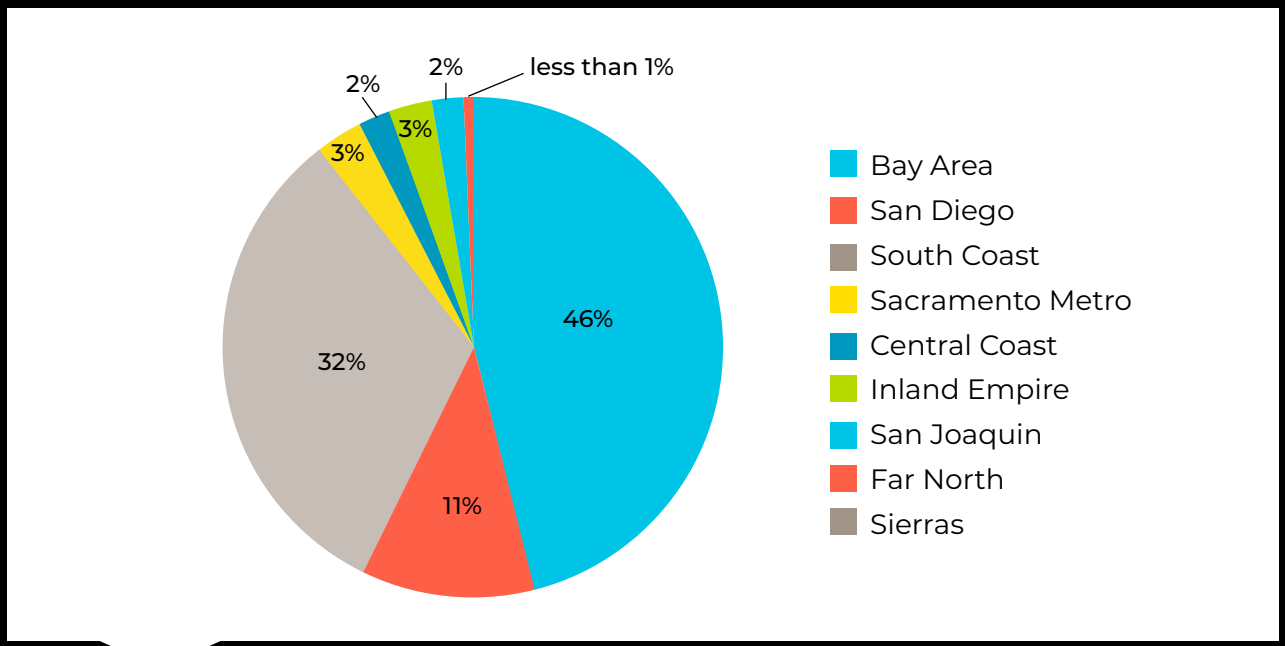
DATA SOURCE: CB Insights Global Unicorn List

ANALYSIS: Bay Area Council Economic Institute

CALIFORNIA HAS STRONG TECH TALENT POOLS

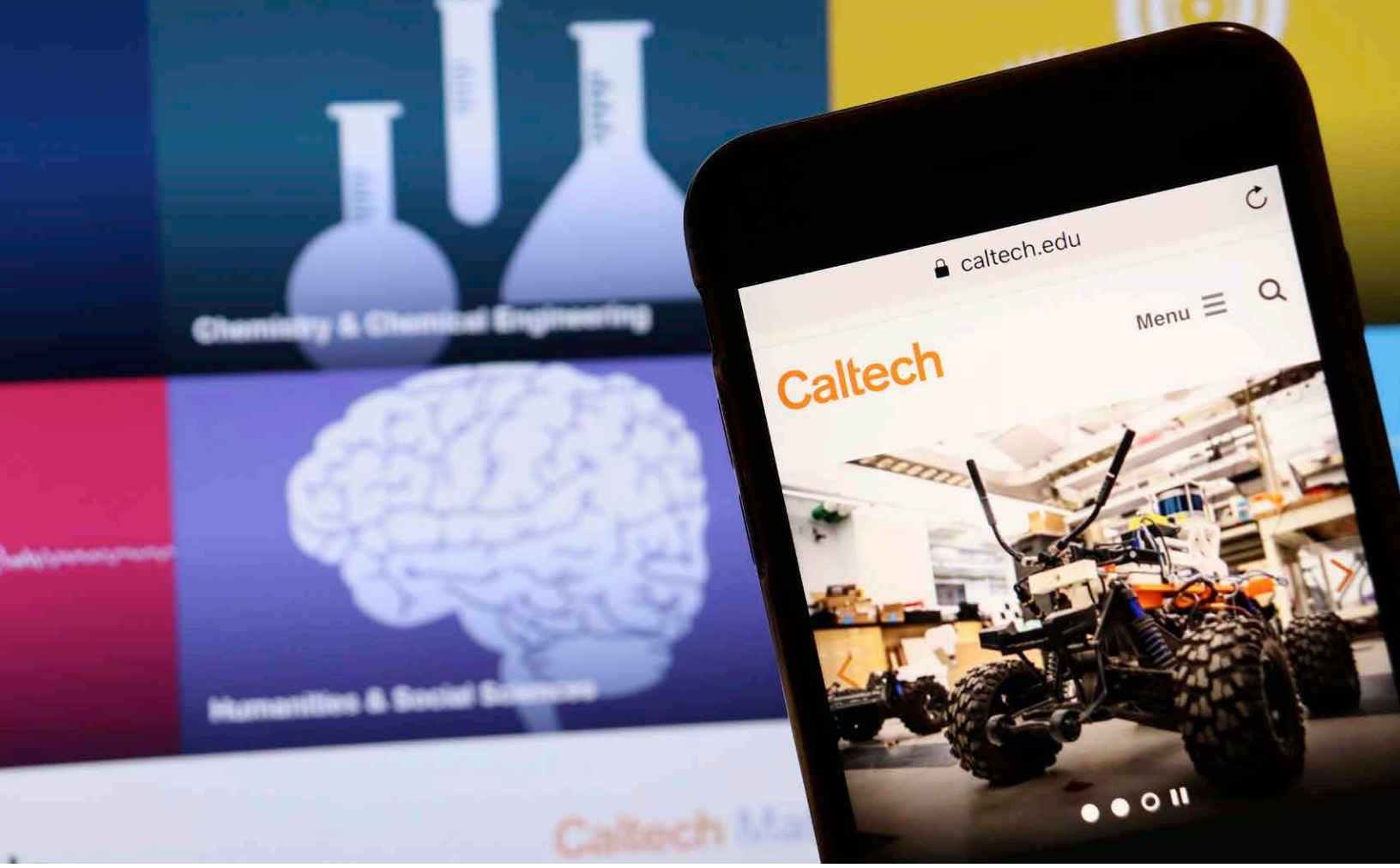
California's competitiveness in technology is closely linked to its extraordinary base of talent and the strong tech regions spread throughout the State. As Figure 5 shows, nearly 90 percent of California's tech jobs are concentrated in three regions: the Bay Area, Los Angeles and Orange Counties, also referred to as the South Coast, and San Diego.

Figure 5 **Nearly 90 Percent of California's Tech Jobs Are Concentrated in Three Regions**



SOURCE: California Employment Development Department: QCEW. https://data.edd.ca.gov/Industry-information-/Quarterly-Census-of-Employment-and-Wages-QCEW-/fisq-v939/data

California's tech talent comes primarily from three places: home-grown talent produced by the state's community college, California State University, and University of California systems and private universities such as Stanford, CalTech and USC; talent from across the nation that is drawn to the state by its innovation economy and universities; and talent from overseas that is also attracted by California's universities and innovation economy.



CALIFORNIA'S HIGHER EDUCATION INSTITUTIONS DIRECTLY CONTRIBUTE TO TECH TALENT

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 UC Berkeley, medical therapeutics and devices near UC San Francisco, and medical therapeutics and software near UC San Diego. Recognizing these positive impacts, University of California campuses have developed entrepreneurial and startup support programs to magnify their economic impact in surrounding communities.

The University of California is a unique asset for the state. All nine of its undergraduate campuses rank among the top 40 public universities in the nation 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 four out of the top five slots. Since 2000, however, the level of investment by the state in the University of California system has fallen by nearly half and has only recently begun to recover.

Despite its importance to the field, California's investment in higher education per student is less than impressive. California was 14th overall in per full-time equivalent student appropriations in FY 2020 at $9,500, which is well below other leading jurisdictions: Wyoming ($21,800) and Washington DC ($21,300). However, California's investment remains above the national average for higher education per student of $8,600, as well as competitors Massachusetts ($8,700), Washington ($8,600) and Texas ($8,100).

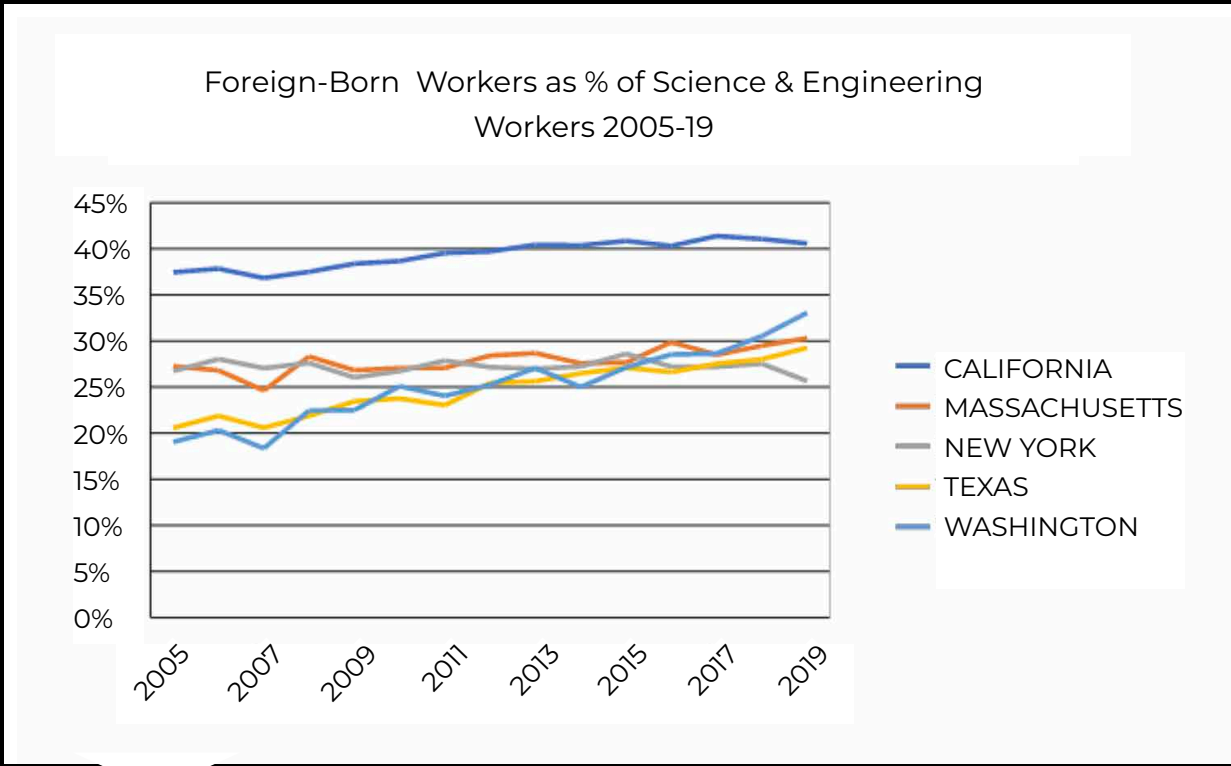
All levels of the state's higher education system are important to its technological leadership: the University of California for research and startup founders, CSU for bachelors and masters level engineers, and community colleges for technicians. While Stanford, for example, is a major source of scientists 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.

FOREIGN-BORN TALENT IS CRITICAL TO CALIFORNIA'S TECH SECTOR

Access to global talent has been particularly important to Silicon Valley, where approximately 45 percent of technology startups are led by founders from other countries. As Figure 6 shows, California's science and engineering sectors are more reliant on foreign-born talent than any other state, underscoring the synergies between the foreign-born workforce and the innovation ecosystem.

Research by the Kauffman Foundation finds that one in four new entrepreneurs in the United States is an immigrant and that immigrants are twice as likely as native born citizens to become entrepreneurs. Other research by the National Foundation for American Policy has examined historical data for 91 unicorns. 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 1,200 jobs per company, the vast majority in the United States. Thirty-three of those were California companies.

Figure 6 **California is Home to a Substantial Number of Foreign-Born Engineers**



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)

Because of its reliance on skilled immigrants for tech talent, California must take steps to decrease the vulnerability of these specialists. High-skilled immigration, which faces systemic bottlenecks due to visa and green card limitations and chronic delays in visa processing, is of particular concern to the tech community. From 2016 to 2020, many immigrants perceived that the United States was not a welcoming place for them, coloring their decisions on whether to come or remain.

Those that do come face formidable technical hurdles. The annual quota for H1-B visas, which opens for applications each year in April each year, is normally filled within days. Also, the U.S. has a 7,000 green card cap for each foreign country, assigning the same number of green cards regardless of a country's size or the strength of its tech workforce. Therefore, many immigrants, such as those from India who fill a wide range of technology positions, can wait as long as ten years for

their applications to be considered. Additionally, 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.

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 workforce through investment in STEM education at all levels, and an open door to high quality talent from abroad.

TRENDS UNDERLYING CALIFORNIA'S FUTURE ADVANCED TECHNOLOGY SCENARIOS

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.

CALIFORNIA'S LEADERSHIP IN ADVANCED TECHNOLOGY FACES COMPETITION

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 large-scale investment in scientific research and in strategically important sectors, such as semiconductors. The volume and quality of scientific research produced in China on Artificial Intelligence (AI) have grown dramatically, and while most observers believe that the U.S. is still in the lead, China is close behind. China is also strong in cloud computing, quantum computing, the Internet of Things (IoT), robotics, Information and Communications Technology (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 Financial Technology (FinTech), artificial intelligence, and health.

Closer to home, from January 2018 through June 2021, 265 companies moved their headquarters out of California. Many are technology leaders. While some companies have always left the state with most replaced by new ones, the pace of departures is accelerating. In the first six months of 2021, 74 companies moved out of California, double the rate of the previous years. Factors contributing to these departures include high housing costs and quality of life issues, as well as tax and regulatory policies.

CALIFORNIA'S ABILITY TO SUSTAIN A HIGH QUALITY OF LIFE IS CRITICAL TO ITS LEADERSHIP

Quality of life remains a strength for California, but is also a growing vulnerability. Its core weakness is the high cost of living in coastal cities, driven by the lack of affordable housing. In April 2021, the median sales price of a single-family home in California topped $800,000 with substantially higher housing costs in the tech-dominant regions. For decades, cities have failed to permit the housing required to meet demand, creating a cumulative deficit that has worsened as the state's booming technology economy has drawn workers to its urban centers. Rental rates have also increased, with San Francisco, San Jose and Oakland having some of the highest average rental rates in the U.S. Wildfires and their effect on air quality are providing additional reason for tech workers and entrepreneurs to look outside of California, and will present a growing challenge as climate change accelerates.

While California's technology leadership is unquestioned, companies have alternatives for where to locate research, manufacturing, and management, and employees 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 the state, enabled by the shift to remote work. Destinations where housing was cheaper and offered more living space include Austin, Dallas, Phoenix, Denver, and Miami, as well as smaller cities such as Boise, Idaho and Bend, Oregon. At the corporate level, leading technology companies such as HP Enterprise, Oracle, Palantir and Tesla have relocated. Corporate departures have

occurred for a range of reasons which should concern state leaders: high housing costs for their employees, taxes that target business and particularly tech, regulations such as CEQA that increase the cost and uncertainty of investing, and a perception that California as a whole presents a difficult climate for businesses to grow.

In the wake of the pandemic, most technology companies are likely to retain a hybrid office model, where workers come to an office when needed but more often work from home. As a consequence, the need for technology workers to concentrate in urban centers such as San Francisco or San Jose will be reduced. This suggests another vulnerability for the state: that with less need to concentrate employees in existing tech centers highly successful companies that are launched and financed in California, and their employees, may choose to grow elsewhere due to housing costs, tax and regulatory issues, and environmental concerns.

The deepest challenge to California's long-term scientific and technology leadership may, therefore, stem less from external threats than from intrinsic failures in the state's infrastructure, and particularly 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.

THE CHALLENGE AND OPPORTUNITY OF CALIFORNIA'S CHANGING DEMOGRAPHICS

California today is a majority minority state, with an increasingly diverse racial mix led by a growing Latino community, but Latino residents and other residents of color are underrepresented among California's scientists and technology entrepreneurs. Failure to more effectively engage the Latino community and other underrepresented groups 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.

REBUILDING ADVANCED MANUFACTURING

While high-value R&D continues to be a California strength, much of R&D is tied to the manufacturing process, suggesting that over the long term the loss of manufacturing capacity will also impact R&D. 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 by industry. Manufacturing's importance must also be recognized and supported by state and local leaders, who many in the industry describe as indifferent to manufacturing's importance and to the need to compete for manufacturing jobs. Biomanufacturing and the semiconductor sectors offer immediate opportunities.

REIMAGINING THE ROLE OF UNIVERSITIES

The decline in public funding for research universities, a national phenomenon that is not limited to California, is unlikely to be dramatically reversed. However, with the catalytic role they play across the state, the role of public universities in advancing technology and innovation should be revisited and more strongly supported. Public higher education, and the University of California in particular, is a powerful asset for the state's economy that impacts its ability to meet broader goals – including solutions to the challenge of climate change and to the economic disparities between California's regions. Focal points should include support for faculty and student entrepreneurs, growing industry partnerships, and supporting regional economic development.

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 defines the role of a research university will need to change.

THE IMPACT OF ADVANCED TECHNOLOGY ON CLIMATE AND ENERGY

Policies and technologies that enable decarbonization have made California a leading laboratory for technological advances, and will grow in importance as climate change accelerates. When coupled with California's technology base and innovative capacity, such policies create new markets and support the state's development as a national and global renewable energy leader. Meeting ambitious targets, and continued investment in renewable energy and energy efficiency research, can ensure that California strengthens its position in high impact energy technologies, with benefits across its regions.

GROWING MORE 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 particular industries and is often connected to a University of California campus. Because of the catalytic role they play in economic development, consideration should be given to how UC and CSU campuses can increase their contribution to the economy even further.

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. The recent announcement that Humboldt State is seeking to be renamed "California State Polytechnic University, Humboldt" presents an opportunity to catalyze a technology hub on the North Coast. The University of California, Merced provides a nucleus for a new technology hub in the Central Valley, as does the University of California, Riverside in the Inland Empire. Strategic partnerships that leverage both 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.

Ultimately, because California is a global leader in science and technology, state leaders should consider including these and other goals in a more clearly articulated California science and technology strategy.

THE FUTURE OF ADVANCED TECHNOLOGY IN CALIFORNIA

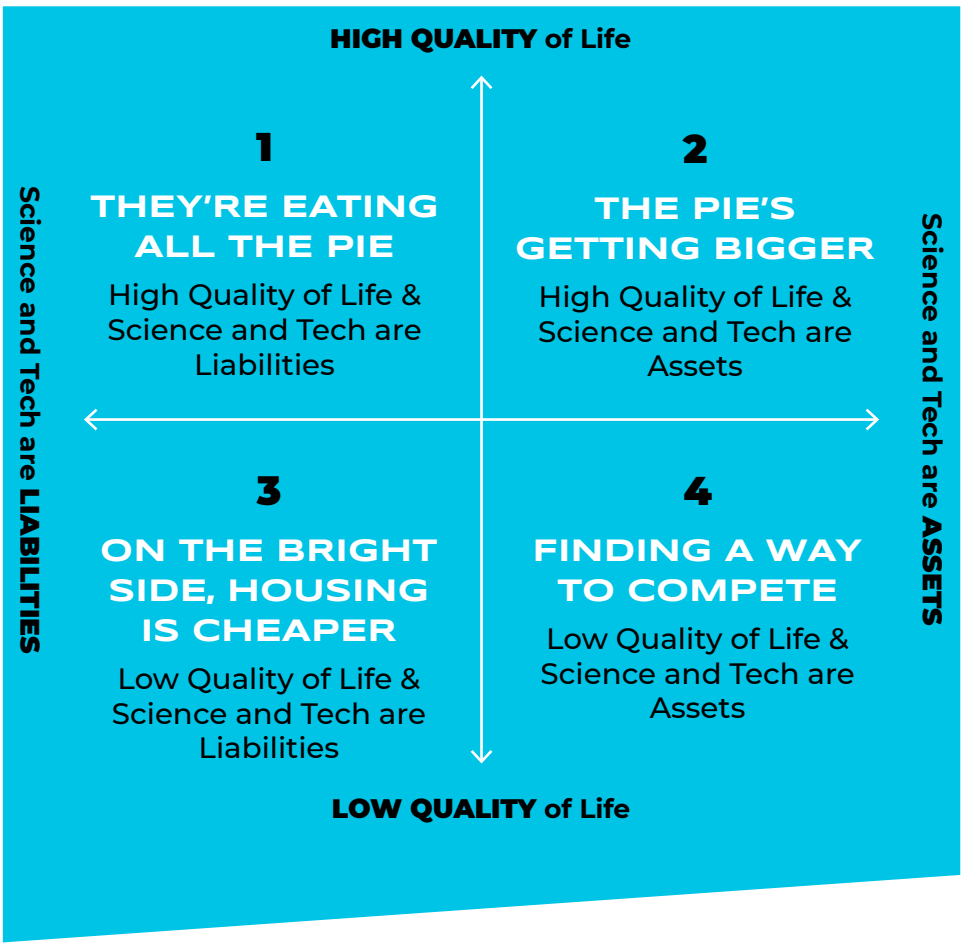
FOUR ALTERNATIVE SCENARIOS

SCENARIOS FROM THE FUTURE

ADVANCED TECHNOLOGY

Foresight practitioners use scenarios to help make future possibilities more vivid and tangible, immersing the reader in the particular details of a future world so that they can mentally situate themselves in what it would feel like to live there. Without scenarios, the signals, trends, and other research that underlie strategic foresight work can feel distant and abstract. Scenarios can be used to center a group conversation in a positive and concrete picture of a future state so that stakeholders can pursue a shared vision for how to respond to that possibility, or mobilize action to avoid an undesirable outcome.

To imagine future scenarios for advanced technology in California, we have selected two critical uncertainties based on the origins and trends identified: the general quality of life for Californians, and the prevailing public and political attitude toward technology. Quality of life is a broad metric that attempts to capture cost of living, environmental quality, health, economic opportunities, education, and other key factors. Of course, the subtleties of whose quality of life and what quality means for different people are important, but this dimension captures the historical fact that California has been considered a great place to live. However, it faces growing concern that—with a proliferation of problems—it may no longer be the golden state. The second critical uncertainty captures Californians' long-standing positive attitude toward advanced technology, seeing it as an engine of economic growth and creativity. But with technology companies coming under scrutiny due to online disinformation, privacy concerns, and other issues, the technology sector is facing a backlash. In addition, the politicization of science in recent years—particularly in relation to climate change and vaccines—threatens to undermine the broad public support the scientific community has long enjoyed.



THEY'RE EATING ALL THE PIE

Continued economic bifurcation fuels resentment

Highly skilled workers continue to flock to California for the highest paid roles, but the middle skill workforce has long since fled for lower cost regions. The economic bifurcation and inequality that accelerated in the late 20th and early 21st centuries continue unabated for decades. This contributes to a declining sense of social solidarity and aggressive policy measures toward tech. Public concerns about automation, privacy, and misinformation have driven a rapid decline in public trust toward tech, with a particularly pronounced drop in the U.S., along with a deepening public skepticism of science.

However, even as tech hubs emerge across the globe, talent remains drawn to California's universities, cachet, and risk-taking culture. Where talent goes, money follows. Despite its challenges, California continues to net 40%+ of overall U.S. venture funding. Housing affordability remains difficult, as 50 years of ineffective California housing policy show no sign of changing.

This is a future of familiar challenges, still being kicked down the road, but California remains a significant economic and technological force on the global stage.

HISTORICAL PRECEDENTS

Gilded Age: Concentration of wealth leads to progressive era policy changes.

1995: Microsoft's software dominance leads to federal antitrust suit that changed Microsoft and the industry.

FUTURE DRIVERS

Quality of Life: Climate change and cost of living (largely driven by housing) will impact talent flows.

Culture: California's innovative culture is self-perpetuating, but resentment and xenophobia could make the state hostile to change.

Technology: Automation and digitization will drive new jobs and industries, but how many, how soon, and in what parts of the state?

SIGNALS

VC funding follows talent

WHAT: California continues to dominate venture capital.

SO WHAT: Despite breathless pronouncements of California's demise, top talent remains in CA, and therefore, so does the money.

wired.com

Half of Americans fear tech will take their jobs, trust in tech falters

WHAT: A March 2021 Edelman report finds trust in the tech sector has cratered since 2019.

SO WHAT: Californians won't embrace innovation if they don't trust innovators.

axios.com

Housing permits and construction lag demand

WHAT: As of April 2021, housing permits were being issued at an annual rate of ~100K, ~55% of what is needed.

SO WHAT: Housing is the biggest driver of CA cost of living, and supply is not keeping pace with demand in most cities.

ppic.org

THE PIE'S GETTING BIGGER

Surging tech ecosystem is source of California pride

California responded aggressively to emerging threats to its tech supremacy in the 2020s and 2030s. A new commitment to growing the UC system together with increased housing supply and investment in transportation mitigate cost of living issues and uneven regional development, solidifying the place of the tech ecosystem as a broadly shared asset. The best and brightest still come to California to stay, while middle skill jobs in industries like healthcare, clean energy, and advanced manufacturing have fueled a resurgent middle class.

The California economy seems to re-load rather than re-build. As mature companies plateau or decline, others are poised to take over as the state's tech icons. California remains a global destination for the brightest students internationally, as the UCs, Stanford, and Caltech remain among the world's top ten research universities. Tech hubs emerge across the globe, but talent remains drawn to California's universities, cachet, and risk-taking culture. California continues to net 40%+ of overall U.S. venture funding.

HISTORICAL PRECEDENTS

1962: President Kennedy responds to the Soviet space program by promising to put a man on the moon.

1958-65: Seven new UC campuses are established.

2010s: Singapore's intentional digital strategy: "Few governments have had their leaders align themselves with digital efforts as closely and visibly as Singapore's". (McKinsey's Diaan-Yi Lin)

FUTURE DRIVERS

Quality of Life: Climatechange and cost of living (largely driven by housing) will impact talent flows.

Public Opinion: Will tech be seen as a shared project or a source of exclusion?

Technology: Will automation and digitization drive new jobs and industries? On what time frame?

SIGNALS

California still leads in VC funding

WHAT: California continues to dominate venture capital.

SO WHAT: Money follows talent, and top talent remains in CA.

wired.com

California still the top destination for foreign students and entrepreneurs

WHAT: More than a third (36%) of international students name California as their preferred U.S. study destination, according to a 2021 report.

SO WHAT: As of 2019, 45% of Fortune 500 companies were founded by immigrants or their children.

keystoneacademic.com

IPOs in the Offing

WHAT: In January 2021, more than half of private companies valued at $1B+ were headquartered in California. Thirteen of the fourteen largest tech IPOs in 2020 were of Bay Area-headquartered companies. As of November 2021, 38 emerging companies valued at over $5 billion were headquartered in the Bay Area, vs. 7 for New York and 5 for Boston..

SO WHAT: These companies are poised to scale, creating new jobs, new investors, and even new industries.

seattletimes.com

ON THE BRIGHT SIDE, HOUSING IS CHEAPER

California decides technology does more harm than good

Technology talent looks for better opportunities in Asia, Europe, and other U.S. regions, and VC funding follows it, draining wealth and energy from California. After first shedding no tears as housing prices stabilized, state leaders are grappling with increasing budget pressures as the tax base weakens. Those woes in turn compound governance problems related to climate, homelessness, and public education. The state's ability to make needed investments in clean energy infrastructure and other priorities becomes increasingly limited.

AI and automation have a huge upside, but costs of these technologies will weigh heavily on communities that don't make needed pivots. Dangerous air blankets the state for weeks each year. With tent cities growing and no policy answers in sight, those who can move, do. China in particular seizes on the decline of California. It aspires to create a world class university system, drawing students from across the globe and making Chinese students in California a rare sight.

HISTORICAL PRECEDENTS

China circa 1600: Concerns about the impacts of trade inspire Chinese leaders to turn inward.

Pittsburgh 1970-1990: 158K manufacturing jobs and 289K residents are lost as the steel industry craters.

FUTURE DRIVERS

Technology: Will automation and AI drive new jobs and industries? On what time frame?

Competition: How will other nations fare relative to CA in combating climate change and supporting innovation culture?

Quality of Life: Climate change and housing costs will impact talent flows.

Federal Policy: Innovation falls as U.S. immigration policy restricts access to entrepreneurial and scientific talent from abroad.

SIGNALS

DeepMind moves toward general AI

WHAT: In summer 2021, DeepMind reported its reinforcement learning system can apply learning in one game to strategy in another, in what some say is a step toward general AI.

SO WHAT: AI's development will continue with or without California in the lead. The trade-offs between risks and rewards of pushing forward will be faced by every jurisdiction, but with potentially global impacts.

venturebeat.com

China invests heavily in Research and Development

WHAT: China's gross R&D expenditure is growing rapidly, by some measures inching ahead of the U.S. for the first time in 2021.

SO WHAT: China has a plan to supplant the United States as the cutting edge of innovation, and the resources to pursue it.

statista.com

California population declines for the first time

WHAT: CA recorded its first ever population decline in 2020.

SO WHAT: Wildfires and the effects of COVID-19 are taking a toll on the mental and physical health of Californians. Many are migrating out of the state in response.

latimes.com

FINDING A WAY TO COMPETE

When the weather isn't enough

The flow of talent into California slows down as housing costs, climate impacts, and rising competitors take their toll. The state leans in with creative measures to remain attractive in the face of strong challenges from other states and abroad, shoring up traditional advantages in venture funding while trying to learn from successes in Europe and Asia on education, infrastructure, and skills development.

HISTORICAL PRECEDENTS

1986: Passage of California R&D tax credit, in face of increasing competitive pressure from Japan.

June 2021: Senate passes U.S. Innovation & Competition Act, with $250B dedicated to keeping pace with Chinese tech investment and $52B to investment in semiconductors.

FUTURE DRIVERS

Quality of Life: Climate change and cost of living (largely driven by housing) will impact talent flows.

Competition: How will other nations fare relative to CA in efforts to combat climate change and support innovation culture?

Federal Policy: Basic research funding and immigration policy will influence technology discoveries and breakthroughs.

SIGNALS

San Jose and Google work together

WHAT: In May 2021, San Jose approved 20K Google jobs downtown, with $200M from Google in community benefits.

SO WHAT: This fight, which went from trench warfare to broad agreement in 18 months, could be a model for future tech/community engagement.

mercurynews.com

Bloomberg Innovation Index 2021 provides reality check

WHAT: South Korea led global innovation in 2021 as U.S. exits top ten, according to Bloomberg.

SO WHAT: Some innovation indices are flimsy. But more and more they are telling a similar story, with the U.S. and California falling behind.

bloomberg.com

CA students look elsewhere as tuition increases loom

WHAT: UC's 18% cap on international student enrollment had exempted UCLA, Berkeley, and San Diego. No longer, as of 2022.

SO WHAT: Capacity constraints will lead to fewer foreign student spots. This will result in reduced tuition revenue, meaning fewer resources and more capacity constraints, fueling a vicious cycle.

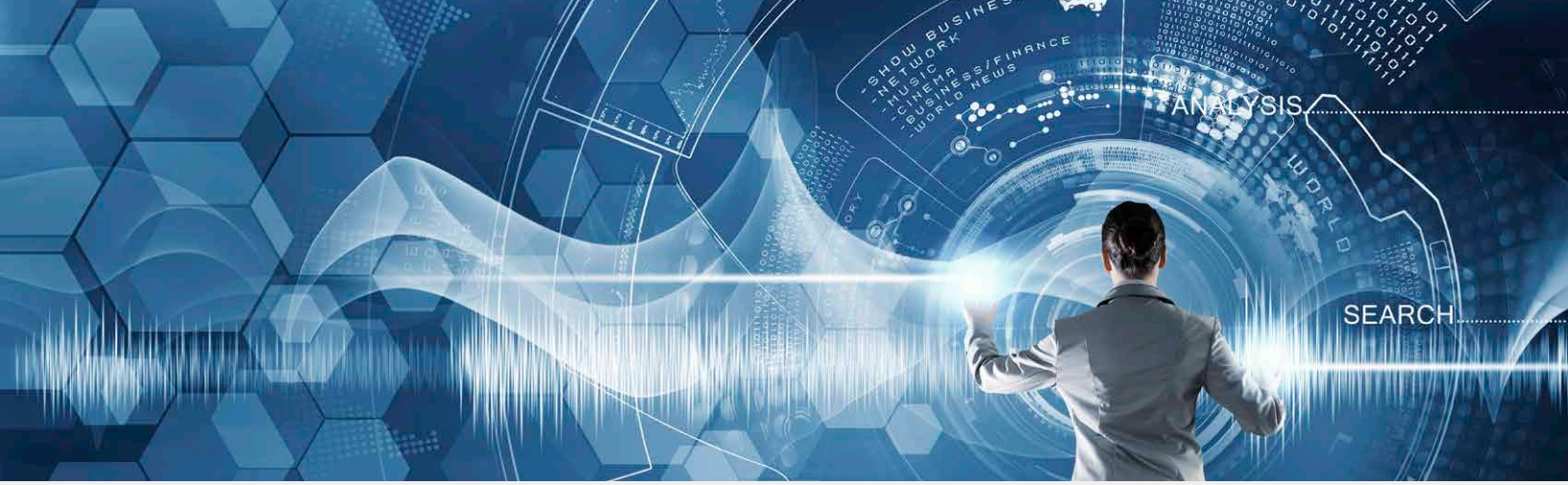
edsource.org

FUTURE ADVANCED TECHNOLOGY AND BASIC RESEARCH POLICIES IN CALIFORNIA

Choices among governmental policies depend partly upon which future scenarios seem most attractive to us, but they also depend upon our perspectives on the proper role of government, on the resources available to government, and on the likelihood that government will succeed in its endeavors. Doing nothing is sometimes the best policy option, but doing nothing often uncritically accepts the current mix of policies and the future they entail without considering the alternatives. Over the past seventy-five years in California, that meant accepting discriminatory racial housing covenants, restrictive zoning laws, few restrictions on air or water pollution, "separate but equal" schooling, the dismantling of transit systems, and many more things that are now thought to have been wrong or misguided. We have also seen aggressive policy measures in California that have had unintended consequences, from the impacts of Proposition 13 on local government budgets to the way the California Environmental Quality Act has affected housing supply and manufacturing.

Because we are thinking about the future and we do not want to be hemmed in by the status quo or a lack of imagination, we put forth an array of alternative policies, and we tie them to different scenarios. Readers should consider which scenario best captures the California they want to live in, and evaluate which policy recommendations they believe will get us there.

For Advanced Technology and Basic Research, the four scenarios focus on external factors that might help or hinder the development of technology in California. We start from the presumption that technology and innovation are mostly good things that we want to nurture. Although this belief is not universally shared, nevertheless it has wide currency in California because of the economic growth that it has produced and the improvements in the quality of life it has engendered. We recognize, however, that like any other asset, technology must be managed to produce benefits and avoid harm. All of the policies recommended below are meant to improve the climate in California for innovation while also dealing with its hazards.



SCENARIO

THE PIE IS GETTING BIGGER:

A Surging Tech Ecosystem is a Broadly Shared Source of California Pride – Science and Technology are Assets and High Quality of Life

In this scenario, California responded aggressively to emerging threats to its tech supremacy in the 2020s and 30s. Its new commitment to a growing UC system together with emerging communication and transportation tech that mitigated housing supply issues and uneven regional development solidified the place of the tech ecosystem as a broadly shared asset. The best and brightest still come to California to stay, while middle skill jobs in industries like healthcare, clean energy and advanced manufacturing have fueled a new middle class. With the economy booming and California's place in the technology ecosystem secure, the state can look to broadening the ecosystem's impacts across its regions, deploying tech to solve public problems in new ways, and making long-term investments in broadly shared prosperity.

State innovation funding for priority technology sectors, underdeveloped regions of the state, and demographic groups

In 1998, Massachusetts created its own development finance agency to provide loans of up to $2.5 million to entrepreneurs in target technologies or targeted demographic groups, or those operating in target regions of the state. California could similarly provide dedicated State funding to support advancement in key technologies, or for entrepreneurs from target regions and demographic groups.

This practice could leverage technologies and founders coming from California's universities and broaden and deepen economic development across California. A related precedent is the 2004 passage of Proposition 71 by 59 percent of the voters in California that provided $3 billion for "Stem Cell Research and Cures" for the creation of the California Institute for Regenerative Medicine (CIRM). California took the lead in this area because of restrictions on funding of stem cell research at the federal level. CIRM's focus was initially on basic research, but it has also funded translational research to get scientific findings through the "valley of death" stage for innovations where the basic science is understood but entrepreneurs are not yet willing to invest in new approaches. CIRM's experiences could inform broader state innovation funding.

Venture capital has historically been invested in limited parts of the state and primarily focused on men of white and Asian background. State innovation funding could contribute to the diversity of the tech workforce, while a loan fund that leverages and supports founders and key technologies produced at California's universities can magnify opportunity and the impact of investment in higher education. Supporting emerging technology companies beyond traditional tech hubs can make those regions more resilient to economic disruption and change.

Expand state funding for the University of California system

State funding for UC often focuses on funding for undergraduate students and neglects support for graduate students. Increased funding should include more support for graduate-level enrollment and targeted initiatives that leverage university and private resources to support both startup growth and regional economic development. This funding would bolster the strength of the UC system while also maintaining its identity as a public institution. Additional funding attracts the strongest students and faculty, leverages federal and private research funding, and stimulates economic activity in targeted technology sectors. UC is a unique competitive asset for the state and a major source of both technology and founders, particularly at the graduate level. This kind of R&D spending would demonstrate an investment in long-term economic development.

SCENARIO

THEY'RE EATING ALL THE PIE:

Continued Economic Bifurcation Fuels Resentment – Science and Technology are Liabilities and High Quality of Life

Highly skilled workers continue to flock to California for the highest paid roles, but the middle skill workforce has long since fled for lower cost regions. The economic bifurcation that accelerated early in the 21st century continued unabated for decades, contributing to a declining sense of social solidarity and aggressive policy measures toward tech economy. Policy challenges and opportunities include economic bifurcation, declining social solidarity, technology not addressing public needs, and high housing costs that drive away middle class residents.

Reform the California Environmental Quality Act (CEQA) and Other Measures to Increase Housing Production

CEQA should be reformed to ensure that environmental goals are met, but also to ensure that CEQA is not misused to prevent housing development and tech and other manufacturing. CEQA is often used as a political tool to stop new housing development, which California desperately needs, especially if it wants to attract and retain talented tech workers and the infrastructure that supports them. To improve California's primary quality of life issue–housing supply–California must revise the policies and laws that directly affect its governance in this area. For example, reforming CEQA would decrease the costs of building a unit of housing in California by bringing the time required for regulatory processes into line with other nations and U.S. states. It would also make it easier for technology companies such as Intel to site new facilities in California and not competing states such as Ohio or Oregon.

Soaring housing costs disproportionately affect middle- and low-income residents as well as people of color. Although the economy in the highest cost regions of the state has remained strong, the economic distribution in those regions, with jobs at both ends of the wage spectrum but without a robust middle class, is likely unsustainable. Lack of housing is a key factor explaining economic bifurcation, poverty and departures from the state.

Triple the number of K-12 students taking computer science (CS) courses in CA

By providing supplemental state funding for school districts to increase CS access, with focus on underserved regions of state, California could triple the number of California K-12 students taking computer science as a way of increasing the number of students graduating from high school prepared for work and study in STEM fields. CS education in primary and secondary school provides a foundation for work and study in the field, and will particularly enhance the workforce pipeline with young people across underrepresented regions and demographic groups. Strengthening the digital skills of native Californians may also forestall immigration policy disruptions that might limit the flow of skilled talent from abroad.

SCENARIO

ON THE BRIGHT SIDE, HOUSING IS CHEAPER:

California Decides Technology Does More Harm than Good – Science and Technology are Liabilities and Lower Quality of Life

The best technology talent in this scenario looks to Asia and Europe, and VC funding follows it. After first shedding no tears, as housing prices stabilized, state leaders are now grappling with increasing budget pressures. Those woes in turn compound governance problems related to wildfires, homelessness and public education, and limit the state's ability to make needed investments in clean energy infrastructure and re-skilling in the face of automation.

Create a Comprehensive California Innovation Strategy to ensure dedicated government support for competition in the technology and R&D industries

California is an outlier among successful tech hubs today in having succeeded with meaningful, but comparatively limited government support. A comprehensive innovation strategy outlines what the state needs in order to be competitive for the balance of the 21st century. While technology leadership will continue to come from the private sector, a statewide strategy can focus and leverage state resources such as the UC, CSU and CC systems, and investment through bodies like the Energy Commission and the California Institute for Regenerative Medicine, to advance California's leadership in key technologies and support policy priorities in economic development and inclusion. Regulatory sandboxes around key technologies can contribute to the environmental conditions that will enable emerging companies and technologies to grow. This practice will help to assure that California has the tools and investments to lead the digital economy, and effectively provide digital government services.

Experimentation in highly regulated industries can allow innovative new products to serve historically underserved populations. For example, past experiments have created new financial services for the unbanked. California's economic diversity has long made the state resilient to economic downturns, and we would argue for intentional policies to maintain and grow that diversity through creative regulation that supports systemic flexibility and innovation.

Pursue an Immigration Policy Advocacy Strategy

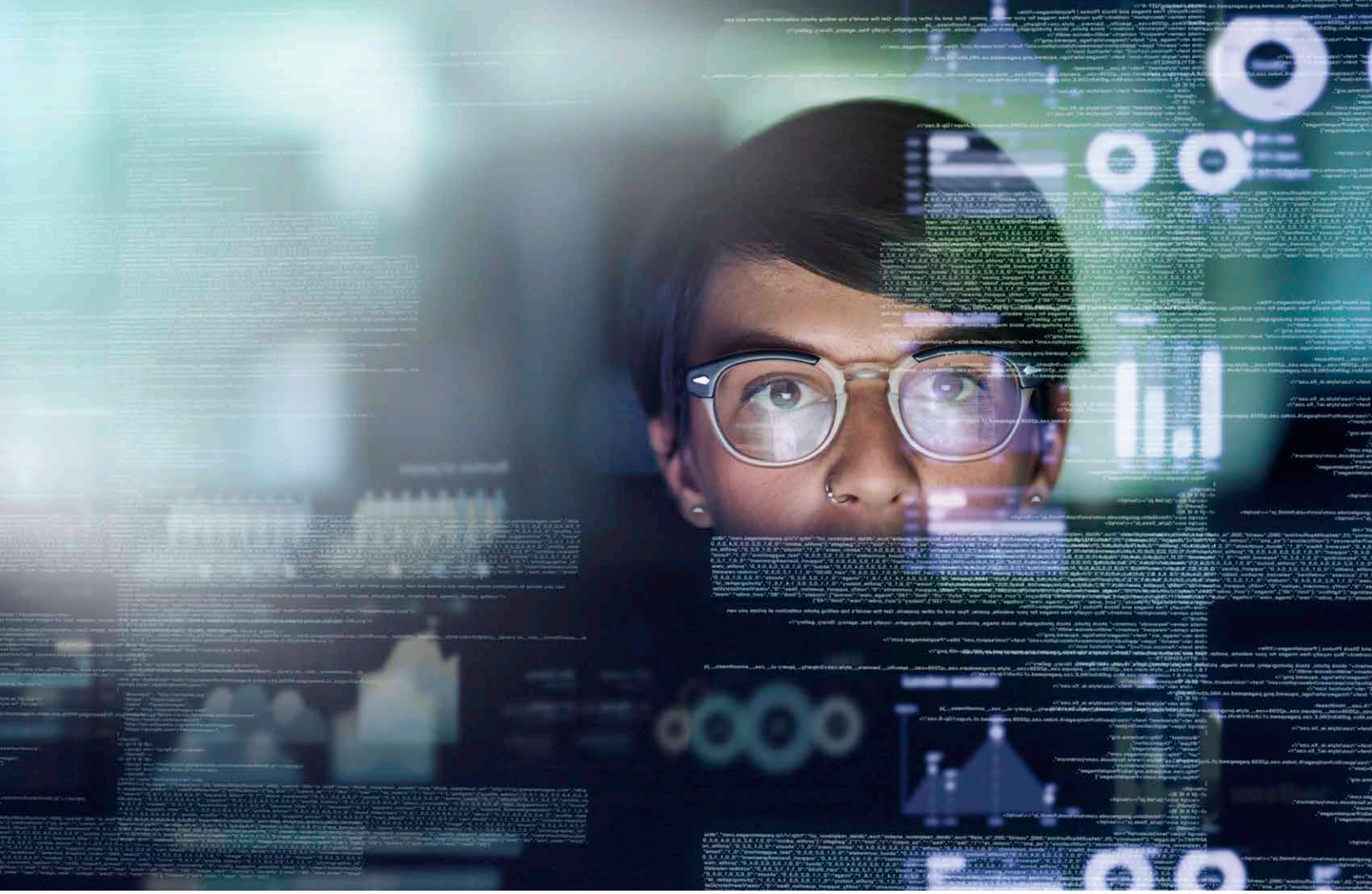
This strategy would advocate for low barriers to entry for foreign-born talent, including increased access to H1-B visas, green cards, and startup visas for foreign-born entrepreneurs. This would put California more strongly behind federal policies that advance the state's competitive advantages in innovation and R&D by drawing the best global research and entrepreneurial talent to the state. California should also consider what it can do as a state to welcome foreign-born talent.

SCENARIO

FINDING A WAY TO COMPETE:

When Weather Isn't Enough – Science and Technology are Assetts and Lower Quality of Life

The flow of talent into California slows as housing costs, climate impacts, and rising competitors take their toll. The state leans in with creative measures to remain attractive in the face of strong challenges from other states and abroad, shoring up traditional advantages in venture funding while trying to learn from successes in Europe and Asia on education, infrastructure and skills development. Bringing talent back to California in the face of vigorous competition from other regions is the top concern, and requires new creativity given quality of life challenges.



Develop Digital Citizenship Opportunities

Digital citizenship would permit people living in other jurisdictions to access California governance structures online and/or in the metaverse, to open businesses, and to simultaneously identify with the state's ethos. This type of digital engagement could draw investment and entrepreneurship in emerging industries – particularly those that will address consumer needs in California, and among target demographic groups, despite individual locations. For example, Estonia developed an e-residency program that allows anyone in the world to obtain access to its digital identity platform. Through this platform, e-residents have access to the EU's specific business environment and can use the EU's public e-services. Digital citizenship could allow California to attract resources from other jurisdictions with solid governance frameworks and diversify state budget revenue streams, even if quality of life issues lead to net outflows of talent.