

CALIFORNIA REPORT ON THE ENVIRONMENT FOR SCIENCE AND TECHNOLOGY SUMMARY



CALIFORNIA COUNCIL ON SCIENCE AND TECHNOLOGY

A summary of the CREST report prepared by the California Council on Science and Technology
November 1999

CREST HIGHLIGHTS

Sustaining California's Technology Miracle

This report, for the first time, assesses the present status and long-term trends affecting the science and technology infrastructure in California. The purpose of the report is to provide information, guidelines and recommendations for long-term planning with respect to policies that affect science and technology and to demonstrate the usefulness of in-depth analysis of the state's science and technology indicators.

California lacks a regularly executed strategic planning process. The CREST report fills a gap in the policy-making process in California and creates an opportunity to engage the state government in long-term planning. The report provides the essential information upon which specific strategic and tactical decisions can be made.

If supported, the technology miracle in California will continue to grow and fuel the economy. However, there is uncertainty as to what the role of the state government will be and whether all Californians will have the opportunity to share the benefits of these new industries.

California's science and technology infrastructure consists of its research-intensive industries, the research and development activities that sustain these industries, and the educational system that supplies these industries prospective employees and advances in fundamental knowledge.

The CREST report clearly demonstrates the importance of the high-tech industry to California's economy and its people. High-technology industries are responsible for a widely envied "California Technology Miracle." In California, 9.3 percent of all jobs are in high-technology industries, far above the national average of 5.6 percent. Average annual wages in high-technology industries are over \$60,000, roughly double average pay in all private, non-farm industries. Research and development sustain these industries, and here again California leads the nation, with 20 percent of the nation's R&D compared to 12 percent of the U.S. population and 13 percent of the U.S. Gross Domestic Product.

The significance of the CREST report is that for the first time in California, the factors that make this technology miracle happen are clearly quantified and analyzed. However, to fulfil the promise of a great future, important changes must occur. Specific actions by the state government, industry and academia can now evolve from the CREST recommendations.

SUSTAINING CALIFORNIA'S TECHNOLOGY MIRACLE

The Miracle Is Centered in High-tech Industry

- The percentage of Californians in high-tech jobs is nearly twice the national average
- Annual wages in high-tech jobs are more than \$60,000, nearly twice other non-farm industries
- California leads the world in the investment of high-tech venture capital

The Miracle Is Not Guaranteed

- California's research engine drives industry growth, but no longer has the lead it once had

The Miracle Is Not Benefiting All Californians

- A significantly growing number of Californians do not have the education preparation to enable them to benefit from job opportunities created by high-tech companies
- The number of Californians being educated with the skills necessary to meet employer needs is insufficient
- Many Californians graduating from K-12 and community college systems are not adequately prepared to enter the high-tech workforce

What Must Be Done

- State government must take a leadership role in sustaining California's high-tech future by supporting the science and technology infrastructure, by setting priorities in its R&D and by coordinating its research policies
- The problems of K-12 education must be addressed, K-12 classroom instruction and teacher training programs must enhance and expand emphasis on science and math education
- Science and technology education in community colleges and in the state's colleges and universities must be expanded

CREST SUMMARY

California is the world's leader in the creation of high technology industry and employment, and in the underlying research in science and technology. However, the infrastructure that has helped establish this status will not be adequate for future growth. The evolving high-tech industry has created the need for systemic changes to a number of areas, such as the way state government coordinates high-tech activities, the educational system, R&D incentives and the tax structure.

These are the main conclusions of a California Council on Science and Technology commissioned report entitled **CREST, the California Report on the Environment for Science and Technology**. CREST has analyzed the state's science and technology (S&T) infrastructure to determine if California has the people, capital investment and necessary state governmental policies to maintain California's leadership in the face of increasing worldwide competition.

Through eight individual research projects, CREST analyzes the state's ability to create and use new technology and offers the following findings and recommendations to policy makers, industry leaders, academic planners and all who contribute to the state's S&T infrastructure.

SUMMARY OF CALIFORNIA S&T INFRASTRUCTURE

Area/Topic	CREST Key Findings
Overall S&T Effort	Outstanding level of activity, but not all elements of the S&T infrastructure are adequate for future growth
High-Tech Industry	High level of R&D investment; however, there is a need for increased partnerships between industry and academia in order to expand the state's basic research base that industry relies on
Academic Research	Essential engine for innovation, excellent quality, but California is losing ground to other high-tech states in commercially crucial technology fields
State Science and Technology Policy	State R&D programs and R&D tax credit need strategic focus
Federal Labs	A major asset: better use should be made by state government and industry
Foundation Support	Opportunity to involve foundations in California S&T effort
Venture Capital	World leader in venture capital investments; opportunity to consider other early-stage, market driven funding methods for selected technology areas and small start-ups.
Labor Force	Essential to improve K-12 education, expand teacher education programs in CSU and UC, and focus California Community Colleges and others on the expansion of life long learning and skill development

Why Science and Technology Matters

For the better part of a century, science and technology have underpinned California's leadership in agriculture, aerospace and defense, electronics, computers, software, motion picture production, multimedia entertainment, biotechnology, medical devices, environmental technologies, and telecommunications. As shown in the table below, science- and technology-based industries constitute an unusually large, high-wage component of the California economy.

But this does not ensure future success. California's status as a high-tech leader is dependent upon the vitality of its schools, universities, federal laboratories, technology-based companies, and venture capital firms, as well as the commitment of its elected and appointed officials.

Project Summary - Findings and Recommendations

Over a two-year period the CREST researchers identified and analyzed science and technology indicators. Detailed descriptions of the findings and recommendations of the research projects are found in the complete report. The following summary identifies the most significant findings and recommendations.

S&T EMPLOYMENT IN CALIFORNIA'S ECONOMY

High-Tech Jobs, CY 1998

Industry	U.S. Total (thousands)	CA Total (thousands)	CA as % of U.S.
Computer Manufacturing & Data Processing	1,978	333	16.8%
Communications Equipment, Electronic Components, & Communications	2,431	367	15.1%
Aircraft & Missiles	612	114	18.6%
Scientific & Medical Instruments	1,138	228	20.0%
Pharmaceuticals	274	31	11.3%
Motion Pictures	564	186	33.0%
High Tech Total	6,997	1,259	18.0%
Nonfarm Total	125,832	13,584	10.8%

Source: Bureau of Labor Statistics, U.S. Department of Labor, <http://stats.bls.gov/sahome.html>, via links for "National Employment, Hours, and Earnings," and "State and Area Employment, Hours, and Earnings."

California R&D Activity

Summary: California conducts a prodigious amount of research and development. Its share of national R&D has held steady since 1989 despite substantial federal cutbacks, as private industry expansion has more than taken up the slack. California is also the world leader in venture capital investments. However, California's share of academic R&D is below its share of the national high-tech economy. Furthermore, industry funding of academic R&D is relatively low. The state's policy tools have the potential to provide substantive stimulus to S&T sector performance, but the state lacks the focus to achieve this. Multiple programs and departments within the state government have similar goals and objectives directed at improving the state's high-tech environment.

Recommendations: State government has the opportunity to develop a statewide science and technology strategy and therefore more effectively contribute to R&D in California. To make a significant impact, California's strategy needs targeted objectives designed to fill in gaps and weaknesses in areas where California already has technological strength among business, academia and federal laboratories.

- Implement a strategic planning process within state government that will ensure R&D funding allocation decisions are based on economic considerations.
- Coordinate disparate high-tech programs throughout the state government.
- Explore and pursue options that encourage industry to continue and expand support of university-based R&D.

California R&D Tax Credit

Summary: California's R&D income tax credit could provide a powerful incentive for technical R&D activity. However, requirements for substantial record keeping make it of limited use to fledgling companies.

Recommendations: State government has the opportunity to create an incentive structure for companies to invest in new business opportunities.

- Conduct an evaluation of the effectiveness of the R&D tax credit, using data on actual tax liabilities and credit claims.
- Explore and evaluate alternate measures to enhance industry's sustained investments in R&D.

California Academic Institutions' Performance

Summary: California's universities conduct very high-quality scientific and engineering research. However, the size of the state's universities science and engineering departments and the extent of their output have been falling relative to other high-tech states. California has lost important ground to Massachusetts in nearly every area of science and engineering, including the commercially crucial technology fields.

Recommendations: State government should improve and sustain higher-education funding levels.

- Advance policy initiatives and legislation intended to increase funding levels for academic support and R&D activities.
- Communicate with the California Congressional Delegation on the importance of sustaining and increasing federal support of the state's R&D activities at universities.

California K-12 Education Evaluation

Summary: Primary and secondary schools in California are not adequately preparing students for the high-tech workplace. This shortcoming is just as critical for students entering the labor force after high school as it is for college graduates. While these failings have not yet seriously impeded development of high-tech industry in California, if not corrected they will prevent those educated in California from fully capitalizing on future development.

Recommendations: State government should ensure that substantive changes are made at the K-12 level to improve the likelihood that students are prepared for high-tech careers when they graduate, and that they have the right combination of skills to satisfy employers.

- Ensure that K-12 students have a solid grounding in math, science and technical skills.
- Develop incentives that encourage K-12 students to pursue elementary and high school teaching careers.
- Expand teacher education programs in the CSU and UC systems.
- Impose reasonable minimum training requirements for public school teachers.
- Develop incentives that encourage teachers to pursue multiple subject certification; and minimize out-of-subject teaching assignments.

California Supply and Demand of Skilled Workers

Summary: To enable Californians to experience the greatest benefit from the high-tech sector expansion, California must educate more of its own scientists, engineers, and skilled workers. The state must increase support for engineering, science, and agriculture undergraduate programs and terminal master's degree programs in these areas if California is going to meet the high-tech human resource needs of a growing science and technology economy. If California does not address this challenge, the state risks increasing the export of high-tech jobs and companies to other states.

Recommendations: The CREST report suggests three avenues for state policymakers to increase the "home grown" supply of science and technology workers. All are considered low risk because they prepare workers to respond to changes in demand, and have the added benefit of making California more attractive to skilled workers.

- Strengthen basic skills through improvements in K-12 education.
- Implement a public education and outreach program encouraging K-12 students to pursue careers in S&T.
- Focus California Community Colleges and other institutions on the expansion of life long learning and skill development.

The California Council on Science and Technology is a nonprofit organization established in 1988 at the request of the California State Government and sponsored by the major post secondary institutions of California, in conjunction with leading private-sector firms. CCST's mission is to improve science and technology policy and application in California by proposing programs, conducting analyses, and helping government implement policies and initiatives for a better economy and quality of life.

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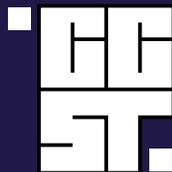
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