

SCIENCE & TECHNOLOGY: EXPANDING HORIZONS



**California Council on
Science and Technology
2003 - 2004 Annual Report**

CCST: A NEW LEVEL OF SERVICE TO CALIFORNIA

California has changed a great deal in the sixteen years since CCST was founded, and we have worked hard to ensure that we have kept pace. The Legislature's original intent in founding CCST was to create a nonpartisan, impartial organization that could offer expert advice and provide recommendations for addressing science and technology-related public policy issues as they arose. Over time, we have built an organization capable of meeting this mandate, and we are now embarking on an ambitious plan to increase our capabilities significantly by partnering with the National Academies.

In the past year, CCST has responded to requests for information on nanoscience and nanotechnology, intellectual property, stem cell research, counter-terrorism, opportunities for collaboration with Mexican research universities and school systems, and energy research programs – and there is plenty more to come. We have already identified a new set of key issues facing California: shortfalls in the science and technology education system; the need to place science and technology experts in the state government to provide their expertise on matters of current importance; the need to identify science and technology opportunities and challenges facing California; and the need to put California issues in perspective with national issues.

The needs are clear, and we're working on developing solutions. We are increasing active connections with policymakers in Sacramento, many of whom attend our Council meetings. We are tracking science and technology legislation and related policy events in a new feature in our newsletter, "Capital Happenings."

Most important, we are now also tapping into the best of the nation's scientific community with a new, far-reaching agreement with the National Academies. This multi-faceted collaboration will bring about new ways for CCST to leverage the considerable resources and expertise of the National Research Council in a manner relevant and accessible to California policymakers. As well, this tie will provide the National Academies with an important new window on matters of science and technology at the state level. In addition to building expert capacity to advise state leaders and provide time-sensitive information and policy reports much more comprehensively and rapidly, we will also be working to expand CCST's staff and facilities.

We are honored to be the first state-level organization to enter into such a collaboration with the National Academies, and anticipate that this will serve as a prototype for possible future Academies' collaborations with other states. The net result for California will be a level of science and technology policy knowledge and wisdom unparalleled at the state level, a fitting position for the nation's leading science and technology state.



C. Judson King
Council Chair

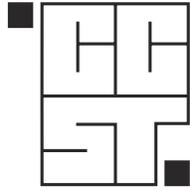


Karl S. Pister
Board Chair

A handwritten signature in cursive script, appearing to read "Judson King".

A handwritten signature in cursive script, appearing to read "Karl S. Pister".

2003-2004 Annual Report



The interior of the National Ignition Facility (NIF) target chamber, which weighs one million pounds and measures 30 feet in diameter.

California Council on Science and Technology

August 2004



Established by state legislation in 1988 as a nonprofit, nonpartisan organization, CCST actively represents the state's science and technology interests. Since its creation, the state's science and technology leaders from industry and academia have worked with the Governor's office, state and federal Legislators, and agencies to recommend policies that will maintain California's role as a leader in technological innovation and maintain a vigorous economy. In this way, CCST is modeled after the National Research Council. More than half of CCST's Members and Fellows are members of the National Academies, and several are Nobel Laureates.

Sustaining Institutions. California's major post-secondary institutions provide important backing, support, and resources to CCST. These include: the University of California, the California Institute of Technology, Stanford University, the University of Southern California, the California State University System, and the California Community Colleges.

Board and Council. A Board of Directors and Council volunteer their time to govern and guide CCST. The Board, which meets twice a year, is made up of 13 leaders from industry and academia. Karl Pister, UC's former vice president for educational outreach and chancellor emeritus of UC Santa Cruz, serves as CCST board chairman.

The Council, which meets three times a year, is comprised of 27 corporate CEOs, academicians, scientists, and scholars of the highest distinction. C. Judson King, director of the Center for Studies in Higher Education at UC Berkeley, chairs the Council.

The Board establishes CCST's policies and provides oversight, while the Council translates those directives into programs and projects that will ensure the state's science and technology leadership. The Council is divided into subcommittees that manage and plan specific projects and studies.

Fellows. The CCST Fellows are a select group of scientists, engineers, and technical experts who volunteer their time to address specific projects or conduct reviews. CCST created the program in 1997; since then, CCST has appointed 107 Fellows who, through project teams, work to address important science and technology issues facing government, education, and industry.

Staff and Offices. Susan Hackwood is CCST's executive director and provides overall day-to-day leadership. There are two CCST offices. One is in Southern California adjacent to UC Riverside, and the other is one block from the State Capitol in Sacramento. Annzell Loufas directs the Sacramento office.

HIGHLIGHTS 2003-2004

CCST works on a growing variety of projects each year. In 2003-2004, CCST completed four major projects, and continued or initiated several others.

PROJECTS COMPLETED

Nanoscience and Nanotechnology

In January 2004, CCST presented a briefing, *Nanoscience and Nanotechnology: Opportunities and Challenges in California*, to the Senate-Assembly Joint Committee on Preparing California for the 21st Century. The briefing includes sections on areas ranging from workforce issues to best practices in commercialization to social and ethical issues, and recommends that California support investment in the infrastructure and knowledge base necessary to sustain high-tech industries already under transformation by this technology.

Second Public Interest Energy Research (PIER) Review

The second Independent Review Panel organized by CCST released its preliminary report in March 2004, and observed that the PIER program has made significant strides in the past three years since the previous review. Organizational challenges remain though, and the panel will be monitoring the PIER program's response to the recommendations of the preliminary report. The panel will release its final report in January 2005.

Retrospective Report on California's Electricity Crisis

Produced at the request of the California Energy Commission, this report released in January 2004 describes the impact of restructuring on California's energy system, and the shortfalls of doing so without clearly assigning responsibility for planning and managing resource portfolios.

Report to the California-Mexico Commission

In June 2004, CCST presented a report to the California-Mexico Commission on Education, Science and Technology exploring how to develop appropriate peer-to-peer collaboration between top high-tech researchers in Mexico and California, and how to address the lack of qualified science and math teachers in the K-12 systems with technology-based professional development systems. The report provided a brief but valuable overview of opportunities for collaboration in both areas.

NEW INITIATIVES

Collaboration with the National Academies

CCST and the National Academies have initiated a unique statewide collaboration to enhance the ability of both organizations to serve California's policy leaders by providing timely and relevant science and technology expertise and giving California issues a national context.

Intellectual Property

Assembly Concurrent Resolution 252, authored by Assembly Member Gene Mullin, requests that CCST, in collaboration with its sustaining institutions, conduct an analysis of California's intellectual property (IP) policies and make recommendations for streamlining the system. The current system is complicated and there are inconsistencies on how IP is handled among state agencies.

Professional Science Master's

California State University Chancellor Charles Reed has requested that CCST assist a coalition of 17 CSU campuses currently exploring the feasibility of implementing professional science master's degree programs in their respective campuses. CCST will be conducting a needs analysis in collaboration with representatives from a variety of high-tech industries throughout the state.

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, although extensive, may not be adequate for the future.

Getting the right information and understanding the potential implications of science and technology policy at the outset is critical for effective planning. The difficulty of long-term strategic thinking and planning when so many short-term issues are urgently pressing is significant. CCST strives to take a balanced approach, offering rapid responses to requests from policymakers on urgently pressing issues while at the same time seeking to provide a longer-term view and presenting a bigger picture.

This is particularly true in education. CCST's 2002 *Critical Path Analysis of California's Science and Technology Education System* documented a shortfall in the production of qualified science and engineering baccalaureates. There are hints that California's predominance in science and technology is already threatened by this shortfall; at least one set of science and technology indicators this year, produced by the Milken Institute, failed to give California the top spot for the first time, citing its education system as a significant problem.

It is easy to do a "quick fix" in the face of an immediate problem, but meaningful solutions often require an understanding of the system as a whole. California needs to be managing its education system proactively as a whole, rather than reacting to isolated issues without taking a systemic view. Reducing class size in K-12 classrooms, for example, impacts the teacher credentialing process, and consequently the university systems. No system can be viewed alone: they are fundamentally interconnected.

It is for this reason that CCST, in cooperation with the National Academies, plans to initiate three interrelated education projects, each of which is designed to enable California to make effective decisions in improving its science and technology education systems for the long-term. The first of these projects will be a critical path analysis for the production and retention of science and math elementary and secondary school teachers. The second project will focus on the California Community College System, where nearly half of the state's science and engineering baccalaureates begin their academic careers. The third will institute the first state equivalent of the landmark National Teacher Advisory Council instituted by the National Academies in 2002, integrating accomplished teachers' "wisdom of practice" in CCST's education research and in the discussion of education related policy at the state level.

By many measures, California remains the nation's high-tech leader, and we are working to ensure that the state has the information it needs to make effective long-term decisions that will enable it to maintain and build upon this leadership. Today's students are the bridge to California's future, and we need to ensure that they have every opportunity of success. Long-term planning can be difficult for a state to undertake, but it can have the best return on investment.



"It is easy to do a "quick fix" in the face of an immediate problem, but meaningful solutions often require an understanding of the system as a whole."

Susan Hackwood
Executive Director
California Council on Science and
Technology

CCST AND THE NATIONAL LABORATORIES

California is home to many of the nation's most prominent science and technology research institutions, and CCST has benefited from the active participation of industry leaders and academia alike. With the recent addition of the director of Lawrence Livermore National Laboratory, the Council now numbers three directors of federally funded research laboratories among its members for the first time.

California is home to more federal research facilities than any other state, including national laboratories at Lawrence Berkeley, Lawrence Livermore, Sandia/California and the Stanford Linear Accelerator Center, as well as NASA's Jet Propulsion Laboratory and Ames Research Center. Collectively, they have a tremendous impact on California's economy and high-tech community; the Lawrence Berkeley Laboratory alone, for example, has been estimated to generate at least half a billion dollars in direct expenditures and indirect impacts annually for the Bay Area economy. With thousands of top scientists and links to a variety of universities and government agencies, the federal research laboratories are a vital part of California's science and technology sector.

Michael R. Anastasio, director of the Lawrence Livermore National Laboratory, became a member of the Council in 2004, joining fellow federal lab directors Miriam E. John, vice president of the Sandia National Laboratories/California, and G. Scott Hubbard, director of the NASA Ames Research Center, who already sit on the Council. While over the years, CCST has worked with the national laboratories and NASA on energy, particle physics research, counter-terrorism, and education projects, the addition of Anastasio means that CCST is now further drawing upon expertise representing all of California's high-tech research and development sectors. Anastasio, John and Hubbard continue a connection first established by former council members and laboratory directors Edward Stone, Jet Propulsion Laboratory; Charles Shank, Lawrence Berkeley National Laboratory; Bruce Tartar, Lawrence Livermore National Laboratory and Burton Richter, Stanford Linear Accelerator Center.

CCST and the Federal Research Labs

Federal research laboratories are actively engaged in CCST projects including:

- ◆ State Strategic Committee on Terrorism (SSCOT) Executive Committee:
Sandia
- ◆ Hydrogen Highway Initiative:
Lawrence Livermore
Sandia
- ◆ Education Programs:
Jet Propulsion Laboratory
Lawrence Livermore
- ◆ Nanotechnology:
NASA Ames



Michael R. Anastasio



G. Scott Hubbard



Miriam E. John

CCST AND THE NATIONAL ACADEMIES

The National Academies and CCST have initiated a unique statewide collaboration to focus the nation's top science, technology and public policy talent on helping policymakers make more informed decisions. This collaboration could create systemic change and greatly improve the decision making process of the state government and other state leaders who set policy and allocate resources that determine the state's agenda in education, security, health care, the environment and many other areas. This is the first such endeavor nationally, and marks an important step in professionalizing the quality of science and technology advice available to the state of California.

"The National Academies have determined that there is a need to seek a connection outside of the federal government with the states... We want to be more proactive."

William A. Wulf
President, National Academy of
Engineering
Vice Chair, National Research Council

The National Academies are comprised of the National Academy of Sciences (NAS), the National Academy of Engineering (NAE), the Institute of Medicine (IOM), and the National Research Council (NRC). They have served as advisors to the nation on science, engineering, and medicine since the Civil War. The primary audiences for the National Academies' work are Congress and federal agencies, which utilize the analyses and recommendations of expert panels to inform federal policies. Their work impacts both policy for science (how we nurture the health of the research enterprise) and science for policy (how we use knowledge more effectively to achieve social goals). The National Academies' work, however, is intended to inform national-level policies. With few exceptions, its reports are not targeted to state-level concerns.

Via this new partnership, CCST will be able to draw upon this nationwide expertise and distill the information that is necessary and relevant for California policymakers, to a degree never before accomplished. The specific objectives of this initiative are to:

- ◆ Firmly establish CCST as the premier source of high-quality, evidence-based policy advice for science and technology issues in California.
- ◆ Through CCST, build the capacity for providing advice on science and technology issues to state leaders that is adapted from, and consistent with, the kind of policy advice provided at the national level by the National Academies.
- ◆ Provide a means of getting vital information to decision makers in a timely way and in a useable form.
- ◆ Create an effective and efficient mechanism through which science and technology policy issues that emerge at the state level can be shared more effectively with national-level leaders.
- ◆ Develop a cadre of highly trained and highly effective science and technology policy fellows to work with state governmental and legislative leaders.
- ◆ Develop a California Science and Math Teachers Advisory Council comprised of expert science and mathematics educators at the K-14 level to inform leaders in higher education, industry, and government about significant issues in science and mathematics education.
- ◆ Establish a formal relationship with *Issues in Science and Technology*, the nation's premier S&T policy journal, and thereby increase opportunities for timely and informed discussions about S&T policy issues that are of concern to states.

There is already substantial overlap between the National Academies and CCST: approximately one third of the members of the National Academies are in California and half of CCST members are also members of the National Academies.

The proposed initiative has three major programmatic areas: collaboration between CCST and the National Academies; building expert capacity to advise state leaders; and providing specific information and policy reports. Each of these three areas includes multiple projects, and are closely related and designed to complement and build on each other.

With the National Academies' strong presence in Washington and CCST's in Sacramento, the two combined will be effectively connected to the policy process. Engaging with CCST will enable the National Academies to gain a clearer perspective of the science and technology issues that are important at the state level, and enable CCST to continue expanding its ability to provide impartial and expert perspective on the politically contentious issues related to science, technology, and education in the state. The collaboration will provide technical knowledge and expertise in a relevant and useable format to policymakers, and allow CCST and the Academies to target new research based on the experience of working with policymakers.

U.S. Totals:

- Membership in NAS: 2380
- Membership in NAE: 2000
- Membership in IOM: 1490
- NRC active committees each year: 1000
- National Academies Press reports each year: over 200

California Totals:

- Membership in NAS: 598
- Membership in NAE: 534
- Membership in IOM: 249

CCST members of the National Academies: 73

A dramatic, industrial revolution is taking place in California, driven by nanotechnology. In January 2004, CCST provided a briefing to help state policy-makers understand the changes underway and plan for the future. *Nanoscience and Nanotechnology: Opportunities and Challenges in California*, was presented to the Senate-Assembly Joint Committee on Preparing California for the 21st Century co-chaired by Sen. John Vasconcellos (D-Santa Clara) and Assm. Sarah Reyes (D-Fresno) on January 20.



"If managed smartly, nanotechnology has the potential to bring jobs and wealth to California. It is the next wave of technology. It's our decision to ride it and make the most of it – or be overwhelmed by it."

John Vasconcellos
California State Senator
21st Century Committee Co-chair

Nanotechnology is concerned with materials and systems at the nanoscale, one-billionth of a meter, whose structures and components exhibit different physical, chemical, and biological processes due to their size. Many disciplines converge in nanoscale research, which has significant implications for materials manufacturing, energy, biotechnology, medical instruments, and computers. Economists predict a trillion-dollar multi-industry market for nanoproducts over the next 10 to 15 years. The federal government is investing substantially in nanotechnology R&D, allocating \$847 million for this year's National Nanotechnology Initiative (NNI) and \$3.68 billion over four years via the Boehlert-Honda 21st Century Nanotechnology Research and Development Act of 2003. In addition, venture capitalists invested an estimated \$1.2 billion in nanotechnology in 2003, and are poised to spend more this year.

The Committee asked CCST to prepare this briefing as part of its two-year investigation of technology issues facing the state. At issue is the opportunity for California's research institutions and industries to be leaders in research and development of this field in the face of stiff worldwide competition while considering the social, ethical and legal implications of a radically new technology.

The CCST briefing document notes that despite California's high-tech advantages, it has serious challenges to overcome if it is to maintain its technological, economic and social leadership in nanotechnology. Organizations such as the Semiconductor Industry Association have stated that current technologies are quickly reaching their physical limits, and that nanotechnology research is needed to extend the limits of current processes through the introduction of new materials, and to eventually supersede current processes with completely new design structures.

In addition to these changes, potential challenges to the healthy development of California's nanotechnology industries include the following:

- ◆ *Loss of Existing Assets* – the loss or degradation of any of California's existing high-tech assets – such as our skilled workforce, concentration of venture capital, strong research institutions – would be extremely problematic.
- ◆ *Scope* – though we often think of nanotechnology as a singular field, it actually represents a collective advance across several disciplines. Development will certainly not be uniform, and there is the potential that public concern about implausible applications may halt research across the board.

- ◆ *Transition* – existing industries will have to undergo radical transformation to survive such changes as the shift from silicon-based computer chips to carbon nanotube-based chips.
- ◆ *Intellectual Property (IP)* – nanotechnology will lead us to uncharted legal territory (can you patent an atom?) and inefficiencies in the transfer of IP between universities, government and industry could dampen business activity.

Recommendations

- ◆ For the California Congressional Delegation: Support implementation of the Boehlert-Honda 21st Century Nanotechnology Research and Development Act.
- ◆ For the California Senate-Assembly Joint Committee on Preparing California for the 21st Century: Create a Select Committee on New and Emerging Technologies in each house of the Legislature, charged with identifying emerging technology issues, monitoring federal programs affecting the state, and addressing intellectual property, ethics, and public education issues.
- ◆ For the Governor’s Office: Establish a Nanotechnology Research and Workforce Advisory Council, staffed by the Governor’s Office of Planning and Research, to monitor California’s competitive advantage, create forums, and recommend policy actions.
- ◆ For the Governor’s Secretary of Education: Create a K-12 Science and Engineering Initiative including nanotechnology.
- ◆ For the Governor’s Office of Planning and Research: Recommend changes in tax incentives and local land zoning to foster manufacturing spin-off locations within the state of California.
- ◆ For the California Community College, State College and University systems: Create a research and technician workforce training plan for California and implement appropriate curricula and major options to support nanotechnology training.
- ◆ For California State Government Agencies and Departments: Additional recommendations are offered for the health and environmental protection related agencies, the Labor and Workforce Development Agency and the Business, Transportation and Housing Agency.

The document consists of sections designed to focus on key areas relevant to California and assist the Committee in understanding the issues, including a definition of nanoscience and nanotechnology; how California is positioned to take advantage of the changes nanotechnology is bringing; how nanotechnology industries are forming and transforming; workforce issues; best practices in nanotechnology commercialization; and social and ethical issues.

On May 20, 2004, Senator Vasconcellos issued a Senate Resolution stating that CCST’s report was an “instrumental force towards establishing, framing, and initiating a well-informed dialogue with massive and complex... ramifications for California’s economy, society, and environment.”



“It’s very important for us to create a framework for the Legislature to deal with the legal, social, and ethical implications of emerging technologies such as nanotechnology.”

Debra Bowen
California State Senator
21st Century Committee Member

PUBLIC INTEREST ENERGY RESEARCH

California's Public Interest Energy Research (PIER) program has made significant strides in the past three years, according to a preliminary Independent Review Panel (IRP) report released by CCST in March 2004.

California's PIER program supports projects focusing on renewable energy technologies, distributed energy resources, end-use energy efficient technologies, and related environmental studies. It awards up to \$62 million annually to conduct the most promising public interest energy research by partnering with R&D organizations such as public and private research institutions, as well as individuals and businesses. The program was created by the Legislature in 1996 when California's energy industry was restructured. Currently, PIER is scheduled to run through 2011.

This is the second time CCST has led an independent review of the PIER program. The first, conducted from 1999-2001, delivered its final report in March 2001. As a follow-up to the first review, Senate Bill 1038 required that the California Energy Commission (CEC) convene a new panel to further review the PIER program and determine the extent to which it has successfully implemented the recommendations of the first IRP. The new 15-member review panel convened by CCST includes several members from the first IRP, with additional new members from academia, industry, and government agencies who represent the range of economic, technical, and policy skills needed to effectively assess the program.

The March 2004 report notes that the PIER program has implemented many of the recommendations made in the 2001 report. The new IRP found that each of the 13 expectations of the previous IRP was addressed, and in most cases, real progress was made. At present, PIER program areas are better defined, with competent team leaders in place; well-conceived research strategies are in development; and contracting procedures have been streamlined since the previous evaluation.

According to the new report, the principal problems facing PIER at present are organizational limitations. The IRP concluded that PIER needs greater independence and that its management structure and relationship with the CEC needs to be reconsidered if the program is to achieve its maximum potential.

The panel will continue to meet through the end of 2004 to assess the extent to which the CEC and the PIER program are following the recommendations of the preliminary report. The IRP will present its final report on the PIER program in January 2005.

On a related topic, in January 2004, at the request of the CEC, CCST released its *Retrospective Report on California's Electricity Crisis* which describes the impact of restructuring on California's energy system, and the shortfalls of doing so without clearly assigning responsibility for planning and managing resource portfolios.

RECOMMENDATIONS

Fill the existing knowledge gap.

CEC needs to give the PIER director authority to fill vacancies to counteract the unintended consequence of staff resource cuts, which have burdened the remaining staff and threaten the program's effectiveness.

Streamline the advisory committee process.

The number of program-area advisory committees can be reduced and linked with the PIER Policy Advisory Council.

Give the PIER director funding authority.

This will help PIER better integrate with R&D programs at the state and national level, and open up more opportunities to pursue collaboration.

Develop a strategic operational and implementation plan to solve PIER's structural problems.

Two parallel plans should be developed, one within the CEC and one external to the CEC. These should be completed by August 2004 so the IRP can discuss them in its final January 2005 report.

"We are pleased with the progress that PIER has made, and are confident that the coming year will see further improvements. The principal problems are organizational limitations: PIER needs the independence and authority appropriate for a top-notch R&D program."

Carl Weinberg
Principal, Weinberg Associates
Chair, PIER Independent Review Panel

THE CALIFORNIA-MEXICO COMMISSION ON EDUCATION, SCIENCE, AND TECHNOLOGY

In June 2004, officials from the scientific communities in California and Mexico, including UC President Robert Dynes and Jaime Parada Ávila, the director of CONACYT (Consejo Nacional de Ciencia y Tecnología), met in Riverside to pursue innovative solutions to some of the challenges shared by Mexico and California, using CCST's report, *Opportunities for Collaboration in High-Tech Research and Teacher Professional Development*, to help plan for the future.

The California-Mexico Commission on Education, Science and Technology is a binational high-level commission dedicated to exploring mutual challenges related to science and technology policy areas. In May 2003, the Commission requested that CCST help identify common science and technology research areas and suggest collaborative programs of mutual interest where a joint effort between California and Mexico could make a difference to the economies and education systems of both.

CCST was asked to pursue two lines of inquiry:

- ◆ How to foster small but important clusters of innovation in Mexico's high-tech areas and address the concern that Mexico loses top research talent to the United States, and
- ◆ How to address the lack of qualified science and math teachers in the K-12 systems by providing better, particularly on-line, in-service support.

The first section of CCST's report, *Developing a Framework for High-Tech Research Collaboration*, is designed to help foster clusters of innovation in Mexico's high-tech areas and address concern that Mexico loses research talent to the U.S. It offers a provisional matrix of top science and technology university programs in Mexico and California using data provided by the National Research Council and CONACYT, as well as interviews with officials in CONACYT and research institutions.

The second section, *Professional Development of In-Service Teachers in California and Mexico*, provides an overview of technology-based professional development capabilities in both California and Mexico. This project outlines strategies for implementing effective computer based science and math professional development tools for use by both. Dozens of programs are considered, and viable candidates for the Commission's consideration are identified in both California and Mexico. The report was well received and the Commission requested that CCST initiate a comparable project examining the roles and success of university extension centers in California and Mexico. This project is scheduled to be completed by the end of 2005.

"This proactive program is a productive collaboration of science and technology research and education related institutions in both regions."

France Córdova
Chancellor of UCR
Commission member

"It is urgent for Mexico to develop human capital and knowledge to solve the problems in a country in which half the population lives in severe poverty."

Jaime Parada Ávila
Director General
Consejo Nacional de Ciencia y Tecnología
(CONACYT)



California's economy is built on high-tech innovation, and intellectual property (IP) ownership and development are vital to the successful transition of this innovation into the marketplace. Evidence suggests that most IP is turned into products only when there is a significant economic incentive to do so. But in California, IP policies and contracting procedures can be a labyrinthian ordeal for researchers; regulations are handled piecemeal by each state agency, making incentives uncertain or difficult to establish. If a proposed resolution is passed, CCST will be asked to help lay the groundwork for the state to streamline these procedures.

Assembly Concurrent Resolution (ACR) 252, authored by Assembly Member Gene Mullin, requests CCST, in collaboration with its sustaining institutions, and state agencies including the Attorney General and the Department of General Services, to conduct an analysis of California's IP policies and make recommendations for streamlining the process. Statements of support for the resolution have been provided by the University of California, Stanford University, and the California Healthcare Institute.

At the federal level, policies such as the Bayh-Dole Act provide guidance on the handling and ownership of IP produced when the government contracts with the private sector or academia. However, at the state level, there are considerable inconsistencies on how IP is handled among state agencies. A lack of consensus on existing IP and lack of understanding about the research enterprise and technology transfer, as well as lack of state government incentives for developing IP into marketable products makes it difficult for California to implement an effective IP policy. The University of California, for example, entered into 900 contracts with 74 state agencies for a total of \$220 million in 2003, most of which had to be negotiated individually.

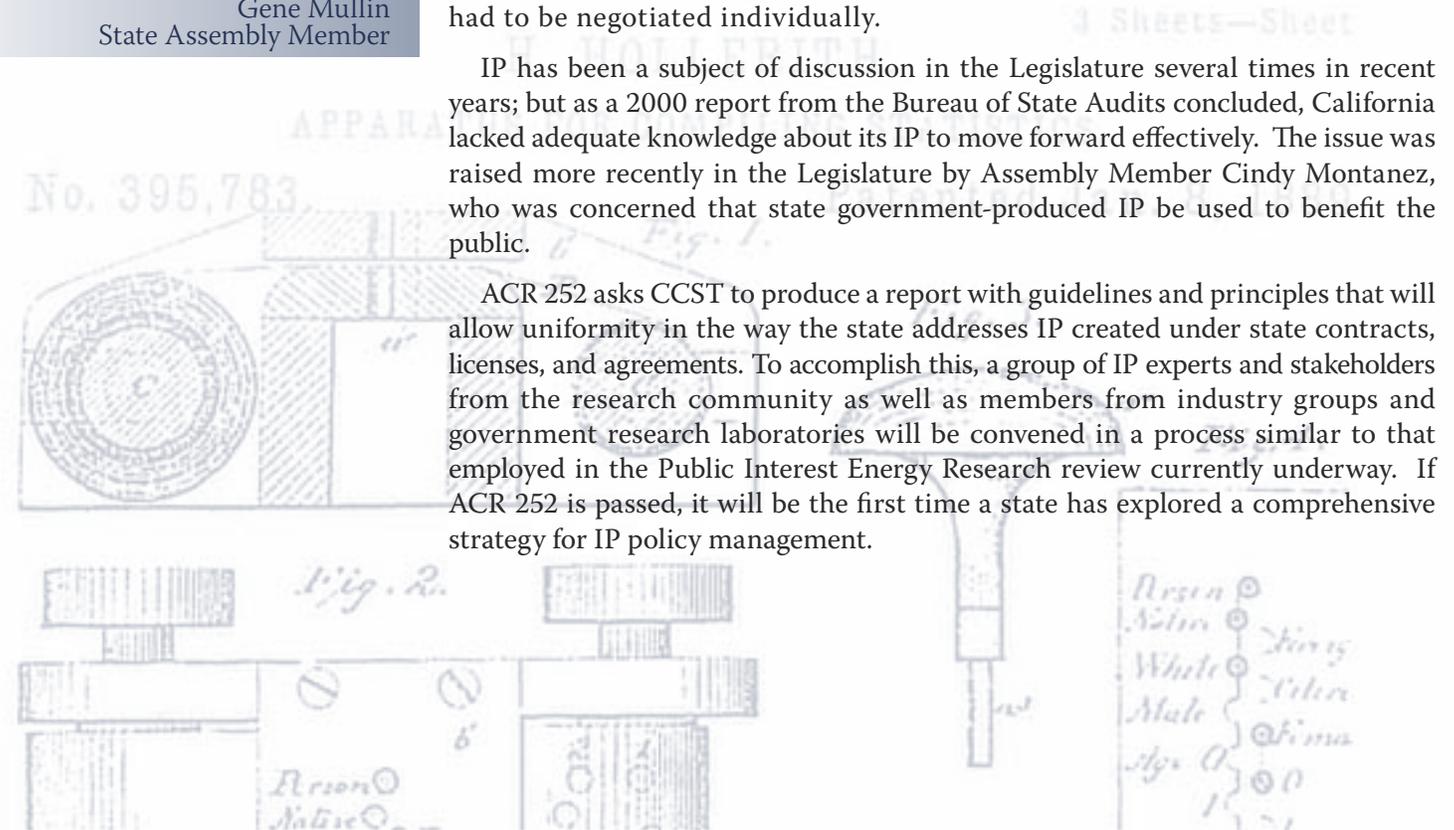
IP has been a subject of discussion in the Legislature several times in recent years; but as a 2000 report from the Bureau of State Audits concluded, California lacked adequate knowledge about its IP to move forward effectively. The issue was raised more recently in the Legislature by Assembly Member Cindy Montanez, who was concerned that state government-produced IP be used to benefit the public.

ACR 252 asks CCST to produce a report with guidelines and principles that will allow uniformity in the way the state addresses IP created under state contracts, licenses, and agreements. To accomplish this, a group of IP experts and stakeholders from the research community as well as members from industry groups and government research laboratories will be convened in a process similar to that employed in the Public Interest Energy Research review currently underway. If ACR 252 is passed, it will be the first time a state has explored a comprehensive strategy for IP policy management.



"The development of innovative technologies and the underlying ownership of IP is a pretty fundamental issue in California. Managing the IP process appropriately is a vital economic issue for our state."

Gene Mullin
State Assembly Member



PROFESSIONAL SCIENCE MASTER'S

California's shortage of qualified science and technology graduates was well documented by CCST's 2002 report, *Critical Path Analysis of California's Science and Technology Education System*. One of the many suggestions made in that report was to consider instituting a new type of master's degree program to produce a different class of science and technology experts. The "professional science master's" (PSM) degree suggested by CCST in that report has been implemented on a limited scale at over 45 institutions in 20 states. Now, CCST is responding to a request from California State University Chancellor Charles Reed to explore the feasibility of implementing such degree programs over 17 CSU campuses, making this a potentially major initiative for the CSU.

"Instituting new programs such as this on a wide-spread basis would constitute a major new effort for the CSU... I am confident that CCST is the right organization to provide a valid "snapshot" of industry need for such degree programs."

Charles B. Reed
Chancellor
California State University System

A group of 17 CSU campuses has obtained a planning grant from the Alfred P. Sloan Foundation to establish whether and how PSM programs could be established in participating campuses. The Sloan Foundation has long advocated such programs, and has provided partial startup funding for new degree programs at 45 institutions around the country. The CSU proposal would mark the first time that the Sloan Foundation has considered support for a systemwide introduction of the degree.

PSM programs differ from typical science master's degree programs in that they attempt to better prepare students for employment in the business environment, often by incorporating business coursework into a more traditional science curriculum. At least eight institutions in California already offer PSM programs, including the University of California, Los Angeles, the University of Southern California, Stanford University, and CSU Fresno. California is considered an attractive venue to consider more widespread implementation of PSM programs because it has, and continues to attract, emerging high-tech industries, as well as established industries in environmental measurement and regulation and water resources and regulation in both the public and private sectors.

CCST, as an independent organization, has been asked to conduct a needs analysis. This project will aim to clarify the needs and perspectives of employers relevant to employees with PSM degrees. In order to gain an effective assessment of industry, public sector, and law enforcement demand, CCST will be conducting a series of meetings with a range of representatives throughout the state.



Left to Right: Carlos Gutiérrez, CCST council member and professor of chemistry, CSU Los Angeles; Milton Gordon, president, CSU Fullerton; James Rosser, CCST council member and fellow, and president, CSU Los Angeles; Winston Doby, vice president of educational outreach, UC Office of the President.

Through CCST's network of academic institutions and industry contacts, we will undertake a series of meetings with the following goals:

- ◆ Ascertain local and state-wide industry demand for PSM degree-holding employees
- ◆ Ascertain willingness to support graduate programs
- ◆ Ascertain what kind(s) of PSMs would be most in demand

CCST meets three times a year. These meetings inform state leaders about CCST's ongoing projects and initiatives and focus attention on other S&T related issues. Visitors and guests include heads of state agencies, Legislators, and leading experts from a variety of scientific and technological disciplines. Each meeting features speakers who are experts in their field.



Neil Smelser

OCTOBER 2003 – MAJOR THEME: Counter-terrorism

Counter-terrorism poses unprecedented and difficult challenges at the state and national level alike, according to Neil Smelser, and requires effective communication and coordination between the scientific community and policymakers. During 2001-2002, Smelser, a National Academy of Sciences member, assumed responsibility for organizing the contribution of the National Research Council (NRC) to the understanding of contemporary terrorism from the perspective of the behavioral and social sciences. He chaired two panels on the topic and edited the two corresponding reports from the NRC.

Smelser's talk, *The Nature of the Terrorist Threat and Dilemmas Involved in Responding to It*, explored the implications of the fact that terrorism poses a unique type of threat - rare events perpetrated in the context of extreme uncertainty and maximization of surprise. Several dilemmas of preparing, warning, responding, and recovering were explored. Reference was made to the role of science and technology, always, however, in the context of human and organizational factors.

Smelser is professor emeritus of sociology at the University of California, Berkeley, and the former director of the Center for Advanced Study in the Behavioral Sciences at Stanford University.

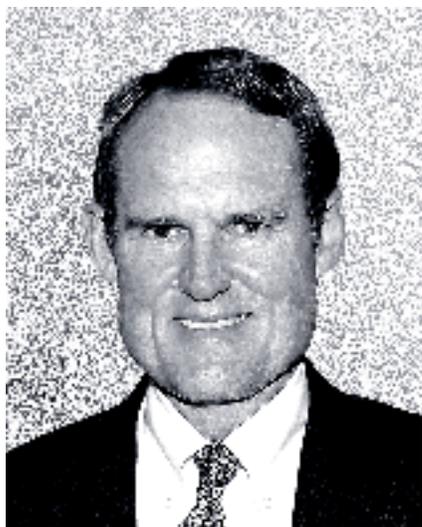
FEBRUARY 2004 – MAJOR THEME: California's Position as High-tech Leader

California has long been the nation's high-tech leader, with a commanding percentage of leading research institutions and high-tech industry clusters. It is still unmatched in most respects worldwide, though there are signs that this dominance may be in jeopardy, particularly with regards to its science and technology workforce, according to R. Sean Randolph, president of the Bay Area Economic Forum.

Randolph described how the multi-faceted economy and increasing number of large companies in the Bay Area have helped ensure that the region remains a substantial economic driver for the state even as high-tech industry throughout the nation suffered a downturn in 2002-2003. However, even in the Bay Area there are issues that need to be addressed.

"When the cost of living is factored in, the Bay Area's lead in productivity is significantly diminished," acknowledged Randolph. "This is something that needs to be looked at in the long term."

Randolph's talk stressed that the education level of the workforce is a key to the strength of this region and the state in general, and that the infrastructure that produces and attracts qualified professionals to the Bay Area and to California needs to be shored up and expanded over the long term.



R. Sean Randolph

MAY 2004 – MAJOR THEME:

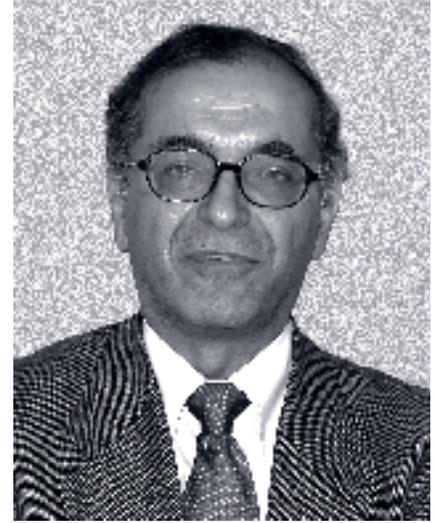
Space Exploration

Charles Elachi, director of NASA's and Caltech's Jet Propulsion Laboratory (JPL), provided a vision for the future of space exploration in the first decade of the twenty-first century in his talk, *Challenges of Robotic Space Exploration in the Next Decade*.

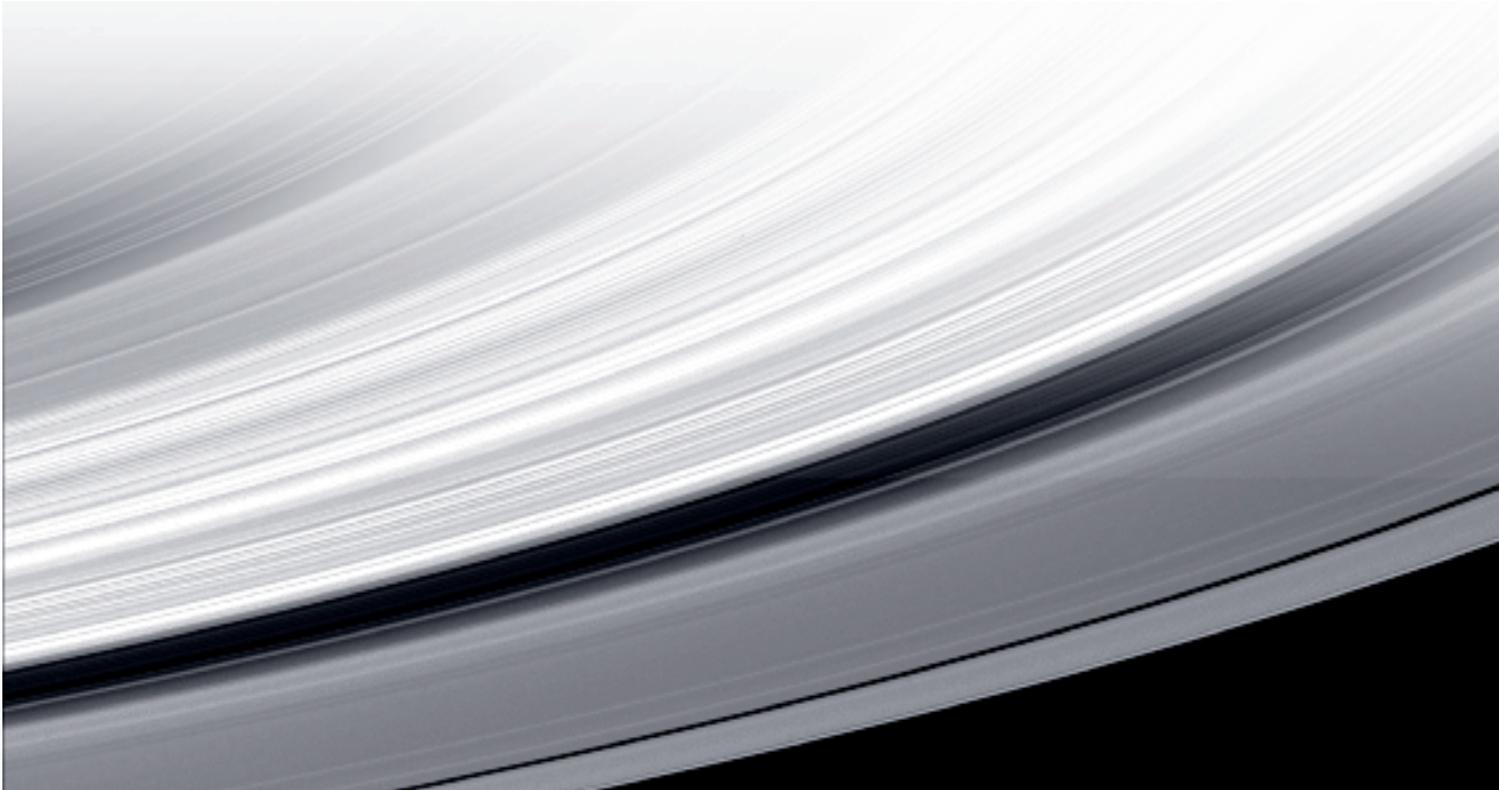
After briefly summarizing the first 46 years of exploration using unmanned robotic spacecraft, and describing currently operating missions in orbit and on the surface of Mars (Mars Global Surveyor, Odyssey, Spirit, Opportunity), retrieving comet and solar material (Stardust and Genesis), and space telescopes studying the universe in the infrared (Spitzer) and ultraviolet (Galaxy Evolution Explorer or GALEX), Elachi emphasized the themes that will guide space exploration for future missions to Mars, to other solar system bodies, to search for planets around nearby stars, to study the origins of galaxies and of the universe, and to study and protect our own planet. He also emphasized the longstanding relationship JPL enjoys with the California research community in general.

“In addition to our association with Caltech, JPL has benefited enormously from the high density of aerospace companies and universities in the area...California is a magnet for top research talent and visionaries,” said Elachi.

JPL has dominated headlines for much of 2004, first with its resoundingly successful Mars missions in March and then with the arrival of the Cassini-Huygens probe in orbit around Saturn in July.



Charles Elachi



Nine days before it entered orbit, Cassini spacecraft captured this exquisite natural color view of Saturn's rings. The images that make up this composition were obtained from Cassini's vantage point beneath the ring plane with the narrow angle camera on June 2, 2004, at a distance of 6.4 million kilometers (4 million miles) from Saturn. The image scale is 38 kilometers (23 miles) per pixel.

2003-2004 CCST BOARD MEMBERS

Karl S. Pister, Board Chair

Former Vice President - Educational Outreach
University of California
Chancellor Emeritus
University of California, Santa Cruz

Lloyd Armstrong, Jr.

Provost and Senior Vice President, Academic Affairs
University of Southern California

Warren J. Baker

President
California Polytechnic State University,
San Luis Obispo

Arthur Bienenstock

Vice Provost and Dean of Research and Graduate Policy
and Professor of Materials Science and Engineering and of
Applied Physics
Stanford University

Bruce B. Darling

Senior Vice President, University Affairs
University of California

John S. Foster, Jr.

Consultant
Northrop Grumman Space Technology

David L. Goodstein

Vice Provost & Frank J. Gilloon Distinguished Teaching
and Service Professor
California Institute of Technology

Susan Hackwood

Executive Director
California Council on Science and Technology

Charles E. Harper

Executive Chairman
Sierra Monolithics, Inc.

C. Judson King

Director
Center for Studies in Higher Education
University of California, Berkeley

Victoria Morrow

Executive Vice Chancellor
California Community Colleges

Robert J. Spinrad

Consultant

Henry T. Yang

Chancellor and Professor of Mechanical Engineering
University of California, Santa Barbara



Leaders from the California Department of Food and Agriculture and the California Water Resources Control Board join CCST board member Warren Baker at CCST's February dinner program in Sacramento. Left to right: Chuck Ahlem, A.G. Kawamura, Warren Baker and Art Baggett, Jr.

2003-2004 CCST COUNCIL MEMBERS

C. Judson King, Council Chair

Director, Center for Studies in Higher Education
University of California, Berkeley

Michael R. Anastasio

Director
Lawrence Livermore National Laboratory

David Auston

President
Kavli Foundation

Francine D. Berman

Director, San Diego Super Computer Center
University of California, San Diego

Alfonso Cárdenas

Professor of Computer Science
University of California, Los Angeles

Arthur N. Chester

Retired President and General Manager
HRL Laboratories, LLC

Michael T. Clegg

Donald Bren Professor of Biological Sciences
Department of Ecology & Evolution
University of California, Irvine

Linda R. Cohen

Professor of Economics
University of California, Irvine

Lawrence B. Coleman

Vice Provost for Research
University of California

France A. Córdova

Chancellor
University of California, Riverside

Carlos Gutiérrez

Professor of Chemistry
California State University, Los Angeles

Susan Hackwood

Executive Director
California Council on Science and Technology

Alice Huang

Senior Councilor for External Relations
California Institute of Technology

G. Scott Hubbard

Center Director
NASA Ames Research Center

Miriam E. John

Vice President
Sandia National Laboratories/California

Charles F. Kennel

Director, Scripps Institution of Oceanography
Dean and Vice Chancellor of Marine Sciences
University of California, San Diego

John P. McTague

Professor of Materials
University of California, Santa Barbara

Tina S. Nova

President, CEO and Founder
Genoptix

Lawrence T. Papay

Consultant

Elisabeth Paté-Cornell

Burton J. and Ann McMurtry Professor and Chair
Department of Management Science and Engineering
Stanford University

Henry E. Riggs

Chair of the Board and President Emeritus
Keck Graduate Institute of Applied Life Sciences, a
member of The Claremont Colleges

James M. Rosser

President
California State University, Los Angeles

Stephen J. Ryan, M.D.

Professor of Ophthalmology, Keck School of Medicine, and
President, Doheny Eye Institute
University of Southern California

Anneila Sargent

Director, Owens Valley Radio Observatory
California Institute of Technology

Cornelius W. "Neal" Sullivan

Vice Provost for Research
University of Southern California

Larry Toy

President
Foundation for California Community Colleges

Max T. Weiss

Retired Vice President and General Manager
Northrop Grumman Corporation

Harold M. Agnew

Retired President, General Atomics
Past Director, Los Alamos Scientific
Laboratory

Bruce N. Ames

Professor of Biochemistry and Molecular
Biology
University of California, Berkeley
Senior Research Scientist
Children's Hospital Oakland Research
Institute

Francisco J. Ayala

Donald Bren Professor of Biological
Sciences
University of California, Irvine

Dorothy F. Bainton, M.D.

Vice Chancellor, Academic Affairs
Professor of Pathology
University of California, San Francisco

David Baltimore

Nobel Laureate
President and Professor of Biology
California Institute of Technology

Richard E. Balzhiser

President Emeritus
Electric Power Research Institute, Inc.

C. Gordon Bell

Senior Researcher
Microsoft Bay Area Research Center

Robert Biller

Professor Emeritus of Public
Administration
School of Policy, Planning and
Development
University of Southern California

Joel S. Birnbaum

Senior Technical Advisor to the Chairman
and CEO
Hewlett-Packard Company

J. Michael Bishop, M.D.

Nobel Laureate
Chancellor and University Professor
University of California, San Francisco

Robert L. Byer

CCST Council Chair Emeritus
William R. Kenan, Jr. Professor in the
School of Humanities and Sciences
Director, Hansen Experimental Physics
Laboratory
Stanford University

Robert P. "Chris" Caren

Retired Corporate Vice President
Science and Engineering
Lockheed Corporation

Jerry D. Caulder

Chairman and Chief Executive Officer
Advanced Stent Technologies, Inc.

Arthur N. Chester

Retired President and General Manager
HRL Laboratories, LLC

Steven Chu

Nobel Laureate
Theodore and Frances Geballe Professor of
Physics and Applied Physics
Stanford University

Ralph J. Cicerone

Chancellor
University of California, Irvine

Linda R. Cohen

Professor of Economics
University of California, Irvine

Harry M. Conger

Chairman Emeritus
Homestake Mining Company

Michael R. Darby

Warren C. Cordner Professor of Money
and Financial Markets
John E. Anderson Graduate School of
Management
University of California, Los Angeles

Thomas B. Day

President Emeritus
San Diego State University

Octavia Diener

President
Densmore Engines

Steven D. Dorfman

Retired Vice Chairman
Hughes Electronics Corporation

Sidney D. Drell

Professor Emeritus of Theoretical Physics
Deputy Director Emeritus
Stanford Linear Accelerator Center
Senior Fellow, The Hoover Institution
Stanford University

Robert C. Dynes

President
University of California

Thomas E. Everhart

President Emeritus
California Institute of Technology

Sandra M. Faber

Professor of Astronomy and Astrophysics
Lick Observatory
University of California, Santa Cruz

John S. Foster, Jr.

Consultant, Northrop Grumman
Space Technology
Retired Director
Lawrence Livermore National Laboratory

T. Kenneth Fowler

Professor Emeritus
Nuclear Engineering
University of California, Berkeley

Edward A. Frieman

Senior Vice President, Science and
Technology
Science Applications International
Corporation
Director Emeritus
Scripps Institution of Oceanography
University of California, San Diego

Theodore H. Geballe

Professor Emeritus of Applied Physics
Stanford University

Marvin L. Goldberger

Professor Emeritus of Physics
University of California, San Diego

Sidney H. Golub

Executive Director
Federation of American Societies for
Experimental Biology
Former Executive Vice Chancellor
University of California, Irvine

Susan L. Graham

Pehong Chen Distinguished
Professor of Electrical Engineering
And Computer Science
University of California, Berkeley

Harry B. Gray

Founding Director
The Beckman Institute
California Institute of Technology

Robert D. Grey

Provost and Executive Vice Chancellor
Emeritus
Professor Emeritus of Cellular & Molecular
Biology
University of California, Davis

Charles E. Harper

Executive Chairman
Sierra Monolithics, Inc.

John L. Hennessy

President
Stanford University

Stephen L. M. Hockaday

Professor Emeritus of Civil and
Environmental Engineering
California State Polytechnic University,
San Luis Obispo

David A. Hodges
Professor of Electrical Engineering
and Computer Sciences
University of California, Berkeley

Theodore L. Hullar
Director
Higher Education Programs
Atlantic Philanthropies USA, Inc.

Irwin M. Jacobs
Chairman and CEO
QUALCOMM, Inc.

Paul C. Jennings
CCST Council Chair Emeritus
Professor Emeritus of Civil Engineering and
Applied Mechanics
California Institute of Technology

Lewis L. Judd, M.D.
Mary Gilman Marston Professor
Chair, Department of Psychiatry
School of Medicine
University of California, San Diego

David N. Kennedy
Consulting Engineer
Retired Director
California Department of Water Resources

Robert P. Kennedy
Consulting Engineer
RPK Structural Mechanics Consulting, Inc.

Charles F. Kennel
Director
Scripps Institution of Oceanography
Dean and Vice Chancellor of Marine
Sciences
University of California, San Diego

Lee R. Kerschner
Vice Chancellor Emeritus
California State University

Steven E. Koonin
Professor of Theoretical Physics
Former Provost
California Institute of Technology

Arthur Kornberg, M.D.
Nobel Laureate
Merner Professor of Medical Science
Stanford University

Daniel E. Koshland, Jr.
Professor of the Graduate School
Biochemistry and Molecular Biology
University of California, Berkeley

William C. Y. Lee
Chairman
LinkAir Communications

James U. Lemke
President
AEROLIFT, INC.

Mark D. Levine
Director
Environmental Energy Technology Division
Lawrence Berkeley National Laboratory

Johnetta MacCalla
CEO
ASCI, Incorporated

Perry L. McCarty
Silas H. Palmer Professor Emeritus
of Civil and Environmental Engineering
Stanford University

James L. McGaugh
Director
Center for the Neurobiology of Learning &
Memory
University of California, Irvine

Burton J. McMurtry
Venture Capitalist

Duane T. McRuer
Chairman
Systems Technology, Inc.

Jarold A. Meyer
Principal
J. A. Meyer Associates

William F. Miller
Herbert Hoover Professor of Public and
Private Management Emeritus
Graduate School of Business
Stanford University

Douglas C. Moorhouse
Chairman Emeritus
Woodward-Clyde Group, Inc.

Venkatesh Narayanamurti
John A. and Elizabeth S. Armstrong
Professor of Engineering and Applied
Science
Dean and Professor of Physics
Harvard University

J. Fernando Niebla
President
International Training Partners

C. L. "Max" Nikias
Dean of the School of Engineering
Founding Director
Integrated Media Systems Center
University of Southern California

Roger G. Noll
Morris M. Doyle Professor of Public Policy
Department of Economics
Stanford University

David Okrent
Research Professor of Engineering and
Applied Science, Emeritus
University of California, Los Angeles

Elisabeth Paté-Cornell
Burton and Ann McMurtry Professor and
Chair
Department of Management Science and
Engineering
Stanford University

C. Kumar N. Patel
Professor of Physics
Former Vice Chancellor for Research
University of California, Los Angeles

Roy Pea
Professor of Education and Learning
Sciences
Director, Stanford Center for Innovation
in Learning
Stanford University

Jack W. Peltason
President
The Donald Bren Foundation
President Emeritus/Chancellor Emeritus
University of California, Irvine

Edward E. Penhoet
Chief Program Officer
Gordon and Betty Moore Foundation
Professor of Health Policy and
Management, and Molecular and Cell
Biology
University of California, Berkeley

Joseph Penzien
Chair, Board of Directors
International Civil Engineering
Consultants, Inc.

Burton Richter
Nobel Laureate
Paul Pigott Professor of Physical Sciences
Director Emeritus
Stanford Linear Accelerator Center
Stanford University

James E. Roberts
Retired Chief Deputy Director
California Department of Transportation

Stephen D. Rockwood
Executive Vice President
Science Applications International
Corporation

James M. Rosser
President
California State University, Los Angeles

F. Sherwood Rowland

Nobel Laureate
Donald Bren Research Professor of
Chemistry
University of California, Irvine

William J. Rutter

Chairman Emeritus
The Chiron Corporation
Hertzstein Professor of Biochemistry
Emeritus
University of California, San Francisco

Maxine L. Savitz

Retired General Manager
Technology Partnerships
Honeywell, Inc.

George Scalise

President
Semiconductor Industry Association

John H. Seinfeld

Louis E. Nohl Professor of Chemical
Engineering
California Institute of Technology

Charles V. Shank

Director
Lawrence Berkeley National Laboratory

Lucy Shapiro

Director of the Beckman Center for
Molecular and Genetic Medicine, and
D.K. Ludwig Professor of Cancer Research
Stanford University School of Medicine

Robert N. Shelton

Executive Vice Chancellor and Provost
University of North Carolina at Chapel Hill

John B. Slaughter

President
National Action Council for Minorities in
Engineering
President Emeritus, Occidental College

Robert J. Spinrad

Consultant

Edward C. Stone

David Morrisroe Professor of Physics
California Institute of Technology

Cornelius W. "Neal" Sullivan

Vice Provost for Research
University of Southern California

Bob H. Suzuki

Retired President
California State Polytechnic University,
Pomona

James L. Sweeney

Professor
Department of Management Science and
Engineering
Stanford University

Clarence A. Syvertson

Emeritus CCST Fellow
Retired Director
NASA Ames Research Center

R. Michael Tanner

Provost and Vice Chancellor for Academic
Affairs
University of Illinois at Chicago
Former Executive Vice Chancellor
University of California, Santa Cruz

C. Bruce Tarter

Associate Director at Large
Lawrence Livermore National Laboratory

Ignacio Tinoco, Jr.

Professor in the Graduate School
University of California, Berkeley
Faculty Senior Scientist
Physical Biosciences Division
Lawrence Berkeley National Laboratory

Hal R. Varian

Dean and Professor
School of Information Management and
Systems
University of California, Berkeley

David H. Warren

Professor of Psychology
Former Executive Vice Chancellor
University of California, Riverside

Carl J. Weinberg

Principal
Weinberg Associates

Max T. Weiss

Retired Vice President and General
Manager
Electronic Systems Division
Northrop Grumman Corporation

Robert H. Wertheim

Rear Admiral, USN (retired)
Private Consultant
Science Applications International
Corporation

John Oliver Wilson

Board of Directors
Calpine, The Ryland Group Incorporated
and SDR Capital Management

Loring A. Wyllie, Jr.

Board Chair Emeritus and Senior Principal
Degenkolb Engineers

Henry T. Yang

Chancellor
Professor of Mechanical Engineering
University of California, Santa Barbara

Richard N. Zare

Marguerite Blake Wilbur Professor in
Natural Science
Stanford University

Abe M. Zarem

Founder and Managing Director
Frontier Associates

Ed Zschau

Visiting Lecturer
Princeton University

Lynne G. Zucker

Professor of Sociology and Policy Studies
Director, Center for International Science,
Technology and Cultural Policy
School of Public Policy and Social Research
University of California, Los Angeles

John Zysman

Professor of Political Science
Co-Director, Berkeley Roundtable on the
International Economy (BRIE)
University of California, Berkeley

PHOTO CREDITS

Beckman Center: page 7

Hector Gonzalez: pages 2, 8, 13, 14 (bottom photo), 15 and 16

JPL/NASA: front cover and pages 15, 16, 17, 18, 19 and 20

Lawrence Livermore Lab: page 5 (left photo)

NASA Ames: page 5 (middle photo)

NASA/JPL/Max-Planck-Institute for Chemistry: front cover collage and title page

NASA: front cover collage and pages 3 and 11

Sandia Labs/California: page 5 (right photo)

Stanford University: front cover collage

U. S. Patent Office: page 12

PRODUCTION TEAM

Writer and Editor: M. Daniel DeCillis

CCST Graphic Artist: Erik A. Mattila

CCST Staff:

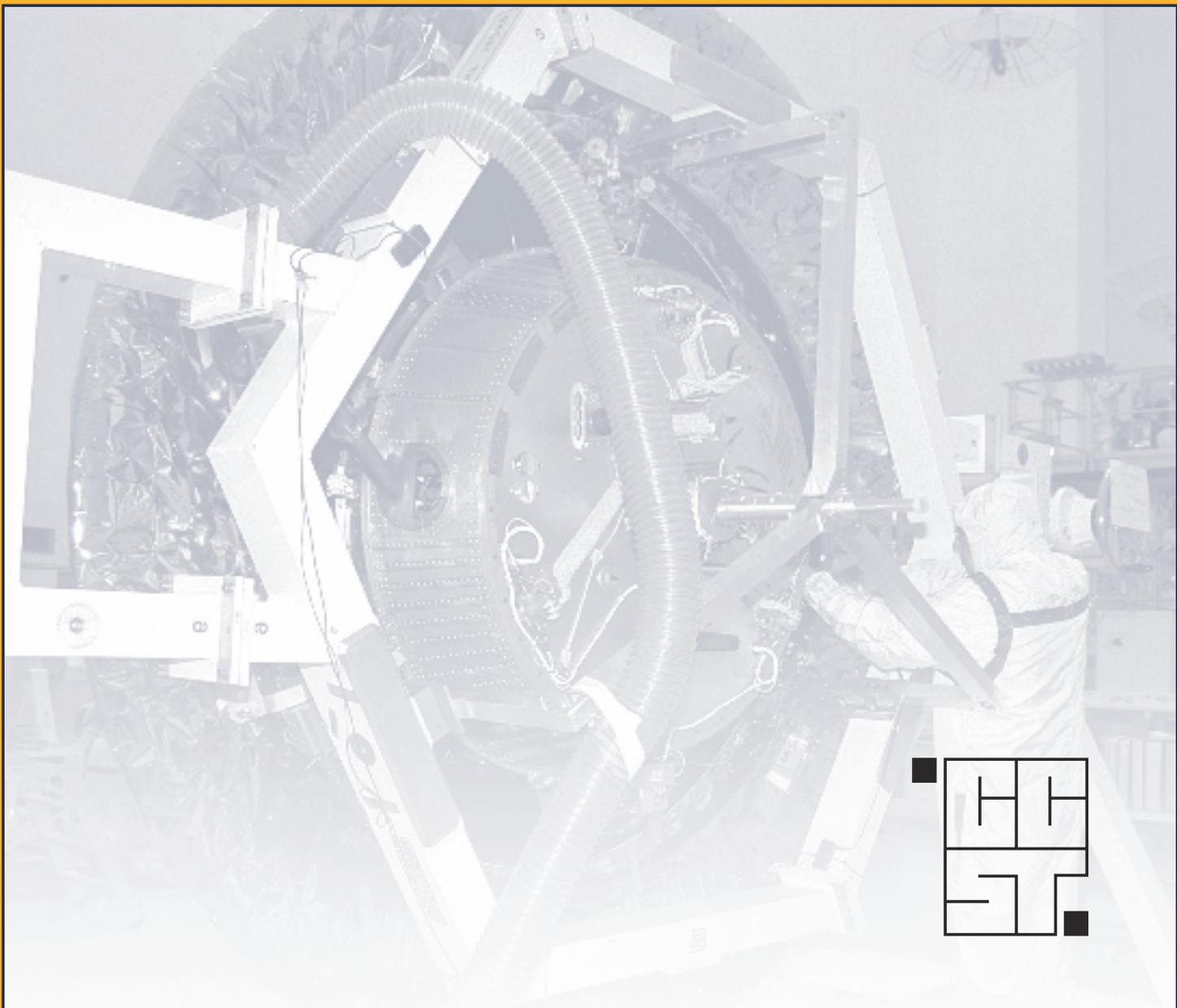
Susan M. Harris, Project Support

Donna King, Project Support

Anzell Loufas, Sacramento Office Director

Christina Ramirez-Rios, Project Support

Printer: Crystal Printing, Sacramento, CA



SACRAMENTO OFFICE:

California Council on Science and Technology
1130 K Street, Suite 280
Sacramento, CA 95814
(916) 492-0996 (telephone)
(916) 492-0999 (fax)

RIVERSIDE OFFICE:

California Council on Science and Technology
5005 La Mart Drive, Suite 105
Riverside, CA 92507
(951) 682-8701 (telephone)
(951) 682-8702 (fax)
E-MAIL: ccst@ccst.us

INTERNET: <http://www.ccst.us>