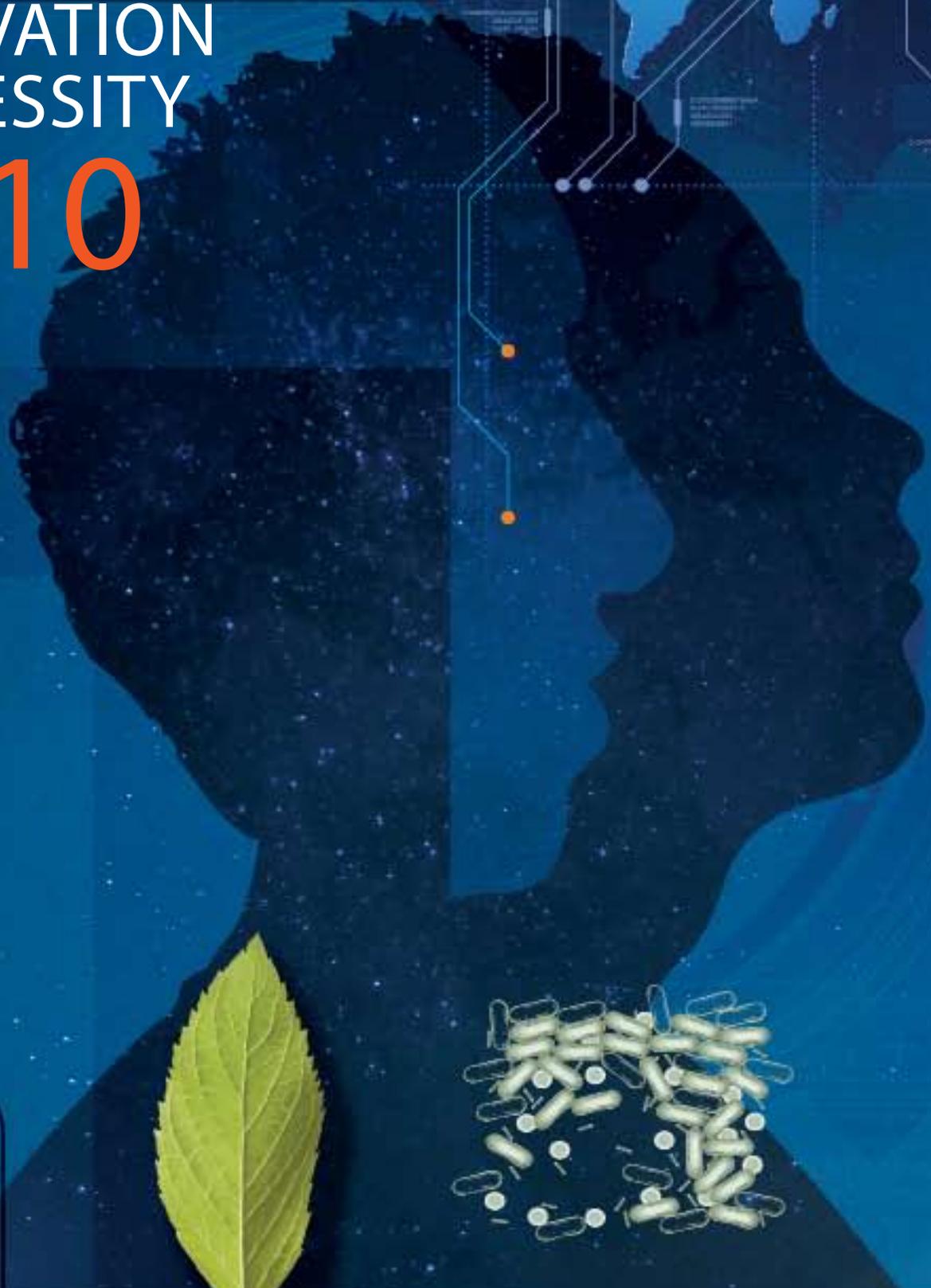


CCST Annual Report

INNOVATION +NECESSITY

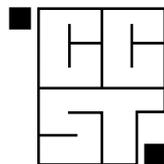
2010



California Council
on Science
and Technology

2010

ANNUAL REPORT



AUGUST 2010

Innovation and Necessity



Karl S. Pister
Board Chair

The economic crisis facing California is no longer an alarming surprise, but rather a discouraging reality. Despite two years of steep cuts, the state is facing yet another significant budget deficit – an estimated \$19 billion as of press time – and there are no easy decisions left to make. Even if the state's overall economy turns around in the next few years, as many economists predict, the legacy of these years of fiscal shortfall will have a tangible, potentially irreversible impact for years to come.

CCST's research over the years has emphasized the criticality of a long-term view and sustained commitment to the effective management of the infrastructure – the people, institutions, public policy, and physical assets – that supports California's science and technology (S&T) enterprise. CCST has also been concerned for some time about the steady erosion of the science, technology and education infrastructure that has made this state great; that erosion has accelerated with the economic crisis. The state's economic recovery is unlikely to be sustained without a reversal of that trend. And the budget climate is such that even some of the state's visionary achievements in S&T policy – such as the Global Warming Solutions Act of 2006 – are being challenged on the grounds that complying with them would cost too much.



Charles F. Kennel
Council Chair

Clearly California is in need of innovative solutions to its persistent fiscal problems; it needs to reassess the very nature of innovation, which has been such a driving force for the state during the past several decades. If it does not, it will lose its place in the vanguard of science and technology. The rest of the nation, and indeed the world, are not standing still. California is facing competitive challenges of a comprehensiveness, scale, and financial potency never before encountered or contemplated.

It is for these reasons that CCST is undertaking a comprehensive assessment of California's current innovation ecosystem. Opportunities can far exceed the barriers to innovation leading to economic development, job creation and growth, and attraction and retention of S&T talent, but we must be able to identify them. They may well lie in new public/private partnerships, and/or nascent industries.



Miriam E. John
Council Vice-chair

It is often said that necessity is the mother of invention. Necessity has become the dominant watchword in California's fiscal planning. We are energized by the possibilities of this new assessment, and look forward to engaging key stakeholders and decision makers in its eventual recommendations.

Karl S. Pister Charles F. Kennel Miriam John

About CCST

CCST is a nonpartisan, impartial, not-for-profit 501(c)(3) corporation established via Assembly Concurrent Resolution (ACR 162) in 1988 by a unanimous vote of the California Legislature. It is designed to offer expert advice to the state government and to recommend solutions to science and technology-related public policy issues.

CCST is modeled in part on the National Research Council, and has developed a close working relationship with the National Academies. More than half of CCST's members and fellows are members of the National Academies, and several are Nobel Laureates.

Since its creation, CCST has worked directly with the governor's office, state and federal legislators, and agencies to recommend policies that will maintain California's role as a leader in generating science and technology innovation and maintaining a vigorous economy.

Sustaining Institutions

The strength of CCST lies in the support and resources provided by its sustaining institutions, the University of California system, the California State University system, California Institute of Technology, Stanford University, University of Southern California, and the California Community Colleges, as well as its affiliate members, Lawrence Berkeley National Laboratory, Lawrence Livermore National Laboratory, Sandia National Laboratory in California, Stanford Linear Accelerator Center, and NASA Ames Research Center and Jet Propulsion Laboratory. CCST also has strong connections to industry through its membership.

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 16 leaders from industry and academia. Karl S. 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, currently includes 30 corporate leaders, academicians, scientists, and scholars of the highest distinction. Charles F. Kennel, distinguished professor of atmospheric science, Scripps Institution of Oceanography; founding director and chairman, International Advisory Board, Environment and Sustainability Initiative, University of California, San Diego, is the chair, and Miriam E. John, former vice president, California Division, Sandia National Laboratories, is the vice-chair.

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.

Senior Fellows

CCST senior fellows are a select group of distinguished 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 135 senior fellows who are engaged in all aspects of CCST's work addressing important science and technology issues facing government, education, and industry.

California Teacher Advisory Council (Cal TAC)

Cal TAC is a group of 12 outstanding K-14 science and math classroom teachers and is modeled after the successful National Teacher Advisory Council, established in 2002 by the National Academies. Cal TAC works to provide a valuable connection between the teaching community and the educational experts and policymakers who are shaping California's educational system. Ann Marie Bergen, teacher in residence at Cal Poly, San Luis Obispo, is the chair, and Barbara Shannon, co-director of the Synergy Kinetic Academy, Los Angeles is the vice-chair.

Staff and Offices

Susan Hackwood is CCST's executive director and provides overall day-to-day leadership; she also sits on the board and council. CCST has two offices. One is in Southern California adjacent to UC Riverside; another is one block from the State Capitol in Sacramento.

Hard Choices



Susan Hackwood
Executive Director

As we move into the next year CCST has its job cut out for it. Times are tough in California as the budget crisis continues. The state is facing another formidable deficit – over \$19 billion – despite many of the austerity measures implemented last year, such as mandated furloughs for state workers, and despite over \$8.7 billion received through the federal stimulus package the American Recovery and Reinvestment Act (ARRA) (with an additional \$13 billion awarded but not yet received). This is the largest state budget deficit in the nation by a significant margin – and not just because California’s overall budget is the largest. Viewed as a percentage of the total, California’s deficit is over 22% of the total state budget. Only twelve other states have deficits of comparable or greater percentages.

Revitalizing the economy is essential to ensuring California’s future. Our state has a legacy of both visionary technological innovation and visionary legislation in support of its high-tech industries. Consistently, California has been ahead of the curve in addressing issues of energy efficiency and emissions control, leading the way in developing new roles for state government in shaping research and development, and focusing on infrastructure issues encompassing the digital as well as the physical world. It is no accident that the President’s Council of Advisors on Science and Technology (PCAST) turned to California, to CCST, for input on the National Nanotechnology Initiative Review. California continues to be a world leader in nanotech research and is one of the few states with any regulatory framework addressing nanotechnology.

However maintaining this leadership and a long-term vision, is extremely difficult when the budget climate is so challenging. As Governor Schwarzenegger noted, in terms of choices for balancing the budget, there are no more low-hanging fruit to be had; in fact there are barely any fruit at all. But it is precisely at this point when CCST believes the state needs to take the long-term view that will continue to foster an environment of innovation, entrepreneurship, and business development. To do so, we need to better understand how to effectively foster and sustain an agile high-tech innovation ecosystem upon which our state’s economy – and hence revenues – so badly depend.

At the request of members of the Legislature, CCST is undertaking an ambitious effort to clarify the existing innovation infrastructure in the state, to assess competitive innovation strategies, and to make policy recommendations back to the Legislature and to the incoming Administration to further California’s innovation ecosystem and leadership. As we begin this work we reflect that historically, one of the most important catalysts for California’s innovation ecosystem has been the state’s investment in science, technology and higher education. Through state investments, and investments from federal and private sector sources, the state has provided exceptional preparation

for its citizens to pursue careers in engineering and the sciences; attracted the most talented students from around the world to study in California and remain in the state to launch new high tech companies; and created a culture in which university and laboratory faculty start businesses that employ thousands of citizens. We also note that this investment has been challenged during these tight budget times. What strategies can we recommend for the State that will help maintain and grow this resource while considering the real constraints of the budgets?

Preserving the science and technology culture in California is important. But it is equally important to identify and to adapt to the realities of how the innovation ecosystem has changed and continues to change with the globalization of our economy and the advances in computer technologies and social networking. As we move forward with this work CCST is focusing on understanding the implications of a shift from a closed innovation system, where ideas are germinated and developed largely within specific research institutions or companies, to an open system, where information is much more freely shared around the world.

This look at innovation is not unique. We've done it before with our California Report on the Environment for Science and Technology (CREST Report) in 1999. Other initiatives are being launched with the goal of catalyzing innovation. In California, the state's Business, Transportation and Housing Agency (BTH) has launched the California Innovation Hub (iHub) initiative, a program designed to enhance the state's competitiveness on a national and global scale by stimulating partnerships, economic development and job creation around specific research clusters. This program has solicited two rounds of applications from across the state. Regions have come together to identify their commercial goals and their innovation resources and have formed public/private partnerships for the express purpose of fueling innovation in their region with a goal of job creation.

On the national front, the Obama Administration is looking at how to catalyze innovation clusters across the country; this initiative is housed in the U.S. Department of Commerce. The U.S. Department of Energy is also looking at identifying and catalyzing innovation clusters in the area of energy efficiency. Both of these initiatives are looking at what processes, programs, and policy levers from the federal level can be engaged to help fire up our innovation engines.

CCST looks forward to providing recommendations on how to maintain and expand our innovation capacity through our work over the coming months. We look forward to providing to the leadership of California our analysis and recommendations to support an effective policy framework that will enable and engage a 21st century innovation ecosystem model critical to tomorrow's high-tech industries and to California's ability to thrive and prosper.

Susan Hachwood

Highlights 2009–2010

innovate2innovation

In May 2010, a bi-partisan, bi-cameral group of legislators asked CCST to conduct a comprehensive assessment of California's "science and technology (S&T) innovation ecosystem," analyzing and reporting current global innovation systems, and recommending to the Legislature actions that should be taken to sustain the state's role as a global leader in science and technology.

S&T Legislative Policy Fellows

The five-year pilot program, modeled after the 35-year-old Congressional S&T Fellows Program administered by the American Association for the Advancement of Science (AAAS), placed the first group of ten fellows throughout legislative offices in Sacramento. A second cohort of 10 Fellows have been selected and will start their tenure in November 2010.

California's Energy Future (CEF)

This project will provide an authoritative analysis of issues related to energy efficiency, transportation, heating, bio-fuels and electricity generation through nuclear power, advanced coal technologies and renewable energy. The analysis is designed to show the technical potential, costs and risks of various energy system choices that need to be addressed to achieve realistic goals for the future.

In a related project, CCST is completing an on-line relational database to facilitate implementation of the Global Warming Solutions Act of 2006 (AB 32).

Personalized Healthcare Information Technology (pHIT)

This project seeks to demonstrate how information technology may enable the integration of personalized healthcare data (i.e., genetic/genomic test results) into an existing electronic health record (EMR) system and how decision-making could be improved by individual patients and their care providers and reimbursers by building a new knowledge-based model for decision support. Breast cancer is the target health issue in the pilot.

Publication: A Qualitative Examination of the Preparation of Elementary School Teachers to Teach Science in California

This report, released in April 2010, provides a quantitative, descriptive and qualitative review of how elementary school teachers are prepared to teach science.

California STEM Learning Network

The CSL Net (formerly the California STEM Innovation Network), jointly managed by CCST and Cal Poly San Luis Obispo through summer 2010, has completed a blueprint for transforming California's STEM education structure into a 21st century K-12 and higher education system where a substantial and increasing number of students are either college bound or workforce ready.

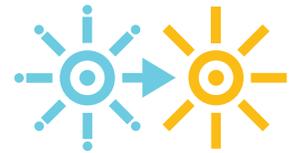
California Teacher Advisory Council (Cal TAC)

Cal TAC continued its collaborations with national organizations, sending a member to present at a National Academy of Engineering (NAE) symposium in September 2009 and using video links to connect their January 2010 meeting with the National Teacher Advisory Council.

Publication: Nanotechnology in California: An overview prepared for the National Nanotechnology Initiative Review

In January 2010, the President's Council of Advisors on Science and Technology (PCAST) asked CCST to present an overview of California's nanotechnology research and commercialization, as part of the National Nanotechnology Initiative Review.

CCST provided a summary of state regulations affecting nanotechnology, an overview of the current status of the industry in California, the status of R&D in California, venture capital funding, the regulatory environment, and the impact of the National Nanotechnology Review.



innovate2
innovation

innovate2innovation

At the request of the State Legislature, CCST is conducting a comprehensive assessment of California's "science and technology (S&T) innovation ecosystem" – specifically human capital, investment, and infrastructure – analyzing and reporting current global innovation systems, and recommending to the Legislature actions that should be taken to sustain the state's role as a global leader in science and technology.

Given the fast paced evolution and globalization of the S&T innovation ecosystem and the impact to California's economic prosperity, the proposed CCST study "innovate2innovation" (i2i) will:

- Assess the condition of California's S&T economy, describing the overall S&T innovation ecosystem in the current global economy; and,
- Recommend actions for maintaining S&T leadership and competitiveness in an increasingly globalized economy, and facilitating new job opportunities through entrepreneurship and education.

Excerpt from Letter to CCST

".... Dear Dr. Pister:

It has been a pleasure to work with CCST on the implementation of the Science and Technology Fellowship. We are very impressed with your work and commitment to laudable pursuits, as well the caliber of individuals you have selected to work as Fellows in our legislative offices.

That is why we again turn to you and your staff to request assistance with an additional important undertaking on behalf of our great State...."

<i>Assembly Member Anthony J. Portantino</i>	<i>President pro Tempore Darrell Steinberg</i>
<i>Assembly Member Sam Blakeslee</i>	<i>Senator Dean Florez</i>
<i>Assembly Member Marty Block</i>	<i>Senator Gloria Negrete McLeod</i>
<i>Assembly Member Joan Buchanan</i>	<i>Assembly Member Jared Huffman</i>
<i>Assembly Member Wilmer Amina Carter</i>	<i>Assembly Member V. Manuel Pérez</i>
<i>Assembly Member Connie Conway</i>	<i>Assembly Member André Swanson</i>
<i>Assembly Member Nathan Fletcher</i>	

The final report will also address the unique attributes of the state's federal laboratories, universities, and other facilities and networks as well as looking toward the horizon, e.g. applications of technology in education to more effectively educate and train students and the workforce of varying needs.

This i2i study will deliver a roadmap to guide policymakers and decision leaders toward effective investment in California and other states' innovation ecosystem to promote and sustain the nation's leading global role in innovation and entrepreneurship.

The bipartisan signatories include the letter author, Assembly Member Portantino; President pro Tempore Darrell Steinberg; Senator Negrete-McLeod, chair of the Senate Business, Professions & Economic Development Committee; and Assembly Member V. Manuel Pérez, chair of the Assembly Jobs, Economic Development & the Economy.

Science & Technology Policy Fellows

The first cohort of California Science and Technology Policy Fellows began in Fall 2009, placing 10 science and technology (S&T) advisors to serve one-year terms in a variety of committees and legislator offices in the California State Legislature.

The fellows for 2009-2010 were hosted by three Senate committees (Energy, Utilities, and Communications, Environmental Quality, and Natural Resources and Water), as well as the Senate Office of Research; the Republican Caucus; two Assembly committees (Natural Resources and Water, Parks and Wildlife) and the offices of Senate Majority Leader Dean Florez, and Assembly Members Wilmer Amina Carter and Sandré Swanson.

Recruited nationally, the fellows have worked to assist their respective legislators and committees in formulating and evaluating S&T policy for California. Areas of consultation have included legislation related to pressing issues and challenges, such as healthcare, bioethics, energy and water resource management.

The program, adapted for California from the 36-year old American Association for the Advancement of Science (AAAS) Congressional Science and Technology Fellowship program, is the first in the nation to place Ph.D. level scientists and engineers in a state legislature.

The California S&T Policy Fellowships began with an introduction on the Assembly floor, followed by a three-week intensive boot camp on how things work in Sacramento. Fellows have undergone intensive training covering the legislative process, the effective translation of science for policymakers, and tips for success in the legislative environment. With this training complete, they began their service in their placement offices in December 2009, and will complete their service in October 2010. The selection process for the second class of fellowships, which will begin in November 2010, took place earlier this year.

With serious budget challenges facing virtually every area of state services, we envision that the California S&T Fellows Program - funded by a coalition of foundations (including the Gordon and Betty Moore Foundation; Stephen Bechtel Fund/S.D. Bechtel Jr. Foundation; Kingfisher Foundation; The Heising-Simons Foundation; TOSA Foundation, and the Gen-Probe Fund) - will prove to be a useful resource to policymakers as they navigate the delicate balance of maintaining long-term policy goals with S&T underpinnings in the face of significant fiscal limitations.



(left to right) Byron Kennedy, Maurice Pitesky, Amber Laura Hartman, Jessica Westbrook, Igor Lacan, Amber Wright, Ryan McCarthy, Janice Tsai, Daniel R. Ballon and Katharine Moore

Senate Offices

Amber Laura Hartman, with the Senate Environmental Quality Committee. Hartman received a Ph.D. in biology from The Johns Hopkins University and a B.S. in biology from Davidson College.

Katharine Moore, with the Senate Natural Resources and Water Committee. Moore received a Ph.D. in atmospheric science from Colorado State University, a M.S. in environmental engineering from the University of California, Berkeley and a B.S. in mechanical engineering from the Massachusetts Institute of Technology.

Maurice Pitesky, with the Senate Energy, Utilities & Communications Committee. Pitesky received his Masters of Preventative Veterinary Medicine and DVM degrees at UC Davis, a M.S. in agriculture from Cal Poly, San Luis Obispo, and a B.S. in biology from UCLA.

Janice Tsai, with the Senate Majority Leader Dean Florez. Tsai received her Ph.D. in engineering and public policy from Carnegie Mellon University. Her educational background also includes a Master of Library and Information Science, Rutgers, and a B.A. in mathematical methods in the social sciences, Northwestern University.

Amber Wright, with the Senate Office of Research. Wright received her Ph.D. in population biology from the University of California, Davis. She received a M.A. in conservation biology from Columbia University and a B.S. in biological sciences (cum laude) from Cornell University.

Assembly Offices

Daniel R. Ballon, with the Assembly Minority Leader/Republican Caucus. Ballon received a Ph.D. in molecular and cell biology from the University of California, Berkeley, and a B.A. in molecular biology and biochemistry, Russian language and literature from Wesleyan University.

Byron Kennedy, with Assemblymember Sandré Swanson. Kennedy received a M.D. and Ph.D. in chronic disease epidemiology, and a M.P.H. in chronic disease epidemiology from Yale University. He also received a B.S. in biological sciences from California State University, Sacramento. He has an active medical license in both California and New York.

Igor Lacan, with the Assembly Water, Parks & Wildlife Committee. Lacan received a Ph.D. in urban ecology, a M.S. in aquatic ecology, and a B.S. in ecology from the University of California, Berkeley.

Ryan McCarthy, with Assemblymember Wilmer Amina Carter. McCarthy received his Ph.D. in civil and environmental engineering from UC Davis. He received a M.S. in civil and environmental engineering from UC Davis and a B.S. (cum laude) in structural engineering from UC San Diego.

Jessica Westbrook, with the Assembly Natural Resources Committee. Westbrook received her Ph.D. from the Department of Horticulture at Cornell University with a minor in plant biology and a B.S. in plant biology from the University of California, Davis.

California's Energy Future

California must dramatically overhaul its energy systems if the state is to achieve its ambitious goals of reducing total greenhouse gas emissions to 1990 levels by 2020 and even lower by 2050. The technological, economic and social challenges are daunting and the range of choices is overwhelming. To help inform the hard decisions state and local governments must make, CCST is planning to release the results of its California's Energy Future (CEF) project this fall.

The two-year study, chaired by Jane Long and Miriam John, brought together scientists, engineers and economists to analyze possible paths to the energy future envisioned by the Global Warming Solutions Act of 2006 and Gov. Arnold Schwarzenegger's Executive Order, S-3-05. The legislation, AB 32, calls for cutting emissions to 1990 levels in the next decade while Schwarzenegger's order requires emissions to be reduced to 80 percent of 1990 levels by 2050. The report is expected to outline three to six portraits of energy systems that would meet these goals and provide reliable, clean energy to California's growing population.

These are the realities of enacting the law:

- California is expected to grow from the current population of 38 million to 60 million by 2050. With concurrent economic growth, we would need roughly twice as much energy in 2050 as we use today.
- This is much like a 90% reduction from the perspective of energy use per capita.
- We need to go from CO₂ emissions of 450 GT/yr to about 85 GT/yr and grow at the same time.

The starting point for the CEF project was a \$3 million national America's Energy Future study supported by the National Academy of Engineering, the National Research Council, Dow Chemical, the Kavil Foundation, the Intel Corporation and the U.S. Department of Energy. Increasingly, CCST has taken responsibility for interpreting and focusing National Academies' research for a California audience. It performed a similar task in 2005, when it analyzed the implications for the state of the Academies' report, *Rising Above the Gathering Storm*, at the request of the Governor.

CEF's goal is to provide an authoritative, non-partisan analysis of issues related to energy efficiency, transportation, heating, bio-fuels and electricity generation through nuclear power, advanced coal technologies and renewable energy. The analysis it has prepared is designed to show the technical potential, costs and risks of various energy system choices.

The CEF committee found California's targets as challenging as expected. To reduce total emissions to 80 percent of 1990 levels by 2050 would require cutting the rate of emissions by some 90 percent when population growth is factored into the equation. Even with increased efficiency, demand for electricity generation would more than double because

eliminating fossil fuel use is critical to reducing emissions. The only substitutes for heating and transportation are electricity or bio-fuels. So, electricity demand would increase and, for the heavy transportation that cannot be electrified, new bio-fuel sources would be required.

The study focused on existing technologies and known energy sources, primarily renewable energy, fossil fuel with sequestration of emitted carbon dioxide, nuclear power, and bio-fuels. At the same time, it identified four key questions to explore:

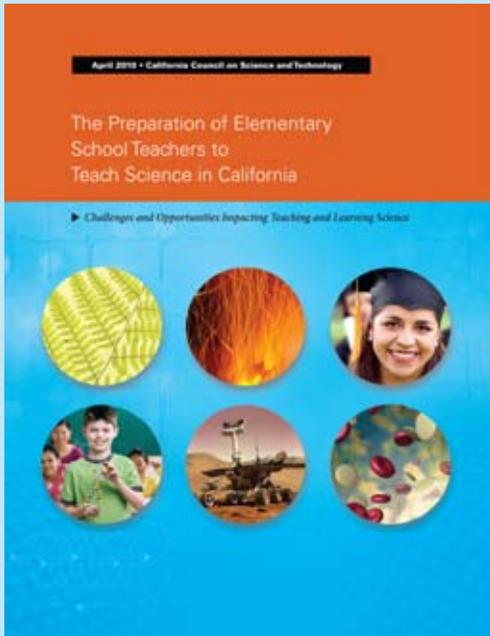
1. How much can energy demand be controlled?
2. How much transportation and heat production can be electrified?
3. How can carbon be removed from the process of electrical generation?
4. How can fuels be developed that produce no net carbon emissions?

The report will show that California's ability to meet the 2050 emission standards hinges on the answers to the key questions about controlling energy demand, electrifying transportation and heating and removing carbon from electricity and fuels. The state will need to apply aggressive energy efficiency measures and change the energy carrier for light duty transportation and heat from fossil fuel to electricity. Simultaneously, the energy system will have to move away from electric power generation that produces emissions at the same time that it doubles the supply of electricity. Even then, the state's ability to meet the rigorous standards will depend on whether bio-fuel becomes a sustainable source of energy.

One point has become clear. California likely will need to take different paths to reach the 2050 goal than to achieve the 2020 target. Slashing greenhouse gas emissions to 80 percent of 1990 levels with a growing population will require profound changes in the state's energy system. It will not be enough to reduce greenhouse gases incrementally. The state will have to aim for a target of nearly zero emissions and some technologies which are helpful in reducing emissions will not carry it far enough toward eliminating them altogether.



The Preparation of Elementary School Teachers to Teach Science



“Top leaders across the CSU are committed to addressing this problem. . . We have a deep shared concern about these issues, and a number of exemplary programs have been or are being developed on CSU campuses that we can build upon to help ensure elementary teachers across California are well-prepared in science.”

~ Warren Baker
 President of Cal Poly, San Luis Obispo,
 and co-chair of the National Business
 Higher Education Forum Initiative, Secur-
 ing America’s Leadership in Science,
 Technology, Engineering and Mathematics
 (STEM)

California’s elementary school teachers feel much less confident in teaching science than they do reading or math, and there is room for significant improvement in elementary school teacher preparation, according to a report CCST released in April 2010.

The Preparation of Elementary School Teachers to Teach Science in California: Challenges and Opportunities Impacting Teaching and Learning Science is an eighteen-month study funded by the S.D. Bechtel, Jr. Foundation. The project provides a descriptive and qualitative review of how well elementary school teachers are prepared to teach science.

The new study follows on the joint CCST-CFTL 2007 report *Critical Path Analysis of California’s Science and Mathematics Teacher Preparation System*, which found that, despite troubling performances of California 4th and 8th graders on national assessments, little attention has been paid to the preparation of elementary school teachers to teach science. Much of the discussion about science and math education tends to focus on high school, where single subject credentials are required to teach in the various disciplines. The preparation of K-6 teachers is fundamentally different: almost all these teachers hold a multiple subject credential, which enables them to teach all subject areas, including science in a self-contained classroom.

Data collected by the California State University Center for Teacher Quality (CTQ) indicate that K-6 teachers rate themselves as substantially less prepared to teach science than mathematics or reading. The supervisors, however, gave more positive ratings to the teachers – a difference that was most prominent for science, and which increased over the course of the survey. By the final year of the study, the difference between student and supervisor assessment reached 20%. This finding is consistent with previous research and indicates that, despite a general rise in student science proficiency scores, and considerable focus on science and math teacher preparation at the secondary level, elementary

school teachers have not shown a rise in confidence over the course of the study, suggesting that significant work remains to be done.

In addition to assessing the preparedness of elementary school teachers, the study also profiles 9 teacher preparation programs identified by a working group of educational experts as having initiatives reflecting promising approaches to improving the preparation of elementary teachers to teach science.

The report resulted in an immediate statement of support co-signed by five CSU presidents, who are planning several initiatives that address the report's recommendations. These include a meeting on best practices in teacher preparation that will include an elementary science teacher preparation symposium, and new Foundational Level General Science credential programs that include community college pathways. The CSU will also make available tools used by the CTQ to facilitate other institutions' collecting and using data on the preparation of elementary teachers in science.

Recommendations:

- Share and disseminate information on existing promising programs and infrastructure proactively and more effectively – CSU should convene a ‘best practices’ symposium within the next six months
- Adapt existing policies to protect and enhance K-6 science teaching – in particular, focusing on aligning community college lower division standards with teacher preparation programs
- Take a leadership role in the discussion of science standards – remain proactively engaged in the national discussion underway
- Follow the recommendations of the National Academy of Science “Building a Village” Convocation from May 2009
- Use new data to guide policy – in particular that collected by the Center for Teacher Quality and the Center for the Future of Teaching and Learning over the coming year

Personalized Healthcare Information Technology

During the past year, the Personalized Healthcare Information Technology (pHIT) Task Force, convened by CCST and the California Business, Transportation and Housing Agency (BTH), has forged a partnership with the CalPERS Health Benefits Committee and is moving forward with a pilot study to determine and demonstrate the potential value of Personalized Health Information Technology as applied to personalized healthcare and make recommendations to the State regarding development and expansion of pHIT programs with potential to improve health care and reduce burdens of disease care. The pHIT Task Force shall, upon pilot study completion, report its findings and recommendations to BTH; the Health and Human Services Agency; Cal eConnect; the Privacy and Security Advisory Board (PSAB); and the California Public Employees Retirement System. The pHIT Task Force is chaired by Dr. Ramesh Rao, California Institute for Telecommunications and Information Technology, UCSD, and has over 30 expert participants from healthcare and information technology.

Specifically, the study seeks to demonstrate how information technology may enable the integration of personalized healthcare data (i.e. genetic/genomic test results) into an existing information system platform and how decision-making could be improved by individual patients and their care providers and reimburse by building a new knowledge-based model for decision support. The pHIT Task Force opted to select breast cancer as the target disease due to the fact that at least two genetic/genomic tests are currently used by physicians as standard of care.

The study builds a breast cancer care decision support model that integrates genetic/genomic information, facilitating broader adoption of such resources into the standard of care and education of the future healthcare workforce. The study also seeks to identify ways to improve the quality of an individual's healthcare, reduce the burdens of "disease care", reduce costs overall, and grow California's innovative businesses.

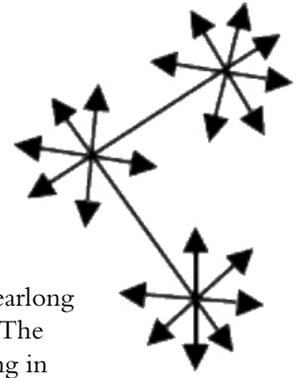
As part of the agreement with CalPERS, this work includes the retrieval of retrospective, de-identified data from the CalPERS Health Care Decision Support System. The study retrospectively evaluates de-identified breast cancer patient records (from CalPERS via Anthem) and genetic/genomic test results (Genomic Health, Myriad Genetics), integrating them in a decision support IT platform (CentriHealth) built upon a breast cancer care ontology that is developed by a panel of experts. The system will be iteratively peer-reviewed.

The Task Force has assembled an Ontology Development Panel of clinical oncologists and health information technology experts as part of the pilot study to develop a scalable prototype healthcare decision support system designed to integrate the de-identified patient records with genetic/genomic test results. The Ontology Development Panel will work with the study's data management partner, CentriHealth, in building out the decision support model.

The pHIT Task Force is charged to propose HIT infrastructure goals for the state in support of personalized health.



California STEM Learning Network (CSL Net)



The California STEM Learning Network (formerly CSI Net) is the outgrowth of a yearlong project to design a blueprint for STEM education in the nation's most populous state. The project is a joint venture of California Polytechnic State University and CCST, working in partnership with The Center for the Future of Teaching and Learning (CFTL), the Bill & Melinda Gates Foundation and the S.D. Bechtel, Jr. Foundation. Work began in 2008 when the Gates Foundation engaged Cal Poly to prepare a new plan for STEM education in California.

On April 6 & 7, 2010, CSL-Net presented the first draft of the blueprint for STEM education at a meeting hosted by CCST Board Member Steve Mayo at the California Institute of Technology in Pasadena. The summit had over 100 attendees representing leaders and agents of change from private industry, educational enterprises, higher education institutions, and foundations. The key recommendations include creating:

1. A STEM Council comprised of program providers and representatives from the education and business sectors to advocate on behalf of CSL Net and to help secure the resources needed by network participants;
2. A STEM Collaborative that convenes leaders from state agencies, state and federally funded STEM programs, K-12 and higher education, and the policy sector to identify ways of leveraging existing resources, and to build consensus around policy recommendations to ensure STEM success;
3. Regional STEM Champions affiliated with CSL Net who will work with a broad coalition of stakeholders at the local level to increase STEM learning opportunities inside and outside of the classroom; and
4. Core staff at a Network Operations Center who will ensure effective communications among all the groups and coordinate the work of the three tiers of the Network.

The S.D. Bechtel, Jr. Foundation and Gates subsequently committed funding. This summer, the project has begun an implementation phase and effective June 30, 2010, CCST transferred the fiscal and managerial functions to the Corporation for Education Network Initiatives in California (CENIC).



California Teacher Advisory Council (Cal TAC)

Cal TAC launched its own newsletter this year, to provide a connective thread to summarize and communicate Cal TAC members' activities through the year as they give voice to science, math, engineering and technology educational issues. The first issue, released in March 2010, covered the two symposia Cal TAC held in 2009 (on STEM workforce preparation and sustaining successful programs in elementary science education) as well as other meetings in which Cal TAC members participated, such as the National Research Council's Board on Testing and Assessment's workshops on best practices for state assessment systems and the National Academy of Engineering/National Research Council's September 2009 symposium on introducing engineering to the K-12 curriculum.

Cal TAC held its general meeting at the Beckman Center in Irvine on January 23, 2010, it was video linked for a portion with the National Teacher Advisory Council meeting held in Washington D.C. There are plans for another joint meeting with the National Academies on integrating formal, informal and after school education. Finally, Cal TAC is planning a symposium to engage a group of policymakers, researchers, and practitioners in a discussion on how to improve student learning in math and science by strengthening the state's assessment system in those subjects. This event will take place in Sacramento on October 21, 2010.

Members actively participated in symposia and workshops around California and the nation, sharing their own expertise with education experts and bringing these experiences back to inform Cal TAC's own symposia.

"... [It] was a phenomenal experience. While the panels were made up mostly of researchers, it was good to hear the voices of teachers, such as the Einstein Fellows, and Peg Cagle of Cal TAC when they went to the microphone to speak. I must admit that it sounded as if nothing had been learned in the 35+ years that I had been in education and schools had been doing assessments and many states were thinking about going back to ways they had tried years before... at the end of the day, the question remained, 'Who are we assessing, students or teachers?' Either way, we should hear from students and teachers before final decisions about the assessments are made."

— Cal TAC member Barbara Shannon, following the December 2009 Best Practices for State Assessment Systems Workshop in Washington D.C.

California Teachers of the Year

At the Sacramento Airport after Speaking at the California Title I Conference



Left to right:

Jose Navarro 2009
Social Studies Teacher

Lewis Chappellear 2008
Cal TAC Member
Engineering, Math,
and Science Teacher

Dawna Countryman 2007
6th Grade Teacher

Melanie Tolan 2010
English-language Arts, History,
and Physical Education Teacher

Alan Lawrence Sitomer 2006
English Teacher and Author



Council Meeting Summaries

October 2009

NASA at 50

Elon Musk, CEO and CTO, SpaceX Corporation



Left to right: Council Member Jude Laspa, Elon Musk and Executive Director Susan Hackwood

CCST reflected on NASA's impact on California over the past five decades at the October 2009 council meeting, where SpaceX CEO Elon Musk talked about the importance of the private sector in the future of space.

"I think really the only way we'll ever extend life beyond Earth is by having a strong commercial role," Musk said. "Because I think we'll never be able to afford it – by a factor of 10 or 100 even – if it's done by the government."

Musk has promoted the commercialization of space travel ever since he founded the Hawthorne, California-based company in 2002. Last year he received an American Institute of Aeronautics and Astronautics award for his innovative, low-cost approaches to space transportation. In just seven years, SpaceX has designed and launched the first privately developed liquid fuel rocket to reach orbit, placed a satellite in space, and landed a \$1.6 billion contract with NASA to transport cargo to the international space station starting next year. It was one of the first two private contracts for space transportation awarded by the agency.

"The common thread is I've always been interested in working on things that I think will change the world in a positive way," Musk says. "The Internet, clean energy and space exploration just seemed like the things that would most affect the future of humanity in a positive way."

February 2010

The Innovation Economy



At the February 2010 meeting, changes, threats and opportunities in California's innovation capacity were discussed, initiating a dialogue on the changing context of innovation in S&T that continued at the May 2010 council meeting. A variety of speakers illustrated changes to various components of the science and technology sector.

“Excellence in science and engineering is not enough to be a world leader – we need to be more creative, and look to radical innovations using social and cultural advantages as seen with Google, YouTube, eBay, and Yahoo,” said CCST Council Chair Charles Kennel. “We also need new kinds of scientists and engineers with communications skills, multicultural understanding and foreign languages.”

Presentations focused on what were considered four key areas with the most change, including:

- **Communications** – including the spread of the Internet, ubiquitous 24/7 access, wireless devices
- **Healthcare** – opportunities resulting from human genomic, growth of medical technologies, big pharmaceutical challenges
- **Education systems** – eroding financial support of higher education, contrasting trends of state-of-the-art technology being created versus failing K-12 system
- **Federal laboratories** – change in perspective of the importance and evolving roles of these national resources

Henry Chesbrough, Haas School of Business, UC Berkeley, observed that the traditional closed innovation model, which has provided great successes in the past, has shifted due to five ‘erosion factors,’ including increasingly mobile trained workers; more capable universities; diminished U.S. hegemony; the erosion of oligopoly market positions; and an enormous increase in venture capital. “Good ideas are widely distributed today,” said Chesbrough. “Companies need to recognize that not all of the smart people in the world work for them, and that industrial R&D has become a distributed system.”

May 2010

The Innovation Ecosystem



At the May 2010 meeting, CCST continued the dialogue initiated in February and discussed the game changers in California's S&T "innovation ecosystem." The meeting focused on the government perspective on economic development, the future of aerospace industries in California, the federal funded laboratories as agents of innovation and tech transfer, and the rise of the "virtual campus." The Council used these additional perspectives in discussing parameters of a study to assess the condition of California's innovation infrastructure.

In addition, the May 2010 meeting was held jointly with the California Space Authority (CSA), which held its annual "Space Day" in the Capitol on May 25. The joint meeting began that evening at 5:30 PM with a reception followed by a private screening of the movie "Hubble 3D" in the IMAX Theater Sacramento.

Moderated by CSA's Andrea Seastrand, "The Future of Space and Aerospace Industries in California" panel provided a comprehensive insight into the challenges and opportunities present in the space and aerospace sectors. JPL Director Charles Elachi said that three essential elements: "education, access to capital, and a great place to live" are what "made California the powerhouse it is." However, there are challenges facing the state today, namely the competitive market from other states like New Mexico, which has proven willing to invest \$200 million in a spaceport; South Carolina, which has forged a strategic alliance with Boeing; and more favorable corporate tax rates in other states. "California has a good legacy to build on," said Elachi, "but it needs to seize the opportunities."



CCST – A Unique and Expanding Role

CCST continues to serve a unique role in California and in the nation. As the complexities of the issues facing the state of California increase, CCST continues to provide real-time value to the Legislature. Of particular note, this past year CCST has been able to significantly expand its contribution to the state policy dialogue through the launching of our new S&T Policy Fellowships for the State Legislature. The members of the inaugural class of Fellows were well received by their legislative hosts as they contributed valuable expertise to the policy arena.

Conceived as a catalyzing agent, CCST has long served as an effective focal point and interface between California's rich intellectual resources and the state government. Through the Board, Council, Senior Fellows, and now the new S&T Policy Fellows, CCST is able to quickly draw upon the expertise of top research universities, high-tech industries and innovators, and California's federal research laboratories. This unique networking service is enhanced by the nimbleness of CCST's structure and size, which enables it to be responsive to rapidly emerging issues. This unique capacity has also helped CCST weather the financial slowdown this past year relatively well. CCST runs projects with lean and tight budgets and secures funding for specific projects from a variety of grants. This approach has enabled CCST to respond to a changing environment of resource availability, ensuring smooth continuity in our operations in spite of the state's fiscal difficulties.

During this past year we have renewed our strategic plan under the leadership of Council Chair Charlie Kennel and Vice-chair Mim John. As we look back, CCST has achieved the goals set out by its founders over twenty years ago. Today, in 2010, we are routinely called upon by the Legislature for science-based perspective during the legislative process, by providing technical assistance and testimony at policy, informational and investigative, or oversight hearings. We routinely provide contemporary and real-world assessments of impending science and technological issues before decision-makers. This may include debunking myths as well as providing verifiable evidence related to a variety of issues.

CCST also commissions and publishes timely reports and studies related to issues being considered, or that our Board feels should be considered, by the Legislature. CCST establishes



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CCST Dinners and Receptions

October 2009



February 2010



May 2010



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- a: Council Members Milton Gordon and Julie Meier Wright
- b: Board Member Stephen Mayo and Senior Fellow Linda Cohen
- c: Amber Laura Hartman, Senator Fran Pavley, Katharine Moore, Igor Lacan, Randy Pestor, Tina Cannon-Leahy, Nettie Sabelhaus, Daniel Ballon, Byron Kennedy, Janice Tsai, Maurice Pitesky, Bob Alvarez, Assembly Member Sandré Swanson, Robbin Lewis-Coaxum, Assembly Member Nancy Skinner, Ryan McCarthy, Jessica Westbrook, Lawrence Lingbloom, Amber Wright, Kip Wiley
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- f: Steven Zornetzer and Senior Fellow Lawrence Coleman
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Left to right: Cal TAC Vice-chair Barbara Shannon
and Cal TAC Chair Anne Marie Bergen

CAL TAC

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Lawrence Livermore National Laboratory, Precision Robotic Assembly Machine, page 18

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