

**U.S. House of Representatives  
Committee on Science and Technology  
Subcommittee on Technology and Innovation**

**Testimony of Mr. Randell H. Iwasaki  
Tuesday, June 24, 2008  
10:00 AM – 12:00 PM**

Mr. Chairman, members of the subcommittee:

My name is Randell Iwasaki. I am the Chief Deputy Director of the California Department of Transportation, also known as Caltrans. I would like to thank you for the invitation to testify before you today.

As Chief Deputy Director of Caltrans, I am responsible for a budget of 14 billion dollars, an organization of more than 23,000 employees, and a transportation system that includes 52,000 lane-miles of state highways, two of the five largest transit systems in the nation, three Amtrak routes, and the two busiest ports in the United States.

I serve as the Chair of the Intelligent Transportation Society of America's Board of Directors. I am also a member of the Intelligent Transportation Systems (ITS) Advisory Committee, which is providing executive-level advice and guidance for U. S. Department of Transportation (DOT) Secretary Mary Peters' Five-Year ITS Program Plan.

As you know, all state departments of transportation belong to the American Association of State Highway and Transportation Officials, or AASHTO. I have been a member of the AASHTO Standing Committee on Research since 1999. This committee represents the Association's interests in all research activities for all transportation modes. The Committee makes reports and recommendations on the \$35 million National Cooperative Highway Research Program (NCHRP) and other activities to the AASHTO Board of Directors. I am also a founding member of the AASHTO Technology Implementation Group (TIG) that provides leadership for promoting and supporting rapid implementation of selected technologies.

With regard to the Transportation Research Board (TRB) Strategic Highway Research Program (SHRP 2), I am Chair of the Technical Coordinating Committee for Renewal.

I was recently a member of the Committee on Climate Change and U.S. Transportation for TRB's Special Report 290: Potential Impacts of Climate Change on U.S. Transportation.

California is growing rapidly, and by 2020, its population is expected to increase from 37 million to 44 million people; about one out of every eight Americans now lives in California. We have more registered vehicles (24 million) than we have licensed drivers (22 million), so vehicle travel is an important part of our culture, and by 2020, annual vehicle miles traveled will increase by 38 percent to 475 billion miles. Trade volumes through our ports will also more than double by 2020. Responding to this growth is a high priority for the state. Our objectives are to protect

the existing investment, fuel the economy, enhance the quality of life for our citizens, and protect our environment. Achieving these objectives will require a substantial effort.

The need for the benefits that we receive from new materials and technologies could not be more apparent anywhere than it is here in California. Each year, our State suffers a societal cost of more than \$46 billion in terms of car crashes and traffic congestion. Car crashes annually cause more than 4,000 deaths, 300,000 serious injuries, and the associated level of property damage. Traffic congestion leads to a loss of economic productivity, wasted fuel, and disrupted goods movement, the cost of which continues to rise. We sincerely believe that new materials and technologies will help us significantly improve safety and reduce traffic congestion, and we are committed to investigating the benefits of implementing them.

On June 1, 2005, Governor Schwarzenegger signed Executive Order (EO) S-3-05, which established climate change emission reduction targets for the State. The Climate Action Team (CAT) was created to coordinate the statewide effort. Assembly Bill (AB) 32: California Global Warming Solutions Act of 2006 further established the first-in-the-world comprehensive program of regulatory and market mechanisms to achieve quantifiable and cost-effective reductions of greenhouse gases (GHG), and required the reduction of GHG emissions to 1990 levels by 2020. Caltrans is a member of the CAT, and we are committed to working with the California Air Resources Board to implement transportation strategies that will help reduce GHG emissions. The Caltrans' Climate Action Program was developed to promote clean and energy efficient transportation and provide guidance for incorporating innovative solutions into its business operations. Furthermore, Governor Arnold Schwarzenegger's Strategic Growth Plan, a ten-year mobility investment program, targets a significant decrease in traffic congestion below today's level by 2016. Therefore, Caltrans' approach to lowering fuel consumption and GHG from transportation is to:

- 1) Reduce congestion and improve efficiency of transportation systems through smart land use, operational improvements, and Intelligent Transportation Systems. These are objectives of the State Strategic Growth Plan; and
- 2) Institutionalize energy efficiency and GHG emission reduction measures and technology into planning, project development, operations, and maintenance of transportation facilities, fleets, buildings, and equipment.

Innovation is one of the four core values that guide and shape the department, and staff is empowered to seek creative solutions and take intelligent risks. Caltrans has the largest and most vigorous research division of a state DOT in the nation. We have ongoing studies that address the potential impacts of climate change and state legislation that mandates the consideration of environmental impacts in state decision-making and project development. We use innovative technologies for traffic management systems. We also have programs to develop alternative fuels, green pavement, fleet vehicle greening, smart parking, and many other projects that help to improve mobility and sustain a high quality of life in California.

## Questions:

- 1) **What innovative materials and technologies are currently available to state and local transportation departments, and how do you decide which materials and technologies to use in California? Who are your resources for information on technical capabilities and engineering and design, and how would you rate their technology transfer efforts? How are new materials and technologies integrated into existing transportation networks, especially across multiple regions and jurisdictions?**

Caltrans encourages the use of innovative solutions. We have instituted a Green Highway Program to guide us in using environmentally friendly and recycled products and technologies. Caltrans' environmentally friendly business practices include using innovative materials, waste tires, pavement recycling, office waste recycling, and many other applications. Here are a few highlights from this program:

- **Cold Foam Recycle** – Caltrans' Interstate 80 Cold Foam Recycle Project won an award from Green Technology, a nonprofit organization that works with federal and state officials on environmental solutions. The project was the first in California and the United States to recycle in-place materials on a high-speed, high-traffic volume roadway (Traffic counts range from 30,000 to 60,000 vehicles/day).

The innovative aspect of the project was three-fold: First, the recycling methodology used 100 percent of the existing in-place asphalt concrete on a high-volume, high-speed interstate. This was done in a single pass, allowing for the free flow of traffic through the construction zone. This method reduced construction zone congestion and idling motors at traffic standstills, therefore lowering non-construction vehicle emissions. Second, trucks were not needed to haul away the existing milled asphalt concrete or bring in new replacement hot mix asphalt. Third, the modern computer-driven all-in-one recycler eliminated the need for the following three high-horsepower diesel engines: paver, pickup machine and breakdown roller. This saved additional fuel and further reduced the emissions as compared to conventional construction methodology. The Cold Foam technology has been used successfully in over 10 projects statewide, and more projects are anticipated in 2008/2009.

- **Waste Tires** – Caltrans has established a variety of uses for waste tire products. They include rubberized asphalt concrete as a pavement alternative and shredded waste tires, which are used as lightweight fill for embankments.
- **Environmentally Friendly Cement** – Carbon dioxide (CO<sub>2</sub>) is a major byproduct in the production of cement (0.86 ton of CO<sub>2</sub> per ton of cement in California, where cement plants are among the most efficient in the world). California's production of cement accounts for two percent (2%) of the state's total CO<sub>2</sub> emission. Caltrans, the Air Resources Board, the California Environmental Protection Agency, and our concrete industry are international leaders in efforts to reduce GHG from cement production and concrete cement usage. Our goal is to stretch the amount of cement used in concrete and to reduce the energy necessary for production. We are focused on concrete that meets

our materials quality requirements as we strive to meet the goals of state statute AB 32 (similar to the Kyoto Treaty).

Specifically, Caltrans and our industry have been looking into ways to reduce the amount of carbon in concrete mixes by using more supplementary cementitious materials (SCM) and by limiting the amount of cement in concrete mixes. For example, we are reducing the amount of cement in the mix by allowing up to five percent (limestone and 25 percent fly ash. The percent of fly ash may be increased to 50 percent. Last year Caltrans won an award from the EPA for building the new San Francisco Oakland Bay Bridge with concrete that had 50 percent of the cement replaced with SCM. We are investigating using different fuels to produce cement so there are less GHG emissions.

Caltrans is also studying the adoption of a GHG emission standard to assure that cement imported to California has at most the same cement intensity (so that it is as GHG friendly) as cement produced in California. To accomplish this objective, we are looking into the amount of GHG from shipping material by different modes of transportation including ship, train and truck.

- **Caltrans Vehicle Fleet Greening Program** – This program began as a five-year plan in August 2000 to reduce emissions from the Caltrans fleet, ahead of future regulations, and set an example for the use of emerging, clean air technologies. Today, Caltrans continues to promote an efficient fleet mix and use of efficient, low emission vehicles to reduce our use of petroleum, and our emissions of air pollutants and greenhouse gases. Through a combination of regulatory compliance, state purchasing policies, and innovative demonstrations, we have implemented hybrid passenger vehicles; solar-powered equipment; propane-fueled vehicles; low dust street sweepers, diesel particulate filters on heavy-duty, diesel-powered vehicles; hydrogen demonstration vehicles; and an E-85 fuel ethanol demonstration project. We are also pioneers in the use of low-sulfur diesel and bio-diesel in our vehicle fleet.
- **California Hydrogen Highway Network (CaH2Net)** – Created as part of Executive Order S-7-04 issued by Governor Arnold Schwarzenegger, the mission of the program is to assure that infrastructure is in place to enable fuel cells and other hydrogen vehicle technologies to be used by consumers as they reach commercial readiness. Working in partnership with other components of California's environmental and energy programs, the CaH2Net can help achieve more stable and sustainable energy usage, and increase the number of zero emission vehicles (ZEVs) on California's roads. We are also currently installing a hydrogen fuelling facility in one of our equipment shops in the Los Angeles area.
- **Long-life Pavement Rehabilitation Strategies (LLPRS)** – The goal is to rebuild high volume urban freeways with pavements that are designed to last more than thirty years with minimal maintenance. The program will reduce the need for future repair projects and ultimately save public resources and help preserve the environment for future generations of road users. LLPRS candidate projects were selected from among highways that experience minimum volume demands of 150,000 Average Daily Traffic

or 15,000 Average Daily Truck Traffic, and that have poor structural pavement condition and ride quality. Most LLPRS candidate sections are Portland cement concrete pavements on interstate freeways in urban networks, 80 percent of which are within the Los Angeles Basin, and 15 percent of which are in the San Francisco Bay Area. Pilot projects include the I-10 concrete rehabilitation in Pomona, I-710 asphalt concrete rehabilitation in Long Beach, and I-15 concrete rehabilitation in Devore.

- **Rapid Rehab: Construction Analysis for Pavement Rehabilitation Strategies (CA4PRS)** – By reducing highway construction time and its impact on traffic, CA4PRS is a schedule and traffic analysis tool that helps designers select effective, economical rehabilitation strategies. The software’s scheduling module estimates highway project duration, incorporating alternative strategies for pavement designs, lane-closure tactics, and contractor logistics. On the I-15 Devore reconstruction project, CA4PRS software justified implementing the one-roadbed continuous (24/7) closure scenario, which saved \$6 million in construction costs and \$2 million in road user delay costs. The project was completed in 18 days by closing down one direction of traffic and reconstructing the freeway. This project would normally have taken 10 months to complete with nighttime closures. CA4PRS is funded through a Federal Highway Administration (FHWA) pooled-fund, multistate consortium (California, Minnesota, Texas, and Washington), CA4PRS was developed by the University of California Pavement Research Center through the UC Berkeley Institute of Transportation Studies. FHWA formally endorsed CA4PRS as a “Priority, Market-Ready Technologies and Innovations” product in 2008 for nationwide deployment. Over 700 people have been trained on the use of this software product.
- **Caltrans Stormwater Management Program** – The program received a Green Technology Leadership Award in the transportation category for its pioneering integrated approach to incorporate protection and treatment of stormwater. The approach starts with project planning, design and construction, and includes ongoing efforts in operations and roadside maintenance. Through the corporate business cycle, practices are continually being evaluated and improved.

Our resources for information on technical capabilities and engineering come from many areas, including academia, Federal, State and Local governments, private industry, and from other nations. Caltrans has established excellent working partnerships with our research community. Here are some of the partners we work closely with:

- Advanced Highway Maintenance and Construction Technology (AHMCT), University of California, Davis,
- California Partners for Advanced Transit and Highways (PATH), University of California, Berkeley,
- California Center for Innovative Transportation (CCIT) – As part of the Institute of Transportation Studies at UC Berkeley, (Its focus is technology transfer efforts),
- Partnered Pavement Research Center – UC Berkeley and UC Davis,
- Western Transportation Institute (WTI), Montana State University-Bozeman (MSU),
- University Transportation Centers:
  - The University of California Transportation Center (UCTC) at UC Berkeley,

- The Mineta Transportation Institute at California State University, San Jose,
- The METRANS University Transportation Center at the University of Southern California,
- The Sustainable Transportation Center at the University of California, Davis,
- The Leonard University Transportation Center at California State University, San Bernardino,
- U.S. Department of Transportation, including the FHWA, the Federal Transit Administration (FTA), and the Federal Motor Carrier Administration (FMCSA),
- Transportation Research Board (TRB),
- American Association of State Highway and Transportation Officials (AASHTO), and
- International Partners:
  - France – Mobility Research,
  - Denmark – Pavement Research,
  - Japan/Taiwan – Seismic Research,
  - Holland – Sustainable Transportation Research,

Caltrans is committed to the research and timely deployment of new and innovative materials and technologies, which includes the development of policies that promote sustainability and reduce energy consumption and impacts to the environment. At the same time, there are industry standards that we must follow to be in compliance with federal and state regulations for types of materials used, construction standards, and the like. These policies support our commitment to safety and reliability of the state transportation system. For example, in our pavement unit, a Pavement Standards Team (PST) evaluates pavement design, construction, and maintenance practices and procedures and, as appropriate, develops standard special provisions in a collaborative manner within Caltrans and with FHWA and industry associations. Many times, when changes are deemed necessary or when innovative changes need to be evaluated, pilot programs are initiated. Pilot programs typically require the construction of pilot projects to evaluate the proposed changes; especially, if the change involves an improved maintenance or construction practice, validating enhancements to pavement performance and/or life; and changes in material properties or sampling and testing. Pilot programs and pilot projects require prior approval from PST before they are initiated.

**2) What are the biggest impediments to the use of new infrastructure-related materials and technologies? How can the Federal government, academia, and industry contribute to overcoming these barriers? What role do technology demonstration projects play, and has California undertaken any specific demonstration projects? How are the results of these demonstrations disseminated?**

Based on our extensive experience with transportation innovation, here are some of the primary impediments to the use of new infrastructure-related materials and technologies:

- Insufficient resources for implementation,
- Resistance to change at multiple levels within the implementing agency,
- Restrictive legal requirements, such as ownership and use of intellectual property, and indemnification,
- Difficulty in operating and maintaining cutting-edge technologies (lack of workforce with the necessary job skills),
- Procurement challenges due to non-competitive bid (sole source) situations with technologies that are only available from one source,
- Lack of executive-level sponsorship within the implementing agency,
- Challenges with getting Federal approval to use new materials and technologies when they have not been educated on them (“Public Interest Finding” process),
- Lack of performance requirements and guidelines for implementing the new idea,
- Risk-averse cultures within the implementing agency, and
- Lack of clear performance measures that determine success.

Here are some of the ways to overcome these barriers to the use of new infrastructure-related materials and technologies:

- Develop products that meet the user’s needs,
- Strengthen management commitment to using the product,
- Provide funding to enable state DOTs to meet with cutting-edge technology leaders to share experiences and to learn from them,
- Develop products with user participation,
- Provide sufficient resources to fund complete development of the product, and
- Use pilot projects to demonstrate the benefits of the product.

The Federal government can help by providing national leadership, serving as a repository for information on best practices, and providing the higher level of resources that are needed for taking a product from research to deployment. Academia is our primary partner for performing research on new infrastructure-related materials and technologies. We then work with the private sector to commercialize these products so they Caltrans and others can use them.

Technology demonstration projects play a key role in addressing the impediments to the use of new infrastructure-related materials and technologies. For example, they enable an implementing agency to deploy a new product on a limited scale to measure and evaluate its benefits. If the results of the evaluation are promising, it becomes much easier for the agency to overcome institutional resistance to change, to gain executive-level support, and to address a

risk-averse culture. Another key aspect in the success of a technology demonstration project is to include the end-user of the product in its development and execution. When users play an active role in the project, they can become a champion for it among their peers, making it easier to overcome resistance to change.

As a leader in the field of transportation innovation, Caltrans has participated in many technology demonstration projects. Here are a few of the notable examples:

- **Vehicle-Infrastructure Integration (VII)** – Caltrans is working with ten other state DOTs, members of the auto industry, and the U. S. DOT in a cooperative effort whose outcome will be a new approach to transportation, whereby auto manufacturers and transportation agencies would build systems that communicate wirelessly with one another to:
  1. Enable the implementation of cooperative safety features that prevent vehicle crashes,
  2. Provide unprecedented levels of reliable traveler information, and
  3. Give transportation managers full knowledge of the real-time operating conditions on the nation’s roadway network.
- **SAFE TRIP-21** – Caltrans is working with the U. S. DOT on a program closely related to VII. Instead of emphasizing communications equipment that is deeply embedded within a car, it explores the use of consumer mobile devices, such as cell phones that drivers typically carry with them when they travel, as the communications medium for collecting traffic data from cars and sending traveler information to drivers. Our project is a successful public-private partnership that includes several industry giants, such as Nokia, NAVTEQ, and Nissan.
- **Cooperative Intersection Collision Avoidance Systems** – This project is also closely related to VII. It uses the wireless communications technology developed under VII to enable an application that warns distracted or inattentive drivers before they run a red light, thereby avoiding many of the serious crashes that occur at intersections.
- **On-board Driver Monitoring System** – Caltrans is working with the Federal Motor Carrier Safety Administration on this project to develop equipment that monitors the performance of commercial truck drivers and warns them of unsafe driver behavior. It can also detect the onset of drowsiness and advise the driver to take a break.
- **Travel Times on Changeable Message Signs (CMS)** – This project provides information on current traffic conditions to drivers while they are commuting. Trip time is the most practical information that commuters can use to assess traffic and adjust their routes. The CMS displays information about downstream corridor delays, traffic incidents, and estimated travel times. Displaying accurate travel times on CMS helps commuters assess traffic, alleviates driver stress, and allows drivers to make better route decisions. Knowing the driving times to popular destinations, travelers may choose a less-congested route or a different form of transportation.
- **Integrated Corridor Management** – Caltrans is working with the FHWA and two regional transportation agencies (San Francisco and San Diego) on ways to integrate both operations and traveler information for different roads (arterials and highways) and different modes (cars, commercial trucks, buses, and commuter rail) along strategic



transportation corridors. When implemented, travelers can make more efficient decisions on mode and route choice, saving them time and money.

- **System-Wide Adaptive Ramp Metering (SWARM)** – Along Interstate 210 in the Los Angeles Region, Caltrans has implemented a ramp metering algorithm that substantially reduces the amount of traffic congestion along the corridor. Based on the success of this demonstration, the SWARM algorithm will be implemented along several other strategic corridors in the near future.
- **Caltrans Automated Warning System (CAWS)** – This technology has been deployed in the Central Valley of California to detect and automatically inform drivers of foggy and other reduced visibility conditions. It is now being expanded to other regions that are prone to foggy conditions.
- **Electronic Toll Collection (ETC)** – The California State Legislature passed a law requiring standardization of the technologies for electronic toll collection, and Caltrans and its regional partners have implemented this technology on toll bridges and toll roads throughout California. ETC enables tolls to be collected without requiring the driver to wait in line to pay a toll collector, reducing the exhaust emissions created by idling vehicles.
- **Traffic Signal Synchronization** – Caltrans is working with the City of Los Angeles' Department of Transportation to coordinate and synchronize traffic signals on city streets with those on adjacent state highway routes. This effort will result in a substantial reduction in traffic delay for users of both roadways.
- **Light Emitting Diode (LED) Traffic Signals** – Caltrans was one of the first public agencies to adopt LED technology for traffic signal lights, instead of the traditional incandescent light fixtures. This change results in a considerable reduction in electric power usage, in addition to the longer life of LED technology and their ability to operate with battery-backup during power outages.
- **Bus Forward Collision Warning Systems** – Caltrans worked with the San Mateo Transit District to develop and implement a system to warn bus drivers of possible dangers ahead in time for them to avoid a crash. This technology is now available to all transit operators as an option when they purchase a new transit bus.
- **Bus Rapid Transit** – This project developed methods for operating buses on priority right-of-way to make bus transit perform like rubber-tired light-rail systems, but with the flexibility to operate on existing roadways. Some of the technologies used include bus precision docking, automated lane-guidance, and adaptive transit signal priority.
- **Efficient Deployment of Advanced Public Transportation Systems (EDAPTS)** – Caltrans worked with a small rural transit district in San Luis Obispo to develop technologies that reduce life-cycle costs, promote easy system expansion, and contain adjustable levels of complexity and function. EDAPTS uses a modular approach characterized by common connections, standard communications interfaces, and off-the-shelf hardware coupled with open-source software. EDAPTS will be shared with other similar transit agencies to improve their operations.
- **Shakecast** – After an earthquake, this software decision support tool uses Google Earth maps and data available from multiple sources to estimate and prioritize the likelihood of damage to transportation infrastructure in the vicinity of the earthquake. The tool enables Caltrans to send its inspection crews to check out the structures most likely to have been damaged first, so that they can be re-opened as quickly as possible

- **National Automated Highway Systems Consortium** – Caltrans was a core member of this consortium that was tasked with developing and demonstrating automated highways, where cars would travel under the control (steering, throttle, and brakes) of computers embedded in the car, instead of being operated by a driver. The objective of the project was to improve safety, since human drivers cause a large percentage of vehicle crashes, and to increase mobility, since more vehicles can be safely packed onto the existing roadway if humans are not driving them. Despite a successful demonstration in San Diego in 1997, the USDOT terminated funding for the project due to changing priorities.

There are many ways to disseminate the results from a technology demonstration project. At a minimum, the sponsors of these projects require that a final report is prepared, delivered, and circulated to other states. In many cases, however, Caltrans does much more to spread the word on successful projects. All of our research reports are available on our web site, which also includes contact information for key staff that have additional knowledge about the project. They are also accessible in the TRB Transportation Research Information System. We have also conducted video teleconferences on select projects using the FHWA's facilities to reach out to our colleagues in other states. We are currently experimenting with Webinars as an additional mechanism for sharing the results of our work. Caltrans has used their videoconference facilities to host the "research connection" where researchers provide their research findings directly to Caltrans practitioners. UCTC and PATH conduct an annual conference to share research results with Caltrans and local government agencies. Finally, much of our research is conducted in partnership with university research centers, and we encourage the academic researchers to write and publish papers documenting their work for industry-related events, such as TRB's Annual Meeting.

**3) What are your priorities for research and development of new technologies? Is the research community doing an adequate job of responding to the short and long-term needs identified by the user community?**

Caltrans ties its research to the Department’s Strategic Goals through the Strategic Research Plan. The Strategic Goals are:

- **Safety** - Provide the safest transportation system in the nation for users and workers.
- **Mobility** - Maximize transportation system performance and accessibility.
- **Delivery** - Efficiently deliver quality transportation projects and services.
- **Stewardship** - Preserve and enhance California’s resources and assets.
- **Service** - Promote quality service through an excellent workforce.

The research priorities are also tied to the Strategic Growth Plan (SGP) unveiled by Governor Schwarzenegger in January 2006. Central to this plan was a proposed 10-year investment of \$222 billion into the state’s infrastructure including \$107 billion in transportation investment. Caltrans developed a “Strategic Growth Plan Pyramid” as a dynamic illustration of the transportation elements of the State SGP:



As part of the Strategic Research Plan, a list of strategic research questions was developed to guide prioritization and selection of transportation research projects and ensure that all research projects supported by Caltrans are in alignment with Caltrans’ Mission, Goals, and Objectives.

- 1. Data** - How can we improve/enhance data collection and interpretation across modes?
- 2. Travel Demand Management (Real-Time)** - What are the most effective real-time strategies to influence travel demand?
- 3. Travel Demand Management (System Elements)** – What transportation system elements and land use options are most effective in reducing travel demand by enhancing choices?

- 4. Integrated Corridor Management** - How can we optimize movement through a corridor?
- 5. Goods Movement** - How can we improve goods movement throughout the State to generate jobs, increase mobility and relieve traffic congestion, improve air quality and protect public health, enhance public and port safety and improve California's quality of life?
- 6. Design/Construction** - What design features and construction standards can be utilized to improve highway safety?
- 7. Proactive Safety** - What can Caltrans do to mitigate collisions?
- 8. Climate Change** - How can Strategic Growth Planning be advanced through addressing climate change adaptations and mitigations?
- 9. Transportation Infrastructure** (e.g. Pavement, Structures, Maintenance Stations, Office Buildings, and others not listed) - How can we optimize the performance of our transportation infrastructure?

Research roadmaps were developed to identify all research projects and activities needed over time and their expected research outcomes. Research roadmaps facilitate programming research activities and provide guidance to partnering with other organizations with common research needs.

A Research and Deployment Steering Committee (RDSC) comprised of Deputy Directors and District Directors sets the Department-wide research priorities. The RDSC approves all research proposals and projects included in the program. Research projects are selected and programmed annually, using an integrated RFP (Request For Proposals) process. A short turn-around (quarterly) process responds to projects that require approval outside the annual cycle.

Caltrans research project selection process emphasizes customer participation throughout the research process and customer ownership of the research products. In addition to the RDSC, research committees were established in various levels to get the customers involved in the research selection, management, and deployment process.

Caltrans has established excellent working partnerships with the research community. In keeping with its Strategic Plan, Caltrans works with its research partners to create deployable research products. This applied-research approach results in a safer, more efficient and better-built transportation system that serves the short and long-term needs of the traveling public. Four ways that Caltrans partners with the research community are:

- The Research and Technology Advisory Panel Executive Committee,
- University-Contracted Research,
- The University Transportation Centers (UTCs), and
- Educational opportunities.

The Research and Technology Advisory Panel Executive Committee (RTAP) is an external academic advisory committee created by Caltrans, in cooperation with leadership at the California Business, Transportation and Housing Agency. This committee is comprised of influential members of the academic research community and key state decision-makers. The RTAP advises Caltrans on critical long-term transportation research needs and helps to identify

and evaluate critical long-term trends and research needs the department might otherwise overlook.

Caltrans contracts with universities for the bulk of its research. Much of this research is conducted through partnerships with university-based research institutes. These institutes include the following:

- Advanced Highway Maintenance and Construction Technology (AHMCT) – This partnership with University of California, Davis, develops work zone concept vehicles and equipment for Caltrans. So far, 16 concept vehicles and 18 pieces of equipment or software have been developed.
- California Partners for Advanced Transit and Highways (PATH) – This partnership with University of California, Berkeley, emphasizes research in new technologies that offer potentially large improvements in traffic operations, transportation safety, transportation policy, and transit operations.
- California Center for Innovative Transportation (CCIT) – As part of the Institute of Transportation Studies at UC Berkeley, this organization’s goal is to “accelerate the implementation of research results and the deployment of technical solutions by practitioners to enable a safer, cleaner and more efficient surface transportation system.”
- Partnered Pavement Research Center – The key objectives of this research group are to optimize pavement performance, lower life-cycle cost, increase service life, and increase highway safety through smoother pavement and more efficient maintenance and construction.
- Western Transportation Institute (WTI) – Established by the Montana and California Departments of Transportation in cooperation with Montana State University-Bozeman, this UTC focuses on “real transportation challenges facing rural America.”

Caltrans maintains a close relationship with California's federally funded University Transportation Centers, as well as those from other states. The five California UTCs are:

- The University of California Transportation Center at UC Berkeley,
- The Mineta Transportation Institute (MTI) at California State University, San Jose,
- The METRANS University Transportation Center at the University of Southern California,
- The Sustainable Transportation Center at the University of California, Davis, and
- The Leonard University Transportation Center at California State University, San Bernardino.

Again, this partnership ensures that the research we support provides products that are more practical than theoretical.

Last but not least, Caltrans supports educational opportunities for graduate students to develop advanced skills that focus on the most significant "real-world" transportation issues and problems. By partnering with the UTCs and other university researcher programs, Caltrans recognizes the long-term benefits of supporting high quality education and graduate training for transportation professionals and future transportation researchers. Garrett Morgan competition is held annually through MTI to encourage young middle school students to pursue science and engineering degrees.

In all of the above examples, Caltrans strives to nurture a dynamic on-going relationship with the transportation research community to be a catalyst for applied transportation solutions. This helps to ensure that its strategic research program is continually responsive to the changing transportation demands of California citizens and of the nation.

Since much of our research has common interest across the country, Caltrans is very active in research and the national level. We conduct partnered research with other states and the FHWA through the FHWA Pooled Fund Program. We have a long history of partnered research with the FHWA and FTA through the ITS Program and the Turner-Fairbank Highway Research Center. Caltrans pays special attention to research conducted the TRB, especially its cooperative research programs and the Strategic Highway Research Program (SHRP 2).

Research and development of innovative methods and technologies can contribute significantly to the sustainability of highway transportation. The second Strategic Highway Research Program, authorized by Congress in SAFETEA-LU, is addressing the sustainability of the highway transportation system from several perspectives. The “Capacity” portion of SHRP 2 is developing a new approach to transportation planning and development of highway projects. This approach, called the Collaborative Decision Making Framework (CDMF), will more effectively integrate engineering, economic, social, and environmental considerations into highway planning and development. The research focuses both on the institutional and process aspects and on developing more robust economic inputs and scientific data regarding environmental impacts. Earlier stages of the CDMF focus on assessing the suitability of different strategies (including different transportation modes) for addressing local needs. Later stages focus on improving the environmental, social, and economic impacts of new highway capacity. Specific projects focus on green house gases, ecology, conservation, smart growth, economic impacts, and highway operations.

The “Renewal” portion of SHRP 2 is focused on renewing aging infrastructure more rapidly, with less disruption to users, and producing longer-lived facilities that will require less maintenance and cause less user disruption in the future. This research is addressing an array of tactics for speeding up delivery of highway renewal projects: performing more work off site and bringing completed portions of the facilities (modular bridges or pavements) to the site for quick installation; rapid techniques for work that must be completed on site; non-destructive testing and evaluation technologies; and improved communication and collaboration methods to reduce the delays that arise when railroads and utilities cross or abut highway rights-of-way. Specific research projects address the use of recycled materials in rapid highway renewal, development of performance specifications to promote use of these and other materials, and techniques for encouraging innovation through better allocation and mitigation of risks.

The “Reliability” portion of SHRP 2 addresses congestion caused by non-recurring events such as crashes, work zones, inclement weather, and special events. Approximately half of highway delay is due to non-recurring events; this delay leads to significant waste of fuel and contributes to poor air quality. SHRP 2 research addresses data needs and performance measures for improved travel time reliability; institutional structures and training for improving highway operations related to reliability and incident management; innovative approaches for the future;

and integration of reliability factors into highway programming, planning, and design processes. This last set of projects will produce the scientific and technical material needed to modify planning models and design standards to reflect the impacts of better highway operations, specifically in terms in incident management and other ways of improving travel time reliability. The planning portion of the work will be carried out in concert with the SHRP 2 Capacity work described above.

SHRP 2 also has a significant focus on highway safety. SHRP 2 will study the interaction among driver behavior, vehicle and roadway characteristics, and environment to understand safety risk factors, identify crash surrogates, and provide the basis for improved safety countermeasures. This “naturalistic driving study” will involve instrumenting vehicles of 4,000 volunteers in several areas of the country. While primarily focused on safety, the data gathered in this study show promise for other applications. SHRP 2 will soon start a project to look at the feasibility of using these data to study driver behavior from an operational point of view to develop more efficient designs and operational strategies.

SHRP 2 research will be completed over the next few years and be ready for field demonstrations. The ultimate success of this research, in terms of improved environmental, social, and economic sustainability of highway transportation, will depend on widespread deployment. Funding to support SHRP 2 implementation activities in the next authorization will bring the promise of this research to fruition. Additional information on SHRP 2 can be found on the programs web page: <http://www.trb.org/shrp2/> .

In conclusion, Caltrans has the need for research to solve our transportation problems, the plans and the research projects to develop solutions, and the partnerships to leverage resources and expertise. We are active locally, nationally, and internationally as leaders in the pursuit of safer, more efficient, and “greener” transportation systems.