U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY
SUBCOMMITTEE ON TECHNOLOGY AND INNOVATION

HEARING CHARTER

Sustainable, Energy Efficient Transportation Infrastructure

Tuesday, June 24, 2008
10:00 a.m. – 12:00 p.m.
2318 Rayburn House Office Building

I. Purpose

On Tuesday, June 24, 2008, the Subcommittee on Technology and Innovation will hold a hearing to review ongoing Federal, State, academic, and industry research and development activities related to reducing lifecycle energy consumption, reducing fuel use and promoting sustainability for surface transportation infrastructure. The hearing will also address technical, regulatory, social, and financial challenges to implementing new measures and integrating new materials and technologies into existing transportation networks.

II. Witnesses

Mr. Paul Brubaker is the Administrator of the Research and Innovative Technology Administration (RITA) of the U.S. Department of Transportation.

Mr. Randell Iwasaki is the Chief Deputy Director of the California Department of Transportation (Caltrans).

Dr. Robert Bertini, P.E. is the Director of the Oregon Transportation Research and Education Consortium (OTREC).

Mr. Gerald Voigt, P.E. is the President and CEO of the American Concrete Pavement Association.

Dr. Christopher Poe, P.E. is the Assistant Agency Director and Director of the Center on Tolling Research at the Texas Transportation Institute.

III. Brief Overview

- The surface transportation sector is a major contributor to energy use and pollution, accounting for 33 percent of carbon emissions in the U.S. annually. In addition to energy use and pollution from vehicles, infrastructure construction, maintenance, and destruction have high fuel costs and require significant materials manufacturing. Transportation infrastructure also is a factor in heat, noise, and water pollution.

- Materials and technologies currently exist to combat pollution and energy waste from transportation infrastructure. Recycled or high performance pavement materials reduce manufacturing and maintenance needs and can also cut fuel use by reducing friction. Sophisticated traffic management and data collection technologies reduce congestion, which resulted in 2.9 billion gallons of wasted fuel in 2007, according to the Texas Transportation Institute.
- Many state and local governments are beginning to adopt innovative surface transportation infrastructure materials and technologies reduce energy costs and promote sustainability, but widespread implementation remains slow. Some impediments include lack of performance data, high costs, lack of trained engineers and planners, and industry reluctance to embrace new construction techniques and materials. Additionally, new materials and technologies must be integrated with existing transportation systems, requiring cooperation between researchers and planners.
- Research, development, testing, and evaluation (RDT&E) carried out by Federal and State agencies, academia, and industry is helping advance knowledge in the field of innovative surface transportation materials and technologies, but additional technology transfer and education efforts are needed to engage policymakers and the public. Strong partnerships between the research and user communities are vital to ensure that R&D efforts are tied to user needs and that demonstration projects prove the effectiveness of various technologies and materials.

IV. Issues and Concerns

What research and development efforts are needed to address current challenges in the surface transportation sector? How should the research community determine R&D priorities? What data collection needs currently exist, and how do researchers measure whether new materials and technologies have the desired impact of reducing energy use and promoting sustainability? Researchers have established a strong link between surface transportation infrastructure and a host of negative environmental impacts, including wasted fuel, urban heat island effects, carbon emissions, noise pollution, and demand on virgin materials for pavement. The R&D community addressing these challenges is diverse, ranging from Federal agencies such the U.S. Department of Transportation's Federal Highway Administration (FHWA) and Research and Innovative Technology Administration (RITA) and the Environmental Protection Agency, universities, and industry. While entities such as the Transportation Research Board exist to help bridge gaps between the research and user communities, the R&D community further benefits from formal and informal connections to their immediate communities in order to understand users' research priorities. Additionally, data collection helps frame the environmental, economic, and safety challenges and influences research priorities by identifying the areas of greatest need.

What are the roles of the Federal government, State agencies, academia, and industry in technology transfer? How should these entities help policymakers find a balance between environmental impact and safety, cost, and efficiency? Because transportation infrastructure needs vary by region, technology transfer is most effective when it involves partnerships between local experts and policymakers. Many universities involved in transportation research convene formal and informal meetings to discuss how available technologies might be integrated into transportation networks. The Federal government also engages in technology transfer activities through partnerships, training, and demonstration projects. FHWA offers courses through the National Highway Institute, some of which cover innovative technologies. FHWA and the EPA also participate in the Green Highways Partnership, which coordinates outreach and education efforts and demonstration projects to promote use of environmentally friendly materials and technologies. However, acceptance and use of new transportation technologies remains slow. Decisions on the use of innovative technologies are made by State or local transportation officials who may or may not have access to data on their efficacy and cost.

What standards development activities are needed in both materials and intelligent transportation systems? What is the impact of the lack of standards? Stakeholders have engaged in some standards development activities for pavement materials and intelligent transportation systems, but the community has identified a need for further efforts. In the materials field, the expanded use of recycled materials and industrial byproducts in pavement to cut landfill waste requires characterization of products (such as fly ash, slag, or even construction waste like drywall) that may not be uniform in size, shape, or composition. The National Institute of Standards and Technology (NIST) has done some work in characterization and hosts a virtual lab to allow researchers to test their mixture of recycled materials via computer simulation To meet users' performance requirements, manufacturers need standards that specify the percentage of each type of recycled material that can be safely incorporated into cement. For data collection and traffic management systems, end users have identified a need for technical standards that allow interoperability of systems across jurisdictions to ensure that the benefits of these technologies are seen region-wide.

V. Background

Environmental Challenges in Surface Transportation

The surface transportation sector is a major contributor to energy use and pollution. Vehicle use, construction, maintenance, and destruction all result in significant energy costs, and the production of pavement materials uses valuable natural resources. Transportation infrastructure can also contribute to noise and heat pollution, increasing its environmental impact. Currently, the U.S. Department of Energy estimates that the transportation sector accounts for 33 percent of carbon emissions in the United States annually.

The United States consumes approximately 128 million tons of cement annually, with a significant share being used for transportation infrastructure. Though the industry has effectively cut energy use and carbon emissions over the last few decades, the scope of cement manufacturing means that the environmental impact remains noteworthy, accounting for 1.5 percent of carbon emissions. According to a report by the American Concrete Pavement Association, this translates to 52,800 tons of carbon dioxide emitted for the construction of a typical 100 kilometer highway. In addition, the construction of infrastructure also carries considerable fuel costs, ranging from nearly 2000 to over 10,000 gallons of fuel per lane-mile, depending on the material used for pavement.

Vehicle use also results in fuel use and emissions, especially in congested areas. The Texas Transportation Institute estimated that traffic congestion in the United States in 2.9 billion gallons of wasted fuel in 2007. In a study of 85 urban areas with serious congestion problems, TTI also found that travel delays that result in idling, and thus fuel waste and extra emissions, have grown since 1982.

Research and development activities

Research and development activities to combat the negative environmental impacts of surface transportation have been ongoing in the U.S. for several decades, with contributions from Federal agencies, academia (especially U.S. DOT-funded University Transportation Centers), and industry. State transportation agencies also participate in data collection activities to help frame challenges and determine the efficacy of various measures. Current research covers traffic management and data collection activities through the use of intelligent transportation systems, materials characterization, design, and manufacturing research, and urban planning and transportation system design studies.

Specific research activities addressing energy efficiency and sustainability range from intelligent transportation system (ITS) design and data collection technologies to paving materials design. ITS technologies help reduce fuel consumption and emissions by managing traffic flow to cut congestion and keep vehicles moving smoothly. Specific projects include traffic signal timing, highway onramp management, truck scales embedded in travel lanes, and other traffic management tools. Additionally, ITS technology can be used for data collection to identify problem areas or determine the effectiveness of traffic management technologies. Many of these technologies also have further safety benefits in addition to ensuring smoother traffic flow by helping avoid collisions.

Materials research focuses on promoting sustainability and reducing energy use in the manufacturing process by incorporating recycled materials into paving materials or by designing high performance paving materials that reduce friction and require less maintenance. Industrial byproducts such as fly ash from coal power plants promote sustainability and energy savings by reducing the need for producing new materials while also cutting landfill waste. Academic and industry researchers are working to determine the types of materials that can be safely incorporated into cement, such fiberglass or drywall. They are also studying the maximum percentage of the mix that these byproducts can comprise.

Extending the lifecycle of pavement is another important goal for researchers working to improve energy efficiency in the transportation structure. Doing so reduces maintenance and construction needs, thus cutting energy costs. Researchers address this challenge through multiple approaches, including developing pervious pavements to reduce erosion or designing stronger pavements that are less vulnerable to cracking and potholes. Some of the smoother high performance pavements also help cut fuel use by reducing friction, especially for large vehicles. A study by the National Research Council of Canada found that fuel consumption by fully loaded trucks can be reduced by one to six percent when traveling on smooth pavement.

Finally, some materials research efforts also address heat pollution. Dark pavement absorbs heat from the sun and has been found to raise ambient temperatures in urban areas by 9°F and increase demand for energy for air conditioning. Lighter colored pavements reflect sunlight, thus reducing the urban heat island effect.

Technology transfer and implementation issues

Technology transfer in transportation infrastructure typically faces particular challenges related to regulations, cost, education and training, and industry reluctance to embrace new construction techniques. The Federal government, academia, and industry all play a role in demonstrating the effectiveness of new technologies, training engineers on their use, and helping meet regulatory requirements.

A lack of standards is a key impediment to the implementation of pavements using recycled materials and intelligent transportation systems. For pavements, state and local regulatory performance requirements related to the mix of materials comprising cement mean that byproducts must be characterized to understand their effect on the strength and performance of the pavement. Because there are not standards for the size, composition, or other characteristics of byproducts such as fly ash, manufacturers and researchers have a difficult time proving the performance of their materials from batch to batch. Technical standards for intelligent transportation systems (ITS) are also a key requirement prior to implementation. Especially in dense areas, such as the DC area, where multiple local governments oversee a broad transportation system, ITS technology must be interoperable to ensure that the benefits are seen region wide.

The cost of technologies and materials also prevents their manufacture and use. Concrete manufacturers must locate and ship byproducts to be incorporated into their mixes, increasing initial capital costs. Additionally, engineers and architects require further training for new materials, resulting in additional expenditures. Similarly, end users may pay more initially for innovative materials and technologies for managing traffic. Researchers and the Federal government can help promote technology transfer in the face of cost concerns by providing further information on costs over the lifecycle of the infrastructure, rather than initial costs. Lifecycle costs are typically reduced through the use of innovative materials and technology.

Demonstration projects play an invaluable role in encouraging implementation of new materials and technologies. The Federal government funds some local demonstrations of new technologies, which prove to engineers and policymakers that new technologies can be effective in spite of training needs and high initial costs. Specifically, the U.S. Environmental Protection Agency (EPA) and Federal Highway Administration (FHWA) partner with State governments and industry on the Green Highway Partnership to demonstrate environmentally-friendly highway construction methods. University Transportation Centers also work with local agencies to demonstrate technologies suited to their region’s specific needs.