Energy and Mobility

Summary of a plenary session at the 2014 Global Symposium on Connected Vehicles and Infrastructure
University of Michigan, Ann Arbor

In the United States and globally, transportation systems face numerous challenges, and improving safety as well as addressing key energy-related concerns such as petroleum demand and CO₂ emissions are among the most urgent. At the same time, progress in advanced information technologies and capabilities for handling voluminous data are enabling greater connectivity of vehicles and infrastructure in ways that will lead to a progressive automation of vehicle functions. The use of real-time data can enhance both safety and energy efficiency while creating new forms of customer value. The imminent emergence of connected and automated mobility systems promises the most exciting breakthrough in surface transportation since the invention of the automobile. These developments will trigger disruptive change that radically transforms the sector, altering our traditional views of mobility as well as dramatically improving safety and profoundly affecting transportation energy use.

A high-level discussion of these new opportunities for energy and mobility was featured in a special plenary session during the 2014 Global Symposium on Connected Vehicles and Infrastructure hosted by the University of Michigan Transportation Research Institute in Ann Arbor. Held on April 23 and moderated by research professor John DeCicco of the University of Michigan Energy Institute, the Energy and Mobility panel included Reuben Sarkar, Deputy Assistant Secretary for Sustainable Transportation at the U.S. Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy (EERE); Jean Redfield, President and CEO of Michigan's NextEnergy technology incubator; Chris Gearhart, Director of the Transportation and Hydrogen Systems Center at the National Renewable Energy Laboratory (NREL); and Marcia Pincus, Manager in the Intelligent Transportation Systems (ITS) Joint Program Office at the U.S. Department of Transportation (DOT). The ensuing discussion highlighted research, already underway and needed in the years ahead, addressing transportation energy issues in light of progress in connected and automated mobility systems.

Reuben Sarkar of DOE led off the panel by underscoring that 36 percent of all U.S. energy use is supplied by petroleum and 70 percent of U.S. petroleum demand occurs in the transportation sector. The work of his office is guided by targets of reducing greenhouse gas emissions by 17 percent and reducing net oil imports by 50 percent by 2020. Sustainable transportation work is a major priority for DOE, and the associated research, development, demonstration and deployment efforts span three technology offices -- addressing vehicles, bioenergy, and hydrogen and fuel cells -- within the Office of Energy Efficiency and Renewable Energy (EERE). Sustainable transportation accounts for $705 million of EERE's overall $2.3 billion budget request for fiscal year 2015.
DOE is in the initial stages of involvement in terms of connected vehicles and infrastructure, noted Sarkar, who said that "a current focus is on conducting foundational studies to examine the synergistic gains" for safety and energy. Areas of synergy are highlighted in the adjoining image, and analytic work is needed on assessments of the likely impacts on fuel efficiency, comparative studies of safety and efficiency-related algorithms, and the potential for vehicle lightweighting and improved aerodynamics as a result of increasing automation and collision avoidance.

Sarkar also pointed out how DOE's longstanding work on sustainable transportation offers lessons likely to be useful for speeding the adoption of automated mobility systems (see image at right). He also noted that the economic and business opportunities are diverse and significant. To determine fruitful areas of research collaboration, key steps will be discussions between DOE and DOT (including its safety and research administrations) as well as engagement with UMTRI, other universities, ITS America and other non-profits, and collectively identifying the best layers of connected and automated transportation technology RD&D in which to participate.

To drive innovative solutions forward, public-private partnerships are critical, noted Jean Redfield of NextEnergy, a nonprofit that promotes energy-related investments and job creation in Michigan. Given the many considerations involved in energy and transportation, “It’s important to understand market trends ... what’s upstream,” Redfield said. “The issue of investment strategies is extremely critical.” NextEnergy hosts testing and demonstration platforms for a range of new technologies, including electric vehicle charging and other alternative fuel infrastructure as well as one of the first microgrid research pavilions in the nation. Redfield views advanced mobility as a "system of systems" for efficiently moving people, goods, information and energy, and said that NextEnergy can foster multi-industry collaborations and public-private partnerships for moving innovations forward.

Chris Gearhart, director of the Transportation and Hydrogen Systems Center at the National Renewable
Energy Laboratory (NREL), said that his office is wholly dedicated to renewable energy and energy efficiency. NREL has been a leader in U.S. clean energy R&D for 35 years and their work includes a strong emphasis on accelerating the entry of new technologies into the marketplace. Gearhart sees the emergence of intelligent and automated vehicles as offering significant new energy and economic opportunities for the United States.

Such systems will be a boon to the national priorities of increasing energy efficiency, reducing petroleum dependence, expanding manufacturing capabilities and creating high-tech jobs. Gearhart pointed out how a number of energy savings opportunities will be enabled through levels of connectivity and automation likely to be feasible in near mid-term timeframes, with impacts as shown in the adjoining image (based on preliminary analysis by NREL). Although many of the features that will be enabled are projected to have positive energy outcomes, i.e., result in energy savings, automation may also result in additional travel and therefore increase energy use. New analysis is needed to understand the range of energy-related outcomes and identify ways to maximize the positive energy outcomes as technologies for connecting and automating transportation systems are deployed.

Gearhart characterized developments in intelligent and automated transportation systems as “an emerging trend that’s already here.” He highlighted benefits resulting from deployment of connected and automated vehicles in terms of today (safety), near term (fuel economy) and long term (system-wide benefits). The most significant energy savings and opportunities are enabled by near mid-term levels of automation and connectivity, he said. A number of current NREL activities can inform connected vehicles and infrastructure, including vehicle platooning, driving analysis and behavior, systems aspects (e.g., buildings and grids), and green routing and adaptive control. NREL also focuses on big data and analysis and is a leader in collection, validation, and dissemination of real-world energy-related transportation data.

Marcia Pincus, program manager for the ITS Joint Program Office, U.S. Department of Transportation (DOT), highlighted benefits related to vehicle connectivity in three main areas: safety (e.g., V2V and V2I), mobility (e.g. real-time data capture) and the environment (see adjoining slide). The key initiative for research and development of environmental applications is known as DOT’s AERIS program, which stands for “Applications for the Environment: Real-Time Information Synthesis.” In describing the AERIS objectives, Pincus said that she and her colleagues began by asking, “If we were to reimagine transportation, what could we do?” The resulting program objectives are to create operational scenarios, to incentivize green choices, and to conduct supportive modeling and analysis.
The Joint Program Office came up with five operational scenarios: eco-signal operations, eco-lanes, low-emission zones, eco-traveler information and eco-integrated corridor management. The idea, Pincus said, was to create a complete decision-support system with integrated information from a variety of sources that allows motorists to make green choices that help reduce the overall environmental impact of transportation. AERIS has examined the potential benefits of these operational scenarios through demonstrations and testing at several locations around the country as well as simulation analyses.

Eco-signal operations, for example, use connected vehicle technologies to reduce fuel consumption and emissions by reducing the number of stops and time spent idling, avoiding unnecessary acceleration and deceleration and generally improving traffic flow through intersections. Eco-lanes are dedicated freeway lanes optimized for the environment, including optimal speed control, adaptive cruise control, platooning and other operational enhancements. Low-emission zones seek to incentivize green transportation choices, which may include restriction of high-emitting vehicles from the zone, and otherwise using V2I connectivity to enable a defined area of a city to manage traffic in order to minimize pollution and respond to environmental conditions. Eco-traveler information involves developing apps for informing travelers about routing and parking choices, multimodal opportunities or information about locating alternative fuel or charging infrastructure. Finally, eco-integrated corridor management enables using real-time data and decision support systems to enable the operators of various parts of a surface transportation system to treat travel corridors as an integrated asset that is optimized to reduce fuel consumption and air pollution while maximizing safety and other operational needs.

Collectively, the presentations at the April 2014 Energy and Mobility session identified a large range of benefits that connected and automated mobility systems can have for addressing transportation’s energy and environmental challenges, and the panel discussion highlighted the opportunity for a coordinated approach across government agencies along with research institutions and industry partners to develop, test and deploy these emerging technologies in ways that offer multiple public benefits.

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Source: Marcia Pincus, DOT