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Intelligent Transportation Systems for Improving Traffic Energy Efficiency and Reducing GHG from Roadways

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Intelligent Transportation Systems Show Promise in Reducing Energy Consumption and GHG Emissions

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POLICY BRIEF

Issue

Intelligent Transportation Systems (ITS) have generated considerable enthusiasm in the transportation community due to their potential for improving roadway safety, reducing traffic congestion, and enhancing the mobility of people and goods. In addition to these benefits, ITS can play a major role in reducing criteria pollutant and greenhouse gas (GHG) emissions, as well as energy consumption. Research has shown that individual environmental-ITS applications typically provide energy and GHG emissions reductions on the order of 5% to 15%. Further, there is the potential for even greater reductions if multiple environmental-ITS programs are combined in one place.

Key Research Findings

ITS programs consist of a wide variety of technologies and applications. In general, ITS can be categorized into three areas: *vehicle systems, traffic management systems, and travel information systems.*

Vehicle systems represent vehicle features and functions that allow a vehicle to "see", respond, and communicate with its surroundings. Sensors such as on-board radar and computer vision technologies that enable a vehicle to monitor the distance to the vehicle in front, detect when a vehicle is leaving a lane, and support adaptive cruise control systems that allow a driver to select a desired speed and set a following distance. In addition, dedicated short-range communication radios will likely be deployed to enable vehicle-to-vehicle, vehicle-to-infrastructure, and infrastructure-to-vehicle applications that are primarily focused on improving safety. However, mobility and environmental applications will also likely emerge. These applications take advantage of connected vehicle technology such as cooperative adaptive cruise control where vehicles communicate with each other to cooperatively manage following distance, braking, accelerating, and more.

Traffic management systems have become more sophisticated with the advent of better sensor technology, more reliable communication channels, and advanced information processing. Transportation managers are better equipped to estimate traffic conditions, detect and remove traffic incidents, and craft better travel demand management strategies (i.e., managing the amount of vehicles on a congested roadway). The overarching goal of traffic management is to take full advantage of the existing roadway capacity, thus keeping traffic flowing smoothly at moderate speeds. As such, this will have a large impact in reducing energy consumption and GHG emissions from each vehicle. In addition, traffic management system strategies go even further by reducing the number of vehicles and vehicle-miles travelled (VMT) in the transportation network without compromising overall travel needs, thereby reducing the total contributions of energy consumption and emissions from the transportation sector.

Travel information systems provide information to drivers, such as route guidance systems, geo-location systems, and electronic payment systems. All of these systems add convenience to the traveler while reducing energy consumption and emissions. For example, a route guidance system will cutback on

unnecessary travel that may occur when a driver gets lost or chooses a long, out-of-the-way path. En-route driver information can reduce energy and emissions associated with driving around, searching for a specific location. Electronic payment systems also eliminate the need for a driver to decelerate the vehicle, idle while a manual transaction takes place, and then accelerate the vehicle back to a desired speed. If this payment can occur without slowing down, energy consumption and emissions are greatly reduced.

Conclusion

Environmental-ITS programs have only emerged recently, compared to safety and mobility programs. Pioneering research programs in the United States, the European Union, and other regions have made significant progress in developing and testing ITS applications and technologies with a focus on environmental benefits. From these research programs, it is clear that specific environmental benefits can be maximized when different ITS applications are "tuned" so that emissions and energy consumption are reduced – on the order of 5% to 15%. It is important to point out that there is not a single ITS technology solution that has demonstrated a large reduction in energy consumption and

emissions. But since most of these applications are additive, greater benefits may be achieved when a combination of environmentally-friendly ITS programs is put into place.

Further research is needed to improve our understanding of the connection between environment, mobility, and safety performance of any ITS programs. Research is also needed to quantify the potential induced-demand effects of ITS program deployment. For example, preliminary results from a study on how automated vehicles may affect travel demand show that a modest introduction of automated vehicles may result in a 5% increase of VMT. This information may allude to the relationship between ITS and VMT, but no conclusions can be made unless there is further research on the effects of ITS on travel demand.

Further Reading

This policy brief is drawn from the full white paper "Intelligent Transportation Systems for Improving Traffic Energy Efficiency and Reducing GHG Emissions from Roadways" by Matthew Barth, Guoyuan Wu, and Kanok Boriboonsomsin at University of California, Riverside. The full white paper can be downloaded at: ncst.ucdavis.edu/white-paper/ucr-dot-wp1-1.