U.S. Department of Transportation
Federal Transit Administration

# FTA National Research Programs

## Federal Transit Administration

*"Delivering Solutions that Improve Public Transportation"*


ANNUAL RESEARCH REPORT 2007

## NOTICE

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# Introduction

Introduced on September 30, 2005, the Federal Transit Administration's (FTA's) Strategic Research Plan set forth FTA's five new Strategic Research Goals. Placed first among these Goals, at the request of the Transportation Research Board's Transit Research Analysis Committee is for FTA to Provide Transit Research Leadership.

In support of this goal, I am pleased to present to you FTA's Annual Research Report for fiscal year (FY) 2007. Like last year's report, this report highlights many of the achievements FTA has made this past year in support of our strategic research vision to "Deliver Solutions that Improve Public Transportation." Also like last year's report, this report is organized by goal area and describes our accomplishments in the following areas:

- Provide Transit Research Leadership (Goal 1)
- Increase Transit Ridership (Goal 2)
- Improve Capital & Operating Efficiencies (Goal 3)
- Improve Safety & Emergency Preparedness (Goal 4)
- Protect the Environment & Promote Energy Independence (Goal 5).

The success of FTA's National Research Program in FY 2007 is a testament to the hard work and quality of FTA staff, the researchers, and support staff. By working closely with customers and stakeholders, FTA will continue to develop and execute a comprehensive transit research program that delivers results to the American public and provides real solutions to the transit industry.

Given the large number of projects underway at FTA, this report can highlight only some of them. I encourage you to visit the Research, Technical Assistance, & Training section of FTA's website at http://www.fta.dot.gov/research.html to learn more about our programs.

Sincerely,

Vincent Valdes
Associate Administrator for
Research, Demonstration, and Innovation

# Contents

# The Strategic Framework

Prepared by the Office of Research, Demonstration, and Innovation (TRI), the Federal Transit Administration (FTA) National Research Program Annual Research Report serves as a report card for our strategic research program. This year's report highlights FTA's research accomplishments for fiscal year (FY) 2007, outlines future research needs and plans, and provides realistic expectations for achieving FTA's research goals in the coming years.

## Federal Transit Administration Vision, Mission, and Goals

FTA's Strategic Research Plan sets the strategic framework for FTA's research priorities and serves as our "touchstone" for investing scarce public funds in relevant and useful research projects that will improve our nation's public transportation sytems.

FTA's research program directly supports the strategic goals of FTA and the U.S. Department of Transportation (DOT), and helps FTA achieve its mission of delivering solutions that improve public transportation. FTA's strategic research goals are aligned with DOT's strategic goals.

| FTA Strategic Research Goals | DOT Strategic Goals |
|---|---|
| **Provide Transit Research Leadership** | **Organizational Excellence**—Advance DOT's ability to manage for results and innovation. |
| **Increase Transit Ridership** | **Reduce Congestion**—Advance accessible, efficient, intermodal transportation for the movement of people and goods. |
| **Improve Capital and Operating Efficiencies** | **Global Connectivity**—Facilitate a more efficient domestic and global transportation system that enables economic growth and development. |
| **Improve Safety and Emergency Preparedness** | **Safety**—Enhance public health and safety by working toward the elimination of transportation-related deaths and injuries. |
| | **Security Preparedness and Response**—Balance homeland and national security transportation requirements with the mobility needs of the nation for personal travel and commerce. |
| **Protect the Environment and Promote Energy Independence** | **Environmental Stewardship**—Promote transportation solutions that enhance communities and protect the natural and built environment. |

## Multi-Year Research Program Plan

The *FTA Multi-Year Research Program Plan (FY08 – FY12)* provides descriptive summaries of existing FTA research projects for FY 2008 through FY 2012 and links these projects to the goals and objectives of FTA's Strategic Research Plan. It further identifies future transit industry research needs aligned with FTA's research goals, and it describes new research areas that FTA will consider for funding during the next five years.

# Highlights and Expectations

This annual report is prepared for transit agencies, congressional committees and staff, transit business leaders, public transportation researchers, DOT modal administrations, and FTA staff. Each year, FTA has a goal to deliver six major research projects. Many of the projects highlighted in 2007 will continue in FY 2008.

## Highlights from 2007

A major focus of efforts in FY 2007 was to ensure that FTA provides transit research leadership.

- FTA supported DOT's Congestion Relief Initiative outlined in the May 2006 *National Strategy to Reduce Congestion on America's Transportation Network*.
- FTA increased its expertise and portfolio to conduct research that supports the rail transit sector.
- FTA selected and implemented the demonstration sites of the United We Ride/Mobility Services for All Americans Program.

FTA made important strides in implementing the Safe, Accountable, Flexible, and Efficient Transportation Equity Act—A Legacy for Users (SAFETEA-LU).

- FTA began implementing the projects selected under the National Fuel Cell Bus Program.

  In FY 2007, the Center for Transportation and the Environment in Atlanta, the Northeast Advanced Vehicle Consortium in Boston, and Westart/CALSTART of Pasadena, California, which were selected by FTA to receive a share of the National Fuel Cell Bus Program's $49 million, began implementing their selected projects.

FTA is on target to deliver, by 2010, 30 major research products, innovations, and techniques that support FTA strategic research goals. In FY 2007, FTA published the following seven major reports and guidelines:

1. *2006 Status of the Nation's Highways, Bridges, and Transit: Conditions & Performance*. Report to Congress. January 2007. Available at http://www.fta.dot.gov/publications/publications_5838.html

2. *Alternative Fuels Study: A Report to Congress on Policy Options for Increasing the Use of Alternative Fuels in Transit Vehicles*. December 2006. Available at http://www.fta.dot.gov/publications/publications_5836.html

3. *Environmental Benefits of Alternative Fuels and Advanced Technology in Transit*. July 2007. Available at http://www.fta.dot.gov/assistance/research/research_5638.html

4. *Transit Bus Life Cycle Cost and Year 2007 Emissions Estimation*. July 2, 2007. Available at http://www.fta.dot.gov/assistance/research/research_5638.html

5. *Construction Project Management Handbook*. Revision 1. April 2007. Available at http://www.fta.dot.gov/assistance/research/research_5638.html

6. *Useful Life of Transit Buses and Vans*. April 2007. Available at http://www.fta.dot.gov/assistance/research/research_5638.html

7. *Assessing the Business Case for Integrated Collision Avoidance Systems on Transit Buses*. August 2007. Available at http://www.fta.dot.gov/assistance/research/research_5638.html

## Expectations for 2008

In FY 2008, FTA will continue to examine how it can better Provide Transit Research Leadership for the transit research community. As part of this effort, FTA will produce the FY 2009 – FY 2013 Multi-Year Research Program Plan. FTA will also review its current Strategic Research Plan to ensure it fully supports DOT's new Strategic Plan, "New Ideas for a Nation on the Move," FY 2006 – FY 2011.

FTA will continue to encourage its offices to adopt more robust methods for developing research project ideas and plans that support DOT and FTA goals, and FTA will actively support and encourage new research project development that is focused on FTA's strategic research goals at the Transit Cooperative Research Program (TCRP), the National Transit Institute (NTI), and University Transportation Centers (UTCs).

In 2008:

- FTA will begin second phase research activities under the MSAA initiative.
- FTA will complete and publish an update to the "Characteristics of Bus Rapid Transit for Decision-Making" report.
- FTA will issue a report on improving bus passenger safety during accidents.
- FTA will complete a feasibility study on using machine vision (smart video) to detect obstacles on and intrusions into rail rights-of-way.
- FTA will complete a strategic plan addressing the needs of bus and rail electric drive technology research and development.

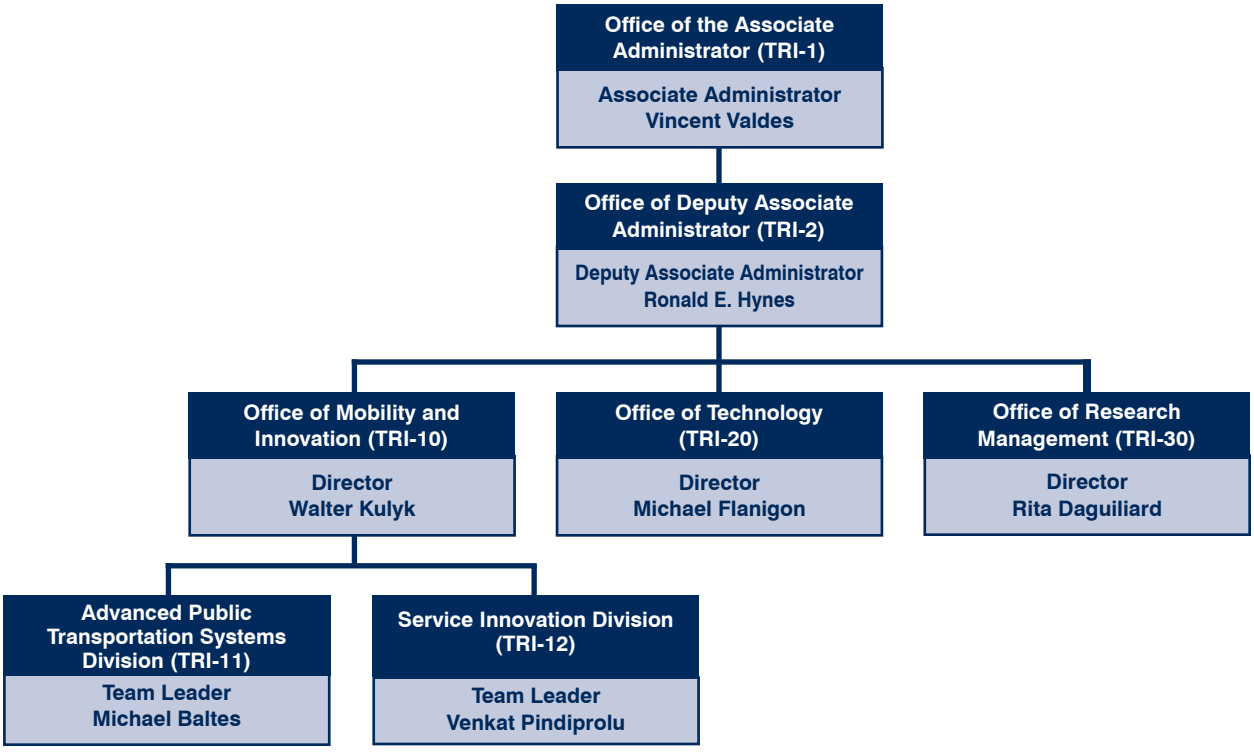
# The Office of Research, Demonstration, and Innovation (TRI)

As the office responsible for maintaining the national perspective for transit research, TRI manages and oversees FTA's transit research program and provides policy makers and industry with the information and skills to make good business decisions about transit technology and operational and capital investments. Research is also carried out by other FTA headquarters offices.

## Organization

The Research Office is organized as follows to administer and oversee FTA's research agenda and to disseminate results and information.

### FTA Office of Research, Demonstration, and Innovation



# Progress Toward Strategic Transit Research Goals

The FTA Strategic Research Plan provided five specific goals and 17 objectives for a comprehensive national transit research program aligned with industry and public needs and DOT's strategic goals. In 2007, FTA successfully completed research projects for all of these goals. Descriptions of selected research projects in-progress and completed in 2007 are provided below, indexed by FTA strategic research goal.

## Goal 1: Provide Transit Research Leadership

**Goal 1 Objectives**
- Ensure that transit research supports national goals
- Continue to improve research management
- Facilitate implementation of research results by the transit industry

Transit research is carried out by a number of entities throughout the United States, including the FTA, state departments of transportation, transit agencies, universities, and industry. FTA alone, however, has the responsibility of addressing transit research from a national perspective. FTA research programs must be balanced and must support national goals. As it undertakes research, FTA first identifies and analyzes candidate methods and technologies. These methods and technologies are then evaluated after being tested or demonstrated. FTA then ensures that research results are disseminated to industry. FTA also coordinates its research with DOT's Research and Innovative Technology Administration (RITA).

Besides leading and supporting domestic research, FTA shares international best practices with the U.S. transit industry and provides decision makers with the tools and information they need to make informed decisions.

### Highlights of FY 2007 Accomplishments

**Laying out the Transit Research Agenda.** FTA's Multi-Year Research Program Plan (FY08 – FY12) provides descriptive summaries of FTA's existing and proposed research products and links them to the goals and objectives of FTA's Strategic Research Plan.

**Reporting to Congress on Conditions and Performance.** FTA and the Federal Highway Administration (FHWA) produced the 2006 Status of the Nation's Highways, Bridges, and Transit: Conditions & Performance Report to Congress. This report, published bi-annually, is an

objective appraisal of the current and future physical conditions, operational performance, and financing mechanisms of highways, bridges, and transit systems in the United States. Projections are based on current and alternative investment scenarios.

**State and National Transit Investment Analyses.** TCRP developed a comprehensive, independent estimate of public transportation capital investment needs to inform the SAFETEA-LU Commission, the American Association of State Highway and Transportation Officials (AASHTO), other decision makers, and the transit industry about the magnitude of national needs.

# Goal 2: Increase Transit Ridership

**Goal 2 Objectives**
- Identify best practices and technologies to increase transit ridership
- Identify and overcome barriers to the adoption of ridership enhancement techniques
- Identify solutions to provide public transportation for targeted populations
- Identify cost-effective solutions to provide rural public transportation

Increasing the number of transit riders is important because transit ridership facilitates a range of societal benefits. These benefits include increasing mobility, improving safety, reducing air pollution, and improving energy efficiency. Research results for 2007 include model designs for more flexible and accessible transit services, deployment and demonstration of Intelligent Transportation System (ITS) technologies to enhance transit and paratranist management and operations, a swipe-technology fare-card rollout, and advanced parking management systems at transit park-and-ride facilities.

## Highlights of FY 2007 Accomplishments

### Mobility Services for All Americans

Funded by FTA and DOT's ITS Joint Program Office, the MSAA program promises to create more flexible and more accessible transportation services, especially for targeted populations of concern. In January 2007, eight sites in the eastern United States were awarded more than $2.7 million for the design and development of coordinated human service transportation systems that use ITS capabilities.

Phase I for each of the sites includes planning and design of scalable and replicable model Travel Management Coordination Centers (TMCCs). These TMCCs will be deployment-ready, ITS-enhanced human service transportation models designed to meet local needs. The inclusion of eight sites allows development of multiple TMCCs of various sizes and

## Mobility Services for All Americans (Cont'd)

functionalities, including urban, small urban, and rural transportation, as well as various partnership types to fulfill local needs.

The model designs are due in June 2008. Of the eight TMCC designs, FTA and the Joint Program Office will select at least two for Phase II deployment in 2008.

**Civil Rights Implications of Allocation of Funds Between Bus and Rail.** Title VI, 42 United States Code § 2000 et seq. (Title VI) prohibits discrimination on the basis of race, color, and national origin in programs and activities receiving federal financial assistance. In FY 2007, TCRP initiated a study to determine (1) the Title VI actions that exist specific to transit agencies and their legal forums, and whether they are decreasing; (2) the variability in character of the Title VI actions; (3) specific defense strategies available to transit agencies faced with Title VI actions; and (4) non-regulatory measures that transit agencies take to uphold Title VI protections.

## Bus Rapid Transit

Bus Rapid Transit (BRT) has been growing conceptually and evolving technologically for more than 15 years. As part of their ongoing promotion of BRT, in 1999 FTA provided grants to 10 transit agencies to start the National BRT Demonstration Program. Since that time, BRT has redefined itself from an express bus system with few stops to an enhanced bus system that operates on bus lanes or other transit ways to combine the flexibility of buses with the efficiency of rail. BRT systems now boast a combination of infrastructure and operational investments and advanced technologies that provides significantly better service to transit customers. They operate at faster speeds and provide greater reliability and convenience.

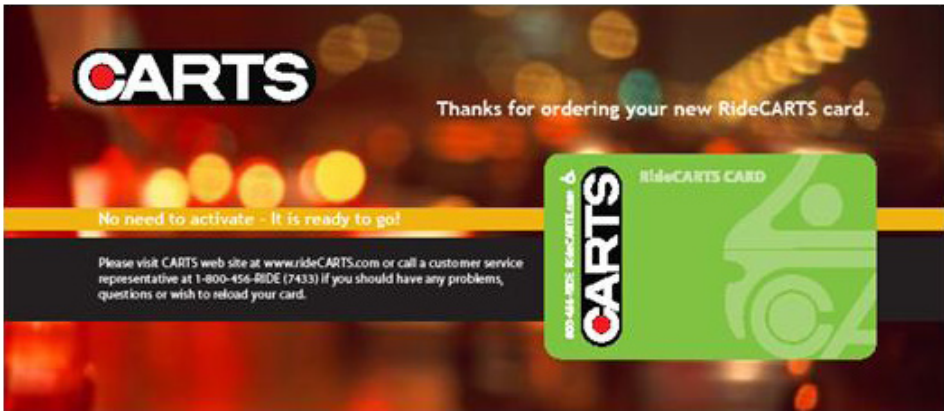
With the introduction and integration of ITS technologies and advanced/cleaner bus propulsion systems, over the past 10 years BRT systems have made dramatic improvements, to the point of offering and even surpassing the benefits of rail-like operations through innovative vehicles with improved accessibility and capacity, a wide choice of running ways, decreased travel time, improved fare collection, enhanced stations, improved environmental quality, transit-supportive land development, and improved capital and operating cost effectiveness and efficiency.

The National BRT Institute now lists 18 BRT systems in operation across the United States, and FTA reports several more in the final stages of startup. In 2008, work will continue in technology development, training, and evaluation of operations. In addition, an update of *Characteristics of Bus Rapid Transit for Decision Making* is expected.

**Upper Great Plains Training Expanded.** The Upper Great Plains Transportation Institute at North Dakota State University expanded its training this year, offering 14 training courses to public transit providers, transit managers and board members, school district transportation directors, public transit and paratransit bus drivers, tribal and human service agency representatives, and other transit stakeholders in ten states: North and South Dakota, Montana, Wyoming, Utah, Minnesota, Pennsylvania, Colorado, Nebraska, and Alaska.

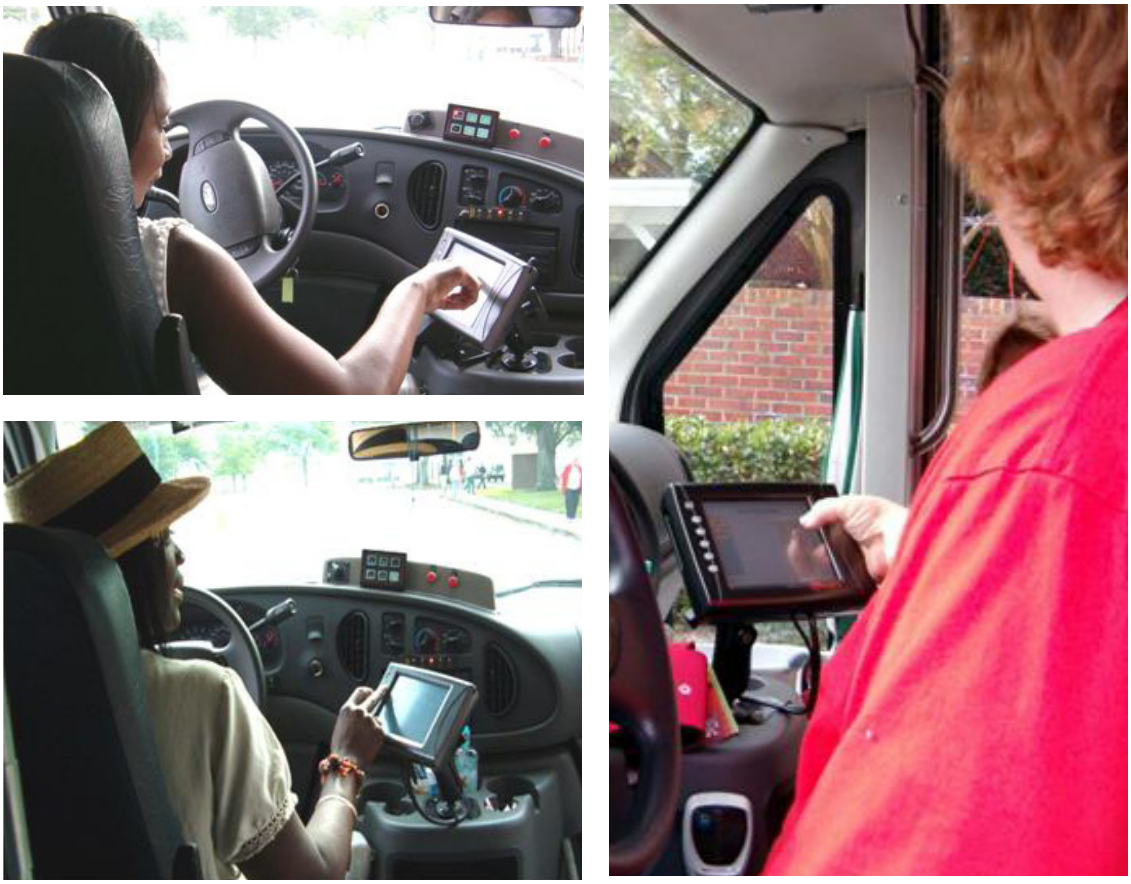
**RideCARTS Rollout in Austin, TX.** The Capital Area Rural Transportation System (CARTS) in Austin is completing pilot testing and preparing to rollout its RideCARTS card as a fare medium and data tracking tool. RideCARTS, which began in 2005, uses swipe-card technology to streamline fare and data collection and to coordinate with the human service agencies for which CARTS provides services. The fare cards, which work like gift or credit cards, are convenient and easy to use, eliminating the need for correct change and keeping track of tickets.

**Mailer Front**




**Eye-catching advertising promotes the recognition and use of new fare cards in Austin.**

**ITS Comes to Rural Florida.** To increase the efficiency of services provided to their customers, in 2006 Polk County Transit Services (PCTS) partnered with the Central Florida Regional Transportation Authority (LYNX) to implement a regionally coordinated rural transportation service, using mobile data terminals (MDTs) to communicate with transit vehicles in their rural areas. By 2007, ten of PCTS's 53 vehicles were equipped with MDTs, which allowed dispatchers to locate drivers with greater precision, enabling customer service to communicate more accurately and to effectively schedule more customers. Assessments showed that use of the MDTs significantly increased the efficiency and productivity of PCTS operations, including number of trips, revenue miles, and revenue hours.



**Providing cost-effective fixed-route and paratransit transportation in rural communities is challenging. Using ITS technology, the Central Florida Regional Transportation Authority and Polk County Transit Services are partnering to implement an operationally efficient rural transportation service.**

**Creating High Ridership Transit Systems.** TCRP Report 111, *Elements Needed to Create High Ridership Transit Systems*, describes the strategies used by transit agencies to create high ridership. It includes cases studies of successful transit agencies that focus on the internal and external elements contributing to ridership increase. It also describes how these agencies influenced or overcame challenges. The report includes a CD-ROM containing a database of ridership strategies and a pamphlet that outlines the key elements for increasing and sustaining ridership. The report and CD are designed for transit managers and staff, as well as policymakers and other regional stakeholders, to help them identify strategies to increase ridership.

**Bus Rapid Transit Practitioner's Guide.** TCRP Report 118, *Bus Rapid Transit Practitioner's Guide*, updates information presented in TCRP Report 90, *Bus Rapid Transit*.[1] It discusses the costs, impacts, and effectiveness of selected BRT components and presents the latest developments and research results related to implementing them. It includes practical information that can be used by transit professionals and policy makers in decision-making.

**Improving the Americans with Disabilities Act (ADA) Complementary Paratransit Demand Estimation.** The ADA of 1990 requires complementary paratransit service for all public transit agencies that provide fixed-route services. This service must complement fixed-route service and serve individuals who, because of their disabilities, are unable to use the fixed-route system. TCRP Report 119, *Improving ADA Complementary Paratransit Demand Estimation*, is a handbook for estimating ADA paratransit demand. It contains tools and methods to predict demand, including an online spreadsheet that calculates demand estimates; graphs to facilitate calculating estimates by hand; and factors that can be used to quickly estimate the effects of small changes to service policies. Public transit agencies can use this report to facilitate development of complementary paratranist services that comply with legal requirements for level of service as specified by the ADA and its implementing regulations.

**Motivating Communities.** TCRP Report 122, *Understanding How to Motivate Communities to Support and Ride Public Transportation*, identifies values, perceptions, and decision-making processes that lead to behaviors that affect community support for and use of public transportation. The report then recommends the most effective methods for motivating individuals to actively support public transportation.

**Understanding Individuals' Travel Decisions.** TCRP Report 123, *Understanding How Individuals Make Travel and Location Decisions: Implications for Public Transportation*, discusses how individuals choose where to live and work and how to travel, and the implications of their choices on planning, designing, and marketing transportation systems. It is a guide that aids public transportation planners and marketers; multimodal transportation planners, modelers, and researchers; and policymakers in understanding how travelers' choices are influenced by their larger social context.

[1] *Bus Rapid Transit, Volume I: Case Studies in Bus Rapid Transit and Volume II: Implementation Guidelines,* TCRP Report 90. August 1, 2003 and January 7, 2004, respectively. Available at http://trb.org/news/blurb_detail.asp?id=1698 and http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_90v2.pdf, respectively.

**Fixed-Route Transit Ridership Forecasting and Service Planning.** TCRP Synthesis 66, *Fixed-Route Transit Ridership Forecasting and Service Planning Methods*, discusses forecasting methods and resource requirements and describes the state of practice in fixed-route transit ridership forecasting and service planning. It also presents transit agency assessments of the effectiveness and reliability of forecasting and analyzes the impacts of service changes by transit agencies of various sizes and from different geographic regions. The synthesis is a resource for transit planners and managers as they develop and refine forecasting methods for their own agencies.

**Bus Transit Service in Land Development Planning.** TCRP Synthesis 67, *Bus Transit Service in Land Development Planning*, describes successful strategies to incorporate bus transit service into land development, including five highly successful case studies. It also addresses the challenges that transit agencies face when attempting to do so. For this synthesis, 32 transit agencies shared their experiences with land development. Transit planners and managers who need to develop relationships with local governments and other stakeholders to improve the integration of bus transit and land development will find this document especially useful.

**Rider Communication Methods.** TCRP Synthesis 68, *Methods of Rider Communication*, describes the current state of practice in transit agency communications with customers, examines the methods transit agencies use to determine the effectiveness of their communications, and presents lessons learned in developing communications programs and communicating by electronic means.

**Web-Based Survey Techniques.** TCRP Synthesis 69, *Web-Based Survey Techniques*, describes the current state of the practice for Web-based surveys, focusing on the strengths and limitations of survey methods. It examines successful practice, reviews the technologies necessary to conduct Web-based surveys, and includes several case studies and profiles of transit agency use of Web-based surveys. The synthesis is a resource for transit planners and managers as they develop Web-based surveys for their agencies.

# Goal 3: Improve Capital and Operating Efficiencies

**Goal 3 Objectives**
- Identify practices and technologies to control capital costs
- Identify solutions to control operating costs
- Identify methods and technologies to improve transit operational efficiencies
- Identify solutions to improve transit infrastructure maintenance
- Improve the capacity of the transit industry and workforce

To facilitate and improve return on investment (ROI), FTA has a goal to improve capital and operating efficiencies. Reducing and controlling capital costs of both infrastructure and vehicles helps ensure that projects are completed on time and within budget. Once a capital investment is in place, ROI is maximized by ensuring that operations are both cost- effective and efficient.

Transit operations also face considerable challenges to controlling costs. Primarily due to the addition of new systems and the expansion of existing ones, operating expenses increased from approximately $16.2 billion in 1995 to almost $25.4 billion in 2004.[2] Tied to reducing operating costs is improving transit operational efficiencies. The transit industry needs information to make appropriate decisions on service operations, and also needs support to build the professional capacity of the transit workforce and the manufacturing industry to meet these challenges.

## Highlights of FY 2007 Accomplishments

### Construction Project Management Handbook

The *Construction Project Management Handbook* discusses the project management process, including project initiation and planning, environmental clearance, real estate acquisition, design, construction, commissioning, and closeout. It provides transit agencies, contractors, and FTA staff with guidance and resources to complete transit facility and system capital construction projects.

### Useful Life of Transit Buses and Vans

The *Useful Life of Transit Buses and Vans* report discusses FTA's minimum-life policies for vans and buses in light of the actual experiences of both transit operators and vehicle manufacturers. It also provides options and recommendations for changing the policies.

The current FTA service-life categories and minimums for buses and vans are:
- Heavy-duty large bus—12 years or 500,000 miles
- Heavy-duty small bus—10 years or 350,000 miles
- Medium-duty and purpose-built bus—7 years or 200,000 miles
- Light-duty mid-sized bus—5 years or 150,000 miles
- Light-duty small bus, cutaways, and modified van—4 years or 100,000 miles.

Key options and recommendations for FTA's consideration include:
- Maintaining the current service-life categories and minimums
- Reviewing the service-life minimums and service-life categories periodically (every 5 to 10 years)
- Adopting a "lemon law" that defines circumstances under which "problem" vehicles can be retired early without financial penalty
- Adopting a technology demonstration option so that, with FTA's prior agreement, agencies can retire vehicles purchased to test new technologies
- Restricting the service-life categories in which vehicles are tested
- Modifying National Transit Database (NTD) reporting requirements to better document service-life categories and actual vehicle retirement ages to enable more cost-effective analyses of service-life data
- Evaluating the sensitivity of bus ridership to changes in vehicle age and condition to determine the effects of increased bus ridership on vehicle condition and durability.

[2] *2004 National Transit Summaries and Trends.*
http://www.ntdprogram.gov/ntdprogram/pubs/NTST/2004/HTML%20files/2004_NTST.htm

**Light-Weight, Noise-Dampening Air Conditioning (AC) Door for Transit Buses.** The Center for Composites Manufacturing developed a light-weight advanced-thermoplastic composite cover door for bus AC systems. The door, developed for use on roof-mounted AC systems on articulated transit buses, is 40 percent lighter than its metal counterpart, and is 100 times more effective in terms of vibration- and noise-dampening than the metal door. It can be readily molded and cost-effectively mass produced. Sixty of the doors were delivered to the North American Bus Industries (NABI) for their BRT articulated buses.

## Wireless Technologies a Boon for Cape Cod Transit Services

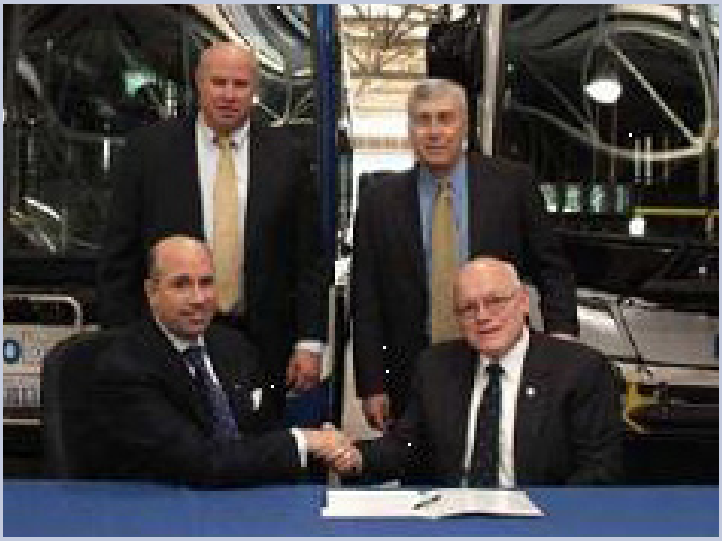
As an FTA grant recipient, the Cape Cod Regional Transit Authority (CCRTA) took advantage of emerging community-wide Internet connectivity, the wireless local area network (WLAN), and large-scale data storage to demonstrate an e-transit village. The Cape Cod Wireless Technology demonstration project was conducted as a partnership between CCRTA and the GeoGraphic Laboratory at Bridgewater State College. It used the campus transit system and the surrounding community of Bridgewater, MA, to demonstrate how emerging transportation technologies can be used in transit and paratransit management and operations. It showed "proof of concept" for community transportation providers to use wireless technologies for these and other customer-oriented applications. The project also used commercial-off-the-shelf military-specification cell phones with assisted global positioning systems (A-GPS) to demonstrate the viability of emerging wireless broadband from cellular carriers to provide real-time automatic vehicle location (AVL) with Web mapping. For details, see *Emerging Wireless Technologies for Coordinating Transit and Paratransit Services — A Final Report on the Cape Cod WiFi Project*.[3]


**Tom Sly, Manager of New Business at Google Transit, presents staff and students at the GeoGraphics Laboratory with "Google Gear" for creating the first automatic vehicle location Web map using Google Mapplet. From left to right, Tom Sly; Uma Shama and Lawrence Harman, Co-directors of the GeoGraphics Laboratory; and Daniel Fitch, senior in computer sciences at Bridgewater State College.**

[3] FTA-MA-26-7098-2007-1.

## Transit Industry Standards

The American Public Transportation Association (APTA) has long been designated the standards development organization for transportation. In FY 2007, FTA supported the APTA stand-ards program (www.aptastandards.com) with approximately $1 million for the continued develop-ment of industry standards for safe, efficient, and secure tran-sit operations. APTA currently has 12 different working groups developing all types of transit standards for bus and rail transportation. In FY 2008, FTA and APTA announced a funding increase of $0.9 mil-lion from FTA, for a total of $1.9 million.



**In December 2007, FTA Administrator Jim Simpson (seated, left) and APTA President Bill Millar (seated, right) announced FTA's $1.9 million grant to APTA for development of transit industry standards. Also present are Thomas Prendergast, vice chair of APTA's standards development oversight council and Senior VP of Parsons Brinckerhoff (standing, left) and Pete Cannito, chair of APTA's standards development council and President of MTA Metro-North Railroad (standing, right).**

**Anticipating Emerging Technologies and Improving Implementations.** TCRP Report 84, Volume 8, *Improving Public Transportation Technology Implementations and Anticipating Emerging Technologies*, summarizes the value of current technologies used in public transportation, describes methods for improving the success of technology implementation, and identifies five promising emerging technologies with application for transit agencies. This report will help chief executive officers and chief information officers of transit agencies, transit managers, program and project managers, ITS professionals, and the public transportation industry in general evaluate emerging technologies for application to their systems and products.

**Integrating Non-Dedicated Vehicles into Paratransit Service.** TCRP Report 121, *Toolkit for Integrating Non-Dedicated Vehicles in Paratransit Service*, provides tools for transportation managers and planners to determine the appropriate split between dedicated and non-dedicated paratransit services to increase cost effectiveness and meet peak demands. The report includes a Non-Dedicated Vehicle Optimization Model and a User Manual as well as findings from nine case studies.

**Mobile Data Terminals (MDTs).** TCRP Synthesis 70, *Mobile Data Terminals*, provides state-of-the-practice information about MDTs in transit. It discusses the capability of mobile data computers offered by technology vendors to the industry, reviews rapidly changing wireless communications infrastructure that supports MDT deployment, and describes the use of MDTs at selected transit agencies across the United States. This synthesis will help transit planners and managers, information technology staff, and others who deploy MDTs in transit address the technology marketplace as informed buyers.

**Transit Vehicles and Facilities on Streets and Highways.** This TCRP guideline was published as a companion to *A Policy on Geometric Design of Highways and Streets*,[4] 5th edition, published by AASHTO. It includes comprehensive geometric design guidelines for accommodating transit vehicles and facilities on or immediately adjacent to streets and highways, and provides a process for selecting transit facilities to accommodate current and future transit demand, based on local conditions, to improve travel times and reliability.

**Rail Base Corrosion Detection and Prevention.** Currently, no standards exist for rail base corrosion detection or prevention. Prepared by the Transportation Technology Center, Inc., TCRP's Web-Only Document 37, *Rail Base Corrosion Detection and Prevention*, provides recommended minimum guidelines to assist transit systems in detecting, monitoring, and preventing corrosion and metal loss at the base of the rail. It describes corrosion effects currently experienced by rail transit systems, discusses a finite-element analysis and flaw-growth model, and provides eight recommended practices for inspection, prevention, and monitoring of rail base corrosion.

**Ridership Estimates for Major Capital Projects.** TCRP's project Background Information and Issues Associated with Ridership Estimates for Major Capital Projects collected and analyzed information on major transit capital projects, their projected versus actual ridership, and the reasons for variances between projected and actual ridership.

**Successful Startup.** The Southern California Regional Transit Training Consortium (SCRTTC) had a successful startup in 2007 and now boasts 32 active members consisting of transit agencies and educational institutions throughout southern California. As part of its startup, the SCRTTC developed and delivered more than 5,000 hours of industry-driven classroom technical training to 392 transit mechanics, technicians, and supervisors in southern California.

[4] *A Policy on Geometric Design of Highways and Streets*. AASHTO Green Book. 5th edition. GDHS-5-M. American Association of State and Highway Transportation Officials. November 2004.

## Transit Goes International for Trade, Technology Transfer, and Human Capacity Building

Created in 1998 through the Transportation Equity Act for the 21st Century (TEA-21), FTA's International Mass Transportation Program (IMTP) allows the U.S. transit industry to access international markets and promotes U.S. exposure to transit innovations worldwide. The program supports three major thrusts: trade, technology transfer, and human capacity building. FY 2007 activities included:

**Trade**
- FTA trade mission to India
- Trade delegation from Nanjing, China
- Trade mission from South Africa
- Transit trade mission to Russia

**Technology Transfer**
- Brazil security delegation visit to FTA
- Promotion of ITS standards in China
- Rail data sharing with Canada
- International exchange on accessibility for the disabled
- Chinese delegation on urban public transportation
- Indian delegation and exchange on urban development
- Information exchange with the South Korean Ministry of Transport
- Videoconferences with South African Department of Transportation
- Transit technology exchange with Germany

**Human Capacity Building**
- Training for Indian transportation officials
- Information sharing with the Japanese Rail Institute
- Learning innovative human resources practices in European transit

# Goal 4: Improve Safety and Emergency Preparedness

**Goal 4 Objectives**
- Identify solutions to improve transit safety
- Identify solutions to reduce criminal activity
- Identify solutions to improve transit emergency preparedness

Transit is one of the safest modes of travel. The National Safety Council's 2004 *Injury Facts* reports that riding a transit bus is 79 times safer than traveling by automobile. Transit rail passengers are 42 times safer than those traveling by car.[5] However, in 2005 transit agencies reported 236 fatalities. In addition, fatalities associated with commuter rail rose to 105, the second-highest number in the past ten years.[6] Thus, safety remains a priority for FTA and transit operators.

Distinguishing between transit safety and transit security is important. Safety involves unintentional events such as crashes. Potential solutions include better driver training and testing, and better vehicle and roadway/guideway design.

Security involves protection against an intentional act of violence and prevention of personal harm from a criminal or terrorist act. By statute, lead responsibility for public transportation security against terrorism threats rests with the Department of Homeland Security (DHS). A Memorandum of Understanding between the DOT and the DHS describes the roles and responsibilities of the departments.[7] FTA works closely with DHS Transportation Security Administration (TSA) to address protection and with DHS Office of Grants and Training (OGT) to address preparedness issues related to terrorism threats. Other security threats, such as non-terrorist criminal acts against transit passengers, employees, or property, are addressed directly by FTA. In recent years, emergency preparedness for natural disasters has also become a high priority.

[5] *Public Transportation Fact Book,* p. xiii.
[6] *Transit Safety and Security Statistics and Analysis Annual Report, Fatalities by Mode and Year.* Available at http://transit-safety.volpe.dot.gov/Data/samis/default.asp?ReportID=2
[7] Annex to the Memorandum of Understanding between the Department of Homeland Security and the Department of Transportation on Roles and Responsibilities concerning Public Transportation Security, September 8, 2005.

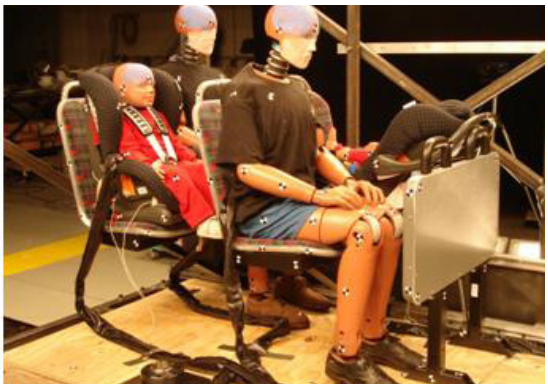
# Highlights of FY 2007 Accomplishments

## Assessing the Business Case for Integrated Avoidance Systems

Produced for FTA and the DOT/ITS Joint Program Office by Booz Allen Hamilton, Inc., *Assessing the Business Case for Integrated Avoidance Systems on Transit Buses* explores a business case for equipping transit buses with collision avoidance technology as part of the Integrated Vehicle-Based Safety Systems (IVBSS). The report assesses the technology, benefit-cost, and industry outreach for seven existing and potential collision avoidance systems and evaluates the industry's willingness to invest in these technologies. It concludes that high costs and lack of system refinements are currently prohibitive, and that further research is needed to make these systems more viable and cost-effective.

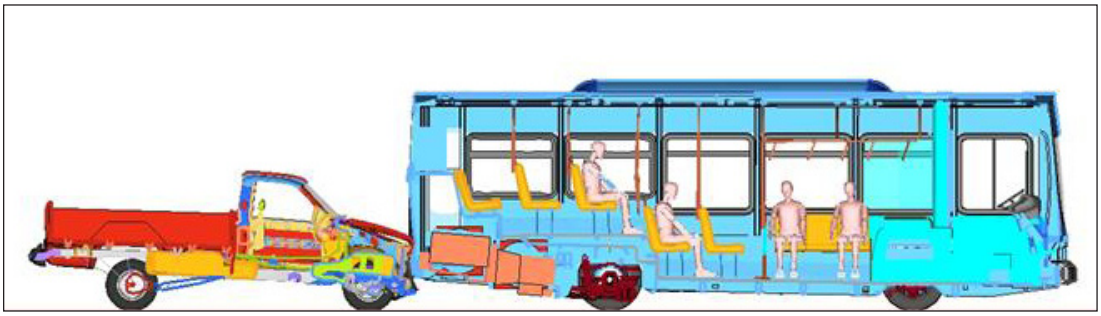
**Collision Simulation Improves Bus Crashworthiness.** Wichita State University continued its evaluation of the crashworthiness of transit buses through simulations and sled testing. In 2007, injury mechanisms for adult and child passengers and operators were identified through sled testing results, and the effectiveness of child restraint systems (CRSs) were evaluated. In addition, bus–car and bus–truck structural compatibility studies were conducted for typical front- and rear-end impact collisions.

**Setting up to measure front-end impacts using the crash simulator sled with test dummies**



**Impact testing with manikins helps to determine the effectiveness of child restraint systems and determine safer interior designs for all bus passengers.**

**Rear impact of pickup truck with transit bus**



**Wichita State University evaluated transit-bus–vehicle compatibility during front- and rear-end simulated collisions.**

## Artificial Intelligence Software Increases Transit Safety and Security

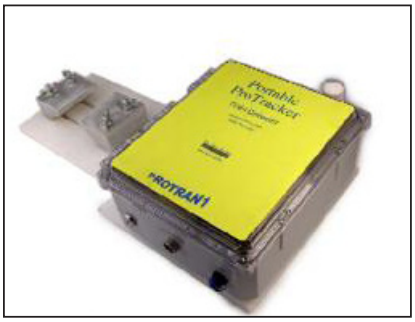
SharpRAIL applies advances in artificial intelligence software that can analyze video images in real time to automatically detect pre-configured safety and security events such as rail trespass, loitering, and vehicles stalled on tracks, and send instant wireless alerts to appropriate locations and personnel. In FY 2007, SharpRAIL designed a prototype integrated system that uses high-speed wireless technologies for real-time, remote communication and machine vision to automatically detect incidents on or near rail tracks and metro stations. SharpRAIL then teamed with the City of Rockville police department to test the prototype system's capability to detect trespassing and loitering in the metro rail system.

**Wireless antenna installed in Franconia Station in Springfield, VA, communicates alerts to appropriate safety and security personnel.**

**Rooftop wireless cameras in Rockville, MD, focus on track and metro stations to detect safety and security incidents.**

The SharpRAIL project was based on a successful partnership with the city of Rockville, MD, police department to test the prototyped system's capability to focus the camera remotely for detecting trespassing and loitering in the vicinity of the metro rail station and to record incidents for later forensic analysis.

**Worker Safety Alert Systems.** To reduce risk to rail rapid transit track workers, flaggers, and other individuals near train tracks, FTA sponsored the development and manufacture of automatic warning devices for both track workers and train operators. The ProTracker™ transceiver mounts in the cab of a train and alerts the operator that people are near the tracks by both audible and visual alarms. A portable ProTracker™ installed on train tracks automatically turns on safety lights and horns set in work zones. At the same time, ProTracker™ pocket devices alert track workers of an approaching train by audible and/or vibrating alarms. New York City Transit, the Maryland Transit Administration, the Massachusetts Bay Transportation Authority, and the Greater Cleveland Regional Transit Authority installed and successfully pilot-tested the devices, which are expected to successfully prevent accidents and injuries to track workers.




**A portable ProTracker™ installed on train tracks can automatically turn on safety lights and horns set in work zones and can also alert track workers of approaching trains via ProTracker™ pocket devices.**



**Train-mounted ProTracker™ transceivers alert train operators that people are near the tracks.**

**Making Transportation Tunnels Safe and Secure.** TCRP Report 86, Volume 12, *Making Transportation Tunnels Safe and Secure*, provides safety and security guidelines for owners and operators of transportation tunnels to use to identify principal vulnerabilities of tunnels to hazards and threats, potential physical and operational countermeasures, and deployable, integrated systems for emergency-related command, control, communication, and information.

**Passenger Security Inspections.** TCRP Report 86, Volume 13, *Public Transportation Passenger Security Inspections: A Guide for Decision Makers*, is a reference guide that can assist transit security personnel in assessing the advantages and disadvantages of a passenger security inspection program. It discusses the most promising types of screening technologies and methods currently in use or being tested, the operational considerations for deployment of these technologies in land-based systems, and the legal precedent that applies or should be contemplated with respect to passenger screening. It also provides a passenger security inspection policy decision model.

**At-Grade Crossings of Exclusive Busways.** Exclusive busways in separate rights-of-way may have at-grade crossings with roadways and with pedestrian and bicycle facilities. TCRP Report 117, *Design, Operation, and Safety of At-Grade Crossings of Exclusive Busways*, provides information and guidelines for improving the safety and performance of at-grade crossings of exclusive busways, including: (1) busways within arterial street medians, (2) physically separated, side-aligned busways, (3) busways on separate rights-of-way, and (4) bus-only ramps. The report addresses highway intersections, mid-block pedestrian crossings, and bicycle crossings. It will assist transit agencies, roadway designers, city traffic engineers, and urban planners in planning, designing, and operating various types of busways through roadway intersections.

**Mitigating Fixed-Route Bus-and-Pedestrian Collisions.** TCRP Report 125, *Guidebook for Mitigating Fixed-Route Bus-and-Pedestrian Collisions*, discusses strategies to assist public transportation systems and their communities in mitigating the frequency and severity of collisions between pedestrians and fixed-route buses in the United States.

**Guards, Girders, and Restraining Rails.** Prepared by the Transportation Technology Center, Inc., TCRP Research Results Digest 82, *Use of Guard/Girder/Restraining Rail*, provides guidelines for applying guards, girders, and restraining rails to improve vehicle curving performance, reduce risk of flange climb derailment, and control wheel/rail wear.

**Requirements for Portable Track Geometry Inspection Systems.** TCRP Research Results Digest 83, *Performance and Testing Requirements for Portable Track Geometry Inspection Systems*, discusses portable track geometry measurement systems and their applicability to transit operations and provides performance guidelines and testing procedures and requirements that transit agencies can use to evaluate and select a portable track geometry system as well as to validate system performance.

## Audible Signals for Pedestrian Safety in Light Rail Transit Environments

Much attention has traditionally been focused on safety associated with motor vehicle/light rail vehicle (LRV) crossings. Somewhat less attention has been paid to pedestrian/LRV conflicts, including collisions, near-misses, evasive actions, and illegal pedestrian movements.

Light rail systems use audible signals as one means to alert vehicles and pedestrians to oncoming trains. However, existing regulations and standard practice concerning the use of audible warnings on light rail systems are based on limited research. Further, loud or frequent audible signals can create community noise impacts and can generate significant community opposition. Consequently, transit agencies must deal with the inherent tradeoffs when using audible warnings in residential areas. Clearly, innovative and effective means of providing audible signals that protect or enhance safety and minimize community noise impacts can greatly benefit all parties.

TCRP Research Results Digest 84, *Audible Signals for Pedestrian Safety in Light Rail Transit Environments*, provides guidelines for using audible signals for pedestrian safety in light rail transit (LRT) environments. The guidelines include descriptions of audible signal systems and associated operating procedures, their integration with other crossing measures, criteria for their use, and their effectiveness and limitations.

All safety concerns associated with LRT systems are exacerbated by the failure of some crossing users to accurately perceive and/or obey crossing control devices and warning systems. In the case of pedestrians and bicyclists, inattentiveness coupled with higher disobedience and misperception of traffic control devices and ordinances (i.e., risky behavior), makes LRT crossings especially vulnerable locations. Thus, crossing control devices and systems to communicate with pedestrians must not only transmit the intended message clearly, but also indicate the required action and the increased level of risk associated with violating the crossing control device. Ultimately, guidelines for the use of audible warnings on LRT systems must lead to reduced risky behavior by pedestrians while simultaneously minimizing adverse noise impacts on adjacent communities.

**Decontaminating Rail Transit Facilities.** The TCRP Innovations Deserving Exploratory Analysis (IDEA) project Chemical and Biological Decontamination System for Rail Transit Facilities (1) developed requirements and a conceptual model for a large-scale automated system for subway station and tunnel decontamination, (2) conducted static tests at a selected WMATA metrorail station, and (3) developed a method to decontaminate rail transit subway stations in the event of a chemical or biological release.

# Goal 5: Protect the Environment and Promote Energy Independence

**Goal 5 Objectives**
- Facilitate development of technologies to improve energy efficiency and reduce transit vehicle emissions
- Identify and overcome barriers to adoption of clean technologies

Transit agencies have increasingly focused on incorporating new fuels and propulsion technologies to make their systems cleaner and more efficient and to reduce fuel consumption. This change is due in part to community pressures and in part to changes in emission standards by the Environmental Protection Agency (EPA) and state agencies such as the California Air Resources Board (CARB).

One such new technology is electric drive. A FY-2005 analysis of electric-drive technologies carried out for FTA reported that transit agencies' interest in cleaner fleets was driven primarily by regulatory and political pressure to reduce emissions or to bring their regions into compliance with federal air quality standards.[8] Specifically, heavy-duty transit bus engines are regulated by EPA for the following pollutants: particulate matter (PM), carbon monoxide (CO), nitrogen oxides (NOx), and hydrocarbon (HC) emissions. These standards became more stringent in 2007 and will become more stringent again in 2010.

**EPA PM and $NO_x$ Emissions Standards for Heavy Buses**

| | Pollutant | |
|---|---|---|
| Year | PM g/bhp-hr | $NO_x$ g/bhp-hr |
| 2004 | 0.05 | 2.5 |
| 2007 | 0.01 | ~1.2 |
| 2010 | 0.01 | 0.2 |

The federal government, as part of its "Twenty in Ten" initiative, also has an interest to reduce depenedence on foreign oil.

From commuter rail to streetcars, most rail transit is electric drive. Virtually all heavy and light rail and many commuter systems use electricity as their energy source. The same ideas of energy storage and hybrid technologies can be applied to rail transit. Rail transit control and braking systems can also be improved to provide more efficiency. These areas of transit technology are open for development, although, to date, little has been done in these areas.

[8] *Analysis Of Electric Drive Technologies For Transit Applications: Battery-Electric, Hybrid-Electric, and Fuel Cells.* FTA-MA-26-7100-05.1. Final Report. August 2005. Available at http://www.fta.dot.gov/documents/Electric_Drive_Bus_Analysis.pdf

# Highlights of FY 2007 Accomplishments

## Advances in Alternative Fuels and Propulsion Technologies

Three of the highlighted FTA research products for FY 2007 are reports on the use and impacts of alternative fuels and advanced propulsion technologies in transit buses. These reports support informed decision making by both the government and transit agencies for cost-effective and environmentally responsible propulsion systems for transit buses.

### Alternative Fuels Study: A Report to Congress on Policy Options for Increasing the Use of Alternative Fuels in Transit Vehicles

Required under SAFETEA-LU, this report, submitted to Congress, discusses the impacts of increasing the use of alternative fuels in transit buses and provides a summary of environmental benefits, drivers for the growing use of alternative fuels, and barriers to increasing that rate of growth. Three policy options were offered for Congressional consideration: (1) defer action, (2) mandate the use of alternative fuels, and (3) create new or enhance existing incentive programs.

### Environmental Benefits of Alternative Fuels and Advanced Technology in Transit

West Virginia University extends the scope of the Report to Congress (above) to discussion of the impacts of increasing the use of alternative fuels or advanced propulsion technologies to 15 percent of the U.S. transit bus fleet. This university report includes fleet and emissions inventories for all transit buses in the U.S. based on the 2003 national inventory, and estimates the fleet and emissions inventories for 2009. Using these inventories as a baseline, the report then estimates how emissions inventories would change if the number of new alternative fuel and advanced propulsion buses in the United States increased by 15 percent. The fuels and technologies considered include "clean" (advanced) diesel, natural gas, diesel hybrid, gasoline hybrid, and biodiesel (20 percent by volume in diesel). Estimates show that diesel–electric hybrid propulsion may offer the best overall environmental benefits, while at the same time reducing the use of fossil fuel.

**Measuring transit bus emissions**

**West Virginia University is measuring emissions from transit buses to help FTA develop a standardized emissions testing program for new model transit buses.**

### Transit Bus Life Cycle Cost and Year 2007 Emissions Estimation

This West Virginia University report estimates the life-cycle costs of a fleet of 100 full-sized transit buses using diesel, biodiesel (20 percent by volume in diesel), natural gas, and diesel hybrid propulsion. Costs considered include bus purchase, fuel, maintenance, and infrastructure. Estimates show that operations costs (fuel and maintenance) are similar for these four propulsion types. The differences in life-cycle costs are driven by the capital costs of the buses and the supporting infrastructure. For the four propulsion types, fleet life cycle costs ranked from lowest to highest are diesel, biodiesel, natural gas, and diesel hybrid.

## National Fuel Cell Bus Program

To facilitate the development of commercially viable fuel cell bus technologies and related infrastructure, SAFETEA-LU authorized $49 million in grants over a four-year period for the National Fuel Cell Bus Program (NFCBP). Funding under the NFCBP requires a 50 percent match by each grant recipient.

In April 2006, FTA initiated competition for the NFCBP and, in November 2006, announced the selected recipients. The contracts for the 14 projects have been put in place and work is underway. FTA selected three non-profit consortia to conduct eight testing and demonstration projects, including 14 fuel cell buses, two component development and testing projects, and four supporting projects:

**The Center for Transportation and the Environment (CTE) in Atlanta, GA**

1. Dual Variable Output Fuel Cell Hybrid Bus Validation Testing and Demonstration in two cities
2. Survey of Hydrogen Bus Demonstrations

**The Northeast Advanced Vehicle Consortium (NAVC) in Boston, MA**

3. Hydrogen Fuel Cell Powered Bus Fleet in Massachusetts
4. Lightweight Fuel Cell Hybrid Bus in New York
5. Demonstration of Fuel Cell Buses in Connecticut
6. Fuel Cell Bus Program in New York
7. Support to the National Fuel Cell Bus Working Group
8. Support to the International Fuel Cell Bus Working Group
9. Facilitation for an annual international fuel cell bus workshop

**Next-generation hybrid bus design**

**CTE is designing and building a 35-foot, 37-seat, next-generation bus with a one-piece composite body.**

**WestStart-CALSTART of Pasadena, CA**

10. Accelerated testing to failure of existing fuel cell buses in California
11. American Advanced Fuel Cell Bus Program in California
12. Compound Fuel Cell Hybrid Bus for 2010 in California
13. Hybrid Fuel Cell Power Converter development
14. Integrated Auxiliary Module for Fuel Cell Buses

The buses being demonstrated include components from four different fuel cell power system manufacturers and various implementations of hybrid electric propulsion systems, energy storage batteries, and ultracapacitors.

FTA has supported fuel cell bus development since the 1980s. Beyond the NFCBP, FTA-funded research currently includes five additional support and demonstration projects.

**Fuel Cell Bus Operates at University of Delaware.** In 2007, a 22-foot, 22-seat fuel cell bus using a 20kW fuel cell stack, 16 kg of hydrogen stored in twin rooftop tanks, and 60kW-hr of batteries was incorporated into the University of Delaware shuttle bus system and used to transport students at the university from their dormitories to campus. Although not yet commercially viable, the prototype bus, which operated for two hours each day during the Spring and Fall quarters, accommodated a ridership exceeding 100 students per day.

**Reducing the Cost of Fuel-Cell Technology.** Fuel-cell technology is expensive. To reduce the costs of hydrogen-fueled vehicles, Northern Illinois University developed and tested a new thin-film platinum electro-catalyst designed to better control and reduce oxygen in fuel-cell batteries in fuel-cell buses. Using this new thin film will lower the cost of fuel cells and thus promote the development of cost-effective hydrogen-fueled vehicles.

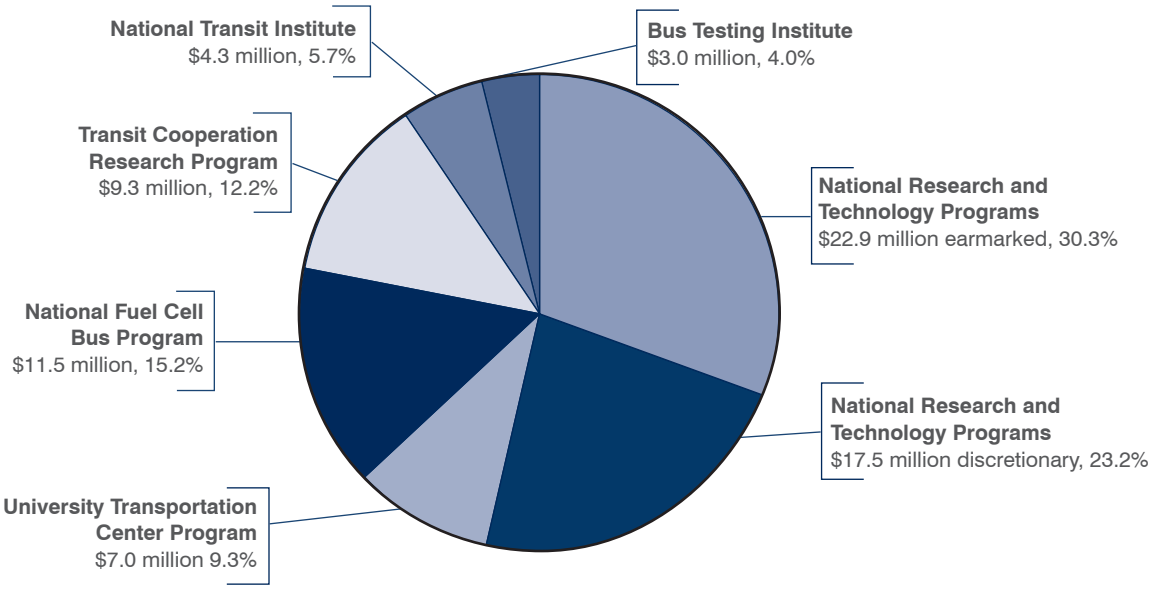
**Evaluating Fuel Choices for 2010 and Beyond.** This TCRP research will update TCRP Report 38, *Guidebook for Evaluating, Selecting, and Implementing Fuel Choices for Transit Bus Operations*. The update will address a range of energy sources and fuels, including diesel, gasoline, CNG, liquefied natural gas (LNG), ethanol, liquefied petroleum gas (LPG), biodiesel, hydrogen and hydrogen blends, and electrical energy sources (e.g., battery, fuel cell, catenary). For each fuel and supporting technology, the update will include the state of the fuel and technology for potential transit application, and information on emissions, capital and operating costs, and impacts on operations and facilities. The update will assist transit managers, policymakers, and transit operations and maintenance professionals considering the deployment of, or conversion to, alternative fuel buses.

# FY 2007 Funding Charts

## FY 2007 Appropriations

In FY 2007, Congress appropriated $61.0 million for FTA's Research and University Research Centers Account. Of this, $9.3 million was provided for the TCRP, $4.3 million for the NTI, and $7.0 million for the UTC program administered by the Research and Innovative Technology Administration (RITA). The balance ($40.4 million) is referred to as the National Research and Technology Program (NRTP), of which $22.9 million was earmarked for specific projects or programs.

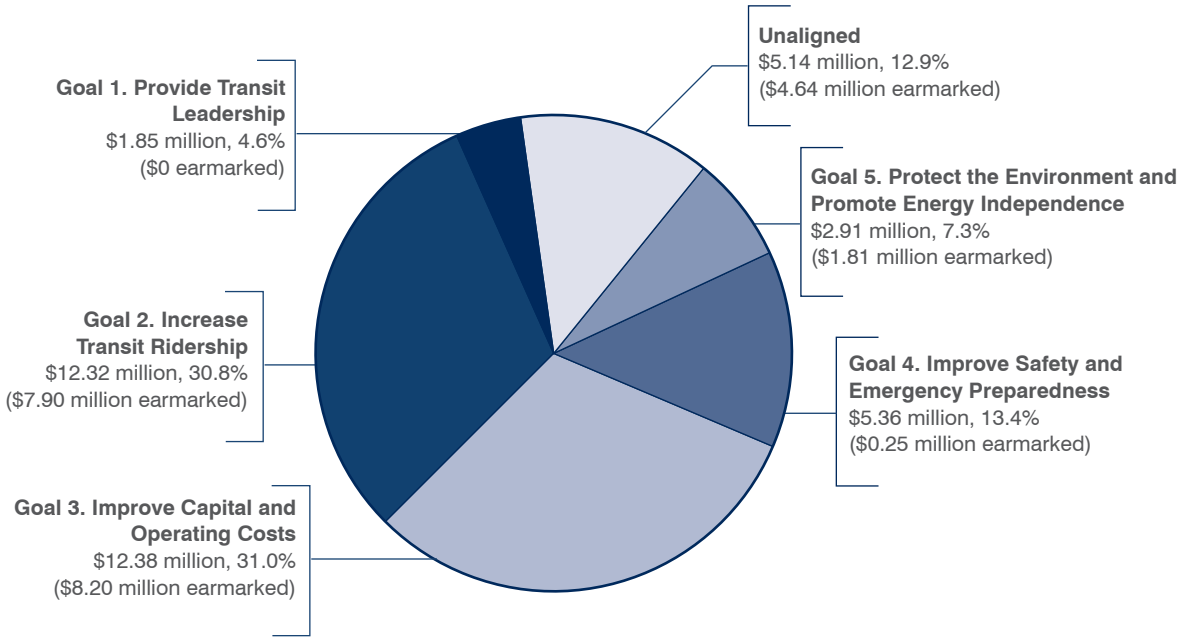
In addition, the Research Office manages the National Fuel Cell Bus Technology Development Program ($11.5 million) and the Bus Testing Institute in Altoona ($3.0 million), which are funded from FTA's capital accounts.




**FY 2007 Funding**

## FY 2007 Funding by Strategic Research Goals

FTA's FY 2007 National Research and Technology Program totaled approximately $40.4 million, of which approximately 57 percent was earmarked for specific projects or programs. The following graph shows NRTP funding by FTA's five strategic goals.




**FY 2007 NRTP Funding by Goal***

The $22.9 million NRTP-earmarked research funds were divided among projects supporting four of FTA's strategic research goals. More than 70 percent of these earmarked dollars went to increase transit ridership and improve capital and operating costs.

The $17.5 million NRTP discretionary research funds were divided among projects supporting all five of FTA's strategic research goals. Almost 30 percent of these research dollars went to research to improve safety and emergency preparedness.

* Figures may not match FY 2007 appropriations due to Small Business Innovation Research (SBIR) deductions, the use of carryover funding from prior years, and funds carried over to FY 2008.

# FTA Research Performance Measures

FTA had four research performance measures in FY 2007. These four measures were defined as part of the Office of Management and Budget (OMB) Program Analysis Rating Tool (PART) process. The goals are designed to be realistic and measurable as well as to allow for steady progress.

**Transit Ridership.** The 150 largest transit operations in the United States serve about 96 percent of transit ridership nationwide. FTA's performance measure captures the average percent increase or decrease in transit ridership among these agencies, adjusted for changes in employment levels in the cities in which the agencies operate. FTA determines changes in employment from studies that document the effect of employment changes on transit ridership.

**Transit ridership, adjusted for changes in employment levels, is increasing.**

| Year | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|
| Percent annual increase | | | | | |
| Target | 2.0 | 1.0 | 1.0 | 1.5 | 1.5 |
| Actual | 0.7 | 1.9 | 2.1 | 2.0 | |

**Transit Safety.** Over the past four years, transit fatalities have steadily declined. FY 2006 and 2007 figures show the decline in the number of fatalities per 100 million passenger miles traveled.

**Transit fatalities per 100 million passenger-miles traveled are declining.**

| Year | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|
| Percent annual increase | | | | | |
| Target | 0.487 | 0.482 | 0.477 | 0.473 | 0.467 |
| Actual | 0.468 | 0.428 | 0.344 | 0.437 | |

**Research Delivery.** FTA tracks major deliverables on an annual basis. FTA is on track to deliver 30 major research products, innovations, and techniques between 2006 and 2010.

**FTA annual deliverables are on track.**

| Year | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| Number of deliverables | | | | | | | |
| Target | NA | NA | 6 | 6 | 6 | 6 | 6 |
| Actual | 6 | 6 | 6 | 7 | | | |

NA: Data not available.

**Research Management Efficiency.** FTA examines how well it manages its research projects by measuring on-time and on-budget deliveries.

**FTA-managed projects are on track for timely deliveries within budget**

| Year | 2004 | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|
| On time and on budget | | | | | |
| Target | NA | NA | 90% | 90% | 90% |
| Actual | 87% | 92% | 91% | 89% | |

NA: Data not available.

# Appendix A: Acronyms and Abbreviations

The following acronyms and abbreviations are used in this report.

| | |
|---|---|
| A-GPS | assisted global positioning system |
| AASHTO | American Association of State Highway and Transportation Officials |
| AC | air conditioning |
| APC | automatic passenger counter |
| APTA | American Public Transportation Association |
| APTS | Advanced Public Transportation System |
| ASCE | American Society of Civil Engineers |
| ATTRP | Advanced Technologies for Transportation Research Program |
| AVL | automatic vehicle location |
| BRT | Bus Rapid Transit |
| BRTC | Bus Research and Testing Center |
| CALSTART | CALSTART Advanced Transportation Technologies |
| CARB | California Air Resources Board |
| CCC | Cape Cod Commission |
| CCNS | Cape Cod National Seashore |
| CCTA | Cape Cod Regional Transit Authority |
| CEM | crash energy management |
| CEO | chief executive officer |
| CIO | chief information officer |
| CNG | compressed natural gas |
| CO | carbon monoxide |
| CRS | child restraint system |
| CTDC | Community Transportation Development Center |
| CTE | Center for Transportation and the Environment |
| DHS | U.S. Department of Homeland Security |
| DOT | U.S. Department of Transportation |
| DRI | Desert Research Institute |
| DRT | demand-response transportation |
| EEO | equal employment opportunity |
| EPA | U.S. Environmental Protection Agency |
| F-T | Fischer-Tropsch |
| FCB | fuel cell bus |
| FEMA | Federal Emergency Management Agency |
| FHWA | Federal Highway Administration |
| FRA | Federal Railroad Administration |
| FTA | Federal Transit Administration |
| FY | fiscal year |
| g/bhp-hr | grams per brake horse-power hour |
| GPS | global positioning system |
| HART | Hillsborough Area Regional Transit |
| HC | hydrocarbon |
| HHICE | hydrogen hybrid internal combustion engine |
| IDEA | Innovations Deserving Exploratory Analysis |
| IMTP | International Mass Transportation Program |
| ISAM | Integrated Starter Alternator |
| ITS | Intelligent Transportation System |
| IVBSS | Integrated Vehicle-Based Safety Systems |
| IVI | Intelligent Vehicle Initiative |
| JPO | Joint Program Office |
| KCATA | Kansas City Area Transportation Authority |
| LNG | liquefied natural gas |
| LPG | liquefied petroleum gas |
| LRT | light rail transit |
| LYNX | Central Florida Regional Transportation Authority |
| MDT | Miami-Dade Transit |
| MDT | mobile data terminal |
| MSAA | Mobility Services for All Americans |
| MUTCD | Manual on Uniform Traffic Control Devices |
| NABI | North American Bus Industries |
| NAVC | Northeast Advanced Vehicle Consortium |
| NBRTI | National BRT Institute |
| NCHRP | National Cooperative Highway Research Program |
| NEMT | Non-Emergency Medical Transportation |
| NFCBP | National Fuel Cell Bus Program |
| NOx | nitrogen oxides |
| NTI | National Transit Institute |
| NRTP | National Research and Technology Program |
| OGT | Office of Grants and Training |
| OMB | Office of Management and Budget |
| PART | Program Analysis Rating Tool |
| PCTS | Polk County Transit Services |

| | |
|---|---|
| PRESS | passenger rail equipment safety standards |
| RAIRS | Rail Accident Incident Reporting System |
| REDSTAR | Radiation Event Detection System: Tracking and Recognition |
| RITA | Research and Innovative Technology Administration |
| SAFETEA-LU | Safe, Accountable, Flexible, and Efficient Transportation Equity Act – A Legacy for Users |
| SBIR | Small Business Innovation Research |
| SCRTTC | Southern California Regional Transit Training Consortium |
| SEPTA | Southeastern Pennsylvania Transit Authority |
| SRI | Southern Research Institute |
| SURTC | Small Urban & Rural Transportation Center |
| TAD | travel assistant device |
| TBP | Office of Budget and Policy |
| TCIP | Transit Communications Interface Profile |
| TCRP | Transit Cooperative Research Program |
| TEA-21 | Transportation Equity Act for the 21st Century |
| TMCC | Travel Management Coordination Center |
| TRAC | Transit Research Analysis Committee |
| TRB | Transportation Research Board |
| TRI | Office of Research, Demonstration, and Innovation |
| TSA | Transportation Security Administration |
| TSI | Transportation Safety Institute |
| TSP | Transit Signal Priority |
| ULSD | ultra-low sulfur diesel |
| U.S.C. | United States Code |
| UTC | University Transportation Center |
| UTCP | University Transportation Centers Program |
| UTFS | Universal Transit Farecard Standards |
| UTSI | University of Tennessee Space Institute |
| UVGI | ultraviolet germicidal irradiation |
| VERSS | vehicle emissions remote sensing system |
| WAMATA | Washington Metropolitan Area Transit Authority |
| WLAN | wireless local area network |
| WSF | Washington State Ferries |
| WVU | West Virginia University |

# Appendix B: FTA FY 2007 Research Reports

**Selected FTA FY 2007 Research Reports.** FTA staff and contractors produce reports to assist grantees and/or to highlight a particular issue in the transit industry. Most reports are available at http://www.fta.dot.gov/research.html unless otherwise noted. Reports are listed alphabetically by title under their respective FTA goals.

### Goal 1

*2006 Status of the Nation's Highways, Bridges, and Transit: Conditions & Performance.* Report to Congress. January 2007. FTA and Federal Highway Administration. Available at http://www.fta.dot.gov/publications/publications_5838.html

*Annual Report on Funding Recommendations. Proposed Allocations of Funds for Fiscal Year 2008. New Starts, Small Starts. Alternative Transportation in Parks and Public Lands*. 2007. Available at http://www.fta.dot.gov/publications/reports/reports_to_congress/publications_6048.html

*Multi-Year Research Program Plan (FY 2008 – FY 2012),* FTA. To be published.

### Goal 2

*Bus Rapid Transit Practitioner's Guide.* TCRP Report 118. July 2007. Available at http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_118.pdf

*Bus Transit Service in Land Development Planning.* TCRP Synthesis 67. December 2006. Available at http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_syn_67.pdf

*Commuting in America III.* TCRP Report 110. October 2006. Available at http://onlinepubs.trb.org/onlinepubs/nchrp/CIAIII.pdf

*Coordinated Approaches to Expanding Access to Public Transportation.* TCRP Research Results Digest. February 2007. Available at http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rrd_81.pdf

*Elements Needed to Create High Ridership Transit Systems.* TCRP Report 111. June 2007. Available at http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_111.pdf

*Fixed-Route Transit Ridership Forecasting and Service Planning Methods.* TCRP Synthesis 66. December 2006. Available at http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_syn_66.pdf

# Appendix B: FTA FY 2007 Research Reports (Cont'd)

*Improving ADA Complementary Paratransit Demand Estimation.* TCRP Report 119. September 7, 2007. Available at http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rpt_119.pdf

*ITS/Operations Resource Guide 2007. 2007.* Available at http://www.resourceguide.its.dot.gov

*Methods of Rider Communication.* TCRP Synthesis 68. January 22, 2007. Available at http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_syn_68.pdf

*Profiles of 511 Traveler Information Services Update 2007.* July 2007. Available at http://www.fta.dot.gov/assistance/research/research_5638.html

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