FEDERAL HIGHWAY ADMINISTRATION (FHWA) RESEARCH AND TECHNOLOGY PROGRAMS

DECEMBER 2023

OVERVIEW

How Is FHWA's Research Program Funded?

FHWA's Research and Technology (R&T) program is largely governed and shaped by Title 23 United States Code (U.S.C.) § 503, which establishes the Highway Research and Development (HRD) Program and Technology and Innovation Deployment Program (TIDP).[1] HRD funds the research and development (R&D) portion of FHWA's R&T program, while TIDP governs the technology transfer (T2) portion and initiatives that accelerate the implementation and deployment of research results.

The Bipartisan Infrastructure Law (BIL) provides $257 million annually to fund FHWA's R&T Program.[2] Of that $257 million, $147 million goes to HRD programs and $110 million to TIDP programs. The U.S.C. and BIL establish six legislative set-aside programs, and FHWA has established seven discretionary research programs.

Mandatory Set-Aside Programs With Fiscal Year (FY) 2024 Funding

The following are mandatory set-aside programs funded through the BIL:

- Accelerated Implementation and Deployment of Pavement Technologies (AIDPT): $12,000,000 (TIDP).[1]
- Small Business Innovation Research (SBIR): $3,462,000 (HRD).[3]
- Strategic Innovation for Revenue Collection (SIRC): $15,000,000 (HRD) (BIL).[4]
- National Motor Vehicle Per-Mile User Fee Funding: $10,000,000 (HRD) (BIL).[2]
- Advanced Transportation Technologies and Innovative Mobility Deployment (ATTAIN): $20,000,000 (HRD), $19,000,000 (TIDP), $21,000,000 intelligent transportation systems (ITS).[5]
- Accelerated Implementation and Deployment of Advanced Digital Construction Management Systems: $20,000,000 (TIDP) (BIL).[5]

Discretionary R&T Programs

The following are discretionary programs funded through the BIL:

- Improving Highway Safety for All Users.
- Improving Infrastructure Integrity, Sustainability, and Practices.
- Institutionalizing Equity, Strengthening Transportation Planning, and Enhancing Environmental Decisionmaking.
- Reducing Congestion, Improving Operations, and Enhancing Freight Productivity.
- Accelerating the Implementation and Delivery of New Innovations and Technologies.
- Accelerating the Discovery of Transformational Solutions.
- Crosscutting.

Within these programs are specific processes, events, and actions that are an intentional part of the program implementation and are referred to as "activities."

U.S. Department of Transportation (USDOT) Strategic Goals[6]

The primary goal of FHWA's R&T programs is to conduct research and T2 that directly supports the FHWA and USDOT strategic goals.[6,7]

Safety—Make Our Transportation System Safer for All People and Advance a Future Without Transportation-Related Serious Injuries and Fatalities

Nearly all FHWA R&T programs support the strategic goal of Safety. Activities include global outreach and technical assistance, research into safety countermeasures and contributing factors to roadway deaths and serious injuries, development of robust data analysis tools and data analytics, and implementation of the Safe System Approach.[8] These supporting activities help identify and implement proven international innovations and enable State, Tribal, and local agencies to integrate safety considerations into the project development process to deliver significant safety improvements to the public.

Economic Strength and Global Competitiveness—Grow an Inclusive and Sustainable Economy. Invest in Our Transportation System To Provide American Workers and Businesses With Reliable and Efficient Access to Resources, Markets, and Good-Paying Jobs.

A wide range of FHWA program activities support the strategic goal of Economic Strength and Global Competitiveness. These activities include developing operational strategies and modeling and travel analysis tools, researching resilient supply chains and system reliability, and monitoring travel and system performance indicators that reveal issues or potential issues of highway condition in the overall supply chain. Together, these activities increase travel time

reliability, manage travel demand, improve connectivity, and support economic strength, especially in rural communities.

Funding and outreach activities will provide State and local DOTs with the tools and expertise to explore and implement innovative strategies to deliver costly and complex infrastructure projects.

Equity—Reduce Inequities Across Our Transportation Systems and the Communities They Affect. Support and Engage People and Communities To Promote Safe, Affordable, Accessible, and Multimodal Access to Opportunities and Services While Reducing Transportation-Related Disparities, Adverse Community Impacts, and Health Effects

Many FHWA program activities support the USDOT strategic goal of Equity. These activities range from research to assess the impacts of different policies and investment strategies on different user groups and geographies across the county to T2 activities, data collection and analysis, and development of tools to enhance and improve relocation planning.

Together, these activities enable transportation agencies to improve equity, access, and mobility for all users—particularly those in underserved populations; implement processes to improve equitable outcomes in transportation network planning; enhance and broaden the reach of public engagement efforts for project development; and close disparities in roadway fatalities and serious injuries.

Climate and Sustainability—Tackle the Climate Crisis by Ensuring That Transportation Plays a Central Role in the Solution. Substantially Reduce Greenhouse Gas (GHG) Emissions and Transportation-Related Pollution and Build More Resilient and Sustainable Transportation Systems to Benefit and Protect Communities.

Programs supporting Climate and Sustainability include activities to develop models and tools that assess and analyze the potential environmental impacts of highway projects, provide insights and approaches that improve air quality, mitigate greenhouse gas emissions, reduce noise pollution, and address congestion caused by high travel demand.

These R&D activities will better inform decisionmaking regarding GHG emissions reduction and performance measurement and ensure economic, social, and environmental effects and tradeoffs inform transportation decisions. T2 and outreach activities will exchange information on best practices and innovative technologies to address highway transportation's impact on climate change.

FHWA will also develop resources to support stakeholders to better predict, estimate, and address future levels of infrastructure exposure to climate change and extreme weather events, including changes in precipitation patterns, temperature, sea-level rise, and cyclonic storm surges and waves.

Transformation—Design for the Future. Invest in Purpose-Driven Research and Innovation To Meet the Challenges of the Present and Modernize a Transportation System of the Future That Serves Everyone Today and in the Decades to Come.

FHWA is recognized as a leader in developing and deploying innovations that improve the highway environment by enhancing safety, increasing mobility, ensuring infrastructure resiliency and sustainability, and addressing equity issues. FHWA's research, development, and technology (RD&T) program broadly supports Transformation through research and innovation.

FHWA activities help partners and stakeholders make the best possible decisions and promote the rebalancing of multimodal investments to address inequalities in underserved communities. RD&T program activities enable and support infrastructure owners in selecting materials and designing, building, preserving, and managing resilient infrastructure in more efficient ways that lower the lifecycle carbon footprint of highway transportation, as well as develop tools to help environmental practitioners improve collaboration with other agencies and the public.

Organizational Excellence—Strengthen Our World-Class Organization. Advance the Department's Mission by Establishing Policies, Processes, and an Inclusive and Innovative Culture to Effectively Serve Communities and Responsibly Steward the Public's Resources.

FHWA's RD&T program supports data-driven initiatives and policies. The primary objective of FHWA's policy analysis research is to provide decisionmakers with empirically based assessments of emerging trends and future transportation needs, as well as the potential for Federal policies, regulations, and strategies to address those needs effectively. Activities will advance policies, processes, and innovations to serve communities effectively.

RD&T activities support State and local practitioners through oversight and technical assistance related to many topic areas, including the Americans with Disabilities Act, Title VI of the Civil Rights Act of 1964, and Disadvantaged Business Enterprise.[9,10,11] Other T2 activities include a five-region innovation summit for Federal land management agencies' partners in safety, infrastructure, transportation planning, digital tools, and workforce development.

FHWA R&T PROGRAMS AND ACTIVITIES

Improving Highway Safety for All Users ($13,293,000)

The Improving Highway Safety for All Users program primarily supports USDOT's strategic goals of Safety and Equity by conducting research, developing training, and assisting USDOT's partners and stakeholders in applying the Safe System Approach to achieve zero deaths.[8]

The Improving Highway Safety for All Users program advances the safety engineering work that overlaps traffic engineering, geometric roadway design, transportation planning, and system management and operations. The program aims to help stakeholders reduce fatalities and serious injuries for all users on all public roadways. Further research into data analysis aims to improve State and local safety data systems that commonly record crashes, roadway inventory, and traffic volume data. The program also researches needs among all roadway users to better understand human behavior and the relationship among all users, infrastructure, and vehicles.

The Improving Highway Safety for All Users program applies the six principles of the Safe System Approach: deaths and serious injuries are unacceptable, humans make mistakes, humans are vulnerable, responsibility is shared, safety is proactive, and redundancy is crucial.[8] The program focuses on countermeasure development that improves the protection of all road users, whether or not those users are in a vehicle. The program also invests in topics such as data-driven safety plans to reduce rural roadway departures and analysis of human behavior in response to automated vehicle technologies. Pedestrian and motorcyclist safety continues to be the focus of the broader safety program because annual pedestrian and motorcyclist fatalities are at their highest levels in decades. New work activities will expand detection technologies for pedestrians, wheelchair users, and other vulnerable road users (VRUs). Further activities on intersection and roadway departure research will yield more precise factors to evaluate the effectiveness of safety countermeasures.

This program recognizes that the safety goal of zero deaths can only be achieved by implementing the program equitably to address the disparities in roadway fatalities and serious injuries experienced by underserved communities. The program continues to develop and promote tools that lead to the reduction of harm from roadway departure, infrastructure, and pedestrian crashes.

Activity
Safety Program Delivery ($2.707 M)
Safety Design and Operations ($4.644 M)
Safety Data and Analysis ($4.243 M)
Human Factors Analytics ($1.699 M)

Safety Program Delivery

The goal of Safety Program Delivery activities is to reduce the number of motor vehicle fatalities and serious injuries on the Nation's roads. In 2024, this activity will focus on providing guidance, policies, tools, and technical assistance to improve safety as well as identify structural causes that contribute to disparities in pedestrian and bicyclist crash mortality and morbidity and develop recommendations for FHWA, State DOTs, and metropolitan planning organizations (MPOs) to address these disparities.

Safety Design and Operations

Under the Safety Design and Operations activity, FHWA staff are leading and collaborating on several initiatives in traffic engineering, geometric roadway design, roadside safety, transportation planning, system management and operations, VRU safety, speed management, data-driven safety analysis, equity in roadway safety, and connected and automated vehicles. Furthermore, R&D in highway construction work zone practices contribute to improved safety by reducing the need for and duration of highway construction work zones while achieving more durable and resilient highway infrastructure.

In FY 2024, FHWA will continue to research how to improve infrastructure to reduce fatalities and serious injuries, eliminate disparities in roadway fatalities and serious injuries, build its knowledge base of safety improvements, and fill information gaps.

Safety Data and Analysis

The main goal of the Safety Data and Analysis activity is to discover new ways to use data and analysis tools to save lives and improve the ability of road owners and operators to make science-based safety decisions. This activity also supports highway infrastructure investment decisionmaking. In FY 2024, continued work on developing crash modification factors for the safety performance of rectangular rapid flashing beacons, left-turn lanes, enhanced delineation for curves, alternative rumble stripes, and delineation of fixed objects will focus on data collection and analysis.

Human Factors Analytics

The Human Factors Analytics program aims to understand all road user behavior and needs so those needs can be incorporated into roadway design, construction, repair, and improvement. Human factors have the potential to guide safety programs, enable innovative approaches to improving safety, and understand how social factors contribute to disparities in traffic fatalities and serious injuries for underserved communities, particularly pedestrians and bicyclists.

The Human Factors Analytics activity uses insights on human behavior to improve the effectiveness of safety countermeasures; understand how cooperative automated vehicles can be safely integrated into the Nation's roadway systems; improve roadway designs that meet the needs of drivers, pedestrians, and other vulnerable users; and understand how people respond to the roadway environment.

In FY 2024, research results will consider the safety issues of automated vehicle technology related to infrastructure and test advanced imaging and detection techniques that promote VRU safety. Research to establish guides and guidelines on variable message signage and cooperative driving automation will also take place.

Improving Infrastructure Integrity, Sustainability, and Practices ($28,751,000)

FHWA's Improving Infrastructure Integrity, Sustainability, and Practices program consists of a coordinated set of RD&T activities focused on leading, supporting, and enabling improvements in highway infrastructure integrity, sustainability, and practices. The program provides the data, information, and systems required to link Federal transportation investments to improvements in system performance. It delivers tools, technologies, information, and guidelines that highway owners can apply to effectively maintain and improve infrastructure integrity and meet user needs.

The overarching objective of FHWA's Improving Infrastructure Integrity, Sustainability, and Practices program is to support and enable advances in infrastructure materials, engineering, construction, and management practices to improve infrastructure integrity, safety, and sustainability.

The Improving Infrastructure Integrity, Sustainability, and Practices program also includes developing and delivering transformational technologies to substantially improve the durability, sustainability, and safety of bridges and pavements and enhance material availability. The program supports the implementation of the updated National Bridge Inspection Standards

(NBIS) and the National Tunnel Inspection Standards (NTIS), thereby enhancing the safety of this critical highway infrastructure.[12,13] Additionally, FHWA research delivers data and information infrastructure owners need to manage pavement and bridge conditions effectively and provides tools, technologies, and guidance to advance the effective management of highway infrastructure and system performance.

The potential economic and societal impact of FHWA's infrastructure research investments is substantial. The improvements in infrastructure condition, resiliency, sustainability, construction, and management enabled by this work will make highways safer, improve system reliability, and reduce GHG emissions arising from highway transportation. As a result, the social, economic, and environmental costs of highway transportation will be reduced.

Activity
Construction and Project Management ($1.659 M)
Geotechnical and Hydraulics ($3.982 M)
Long-Term Infrastructure Performance ($5.943 M)
Pavements and Materials ($7.756 M)
Structures ($8.305 M)
Transportation Performance and Asset Management ($1.106 M)

Construction and Project Management

The improvements in infrastructure condition, resiliency, sustainability, construction, and management enabled by this work will make highways safer, improve system reliability, increase project delivery efficiencies, and reduce GHG emissions from highway transportation. As a result, the social, economic, and environmental costs of highway transportation will be reduced.

Geotechnical and Hydraulics

The outputs include advancements in research, tools and technologies, guidance, and training in innovative geotechnical design and construction methods; advanced site and laboratory characterization; scour geotechnics and hydraulics; geotechnical asset and performance management; geotechnical aspects of pavements; hydrology (such as climate change, extreme events, and floodplains); highway drainage; bridges and culvert hydraulics; and coastal engineering. Expected outcomes from the Geotechnical and Hydraulics activity include transferring and applying new approaches and technologies, datasets, and state-of-the-art geotechnical and hydraulic engineering practices to efficiently design, construct, and manage geotechnical and hydraulic assets for improved long-term performance.

Long-Term Infrastructure Performance (LTIP)

LTIP activity outputs include the expansion of readily accessible datasets documenting infrastructure performance and findings derived through analysis of infrastructure performance data. Outcomes include more widespread application of FHWA datasets, more effective management of highway infrastructure conditions, accelerating the rate at which findings are generated, and enhanced understanding of infrastructure performance.

Pavements and Materials

Pavements and Materials outputs include research findings and data concerning materials innovations and pavement sustainability and resiliency, proposed specifications and guidelines for material selection and mixture design, guidelines for the use of local materials, approaches for building and maintaining pavements that lead to lower lifecycle cost and GHG emissions, improved methods to assess pavement condition, and guidelines for more effective management of pavement condition. Outcomes will include more durable, resilient, and sustainable pavements and more effective management of pavement conditions. Ultimately, this work will contribute to reducing both the lifecycle cost and the carbon footprint of pavements and improving system reliability, sustainability, and safety.

Structures

Structures outputs include revised guidelines, training, and systems in support of the updated NBIS and NTIS, as well as proposed guidelines and specifications for innovations in bridge design, preservation, and construction. Outcomes from this work will include more effective bridge and tunnel safety inspection practices and more durable and resilient bridges and structures, thereby contributing to lower lifecycle cost and carbon footprint of bridges and tunnels and improvements in system reliability and safety.

Transportation Performance and Asset Management

Research in Transportation Performance Asset Management will produce next-generation performance measures and benefit-cost and tradeoff analysis tools, training, and guidelines. These outputs will contribute to achieving more comprehensive lifecycle planning and support risk analysis that considers system resilience to bring about more effective management of highway system performance.

Institutionalizing Equity, Strengthening Transportation Planning, and Enhancing Environmental Decisionmaking ($10,608,000)

The Institutionalizing Equity, Strengthening Transportation Planning, and Enhancing Environmental Decisionmaking research program carries out RD&T to improve and minimize the cost of transportation planning and environmental decisionmaking processes and minimize the potential impact of surface transportation on the environment. It supports USDOT's strategic goals of Safety, Economic Strength and Global Competitiveness, Equity, Climate and Sustainability, and Transformation and promotes safety, mobility, and economic growth while enhancing the quality of life of all Americans.

Activity
Accelerating Project Delivery ($3.246 M)
Performance-Based Planning and Equity ($2.274 M)
Modeling and Analysis Tools ($2.274 M)
Resiliency ($1.407 M)
Multimodal Connectivity ($1.407 M)

Accelerating Project Delivery

The Accelerating Project Delivery activity supports innovative research programs to address environmental stewardship and equity in project delivery to develop well-informed and environmentally sound transportation projects and initiatives through National Environmental Policy Act implementation initiatives, improved coordination and communication between agencies and the public, and capacity-building initiatives for environmental practitioners.(14) Accelerating Project Delivery research also supports the development of rulemaking, guidance, and best practices for real property acquisition processes, which includes relocation planning.

Performance-Based Planning and Equity

The Performance-Based Planning and Equity activity works with States and MPOs to increase safety, accountability, and transparency to the public; provide a strategic and data-driven approach to transportation decisionmaking; and ensure agencies implement performance management while efficiently allocating resources, maximizing the return on investments, and achieving desired performance goals.

Performance-Based Planning and Equity research advances multimodal networks by developing resources that improve access, mobility, and the implementation of processes to improve equitable outcomes in multimodal network planning and implementation for all users, particularly in underserved populations. This activity includes ensuring accessible multimodal mobility options while integrating efficient and affordable innovations in transportation plans, programs, and projects.

Modeling and Analysis Tools

The Modeling and Analysis Tools research activity focuses on developing new analytical tools and refining existing tools to help decisionmakers understand how highway projects improve the performance of the Nation's highway system while minimizing the potential impacts of surface transportation on the environment. These tools enhance transportation planning and decisionmaking in a cost-efficient and environmentally responsible manner and support the opportunity for communities to participate fully in highway project decisionmaking by providing more comprehensive and accurate information about the environmental impacts of highway projects and alternatives being considered for each project, as well as identifying innovative and effective mitigation strategies.

The research activity aims to provide stakeholders at State DOTs, MPOs, and the public with the best tools, data, and regulatory framework to protect human health and the environment. The research activity also explores and adapts modeling methodologies for transportation planning to allow State DOTs and MPOs to better understand their transportation systems. In addition, the activity provides decisionmakers with actionable techniques and tools to better understand how a complex transportation system reacts to investments and policy changes and efficiently makes tradeoffs between performance metrics.

Resiliency

The Resiliency research activity focuses on developing and deploying tools, techniques, strategies, and methodologies for assessing the resiliency, efficiency, and sustainability of transportation plans, projects, and programs. Understanding and addressing the risk of damage and service disruption and increases in the lifecycle costs of infrastructure caused by climate change, extreme weather events, and natural hazards is essential in ensuring the continued integrity, safety, and function of the highway system. This program will also support and encourage the expansion of vehicle electrification and alternative fuel use through the designation of alternative fuel corridors, technical assistance, training, and research.

Multimodal Connectivity

The Multimodal Connectivity activity will promote walking and bicycling infrastructure planning, project development, and networks that address the primary goal of Safety, including Safe Routes to School activities and trails. Multimodal Connectivity research will improve equitable and inclusive outcomes in multimodal planning and project development by ensuring safe, accessible, equitable, and efficient mobility choices, including more connected pedestrian and bicyclist options for all users, particularly for communities with underserved populations, including low-income individuals, minority groups, and persons with a disability.

This Multimodal Connectivity research will also devise strategies for implementing connected active transportation networks that address mobility innovations using emerging technology such as micromobility, shared mobility, and automation. The research will assist partner agencies by providing concise and clear tools, data, methods, performance measures, and other information to maximize economic development and improve the quality of life for all users through strategic highway investments.

Reducing Congestion, Improving Operations, and Enhancing Freight Productivity ($20,600,000)

Transportation Systems Management and Operations (TSMO) promotes the mobility and safety of all modes, manages congestion, minimizes disruptions, and enhances freight productivity while reducing climatic impacts. The transportation system must be well operated to maximize the value of investments and provide safe and reliable travel to the public. Incorporating accurate, real-time, and localized data improves the application of operational strategies by measuring current and future conditions and operation of the freight transportation network. R&D for managing congestion, improving operations, and enhancing freight productivity programs results in innovative technologies and processes leading to systemwide improvements in how agencies manage and improve the efficiency and reliability of the National Highway System (NHS).

The Reducing Congestion, Improving Operations, and Enhancing Freight Productivity program primarily supports USDOT's strategic goals of Economic Strength and Global Competitiveness and Climate and Sustainability by enabling the efficient movement of people and goods across the transportation system using operational strategies that reduce wasted productivity and wasted energy consumption. These efforts also support the Safety goal by smoothing traffic flow,

mitigating disruptions, providing consistent motorist guidance and information about current conditions, and enabling travel choices and safer streets.

Activity
TSMO ($6.305 M)
Manual on Uniform Traffic Control Devices ($0.1 M)[15]
Automation and Connectivity ($6.300 M)
Managing Disruptions to Operations ($3.325 M)
Freight Management and Operations ($3.750 M)
Truck Size and Weight ($0.82 M)

TSMO

The TSMO activity includes several categories. The Foundation for Successful Operations initiative continues the development of outreach and training materials and conducts targeted outreach and T2 to advance the state of the practice and improve the capabilities of agencies for developing and delivering TSMO activities. FHWA's Data-Driven Operations Decisionmaking effort continues enhancing tools and decision support systems for operational/tactical and executive/organizational TSMO decisions by adding functionality for emerging technologies.

The Implementing Operations Strategies initiative provides the R&D of capabilities, tools, and guidance to enable more proactive, dynamic, integrated, and performance-driven management and operations to enhance the application of Active Transportation and Demand Management strategies.

MUTCD

To meet the requirements of Section 11129 of the BIL, activities will focus on publishing the 11th edition of the *Manual on Uniform Traffic Control Devices* (MUTCD).[2,15] This effort involves developing outreach and training materials and a *Standard Highway Signs* book. Support will also be provided for two PFSs of traffic control devices and pedestrian and bicycle transportation.

Automation and Connectivity

The Automation and Connectivity activity will advance automated driving system (ADS)-roadway integration initiatives through the development of new strategies and capabilities that stakeholders can apply to enable a collective understanding of how to jointly move forward to address challenges to safe and efficient integration. Activities include expanding stakeholder collaboration and establishing roadway environment management capabilities that are focused on ADS-roadway integration.

Analysis, modeling, and simulation tools will be advanced by collecting and disseminating new and existing datasets of on-road observations and experimental data on the behavior of automated vehicles in traffic for future integration into microsimulation programs and analytical processes. Finally, work will continue on a "toolbox" of materials for use by infrastructure owners and operators to plan for the modernization of their transportation management system,

including insights into decision support subsystems, developing concepts of operation, and preparing for transitions from legacy systems.

Managing Disruptions to Operations

Several initiatives are being conducted as part of the Managing Disruptions to Operations activity, broken down into four areas: Road Weather Management, Work Zone Management, Traffic Incident Management, and Managing Disruptions to the Operations Data Environment Framework and Strategic Plan.(16)

Freight Management and Operations

Key initiatives under Freight Management and Operations include Freight Data Integration and Visualization, Freight Flow Models and Tools, Freight Infrastructure Needs Identification and Analysis, Freight Program Delivery and T2, Freight Performance and Mobility Trends, supply chain bottlenecks, freight resilience, and truck parking.

Truck Size and Weight (TSW)

TSW activities include those related to the completion and execution of the FHWA TSW Research Implementation Plan and scoping work in the following areas:

- Weigh-in-motion research projects.
- Harmonization and automation of State oversize/overweight permitting systems.
- Research and review of pilot/escort vehicle operator training.
- Emergency routing, bridge strike research.
- Establishment of a communication platform to inform drivers of temporary changes to allowable vehicle weights on the interstate system during an emergency.

Other initiatives may include the development of enhanced bridge deterioration models that can account for impacts of alternative truck configurations, the development of more accurate models that States and others can use to identify impacts of heavy trucks on pavements, analysis of truck types, and safety impact assessments.

Accelerating the Implementation and Delivery of New Innovations and Technologies ($100,083,000)

Accelerating the Implementation and Delivery of New Innovations and Technologies encompasses a variety of initiatives and activities that seek to address all aspects of highway transportation, including planning, financing, operation, structures, materials, pavements, environment, construction, and the duration of time between project planning and project delivery.

Within this program, FHWA supports numerous T2 efforts to accelerate the implementation and delivery of innovations and technologies that result from highway R&D and that benefit all aspects of highway transportation. FHWA works directly with State and local agencies to provide technical assistance and deployment initiatives through the geographically dispersed FHWA Office of Innovation Implementation—Resource Center.

These activities retain their close connection to and support of USDOT's strategic goals. Economic Strength and Global Competitiveness are also supported by FHWA's work to uncover and expand the use of innovative finance strategies, such as debt financing and private investment, to increase the efficiency of current and future cash flow and investment.

FHWA will share the technology solutions and the lessons learned from the R&D projects throughout the highway transportation sector to increase successful deployments and provide widespread benefits to the public and agencies. The activities will be focused on producing outcomes that accelerate the testing, deployment, and implementation of innovations and technologies throughout the highway transportation sector. Benefits achieved will include accelerating the implementation and adoption of innovations and technologies that improve the highway transportation system.

Activity
Every Day Counts ($6.036 M)[17]
State Transportation Innovation Council Incentive ($6.062 M)[18]
Accelerated Innovation Deployment ($8.036 M)
Accelerating Market Readiness ($2.706 M)
Technology Deployment Support ($1.779 M)
AIDPT ($12.000 M)[19]
Accelerated Implementation and Deployment of Advanced Digital Construction Management Systems ($20.000 M)[20]
Advanced Transportation Technology and Innovation ($39.000 M)
Innovative Finance ($964,000)
Research Infrastructure, Technology Transfer, and Partnerships ($3.500 M)

Every Day Counts (EDC)

EDC activities are an agency-wide T2 effort.[17] FHWA program offices and the FHWA Office of Innovation Implementation—Resource Center provide subject matter expertise to form deployment teams that support the implementation of the innovations commensurate with the desired level of adoption or implementation of each State. The State and local highway agencies are the primary beneficiaries of EDC. Other outputs include, but are not limited to, supporting education materials, case studies, and other products.

State Transportation Innovation Council (STIC) Incentive

The FHWA STIC Incentive activity provides resources to help foster a culture of innovation and make innovations standard practice in the States.[18] Through the activity, funding up to $100,000

per State per Federal FY is made available to support or offset the costs of standardizing innovative practices in a State transportation agency or other public sector stakeholders.

Accelerated Innovation Deployment (AID) Demonstration

The AID Demonstration activity provides funding to support the pilot/demonstration of project innovations.

Accelerating Market Readiness (AMR)

AMR is intended to stimulate and spur the advancement of emerging and transformative innovations in the transportation industry by matching these innovations to the transportation organizations interested in testing and evaluating them.

Technology Deployment Support

The Technology Deployment Support activity is used by FHWA field units to provide technical and workforce development assistance to State and local agencies and to engage them in using innovations and technologies.

AIDPT

The AIDPT activity advances strategies for lowering the embodied carbon of paving mixtures and provides tools and information to quantify these strategies.[19] Performance tests to better characterize the durability of materials and pavements will continue to be deployed and implemented. Implementation activities include providing education and guidance on using new tests, support for demonstration and shadow projects, and other information-sharing opportunities such as peer exchanges and workshops.

Accelerated Implementation and Deployment of Advanced Digital Construction Management Systems (ADCMS)

Accelerated Implementation and Deployment of ADCMS aims to ensure that highway construction uses best practices and leverages advanced digital techniques to accelerate project delivery and increase the safety and efficiency of highway construction.[20]

Advanced Transportation Technology and Innovation (ATTAIN)

ATTAIN provides grants to eligible entities to deploy, install, and operate advanced transportation technologies to improve safety, mobility, efficiency, system performance, intermodal connectivity, and infrastructure return on investment. USDOT will share the technology solutions and the lessons learned from the ATTAIN projects with other locations to increase successful deployments and provide widespread benefits to the public and agencies.

Innovative Finance

Innovative Finance includes funding for the FHWA Center for Innovative Finance Support, which provides tools, expertise, and financing to help the transportation community explore and implement innovative strategies to deliver costly and complex infrastructure projects.

Research Infrastructure, Technology Transfer, and Partnerships

The Research Infrastructure, Technology Transfer, and Partnerships activity will identify best practices, formulate strategies, and engage transportation stakeholders in technology and innovation delivery. This activity will support T2 across the entirety of the FHWA R&T program. The activity will also identify, coordinate, and manage strategies related to intellectual property.

Accelerating the Discovery of Transformational Solutions ($45,248,000)

The FHWA Accelerating the Discovery of Transformational Solutions program supports strategic investment in transportation infrastructure, safety, operations, planning, policy, and innovation development and deployment. The program monitors legislative developments, helps coordinate the R&T budget allocation, maintains the Turner-Fairbank Highway Research Center (TFHRC), organizes strategic R&T investment, and provides marketing and communications. At TFHRC, staff conducts R&D activities in the areas of infrastructure, operations, and safety. Research in ITS, policy, innovative finance, planning, and the environment is conducted or administered by FHWA offices located at USDOT Headquarters.

FHWA engages in R&D to leverage the capabilities of TFHRC to develop technologies and innovations of national importance; develop potentially transformational solutions to improve the durability, efficiency, environmental impact, productivity, and safety aspects of highway and intermodal transportation systems; and support research on nonmarket-ready technologies in consultation with public and private entities.

The Accelerating the Discovery of Transformational Solutions program will provide leadership, coordination, and support in administering the FHWA R&T program to help accomplish the USDOT strategic goals.

The Accelerating the Discovery of Transformational Solutions program aims to ensure that highway innovation serves to advance the economic competitiveness of the country, improve equitable outcomes, and offer accessible options for all road users through investment in R&D. Additionally, the program will coordinate and disseminate critical research results with partners and stakeholders to ensure that solutions are making an impact in the real world.

Activity
Research Infrastructure, Technology Transfer, and Partnerships ($11.655 M)
Exploratory Advanced Research ($5.131 M)
SBIR ($3.462 M)
SIRC ($15.000 M)
National Motor Vehicle Per-Mile User Fee Pilot ($10.000 M)

Research Infrastructure, Technology Transfer, and Partnerships

The Research Infrastructure, Technology Transfer, and Partnerships activity maintains and supports the operation of TFHRC and the R&T program. TFHRC focuses on addressing emerging highway technologies that are not addressed by FHWA's partners. This activity also supports critical partnerships with other research organizations to ensure that FHWA's R&T efforts are coordinated to address critical needs. Additionally, this program supports marketing and communication efforts to ensure that partners, stakeholders, and the public are aware of research investments and innovations. Finally, this activity assists in the legislative and budget development process related to the R&T program.

Exploratory Advanced Research (EAR)

The EAR activity is the only funding specifically addressing the need for longer term, higher risk research in highway transportation. EAR conducts investigations across disciplines and program areas to identify topics where a U.S. Government investment has the potential for transformative results and is the only funding specifically addressing the need for longer term, higher risk research in highway transportation.

EAR funding directly impacts the supply of potential technologies and processes necessary for continued industry innovation to meet the challenges of improving the safety, operation, and resilience of the U.S. highway system for years to come. The EAR activity applies proven open and deliberative processes to engage experts within and outside USDOT to identify potential research topics among new discoveries in science and technology that may address current and emerging needs of the highway transportation industry. By leveraging the capabilities of TFHRC, the EAR activity brings new capacity in emerging areas to the facility.

SBIR

SBIR is a highly competitive, awards-based activity encouraging domestic small businesses to engage in R&D that addresses high-priority research areas within USDOT. SBIR favors research that has the potential for commercialization through products and applications sold to the private sector transportation industry, State DOTs, USDOT, or other Federal agencies. Title 15 U.S.C. § 638 establishes that Federal agencies with extramural R&D budgets at the department level that exceed $100 million are required to allocate 3.2 percent of their R&D budget to these programs each year.[(3)]

SIRC and National Motor Vehicle Per-Mile User Fee Pilot

FHWA is also supporting two activities in the BIL that aim to address the challenge of the decline in revenues contributing to the Highway Trust Fund.[2] Through the SIRC and the National Motor Vehicle Per-Mile User Fee Pilot activities, FHWA will identify new solutions and opportunities for revenue collection that may enable the country to adequately fund investments in highway infrastructure into the future, despite emerging challenges and new mobility options. SIRC will provide grants to States and local agencies.

Crosscutting ($38,417,000)

FHWA's Crosscutting program involves a diverse set of programs that support all the USDOT strategic goals and the objectives of the other seven programs outlined in the *United States Department of Transportation Annual Modal Research Plans FY 2024 Program Outlook FY 2025*.[21] Crosscutting involves RD&T activities in Policy Analysis, Global Outreach, Highway Data and Information (HDI), National Performance Management Research Data Set (NPMRDS), Civil Rights, and Federal Lands Highway. Crosscutting also allows FHWA to provide special focus each year on legislative mandates, administration priorities, and certain emerging RD&T issues that the Agency would like to accelerate through increased investment.

The Crosscutting program supports the Performance Management Data Support Program prescribed in Infrastructure Investment and Jobs Act Section 13003 through all HDI and NPMRDS activities.[2] FHWA will continue to develop, update, use, and maintain datasets and data analysis tools to assist MPOs, States, and the Agency itself in carrying out performance management analyses.

This program also supports research and publication of the biennial *Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance Report to Congress*.[22] FHWA is currently modifying its policy analysis models to address the expansion of the legislatively required scope of the report to include conditions and performance of ITS, resiliency needs, and tunnel needs.

Additionally, the Crosscutting program supports the Highway Cost Allocation Study (HCAS). FHWA, in coordination with State DOTs, is carrying out an HCAS to determine the direct costs of highway use by various types of users.

Activity
Policy Analysis ($4.319 M)
Global Outreach ($726,000)
HDI ($6.971 M)
NPMRDS $1.800M
Civil Rights ($890,000)
Federal Lands Highway ($1.668 M)
Emerging/Corporate Needs ($22.043 M)

Policy Analysis

The primary objective of FHWA's Policy Analysis research is to provide decisionmakers with empirically based assessments of emerging trends and future transportation needs and the potential for current and future Federal policies and strategies to address those needs effectively in a manner consistent with FHWA's strategic priorities. Policy Analysis research also studies the policy implications of emerging transportation technologies and explores transportation options to expand access, modal alternatives, and transportation service models to increase access and mobility for all.

The primary outcome of the FY 2024 Policy Analysis research efforts will be improvements to the range and scope of analytical capabilities to support data-driven policy decisionmaking. Key outputs will include Mobility Trends Research and Modeling, which provides quantitative estimates and forecasts of the impact of emerging trends, new transportation service models, and global shifts in travel behavior on system performance and FHWA's strategic priorities.

Global Outreach

FHWA's Global Outreach activities focus on three main initiatives: Global Benchmarking Program, Binational Relations, and Multinational Relations. The Global Outreach activity seeks out and adapts foreign innovations that could significantly improve U.S. highways and highway transportation services. Binational Relations initiatives facilitate knowledge exchange with various countries by leveraging binational government-to-government relationships.

Global Outreach exchanges on Green Public Procurement will lead to improved tools, methodologies, and best practices that support USDOT's Climate and Sustainability strategic goal, as will exchanges with other countries on infrastructure resilience and connected, automated, and electric vehicle infrastructure.

HDI and NPMRDS

HDI activities focus on enabling the effective and efficient delivery of the Federal-Aid Highway Program. HDI's fuel data ensure the apportionment of Federal funds is carried out per the legislation. HDI's highway inventory, including local roads, enables effective national modeling of infrastructure resilience and various emergency evacuation analyses related to hurricanes and other natural disasters.

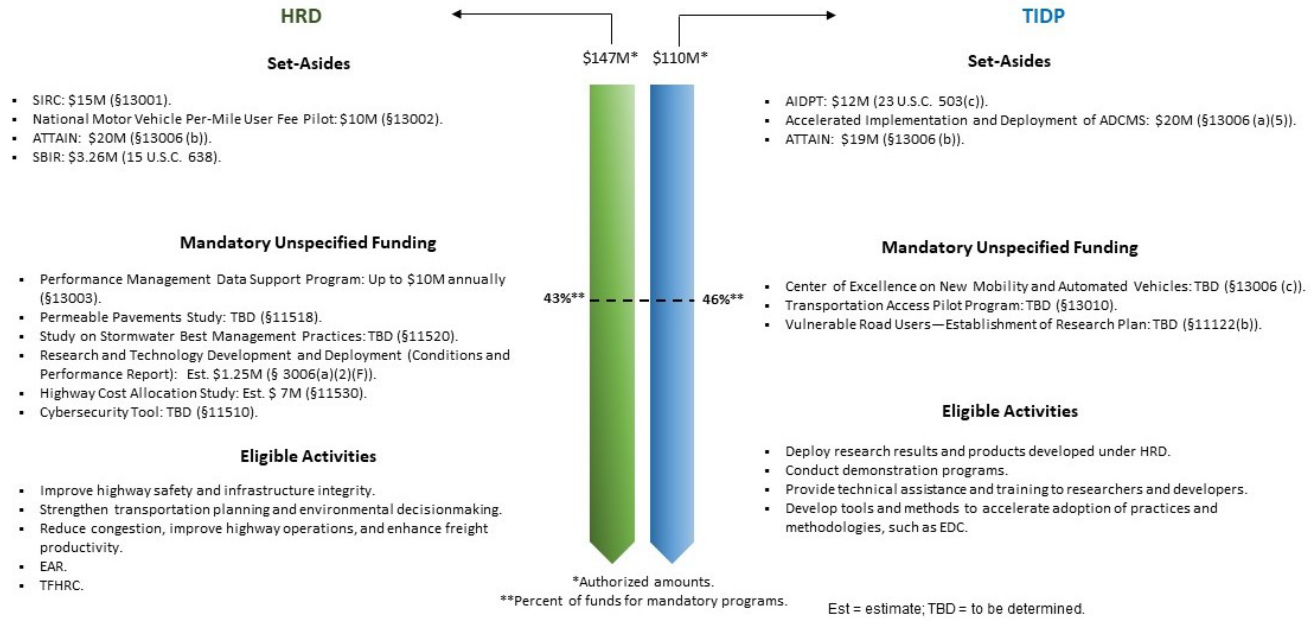
The NPMRDS program enables FHWA to conduct transportation performance management activities by gathering and providing travel time data to all State DOTs and MPOs, covering all NHS roadways throughout the year. The 5-min interval travel time data enable analysis and evaluation of travel reliability, speed, safety, and various performance measures.

Civil Rights, Federal Lands Highway, and Emerging/Corporate Needs

FHWA's Civil Rights, Federal Lands Highway, and Emerging/Corporate Needs activities touch on all goals and programs. These RD&T activities support a safe transportation network for motorists, wildlife, and vulnerable users. These activities also conduct initiatives to improve infrastructure design and implement durable products that are resilient to extreme weather events

and the consequential impacts of changed ecology in public lands. In addition, these RD&T activities support improved planning that will provide more equitable access to the highway transportation system. They will further deliver transportation traveler information systems for more equitable and reliable access to highway transportation and public lands.

APPENDIX



Source: FHWA.

Figure 1: Notable RD&T funding under BIL.[21]

Table 1. FY 2024 RD&T Program Budget Request by DOT Strategic Goal.[21]

RD&T Program Name	FY 2024 U.S. President's Budget Request* ($000)	Safety ($000)	Economic Strength and Competitiveness ($000)	Equity ($000)	Climate and Sustainability ($000)	Transformation ($000)	Organizational Excellence ($000)
Improving Highway Safety for All Users							
Safety Program Delivery	2,707	2,707	0	0	0	0	0
Safety Design and Operations	4,644	4,644	0	0	0	0	0
Safety Data and Analysis	4,243	4,243	0	0	0	0	0
Human Factors Analytics	1,699	1,699	0	0	0	0	0
TOTALS	13,293	13,293	0	0	0	0	0

RD&T Program Name	FY 2024 U.S. President's Budget Request* ($000)	Safety ($000)	Economic Strength and Competitiveness ($000)	Equity ($000)	Climate and Sustainability ($000)	Transformation ($000)	Organizational Excellence ($000)
Improving Infrastructure Integrity, Sustainability, and Practices							
Construction and Project Management	1,659	395	494	0	0	770	0
Geotechnical and Hydraulics	3,982	519	577	0	1,443	1,443	0
LTIP	5,943	253	3,793	0	633	1,264	0
Pavements and Materials	7,756	443	1,900	0	3,039	2,374	0
Structures	8,305	1,789	1,789	0	1,789	2,938	0
Transportation Performance and Asset Management	1,106	99	494	0	118	395	0
TOTALS	28,751	3,498	9,047	0	7,022	9,184	0
Institutionalizing Equity, Strengthening Transportation Planning, and Enhancing Environmental Decisionmaking							
Accelerating Project Delivery	3,246	542	0	1,081	1,082	541	0
Performance-Based Planning and Equity	2,274	325	433	1,082	109	325	0
Modeling and Analysis Tools	2,274	0	324	650	650	650	0
Resiliency	1,407	0	0	0	1,407	0	0
Multimodal Connectivity	1,407	433	434	432	54	54	0
TOTALS	10,608	1,300	1,191	3,245	3,302	1,570	0
Reducing Congestion, Improving Operations, and Enhancing Freight Productivity							
TSMO	6,305	1,262	2,205	314	1,262	1,262	0
MUTCD	100	50	30	10	0	5	5
Automation and Connectivity	6,300	1,323	882	882	1,323	1,890	0
Managing Disruptions to Operations	3,325	1,064	465	299	832	465	200
Freight Management and Operations	3,750	626	1,850	478	55	741	0
TSW	820	26	602	0	192	—	0
TOTALS	20,600	4,351	6,034	1,983	3,664	4,363	205
Accelerating the Implementation and Delivery of New Innovations and Technologies							
EDC	6,036	1,509	1,509	1,209	1,510	299	0
STIC Incentive	6,062	1,513	1,513	1,211	1,512	0	313

RD&T Program Name	FY 2024 U.S. President's Budget Request* ($000)	Safety ($000)	Economic Strength and Competitiveness ($000)	Equity ($000)	Climate and Sustainability ($000)	Transformation ($000)	Organizational Excellence ($000)
AID	8,036	2,010	2,010	1,609	2,010	397	0
AMR	2,706	677	677	544	677	131	0
Technology Deployment Support	1,779	0	0	0	0	1,779	0
Innovative Finance	964	0	964	0	0	0	0
AIDPT	12,000	300	8,000	300	2,200	1,200	0
Accelerated Implementation and Deployment of ADCMS	20,000	500	3,000	250	250	16,000	0
ATTAIN	39,000	7,800	7,800	7,800	7,800	7,800	0
Research Infrastructure, Technology Transfer, and Partnerships	3,500	875	525	350	350	1,050	350
TOTALS	100,083	15,184	25,998	13,273	16,309	28,656	663
Accelerating the Discovery of Transformational Solutions							
Research Infrastructure, Technology Transfer, and Partnerships	11,655	2,913	1,749	1,166	1,166	3,496	1,165
EAR	5,131	494	0	494	989	3,154	0
SBIR	3,462	577	577	577	577	577	577
SIRC	15,000	0	0	0	0	15,000	0
National Motor Vehicle Per-Mile User Fee	10,000	0	0	0	0	10,000	0
TOTALS	45,248	3,984	2,326	2,237	2,732	32,227	1,742
Crosscutting							
Policy Analysis	4,319	0	1,562	335	150	1,922	350
Global Outreach	726	200	30	75	221	200	0
HDI	6,971	1,849	1,742	548	1,717	697	418
NPMRDS	1,800	478	450	141	443	180	108
Civil Rights	890	0	0	742	0	0	148
Federal Lands Highway	1,668	297	247	198	679	49	198
Emerging/Corporate Needs	22,043	5,510	3,307	2,204	2,204	6,613	2,205
TOTALS	38,417	8,334	7,338	4,243	5,414	9,661	3,427

RD&T Program Name	FY 2024 U.S. President's Budget Request* ($000)	Safety ($000)	Economic Strength and Competitiveness ($000)	Equity ($000)	Climate and Sustainability ($000)	Transformation ($000)	Organizational Excellence ($000)
Totals	257,000	49,944	51,934	24,981	38,443	85,661	6,037

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