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Annual Modal Research Plans FY 2024
Program Outlook FY 2025

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Executive Summary

The Federal Highway Administration (FHWA) research, development, and technology (RD&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 governs the research and development (R&D) portion of FHWA's RD&T program. The eligible research areas under HRD include improving highway safety; improving infrastructure integrity; strengthening transportation planning and environmental decisionmaking; and reducing congestion, improving highway operations, and enhancing freight productivity. HRD also provides for conducting exploratory advanced research (EAR).

TIDP governs the technology transfer (T2) portion of FHWA's RD&T program. All aspects of highway transportation relate to TIDP, including planning, financing, operation, structures, materials, pavements, environment, construction, and the time between project planning and project delivery. Under TIDP, responsibilities include conducting T2 activities for the products, technologies, tools, methods, or other findings from highway R&D activities. The eligible research areas under TIDP include accelerating implementation and deployment.

This Annual Modal Research Plan (AMRP) reflects a move toward aligning the FHWA RD&T program with the broad program areas noted in title 23 U.S.C. § 503.[2,1] The RD&T AMRP programs align with the research areas captured under HRD and TIDP.[2] The programs are as follows: 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; and Crosscutting.

This AMRP captures specific processes, events, and actions that are an intentional part of the program implementation, referred to in this document as "activities."[2] Whether ongoing from prior years or new for fiscal year (FY) 2024, the activities are listed and described in the individual AMRP program descriptions in chapters 1 and 2.[2] Additionally, the FHWA AMRP describes "initiatives" throughout the document; these initiatives are examples of specific work occurring under a particular activity.[2] The FHWA RD&T program for FY 2024 includes both follow-on and new initiatives and activities that address emerging needs and the six U.S. Department of Transportation (USDOT) strategic goals.

The primary goal of the FHWA RD&T program is to conduct RD&T that directly supports the strategic goals of FHWA and USDOT. FHWA's RD&T program identifies and addresses issues of national significance that other research sponsors cannot or will not address, including areas that require higher complexity, higher risk, longer term research, or specific Federal responsibility. The program also supports implementing new requirements under the Bipartisan Infrastructure Law (BIL), enacted as the Infrastructure Investment and Jobs Act (IIJA)(P.L. 117-58).[3,4] The FHWA RD&T program's activities produce a clear public benefit, support Federal stewardship roles, meet and address

current and emerging needs and challenges, and ensure the coordination of highway RD&T activities.

Through its RD&T programs, FHWA creates efficiencies in the highway and transportation sector and provides information to support policy decisions. The FHWA RD&T program also ensures that critical technical expertise is available in times of crisis or for sensitive matters, including providing technical support during natural disasters, participating in sensitive Federal investigations, and working with other Federal agencies on issues related to national security and defense.

FHWA certifies that the content of this plan does not include duplicative research efforts within the FHWA RD&T program for FY 2024. Through coordination with research partners, FHWA conducts research to maximize value and avoid duplication. FHWA focuses on innovations with broad applicability that leverage research investments through programs with successful T2.

The FHWA RD&T program covers the entire innovation lifecycle, per title 23 U.S.C. § 503(a)(1): setting an agenda, conducting R&D, testing and evaluating technologies, and deploying and evaluating market-ready technologies and innovations.[1] This holistic approach to innovation allows FHWA and USDOT to serve as national transportation leaders; thus, FHWA and USDOT can provide a strategic approach to shaping the direction of innovation development that supports national interests. By working with partners, this leadership ensures FHWA pursues a future that promotes a safe, accessible, equitable, and efficient transportation system while supporting economic competitiveness for the Nation, reducing environmental impacts, and leading the way in developing and promoting transformative solutions. Without the FHWA RD&T program, the Nation would lack strategically aligned research and innovation development and deployment activities—as well as the world-class technical expertise, relevancy, and influence—to ensure that the public has access to the safest, most reliable, and most resilient infrastructure.

FHWA's Office of RD&T is located at the Turner-Fairbank Highway Research Center (TFHRC), a Federally owned and operated national research facility in McLean, VA. TFHRC houses 15 laboratories and support facilities where staff conduct exploratory and applied research. TFHRC staff administer the majority of FHWA's R&D activities in infrastructure, operations, and safety. Staff in the FHWA offices located at USDOT Headquarters primarily conduct or administer research on intelligent transportation systems (ITS), policy, and civil rights, planning, and environment. In addition, the FHWA Office of Federal Lands Highway (FLH) works with Federal land management agencies (FLMA) and Tribal Governments to deliver quality, durable projects and provide technical expertise in emerging technologies.

Emerging technologies are profoundly altering the transportation system. The development of cooperative and automated transportation technologies is among the most significant advances in recent times. In addition to electric and automated vehicles, ride-sharing applications, innovative forms of public transportation such as ADS-equipped shuttles, and other emerging technologies are influencing the transportation industry and infrastructure. From a technical perspective, data collection technologies, advanced

sensors, and artificial intelligence (AI) enable the collection of previously unavailable data and create an opportunity for improved asset management and system resilience. Other emerging technologies, including edge computing and blockchain technologies, improve the system's security and efficiency.

These advancements have the potential to lessen the detrimental effects of transportation on the natural and human environments, in addition to making mobility more accessible and convenient. With respect to connected and automated vehicles and emerging technologies, FHWA supports the application and deployment of technology and works to improve the ability of State and local transportation agencies to effectively and safely incorporate emerging technologies into operational elements of roadway systems. These initiatives aim to increase the capacity of regional and local transportation organizations. In addition to addressing technical difficulties, RD&T initiatives emphasize granting equitable access to these cutting-edge technological advancements to all people and integrating and modifying the current infrastructure.

Additionally, FHWA has a long history of successful coordination and communication with both internal and external partners through USDOT modal administrations. Particularly important is the relationship and coordination between FHWA and the ITS Joint Program Office (JPO). Title 23 U.S.C. §§ 512–519 establishes the ITS program plan.[5] The ITS research program provides for the research, development, and operational testing of ITS to solve congestion and safety problems, improve operating efficiencies in transit and commercial vehicles, and reduce the environmental impact of growing travel demand. Each USDOT modal administration is responsible for ITS requirements, guidance, and research relevant to that mode.

FHWA leverages long-standing collaborations with State and Federal agencies, academic institutions, and private industry organizations to advance shared goals by coordinating efforts and utilizing the unique capabilities of each. Working within this partnership framework, FHWA strategically identifies opportunities for collaboration, coordination, and independent research that advance the FHWA and USDOT goals. FHWA works closely with the National Academies of Sciences, Engineering, and Medicine's Transportation Research Board (TRB) and with the TRB-sponsored advisory group, the Research and Technology (R&T) Coordinating Committee, to obtain an outside perspective on the direction of the FHWA RD&T program and identify future opportunities for coordination and collaboration.

FHWA also supports numerous T2 efforts to accelerate the implementation and delivery of new and proven innovations and technologies that result from highway R&D and benefit all aspects of highway transportation. FHWA has traditionally used a multipronged approach to deployment, including direct technical and financial assistance; training; peer exchanges; collaboration with industry groups to disseminate knowledge and information; and evaluation of deployment methods to determine effectiveness, assess needed improvements, and document outcomes.

Key deployment and T2 stakeholders include State departments of transportation (DOTs) and local agencies, FLMAs, Tribal Governments, and industry groups. These stakeholders are often the intended audiences for the research deployment outputs. FHWA continues to work directly with State and local agencies through the geographically dispersed FHWA Resource Center and with Tribal Governments through FHWA's Office of FLH. Local Technical Assistance and Tribal Technical Assistance programs and other deployment initiatives play a critical role in T2 activities with these stakeholders.

FHWA will use a series of successful deployment avenues in FY 2024, including Every Day Counts (EDC), a State-based model for deployment; Accelerated Innovation Deployment (AID) Demonstration; Accelerating Market Readiness (AMR); and the State Transportation Innovation Council (STIC), a State-based innovation deployment approach.[6]

FHWA will also use the following successful deployment avenues in FY 2024:

- Virtual public involvement (VPI), including diverse examples of how various State DOTs conducted VPI in the National Environmental Policy Act (NEPA) process and highlights of successful VPI approaches, challenges, benefits, outreach methods, lessons learned, next steps, and contact information.[7]
- National Highway Institute classes for NEPA transportation decisionmaking and piloted environmental justice in NEPA.

RD&T Funding Overview

HRD and TIDP provide funding for FHWA's RD&T program. Under the BIL, $147 million, or about 57 percent of FHWA's RD&T funding, is provided annually to HRD.[3] Of the authorized funds for HRD, $15 million is legislatively set aside annually for the Strategic Innovation for Revenue Collection (SIRC) program, and $10 million is set aside annually for the National Motor Vehicle Per-Mile User Fee Pilot. In addition, 3.2 percent of the FHWA extramural R&D budget is reserved for awards to small businesses through the Small Business Innovation Research (SBIR) activity. This competitive, awards-based activity encourages domestic small businesses to engage in R&D, addressing high-priority research areas within USDOT.

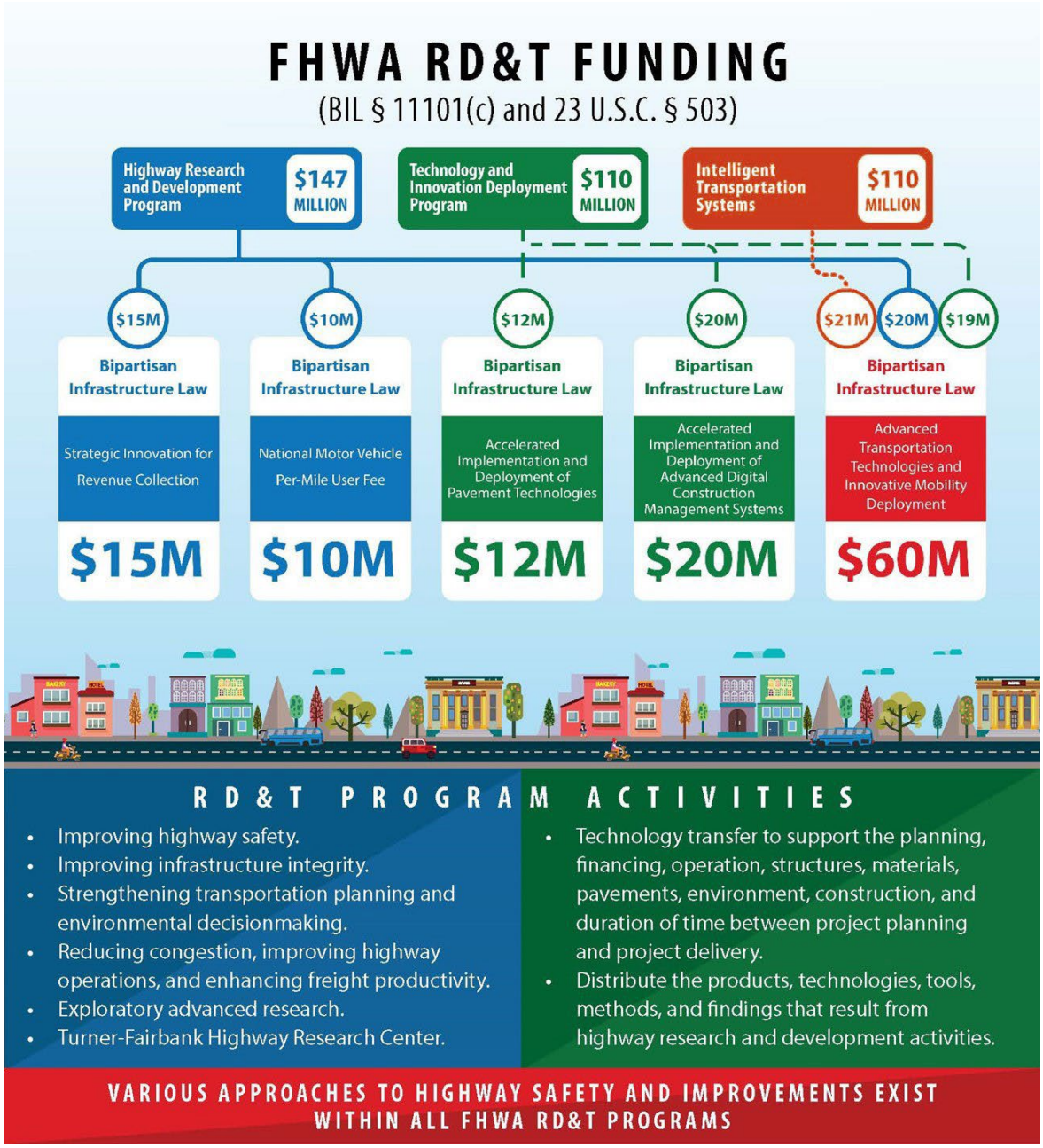
Under the BIL, $110 million, or about 43 percent of FHWA's RD&T funding, is provided annually to TIDP.[3] Of the authorized funds for TIDP, $12 million is legislatively set aside annually for the Accelerated Implementation and Deployment of Pavement Technologies (AIDPT) activity and $20 million is set aside annually for the Accelerated Implementation and Deployment of Advanced Digital Construction Management Systems (ADCMS).[8,9]

In addition to HRD and TIDP, FHWA RD&T shares some funding, research planning, and research objectives with the USDOT ITS JPO, which has a separate AMRP.[2] Title 23 U.S.C. § 512–519 establishes the ITS program plan with authorized funding of $110 million annually under the BIL.[5,3] ITS JPO coordinates and jointly funds activities with overlapping responsibilities and priorities with the other modal administrations, including FHWA. Each modal administration uses a combination of mode-specific funding and legislatively dedicated ITS funding to accomplish the ITS mission. Additionally, some ITS JPO funds

supplement FHWA research activities where additional revenues are needed to meet Department program objectives or ensure synchronization with USDOT multimodal needs.

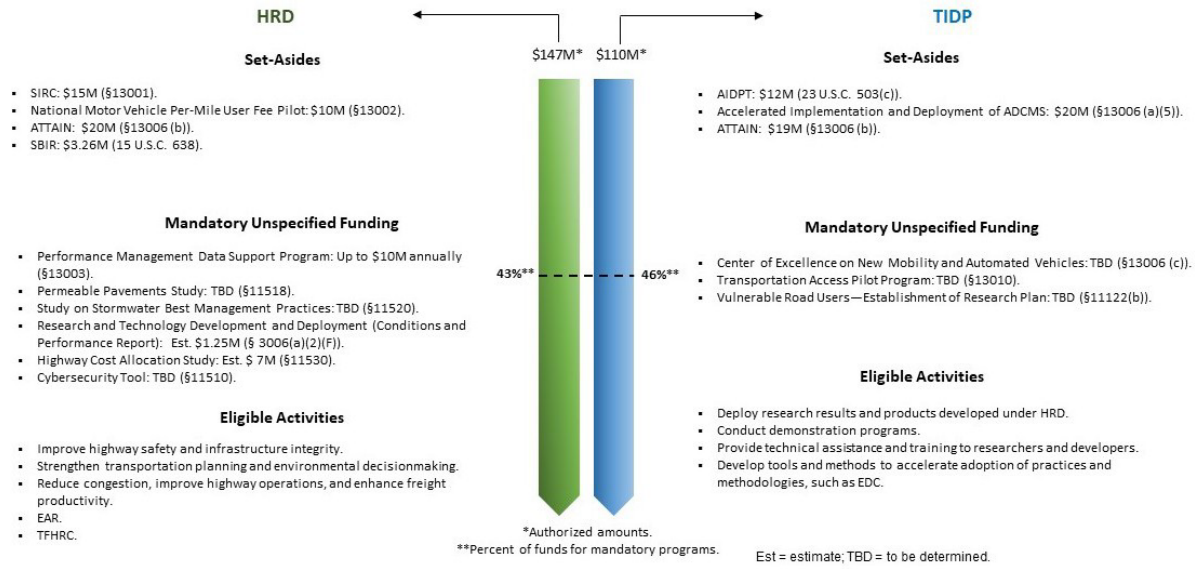
Title 23 U.S.C. § 503 also establishes Advanced Transportation Technologies and Innovative Mobility Deployment, formally known as Advanced Transportation Technology and Innovation (ATTAIN).[1] ATTAIN provides competitive grants to eligible entities to deploy, install, and operate advanced transportation technologies to improve safety, mobility, efficiency, system performance, intermodal connectivity, and infrastructure return on investment. The BIL provides a legislative set-aside of $60 million annually for ATTAIN from HRD, TIDP, and ITS funding.[3]

The following diagram shows how the BIL funds FHWA's RD&T program.[3]



Source: FHWA.[10]

The following figure and its corresponding table highlights the notable RD&T funding under BIL.[3] Additional information about these activities is in chapter 1 and chapter 2.



Source: FHWA.[10]

RD&T Funding	HRD	TIDP
Set-Asides	• SIRC: $15M (§13001). • National Motor Vehicle Per-Mile User Fee Pilot: $10M (§13002). • ATTAIN: $20M (§13006 (b)). • SBIR: $3.26M (15 U.S.C. 638).	• AIDPT: $12M (23 U.S.C. 503(c)). • Accelerated Implementation and Deployment of ADCMS: $20M (§13006(a)(5)). • ATTAIN: $19M (§13006(b)).
Mandatory Unspecified Funding	• Performance Management Data Support Program: Up to $10M annually (§13003). • Permeable Pavements Study: TBD (§11518). • Study on Stormwater Best Management Practices: TBD (§11520). • Research and Technology Development and Deployment (Conditions and Performance Report): Est. $1.25M (§3006(a)(2)(F)). • Highway Cost Allocation Study: Est. $7M (§11530). • Cybersecurity Tool: TBD (§11510).	• Center of Excellence on New Mobility and Automated Vehicles: TBD (§13006(c)). • Transportation Access Pilot Program: TBD (§13010). • Vulnerable Road Users—Establishment of Research Plan: TBD (§11122(b)).

RD&T Funding	HRD	TIDP
Eligible Activities	• Improve highway safety and infrastructure integrity. • Strengthen transportation planning and environmental decisionmaking. • Reduce congestion, improve highway operations, and enhance freight productivity. • EAR. • TFHRC.	• Deploy research results and products developed under HRD. • Conduct demonstration programs. • Provide technical assistance and training to researchers and developers. • Develop tools and methods to accelerate adoption of practices and methodologies, such as EDC.
Authorized Amounts	$147M	$110M
Percent of Funds for Mandatory Programs	43%	46%

Est = estimate; TBD = to be determined.

Addressing the USDOT Strategic Goals

FHWA's RD&T program activities and initiatives improve highway safety, reduce congestion, enhance infrastructure design and construction, invest in transformative solutions, and provide data and analyses to decisionmakers throughout the transportation community. The following sections describe how the FHWA RD&T program supports each USDOT strategic goal.

Safety

FHWA's Improving Highway Safety for All Users program addresses the contributing factors of roadway deaths and serious injuries related to roadway design, construction, and maintenance. This program develops robust data analysis tools that enable transportation professionals to match crash causes with cost-effective countermeasures. With safety resources aimed at targeted safety problems, State and local agencies can deliver significant safety improvements to the public. FHWA's safety efforts are focused on implementing the Safe System Approach (i.e., anticipating human mistakes and vulnerabilities by designing and managing road infrastructure to keep the risk of a mistake low; but if a crash occurs, the impact on the human body doesn't result in a fatality or serious injury) to achieve the following objectives: reducing fatalities and serious injuries for all users on all public roadways; fostering an equitable, scientific, data-driven approach to safety decisionmaking; and implementing a performance-driven Highway Safety Improvement Program (HSIP).[(11)]

As Safety is FHWA's number one strategic goal, nearly all RD&T programs impact safety. Global outreach is a valuable tool in identifying, accessing, evaluating, and implementing proven international innovations to address safety challenges. FHWA's Highway Data and Information (HDI) activity enables the Agency and the transportation community to conduct systematic research and program development by providing relevant data and advanced data analytics. Tools, research activities, and technical assistance under

Institutionalizing Equity, Strengthening Transportation Planning, and Enhancing Environmental Decisionmaking support the integration of safety considerations into the project development process.

The Office of Tribal Transportation under the Office of FLH supports improved safety for vulnerable users of low average daily traffic (ADT), National Highway System (NHS), and non-NHS public roads. All the activities within the Reducing Congestion, Improving Operations, and Enhancing Freight Productivity program reflect FHWA's support of Safety as the top USDOT strategic goal by smoothing traffic flow, mitigating disruptions, emphasizing critical infrastructure cybersecurity, providing consistent motorist guidance and information about current conditions, and enabling travel choices and safer streets. FHWA's Improving Infrastructure Integrity, Sustainability, and Practices program will reduce the need for and duration of highway construction work zones. This program will contribute to improved safety by achieving more durable and resilient highway infrastructure and improved construction practices. FHWA will advance research into wildlife and aquatic organism passage, which promotes safety for the traveling public while producing benefits for the natural environment.

Economic Strength and Global Competitiveness

FHWA supports USDOT's strategic goal of Economic Strength and Global Competitiveness through numerous efforts. The Reducing Congestion, Improving Operations, and Enhancing Freight Productivity program includes operational strategies that enable the efficient movement of people and goods across the transportation system and focuses on investing in improvements that will lead to resilient supply chains, system reliability, and connectivity. HDI's travel (demand and condition), fuel, usage, travel time, and travel behavior data provide valuable and relevant indicators of the performance of the Nation's supply chain. In addition, the travel demand and condition information from the Highway Performance Monitoring System reveals issues or potential issues of highway condition in the overall supply chain.[12] The Modeling and Analysis Tools activity under the Institutionalizing Equity, Strengthening Transportation Planning, and Enhancing Environmental Decisionmaking program can be used to analyze corridor and system operations to increase travel time reliability, manage travel demand, and improve connectivity. Additionally, the Multimodal Connectivity activity will support economic strength, especially in rural communities, by documenting the economic benefits of highways, including scenic byways.

The Policy Analysis activity within the Crosscutting area provides foundational economic tools and complex analysis including support for the development of multiple models—including the Highway Economic Requirements System (HERS) and the National Bridge Investment Analysis System (NBIAS)—that are used to assess national infrastructure needs and monitor a key USDOT performance measure to "reduce the highway repair backlog by 50 percent by 2040."[13,14,15] The Geo-Economic Multimodal System model (GEMS), which helps in understanding the impacts of different policies and investment strategies on different types of locations to enhance equity, mobility, and accessibility, and in maximizing benefits out of money spent.[16] In the same vein, the United States Applied General Equilibrium (USAGE)-Hwy model helps in understanding the impacts of transportation-

related policy interventions on macroeconomic indicators such as gross domestic product (GDP), employment, productivity, and personal welfare.(17)

The Office of FLH will support the Office of Infrastructure (HIF) in the areas of lifecycle extension and durable products and will advance a bridge lifecycle analysis model to predict asset (structures) deterioration rates to help prioritize projects based on the urgency of need and funding available for its FLMA partners.

Infrastructure investment is the foundation of a strong economy. "Innovative finance" generally refers to debt financing, which can potentially increase the efficiency of current and future cashflows. Although the pay-as-you-go approach to public spending offers little financial risk, it can result in delays that defer the benefits of infrastructure investment. Due to the cost of major projects, debt financing is almost always utilized. Public agencies willing to consider private financing may find opportunities to leverage private sector innovation. The Innovative Finance activity includes funding for FHWA's 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.

Equity

FHWA will develop a promising practice guide and conduct outreach with States and metropolitan planning organizations (MPOs) to improve equity, access, and mobility for all users, particularly in underserved populations. Through the Institutionalizing Equity, Strengthening Transportation Planning, and Enhancing Environmental Decisionmaking program, FHWA will work with States and MPOs to consider equity early and often through public participation, data collection and analysis, and updated geographic information system (GIS) tools. These efforts will improve the ability of States and MPOs to adequately see and respond to community needs through the planning process. Initiatives will implement processes to improve equitable outcomes in transportation network planning and implementation, including in communities near major roadways that are disproportionately affected by air pollution and noise impacts. The Office of Real Estate Service's relocation retrospective research will examine the impact on those persons required to relocate from their homes because of projects that received Federal aid.

The Accelerating Project Delivery activity supports efforts to promote VPI, which enhances and broadens the reach of public engagement efforts for project development, including considerations and strategies for engaging traditionally underserved individuals and communities. The Office of Real Estate Service's Accelerating Project Delivery efforts include the development of tools to enhance and improve relocation planning for those who may be displaced by a Federal-aid project and stewardship and oversight tools for direct grant recipients. These tools will enhance project development, expedite right-of-way acquisition, and promote effective stewardship and oversight.

The Office of Civil Rights(HCR) uses research funds for many initiatives that evaluate and provide resources, such as handbooks, to practitioners to reduce transportation-related Title VI disparities and adverse community impacts and to increase accessibility in the

public right-of-way.[18] Funds will be used to conduct reviews of States' compliance with the Americans with Disabilities Act (ADA) and develop a training course to provide ADA-complaint investigation education.[19] Additional training courses and technical assistance will contribute to Disadvantaged Business Enterprises (DBEs) receiving payment and returning retainage promptly, deliver Title VI nationwide best practices for reviews, and assist in identifying and mitigating potential Title VI disparate impacts.[18]

Most of the Reducing Congestion, Improving Operations, and Enhancing Freight Productivity program activities focus on deploying tools and technologies that help agencies and the public address challenges and improve the quality of transportation system operations and satisfaction for all users. The Office of FLH supports FLMA and Tribal Governments by developing prototype customized asset management models that will allow Tribal transportation departments to identify, analyze, and prioritize adaptation options, substantively informing their transportation decisions.

Many initiatives in the Office of Policy and Governmental Affairs (HPL) support equity, including a cost allocation study exploring equity from the system cost responsibility of users and a revenue and taxation perspective and studies and information exchanges with binational counterparts and the World Road Association (globally known as PIARC) on issues related to gender inclusion, social equity, and social accessibility. Policy Analysis research assesses the impact of different policies and investment strategies on different user groups and geographies across the country. Related equity impact analyses using other tools support the understanding of the relationship between the availability and quality of highways and their impacts on access to economic opportunities for individuals and communities. In addition, HDI's travel behavior data are the only USDOT-wide resource offering insights into how and why people travel; the data include dimensions of race, ethnicity, income, and education.

The Equity in Roadway Safety program in the Office of Safety (HSA) supports equity by working to reduce disparities in roadway fatalities and serious injuries for underserved communities through research, training, and awareness-raising activities. The program is currently conducting research to understand the social contributors to disparities in pedestrian and bicyclist fatalities and serious injuries.[20]

Climate and Sustainability

The Office of Planning, Environment, and Realty's (HEP's) models and tools assess and analyze the potential environmental impacts of highway projects. These models and tools also provide important insights and approaches that will improve air quality, mitigate greenhouse gas (GHG) emissions, reduce noise, and address congestion caused by high travel demand on the highway system. FHWA conducts R&D activities to better inform decisionmaking regarding GHG emissions reduction and performance measurement and ensure transportation decisions are informed by economic, social, and environmental effects and tradeoffs. For example, the Greenhouse Gas Emission Measure rulemaking will establish a method for the measurement and reporting of certain GHG emissions associated with transportation.[21]

Policy Analysis activities within the Crosscutting program provide a framework and analysis tools to evaluate the impact of environmental policies on system users and system performance, including GHG. For example, Mobility Trends research quantifies the impact of emerging trends, such as electric vehicle (EV) ownership and charging infrastructure investment, on GHG. In addition, the recently developed GEMS decision support model quantifies the GHG effects and tradeoffs of policy alternatives in different locations in the country.(16) Planned Policy Analysis research will also focus on incorporating resilience into benefit-cost analysis and modeling impacts of investments on the resilience of the Nation's transportation system. Planned research will also focus on the environment benefits of policy alternatives such as shifting trips to climate-friendly vehicles and modes of travel.

HDI's fuel data and vehicle miles traveled provide the most efficient and reliable GHG emission estimates by State, region, and the Nation; the data offer insight into program and policy effectiveness related to USDOT's Climate and Sustainability goals. Global outreach, through the Global Benchmarking Program (GBP), multinational and binational efforts, exchanges 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. FHWA will make substantial investments to develop and advance tools, technologies, and practices that enable the construction and maintenance of highway infrastructure that is more resilient and more sustainable. These investments will include lower carbon materials and tools and technologies to support well-founded lifecycle assessments. The Office of FLH will support the development of an asset management prediction model to forecast at-risk culverts for the U.S. Forest Service. Vulnerable culverts are victims of climate change effects such as intense precipitation events and wildfires, which cause an increase in debris-flow damage to undersized culverts.

The Reducing Congestion, Improving Operations, and Enhancing Freight Productivity program also contributes to Climate and Sustainability through operational strategies that reduce wasted productivity and wasted energy consumption.

HEP will provide stakeholders with climate change and sustainability technical assistance and coordinate activities within USDOT and other Federal agencies. Several partnerships and exchanges are supporting many climate and sustainability topics, including an FHWA-Rijkswaterstaat (Netherlands) Bilateral Collaboration on Climate Change Sustainability and Resilience, which will focus on mainstreaming climate change resilience in transportation planning, design and construction, asset management, and maintenance procedures. This office will also lead multimodal activities to shift person trips to more sustainable options, such as active transportation and improving walking and biking access to transit.

Transformation

FHWA is a recognized leader in developing and deploying innovations that produce real improvements in the highway environment by enhancing safety, increasing mobility, ensuring infrastructure resiliency and sustainability, and addressing equity issues. FHWA's RD&T program broadly supports Transformation through research and innovation, including on low-volume roads comprising most of the Nation's transportation network. The Accelerating the Discovery of Transformational Solutions program includes a focus on supporting R&D at TFHRC and across all other program areas.

FHWA also helps partners and stakeholders make the best decisions possible. FHWA's Multimodal Connectivity activity promotes the rebalancing of multimodal investments to address inequalities in underserved communities. The Improving Infrastructure Integrity, Sustainability, and Practices program enables and supports infrastructure owners in selecting materials and designing, building, preserving, and managing resilient infrastructure in ways that are more efficient and lower the lifecycle carbon footprint of highway transportation. HEP will develop planning tools to help States and MPOs that are exploring methodologies in transportation planning understand community needs and provide actionable techniques and tradeoffs between different futures and their relative impacts on different community goals. HDI's effort in data gathering, analyzing, and forecasting methods focuses on big data and big data analytics to reveal new transformative ways of doing business at USDOT and FHWA and with State DOTs, MPOs, and other entities and enterprises. Policy Analysis research provides a system lens and user focus to identify the opportunities, challenges, and unintended outcomes that transformational technologies create to assess policy alternatives and implications on strategic priorities. Through the adoption and use of open data procedures during the development and dissemination of policy analysis products, FHWA is able to actively collaborate with the wider research community. Additionally, policy analysis initiatives use scenario planning around policy and investment decisions and the analysis of the policy implications of emerging transportation technologies.

FHWA also values collaboration. By optimizing established partnerships with other Federal agencies, the Office of FLH bridges the gap between practitioners and researchers in the areas of assets (structures, culverts, rock walls), vulnerabilities (wildfires and unstable slopes, erosion, and gravel roads), and equity (remote access and equitable access). Additionally, HEP will develop tools to help environmental practitioners improve collaboration with other agencies and the public. These tools have the potential to accelerate the delivery of transportation projects without sacrificing important collaboration with those affected by the projects. The GBP supports study teams with both implementation expertise and funding to accelerate early implementation activities, starting with developing an implementation plan. The program evaluates the most promising technologies and practices identified abroad, shares them with relevant organizations, and develops strategies for domestic adaption and implementation. Binational and multinational programs engage with countries and organizations that are leaders in highway innovations and best practices and can help advance the national highway transportation system in the United States.

Organizational Excellence
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. Further, the HDI activity supports data-driven policymaking by delivering consistent and credible past, present, and future highway-related data for the entire transportation community, promoting accountability, transparency, economic development, and advanced R&D.

FHWA also supports those with whom it has a working relationship. The HCR supports State and local practitioners through oversight and technical assistance related to many topic areas that USDOT and FHWA have identified as key strategies, including ADA, Title VI, and DBE.[19,18] The Office of FLH, with support from the Center for Accelerating Innovation within the FHWA Office of Innovation and Workforce Solutions, sponsors a five-region innovation summit for FLMA partners in the areas of safety, infrastructure, transportation planning, digital tools, and workforce development. Within the Reducing Congestion, Improving Operations, and Enhancing Freight Productivity program, the *Manual on Uniform Traffic Control Devices* (MUTCD) and Managing Disruptions to Operations activities advance policies, processes, and innovations to serve communities effectively.[22]

Highlighted Initiatives That Support USDOT Strategic Goals

The following initiatives support USDOT's strategic goals that will be addressed as part of the FY 2024 FHWA RD&T program.

EAR and Vulnerable Road Users (VRUs): Beginning in FY 2024, the EAR program (through the Office of Research, Development, and Technology) will build on research investments from FY 2018 and FY 2022 by exploring AI and machine learning (ML) to improve VRU's safety and asset owner's management of pavements and structures. Research on VRUs will consider the application of emerging technologies that can provide safety for all people, including those that use assistive devices for travel. FHWA also is advancing AI and ML from applied research to commercialization through the SBIR program. FY 2024 investments include phase II developments of a system to reduce vehicle conflicts at signalized intersections and a system to enforce travel by heavy commercial vehicles on bridges with load restrictions.

Research to Reduce GHGs and Improve Resilience to Climate Change: To support climate solutions, FHWA will work to develop and deploy tools for State DOTs and MPOs to analyze GHGs through the HIF. FHWA also recognizes the need to make transportation infrastructure more resilient to the impact of climate change. Innovators across the United States are developing concrete-like materials that reportedly have reduced embodied carbon; however, these materials' performance remains unknown. Researchers at FHWA's TFHRC are developing a performance-based framework to assess novel materials and gauge their appropriateness in transportation infrastructure.

Intersection Safety Challenge: In response to growing concerns regarding the safety of VRUs at intersections and as part of USDOT's implementation of the National Roadway Safety Strategy (NRSS), the USDOT Intersection Safety Challenge aims to transform intersection safety by incentivizing the innovative application of new and emerging technologies to identify and mitigate unsafe conditions involving vehicles and VRUs.[23] This initiative is implemented through the HSA. The objective is to leverage advanced sensing, communications technologies, AI, and ML to improve intersection safety at scale in new and effective ways. The Intersection Safety Challenge, announced in 2023, encourages the formation of nontraditional teams combining expertise in emerging technologies with experience in traffic and safety engineering to develop new and potentially transformative intersection safety approaches. This project is led by USDOT's Office of the Assistant Secretary for R&T, jointly funded by FHWA and the Intelligent Transportation Systems Joint Program Office (ITS JPO) and supported by Federal Motor Carrier Safety Administration (FMCSA), Federal Transit Administration (FTA), and National Highway Traffic Safety Administration (NHTSA).

Managing Disruptions to the Operations Data Environment (MDODE) Strategic Plan and Framework: The Nation's transportation finance system is transitioning from a concentration on delivering construction projects to one that is increasingly concerned with sustaining access to mobility as a public service.[24] This initiative is through the Office of Operations (HOP). Supporting this evolution will require tools and capabilities for virtualizing transportation operations and making transportation management decisions in a digital environment. Building on the successful ongoing national deployment of the Work Zone Data Exchange, the FHWA HOP (in active engagement with the ITS Joint Program Office (ITS JPO) and the USDOT John A. Volpe National Transportation Center (Volpe)) is leading the expansion of this program to other nonrecurring events. The MDODE Strategic Plan and Framework will develop an operational structure and specification for a data marketplace in which information on work zones, incidents, road weather disruptions, and special events is generated and shared nearly in realtime.[24] MDODE will serve the objectives of the FHWA Strategic Plan by prioritizing safety and equity of information access while creating opportunities for transformative innovation led by collaborative public-private engagement to develop the tools and methods for data capture, management, and utilization in an agency Transportation Systems Management and Operations (TSMO) context.[24]

Research to Support Best Practices in Electric Vehicle Charging and Alternative Fueling Infrastructure Deployment: FHWA will conduct research to document and share best practices related to the deployment of charging and fueling infrastructure through HEP. This work will include support of peer-to-peer exchange among States and local governments, documentation of case studies, and delivery of technical assistance.

Highway Cost Allocation Study (HCAS): In FY 2024, the Office of Transportation Policy Studies will continue carrying out an HCAS as directed by Section 11530 of the BIL.[3] This initiative is through HPL. The study intends to estimate and evaluate highway costs and highway user fee revenues attributed to various classes of highway users. The study results will provide critical information for making user fee policy decisions while taking into account equity considerations. Completing an HCAS will require examining the existing methods, developing new techniques and analytical models, enhancing and updating existing analytical models, and identifying and utilizing existing and new data sources.

DBE Program Oversight Tools for Monitoring Subcontractor Prompt Payment and Return of Retainage Requirements: Access to capital has traditionally been a barrier for DBEs and all small businesses, especially in the heavy highway civil construction industry. This initiative is through the FHWA HCR, which has prepared an informative toolkit and an optional monitoring tool to aid recipient State DOTs and local agencies in meeting monitoring and enforcement criteria for prompt payment. These documents aim to clarify regulatory requirements and USDOT guidelines and offer States an easy-to-use tool to monitor prompt payment and return of retainage for all subcontractors on Federally aided contracts. Underlining those requirements is essential for quick payment and return of retainage to all subcontractors, not just DBEs. In the BIL, Congress emphasized the significance of quick payment.[3] Prompt payment and return of retainage are imperative for subcontractors to keep up with expenses like payroll, materials, equipment, and other business expenses that are key to their survival. Delayed payments by prime contractors can result in devastating financial hardship for all subcontractors.

Table 1. FY 2024 RD&T Program Funding Details

The FY 2024 RD&T program funding table shows how much funding is dedicated to each RD&T program. It includes the amount of funds for each program in the FY 2024 U.S. President's budget request and the total amount spent on basic and applied research, T2, facilities, experimental development, and major equipment and R&D equipment. FHWA does not fund basic research but uses most of the funds on technology deployment and applied research. In FY 2024, FHWA expects to allocate 35.2 percent of R&T funds toward applied research, 58.2 percent for T2, and 6.6 percent for experimental development. No funds are planned for facilities, major equipment, or R&D equipment.

RD&T Program Name		FY 2024 U.S. President's Budget Request* ($000)	Applied ($000)	Technology Transfer ($000)	Facilities ($000)	Experimental Development ($000)	Major Equipment, R&D Equipment ($000)
Improving Highway Safety for All Users	**Safety Program Delivery**	2,707	0	2,707	0	0	0
	Safety Design and Operations	4,644	3,478	1,166	0	0	0
	Safety Data and Analysis	4,243	2,709	1,534	0	0	0
	Human Factors Analytics	1,699	1,699	0	0	0	0
	TOTALS	13,293	7,886	5,407	0	0	0
Improving Infrastructure Integrity, Sustainability, and Practices	**Construction and Project Management**	1,659	495	494	0	670	0
	Geotechnical and Hydraulics	4,092	1,483	1,126	0	1,483	0
	Long-Term Infrastructure Performance (LTIP)	4,644	2,965	690	0	989	0
	Pavements and Materials	8,073	6,096	0	0	1,977	0
	Structures	9,177	4,449	2,471	0	2,257	0
	Transportation Performance and Asset Management	1,106	0	711	0	395	0
	TOTALS	28,751	15,488	5,492	0	7,771	0
Institutionalizing Equity, Strengthening Transportation Planning, and	**Accelerating Project Delivery**	3,246	2,791	455	0	0	0
	Performance-Based Planning and Equity	2,274	1,624	325	0	325	0

RD&T Program Name		FY 2024 U.S. President's Budget Request* ($000)	Applied ($000)	Technology Transfer ($000)	Facilities ($000)	Experimental Development ($000)	Major Equipment, R&D Equipment ($000)
Enhancing Environmental Decisionmaking	**Modeling and Analysis Tools**	2,274	931	910	0	433	0
	Resiliency	1,407	650	324	0	433	0
	Multimodal Connectivity	1,407	1,061	173	0	173	0
	TOTALS	10,608	7,057	2,187	0	1,364	0
Reducing Congestion, Improving Operations, and Enhancing Freight Productivity	**TSMO**	6,305	6,305	0	0	0	0
	MUTCD[22]	100	70	20	0	10	0
	Automation and Connectivity	6,300	4,562	869	0	869	0
	Managing Disruptions to Operations	3,325	2,138	593	0	594	0
	Freight Management and Operations	3,750	3,264	83	0	403	0
	Truck Size and Weight (TSW)	820	570	0	0	250	0
	TOTALS	20,600	16,909	1,565	0	2,126	0
Accelerating the Implementation and Delivery of New Innovations and Technologies	**EDC[6]**	6,036	0	6,036	0	0	0
	STIC Incentive	6,062	0	6,062	0	0	0
	AID	8,036	0	8,036	0	0	0
	AMR	2,706	0	2,706	0	0	0
	Technology Deployment Support	1,779	0	1,779	0	0	0
	Innovative Finance	964	494	470	0	0	0
	AIDPT[8]	12,000	1,000	11,000	0	0	0
	Accelerated Implementation and Deployment of ADCMS[9]	20,000	2,000	18,000	0	0	0
	ATTAIN	39,000	0	39,000	0	0	0
	Research Infrastructure, Technology Transfer, and Partnerships	3,500	1,001	2,135	0	364	0

RD&T Program Name		FY 2024 U.S. President's Budget Request* ($000)	Applied ($000)	Technology Transfer ($000)	Facilities ($000)	Experimental Development ($000)	Major Equipment, R&D Equipment ($000)
	TOTALS	100,083	4,495	95,224	0	364	0
Accelerating the Discovery of Transformational Solutions	**Research Infrastructure, Technology Transfer, and Partnerships**	11,655	3,333	7,121	0	1,201	0
	EAR	5,131	5,131	0	0	0	0
	SBIR	3,462	2,423	345	0	694	0
	SIRC	15,000	0	15,000	0	0	0
	National Motor Vehicle Per-Mile User Fee	10,000	10,000	0	0	0	0
	TOTALS	45,248	20,887	22,466	0	1,895	0
Crosscutting	**Policy Analysis**	4,319	3,608	411	0	300	0
	Global Outreach	726	326	400	0	0	0
	HDI	6,971	5,001	1,837	0	133	0
	National Performance Management Research Data Set (NPMRDS)	1,800	1,292	474	0	34	0
	Civil Rights	890	296	297	0	297	0
	Federal Lands Highway	1,668	1,668	0	0	0	0
	Emerging/ Corporate Needs	22,043	6,304	13,468	0	2,271	0
	TOTALS	38,417	18,495	16,887	0	3,035	0
Administrative and Facilities Costs	**Administrative and Facilities Costs**	9,008	2,577	5,503	—	928	—
Totals		266,008	93,794	15,4731	—	17,483	—

—No data.

The AMRP reflects funding as found in the annual President's budget request per 49 U.S.C. Chapter 65 Sec. 6501 Research Planning. The enacted numbers will be posted as part of the President's budget request for the ensuing fiscal year.

Table 2. FY 2024 RD&T Program Budget Request by DOT Strategic Goal

The following table shows the amount of FY 2024 funds in the President's budget request for each RD&T program for each of the USDOT's strategic goals. Most of the requested funds support the Transformation, Safety, and Economic Strength and Global Competitiveness goals. In FY 2024, FHWA expects to allocate the following percentages of R&T funds to support each of the strategic goals: 19.4 percent for Safety, 20.0 percent for Economic Strength and Global Competitiveness, 9.8 percent for Equity, 14.8 percent for Climate and Sustainability, 33.2 percent for Transformation, and 2.6 percent for Organizational Excellence.

RD&T Program Name		FY 2024 U.S. President's Budget Request* ($000)	Safety ($000)	Economic Strength and Competitive-ness ($000)	Equity ($000)	Climate and Sustain-ability ($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
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	**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

RD&T Program Name		FY 2024 U.S. President's Budget Request* ($000)	Safety ($000)	Economic Strength and Competitive-ness ($000)	Equity ($000)	Climate and Sustain-ability ($000)	Transformation ($000)	Organizational Excellence ($000)
Decisionmaking	**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[22]	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]**	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
	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[8]	12,000	300	8,000	300	2,200	1,200	0
	Accelerated Implementation and Deployment of ADCMS[9]	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	**Research Infrastructure,**	11,655	2,913	1,749	1,166	1,166	3,496	1,165

RD&T Program Name		FY 2024 U.S. President's Budget Request* ($000)	Safety ($000)	Economic Strength and Competitive-ness ($000)	Equity ($000)	Climate and Sustain-ability ($000)	Transformation ($000)	Organizational Excellence ($000)
Transformational Solutions	**Technology Transfer, and Partnerships**							
	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
Administrative and Facilities Costs	**Administrative and Facilities Costs**	9,008	2,253	1,353	900	900	2,702	900
Totals		266,008	52,197	53,287	25,881	39,343	88,363	6,937

—No data.

The AMRP reflects funding as found in the annual President's budget request per 49 U.S.C. Chapter 65 Sec. 6501 Research Planning. The enacted numbers will be posted as part of the President's budget request for the ensuing fiscal year.

Table 3. Summary of FY 2024 RD&T Program Budget Request by DOT Strategic Goal and AMRP Program

The following table shows a summary of table 2 from top to bottom and illustrates the percent of the FY 2024 RD&T program budget request by each AMRP program from left to right.[2] In FY 2024, FHWA expects to allocate 60 percent of the budget request to discovering and implementing new innovations and transformational solutions.

RD&T Program Name	Safety ($000)	Economic Strength and Competitiveness ($000)	Equity ($000)	Climate and Sustainability ($000)	Transformation ($000)	Organizational Excellence ($000)	Total (Percentage)
Improving Highway Safety for All Users	13,293	0	0	0	0	0	13,293 (5)
Improving Infrastructure Integrity, Sustainability, and Practices	3,498	9,047	0	7,022	9,184	0	28,751 (11)
Institutionalizing Equity, Strengthening Transportation Planning, and Enhancing Environmental Decisionmaking	1,300	1,191	3,245	3,302	1,570	0	10,608 (4)
Reducing Congestion, Improving Operations, and Enhancing Freight Productivity	4,351	6,034	1,983	3,664	4,363	205	20,600 (8)
Accelerating the Implementation and Delivery of New Innovations and Technologies	15,184	25,998	13,273	16,309	28,656	663	100,083 (39)
Accelerating the Discovery of Transformational Solutions	3,984	2,326	2,237	2,732	32,227	1,742	45,248 (18)
Crosscutting	8,334	7,338	4,243	5,414	9,661	3,427	38,417 (15)
Totals (Percentage)	49,944 (19)	51,934 (20)	24,981 (10)	38,443 (15)	85,661 (33)	6,037 (2)	257,000

The AMRP reflects funding as found in the annual President's budget request per 49 U.S.C. Chapter 65 Sec. 6501 Research Planning. The enacted numbers will be posted as part of the President's budget request for the ensuing fiscal year.

Chapter 1—FY 2024 RD&T Programs

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

Program Description

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.[11] The program supports HSIP, which aims to significantly reduce fatalities and serious injuries on all public roads.

The Improving Highway Safety for All Users program also advances the safety engineering work that overlaps with 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.

Major Program Objectives

The Improving Highway Safety for All Users program will apply 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.[11] 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 will also invest 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. A pedestrian safety initiative launched in 2020 will establish enhanced equity methods for pedestrian data collection and more accurately determine how and where pedestrian risk is greatest. FHWA will be planning new testing procedures along with TRB's National Cooperative Highway Research Program (NCHRP) to examine vehicle side impacts on barriers. New barrier designs that are context sensitive with National Parks will be tested for safety standards compliance of the materials. In FY 2024, FHWA's Human Factors Team will use the recently expanded capability of the Virtual Reality Laboratory to support and evaluate various pedestrian and bicyclist testing. Further human factors initiatives will assess cooperative driving operations, safety applications, and use cases to understand human behavior effects. New analytics are under development to provide greater focus on alleviating the impact on social and demographic communities that suffer disproportionately from preventable death and fatal injury from crashes.

Anticipated Program Activities

The Improving Highway Safety for All Users program aims to conduct a range of R&D activities that support the evolving needs of all roadway users and advance FHWA's commitment to the Safe System Approach.[11] New work activities will expand detection technologies for pedestrians, wheelchair users, and other VRUs. Further activities on intersection and roadway departure research will yield more precise factors to evaluate the effectiveness of safety countermeasures. Continued work with FHWA partners in the HSIP and Safe Streets and Roads for All grant program (SS4A) will increase the deployment of lifesaving safety countermeasures for all roadway users.

The Improving Highway Safety for All Users program also supports the VRU research plan (released in FY 2023), which will identify research priorities, organize those priorities around four goals (safety, equity, networks, and trips), and define specific objectives for FHWA with example research activities that advance these objectives. The Intersection Safety Challenge announced in 2023 will accelerate market-ready technologies that improve the sensing of VRU immediately around an intersection.

Key FY 2024 FHWA Improving Highway Safety for All Users R&T Program Activities.

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

Potential Program Outputs, Outcomes, and Impacts

A range of anticipated program outcomes express the breadth of this program.

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. FHWA will continue to encourage a data-driven, performance-based, equitable approach to saving lives through the HSIP and other efforts. In FY 2024, efforts will build upon the FY 2023 activities and ensure alignment with the USDOT and FHWA strategic plans as well as the USDOT NRSS.[23] FHWA also will conduct a study to examine disparities in roadway fatalities and serious injuries, with a focus on pedestrian and bicyclist fatalities and injuries.[20] The research aims to identify the structural causes that contribute to disparities in pedestrian and bicyclist crash mortality and morbidity and to develop recommendations for FHWA, State DOTs, and MPOs to address these disparities.[20]

Safety Design and Operations

Under the Safety Design and Operations activity, FHWA staff are leading and collaborating on a number of 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 (CAVs). 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. Efforts in FY 2024 will build upon the FY 2023 activities and ensure alignment with the USDOT and FHWA strategic plans as well as the USDOT NRSS. Research results on the safety effectiveness of aesthetically treated crosswalks will be available in FY 2024.[23] Work with the National Park Service and the FHWA Office of FLH will produce testing reports and design refinements for aesthetic barriers. Safety performance evaluation of Point-to-Point Safety Speed Camera Enforcement through Pilot Testing will examine automated techniques that have been proven to save lives elsewhere. In FY 2024, this project will work with stakeholders on locating a testing site and examining the configuration that is most suitable.

Safety Data and Analysis
Data-driven technologies and decisionmaking are key themes for all FHWA programs, especially for Safety. The Safety Data and Analysis activity reflects the emphasis placed on supporting highway infrastructure investment decisionmaking. The main goal of the 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. Efforts in FY 2024 will build upon the FY 2023 activities and ensure alignment with the USDOT and FHWA strategic plans, as well as USDOT NRSS.[23] 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 activity aims to accomplish the following:

- Improve the effectiveness of safety countermeasures as well as tools that promote operational efficiency.
- Understand how CAVs can be safely integrated into the Nation's roadway systems by evaluating the human behaviors related to the deployment of cooperative automation.
- Improve roadway designs that meet the needs of drivers, pedestrians, and other vulnerable users.
- Understand how people respond to the roadway environment, including signs and markings, emerging vehicle and roadway technology, innovative operational changes, safer streets with improved walkability, and other new roadside innovations.
- Identify how human factors may guide safety programs and enable innovative approaches to improving safety.
- Understand how social factors contribute to disparities in traffic fatalities and serious injuries for underserved communities, particularly pedestrians and bicyclists.

In FY 2024, research results will consider the safety issues of automated vehicle technology related to infrastructure. This activity will also test advanced imaging and detection techniques that promote VRU safety. Additionally, guidelines on variable message signage

during nonrecurring events will provide more human-response research into how this technology may enable proactive roadway management to reduce secondary crashes. Continued work will yield research results on operational guides for cooperative driving automation (CDA) that promote safe operation in the presence of pedestrians and VRUs.

Potential Economic or Societal Impacts

The Safe System Approach is based on six principles: deaths and serious injuries are unacceptable, humans make mistakes, humans are vulnerable, responsibility is shared, safety is proactive, and redundancy is crucial.[11] The Safe System Approach has resulted in dramatic improvements in highway safety around the world.[11] In the Improving Highway Safety program, FHWA has adopted the Safe System Approach as a guide toward defining the priorities for the program as a whole.[11] The Safe System Approach broadens FHWA's view of the safety of the transportation system.[11] It encompasses working closely with roadway professionals beyond the safety discipline and with agencies and organizations responsible for other aspects of the transportation system to achieve safe roads, safe speeds, safe people, safe vehicles, and better post-crash care. FHWA's Safe System Approach includes a focus on safety for road users outside of vehicles—the pedestrians, bicyclists, motorcyclists, and others who make up a growing portion of roadway fatalities.[11]

Potential Progress Made Toward Achieving Strategic Goals

The Improving Highway Safety for All Users program is making steady progress in realizing the primary USDOT goal of safety. 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. Efforts through prior EDC activities continue in practice today, with many State partners adopting data-driven safety assessments as part of their routine practices.[6] This effort has been further advanced through FHWA's collaboration with the American Association of State Highway and Transportation Officials (AASHTO) to deliver tools, training, and technical assistance for the Interactive Highway Safety Design Model and prepare the States to manage the tool.[26]

Collaboration Partners

The Improving Highway Safety for All Users program collaborates internally and externally to develop research activities and exchange information among peer organizations. FHWA manages pooled fund studies (PFS), including the Traffic Control Devices, Evaluation of Low-Cost Safety Improvements, and Naturalistic Driving studies, to collaborate with dozens of State DOT partners, local agencies, and associations to address research needs to further streamline implementation. FHWA staff engaged in this program are active participants in national and international organizations and committees such as PIARC, TRB, the Institute of Transportation Engineers (ITE), AASHTO, the National Safety Council (NSC), Operation Lifesaver, and the Governors Highway Safety Association.

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

Program Description

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 leadership and work products provided through FHWA's Improving Infrastructure Integrity, Sustainability, and Practices program are aligned with the USDOT's strategic goal of Transformation and will contribute to the achievement of the Safety, Economic Strength and Global Competitiveness, and Climate and Sustainability strategic goals.

Major Program Objectives

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 bring about improved infrastructure integrity, safety, and sustainability. The program works to achieve the following:

- Transform infrastructure construction, contracting, and stewardship practices to efficiently achieve long-lasting, resilient infrastructure and safer construction work zones.
- Support and enable improved infrastructure resiliency.
- Develop more durable and sustainable materials.
- Provide guidelines and tools to support comprehensive lifecycle assessment of infrastructure sustainability.

The Improving Infrastructure Integrity, Sustainability, and Practices program also includes developing and delivering transformational technologies to substantially improve the durability (and ultimately the sustainability and safety) of bridges and pavements and enhance material availability. The program also 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. Additionally, FHWA research is delivering the data and information infrastructure owners need to manage pavement and bridge conditions effectively and providing tools, technologies, and guidance to advance the effective management of highway infrastructure and system performance.

Anticipated Program Activities

The Improving Infrastructure Integrity, Sustainability, and Practice program supports the Permeable Pavements Study. The study will examine the effects of permeable pavements on flood control in different contexts, including in urban areas, and over the lifetime of the

permeable pavement. This work was fully funded at $150,000 in FY 2022 and will continue into FY 2023.

Planned FY 2024 Improving Infrastructure Integrity, Sustainability, and Practice program activities are listed in the following table. These activities encompass projects spanning the technology spectrum from applied research through the deployment of established technologies and address infrastructure lifecycle phases from design onward. Allocation of funding among these activities has been adjusted from prior years based on current needs and priorities.

Key FY 2024 FHWA Improving Infrastructure Integrity, Sustainability, and Practices R&T Program Activities.

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

Potential Program Outputs, Outcomes, and Impacts

Construction and Project Management

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, 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 (such as tremie concrete for mass underground pours and improvements in limit state design); advanced site and laboratory characterization (such as evaluating specialized tests and developing correlations between lab and field parameters); geotechnics of scour (such as evaluating methods to determine soil erosion resistance); geotechnical asset and performance management (such as collection and dissemination of geotechnical datasets); geotechnical aspects of pavements (such as the design and selection of subbase and base materials for the Pavement Testing Facility); hydrology (such as climate change, extreme events, and floodplains); highway drainage; bridges and culvert hydraulics; hydraulics of scour; and coastal engineering. Expected outcomes include the transfer and application of 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. This multifaceted program activity

yields an effective crosscutting approach to address geotechnical and hydraulic challenges, resulting in more resilient and cost-effective highway infrastructure.

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

Pavements and Materials
Pavements and Materials outputs will include research findings and data concerning materials innovations (including materials having lower embedded carbon) 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 improvements in system reliability, sustainability, and safety.

Structures
Structures outputs will 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 arising 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
The research in Transportation Performance Asset Management will produce next-generation performance measures as well as 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.

Potential Economic or Societal Impacts

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.

Potential Progress Made Toward Achieving Strategic Goals
As is evident from the outcomes and impacts described in the preceding sections, FHWA's Improving Infrastructure Integrity, Sustainability, and Practice program will make substantive contributions to achieving the USDOT Transformation strategic goal. The Improving Infrastructure Integrity, Sustainability, and Practice program will also contribute to achieving the Safety, Economic Strength and Global Competitiveness, and Climate and Sustainability strategic goals by supporting and enabling accelerated project delivery and improved infrastructure integrity. In addition, the program will contribute through work with materials that reduce GHG emissions arising from highway infrastructure construction, preservation, and maintenance.

Collaboration Partners
FHWA infrastructure leaders and program staff regularly engage with key stakeholders in both formal and informal settings to gather input concerning challenges and opportunities that might be addressed through the program and information on work undertaken by other organizations nationally and internationally. Stakeholders include representatives of individual State DOTs; pertinent committees of AASHTO and TRB; industry organizations (e.g., the American Society of Civil Engineers; the National Asphalt Pavement Association (NAPA); the American Concrete Pavement Association (ACPA); the National Stone, Sand & Gravel Association; the Precast/Prestressed Concrete Institute; the National Steel Bridge Alliance; the Deep Foundations Institute; the International Association of Foundation Drilling; the Geosynthetic Materials Association; the Associated General Contractors of America (AGC); and the American Road & Transportation Builders Association (ARTBA)); standard-setting organizations such as the American Concrete Institute (ACI) and ASTM International; and university faculty engaged in related work. Peer exchanges and technical feedback group meetings are held to exchange best practices and ascertain stakeholder needs. Participation in PFS projects provides for collaboration with State and industry stakeholders to address shared issues.

The individual State DOT owners of the pavements and bridges under study through LTIP research actively support data collection efforts. Their active engagement makes LTIP research possible. Due to the importance of their engagement, FHWA contracts with TRB for a Federal Advisory Committee Act (FACA)-compliant LTIP Advisory Committee that provides consensus stakeholder advice on the conduct of the program via letter reports to the FHWA Administrator.[27] In addition, FHWA LTIP activity staff regularly engage with stakeholders in both formal and informal settings to gather input concerning challenges and opportunities that might be addressed through the program and information on related work undertaken by other organizations both nationally and internationally. A State coordinators group has been established for each program as a forum to strengthen the partnership between FHWA and the State DOTs.

FHWA engages with the other DOT modal administrations through both the USDOT State of Good Repair working group and activity-specific collaboration. Additionally, FHWA collaborates with other Federal agencies such as the National Institute of Standards and Technology (NIST), FLMAs, the U.S. Geological Survey, and the National Oceanic and Atmospheric Administration on topics of mutual interest and concern.

Formal interactions with AASHTO, TRB, and industry organizations generally occur at regular intervals (at least annually and as often as quarterly) but are not formally tracked or measured. Ad hoc interactions in the form of technical assistance requests are logged on an internal collaborative platform.

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

Program Description

The Institutionalizing Equity, Strengthening Transportation Planning, and Enhancing Environmental Decisionmaking research program will carry 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. This program supports many of USDOT's strategic goals.

Accelerating Project Delivery

The Accelerating Project Delivery activity supports innovative research programs to address environmental stewardship and equity in project delivery. This activity helps FHWA develop well-informed and environmentally sound transportation projects and initiatives through NEPA implementation initiatives, improved coordination and communication between agencies and the public, and capacity-building initiatives for environmental practitioners. The primary strategic goals of the Accelerating Project Delivery activity are Safety, Climate and Sustainability, and Equity; a secondary goal is Transformation.

Accelerating Project Delivery research also supports the development of rulemaking, guidance, and best practices for real property acquisition processes, which includes relocation planning. Project scheduling uses relocation planning information to develop a timeframe to complete the real property acquisition process. Relocation planning helps develop solutions to problems and challenges brought about by the impacts of surface transportation projects on the pre- and post-project environment for the community and individuals.

Performance-Based Planning and Equity

The Performance-Based Planning and Equity research activity supports title 23 U.S.C. §§ 134, 135, and 150 and implements title 23 Code of Federal Regulations (CFR) Parts 420 and 450, in which the USDOT is required to work with States and MPOs to encourage continuous improvement and evolution of the metropolitan and statewide transportation planning processes using a performance-based approach.[28–32] USDOT assists States and MPOs in documenting and meeting performance measures and associated targets related to national highway and transit performance goals. USDOT also provides risk-based oversight and stewardship on performance measures and targets. Additionally, Executive Orders 13985 ("Advancing Racial Equity and Support for Underserved Communities Through the Federal Government") and 14091 ("Further Advancing Racial Equity and Support for Underserved Communities Through the Federal Government") require Federal agencies to advance equity across the Federal Government to create opportunities for improving communities that have been historically underserved and provide all people an opportunity to reach their full potential.[33,34]

This research activity supports USDOT's strategic goals of Safety, Economic Strength and Global Competitiveness, Equity, Transformation, and Organizational Excellence. The Performance-Based Planning and Equity activity will work 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 measures and targets are connected through long-range transportation plans and transportation improvement programs developed at the statewide and metropolitan levels. The Performance-Based Planning and Equity research will also advance multimodal networks through the development of resources that improve access and mobility as well as implement 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. It also refines 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 will enhance transportation planning and decisionmaking in a cost-efficient and environmentally responsible manner. This research supports 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.

This research activity supports four of USDOT's strategic goals: Climate and Sustainability, Equity, Safety, and Economic Strength and Global Competitiveness. Models and tools are developed to assess and analyze the potential environmental impacts of highway projects and to provide important insights and approaches that will contribute to improving air quality, mitigating GHG emissions, reducing noise, and addressing congestion caused by the high demand for travel on the highway system. These tools will also help evaluate the impacts and identify equitable transportation project decisions, especially in communities near major roadways that are disproportionately affected by air pollution and noise impacts. In addition, the tools can evaluate the potential health effects of harmful emissions,

especially on vulnerable and overburdened communities, and provide data to help identify options to reduce health and safety risks for the public, including vulnerable populations. These tools can also be used to analyze corridor and system operations to increase travel time reliability, manage travel demand, and improve connectivity. This analysis can help promote the adoption of noteworthy multimodal transportation system management and operations practices.

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. 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. To better address these risks and vulnerabilities, FHWA will conduct research and develop activities to integrate resiliency and sustainability into transportation planning, project development, and design. FHWA will also work with other Federal agencies to better predict and estimate the 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. FHWA will conduct R&D activities to better inform decisionmaking regarding GHG emissions reduction and performance measurement and ensure transportation decisions are informed by economic, social, and environmental effects and trade-offs. 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.

Resiliency research directly supports the Department's Climate and Sustainability goal. The Resiliency research activity helps address the climate crisis by developing and deploying tools and methods for State and local governments to inform decisions regarding climate impacts on transportation and reducing transportation sector-related GHG emissions. In addition, this research supports agencies investigating a broad range of sustainability goals and objectives when making transportation decisions by developing and deploying tools focused on sustainable transportation.

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. The secondary goals served by the multimodal network connectivity approach are Equity and Climate and Sustainability, as these networks provide affordable transportation with reduced carbon output.

Major Program Objectives
The Institutionalizing Equity, Strengthening Transportation Planning, and Enhancing Environmental Decisionmaking research program supports USDOT's strategic goals of Safety, Economic Strength and Global Competitiveness, Equity, Climate and Sustainability, and Transformation. FHWA's mission is to promote safety, mobility, and economic growth

while enhancing the quality of life of all Americans. FHWA accomplishes this mission through leadership, innovation, oversight, and stewardship that ensures the Nation's roads and highways continue to be among the safest and most technologically sound in the world.

Accelerating Project Delivery
The Accelerating Project Delivery activity supports initiatives and projects to help FHWA improve the environmental review process, coordinate with the public and agencies, and arrive at better environmental outcomes for transportation projects. This effort aligns with the goals of reducing the potential impact of highway infrastructure and operations on the environment, advancing improvements in environmental analysis, reducing the impact of highway runoff on the environment, and improving transportation planning decisionmaking and coordination.

The Accelerating Project Delivery activity supports programs and projects that aim to reduce the potential impact of highway infrastructure and operations on individuals and communities affected by those programs and projects. Accelerating Project Delivery research also supports relocation planning, real property acquisition cost estimation, design, transportation planning, environmental and civil rights project development review, project-related decisionmaking and coordination, and project budgeting and scheduling.

Performance-Based Planning and Equity
Performance-Based Planning and Equity will work with States and MPOs to apply performance management within the transportation planning and programming processes and help them achieve their desired performance outcomes for a multimodal transportation system. Performance-Based Planning and Equity ensures that transportation investment decisions are made (both in long-term planning and short-term programming of projects) based on their ability to meet established targets. This research will support USDOT's and FHWA's strategic goals and promote more informed decisionmaking that improves transportation planning, programming, operations, and coordination.

Performance-Based Planning and Equity will highlight how States and MPOs are working with communities to participate in the project decisionmaking process. This process includes providing information about the environmental impacts of highway projects and alternatives being considered for each project and identifying innovative and effective mitigation strategies. This activity will provide stakeholders at State DOTs, MPOs, and the public with tools, data, and a regulatory framework to protect human health and the environment. FHWA will also explore and adapt modeling methodologies for transportation planning to allow State DOTs and MPOs to better understand their transportation systems. FHWA's efforts will also provide decisionmakers with actionable techniques and tools to better understand how a complex transportation system reacts to investments and policy changes and efficiently make trade-offs between performance metrics.

Modeling and Analysis Tools
The Modeling and Analysis Tools research activity supports USDOT's strategic goals and policy objectives as follows:

- Reduce the potential impact of highway infrastructure and operations on the environment.
- Advance improvements in environmental analyses and processes and context-sensitive solutions for transportation decisionmaking.
- Accelerate construction to reduce congestion and related emissions and improve understanding and modeling of the factors that contribute to the demand for transportation.
- Support investments that encourage safe, equitable, multimodal transportation and strategies to minimize, avoid, or mitigate negative impacts of transportation projects on disadvantaged or overburdened communities.

Improving current air quality and noise modeling tools to produce more accurate and reliable results will provide decisionmakers with the best possible information about the air quality and noise impacts of proposed highway projects when making future infrastructure investment decisions. Accurate predictions of these impacts are critical to engaging the community, understanding the local environment, avoiding costly legal challenges, and supporting innovative infrastructure investments that are vital to the economic growth of the Nation.

Modeling and analytical tools are essential for State DOTs and MPOs to demonstrate to the public that highway projects in their communities do not adversely affect their health and well-being. Developing and deploying new and innovative tools and methods will allow for additional analyses to ensure the protection of human and natural environments.

Resiliency
The Resiliency activity objectives include the following:

- Developing and deploying tools and methods, promoting best practices, and developing and delivering training to help decisionmakers incorporate climate change resiliency, GHG reduction, and sustainability in transportation plans, projects, and programs.
- Accelerating the adoption of electric and alternative-fueled vehicles by supporting fueling and charging infrastructure deployment.
- Conducting training and technical assistance for State DOTs and MPOs.
- Conducting research on best practices, usage, behavior, and stakeholder needs.
- Designating alternative fuel corridors.
- Exploring opportunities to use highway right-of-way to enhance sustainability and reduce GHG emissions, generate additional benefits, and reduce costs that are consistent with operational and safety concerns.

The Resiliency activity directly supports several of the program objectives included in 23 U.S.C. § 503, including studying the vulnerabilities of the transportation system to seismic activities and extreme events and methods to reduce those vulnerabilities; improving transportation planning decisionmaking and coordination; reducing the

potential impact of highway infrastructure and operations on the environment; and advancing improvements in environmental analyses and processes and context-sensitive solutions for transportation decisionmaking.(1)

Multimodal Connectivity
Multimodal Connectivity research will improve equitable 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. This research will help ensure inclusive multimodal planning, design, and programming to facilitate equitable project delivery outcomes. It 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.

Anticipated Program Activities
The Institutionalizing Equity, Strengthening Transportation Planning, and Enhancing Environmental Decisionmaking research program will support the Study on Stormwater Best Management Practices. FHWA, in coordination with the U.S. Environmental Protection Agency (EPA), formally offered to enter into an agreement with TRB to conduct the study. The contract to do the study is about to be finalized.

This program also supports the new Transportation Access Pilot Program. FHWA will work with States, MPOs, and regional transportation planning organizations (RTPOs) to develop and use accessibility datasets to measure the level of access by surface transportation mode to important destinations. These destinations include jobs, healthcare facilities, childcare services, educational and workforce training facilities, housing, food sources, points within the supply chain for freight commodities, domestic and international markets, and connections between surface transportation modes. In 2024, FHWA will finalize a report to Congress on the results of the pilot program and FHWA's ability to develop and provide accessibility datasets for all States, regions, and localities.

Key FY 2024 FHWA Institutionalizing Equity, Strengthening Transportation Planning, and Enhancing Environmental Decisionmaking R&T Program Activities.

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 will address the evolving environmental policy landscape. FHWA will continue to promote existing successful practices such as the national liaison program, the Project and Program Action Information System (PAPAI), the Interagency NEPA & Permitting Collaboration Tool (INPCT), NEPA Assignment, Planning and Environment Linkages (PEL), and VPI.[35,36,37] FHWA continues to support research and outreach related to equity, compliant real property acquisition, and climate change. FHWA will continue to provide funding for the Center for Environmental Excellence by AASHTO and provide updates on regulation, policy, and guidance.

Performance-Based Planning and Equity
Performance-Based Planning and Equity will support and distribute State and MPO best practices for making investment decisions based on a data-driven performance-based planning and programming (PBPP) approach and estimate the economic benefits and other cost-saving options. The activity will monitor the effectiveness of PBPP at the State and regional levels and coordinate with key stakeholders to ensure consistent monitoring and documentation of performance measures and targets. FHWA will apply analytical tools and data resources in the transportation planning decisionmaking process and work with States and MPOs to identify notable practices.

PBPP includes partnering with transportation agencies to develop and deploy best practices, case studies, and other capacity-building activities that support enhanced small, rural, and midsized communities and regions. FHWA will provide stakeholders with technical assistance by developing training essentials, peer reviews, peer exchanges, workshops, virtual forums, and other mediums that promote planning best practices. This activity will identify innovative visualization methods to analyze, map, present, and report equity information to transportation practitioners, elected officials, and the public. The research will evaluate planning needs in partnership with key stakeholders and identify opportunities and risks of existing procedures to support the continuing, cooperative, and comprehensive planning process.

FHWA will also partner with key entities (domestic and international) to market emerging products and technologies to meet planning research needs.

Modeling and Analysis Tools
As part of the Modeling and Analysis Tools activity, FHWA will develop and deploy state-of-the-art models and analytical tools to improve data collection methods to enhance air quality, noise, and GHG analyses. A review of the noise model's acoustical assumptions to enhance the noise impact analysis is underway. A research effort will be initiated to identify and evaluate innovative mitigation and abatement measures and assess their effectiveness in reducing emissions and noise impacts. Tools to assist State DOTs and MPOs in assessing air quality and noise impacts at the community level in the near-road environment may also be developed.

Resiliency

The Resiliency activity will partner with State DOTs and others to improve processes, tools, and methods through developmental applied research and demonstration projects for incorporating climate change, extreme events, and natural disaster resilience. FHWA will provide continued support, training, and technical assistance on climate change, extreme events, and natural disaster resilience for highway planning, design, construction, operations and maintenance, and asset management. The program will develop tools and techniques to better inform decisionmaking on GHG emission reductions and sustainability. FHWA will also support the expansion of alternative fuels and EV charging infrastructure by designating alternative fuel corridors, providing technical assistance and training, and conducting research. Support will be provided to innovative and alternative right-of-way uses, including installing renewable energy generation and providing broadband for additional societal benefits consistent with highway operation and safety concerns. Part of the Resiliency activity will be conducting research and supporting the implementation of highway construction and materials that reduce environmental impacts and emissions and maximize material efficiency and recycling.

Multimodal Connectivity

The Multimodal Connectivity activity will promote connectivity practices through a cooperative agreement to operate a national Pedestrian and Bicyclist Information Center to develop and share resources vital to advancing mobility, access, equity, and safety for pedestrians and bicyclists. This activity will also conduct research through an intra-agency agreement with USDOT Volpe. Other research projects that will support this activity include a task to ensure that new and innovative pedestrian and bicyclist facilities are accessible for people with disabilities. Multimodal Connectivity will provide for the administration of the NHS official record and GIS database to facilitate National Highway Performance Program eligibility determination and NHS system performance tracking.(38) FHWA will conduct research and develop resources related to the role of equity in shared micromobility systems. This work includes developing micromobility case studies, such as providing electric bikes and scooters in underserved neighborhoods and the impacts of e-scooter programs on access and climate goals.

Potential Program Outputs, Outcomes, and Impacts

Accelerating Project Delivery

Accelerating Project Delivery will support the development of environmental and real property acquisition regulation and policy, reauthorization implementation, project development tools, and collaboration on programs and studies that promote environmental and real property acquisition stewardship and equity in the project development. FHWA will continue to help State DOTs and project stakeholders achieve well-informed environmental outcomes using tools such as INPCT (an interagency collaboration tool that aids project development), PEL (a collaborative approach to bridging project phases), PAPAI (an online tool that helps FHWA monitor project progress), VPI, programmatic agreements, Environment Discipline Support System, and NEPA Assignment support.[36,37,35] This activity will fund national liaison initiatives with other Federal agencies to improve cross-agency efficiency and collaboration. This activity will also support the development of tools for streamlining and accelerating real property acquisition initiatives. Finally, Accelerating Project Delivery will support partnerships, such as the Center for Environmental Excellence, with the private sector, research organizations, and State and local governments on research topics such as stormwater permitting, Endangered Species Act compliance, and historic preservation.[39]

Performance-Based Planning and Equity

Performance-Based Planning and Equity research will undertake the following:

- Offer capacity-building opportunities that plan for and prioritize investments and accelerate project delivery.
- Update tools, technologies, and guidance to further performance-based planning.
- Improve connectivity, accessibility, safety, and convenience for all users, including those in rural areas.
- Promote and maintain a highway infrastructure asset system in a state of good repair.

Additionally, FHWA will consider how various factors, such as revenue constraints, demographic trends, economic shifts, or technological innovation, can affect a State or region and its transportation system performance.

Modeling and Analysis Tools

Modeling and Analysis Tools will be delivered to transportation stakeholders (State DOTs and MPOs) and the public in a variety of ways, such as conferences, workshops, webinars, training courses, peer exchanges, and social media postings. Documents such as research reports, case studies, model sensitivity and validation analyses, and technical guidance will be posted online and marketed at industry events. Research results will also support regulation, guidance, and policy updates.

This research will develop data-driven tools and methodologies to evaluate and demonstrate adequate environmental protection. State DOTs and other stakeholders can use the new and refined analytical tools, data, and other research products to assess air quality and noise impacts and the highway system's performance and support evidence-

based decisionmaking. These new tools can take advantage of technological advancements and use the latest scientific information to improve accuracy.

With accurate and timely information, States and MPOs can better engage the communities they serve. The effectiveness of mitigation strategies for noise and air quality is complex to evaluate and difficult to quantify. Mitigation of air quality impacts and abatement of noise impacts are important to ensure that noise and emissions levels are within the standards established in law and, in the case of air quality, to meet established performance measure targets. The research will develop tools to measure the amount of emission and noise-level reductions from existing standards and future innovative mitigation strategies. The tools can also be used to identify and assess effective mitigation and abatement strategies to alleviate impacts for communities near major corridors that face disproportionate exposure to air quality and noise pollution from vehicular traffic.

Resiliency
Expected activity outputs and outcomes include new partnerships with State DOTs and others to reduce GHG emissions; expedite the transition to electric and alternative-fuel vehicles; improve resiliency and sustainability processes, tools, and methods; and develop and deliver technical assistance and training on climate change, emission reduction, energy efficiency, sustainability, and resilience. These efforts would also include training and technical assistance developed and delivered on alternative fuels and EV charging, resulting in expanded EV charging and alternative fueling infrastructure and the generation of renewable energy in the highway right-of-way. This research provides examples, best practices, tools, and methods for the consideration of resiliency in transportation planning requirements under title 23 CFR § 450 and the integration of resiliency into asset management requirements under title 23 CFR § 515.[40]

Multimodal Connectivity
As Multimodal Connectivity increases in importance in network planning, FHWA will disseminate examples, case studies, and technical assistance resources through topical newsletters, Web portals, and other communications channels. Multimodal Connectivity will promote the rebalancing of multimodal investments to address inequalities in underserved communities. The economic benefits of highways and scenic byways, particularly in rural communities, will be identified. Outcomes include an increase in affordable mode choice and more multimodal trips (e.g., walking, biking, and scooting to transit). Improvements in network access analysis will reflect all users' needs for comfort, safety, and mobility to desired destinations. Advances in community impact analysis will bolster plans and projects that support wealth creation and community revitalization.

Potential Economic or Societal Impacts

Accelerating Project Delivery
Accelerating Project Delivery supports research activities that improve public involvement and the environmental decisionmaking process for transportation projects, leading to better community coordination and, ultimately, better community outcomes. FHWA developed case studies and fact sheets for VPI, which enhances and broadens the reach of public engagement efforts, including considerations and strategies for engaging

traditionally underserved communities. This approach makes participation more convenient, affordable, and enjoyable. When used in combination with traditional public involvement strategies, virtual tools provide increased transparency and access to transportation planning activities and project development and decisionmaking processes. FHWA is developing a case study of the relocation experiences of displaced persons that will inform FHWA on how to better address the problems and challenges faced by persons required to relocate and of communities impacted by Federal-aid projects.

Performance-Based Planning and Equity

Performance-Based Planning and Equity supports research activities that ensure transportation agencies around the country are demonstrating how cooperation across agencies can enhance transportation planning. The transportation system's performance affects public policy concerns, such as safety, air quality, environmental resource consumption, social equity, resilience, land use, urban growth, economic development, and security. Transportation planning recognizes the critical links between transportation needs and other societal goals. It includes strategies for operating, managing, maintaining, and financing the transportation system to advance an area's long-term goals and the regional community's shared vision for the future. This approach requires thinking beyond traditional borders and bringing together many entities to support common goals on transportation planning topics, such as equity, congestion management, safety, freight, and commerce. Performance-Based Planning and Equity activities help improve decisionmaking, save time and money through shared resources, and help agencies achieve more by working together.

Modeling and Analysis Tools

Air quality and noise analyses should consider the effects of a project's air quality and noise level changes within the health, equity, and environmental justice framework. The regulatory models for these analyses can be complex and difficult to use. FHWA's research aims to develop and update tools and methods to simplify the models to analyze impacts and mitigation to better serve the public need. In addition, air quality and noise models need to be updated to reflect the most current data and the most up-to-date modeling techniques. This research will ensure that States and MPOs have models that reflect the most recent information and best state-of-the-practice techniques to comply with laws and to assess system performance as accurately as possible. Analyses using these tools and models provide the basis to update air quality and noise regulations, guidance, and policy.

Resiliency

Deployment and implementation of the research tools and techniques under the Resiliency activity will help States and communities anticipate and adapt their infrastructure to account for the future challenges and impacts caused by climate change and extreme weather events, including consideration of the disproportionate impacts on disadvantaged communities. This research will also support the achievement of GHG reduction goals through the application of research tools and techniques to inform transportation projects and program decisions. This research would include the siting and deployment of EV charging infrastructure, the setting and achievement of GHG targets, and the implementation of renewable energy infrastructure in the highway right-of-way.

Multimodal Connectivity
The Multimodal Connectivity activity will promote the rebalancing of multimodal investments to address inequalities in underserved communities. The research will identify the economic benefits of highways and scenic byways, particularly in rural communities. Outcomes include an increase in affordable mode choice and more multimodal trips (e.g., walking, biking, and scooting to transit). Improvements in network access analysis will reflect all users' needs for comfort, safety, and mobility to desired destinations. Advances in community impact analysis will bolster plans and projects that support wealth creation and community revitalization.

Potential Progress Made Toward Achieving Strategic Goals

Accelerating Project Delivery
Accelerating Project Delivery will help FHWA address the primary strategic goals of Safety, Climate and Sustainability, and Equity and the secondary goal of Transformation. The Accelerating Project Delivery activity will help FHWA expedite project delivery while ensuring sound environmental stewardship, compliant real property acquisition, and robust public participation in the project development process. This activity supports improving NEPA and compliant real property acquisition processes and improves coordination and communication between Federal and State agencies, the public, and other stakeholders. Additionally, this activity supports capacity building for environmental and real property acquisition practitioners, integrating planning, real property acquisition, and environmental processes; and disseminating information about environment, sustainability, equity, and community engagement.

Performance-Based Planning and Equity
Performance-Based Planning and Equity will help FHWA address the strategic goals of Safety, Economic Strength and Global Competitiveness, Equity, Transformation, and Organizational Excellence. Transportation planning plays a critical role in a State, region, or community's vision for its future through the application of performance management. States and MPOs are responsible for setting performance targets for agreed-upon performance measures for the statewide, nonmetropolitan, and metropolitan transportation planning processes. USDOT is responsible for identifying performance measures related to national highway and transit performance goals that States and MPOs use in setting performance targets. With these national goals as a baseline, States and MPOs may identify additional performance measures and targets that address local community visions and goals.

Modeling and Analysis Tools
Modeling and Analysis Tools can support State DOTs and other agencies in conducting analyses that allow them to engage people and communities to promote safe, affordable, accessible, and multimodal access to opportunities and services while reducing transportation-related disparities, adverse community and environmental impacts, and health effects. Analysis can assess and support investments that expand accessibility to ensure that transportation networks meet the needs of all people, including disadvantaged populations. Modeling and Analysis Tools can support the expansion of transportation options in underserved rural and urban communities and help minimize, avoid, or mitigate

the negative impacts of transportation projects on disadvantaged or overburdened communities. FHWA research and initiatives support options to reduce trips and shift trips to climate-friendly vehicles and modes, including promoting active transportation; reducing exposure to harmful emissions and noise impacts on disadvantaged and overburdened communities; and increasing availability and access to clean transportation options, including affordable EVs.

Resiliency
The research produced in the Resiliency activity will build upon past research products by improving and updating tools and techniques and deploying research tools and methods developed in the past few years. For example, climate resiliency tools developed previously are continually being updated to account for new and developing best practices in the field and more recent climate science developments. Best practices and methods for considering climate effects and estimating GHG emissions from transportation that are nearing completion will require new efforts to deploy and test those tools in the field.

Multimodal Connectivity
Multimodal Connectivity supports the Safety strategic goal through design guides and technical assistance that aids agencies in implementing safer roadway features, including Complete Streets and complete network elements. The Economic Strength and Global Competitiveness goal is supported by documenting the economic benefits of highways, including scenic byways in rural communities. Equity support comes from building capacity to support and implement an equity-focused network that safely integrates multiple modes of travel convenient for all transportation system users. Climate and Sustainability are supported by assisting partner agencies in identifying low-carbon transportation options, including pedestrian, bicycle, and shared micromobility options. Multimodal Connectivity supports Transformation by promoting the rebalancing of multimodal investments to address inequalities in underserved communities.

Collaboration Partners

Accelerating Project Delivery
Accelerating Project Delivery involves collaboration with Federal partners, State DOTs, nongovernmental entities, and public stakeholders. Volpe provides valuable support to FHWA by developing products and workshops on a variety of topics and assisting with public stakeholder engagement. FHWA maintains agreements with agencies that oversee Federal environmental programs, including the Advisory Council on Historic Preservation, the National Marine Fisheries Service, the U.S. Army Corps of Engineers (USACE), the U.S. Coast Guard, the EPA, and the U.S. Fish and Wildlife Service.

Performance-Based Planning and Equity
Under Performance-Based Planning and Equity, FHWA will collaborate with key stakeholders in formal and informal settings to gather input on planning and environmental opportunities and challenges. Key stakeholders include State DOTs, MPOs, RTPOs, pertinent AASHTO planning committees, the Association of Metropolitan Planning Organizations (AMPO), National Association of Regional Councils, National Association of Development Organizations, National Association of Counties (NACo), TRB, universities

engaged in planning and environment-related work, and professional organizations such as the American Planning Association (APA). Interactions with professional research organizations will occur at regular intervals (as often as quarterly). FHWA will also collaborate with nongovernment groups to support planning and environmental decisionmaking.

Modeling and Analysis Tools
FHWA works with diverse stakeholders to share noteworthy practices and accelerate the adoption of innovations and technologies. Collaboration on modeling research regularly involves engaging with key stakeholders in both formal and informal settings to gather input concerning challenges and opportunities that might be addressed and information on work undertaken by other organizations both nationally and internationally. FHWA routinely works across internal offices and other modal administrations within USDOT, including Volpe. FHWA also routinely engages stakeholders, including representatives of individual State DOTs, MPOs, regional planning agencies, pertinent AASHTO committees, AMPO, TRB, universities engaged in related work, and professional organizations such as ITE and APA. Interactions with AASHTO, AMPO, TRB, and professional organizations generally occur at regular intervals (at least annually and as often as quarterly). Other Federal agencies, including EPA and the Centers for Disease Control and Prevention, and other nongovernment groups, such as the Health Effects Institute, partner and contribute to modeling research through both formal (interagency agreements, FACA workgroups) and informal (workshops, modeling staff workgroups) arrangements.(27)

Resiliency
Collaboration on climate resiliency, GHG reduction, and sustainability involves engagement with key stakeholders in both formal and informal settings to gather input concerning research challenges and opportunities that might be addressed through the activity, as well as information on work undertaken by other organizations both nationally and internationally. Primary stakeholders include representatives of individual State DOTs and MPOs, FLMAs, pertinent AASHTO committees, and TRB. Interactions with AASHTO, TRB, and professional organizations generally occur at regular intervals (at least annually and as often as quarterly) but are not formally tracked or measured. In addition, resiliency and sustainability research is conducted in coordination and partnership with several other FHWA program offices. Nongovernmental groups also partner with this program. AASHTO provides a stakeholder perspective and collaborates on research projects.

Multimodal Connectivity
FHWA coordinates with internal DOT working groups on a regular basis on environmental justice, bicyclist and pedestrian initiatives, micromobility, human environment, economic development, VPI, planning stakeholders, recreational trails, Safe Routes to School, transportation alternatives, and Complete Streets. Partnerships with nongovernment groups on this research will include AASHTO; TRB; universities (particularly university transportation centers (UTCs)) that engage in related work; professional organizations such as ITE, the Association of Pedestrian and Bicycle Professionals, the National Association of City Transportation Officials, and APA; and advocacy organizations such as the League of American Bicyclists, Rails-to-Trails Conservancy, and Safe Routes

Partnership. Interactions with these organizations and key external stakeholders, such as State DOTs, Tribes, MPOs, and other regional planning agencies, will help gather critical input concerning challenges, opportunities, and lessons learned from existing multimodal planning efforts undertaken by other organizations and inform how the program research can best address current needs.

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

Program Description

The United States has invested billions of dollars in building its existing transportation infrastructure. The transportation system is the economic engine of America; effective operations ensure the safe and efficient movement of people and goods. TSMO promote the mobility and safety of all modes, manage congestion, minimize disruptions, and enhance freight productivity while reducing climatic impacts. The transportation system must be operated well to maximize the value of investments and provide safe and reliable travel to the public. Incorporating more 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 FHWA, along with State and local agencies, manages and improves the efficiency and reliability of the 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.

Major Program Objectives

The Reducing Congestion, Improving Operations, and Enhancing Freight Productivity program invests in topics such as operations strategies to improve equitable mobility and climate change, active management techniques to increase operational resiliency and safety and advance integration of emerging technologies, and freight mobility to enhance the movement of goods supporting economic competitiveness. By empowering State and local transportation agencies to manage and operate the multimodal transportation system effectively and equitably, those State and local agencies are able to develop a more holistic approach to addressing congestion issues and maximize their existing transportation network infrastructure and technology investments. This effort results in enhanced safety and options for all users, reduced emissions and fuel consumption, expanded mobility services to underserved communities, and economic improvement through improved and reliable passenger and freight movement.

Anticipated Program Activities

Program activities require research and specialized attention to comprehend the opportunities and challenges presented by advanced technologies, such as CAVs; understand the operational impacts of nonrecurring event disruptions to develop predictive and real-time decision support systems that facilitate proactive operations;

provide tools to determine the best approaches to address traffic problems and support multimodal solutions; help the U.S. freight industry meet the growth in demand in a safe, responsible, effective, and sustainable way; and build the capability and capacity for operating agencies to optimize safety and system performance through outreach strategies such as capability maturity models, development of procedures and guidance, and T2.

Key FY 2024 FHWA Reducing Congestion, Improving Operations, and Enhancing Freight Operations R&T Program Activities.

Activity
TSMO ($6.305 M)
MUTCD[22] ($0.1 M)
Automation and Connectivity ($6.300 M)
Managing Disruptions to Operations ($3.325 M)
Freight Management and Operations ($3.750 M)
TSW ($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. Improving modeling, analysis, and simulation processes and tools enhances the application of Active Transportation and Demand Management strategies to integrate the operation of the freeway and surface street networks to promote the safe and efficient movement of all modes.

MUTCD

To meet the requirements of Section 11129 of the BIL, activities will focus on publishing the 11th edition of the MUTCD.[41,42] This effort involves developing outreach and training materials and a *Standard Highway Signs* book.[43] Support will also be provided for two PFSs of traffic control devices and pedestrian and bicycle transportation.

Automation and Connectivity

Automated driving system (ADS)-roadway integration initiatives will be advanced 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, including access to and exchange of data through digital infrastructure, the roadway assets that support ADS operation, and interoperable

transportation connectivity. 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. Smart infrastructure functions for CDA designed to improve pedestrian safety, reduce emissions at intersections, and improve the safety of work zones and emergency responders will be simulated and demonstrated on closed-course facilities, and an independent evaluation of benefits will be conducted. The capability to fuse input from various infrastructure-based sensors, including infrared cameras and light detection and ranging (LiDAR), will be assessed to improve the detection of VRU. 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 MDODE Framework and Strategic Plan.[24]

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.

Potential Program Outputs, Outcomes, and Impacts
Program outputs for all the activities in the previous section will include research, review, analysis, and management of existing data; enhanced data and models that facilitate performance-based, data-driven analysis and decisionmaking; and tools and organizational support, including training materials and case studies to support stakeholders. The

outcomes of all activities will foster the coordination and collaboration necessary to move toward implementing roadway investments that support the program while providing new capabilities and strategies to improve safety and contribute to infrastructure preservation. The impacts will improve the reliability of travel and freight movement; provide an overall smarter, cleaner, and safer transportation network for all users; and provide resources that permit States and other stakeholders to incorporate freight infrastructure improvement projects into transportation program delivery.

Potential Economic or Societal Impacts

The need continues to grow for a transportation system that provides travel options for the effective movement of people and goods that will mitigate congestion impacts on urban areas and allow for increasing freight transportation, especially with a growing awareness of the needs of underserved communities. As consumer technologies (e.g., smartphones, applications, Global Positioning Systems (GPSs)) progress, the traveling public expects that transportation agencies will find creative ways to apply these advances to improve their travel experience.

Automation and Connectivity research activities continue to address the challenges of integrating vehicles with ADS with the road infrastructure system and taking advantage of connectivity to improve the safety, efficiency, and equitable benefits of the highway transportation system. Maintaining and updating the MUTCD in a timely manner is necessary to reflect the current and forthcoming needs of practitioners and road users and to accommodate ADS.[22] Managing Disruptions to Operations activities improve resiliency and organizational preparedness to deal with nonrecurring events and associated disruptions to transportation operations.

The Freight Management and Operations activities seek to better the highway system's physical components—including roads, bridges, pavement, parking facilities, and other elements—that support goods movement. The TSW activities provide the U.S. Congress, States, and other stakeholders with information to create safe and efficient networks and systems for freight movement across the Nation and international borders.

Potential Progress Made Toward Achieving Strategic Goals

FHWA continues to develop tools and organizational support to enable agencies to evaluate, plan, fund, design, and quickly capitalize on emerging cost-effective transportation technologies and operational strategies to improve reliability, mobility, safety, and economic competitiveness. The storage, management, and utilization of data acquired from operations projects provide practitioners with improved tools and techniques for traffic management at various levels and an understanding of how and when to apply different strategies to reduce congestion, improve operations, and enhance freight movement.

Collaboration Partners

Both internal and external partners play a valuable role in helping to identify research needs and emerging issues, guiding the form and focus of outreach and technical assistance efforts to share the research results and encourage their implementation, and providing

real-world feedback on implementation results. FHWA, in collaboration with ITS JPO, other USDOT modes, State and local public agencies (LPAs), academia, industry, and other surface transportation stakeholders, continues R&D efforts. FHWA gains input from external partners through conference sessions and discussions (e.g., TRB, ITE, and AASHTO annual conferences); technical committees and working groups (e.g., TRB committees and AASHTO subcommittees); technical project panels; reviews of partner research reports and plans; workshops and technical assistance to States, MPOs, and regional agencies; and FHWA division office interactions with their State counterparts. Internally, collaboration occurs on key topics of mutual interest through joint review of research products and research ideas, participation in project panels, and periodic coordination meetings.

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

Program Description

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 new innovations and technologies that result from highway R&D and that benefit all aspects of highway transportation. FHWA will continue to use a series of successful deployment vehicles in FY 2024, including the following:

- EDC, a State-based model for deploying market-ready but underutilized technologies that make the transportation system adaptable, sustainable, equitable, and safer for all.(6)
- AID Demonstration, a discretionary grant activity.
- AMR, an activity to support technologies emerging into the transportation industry.
- STIC, an activity that facilitates a State-based innovation deployment approach.

FHWA will also continue to work directly with State and local agencies to provide technical assistance and deployment initiatives through the geographically dispersed FHWA Office of Innovation Implementation—Resource Center. FHWA will provide Technology Deployment Support activities including, but not limited to, technical assistance; peer exchanges; innovation/T2; and training in the use of tools and decisionmaking processes that assist divisions, States, and local and other transportation partners in effectively implementing surface transportation programs, projects, and policies.

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 cashflow and investment. Another example of this connection with the USDOT strategic goals is the AID Demonstration activity, which enables the piloting of transportation innovation in all aspects of highway transportation, including planning, financing, operation, structures, materials, pavements, environment, and construction.

Accelerating the Implementation and Delivery of New Innovations and Technologies also includes initiatives directed at accelerating the implementation and deployment of pavement technologies; ADCMS; and deploying advanced technologies and related strategies to improve safety, mobility, efficiency, system performance, intermodal connectivity, and infrastructure return on investment.(9) FHWA is also working to develop and deploy Innovative Finance tools to maximize the ability of States to leverage Federal

capital, attract new sources of funds to transportation investment, accelerate project completion dates, and more effectively utilize existing funds.

Major Program Objectives

Accelerating the Implementation and Delivery of New Innovations and Technologies in FY 2024 includes the seventh cycle of EDC (EDC-7).[44] EDC-7 promotes a portfolio of proven, market-ready, and transformative innovations that are adaptable, sustainable, equitable, and safer for all.[44] EDC-7 will facilitate the adoption of innovative technologies by the surface transportation community.[44]

The EDC-7 innovations are closely connected to USDOT's strategic goals.[44] The Safety strategic goal is reflected through the Nighttime Visibility for Safety and Next Generation Traffic Incident Management EDC-7topics.[44] The Economic Strength and Competitiveness goal is supported through the Strategic Workforce Development topic. The Equity goal is supported through the Rethinking DBE for Design-Build topic, and the Climate and Sustainability goal is supported through the Enhancing Performance with Internally Cured Concrete, Integrating GHG Assessment and Reduction Targets in Transportation Planning, and Environmental Product Declarations (EPDs) for Sustainable Project Delivery topics.

The AID Demonstration and STIC Incentive activities will continue to complement EDC by providing additional resources to help the surface transportation community accelerate the adoption and standardization of innovative technologies.[45,46,6] FHWA will disseminate information on previously awarded AMR projects as they are completed and award a new group of projects through a Broad Agency Announcement (BAA).

The AIDPT activity coordinates with FHWA Pavement and Materials R&D and the Long-Term Pavement Performance (LTPP) program to provide a coordinated approach to implement research, deploy tools and technologies, and provide guidance to support updated policies.[8] The AIDPT activity focuses on improving the safety, durability, sustainability, and cost-effectiveness of highway pavements and the materials from which highway infrastructure is constructed.[8] The AIDPT activity serves as the implementation and deployment mechanism for innovations from the Pavement and Materials and LTPP research activities.[8]

The primary goal of the ADCMS activity is to transform State DOTs and LPAs by promoting, implementing, deploying, demonstrating, showcasing, supporting, and documenting the application of ADCMS practices, performance, and benefits.[9] ADCMS are digital technologies and processes for managing construction and engineering activities, including systems for infrastructure planning and coordination, design, construction, maintenance, modernization and management, and asset management, including hardware, mobile devices, software, Internet of Things (IoT), and personnel.[9] ADCMS also includes developing and supporting systems to enhance and share data across an asset's lifecycle and between organizational silos, also referred to as maximizing interoperability.[9]

Secondary goals include reducing the environmental footprint of construction projects, increasing the availability of technology training and workforce development to build the

capabilities of sponsors, and enhancing worker and pedestrian safety, resulting in increased transparency.

In addition to the previously mentioned initiatives, the vision for the ATTAIN activity (title 23 U.S.C. § 503(c)(4)) includes providing grants to eligible entities to deploy, install, and operate advanced technologies and related strategies to improve safety, mobility, efficiency, system performance, intermodal connectivity, and infrastructure return on investment.[1] These advanced technologies will be integrated into the routine functions of the location or jurisdiction and play a critical role in helping agencies and the public address their challenges.

Anticipated Program Activities

Planned activities for the FY 2024 FHWA Accelerating the Implementation and Delivery of New Innovations and Technologies are listed in the following table. These activities will include demonstration grants to State and local transportation agencies as well as direct and indirect assistance to implement new innovations and technologies.

Key FY 2024 FHWA Accelerating the Implementation and Delivery of New Innovations and Technologies R&T Program Activities.

Activity
EDC[6] ($6.036 M)
STIC Incentive[45,46] ($6.062 M)
AID ($8.036 M)
AMR ($2.706 M)
Technology Deployment Support ($1.779 M)
AIDPT[8] ($12.000 M)
Accelerated Implementation and Deployment of ADCMS[9] ($20.000 M)
ATTAIN ($39.000 M)
Innovative Finance ($964,000)
Research Infrastructure, Technology Transfer, and Partnerships ($3.500 M)

EDC

EDC activities essentially constitute an agency-wide T2 effort. 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.[6] The State and local highway agencies are the primary beneficiaries of EDC.[6] Other outputs include, but are not limited to, supporting education materials, case studies, and other products.

STIC Incentive

The FHWA STIC Incentive activity provides resources to help foster a culture of innovation and make innovations standard practice in the States.[45,46] 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.

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

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 new innovations and technologies.

AIDPT
The AIDPT activity will advance strategies for lowering the embodied carbon of paving mixtures and provide tools and information to quantify these strategies.[8] 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 the use of new tests, support for demonstration and shadow projects (where new technologies are used alongside existing technologies), and other information-sharing opportunities such as peer exchanges and workshops.

Accelerated Implementation and Deployment of 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.[9]

ATTAIN
ATTAIN will provide 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.

Potential Program Outputs, Outcomes, and Impacts
The *EDC-6 Summit Summary and Baseline Report* summarizes each current innovation and documents the national implementation goals and associated impacts for each innovation. The key output and performance indicator of the AID Demonstration and AMR activities is the award of project grants and the further sharing of benefits and lessons learned by the awardees.[47] The STIC Incentive activity's outputs include delivering job aids and technical resources, training and education materials (e.g., webinars and workshops), and peer-to-peer information exchanges.[45,46] Each STIC self-defines the outcome being sought by implementing the innovations and monitoring performance to ensure those outcomes are met.[45,46] By setting goals, the STIC communicates the expected outcome and results from innovation deployment and encourages successful implementation.[45,46] The ultimate benefit of each of these complementary efforts is the advancement of a culture of innovation and the adoption of tools and technologies that can save time, more effectively use resources, and enhance safety.

Outputs from the AIDPT activity will be demonstration projects, information disseminated about demonstration projects, information on new technologies and practices, training efforts including workshops and webinars, and technical assistance.[8] Successful outcomes include practitioner training, adoption of new technologies and practices through specification changes, and trial and demonstration projects. Impacts lead to more durable and cost-effective pavements and lower embodied carbon of materials and pavements.

Foremost, 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 new innovations and technologies throughout the highway transportation sector.

Potential Economic or Societal Impacts
Benefits achieved will include accelerating the implementation and adoption of innovations and technologies that improve the highway transportation system. For instance, the adoption of advanced digital techniques will accelerate project delivery and increase the safety and efficiency of highway construction. An additional benefit will be the increased engagement of diverse populations through the use of VPI tools in project development and promoting strategies aimed at helping State and local agencies identify, train, and place workers in the contractors' workforce to deliver projects.[48]

Potential Progress Made Toward Achieving Strategic Goals
Progress advanced through the implementation efforts will outlive the award of individual projects in each program. The solicitation vehicles and communication strategies for promoting these activities will include references and evaluation criteria based on USDOT priorities and strategic goals. FHWA will further ensure that the selection of grant recipients represents diverse geographic areas of the United States, including urban and rural areas.

Collaboration Partners
Stakeholders for EDC include State DOTs, local governments, Tribes, FLMAs, USACE, private industry, AASHTO, ARTBA, American Council of Engineering Companies, and AGC.[6] With the launch of EDC-7, FHWA has begun to engage other transportation modes, most notably the FTA, transit organizations, and stakeholders, for awareness of the program and the topics being highlighted.[44] These stakeholders provide input to support FHWA's identification and selection of a new collection of EDC innovations every 2 yr.[6] Stakeholders in other initiatives are diverse. The broader the diversity of the transportation industry represented by the individual STICs, the greater the opportunity to comprehensively and strategically advance innovation.[45,46]

FHWA collaborates with ACPA, NAPA, and standard-setting organizations such as ACI and ASTM International. FHWA also encourages the participation of the academic/research community. For instance, stakeholders for the AMR program include entities eligible to apply for project awards (e.g., State DOTs, academic institutions, and the private sector) and State, local, and Tribal transportation agencies as the AMR technologies move into more widespread practice. For programs providing grants, public and stakeholder input is considered in developing the annual Notice of Funding Opportunity.[49] USDOT facilitates a cohort of grant recipients to share implementation lessons learned.

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

Program Description

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 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.

EAR

The EAR activity 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. Section 638 of 15 U.S.C. 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.(50)

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.(3) 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.

Major Program Objectives

The Accelerating the Discovery of Transformational Solutions program will provide leadership, coordination, and support in the administration of the FHWA R&T program to help accomplish the USDOT strategic goals. To accomplish these goals, the program will continue to foster and promote enhanced coordination of highway research among all stakeholders; communicate, publish, market, and disseminate research results to appropriate audiences; coordinate strategic resource allocation; and conduct R&T program evaluations.

Research Infrastructure, Technology Transfer, and Partnerships

The Research Infrastructure, Technology Transfer, and Partnerships activity will maintain and support the operation of TFHRC and the R&T program. The highway R&D relating to emerging highway technology that occurs at TFHRC focuses on addressing research gaps 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 provides assistance in the legislative and budget development process related to the R&T program.

EAR

The EAR activity conducts investigations across disciplines and program areas to identify topics where a U.S. Government investment has the potential for transformative results. The EAR activity regularly screens results from its portfolio of active research projects and vigorously supports efforts to transition results that demonstrate high potential impact to applied research programs. Throughout and across activity processes, FHWA engages experts inside and outside the Federal Government to ensure efforts reflect the most recent advances in science and technology, fulfill the needs of the U.S. highway industry, and benefit all travelers.

SBIR

The objective of the SBIR activity is to encourage small businesses to engage in R&D that has the potential for commercialization and meets Federal R&D objectives. The SBIR activity is uniquely positioned to support both the interests of FHWA and small businesses. In this respect, the SBIR activity aims to provide essential funding to small businesses with the goal of commercialization of products that align with FHWA and USDOT strategic goals.

SIRC and National Motor Vehicle Per-Mile User Fee Pilot

These two revenue collection programs included in the BIL aim to identify innovative and operationally successful solutions to ensure that the country has dedicated and sufficient funding mechanisms for highway infrastructure investment in the future.[3]

Anticipated Program Activities

The activities within the Accelerating the Discovery of Transformational Solutions program will support T2 across the entirety of the FHWA R&T program; conduct program

evaluations; provide marketing, communications, and publication services; maintain critical corporate partnerships; and support TFHRC.

Key FY 2024 FHWA Accelerating the Discovery of Transformational Solutions R&T Program Activities.

Activity
Research Infrastructure, Technology Transfer, and Partnerships ($11.655 M)
EAR ($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 conducts program evaluations; provides marketing, communications, and publication services; maintains critical corporate partnerships; and supports TFHRC.

EAR
The EAR activity conducts initial stage investigations; supports early stage, extramural research, and intramural research through open solicitations, partnering with other agencies, and placement of postdoctoral researchers in FHWA; and works to actively transition research results toward transformative changes in transportation practice.

SBIR
The SBIR activity will participate in the annual solicitation of topics and support current Phase I, II, and IIB projects. Additionally, the FHWA SBIR activity will continue with the Technology Readiness Level (TRL) Assessments throughout Phase II and IIB projects.

SIRC
The SIRC activity will provide grants to State DOTs, local agencies, or MPOs to demonstrate user-based alternative revenue mechanisms to maintain the long-term solvency of the Highway Trust Fund. The annually awarded grants will be for projects designed to test innovative ways to replace or supplement the Federal gas tax.

National Motor Vehicle Per-Mile User Fee Pilot
The National Motor Vehicle Per-Mile User Fee Pilot activity will demonstrate a national motor vehicle per-mile user fee, establish a Federal System Funding Alternative Advisory Board, and carry out a public awareness campaign regarding a national motor vehicle per-mile user fee. The Secretary of Transportation, in coordination with the Secretary of the Treasury, will test the design, acceptance, implementation, and financial sustainability of a national motor vehicle per-mile user fee designed to restore and maintain the long-term solvency of the Highway Trust Fund.[51]

Potential Program Outputs, Outcomes, and Impacts

The Accelerating the Discovery of Transformational Solutions program will deliver a variety of products and services that benefit the entirety of the FHWA RD&T program and advance the mission and goals of FHWA and USDOT. This program will facilitate information sharing with critical research partners by providing access to essential research publications, supporting marketing and communications efforts, and maintaining research databases that provide access to legacy materials and new research products. Additionally, this program will provide the necessary technical support and access to facilities for the FHWA RD&T staff to ensure that strategic and innovative solutions are being developed and deployed to the network of transportation partners.

This program includes investing in core research infrastructure at TFHRC to ensure that critical experimental and analytical tools are available to successfully achieve the FHWA RD&T program's objectives. The development of new research capabilities allows FHWA to investigate and advance emerging technologies to the benefit of the Nation's highway transportation system. In addition, this program operates and maintains the FHWA Research Library, which provides technical research and publication resources to FHWA researchers. Finally, this program ensures that all research efforts are coordinated and communicated with FHWA's research partners, creating a market of research ideas that reduce duplication and strategically investing FHWA's research funds where they are needed most.

EAR

EAR seeks to demonstrate the potentially transformative nature of advances in basic science and technology for addressing transportation research priorities such as equity or climate change. The program then proactively seeks transition partners that can continue to mature the research results toward practice-ready products.

The EAR activity outputs include the proof of concept of new research methods, development of data or analytic tools, and spread of knowledge of both advances and impediments. Midterm outcomes include continued and broadening investment in R&D, leading to systems or processes ready for pilot applications and public testing. Longer term impacts can be seen in broad changes to practice that establish measurable improvements in highway system safety, reliability, or sustainability.

SBIR

Through the SBIR activity, FHWA aims to advance technologies and make problem-solving innovations available to the end user. To achieve that goal, FHWA will identify the most promising new innovations, advance Phase I and Phase II projects that have a clear path to commercialization and focus on market-driven needs. This activity creates a win-win-win opportunity for the Federal Government, small businesses, and the traveling public. The Federal Government advances its strategic goals by investing in promising innovations; small businesses benefit from the ability to pursue a good idea through Federal seed funding and, if successful, the sale of their innovative products and solutions; and the public benefits from innovations in the marketplace that enhance the travel experience.

SIRC and National Motor Vehicle Per-Mile User Fee Pilot
USDOT will facilitate sharing lessons learned among SIRC grant recipients and with other jurisdictions through required reporting. USDOT will gather data to provide a report to Congress in 2024 about the SIRC pilot projects.

Potential Economic or Societal Impacts
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.

SBIR
The SBIR activity provides economic opportunities for domestic small businesses by providing seed funding to invest in the development of innovations that will benefit the traveling public. Small businesses often struggle to establish themselves in the crowded transportation R&D market because of the high startup costs and the lack of nontechnical resources, such as commercialization support and business services. The SBIR activity offers critical support in these areas and provides dedicated funding streams to alleviate some of the initial risks.

SIRC
The SIRC activity is a discretionary grant program. FHWA will ensure that the selection of grant recipients represents diverse geographic areas of the United States. In addition, grant recipients will be required to address equity.

Potential Progress Made Toward Achieving Strategic Goals
This program will support all of USDOT's strategic goals by investing in and supporting FHWA's critical R&D activities. Additionally, the program will ensure that research results are appropriately coordinated and delivered to FHWA's partners and stakeholders.

EAR
Through open solicitations and partnering with other agencies, such as the National Science Foundation (NSF), the EAR activity plans to support research that takes advances in science and technology and demonstrates the potential for improving transportation for all people in support of equity and transportation resilience in support of climate.

SBIR
The SBIR activity provides opportunities to support all of the USDOT strategic goals. The selection of topics and projects is driven by the opportunity to advance the Department's goals. In particular, the SBIR activity transforms through investment in innovations that can improve safety, advance economic strength, ensure equity, support climate sustainability, and develop organizational excellence.

Collaboration Partners
This program will continue to support critical research partnerships. The program will continue coordinating research program information with TRB and the AASHTO Special Committee on Research and Innovation. Furthermore, through this program, FHWA will continue to coordinate research activities through input into the NCHRP; through engagement with the academic research community, including UTCs; and through international partnerships. Finally, the program will continue to work with State and local partners to coordinate research agendas, particularly through the Transportation Pooled Fund Program management.

EAR
The EAR activity regularly works with technical experts from across USDOT (Bureau of Transportation Statistics (BTS), FMCSA, Federal Aviation Administration, FTA, ITS JPO, and NHTSA) and other agencies to participate in scoping activities by serving on technical review panels for EAR activity investments, technical working groups reviewing ongoing EAR-funded research, and TRL Assessment panels that provide input into the transition of results. Additionally, the EAR activity and the NSF Computer Science and Engineering Directorate signed a memorandum of understanding in 2019 to coordinate research leveraging expertise across different research communities on critical transportation research issues.(52) The EAR activity also coordinates with the U.S. Department of Defense, the U.S. Department of Energy (DOE), the National Aeronautics and Space Administration laboratories, the U.S. Department of Commerce NIST, and the U.S. Department of Homeland Security on specific research topics with potential joint benefits. Finally, the EAR activity works closely with UTCs, other leading research universities, Historically Black Colleges and Universities, and other Minority Serving Institutions in scouting new topics, conducting research, and transitioning results. The activity also specifically engages State and local agencies and private industry when assessing the potential for research results to transition to practice.

SBIR
The FHWA SBIR activity is coordinated internally within USDOT, and methods and practices are shared with other modes through Volpe, which administers the SBIR activities for USDOT.

SIRC and National Motor Vehicle Per-Mile User Fee Pilot
USDOT will collaborate with stakeholders regarding the SIRC and National Motor Vehicle Per-Mile User Fee Pilot activities through participation in relevant national trade association meetings and independent peer exchanges. USDOT will also establish a Federal System Funding Alternative Advisory Board to help carry out the goals of the national pilot.

Crosscutting
($38,417,000)

Program Description

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 this AMRP.[2] Crosscutting involves RD&T activities in Policy Analysis, Global Outreach, HDI, + 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.

Major Program Objectives

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.

Global Outreach

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. Multinational Relations initiatives span a wide range of program and research activities, working with entities such as PIARC and the European Union.

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. HDI's effort in data gathering, analysis, and forecasting methods focuses on big data and big data analytics to reveal new transformative ways of doing business at USDOT and FHWA with State DOTs, MPOs, and other entities and enterprises. More informative and revealing data are gathered through these new approaches, and more relevant information is extracted while making the data program more cost sustainable. 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.

Anticipated Program Activities
The Crosscutting program supports the Performance Management Data Support Program prescribed in IIJA Section 13003 through all HDI and NPMRDS activities.(53) 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 is anticipated to be funded annually at up to $10 million each year.

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* (*C&P Report*).(54) 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 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 (vehicles with different dimensions, weights, number of axles, and other specifications).

Planned Activities for the FY 2024 FHWA Crosscutting program are listed in the following table. These activities will include R&D initiatives as well as T2 initiatives.

Key FY 2024 FHWA Crosscutting R&T Program Activities.

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
FHWA Policy Analysis research focuses on identifying policy needs, gaps, and unintended outcomes of current and emerging issues and strategic priorities through system level policy research, the development of analytical tools, and analysis of potential policy alternatives.

Global Outreach
FHWA's Global Outreach activities focus on three main initiatives: GBP, Binational Relations, and Multinational Relations. The GBP initiative seeks out and adapts existing foreign innovations that could significantly improve highways and highway transportation services in the United States. Binational Relations programs facilitate knowledge exchange with a variety of countries by leveraging binational government-to-government relationships. Multinational Relations span a wide range of program and research activities, working with entities such as PIARC and the European Union.

HDI
FHWA's HDI activity is crosscutting and multifaceted, supporting all FHWA R&T activities and the delivery of the Federal-Aid Highway Program. The HDI activity consists of initiatives to develop and improve data methods and guidelines and collect, process, analyze, model, visualize, and disseminate data and information by working with States, local transportation agencies, private businesses, and research communities.

NPMRDS
FHWA's NPMRDS program enables State DOTs, MPOs, and the FHWA to carry out all transportation performance management activities. This program collects travel time data covering all NHS roadways throughout the year with a 5-min interval, enabling travel reliability, speed, safety, and other performance measures to be quantitively assessed and evaluated.

Civil Rights
Civil Rights RD&T is focused on transforming, protecting, and enhancing the quality of life for all by improving access to a fair and equitable transportation system. The results of the RD&T initiatives are designed to lead the multidisciplinary highway community in ensuring all programs are delivered in a nondiscriminatory manner.

Federal Lands Highway
Federal Lands Highway RD&T activities support FHWA's partnership with FLMAs and Tribes and seek to implement innovative transportation solutions that provide access to and through public lands. These RD&T activities support improved safety and mobility for vulnerable public road users, typically non-NHS transportation networks with low ADT. However, large public land holdings are also accessible by roads and adjacent networks that rival or are included in the NHS system and have remarkable ADT, such as the Blue Ridge Parkway and the George Washington Parkway.

Emerging/Corporate Needs
Within the Crosscutting program, funds are available for Emerging/Corporate Needs that address new initiatives, accelerate RD&T activities, conduct legislative mandates,

encourage cross-discipline and multimodal RD&T, and highlight Administration priorities. These funds will also be used to research new ways to tackle the climate crisis and achieve equitable transportation access. Initiatives like Complete Streets, which focuses on safe access for all groups that need to use the transportation network, will be advanced in this program. Emerging/Corporate Needs will also conduct RD&T initiatives to prepare for the widespread integration of CAVs on the highways.

The Complete Streets initiative received funding in FY 2022 and FY 2023 and will complete the development of a safety analysis approach and begin testing the approach with case studies developed by other parties. Work will also proceed on developing methods for reducing data collection costs for pedestrians, bicyclists, and other VRUs. Other work will create a primer that examines the operations aspects of Complete Streets. Further research into policy impacts will consider the benefits and model the effects of the implementation of complete street policy choices.

In FY 2022, Emerging and Corporate Needs funds were also used to establish the Climate Challenge Initiative. To demonstrate effective and measurable progress toward the Administration's goals for net-zero emissions, stakeholders must be able to quantify GHG emissions from materials and practices for the design, construction, and maintenance of pavements. EPDs are a tool used to communicate environmental impacts and quantify GHG emissions from materials and products.

FY 2022 Emerging/Corporate Needs funds were also used to fund programs mandated in the BIL, but for which no specific funds were set aside.[3] These programs included: the Performance Management Data Support Program (§ 13003), Permeable Pavements Study (§ 11518), Center of Excellence on New Mobility and Automated Vehicles (§ 13006(c)), Transportation Access Pilot Program (§ 13010), and Vulnerable Road User Research Plan (§ 11122(b)). Research on these initiatives continued in FY 2023, and funding will also be provided for a Study on Stormwater Best Management Practices (§ 11520) and Cybersecurity Tools (§ 11510).[55–61] In addition, in FY 2023, initiatives like Complete Streets will receive funding, and funding will continue for the Performance Management Data Support Program (§ 13003), Center of Excellence on New Mobility and Automated Vehicles (§ 13006(c)), and Transportation Access Pilot Program (§ 13010).[55,62–63]

Potential Program Outputs, Outcomes, and Impacts

Policy Analysis

The primary outcome from 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 (such as electric vehicle use), new transportation service models, and global shifts in travel behavior (such as telework) on system performance and FHWA's strategic priorities. FHWA will also develop the second edition of the biennial *Transportation Future: Trends, Transportation, and Travel* report, which provides a holistic view of current and emerging trends and their impact on transportation demand and system performance across all modes of travel.[64] A new Quantitative Spatial Model for Calculating the Impacts of Transportation

Infrastructure Projects research activity will enable FHWA to estimate the impacts of highway investments on local and regional economies and the spatial and demographic distribution of those impacts. FHWA will develop a graphical user interface for the recently developed GEMS, and will apply GEMS to analyzing the impacts of alternative transportation options and policies on different types of communities.(16)

The HERS and NBIAS models will be upgraded to support the inclusion of more robust analyses in the 27th *C&P Report* due to Congress in FY 2027.(13,14,54) Economic analyses will be conducted for proposed significant rulemaking agency-wide. The HCAS's analytical framework, which forms the scope of the study, will be established with implementation support from a Transportation Pooled Fund. The HCAS, over the course of the study, develops the evaluation principles or criteria for setting future Federal highway user fee options to recommend to Congress, aiding in finding an equitable solution to the solvency of the Highway Trust Fund.(51) The products resulting from Policy Analysis research are used to support USDOT priority programs, including discretionary grant screening and review, Justice40, and the NRSS, including Complete Streets.(23)

Global Outreach
Outputs from Global Outreach activities will be in the form of successful exchanges with foreign counterparts, reports, guidelines, and other information tools such as webinars, videos, articles, and fact sheets. Global Outreach outcomes accelerate changes that improve the safety and effectiveness of the U.S. highway system; increase the number of available solutions through innovations already proven abroad; and successfully promote U.S. training, approaches, standards, and technologies to foreign counterparts through exchanges and technical assistance. Information obtained from Global Outreach saves research dollars by capturing mature and emerging technologies, policies, and practices; improves the safety and effectiveness of the U.S. highway system, assists select countries' efforts to improve their highway systems, and supports U.S. foreign policy and relationships. Global Outreach exchanges on Green Public Procurement (GPP) 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 EV infrastructure.

HDI and NPMRDS
The HDI activity intends to deliver two main categories of outputs. The first output category includes the following:

- Developing improved, new, and innovative data collection, processing, and analysis methods and guidelines related to private passive data in place of the traditional time-consuming and limited coverage data collection methods used by State and local transportation agencies.
- Assessing data representativeness, quality, and cost associated with travel behavior data collection between the online panel member survey method and the traditional addressed-based survey method, as well as identifying potential new approaches.
- Exploring potential cost-effective and quality data methods to gather micromobility travel data, including electric bicycles and scooters.

- Exploring potential mechanisms to partner with industries and non-governmental entities for data sharing in vehicle operations and infrastructure inventory areas.
- Deploying the updated *Traffic Monitoring Guide* to State DOTs and MPOs through workshops and webinars.(65)
- Updating *A Guide to Reporting Highway Statistics* to deploy to State and local agencies.(66)
- Working with State agency partners (i.e., pilot States) to gather and assess information that will be used to develop new and enhanced requirements for States to assemble and submit, to FHWA, unprocessed vehicle identification number, other vehicle registration-related, and licensed driver data for future implementation.(18)
- Initiating recurring studies in response to a new IIJA-related mandate to evaluate and report to Congress on the model used to estimate fuel use in vehicles traveling on recreational trails and backcountry terrain.(4)

The second output category includes actual data and information covering the following:

- Data on motor fuel distribution and consumption, highway infrastructure funding, and highway system users—Registered vehicles and licensed drivers.
- Data on highway performance and monitoring—Infrastructure inventory, including geometrics, travel demand, travel condition, and performance.
- Data on traffic—Volume, class, weight, travel time, vehicle miles traveled, and travel reliability.
- Nonmotorized data—Specifications for nonmotorized (bicyclists, pedestrians, e-scooterists, and e-bicyclists) data formats and nonmotorized infrastructure geospatial locating templates.
- Data on future national travel demand—Projected future demand on vehicle miles traveled.
- Data on national travel behavior and origin-destination—Outcomes for these activity-driven outputs will lead to more efficient and effective data collection, processing, and reporting with Federal, State, and local agencies. It will improve data quality and timeliness while making the data program more economically sustainable.

The data outputs will enable the faithful delivery of the Federal-Aid Highway Program according to legislation (e.g., apportionment and performance management) and lay the foundation for all R&D activities. The HDI activity impacts the entire Federal-Aid Highway Program delivery by enabling appropriate Federal-aid apportionments to States, gaining an understanding of the condition and performance of the highways and bridges, utilizing performance management for accountability and transparency, offering practical and efficient tools for State and local use, and promoting a safe and efficient highway system for the public.

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

The Civil Rights, Federal Lands Highway, and Emerging/Corporate Needs activities within the FHWA Crosscutting program will deliver a variety of products and services that benefit the entirety of the FHWA RD&T program and advance the mission and goals of FHWA and USDOT. For example, to reduce the number of fatalities and serious injuries on highways

and public lands, FHWA will develop and implement roadside hardware, detection systems, and countermeasures that support the Complete Streets Design Model. FHWA will also develop real-time decisionmaking tools to identify vulnerable culverts on U.S. Forest Service public lands, which will reduce road overtopping and inundation of sensitive ecological systems and accommodate debris flow caused by wildlife destruction of vegetation on unstable slopes. FHWA will also continue supporting the development of datasets for Transportation Access Pilots.

The Complete Streets initiative completed the development of a safety analysis approach and began testing the approach with case studies developed by other parties. Work will also proceed on developing methods for reducing data collection costs for pedestrians, bicyclists, and other VRUs. Other work will create a primer that examines the operations aspects of Complete Streets. Further research into policy impacts will consider the benefits and model the effects of implementation.

Potential Economic or Societal Impacts

Policy Analysis

The measurement of economic and societal impacts is a major focus of FHWA Policy Analysis research and includes analyses of equity-related impacts. Ongoing research on transportation and the economy includes exploring areas and subgroups for whom negative impacts in terms of property values have outweighed the benefits of infrastructure investments. The USAGE-Hwy model will be modified to predict the impacts of alternative investment levels, including the IIJA, on private investments, employment and productivity at the national and sectoral level.[17,4] The GEMS model facilitates the evaluation of alternative modal transportation options and policy impacts on different types of communities.[16] Research on Mobility Trends and Transportation Futures supports understanding equity from demographic, socioeconomic, and geographic (e.g., rural, suburban, or urban) perspectives and in the context of trends in technology and transportation service. Policy Analysis research also supports research on the impact of investment on macroeconomic indicators, such as GDP, employment, and wages, and on the refinement and application of benefit-cost analysis tools for developing future investment scenarios and predicting the impacts of alternative policies and regulatory initiatives. The HCAS required by the BIL will explore equity from a revenue and taxation perspective and analyze the user, agency, and societal costs of highway investments relative to the vehicles responsible for generating these costs.[3]

Global Outreach

Global Outreach is valuable in identifying, accessing, evaluating, and implementing proven international innovations to address challenges. Activities currently underway include studies and information exchanges with PIARC on issues related to gender inclusion, social equity, and social accessibility. FHWA's involvement in these projects aims to fill in knowledge gaps and obtain information on emerging road-related policies and practices in support of FHWA's priorities related to equity. Discussions are planned with foreign counterparts to exchange insights regarding advancing equity, as well as sharing U.S. experiences with others. Exchanges regarding climate solutions may lead to reducing the transportation sector's overall carbon footprint.

HDI and NPMRDS
The HDI activity serves as the foundation for the Federal-Aid Highway Program and offers data to the entire transportation community. The data enable the assessment of program and policy effectiveness and the efficiencies of various Federal-Aid Highway Programs. Because of the data program, travel among mega-regions and between work and leisure among various demographic groups can be analyzed. In addition, private businesses of all sizes, academia, and myriad research entities are also using the HDI data to support their business decisionmaking, promoting economic growth. HDI's travel behavior data are the only publicly available data covering travel behavior and needs, which can be further dissected by race, ethnicity, income, and education. The travel behavior data have offered valuable insights into the USDOT equity analysis. The NPMRDS data enable FHWA to conduct transportation performance management activities for the NHS roadways. The travel time data collected for all NHS roadways offers quality, consistent data to all State DOTs and MPOs, promoting consistency in FHWA's transportation performance management program.

Civil Rights RD&T investigates and adopts more efficient practices to ensure compliance with anti-discrimination laws. The ADA-related RD&T will positively impact society by maximizing accessibility to pedestrian facilities for people with disabilities.[19]

Federal Lands Highway and Emerging/Corporate Needs
Federal Lands Highway and Emerging/Corporate Needs will promote safety, including reduced collisions with wildlife and the development of improved design elements to promote safe and equitable access to transportation. Increased durable assets will extend the lifecycle and need for rehabilitation and replacement at inflated costs for materials. Using improved planning models will result in a wiser investment of limited funds for the right projects at the right time with the right fix and will improve the economic business plans for State DOTs and FLMA partners. Further, improving the efficient flow of freight and travelers on public highways and within public lands will reduce congestion and impacts on the surrounding ecology. Increased use and awareness of new innovations and technology will provide for improved workforce development and improve the design of projects for more durability and sustainability in the wake of climate change events.

The primary societal benefit from a Complete Streets design model will be in reducing fatalities and serious injuries, which disproportionately affect minority, underserved, and rural communities. Connected multimodal and low-emission vehicle network improvements will provide additional economic and social benefits. The multidisciplinary approach toward the development of Complete Streets will define new ways of characterizing the additive effects for air quality, quality of life, and reduction of obesity, among others.

Potential Progress Made Toward Achieving Strategic Goals

Policy Analysis
Policy Analysis research supports progress toward strategic goals both directly and indirectly. Analytical models developed as part of Policy Analysis research directly support a key USDOT performance measure for the Economic Strength and Global Competitiveness

strategic goal. Indirect research and analysis provide the framework, research, and models to understand the potential impacts of policies and emerging trends on USDOT strategic goals and Administration priorities such as safety, equity, sustainability, and resilience. Policy Analysis research activities will continue to support priority initiatives including Justice40, Complete Streets, and user safety, mobility, and access.

Global Outreach

The GBP supports study teams with both implementation expertise and funding to accelerate early implementation activities. A study on the use of unmanned aircraft systems (UAS) to enhance the design, maintenance, inspection, and construction of transportation infrastructure will support the implementation of this transformational technology. The study is in the report development and implementation phases. Studies on reducing pedestrian fatalities and serious injuries on urban signalized arterials and on turbo roundabouts will be completed, providing implementation strategies in support of USDOT's Safety strategic goal. Also, GBP has proposed a study on preventing bridge strikes by over-height and over-dimension vehicles, which are among the highest causes of bridge damage and account for 13 percent of bridge failures. Given the significance of this problem, its impact on road safety, and its nation-wide relevance, a GBP study has great potential to help advance the United States state of practice by identifying effective solutions used abroad and transferring this information to States and localities. GBP will also continue activities related to the study on GPP in support of USDOT's strategic goal on Climate and Sustainability. In addition, the GBP has proposed a study on roadway infrastructure resilience. Although there has been significant research on planning for climate change, extreme events, and natural disasters—including a pilot GBP study in 2015—there has been limited research related to engineering and construction resilience strategies. This proposed GBP study would allow FHWA to address this important research gap by focusing on examining international best practices for designing, constructing, and maintaining roadways that are resilient to the impacts of changes in climate and extreme natural events. Binational exchanges on GPP may lead to improved tools and methodologies that support the Climate and Sustainability goal, as will exchanges with other countries on infrastructure resilience. Program elements regarding connected, automated, and EV infrastructure will contribute to advancing Transformation and Climate and Sustainability goals. Activities with Switzerland, Japan, Chile, and Korea regarding bridges and other infrastructure elements will also contribute to the Transformation goal. Exchanges with Sweden, Japan, and Switzerland will advance the Safety goal. FHWA has recently begun exploring a collaborative relationship with the South African National Roads Agency SOC Ltd (SANRAL) on developing EV infrastructure and Smart Mobility systems in South Africa.

HDI and NPMRDS

The HDI activity has continuously enabled the Federal-Aid Highway Program by providing timely, accurate data. On an annual basis, the HDI data ensure accurate Federal-aid apportionment of Federal funds per the legislative requirements; enable performance management, including both performance target setting and progress measurement covering safety, travel time reliability, and pavement conditions; and promote data program efficiency among all stakeholders through a strategy of "collecting once and using

often." In addition, HDI has been making incremental efficiency and effectiveness improvements in data collection, analysis, and applications in Federal, State, and local governments and private sectors. NPMRDS data gathering has been timely, which allows continuous delivery of data and tools to FHWA, State DOTs, and MPOs, meeting all transportation performance management program needs on schedule. The activity will be continued with an emphasis on making data usage more user-friendly.

Civil Rights
In Civil Rights RD&T, the ADA team aims to remove barriers to accessibility in the public right-of-way.[19] Another goal of the ADA team is to ensure that ADA/504 programs are implemented to prevent and remedy discrimination on the basis of disability.[19] The team is achieving this goal by ensuring that research, technology, and guidance resources are developed to include accessibility for people with disabilities.

Federal Lands Highway and Emerging/Corporate Needs
The breadth of Federal Lands Highway and Emerging/Corporate Needs activities ensure that all the USDOT strategic goals are being addressed.

In particular, Federal Lands Highway implements new technologies and solutions that can be tailored to the needs of roadways under FLMAs. Complete Streets RD&T will develop standards and policies to ensure the safe and adequate accommodation of all users of the transportation system, including pedestrians, bicyclists, public transportation users, children, older individuals, individuals with disabilities, motorists, and freight vehicles.

Collaboration Partners
Key collaboration partners include State DOTs, MPOs, AASHTO, the AASHTO Research Advisory Committee, the AASHTO Special Committee on Research and Innovation, NCHRP, NSC, the Smart Growth America Coalition, TRB, NACo, AMPO, ARTBA, the American Public Transportation Association, ITE, the American Trucking Associations, the American Association of Retired Persons, AAA Foundation for Traffic Safety, Internal Revenue Service, Federation of Tax Administrators, International Fuel Tax Association, Energy Information Administration, American Association of Motor Vehicle Administrators, and International Bridge, Tunnel and Turnpike Association. Additional partners include other industry organizations, research institutes, and institutions of higher education.

Within USDOT, FHWA collaborates with the Office of the Secretary of Transportation, BTS, the Federal Railroad Administration, the FTA, NHTSA, FMCSA, and the Maritime Administration.

FHWA also collaborates with the FLMAs, the DOE, and the U.S. Department of Labor.

Internationally, FHWA collaborates with PIARC, the Forum of European National Highway Research Laboratories, the International Transport Forum, the World Bank, and the Southern African Development Community. Also, in 2023, and as the result on a Global Benchmarking Study on Electrically Isolated Tendons conducted in 2019, FHWA joined the International Federation for Structural Concrete as a national member. Binational relationships currently include Japan, South Korea, the Netherlands, Switzerland, Chile,

Australia, Sweden, Canada, Mexico, and Brazil. New relationships with India and Germany are being explored. FHWA has recently begun exploring a collaborative relationship with the SANRAL on the development of EV infrastructure and smart mobility systems in South Africa, as well as other possible relationships with Senegal, Tanzania, and Malawi.

Chapter 2—FY 2025 RD&T Programs

The AMRP FY 2025 outlook year chapter in the annual plan is not developed in alignment with the President's budget request of the same year due to the AMRP development schedule per 49 U.S.C. Chapter 65 Sec. 6501 Research Planning.[2,25]

Improving Highway Safety for All Users

Program Description

The Improving Highway Safety for All Users program primarily supports the USDOT strategic goal of Safety and, secondarily, the Equity goal by conducting research, developing training, and assisting USDOT's partners and stakeholders in applying the Safe System Approach with the aim of achieving zero deaths.[11] The program provides support for the HSIP, a core Federal-Aid Highway Program with the purpose of achieving a significant reduction in fatalities and serious injuries on all public roads.

This program also advances the safety engineering work that overlaps traffic engineering, geometric roadway design, transportation planning, and system management and operations. It 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 the needs of all roadway users to better understand human behavior and the relationship among all users, infrastructure, and vehicles.

Major Program Objectives

In FY 2025, the program will continue developing new research, technical assistance, and stakeholder engagement to advance the Safe System Principles. The program will continue research through PFS to engage State DOTs, other locality partners, and industry associations to define new safety countermeasures and greater precision expressions for such tools. Work with the NCHRP will identify new research activities of interest to the States that can be readily deployed and help reduce the effects of crashes on communities. New engagements and data analytics methods will be identified to help address the scope of equity in the context of safety and start with defining the means to prioritize where safety improvement investments can be made, with equity as a major factor.

Anticipated Program Activities

Key FY 2025 FHWA Improving Highway Safety for All Users R&T Program Activities.

Activity
Safety Program Delivery
Safety Design and Operations
Safety Data and Analysis
Human Factors Analytics

The Improving Highway Safety for All Users program supports the VRU Research Plan that will prioritize research on roadway designs, the development of safety countermeasures to minimize fatalities and serious injuries to VRUs, and the promotion of bicycling and

walking. Additional funding will be needed in future years to carry out the research and develop a legislatively required 2-yr update to the U.S. Congress due in 2026.

The Improving Highway Safety for All Users program aims to achieve its objectives for FY 2025 through the following activities.

Safety Program Delivery
The Safety Program Delivery activity will continue to assess FY 2025 State safety performance targets to determine which States met or made significant progress toward their safety targets. Safety Program Delivery activities will provide technical assistance to help State and local agencies effectively and equitably administer and manage the HSIP, SS4A, Strategic Highway Safety Plans, Safety Performance Management, High-Risk Rural Roads, and the Railway-Highway Grade Crossing Safety Improvement Program, among others. The evaluation and planning of pilot deployments on speed management through automated techniques will support developing new guidelines after the pilot deployment is fully tested. The Intersection Safety Challenge evaluation will yield a suite of effective applications and sensing technologies.

Safety Design and Operations
The Safety Design and Operations activity will promote certain infrastructure-oriented safety treatments and strategies based on proven effectiveness and benefits to encourage widespread implementation by State, Tribal, and local transportation agencies to reduce serious injuries and fatalities on the Nation's highways. This activity will collaborate with agencies as they design and operate roadways to fully integrate the needs of all users, accommodate human error, and minimize injury severity.

Safety Data and Analysis
The leading resource for analyzing crash factors over time will be revised in favor of a new architecture that will allow researchers to apply multiple safety datasets at once. In addition, the Safety Data and Analysis activity will complete novel data analytics approaches on pedestrian safety that could help overcome certain cost-prohibitive data collection methods. New data collection techniques explored through research may enable updates to data collection guidelines. Crash Modification Factors for rectangular rapid flash beacons, enhanced curve delineations, left-turn lanes, alternative rumble strips, and fixed object delineation will enable more refined safety analyses. This activity will continue to explore new analysis methodologies, such as interrupted time series and novel datasets, including synthetic data, such as realistic artificial data.

Human Factors Analytics
The Human Factors Analytics activity will continue empirical research using human participants in studies in the Highway Driving Simulator, field research vehicles, and the Human Factors Laboratory's Sign Laboratory. The work will help promote better and safer traffic control devices and signing, increase pedestrian and bicyclist safety, and facilitate and accelerate the safe integration of emerging ADS technology into the Nation's roadway system in a safe and acceptable manner for all roadway users.

The Federal Lands Highway activity also supports safety activities and initiatives through implementing and T2 of recently completed safety research and continuing safety research for VRUs (walking, rolling) in public lands and Tribal communities.

FY 2025 safety research technology activities will focus on Safety Data and Analysis, Safety Design and Operations, and Safety Program Delivery. Initiatives will include the following:

- Wildlife crossing safety: Infrastructure best practices and wildlife crossing detection technology to reduce wildlife-vehicle collisions.
- *Manual for Assessing Safety Hardware*: Updates to include testing for aesthetically pleasing guide rails and bridge railings.[67]

Improving Infrastructure Integrity, Sustainability, and Practices

Program Description

FHWA's Improving Infrastructure Integrity, Sustainability, and Practices program is 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 maintain and improve infrastructure integrity effectively and meet user needs. The leadership and work products provided through FHWA's Improving Infrastructure Integrity, Sustainability, and Practices program are aligned with the USDOT Transformation strategic goal and will contribute to achieving the Safety and Climate and Sustainability strategic goals.

Major Program Objectives

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 program works to achieve the following:

- Transform infrastructure construction, contracting, and stewardship practices to efficiently achieve long-lasting, resilient infrastructure and safer construction work zones.
- Support and enable improved infrastructure resiliency.
- Develop more durable and sustainable materials.
- Provide guidelines and tools to support the comprehensive lifecycle assessment of infrastructure sustainability.

The Improving Infrastructure Integrity, Sustainability, and Practices program also includes the development and delivery of transformational technologies to substantially improve the durability (and ultimately the sustainability and safety) of bridges. The program also supports the implementation of the updated NBIS and NTIS, thereby ensuring the safety of this critical highway infrastructure. Additionally, FHWA research is delivering the data and information infrastructure owners need to effectively manage pavement and bridge conditions and providing tools, technologies, and guidance to advance the effective management of highway infrastructure and system performance.

Anticipated Program Activities

Key FY 2025 FHWA Improving Infrastructure Integrity, Sustainability, and Practices R&T Program Activities.

Activity
Construction and Project Management
Geotechnical and Hydraulics
LTIP
Pavements and Materials
Structures
Transportation Performance and Asset Management

Construction and Project Management

Construction and Project Management research will pursue advances in construction and contract administration practices for more efficient construction, more effective contract administration, and improved safety for both the construction workforce and the traveling public.

Geotechnical and Hydraulics

Research in Geotechnical and Hydraulics will develop technical knowledge and advance state-of-the-art engineering technologies and practices to enable more resilient and cost-effective highway infrastructure.

LTIP

LTIP research will continue to expand access to data documenting infrastructure performance and deliver findings derived through analysis of infrastructure performance data.

Pavements and Materials

Pavements and Materials research will continue to explore innovations in materials, test methods, and lifecycle analysis to advance sustainable pavement practices and the use of nontraditional materials.

Structures

Structures research will continue to support the updated NBIS and NTIS implementation and pursue innovations in bridge design, preservation, and construction to bring about more durable and cost-effective highway structures.

Transportation Performance and Asset Management

In FY 2025, research in Transportation Performance and Asset Management will continue to pursue advances to bring about more effective risk-based management of highway system performance.

Federal Lands Highway activities will support FHWA's HIF in the areas of lifecycle extension and durable products, such as more durable pavement materials and mix designs

and durable concrete and asphalt. Similarly, Federal Lands Highway will advance a bridge lifecycle analysis model to predict asset (structures) deterioration rates to help prioritize projects based on the urgency of need and funding available for its FLMA partners.

Federal Lands Highway activities will support the development of an asset management prediction model to forecast at-risk culverts for the U.S. Forest Service. Vulnerable culverts are the victim of climate change effects, such as intense precipitation events and wildfires, causing an increase in debris-flow damage to undersized culverts.

Institutionalizing Equity, Strengthening Transportation Planning, and Enhancing Environmental Decisionmaking

Program Description

In FY 2025, the Institutionalizing Equity, Strengthening Transportation Planning, and Enhancing Environmental Decisionmaking program will carry out research to improve and minimize the cost of transportation planning and environmental decisionmaking processes and to minimize the potential impact of surface transportation on the environment. This program supports many of the USDOT strategic goals.

Accelerating Project Delivery

In FY 2025, the Accelerating Project Delivery activity will continue to help FHWA develop well-informed and environmentally sound transportation projects and programs. It will support FHWA's implementation of NEPA and related environmental requirements through improved coordination and communication between Federal and State agencies, the public, and other stakeholders. In addition, this activity will promote capacity building for environmental practitioners, integration of planning, real property acquisition, environmental processes, and information dissemination.

Performance-Based Planning and Equity

In FY 2025, Performance-Based Planning and Equity will continue to provide a strategic and data-driven approach to transportation decisionmaking that allows agencies to advance transportation planning and PBPP. FHWA will work with States and MPOs to update their measures and targets through long-range transportation plans and transportation improvement programs. This activity will ensure that equity considerations are integrated efficiently into State and MPO transportation plans and projects and improve access and mobility for all users, particularly in underserved populations.

Modeling and Analysis Tools

For FY 2025, the Modeling and Analysis Tools research will continue to focus on developing and deploying new and refined analytical tools. These tools will improve efficiencies and accuracy in support of the delivery of highway projects in consideration of the traveling public's needs and reduce adverse air quality and noise impact on the adjacent communities, including vulnerable populations. FHWA will also continue researching new data sources to ensure necessary analyses remain up-to-date and protect the environment. The research activity will assess innovative and effective mitigation and abatement strategies to alleviate impacts on communities near major corridors that face disproportionate exposure to poor air quality and noise pollution from vehicular traffic. The research program will support the USDOT strategic goals on Climate and Sustainability, Equity, Safety, and Economic Strength and Global Competitiveness.

Resiliency

The FY 2025 Resiliency research activity will continue with the same main goals as in FY 2024: the development and deployment of tools, techniques, strategies, and methodologies for assessing climate resiliency, GHG emissions, and the efficiency and sustainability of transportation plans, projects, and programs. However, the FY 2025 program will build on

these goals by focusing on the quickly developing technological areas associated with higher level (faster) EV chargers and continuing to fill gaps in the nationwide system of alternative fuel corridors. Climate resiliency efforts will continue to focus on improving resiliency in postdisaster decisionmaking and institutionalizing planning and engineering best practices into standard practices at State DOTs. Resiliency research will also emphasize tool development, technical assistance, and training to better assist State DOTs and MPOs in assessing and evaluating GHG emissions and strategies to reduce emissions.

Multimodal Connectivity
The goals of the FY 2025 Multimodal Connectivity activity are to increase transportation equity; implement a connected multimodal transportation system that provides travelers with improved, innovative mobility options, particularly in underserved communities; facilitate economic revitalization; and lower the number of pedestrian and bicyclist fatalities and serious injuries. These activities will pivot around a completed Strategic Agenda for Advancing Pedestrian and Bicycle Transportation and the VRU research plan. Further, Multimodal Connectivity activities will also support mobility innovation, active transportation, accessibility planning, context-sensitive design solutions, community impact assessment, and equitable economic development to help address inequalities from transportation disinvestment in underserved communities.

Major Program Objectives
Accelerating Project Delivery
The Accelerating Project Delivery activity builds tools and collaborates on studies to improve project delivery while ensuring sound environmental stewardship and robust public participation in the project development process and compliant real property acquisition. This activity aligns with the objectives of reducing the potential impact of highway infrastructure and operations on the environment, advancing environmental analysis improvements, reducing highway runoff's impact on the environment, and improving transportation planning decisionmaking and coordination.

Performance-Based Planning and Equity
The Performance-Based Planning and Equity activity will allow communities to fully participate in the highway planning and project decisionmaking process by providing information about the anticipated environmental impacts of highway projects and alternatives being considered for each project during the planning process. This effort will provide States, MPOs, and the public with tools, data, and the regulatory framework to protect human health and the environment. Exploring and adapting modeling methodologies for transportation planning also allows State DOTs and MPOs to better understand their transportation systems and provide decisionmakers with actionable techniques and tools to better understand how a complex transportation system reacts to investments and policy changes and efficiently make tradeoffs between performance metrics.

Modeling and Analysis Tools
The objective of the Modeling and Analysis Tools research activity is to identify, develop, and deploy technologies, tools, analysis methods, and performance management

approaches. The goal is to effectively, accurately, and efficiently analyze the impacts of projects on the environment and communities so that transportation projects will be delivered efficiently while maintaining a healthy environment, safeguarding communities, and stimulating economic growth.

Resiliency
Consistent with the objectives of this activity in FY 2024 and operational and safety concerns, the objectives for FY 2025 include the following:

- Developing and deploying tools and methods, promoting best practices, and developing and delivering training to help decisionmakers incorporate climate change resiliency, GHG reduction, and sustainability into transportation plans, projects, and programs.
- Accelerating the adoption of electric and alternative-fueled vehicles by supporting fueling and charging infrastructure deployment.
- Conducting training and technical assistance to State DOTs and MPOs.
- Conducting research on best practices, usage, behavior, and stakeholder needs.
- Designating alternative-fuel corridors.
- Exploring opportunities to use highway right-of-way to enhance sustainability and reduce GHG emissions, generate additional benefits, and reduce costs that are consistent with operational and safety concerns.

Multimodal Connectivity
The Multimodal Connectivity activity will promote policy that supports the delivery of a nationally connected multimodal transportation system that is safe, equitable, and facilitates economic growth. The research will help transportation agencies build capacity to support and implement an equity-focused network that safely integrates multiple modes of travel and is safe and convenient for all transportation system users. This program will support equitable economic growth and improve multimodal mobility options for all users.

Anticipated Program Activities
The Institutionalizing Equity, Strengthening Transportation Planning, and Enhancing Environmental Decisionmaking research program will support the Study on Stormwater Best Management Practices. FHWA, in coordination with EPA, made a formal offer to enter into an agreement with the TRB to conduct the study. This study will continue in FY 2025.

This program also supports the Transportation Access Pilot Program. FHWA will develop or procure an accessibility dataset; make the dataset available to requested States, MPOs, and RTPOs; and work with the States, MPOs, and RTPOs to assess the change in accessibility. The estimated cost is $2,550,000 and will be funded over multiple years, including in FY 2024. In FY 2025, FHWA will develop a Report to Congress on the pilot program's results, including the feasibility of developing and providing periodic accessibility datasets for all States, regions, and localities.

Key FY 2025 FHWA Institutionalizing Equity, Strengthening Transportation Planning, and Enhancing Environmental Decisionmaking R&T Program Activities.

Activity
Accelerating Project Delivery
Performance-Based Planning and Equity
Modeling and Analysis Tools
Resiliency
Multimodal Connectivity

Accelerating Project Delivery
In FY 2025, FHWA anticipates developing new activities to meet requirements under the BIL and the evolving environmental policy landscape.[3] FHWA expects a heightened need for research and outreach related to equity, compliant real property acquisition, and climate change. In FY 2025, FHWA will continue to promote existing successful practices such as PEL, enhancements to INPCT, VPI, programmatic approaches, NEPA Assignment and audit support, Eco-Logical, resource agency liaison program support, and the Environment Discipline Support System.[37,35,47,36] The Accelerating Project Delivery activity will support regulation, policy, and guidance updates, particularly as the Council on Environmental Quality and other Federal agencies update their regulations.

Performance-Based Planning and Equity
In FY 2025, the Performance-Based Planning and Equity activity will continue to support the new planning requirements under the BIL and continue to work with States and MPOs to maintain their data/data-driven plans, studies, and priorities and evaluate the effectiveness of their planned transportation improvements.[3] This research will further the ability of States and MPOs to achieve their desired performance outcomes and evaluate and recommend strategies, projects, and programs to transportation decisionmakers based on anticipated systemwide impacts and goals. The Performance-Based Planning and Equity activity will support regulation, policy, and guidance updates, including housing coordination, human capital/workforce, resiliency, travel demand data and modeling, safety, freight, and more.

Modeling and Analysis Tools
In FY 2025, the Modeling and Analysis Tools research activity will continue to develop and deploy state-of-the-art models, tools, data, and methods to enhance air quality and noise analyses and to support infrastructure investment decisionmaking, the highway project development, and the environmental review process. Research products such as analytical tools and models that are completed will be delivered to transportation stakeholders (State DOTs and MPOs) and the public in a variety of ways, such as conferences, workshops, webinars, training courses, and peer exchanges. Documents such as research reports, case studies, model sensitivity and validation analyses, and technical guidance will be posted online and marketed at industry events.

Resiliency
In FY 2025, the Resiliency activity expects to build new and expanded partnerships with State DOTs and others to accomplish the following:

- Institutionalize hydraulic best practices standard design manuals.
- Implement resilience improvements such as nature-based solutions.
- Continue improving processes, tools, and methods through developmental and applied research and demonstration projects to incorporate resiliency and sustainability.
- Update and enhance technical assistance on resilience for all stages of highway planning, design, construction, operations, maintenance, and asset management.
- Support expansion of alternative fuels through the designation of alternative-fuel corridors, technical assistance, training, and research, continuing to shift focus to new and emerging technologies.

The research will also continue to explore opportunities and support the deployment of alternative uses of the highway right-of-way. In addition, Resiliency activities will research and support the implementation of highway construction and materials that reduce environmental impacts and emissions and maximize material efficiency and recycling.

Multimodal Connectivity
In FY 2025, Multimodal Connectivity initiatives are expected to support an equitable, connected multimodal network that integrates safe and efficient mobility options for all users. The activities will further advance transportation equity, promote economic revitalization, integrate emerging mobility technology systems in transportation planning and project development, and promote the rebalancing of multimodal investments to address inequalities in underserved communities.

In addition, the Office of FLH notes that transportation systems are critical to maintaining and improving the livelihoods of Tribes who are increasingly under threat from extreme weather and climate effects. The Office of FLH supports its FLMA and Tribal partners with the development of prototype, customized asset management models. The *Vulnerability Assessment and Adaptation Framework* funded in FY 2024 will assess the vulnerability of each Tribe's transportation infrastructure by evaluating its exposure, sensitivity, and adaptive capacity in the face of these extreme weather and climate impacts.[68] This assessment will allow Tribal transportation departments to identify, analyze, and prioritize adaptation options, substantively informing their transportation decisions. The model developed for Tribes has transferability to other FLMA partners.

Reducing Congestion, Improving Operations, and Enhancing Freight Productivity

Program Description
The United States has invested billions of dollars in building its existing transportation infrastructure; however, when these facilities are congested, the efficient movement of people and goods is disrupted, causing impacts on the economy, climate, and quality of life. Facilities need to be operated well so they are used efficiently and effectively to maximize the value of these investments. Incorporating more accurate, real-time, and localized data improves the ability to measure current and future conditions and operation of the freight transportation network. R&D for the Reducing Congestion, Improving Operations, and Enhancing Freight Productivity program results in innovative technologies and processes leading to systemwide improvements in how FHWA, along with State and local agencies, manages and improves the efficiency and reliability of the NHS.

The program primarily supports the USDOT 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 both 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.

Major Program Objectives:
The program invests in topics such as operations strategies to improve equitable mobility and climate change, active management techniques to increase operational resiliency and safety, advanced integration of emerging technologies, and freight mobility to enhance the movement of goods and support economic competitiveness. By empowering State and local transportation agencies to manage and operate the multimodal transportation system effectively and equitably, those agencies are able to develop a more holistic approach to addressing congestion issues and maximize their existing transportation network infrastructure and technology investments. This effort results in enhanced safety and options for all users, reduced emissions and fuel consumption, expanded mobility services to underserved communities, and economic improvement through improved and reliable passenger and freight movement.

Anticipated Program Activities:
The Reducing Congestion, Improving Operations, and Enhancing Freight Operations program supports the Cybersecurity Tool and is continuing to work with the Cybersecurity and Infrastructure Security Agency (CISA) on its adoption. FHWA is collaborating with the Transportation Security Administration and the CISA. Initiatives and resources will be coordinated through a memorandum of understanding for providing a method to assist transportation authorities in identifying, detecting, protecting against, responding to, and recovering from cyber incidents. This work has not yet been funded.[51]

Key FY 2025 FHWA Reducing Congestion, Improving Operations, and Enhancing Freight Operations R&T Program Activities.

Activity
TSMO
MUTCD[22]
Automation and Connectivity
Managing Disruptions to Operations
Freight Management and Operations
TSW

TSMO
The key FY 2025 activities will continue developing outreach and training materials and conducting targeted outreach and T2 to advance the state of the practice and improve FHWA's capabilities for developing and delivering TSMO activities. Tools and decision support systems for operational/tactical and executive/organizational TSMO decisions will be enhanced by adding functionality for emerging technologies. Implementing operation strategies will continue through the development of capabilities, tools, and guidance to enable more proactive, dynamic, integrated, and performance-driven management and operations to advance the adoption of solutions and strategies.

MUTCD
Research undertaken will be related to implementing the 11th edition of the MUTCD, preparing the initial material for the 12th edition of the MUTCD (or equivalent revision to the 11th edition), training on MUTCD use, and expanding outreach on the future of the MUTCD.[42,22]

Automation and Connectivity
Planned activities will continue R&D efforts from prior years with the intent to foster the coordination and collaboration necessary to move toward implementing roadway investments that support ADS-roadway integration; provide new modeling capabilities that accurately reflect the impact of the deployment of ADS-equipped vehicles in traffic; and develop, test, and validate CDA capabilities for TSMO strategies.

Managing Disruptions to Operations
In FY 2025, FHWA will continue to actively research, develop, and deploy projects in road weather management, work-zone management, traffic incident management, and nonrecurring event data framework management. Together, these efforts support the USDOT strategic goals and help provide better traveler choices and safer infrastructure.

Freight Management and Operations
Activities will continue to enhance freight-focused performance measurement tools and present national freight performance and mobility measures to understand trends and needs for improvement to the freight transportation system. Other activities include coordinating and investigating truck parking issues; researching the resiliency of the

freight transportation system, including through implementing the recommendations of the USDOT Emergency Route Working Group; and coordinating with FHWA partners on safety and resiliency areas impacting freight, including improvements to data collection methodologies, travel demand models, analysis tools, and strategies to facilitate public-private sector data coordination and sharing.

TSW

The TSW research implementation plan will continue to guide specific resources toward research projects that are topically crosscutting and impact multiple agencies and departments. FHWA will produce resources to determine needed information for freight vehicle size and weight analysis and support harmonization and automation of State permitting systems. FHWA is partnering with stakeholders in the United States and internationally on studies to prevent bridge strikes by trucks and will establish a framework for collecting bridge strike data and use that data to support operational changes and develop countermeasures.

Additionally, the Office of FLH is working with the National Park Service to evaluate innovative ways to capitalize on emerging technologies, such as mobile devices and big data, to help answer key transportation and visitor use questions related to travel patterns, congestion, and other transportation analytics. The Integrating Emerging Traveler Data Collection Methods research project includes introducing new methods of capturing traveler data in rural and remote areas absent GPS satellite connection (wireless network/wireless technology). Cell panels help collect and transmit data that were unachievable without satellite access. Data captures will inform decisionmaking for identifying projects that reduce congestion in internal (parking lots) and external (gateways) areas of national parks.

Accelerating the Implementation and Delivery of New Innovations and Technologies

Program Description

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 time between project planning and project delivery.

Within this program, FHWA supports numerous T2 efforts to accelerate the implementation and delivery of new innovations and technologies that result from highway R&D and that benefit all aspects of highway transportation. FHWA will continue to use a series of successful deployment vehicles in FY 2025, including the following:

- EDC, a State-based model for deploying market-ready but underutilized technologies that make the transportation system adaptable, sustainable, equitable, and safer for all.[6]
- AID Demonstration, a discretionary grant program.
- AMR, an activity to support technologies emerging into the transportation industry.
- STIC, an activity that facilitates a State-based innovation deployment approach.[45,46]

FHWA will also continue to work directly with State and local agencies to provide technical assistance and deployment initiatives through the geographically dispersed FHWA Office of Innovation Implementation—Resource Center. FHWA will provide Technology Deployment Support activities including, but not limited to, technical assistance; peer exchanges; innovation/T2; and training in the use of tools and decisionmaking processes that assist divisions, States, and local and other transportation partners in effectively implementing surface transportation programs, projects, and policies.

Accelerating the Implementation and Delivery of New Innovations and Technologies also includes initiatives directed at accelerating the implementation and deployment of pavement technologies and ADCMS and deploying advanced technologies and related strategies to improve safety, mobility, efficiency, system performance, intermodal connectivity, and infrastructure return on investment.[9] FHWA is also working to develop and deploy innovative finance tools to maximize the ability of States to leverage Federal capital, attract new sources of funds to transportation investment, accelerate project completion dates, and utilize existing funds more effectively.

Major Program Objectives

EDC

Accelerating the Implementation and Delivery of New Innovations and Technologies in FY 2025 includes the continuation of EDC with EDC-7, which will facilitate the adoption of innovative technologies by the surface transportation community.[6,44] The AID Demonstration and STIC Incentive activities will continue to complement EDC by providing additional resources to help the surface transportation community accelerate the adoption and standardization of innovative technologies in their programs.[4546,6] FHWA will

disseminate information on previously awarded AMR projects while soliciting a new group of projects through a BAA.

AIDPT
AIDPT coordinates with FHWA's Pavement and Materials R&D and LTPP to provide a coordinated approach to implement research, deploy tools and technologies, and provide guidance to support updated policies.[8] The AIDPT activity focuses on improving the safety, durability, sustainability, and cost-effectiveness of highway pavements and the materials from which highway infrastructure is constructed.[8] AIDPT serves as the implementation and deployment mechanism for innovations coming out of Pavement and Materials and LTPP research.[8]

ADCMS
The primary goal of the ADCMS activity is to transform State DOTs and LPAs by promoting, implementing, deploying, demonstrating, showcasing, supporting, and documenting the application of ADCMS practices, performance, and benefits.[9] ADCMS are digital technologies and processes for managing construction and engineering activities, including systems for infrastructure planning and coordination, design, construction, maintenance, modernization and management, and asset management, including hardware, mobile devices, software, IoT, and personnel.[9] ADCMS also includes developing and supporting systems to enhance and share data across an asset's lifecycle and between organizational silos, also referred to as maximizing interoperability.[9]

Secondary goals include reducing the environmental footprint of construction projects; increasing the availability of technology training and workforce development to build the capabilities of sponsors; and enhancing worker and pedestrian safety, resulting in increased transparency.

ATTAIN
In addition to the previously mentioned initiatives, the vision for the ATTAIN activity (23 U.S.C. § 503(c)(4)) includes providing grants to eligible entities to deploy, install, and operate advanced technologies and related strategies to improve safety, mobility, efficiency, system performance, intermodal connectivity, and infrastructure return on investment.[1] These advanced technologies will be integrated into the routine functions of the location or jurisdiction and play a critical role in helping agencies and the public address their challenges.

Anticipated Program Activities:
Planned activities for the FY 2025 FHWA Accelerating the Implementation and Delivery of New Innovations and Technologies program are listed in the following table. These activities will include demonstration grants to State and local transportation agencies and direct and indirect assistance to implement new innovations and technologies.

Key FY 2025 FHWA Accelerating the Implementation and Delivery of New Innovations and Technologies R&T Program Activities.

Activity
EDC[6]
STIC Incentive[45,46]
AID Demonstration
AMR
Technology Deployment Support
AIDPT[8]
Accelerated Implementation and Deployment of ADCMS[9]
ATTAIN
Innovative Finance
Research Infrastructure, Technology Transfer, and Partnerships

EDC
EDC activities essentially constitute an agency-wide T2 effort. 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.[6] The State and local highway agencies are the primary beneficiaries of EDC.[6] Anticipated activities for FY 2025 include the continuation of EDC-7 deployment-related efforts and stakeholder engagement in support of identifying topics for the next 2-yr deployment cycle (EDC-8).[44]

STIC Incentive
The FHWA STIC Incentive activity provides resources to help foster a culture of innovation and make innovations standard practice in the States.[45,46] 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 another public sector stakeholder.

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

AMR
The AMR activity 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
FHWA field units use the Technology Deployment Support activity to provide technical and workforce development assistance to State and local agencies and to engage them in using new innovations and technologies.

AIDPT
The AIDPT activity will advance strategies for lowering the embodied carbon of paving mixtures and provide tools and information to quantify these strategies.[8] FHWA will continue to deploy and implement performance tests to better characterize the durability of materials and pavements. Implementation activities include providing education and guidance on the use of new tests, support for demonstration and shadow projects (where new technologies are used side-by-side with existing technologies), and other information-sharing opportunities such as peer exchanges and workshops.

Accelerated Implementation and Deployment of ADCMS
Accelerated Implementation and Deployment of ADCMS will ensure that highway construction is using best practices and leveraging advanced digital techniques to accelerate project delivery and increase the safety and efficiency of highway construction.[9] The activity will establish and support a building information modeling (BIM)-GIS working group.[38] This working group will include key external stakeholders and meet regularly to coordinate and discuss what various groups are doing. ADCMS will also support pooled-fund efforts that advance ADCMS goals and support FHWA Workforce Development activities related to deploying digital practices within the highway industry.[9] The initiative will further support FHWA Work Zone Safety activities related to deploying digital practices within the highway industry, BIM implementation/R&D activities based on *Advancing BIM for Infrastructure National Strategic Roadmap* priority activities, and EDC activities related to the deployment of digital practices within the highway industry.[69,6] ADCMS will support project sponsors in advancing their UAS initiatives by continuing efforts begun under EDC-5 and providing funding to State DOTs and LPAs to advance ADCMS goals and objectives.[9,7]

ATTAIN
ATTAIN will provide 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

Program Description

The FHWA Accelerating the Discovery of Transformational Solutions program supports the strategic investment in transportation infrastructure, safety, operations, planning, policy, and innovation development and deployment. The program monitors legislative developments, helps to coordinate the R&T budget allocation, maintains TFHRC, organizes strategic R&T investment, and provides marketing and communications.

EAR

The EAR activity 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 the current and emerging needs of the highway transportation industry. By leveraging the capabilities of TFHRC, EAR brings new capacity in emerging areas to the Center.

SBIR

SBIR is a highly competitive, awards-based activity that encourages domestic small businesses to engage in R&D addressing 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. Section 638 of 15 U.S.C. establishes that Federal agencies with extramural R&D budgets at the department level that exceed $100 million allocate 3.2 percent of their R&D budget to these programs each year.[49]

SIRC and National Motor Vehicle Per-Mile User Fee Pilot

FHWA is also supporting two programs included in the BIL that aim to address the decline in revenues that contribute to the Highway Trust Fund.[3,50] 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.

Major Program Objectives

The Accelerating the Discovery of Transformational Solutions program will provide leadership, coordination, and support in the administration of the FHWA R&T program to help accomplish the USDOT strategic goals. To accomplish these goals, the program will continue to foster and promote enhanced coordination of highway research among all stakeholders; communicate, publish, market, and disseminate research results to appropriate audiences; coordinate strategic resource allocation; and conduct R&T program evaluations.

Research Infrastructure, Technology Transfer, and Partnerships
The Research Infrastructure, Technology Transfer, and Partnerships activity will maintain and support the operation of TFHRC and the R&T program. The highway R&D relating to emerging highway technology at TFHRC focuses on addressing research gaps 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 and address critical needs. Additionally, this program supports marketing and communications efforts to ensure that partners, stakeholders, and the public are aware of FHWA's research investments and innovations. Finally, this activity aids in the legislative and budget development process related to the R&T program.

EAR
The EAR activity conducts investigations across disciplines and program areas to identify topics where a Government investment has the potential for transformative results. EAR regularly screens results from its portfolio of active research projects and vigorously supports efforts to transition results that demonstrate high potential impact to applied research programs. Throughout and across activity processes, FHWA engages experts inside and outside government to ensure efforts reflecting the most recent advances in science and technology are well targeted to the needs of the U.S. highway industry and benefit all travelers.

SBIR
The objective of the SBIR activity is to encourage small businesses to engage in R&D that has the potential for commercialization and meets Federal R&D objectives. SBIR is uniquely positioned to support both the interests of FHWA as well as small businesses. In this respect, the SBIR activity aims to provide essential funding to small businesses with the goal of commercialization of products that align with FHWA and USDOT strategic goals.

SIRC and National Motor Vehicle Per-Mile User Fee Pilot
These two revenue collection programs included in the BIL aim to identify innovative and operationally successful solutions to ensure that the country has dedicated and sufficient funding mechanisms for highway infrastructure investment in the future.[3]

Anticipated Program Activities:
Key FY 2025 FHWA Accelerating the Discovery of Transformational Solutions R&T Program Activities.

Activity
Research Infrastructure, Technology Transfer, and Partnerships
EAR
SBIR
SIRC
National Motor Vehicle Per-Mile User Fee Pilot

Research Infrastructure, Technology Transfer, and Partnerships
The Research Infrastructure, Technology Transfer, and Partnerships activity will conduct program evaluations; provide marketing, communications, and publication services; maintain critical corporate partnerships; and support TFHRC.

EAR
The EAR activity conducts initial stage investigations; supports early stage, extramural research and intramural research through open solicitations, partnering with other agencies, and placement of postdoctoral researchers in FHWA; and actively works to transition research results toward transformative changes in transportation practice.

SBIR
The SBIR activity is a highly competitive, awards-based program encouraging domestic small businesses to engage in R&D addressing 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.

SIRC
The SIRC activity will provide grants to State DOTs, local agencies, or MPOs to demonstrate user-based alternative revenue mechanisms that can potentially maintain the long-term solvency of the Highway Trust Fund.(50) The annually awarded grants will be for projects designed to test innovative ways to replace or supplement the Federal gas tax.

National Motor Vehicle Per-Mile User Fee Pilot
The National Motor Vehicle Per-Mile User Fee Pilot activity will demonstrate a national motor vehicle per-mile user fee, establish a Federal System Funding Alternative Advisory Board, and carry out a public awareness campaign regarding a national motor vehicle per-mile user fee. The Secretary of Transportation, in coordination with the Secretary of the Treasury, will test the design, acceptance, implementation, and financial sustainability of a national motor vehicle per-mile user fee designed to restore and maintain the long-term solvency of the Highway Trust Fund.(50)

Crosscutting

Program Description

FHWA's Crosscutting RD&T program involves a diverse set of activities that support all of the USDOT strategic goals and the objectives of the other six programs outlined in this AMRP.[2] Crosscutting involves RD&T activities in Policy Analysis, Global Outreach, HDI, Civil Rights, and Federal Lands Highway. It 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.

Major Program Objectives

Policy Analysis
The primary objective of FHWA's Policy Analysis research is to provide decisionmakers with empirically based assessments of emerging trends current and future transportation needs and the potential for Federal policies and strategies to effectively use available sources to address those needs. Policy Analysis research also analyzes the policy implications of current and emerging transportation technologies and explores transportation options to expand accessibility, mobility, and equity.

Global Outreach
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 a variety of countries by leveraging binational government-to-government relationships. Multinational Relations initiatives span a wide range of program and research activities, working with entities such as PIARC and the European Union.

HDI
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. HDI's effort in data gathering, analysis, and forecasting methods focuses on big data and big data analytics to reveal new, transformative ways of doing business at USDOT and FHWA with State DOTs, MPOs, and other entities and enterprises. More informative and revealing data are gathered through these new approaches, and more relevant information is extracted while making the data program more cost sustainable.

NPMRDS
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 the NHS roadways throughout the year. The 5-min interval travel time data enables analysis and evaluations 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 the 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 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. The Civil Rights, Federal Lands Highway, and Emerging/Corporate Needs activities will further deliver transportation traveler information systems for more equitable and reliable access to highway transportation and public lands.

Anticipated Program Activities
The Crosscutting program supports the Performance Management Data Support Program prescribed in IIJA Section 13003 through all HDI and NPMRDS activities.(52) FHWA will continue to develop, use, and maintain datasets and data analysis tools to assist MPOs, States, and the Agency in carrying out performance management analyses. Annual funding of up to $10 million is anticipated.

This program also supports research and publication of the biennial *C&P Report*. FHWA will expand the required scope of the existing biennial *C&P Report* to include conditions and performance of ITS, resiliency needs, and tunnel needs.(53)

Additionally, the Crosscutting program supports the HCAS. FHWA, in coordination with State DOTs, will continue to carry out an HCAS to determine the direct costs of highway use by various types of users (vehicles with different dimensions, weights, number of axles, and other specifications).

Planned Activities for the FY 2025 FHWA Crosscutting program are listed in the following table. These activities will include R&D initiatives as well as T2 initiatives.

Key FY 2025 FHWA Crosscutting R&T Program Activities.

Activity
Policy Analysis
Global Outreach
HDI
NPMRDS
Civil Rights
Federal Lands Highway
Emerging/Corporate Needs

Policy Analysis
FHWA Policy Analysis research focuses on developing analytical tools and studies identifying current and emerging issues with national implications from a systemwide perspective rather than just a program implementation perspective. One new FY 2025 policy analysis initiative is a project to examine the role of highway investment in socioeconomic mobility, specifically analyzing the relationship between the availability and quality of highways and their impact on the mobility and access to economic opportunities of individuals and communities. A separate project will examine the impact of highway performance (including condition, travel speeds, and access) on the transportation costs of freight in the United States. Based on the findings of this study, a method would be recommended to enhance the USAGE-Hwy model's accuracy estimating the economic impacts of freight transportation cost and performance.(17)

Global Outreach
FHWA's Global Outreach activities focus on three main elements: Global Benchmarking, Binational Relations, and Multinational Relations. The GBP initiative seeks out and adapts existing foreign innovations that could significantly improve highways and highway transportation services in the United States. Binational Relations initiatives facilitate knowledge exchange with a variety of countries by leveraging binational government-to-government relationships. Multinational Relations initiatives span a wide range of program and research activities, working with entities such as PIARC and the European Union.

HDI
FHWA's HDI activity is crosscutting and multifaceted, supporting all FHWA R&T activities and the delivery of the Federal-Aid Highway Program. The HDI activity consists of initiatives to develop and improve data methods and guidelines and collect, process, analyze, model, visualize, and disseminate data and information by working with States, local transportation agencies, private businesses, and research communities.

NPMRDS
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 the NHS roadways throughout the year. The 5-min interval travel time data enables analysis and evaluations of travel reliability, speed, safety, and various performance measures.

Civil Rights
Civil Rights RD&T is focused on transforming, protecting, and enhancing the quality of life for all by improving access to a fair and equitable transportation system. The results of the RD&T initiatives are designed to lead the multidisciplinary highway community in ensuring all programs are delivered in a nondiscriminatory manner.

Federal Lands Highway
Federal Lands Highway activities support FHWA's partnership with FLMAs and Tribes and seek to implement innovative transportation solutions that provide access to and through public lands. These RD&T activities support improved safety and mobility for vulnerable users of public roads, which typically are non-NHS transportation networks with low ADT. However, large public land holdings are also accessible by roads and adjacent networks that rival or are included in the NHS system and have remarkable ADT, such as the Blue Ridge Parkway and the George Washington Parkway.

Emerging/Corporate Needs
Within the Crosscutting program, funds are available for Emerging/Corporate Needs that address new initiatives, accelerate RD&T activities, conduct legislative mandates, encourage cross-discipline and multimodal RD&T, and highlight Administration priorities. These funds will also be used to implement new ways to tackle the climate crisis and achieve equitable transportation access. Initiatives like Complete Streets, which focuses on safe access for all groups that need to use the transportation network, will be advanced in this program. Emerging/Corporate Needs will also conduct RD&T initiatives to prepare for the widespread integration of CAVs on the highways.

The Complete Streets initiative in FY 2025 will continue testing a safety analysis approach with case studies developed by other parties. Work will also proceed on developing methods for reducing data collection costs for pedestrians, bicyclists, and other VRUs. Further research into policy impacts will consider the benefits and model the effects of implementation.

In FY 2025, initiatives like Complete Streets and initiatives to institutionalize Equity will be funded. In addition, funding for the Performance Management Data Support Program (§ 13003 of BIL), Center of Excellence on New Mobility and Automated Vehicles (§ 13006(c) of BIL), and the Transportation Access Pilot Program (§ 13010 of BIL) will continue.[55,57,63]

For More Information on DOT's Research see https://researchhub.bts.gov/search[70] -

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