United States Department of Transportation
Annual Modal Research Plans FY 2022
Program Outlook FY 2023

Federal Highway Administration
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Chapter 1 – Executive Summary

The primary goal of the FHWA research, development, and technology (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 cannot or will not be addressed by other research sponsors, including areas that require higher risk, longer term research, higher complexity, or specific Federal responsibility. The FHWA RD&T program is responsible for conducting RD&T activities that produce a clear public benefit; support Federal stewardship roles; meet and address current and emerging needs; and ensure the coordination of highway RD&T activities. Additionally, the FHWA RD&T program delivers solutions to meet current and future challenges.

Through coordination with other research partners, FHWA's role is also to conduct research to maximize value and avoid duplication by focusing on innovations with broad applicability and that leverage research investments through programs with successful technology transfer (T2). The FHWA RD&T program also ensures that critical technical expertise is available in times of crisis or for sensitive matters, including the ability to provide technical support during natural disasters, participation in sensitive Federal investigations, and work with other Federal agencies on issues related to national security and defense.

The FHWA RD&T program covers the entire innovation lifecycle: setting an agenda, conducting R&D, testing and evaluating technologies, and deploying and evaluating market-ready technologies and innovations. This holistic approach to innovation allows FHWA and USDOT to serve as national transportation leaders, thus the Agency and Department can provide a strategic approach in shaping the direction of innovation development that supports national interests. This leadership ensures that in working with partners, FHWA pursues a transportation future aligned with the strategic goals of the Department and promotes the most safe and efficient transportation system for taxpayers. Without the FHWA RD&T program, the Nation would lack strategically aligned research and innovation development and deployment activities—not to mention 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 addresses current issues and emerging challenges, creates efficiencies in the highway and transportation sector, and provides information to support policy decisions through its RD&T programs. 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, Virginia. The TFHRC houses 15 laboratories and support facilities and conducts exploratory and applied research. TFHRC staff administer the majority of FHWA's Research and Development (R&D) activities in the areas of infrastructure, operations, and safety. Research in the areas of Intelligent Transportation Systems (ITS), policy, planning, and the environment is conducted or administered primarily by FHWA offices located at USDOT headquarters. In addition, the FHWA Office of Federal Lands works with other Federal Land Management Agencies to deliver quality, durable projects and provide technical expertise in areas of emerging technologies.

FHWA has a long history of success coordinating and communicating research efforts with both internal and external partners through USDOT operating administrations, USDOT Topical Research Working Groups (TRWGs), and other more informal processes. The TRWGs ensure that FHWA does not conduct duplicative research within the Department. Particularly important is the relationship and coordination between FHWA and the ITS Joint Program Office (JPO). Each USDOT operating administration is responsible for ITS requirements, guidance, and research relevant to that mode, and each uses a combination of mode-specific funding and legislatively dedicated ITS funding to accomplish that mission. Some ITS JPO funds supplement FHWA research activities where additional revenues are needed to meet Department program objectives or to ensure synchronization with USDOT multimodal needs.

Additionally, FHWA leverages a long history of strong partnerships and collaborations with State and Federal agencies, academic institutions, and private industry organizations to coordinate efforts and benefit from the unique capabilities of each to advance shared goals. Working within this partnership framework, FHWA strategically identifies opportunities for collaboration, coordination, and independent research that advance the goals of the Agency and the Department. FHWA also works closely with the National Academies of Sciences, Engineering, and Medicine's Transportation Research Board (TRB) and with the TRB-sponsored advisory group, the R&T Coordinating Committee (RTCC), to provide an outside perspective on the direction of the FHWA RD&T program and identify future opportunities for coordination and collaboration.

FHWA's core RD&T program activities improve safety, reduce congestion, enhance infrastructure design and construction, invest in transformative solutions, and provide data and analyses to decisionmakers throughout the transportation community.

- The Safety area addresses the contributing factors for deaths and injuries related to roadway design, construction, and maintenance, and develops robust data analysis tools that enable transportation professionals to match those contributing factors with cost-effective countermeasures.

- The Infrastructure area is forward-looking and supports safety, durability, resilience, environmental sustainability, and asset management. FHWA infrastructure research outcomes stimulate economic growth, productivity, and competitiveness through contributions to improve mobility and accessibility.

- The Operations area develops innovative technologies and processes that lead to system-wide improvements in how FHWA and its State and local partners manage and improve the efficiency and reliability of the National Highway System.

- The Policy area offers comprehensive quality data; evaluates the impacts of a broad range of policy options; and analyzes current and emerging issues that will affect the

way transportation projects are regulated and permitted and how transportation systems are constructed, operated, and maintained.

- The Planning and Environment area assesses new tools and processes that consider the complex relationships among individuals, equity in communities, the economy, and the environment to enable better decision making that leads to improved outcomes.

- The Exploratory Advanced Research Program conducts longer term, higher risk research in all the research areas. The research products from this program have the potential for dramatic breakthroughs in transportation.

RD&T Funding Overview

FHWA's RD&T program is largely governed and shaped by Chapter 5 of Title 23 of United States Code (USC). Title 23 USC 503(a) provides that the Secretary shall (1) carry out research, development, and deployment activities that encompass the entire innovation lifecycle; and (2) ensure that all research carried out under this section aligns with the transportation research and development strategic plan of the Secretary. Title 23 USC 503 establishes the Highway Research and Development (HRD) Program and the Technology and Innovation Deployment Program (TIDP), which provide funding for FHWA's RD&T program.

The HRD Program governs the Research and Development portion of FHWA's RD&T program. Program objectives may include: improving highway safety, improving infrastructure integrity, strengthening transportation planning and environmental decision making, reducing congestion, improving highway operations, and enhancing freight productivity. The HRD Program also provides for the conduct of exploratory advanced research. Under the FAST Act, $125 million, or about 65% of FHWA's RD&T funding, is provided annually to the HRD program. Of the authorized funds for HRD, $20 million is legislatively set aside annually for the Surface Transportation System Funding Alternatives (STSFA) Program. In addition, 3.2% of the FHWA extramural R&D budget is reserved for awards to small business concerns through the Small Business Innovation Research (SBIR) program. The SBIR Program is a competitive, awards-based program that encourages domestic small businesses to engage in research and development addressing high priority research areas within USDOT.

The TIDP governs the T2 portion of FHWA's RD&T program. TIDP relates to 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. This includes the responsibility to distribute the products, technologies, tools, methods, or other findings that result from highway research and development activities. Under the FAST Act, $67.5 million, or about 35% of FHWA's RD&T funding, is provided annually to TIDP. Of the authorized funds for TIDP, $12 million is legislatively set aside annually for the Accelerated Implementation and Deployment of Pavement Technologies (AIDPT).
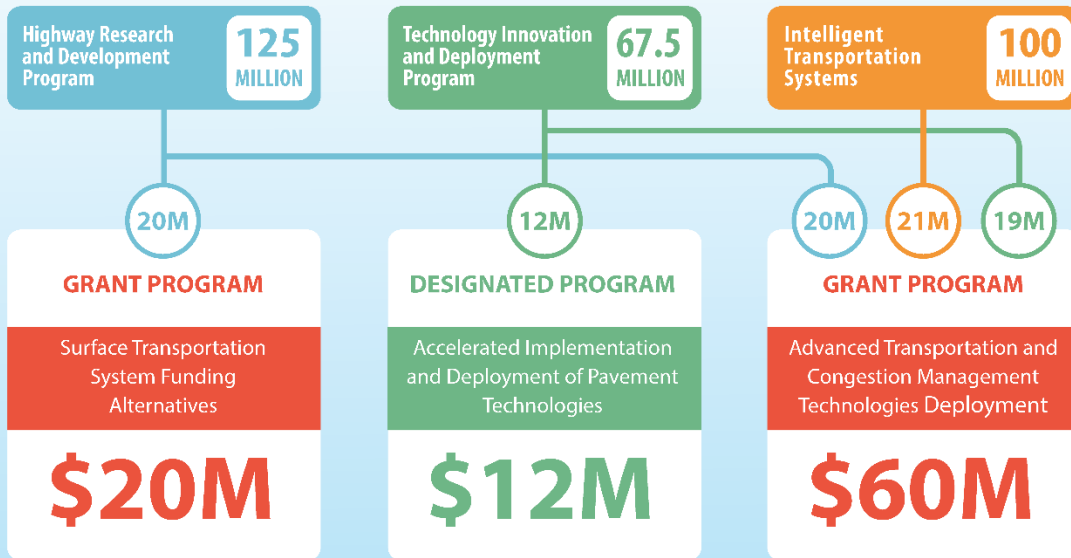
In addition to HRD and TIDP, FHWA RD&T shares some funding, research planning, and research objectives with the USDOT's ITS JPO, which has a separate AMRP. Title 23 USC 512 through 519 establishes the ITS program, which has authorized funding of $100 million annually through the FAST Act. The ITS program provides for the research, development, and operational testing of ITS aimed at solving congestion and safety problems, improving operating efficiencies in transit and commercial vehicles, and reducing the environmental impact of growing travel demand. The ITS program coordinates and jointly funds activities where there is overlapping responsibility and priorities with the other operating administration, including FHWA.

Title 23 USC 503 also establishes the Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Program to make competitive grants for the development of model deployment sites for large scale installation and operation of advanced transportation technologies to improve safety, efficiency, system performance, and infrastructure return on investment. The FAST Act provides for a legislative set aside of $60 million annually for ATCMTD from HRD, TIDP, and ITS funding. Currently, $20 million is set aside annually from HRD, $19 million from TIDP, and $21 million from ITS.

The diagram below shows how FHWA's RD&T program is funded.

FHWA RD&T FUNDING

(23 USC §503)

Highway Research and Development Program	**125** MILLION	Technology Innovation and Deployment Program	**67.5** MILLION	Intelligent Transportation Systems	**100** MILLION

20M	**12M**	**20M**	**21M**	**19M**

GRANT PROGRAM	DESIGNATED PROGRAM	GRANT PROGRAM
Surface Transportation System Funding Alternatives	Accelerated Implementation and Deployment of Pavement Technologies	Advanced Transportation and Congestion Management Technologies Deployment
$20M	**$12M**	**$60M**

ELIGIBLE ACTIVITIES

- Improving highway safety
- Improving infrastructure integrity
- Strengthen transportation planning and environmental decision making
- Reducing congestion, improving highway operations, and enhancing freight productivity
- Exploratory advanced research
- Turner-Fairbank Highway Research Center

- Technology transfer to support the planning, financing, operation, structures, materials, pavements, environment, construction, and the duration of time between project planning and project delivery.
- Distribute the products, technologies, tools, methods, or other findings that result from highway research and development activities.

VARIOUS APPROACHES TO HIGHWAY SAFETY AND IMPROVEMENTS EXISTS WITHIN ALL FHWA RD&T PROGRAMS

FHWA RD&T PROGRAMS

Safety - Infrastructure - Operations - Policy - Environment and Planning
Innovative Program Delivery - Corporate - Exploratory Advanced Research
Small Business Innovation Research

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Technology Transfer (T2)
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. The FHWA RD&T Program aims to accelerate the adoption of proven innovative practices and technologies as standard practice to significantly improve safety, system efficiency, infrastructure health, reliability and performance, and sustainable communities. FHWA uses a series of successful deployment venues in FY 2022, including Every Day Counts (EDC), a State-based model for deployment; the Accelerated Innovation Deployment (AID) Demonstration program; the Accelerating Market Readiness (AMR) program; and the State Transportation Innovation Council (STIC), 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 Resource Center. Further, through the FHWA Office of Federal Lands, FHWA works with other Federal land management agencies as well as tribes to deploy and develop highway-based innovations.

FHWA has traditionally used a multipronged approach to deploy new and proven technologies and transportation-related innovations and processes. The deployments include 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, Federal Land Management agencies, Tribal Governments, and industry groups. These stakeholders are often the intended audiences for the research deployment outputs. The Local and Tribal Technical Assistance Program centers and other deployment programs play a critical role in T2 activities with these stakeholders.

Highlighted Initiatives that Support USDOT Strategic Goals
FHWA plans to build on decades of innovative research and continues to work toward solutions that address the Nation's most critical infrastructure-related needs. The FHWA RD&T Program for FY 2022 includes both follow-on initiatives from prior work and new activities that address emerging needs. Specific activities, whether ongoing from prior years or new for FY 2022, are listed and described in the individual program descriptions in Chapter 2. In all cases, the research activities are aligned with the six USDOT Strategic Goals of Safety, Economic Strength and Modernization, Equity, Climate and Sustainability, Transformation, and Organizational Excellence. They also address topics outlined in 23 U.S.C. § 503, including:

-   Improving highway safety.
-   Improving infrastructure integrity.
-   Strengthening transportation planning and environmental decision making.
-   Reducing congestion, improving highway operations, and enhancing freight productivity.
-   Strengthening exploratory advanced research.

- Advancing technology and innovation deployment.

Below are examples of activities that support USDOT Strategic Goals that will be addressed as part of the FY 2022 FHWA RD&T program.

Safe System Approach for the Urban Core: The FHWA has adopted the Safe System Approach, and there is strong interest in understanding how to apply this approach in high-density areas at an area-wide scale where many have already embraced a zero fatality vision. The Safe System Approach – especially in a dense area with a mix of vehicle types, mixed use development, and diverse road users – considers safety as an ethical imperative of designers and practitioners to use a holistic view of the road system to anticipate human mistakes and keep impact energy on all road users at tolerable levels. The goal of this project is to develop a comprehensive resource for practitioners interested in implementing a Safe System Approach to prioritize safety in the Urban Core, which is a defined term in the 2018 American Association of State Highway & Transportation Officials (AASHTO) Green Book.

Path to Novel Data Analytics (PANDA) Laboratory: In FY22, FHWA will establish the PANDA Laboratory, which will be a data science-focused laboratory where researchers can test techniques developed in other research and overseas for the benefit of all FHWA programs. PANDA is an outcome of research experience in machine learning, machine vision, and big data analysis. FHWA experience in contracting advanced data science tools demonstrates that there is a need for advanced analytics capability within the agency for the benefit of the program offices. New data analytics research for pedestrian safety is proposed where there can be exploration for determining where threats for pedestrian safety are based on available data where observed pedestrian crossing behavior can be mined from demographic data along with other sourced data. This research will support the USDOT Strategic Goal of Safety by developing new analytics that can determine how roadway geometrics and physical environment can influence the number and severity of pedestrian crashes. It will also support the USDOT Strategic Goal of Equity by considering detailed demographics and development pf predictive pedestrian crash models that are focused on socioeconomically disadvantaged communities.

Climate Change Impacts on Infrastructure on Federal Lands: The FHWA Office of Federal Lands will develop real-time decision support tools that can assess the hydrologic vulnerability (risk of failure due to undersizing) to extreme precipitation events, as well as the geomorphologic vulnerability (risk of failure due to susceptibility to erosion, scouring, and clogging by sediments) of culverts and stream/road crossings on forest lands. This will increase the resiliency of vulnerable assets to climate change precipitated events.

Equity in Transportation Planning: FHWA will identify available methods and data resources for evaluating equity concerns and opportunities in transportation plans and transportation improvement programs focusing on Long Range Statewide

Transportation Plans and Statewide Transportation Improvement Programs and in the environmental review process. Currently, few resources are available to guide State DOTs and MPOs in evaluating their plans, programs, and projects through an equity lens when considering how transportation interacts with the communities it serves.

LCAPave Life Cycle Assessment Tool: FHWA has developed a new tool for conducting life cycle assessments for infrastructure projects. Created with stakeholder input, the LCAPave tool uses publicly available background datasets to assist DOTs in quantifying the environmental impacts of pavements and facilitate environmental comparisons of material sources, hauling alternatives, and maintenance, preservation, and end-of-life strategies. The tool also incorporates material environmental product declarations. In FY2022, FHWA will be collaborating with state DOTs to deploy the tool and pilot projects for measuring and benchmarking embodied carbon and mitigation strategies.

Title VI Tools: A new USDOT Title VI Order was issued in June 2021. The new order will bring positive change to how Title VI is implemented by all recipients of federal-aid funds. In support of the new order, FHWA will be updating regulation, developing guidance, conducting research, developing tools, developing measures, gathering commendable practices, and conducting peer exchanges to elevate the compliance of Title VI by all recipients of federal-aid funds.

Involvement in TRWG Planned for FY 2022
The statutory guidance related to the USDOT AMRPs states that all modal plans are reviewed by the USDOT Deputy Assistant Secretary for Research and Technology to ensure that no duplication of effort exists between the modes within their research programs. FHWA achieves this lack of duplication through collaborative efforts across all modes. A primary mode of collaboration is participation in the 12 USDOT TRWGs. Below are examples of how FHWA participates in these groups and some of the outcomes of that collaboration.

FHWA staff are currently serving in a leadership role for several USDOT TRWGs, including serving as Chair for the State-of-Good-Repair and Systemic Safety Approach groups, and Co-Chair for the Technology Transfer and Evaluation group. Additionally, staff participate in working groups addressing the Mobility, Human Factors, Public Access Implementation, Automation, Environmental Stewardship, Climate Change, Economic Competitiveness, Emerging/Enabling Technologies, and Cybersecurity. These TRWGs have increased the level of coordination across all modes. Specifically, the TRWGs have had a direct impact on the development and contents of the FHWA AMRP to ensure there is no duplication of effort and to identify opportunities to compliment research identified within the AMRPs of the other modes. Finally, the TRWGs have also set common expectations across the modes related to critical RD&T topics.

	FY 2021 Enacted ($000)	FY 2022 Pres. Budget ($000)	FY 2022 Bipartisan Infrastructure Law ($000)*
R&DT Program Total	179,106	200,216	265,685

*The recently enacted Bipartisan Infrastructure Law (BIL) authorized R&DT totals greater than funding discussed in detail in this AMRP. The total funding amounts are shared in this table while a continued effort is underway to assess and implement use of these funds.

Table 1 - FY 2022 RD&T Program Funding Details

The FY 2022 RD&T Program funding table shows how much funding for FY 2022 is dedicated to each R&T program. It includes the amount of funds for each program that is in the FY 2022 enacted budget and the total amount of funds that is spent on basic and applied research, technology transfer, facilities, experimental development, and major equipment and R&D Equipment. FHWA does not fund basic research but uses the majority of the funds on technology deployment and applied research. In FY 2022, FHWA expects to allocate 34.2% of R&T funds toward applied research, 57.9% for technology transfer, and 7.9% for experimental development. No funds are planned for facilities or for major equipment or R&D equipment.

RD&T Program Name	FY 2022 Pres. Budget ($000)	Applied ($000)	Technology Transfer ($000)	Facilities ($000)	Experimental Development ($000)	Major Equipment, R&D Equipment ($000)
Infrastructure						
Accelerated Implementation and Deployment of Pavement Technologies	12,000	1,000	11,000	0	0	0
Construction and Project Management	1,900	500	500	0	900	0
Geotechnical and Hydraulics	3,000	1,600	700	0	700	0
Long Term Infrastructure Performance	3,800	2,500	0	0	1,300	0
Pavements and Materials	7,500	5,000	0	0	2,500	0
Structures	9,100	3,500	2,500	0	3,100	0

RD&T Program Name	FY 2022 Pres. Budget ($000)	Applied ($000)	Technology Transfer ($000)	Facilities ($000)	Experimental Development ($000)	Major Equipment, R&D Equipment ($000)
Transportation Performance Management and Asset Management	1,260	200	1,060	0	0	0
Safety						
Safety Program Delivery	2,500	0	2,500	0	0	0
Safety Design and Operations	4,290	3,218	1,072	0	0	0
Safety Data and Analysis	3,920	2,468	1,452	0	0	0
Human Factors Analytics	1,570	1,570	0	0	0	0
Operations						
Transportation Systems Management and Operations	5,930	5,930	0	0	0	0
Automation and Connectivity	5,800	4,200	800	0	800	0
Managing Disruptions to Operations	2,800	1,800	500	0	500	0
Freight Management and Operations	3,400	2,960	75	0	365	0
Truck Size and Weight	1,100	765	0	0	335	0
Environment and Planning						
Accelerating Project Delivery	3,000	2,580	420	0	0	0
Performance-Based Planning and Equity	2,100	1,500	300	0	300	0
Modeling and Analysis Tools	2,100	860	840	0	400	0
Resiliency	1,300	600	300	0	400	0

RD&T Program Name	FY 2022 Pres. Budget ($000)	Applied ($000)	Technology Transfer ($000)	Facilities ($000)	Experimental Development ($000)	Major Equipment, R&D Equipment ($000)
Multimodal Connectivity	1,300	980	160	0	160	0
Policy						
Policy Analysis	3,990	3,100	510	0	380	0
Global Outreach	670	235	435	0	0	0
Highway Data and Information	6,440	3,051	3,389	0	0	0
Transportation Workforce Development and Technology Deployment						
Every Day Counts	6,500	0	6,500	0	0	0
State Transportation Innovation Council Incentive	5,600	0	5,600	0	0	0
Accelerated Innovation Deployment	6,500	0	6,500	0	0	0
Accelerating Market Readiness	2,500	0	0	0	2,500	0
Innovative Finance						
Innovative Finance	890	90	800	0	0	0
Corporate						
Research Infrastructure, Technology Transfer, and Partnerships	14,000	9,330	4,670	0	0	0
Small Business Innovation Research						
Small Business Innovation Research	2,000	1,850	0	0	150	0
Exploratory Advanced Research						
Exploratory Advanced Research	4,740	4,740	0	0	0	0
Designated Grant Programs						
Advanced Transp. and Congestion Management Program	39,000	0	39,000	0	0	0

RD&T Program Name	FY 2022 Pres. Budget ($000)	Applied ($000)	Technology Transfer ($000)	Facilities ($000)	Experimental Development ($000)	Major Equipment, R&D Equipment ($000)
Surface Transp. Funding Alternatives	20,000	0	20,000	0	0	0
Administrative and Facilities Costs						
Administrative and Facilities Costs	*6,986*	*2,124*	3,959	*0*	*903*	*0*
Totals	199,486	68,251	115,542	0	15,693	0

Table 2 - FY 2022 RD&T Program Budget Request by DOT Strategic Goal

The following table shows how much FY 2022 funds are being requested for each RD&T Program by the DOT's strategic goal. Most funds requested support the Economic Strength and Modernization and Safety goals. In FY 2022, FHWA expects to allocate 23.7% of R&T funds to support the USDOT Safety Strategic Goal, 28.2% to support the Economic Strength and Modernization Goal, 12.8% to support the Equity goal, 17.0% to support the Climate and Sustainability Goal, 17.7% to support the Transformation Goal, and 0.6% to support the Organizational Excellence Goal.

RD&T Program Name	FY 2022 Pres. Budget ($000)	Safety ($000)	Economic Strength and Modernization ($000)	Equity ($000)	Climate and Sustainability ($000)	Transformation ($000)	Organizational Excellence ($000)
Infrastructure							
Accelerated Implementation and Deployment of Pavement Technologies	12,000	300	8,000	300	2,200	1,200	0
Construction and Project Management	1,900	300	400	100	200	700	200
Geotechnical and Hydraulics	3,000	1,000	300	0	1,000	400	300
Long Term Infrastructure	3,800	1,300	1,900	0	500	100	0
Pavements and Materials	7,500	2,200	2,600	0	2,000	700	0
Structures	9,100	2,500	2,500	0	600	3,000	500
Transportation Performance Management and Asset Management	1,260	0	0	125	250	885	0
Safety							
Safety Program Delivery	2,500	2,500	0	0	0	0	0
Safety Design and Operations	4,290	4,290	0	0	0	0	0
Safety Data and Analysis	3,920	3,920	0	0	0	0	0

RD&T Program Name	FY 2022 Pres. Budget ($000)	Safety ($000)	Economic Strength and Modernization ($000)	Equity ($000)	Climate and Sustainability ($000)	Transformation ($000)	Organizational Excellence ($000)
Human Factors Analytics	1,570	1,570	0	0	0	0	0
Operations							
Transportation Systems Management and Operations	5,930	1,186	2,072	300	1,186	1,186	0
Automation and Connectivity	5,800	1,200	800	800	1,200	1,800	0
Managing Disruptions to Operations	2,800	900	400	250	700	400	150
Freight Management and Operations	3,400	567	1,677	434	50	672	0
Truck Size and Weight	1,100	35	808	0	257	0	0
Environment and Planning							
Accelerating Project Delivery	3,000	500	0	1000	1000	500	0
Performance-Based Planning and Equity	2,100	300	400	1000	100	300	0
Modeling and Analysis Tools	2,100	0	300	600	600	600	0
Resiliency	1,300	0	0	0	1300	0	0
Multimodal Connectivity	1,300	400	400	400	50	50	0
Policy							
Policy Analysis	3,990	0	1,477	200	0	2,313	0
Global Outreach	670	35	0	0	535	100	0
Highway Data and Information	6,440	1,298	844	0	0	4,298	0

RD&T Program Name	FY 2022 Pres. Budget ($000)	Safety ($000)	Economic Strength and Modernization ($000)	Equity ($000)	Climate and Sustainability ($000)	Transformation ($000)	Organizational Excellence ($000)
Transportation Workforce Development and Technology Deployment							
Every Day Counts	6,500	1,625	1,625	1,300	1,625	325	0
State Transportation Innovation Council Incentive	5,600	1,400	1,400	1,120	1,400	280	0
Accelerated Innovation Deployment	6,500	1,625	1,625	1,300	1,625	325	0
Accelerating Market Readiness	2,500	625	625	500	625	125	0
Innovative Finance							
Innovative Finance	890	0	400	400	90	0	0
Corporate							
Research Infrastructure, Technology Transfer, and Partnerships	14,000	3,280	2,640	2,640	2,880	2,560	0
Small Business Innovation Research							
Small Business Innovation Research	2,000	400	400	400	400	400	0
Exploratory Advanced Research							
Exploratory Advanced Research	4,740	500	0	500	500	3,240	0
Designated Grant Programs							
Advanced Transp. and Congestion Management	39,000	7,800	7,800	7,800	7,800	7,800	0

RD&T Program Name	FY 2022 Pres. Budget ($000)	Safety ($000)	Economic Strength and Modernization ($000)	Equity ($000)	Climate and Sustainability ($000)	Transformation ($000)	Organizational Excellence ($000)
Surface Transp. Funding Alternatives	20,000	2,000	13,000	3,000	2,000	0	0
Administrative and Facilities Costs							
Administrative and Facilities	*6,986*	*1,848*	*1,826*	*1,002*	*1,217*	*1,093*	*0*
Totals	199,486	47,404	56,219	25,471	33,890	35,352	1,150

Chapter 2 – FY 2022 RD&T Programs

Infrastructure

Accelerated Implementation and Deployment of Pavement Technologies
$12,000,000

Program Description:
Together, the Pavement & Materials Research and Development (R&D) Program, the Long-Term Pavement Performance (LTPP) research, and the Accelerated Implementation and Deployment of Pavement Technologies (AIDPT) Program provide a coordinated and cohesive approach to research, development, technology and deployment activities focused on providing tools, technologies and guidance, and supporting updated policies, to improve the safety, durability, sustainability and cost-effectiveness of highway pavements, and the materials from which highway infrastructure is constructed. The AIDPT program serves as the implementation and deployment mechanism for innovations coming out of the Pavement & Materials and LTPP research, and contributes to achievement of the Department's strategic goals for safety, equity, economic strength and modernization, climate and sustainability, and transformation through work addressing advanced materials, design, construction, maintenance technologies, risk based asset management, infrastructure system resilience and advanced inspection tools.

Program Objectives:
FHWA's 2022 AIDPT Program supports the Department's Safety, Equity, Economic Strength and Modernization, Climate and Sustainability, and Transformation Strategic Goals. This program is authorized in section 503(c)(3) of title 23, United States Code, which require the Secretary to establish and implement a program under the technology and innovation deployment program to promote, implement, deploy, demonstrate, showcase, support, and document the application of innovative pavement technologies, practices, performance, and benefits. The AIDPT program directly supports the strategic goals relating to safety, climate and sustainability, and transformation. Specific contributions to the strategic goals and the key program objective to optimize pavement performance are as follows.

Safety: The AIDPT Program will contribute directly to highway safety and the Department's Systematic Safety Approach by continuing to advance implementation of friction management programs to improve pavement safety. The activities will focus on strengthening DOT friction management program(s) through projects demonstrating continuous friction measurement. These efforts will provide State technical assistance and increased education and awareness to better consider safety in pavements related decision-making. This program will save lives by expanding the use of data-driven,

systemic safety management approaches and by increasing the adoption of proven safety solutions by all road owners. In addition, strategies to increase pavement durability and performance will be advances, which will result in less pavement repairs and the need for less work zones.

Transformation: The AIDPT Program supports the Department's Transformation Goal by accelerating the deployment of innovative pavement technologies. The Program will accelerate the deployment of innovative pavement technologies such as non-destructive testing tools for pavement evaluation, which can be used for Quality Control or Acceptance. These tools save time and money and increases worker safety. This innovation is now available for demonstrations and for loan through the AIDPT program. Furthermore, by advancing a framework for performance engineered pavements, the program opens the door to further innovation on the part of the pavement community. Other entities such as NCHRP, the National Center for Asphalt Testing, the National Concrete Pavement Technology Center, and several universities are conducting research that support advancements in this area. The Program also currently leads a pooled fund study aimed at leveraging state DOT resources to advance innovative pavement technologies and processes. FHWA will showcase advanced materials characterization and performance engineered mixtures and mixture design practices and tests through the Mobile Asphalt and Concrete Technology Centers (MATC/MCTC).

Climate and Sustainability: The AIDPT Program supports the Climate and Sustainability Goal by advancing activities that implement methodologies to quantify and benchmark embodied carbon through pavement design, construction, and materials. The Program is leveraging Federal, state, local, and international partnerships as well as working with academia and industry to educate stakeholders on life cycle assessment (LCA) and issues related to public data needs and implementation strategies for environmental product declarations (EPDs) in green public procurement. Additionally, the Program will be deploying a new tool for conducting LCAs on pavement projects. As part of a pooled fund study, the Program is also supporting demonstration projects to explore opportunities to advance related strategies. The Program is also supporting activities related to the performance of recycled materials and addressing impacts from climate change through pavement design.

Anticipated Program Activities:
Activities in the AIDPT program include advancement of activities such as performance engineered mix design for concrete pavements, balance mix design for asphalt pavements, life cycle assessment for the analysis of environmental impacts, and Continuous Friction Measurement (SCRIM). Implementation activities include providing education and guidance on the use of new tests, 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.

Key FY 2022 FHWA AIDPT R&T Program Activities.

Activity	Period of Performance
Deployment and Implementation of Performance Engineered Mixtures for concrete and Balanced Mix Design for asphalt	2017-2025
Deploy and deliver workshops and supporting materials to advance best practices	2016-2025
Stakeholder Technical Working Groups to gather feedback on technical topics	2020-2024
Pavement management activities to improve pavement management systems and pavement performance measures	2018-2023
Pavement sustainability technical support and resources to educate and promote best practices	2017-2023
Pavement design outreach and technical support to advance the state of practice	2020-2025
Pavement preservation technical support and resources to educate and advance state of practice	2018-2023
Quality Assurance technical support that promotes best practices	2020-2025
Pavement Construction technical support and best practices for constructability and quality	2022-2025
Innovation Demonstration to Advance New Pavement Technologies Pooled Fund TPF-5(478)	2022-2027

Expected Program Outcomes:
A wide variety of training opportunities, technical documents, and demonstration projects are conducted for the activities funded by the AIDPT Program.
From the FY 2022 AIDPT Program activities, an annual report is published highlighting key program areas and activities and deliverables. Annual reports are located here:
https://www.fhwa.dot.gov/pavement/aidpt/.

Collaboration Partners:
FHWA AIDPT 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, as well as information on work undertaken by other organizations both nationally, and internationally. Stakeholders include representatives of individual state highway agencies, pertinent committees of the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board (TRB), industry organizations such as the American Concrete Pavement Association (ACPA) and the National Asphalt Pavement Association (NAPA), standard-setting organizations such as the American Concrete Institute (ACI) and ASTM International, and university faculty engaged in related work.

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 SharePoint site.

FHWA has several technical working groups and expert task groups as a means of gathering stakeholder input on feedback on technical topics specific to pavements and materials. The groups are composed of a mix of representatives from State Departments of Transportation and other public agencies, related industry groups (such as asphalt and concrete paving industries, contractors, etc.), and academia.   FHWA also manages and participates in pooled fund studies for some of these activities. Pooled fund activities include representation and input from multiple State DOT technical advisers.

Construction and Project Management
$1,900,000

Program Description:
FHWA's Construction and Project Management Research and Technology (R&T) Program is a coordinated and cohesive program of research, development and technology activities focused on providing tools, technologies and guidance, and supporting updated policies, to improve the effectiveness and efficiency of highway construction and project management. The program's mission is to transform infrastructure project delivery to minimize the impact of construction on the public.

Program Objectives:
FHWA's Construction and Project Management R&T Program seeks to strategically advance innovative technologies and best practices to accelerate construction and improve quality and durability of as-constructed infrastructure. The program is aligned with and supports achievement of the Department's Strategic Goals. Through its effort to increase work zone safety, the Goal of Safety is supported. In support of the Economic Strength and Modernization Goal, the program contributes to improving the nation's infrastructure by improving system performance in support of the Nation's economy, as well as accelerating project delivery.

The Goal of Transformation is facilitated through the development of a modern and digitally integrated approach to construction in both rural and urban communities that foster more efficient and collaborative advanced construction techniques. The program is promoting the idea of liberating data from proprietary systems and increasing data integration throughout a project life cycle. This supports the Goal of Equity by enabling access to data for all who need it. A mantra of the data integration effort is the principle that data should be collected once and used often. This minimizes the need for additional resources to collect data and indirectly supports the Climate and Sustainability Goal.

Anticipated Program Activities:
Construction and Project Management Program activities include research and development to advance technologies and practices that accelerate highway construction, improve infrastructure quality (and therefore durability), improve project efficiencies, and ensure effective management of construction projects. The Program also aims to ensure that recipients of Federal-aid funding adopt and apply an optimized management strategy for construction delivery performance for Federal-aid projects as required by laws, regulations, guidance, Risk Based Stewardship and Oversight, and State Stewardship and Oversight Agreements. It encourages recipients to follow FHWA and State best practices, standard operating procedures, and key performance indexes to improve construction quality and reduce the risk of waste, fraud, and abuse.

Key FY 2022 FHWA Construction and Project Management R&T Program Activities.

Activity	Period of Performance
Optimized Management and Best Practices for Construction & Construction Delivery Performance	2020-2022
Increase Safety in Active Construction Work Zones	2020-2022
Develop and Share Noteworthy Contract Administration Practices	2020-2022
Develop and Promote Effective Preconstruction Planning / Constructability Practices	2020-2022
Construction Technology and Innovation: Advance Digital Construction	2020-2022

Expected Program Outcomes:
FHWA's Construction and Project Management R&T Program supports the Department's Strategic Goals. Investments made in research, analysis, technology transfer and training are ensuring that major projects are timely and within budget, and 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.

Collaboration Partners:
FHWA Construction and Project Management R&T 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, as well as information on work undertaken by other organizations both nationally, and internationally. Stakeholders include representatives of individual State DOTs, pertinent committees of the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board (TRB), industry organizations such as the Associated General Contractors (AGC) and the American Road and Transportation Builders Association (ARTBA), standard-setting organizations such as AASHTO, and university faculty engaged in related work. As a part of the Program, peer exchanges are held to exchange best practices and ascertain stakeholder needs. The program also contributes to pooled fund projects as a means of collaborating with State and industry stakeholders to address shared issues.

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 SharePoint site.

Geotechnical and Hydraulics
$3,000,000

Program Description:
The nation's highway transportation network spans widespread and diverse geological, riverine, and coastal environments and features. Geotechnical and hydraulic situations encountered traversing mountainous passes, crossing broad plains, or travelling along shorelines necessitates the Geotechnical and Hydraulics R&T Program to reflect and encompass an equally broad composition and focus. More than any other infrastructure program, the hydraulic and geotechnical discipline research programs find themselves in an actionable and implementable position to support the Administration's top priorities in climate change and resilience. Our research efforts support the both (1) the causes and quantification of climate projects and (2) the effects of those causes on infrastructure and geology. The Program aligns with the needs and requirements associated with public safety, statutory and regulatory requirements, and other elements of transportation.

The Program goals seek to support all aspects of FHWA project delivery, including planning, environment, resilience, permitting, design, construction, asset management, and emergency relief. Forward thinking and flexible, the Program has historically been successful in using its funding in producing actionable, relevant, and cost-effective products and outcomes that benefit the transportation community. For example, the White House recently cited Program efforts in coastal infrastructure in a "Fact Sheet" detailing major Federal agency initiatives and outcomes in resilience.

The Program provides a coordinated and cohesive approach to research, development, and technology activities to improve the geotechnical and hydraulic performance (e.g., safety, efficiency, durability, resiliency, and cost-effectiveness) of the highway and transportation system. The Program achieves these objectives by addressing what FHWA describes as "functional" or "focus" areas. For FY 2022 these focus areas include Innovative Geotechnical Design and Construction Methods; Advanced Site Characterization; Geotechnics of Scour; Geotechnical Asset and Performance Management; Geotechnical Aspects of Pavements; Hydrology (including floodplains); Highway Drainage; Bridges; Culverts; Scour; and Coastal Engineering. This multi-faceted Program yields an effective, crosscutting approach to address the hydraulic and geotechnical challenges of highway infrastructure.

Program Objectives:
FHWA's Geotechnical and Hydraulics R&T Program seeks to drive innovation in geotechnical and hydraulic engineering practice to ensure and enhance the safety and resiliency of highway infrastructure. Within the focus areas of both disciplines, the Program Objectives are aligned with the Department's USDOT RD&T Strategic Goals. The contributions of the Program support the National Highway System as well as the local and rural road systems.

Anticipated Program Activities:

To support Program objectives, key FY 2022 activities are provided in the table below. These activities are linked to the Program focus areas, but are not all inclusive. The Program focus areas incorporate the flexibility to respond to new or changing priorities and needs within both short-term and long-term timeframes.

Key FY 2022 FHWA Geotechnical and Hydraulics R&T Program Activities.

Activity	Period of Performance
Innovative Geotechnical Design and Construction Methods – Resolving Driven Piles Issues, Optimization of Load Transfer in Drilled Shafts, LRFD Calibration and Refinement, Long-Term Performance of GRS-IBS, Advanced Geotechnical Modeling, Updates to GEC-11, and Quality Assurance Methods.	2020 - 2025
Advanced Laboratory and Site Characterization – Behavior, Performance, and Durability of Native, Lightweight, and Recycled Soils, Aggregates, and Rocks, Tremie Concrete, High Strength Steel and Hollow Bars, Geosynthetics, and other Geotechnical Materials; Application and Evaluation of Geophysics and other Nondestructive Methods to Characterize Site Conditions.	2020 - 2025
Develop NextScour: Hydraulics & Geotechnical Design Tools for Bridge Scour, Stream Stability, and Scour Countermeasures that Incorporates Geotechnical Assessment of Soil Erosion Resistance and Probabilistic Design Approaches	2019 - 2025
Geotechnical Performance Measurement and Asset Management – Bridge Approach Transitions, Corrosion of Buried Steel, Guidance on Management of Slopes and MSE Walls, and Communication of Geotechnical Data.	2018 - 2023
Geotechnical and Hydraulics Aspects of Pavements – Condition Assessment and Optimization of Base Layers and Use of Geosynthetics, Pavement Infiltration, Improve Curb Inlet Design and Mitigate Hydroplaning Risk.	2019-2024
Develop Solutions and Design Guidelines for Impacts (Geohazards, Hydrological, and Coastal) of Climate Change and Extreme Events on Highway Infrastructure	2016 - 2025
Develop Solutions to Key Challenges Associated with Flow Modeling for Bridge and Culvert Hydraulics including Aquatic Organism Passage	2019 - 2025

Expected Program Outcomes:

Critical to the success of the National Bridge Inspection Standard (NBIS) regulatory update, in FY 2022, the Geotechnical and Hydraulics R&T Program will deliver improved guidance on bridge scour and abutment embankment scour protection design, and detail alignment of scour within the NBIS and AASHTO LRFD Bridge Design Specifications. The Program will also examine the resiliency aspects of scour; including applying devices to evaluate the

erosion resistance of subsurface layers. The Program also expects other products such as quantifying the variability of open-graded structural backfills; a National Academies report on the assessment of corrosion of buried steel; and updated guidance and training on design and construction of Mechanically Stabilized Earth (MSE) walls and deep foundations for bridge support. These accomplishments will lead to more safe, reliable, and cost-effective bridge designs.

Collaboration Partners:
The FHWA Geotechnical and Hydraulics R&T Program staff regularly engage with key collaborative partners and stakeholders, both formally and informally, for input concerning challenges and opportunities to achieve the mission of the Program. Stakeholders include representatives of individual highway agencies, pertinent committees of the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board (TRB), the National Academies of Sciences, Engineering, and Medicine (NASEM), industry organizations such as the American Society of Civil Engineers (ASCE), the Geo-Institute of ASCE, the Deep Foundations Institute, the International Association of Foundation Drilling, the Geosynthetic Materials Association, ASTM International, and university faculty engaged in related work. 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 also frequently occur allowing the Program to share knowledge, exchange information, and evaluate partner needs.

Additionally, the Program also collaborates with the other DOT modes and other Federal entities. Currently, the Geotechnical Program is formalizing a nondestructive evaluation (NDE) rodeo in collaboration with the Federal Aviation Administration (FAA), Federal Railroad Administration (FRA) and the Volpe Center; the initiative transpired from the USDOT State of Good Repair Topical Working Group. The Program also has other engagement and collaboration activities; the FHWA Geotechnical and Hydraulics R&T Program staff work with the Federal Lands Highway Division to support Federal Land Management Agency partners (e.g., National Park Service, US Forest Service, Bureau of Land Management, US Army Corps of Engineers, Bureau of Indian Affairs), other Federal agencies (e.g., US Fish and Wildlife Service, United States Geological Survey, National Oceanic Atmospheric Administration), and State and local transportation agencies in addressing challenges related to stream restoration, endangered fish/salmon recovery, climate resiliency, wildfire recovery efforts, wall and slope inventories, etc.

Long Term Infrastructure Performance
$3,800,000

Program Description:
The Long-Term Infrastructure Performance (LTIP) Programs include the Long-Term Pavement Performance (LTPP) Program and the Long-Term Bridge Performance (LTBP) Program. These programs, conducted in close collaboration with the State DOT infrastructure owners, provide for characterization and monitoring of in-service highway pavement test sections (LTPP) and bridges (LTBP) to assemble the data needed to improve infrastructure design and advance the understanding of highway infrastructure performance required to effectively manage transportation assets. The collected data are disseminated to the public through web-based portals. FHWA's investment in obtaining and disseminating the data is leveraged by both public and private sector research organizations that apply the data to address a variety of infrastructure performance needs of local, State, regional, and national interest.

Program Objectives:
FHWA's LTIP Programs seek to advance understanding of how and why highway pavements and bridges perform as they do, knowledge that will enable the improved durability and extended infrastructure life as called for in the most recent transportation bill, the FAST Act. The LTIP research is central to FHWA's work as it pertains to advancing highway safety through the identification of effective infrastructure design and long lasting construction materials reducing maintenance intervals and consequently necessitating less traffic intrusion; maintaining a high performing highway infrastructure to enable further economic growth by providing an efficient system for moving goods and people; and validating existing and new resilient construction materials to enhance the Department capacity to provide climate solutions to future natural disasters.

Anticipated Program Activities:
In 2022 the LTIP programs will continue collection, processing and analysis of pavement and bridge data required to achieve Program objectives. The LTPP InfoPave and LTBP InfoBridge web portals will be updated with additional data to more fully document the long-term performance of the infrastructure under study. New analysis projects will be undertaken to develop bridge performance models and address to-be-selected objectives identified in the LTPP Data Analysis Plan[1].

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[1] A workshop to update the LTPP Data Analysis Plan is planned for the summer of 2020.

Key FY 2022 FHWA Long-Term Infrastructure Performance R&T Program Activities.

Activity	Period of Performance
2022 LTPP Data Collection	2022-2023
2022 LTPP Program Support	2022-2023
2022 LTPP Data Analysis	2022-2023
2022 LTBP Data Collection	2022-2023
2022 LTBP Program Support	2022-2023
2022 LTBP Data Analysis	2022-2023
2022 LTIP Stakeholder Engagement	2022-2023
Highway Infrastructure Engineering and Research Data Services	2022-2024

Expected Program Outcomes:
The ultimate outcome of the LTIP programs will be more effective management of highway infrastructure performance. Intermediate outcomes include improved knowledge and understanding of pavement and bridge performance to inform infrastructure design and management decisions, improved tools, technologies and practices for assessing pavements and bridges, and more reliable performance prediction models.

Collaboration Partners:
The individual State-DOT-owners of the pavements and bridges under study are actively engaged in supporting data collection efforts. Indeed, their active engagements makes the LTIP research possible. Due to the importance of their active engagement, FHWA contracts with the TRB for a Federal Advisory Committee Act (FACA)-compliant Long-Term Infrastructure Performance Committee that provides consensus stakeholder advice on the conduct of the program via letter reports addressed to the Administrator. In addition, FHWA LTIP Program 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, as well as 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 the FHWA and the state DOTs. Other stakeholders include the American Association of State Highway and Transportation Officials (AASHTO) and its Committees on Materials and Pavements (LTPP) and Bridges and Structures (LTBP), the Transportation Research Board (TRB), industry organizations such as the National Asphalt Pavement Association and the American Concrete Paving Association, Institute of Steel Construction, National Concrete Bridge Council (NCBC), and university faculty engaged in related work.

Pavement and Materials
$7,500,000

Program Description:
The goals of the Pavement and Materials Program are to support aspects of FHWA project delivery including: material selection, pavement design, pavement preservation, quality assurance, asset management, and sustainability.

The Pavement & Materials Research, Development and Technology (RD&T) Program together with the Accelerated Implementation and Deployment of Pavement Technologies (AIDPT) Program provide a coordinated and cohesive approach to research, development and technology activities focused on providing tools, technologies and guidance, and supporting updated policies, to improve the safety, durability, sustainability and cost-effectiveness of highway pavements, and the materials from which highway infrastructure is constructed. The Pavement & Materials RD&T Program undertakes research toward improved pavement materials, as well as improve design and analysis practices.

Program Objectives:
Research conducted in this program will address future pavement exigencies and advance technologies, including the impact of climate change, autonomous vehicles, shrinking work force, and changing material slates, availability, and use of recycle materials and their environmental impact. FHWA's Pavement & Materials RD&T Program seeks to drive innovation in pavement materials, design, evaluation and management practices, and seeks to raise the bar on performance for longer lasting, safe, and innovative pavements and preservation treatments while shifting some of the risk and rewards for performance. The Program contributes to the Department's Safety, Economic Strength and Modernization and Climate and Sustainability Goals. Contributions to improved safety come about through work toward improved pavement friction, as well as more durable materials that will decrease the risk of work zone accidents and fatalities through less frequent maintenance, preservation, and replacement. Economic growth is supported by research to advance performance engineered mixtures that will provide contractors with greater flexibility in the materials used in pavement construction, and through durability improvements that reduce highway agency maintenance and rehabilitation expenditures and the costs that users incur as a result of highway work zones. Research to enhance the assessment and selection of materials, mixtures and pavements to advance low carbon footprint solutions will investigate and develop test procedures and analysis methodologies for the engineering and environmental performance of innovative and recycled materials (e.g. RAP, RAS, recycled plastics, ground tire rubber) for use in pavements as an environmentally beneficial pathway for the use of these waste materials to reduce use of virgin resources and minimize environmental and Green House Gas (GHG) impacts. Performance specifications and test methods will be advanced that address the clarity of their relationship to performance, improve their accuracy, and for some tests, greatly reduce the time to conduct the test. Consequently, guidance will be provided to enhance the reproducibility and rapidity of conducting the tests. Utilization of these

developments will improve the pavement design, provide better assurance of construction materials and quality, and ultimately enhance the durability of the pavements consisting of recycled materials. Research on novel pavement assessments and performance prediction for cost effective maintenance and preservation over the pavement life cycle and maintain state of good repair to provide pavements that require fewer maintenance activities and resulting construction related GHG emissions. The Program will also continue to develop approaches for incorporating climate change impacts as part of pavement materials selection, design, maintenance, and management activities.

Anticipated Program Activities:
Activities in the Pavement & Materials RD&T Program include research and development of material test methods and specifications to improve the durability of both virgin and recycled materials (e.g., RAP, RAS, recycled plastic and ground tire rubber) used in highway construction and preservation. Included in this are the investigation of the use of premium and sustainable materials to enhance the life of overlays and preservation treatments and the development of concretes with smaller environmental footprints.

Activities also include the development and application of methods, tools, techniques, including NDE technologies, and best practices for the effective and efficient assessment of in-service pavements to enable informed decisions in the management of pavements over the whole-life cycle and design and construction of safe, sustainable, resilience and long-lasting pavement structures. Additionally, through the Pavement & Materials RD&T Program, FHWA provides technical assistance in support of infrastructure forensic investigations undertaken by the National Transportation Safety Board (NTSB), the Inspector General, State Departments of Transportation, FHWA Division Offices and Federal Lands, and others. Examples of forensic activities include: investigations of premature failures, assistance in fraud cases, and assistance in identifying reasons for low pavement friction that have resulted in crashes.

Key FY 2022 FHWA Pavement & Materials R&D Program Activities.

Activity	Period of Performance
Develop guidance on generating longer lasting "Mill and Fill" surface lifts using premium materials	2021-2024
Develop and amend asphalt binder performance specifications to accommodate current crude oil based and future non-petroleum-based sources	2019-2025
Advance and Validate Performance Engineered Mixtures (PEM) tests and procedures	2018-2024
Evaluation of strategies to lessen the environmental footprint of cement and concrete	2022-2026
Assessment of concrete repair materials and their evaluation criteria	2022-2026
Develop guidance for optimizing asphalt mix designs incorporating Reclaimed Asphalt Pavement (RAP) and Recycled Asphalt Shingles (RAS) and other sustainable materials for more durable pavements and preservation solutions	2021-2025
Develop solutions for mitigating Alkali-Silica Reactivity (ASR) in concrete mixtures rapidly and accurately	2021-2026

Develop guidance on the use of local materials as aggregate, aggregate replacement, and supplementary cementitious materials	2018-2024
Application of NDE to pavement assessment and development of data quality protocols	2021-2022
Develop models to evaluate/predict pavement performance, assess pavement capacity	2021-2024
Application of artificial intelligence and big data to pavement issues	2020-2027
Develop relationship of asphalt mix gradation to macrotexture and safety; investigate relationship between asphalt mix macrotexture measured in the lab and field macrotexture measured with continuous highway speed continuous devices.	2022-2024
Further develop mechanistic based pavement structural and functional performance models and related data collection and analysis tools to support pavement design and pavement management applications	2022-2026
Conduct critical assessment of asphalt balanced mixture specifications and test methods and evaluate threshold validation using well documented field projects	2022-2024
Investigate impacts of natural hazard events (e.g., wildfires, flooding) on pavement performance	2022-2024

Expected Program Outcomes:
The Pavement & Materials RD&T Program will develop innovative and robust technologies, tools, analysis methodologies, and best practices recommendations to support State highway agencies in identifying optimized use of materials, sequence of treatment actions to enhance longevity, safety, and cost-effectively maintain their pavement network over the lifecycle. Best practice recommendations, tools and technologies will also be developed to facilitate consideration of sustainability and resiliency during pavement design and construction and assessment of construction quality on long term performance. Additionally, the program enables Federal-aid recipient to better ensure that they are paying for quality pavement construction that require less frequent repairs due to increased durability.

Collaboration Partners:
FHWA Pavement & Materials RD&T 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, as well as information on work undertaken by other organizations both nationally, and internationally. Stakeholders include representatives of individual highway agencies, pertinent committees of the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board (TRB), industry organizations such as the American Concrete Pavement Association (ACPA) and the National Asphalt Pavement Association (NAPA), standard-setting organizations such as the American Concrete Institute (ACI) and ASTM International, and university faculty engaged in related work.

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 SharePoint site.

Structures
$9,100,000

Program Description:
The Structures Research and Technology (R&T) Program is a coordinated and cohesive program of research, development and technology activities focused on providing tools, technologies and guidance, and supporting updated policies, to improve the safety, structural integrity, longevity, construction processes and cost-effectiveness of highway bridges, tunnels and other structures.

Program Objectives:
FHWA's Structures R&T Program seeks to drive innovation in structural design, construction, inspection, evaluation, and maintenance through the development of best practice guidance and novel solutions to engineering challenges in bridges, tunnels, and ancillary structures. It also includes training and technology transfer initiatives directed toward ensuring the safety of the Nation's bridges and structures, as well as promoting effective management of that infrastructure. It is aligned with the Department's Transformation Strategic Goal and also contributes to achievement of the Department's Safety and Economic Strength and Modernization goals. Accordingly, the over-arching objectives guiding FHWA's Structures R&T Program are to achieve and sustain a high level of performance for bridges, tunnels, and other structures; implement and enhance the effectiveness of transportation asset and performance management; deliver projects faster and more efficiently; and improve the sustainability and resilience of highway infrastructure.
Program activities include work addressing advanced materials, designs, and technologies; risk-based asset management; infrastructure system resilience; advanced inspection tools; and effective application of best practices.

Anticipated Program Activities:
In FY 2022, the Structures R&T program will deliver advancements that support the safe and efficient operation of highway structures. Tools to support appropriate responses to fire-damaged bridges will be developed. Concepts supporting the use of ultra-high performance concrete in optimized bridge girders will be refined and advanced. Stakeholder bridge preservation decision-making processes will be supported through the development of resources designed to enable the engagement of best practices. Non-destructive evaluation technologies will be refined such that infrastructure owners can adopt advanced practices that deliver positive return on investment. Bridge deck repair and rehabilitation solutions will be developed, supporting cost-effective maintenance actions that deliver long-term performance. Training solutions aimed to educate professionals in the practice of bridge engineering will be developed.

Key FY 2022 FHWA Structures R&T Program Activities.

Activity	Period of Performance
Synergies for Using Ultra-High Performance Concrete with Large Diameter Prestressing Strands in Bridge Girders	2022-2023
Measurement of In-Situ Tendon Force to Evaluate the Performance of Post-Tensioned Bridges	2022-2024
Bridge Deck Rehabilitation and Preservation Solutions	2022-2023
Prediction of Constraint-Induced Fracture in Steel Bridge Welded Details	2022-2023
Develop Risk-Based Methodology for the Structural Evaluation of Bridge-Sized Culverts	2021-2023
Guidance Supporting the Planning, Design, and In-Service Assessment of Tunnel Ventilation and Lighting Systems	2021-2022
Develop Immediate Response Tools for Safety Inspections Following a Fire Event on, under, or near a Bridge	2021-2022
Data-Driven Bridge Risk Management for Extreme Events	2021-2022
Develop Correlations Between Element- and Component-Level Condition Data to Support Asset and Performance Management	2022-2024
Develop Bridge Preservation Portal	2022-2023
Integration of NDE into Load Rating Practices	2021-2023
Develop Framework and Tools for Risk-Based Bridge and Tunnel Asset Management	2021-2022
Develop Training Solutions to Educate Professionals for Practice in Highway Bridge Engineering	2022-2023

Expected Program Outcomes:
The Structures RD&T Program will deliver solutions that benefit the broader highway community of stakeholders. Research activities will produce guidance on the use of advanced structural materials, facilitating use of novel structural solutions by early adopter agencies. Activities will create solutions that allow state-of-the-art maintenance and rehabilitation practices to be engaged in support of enhancing the performance of bridge decks. Developed solutions will encourage best practices in bridge preservation. The safety and security of highway infrastructure will be bolstered through the development of guidance related to terrorist attack mitigation and bridge fire responses. Tools to ensure appropriate knowledge within the next generation of bridge engineering professionals will be developed, facilitating the promulgation of best practices across the community.

Collaboration Partners:
FHWA Structures R&T 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, as well as information on work undertaken by other organizations both nationally, and internationally. Stakeholders include representatives of individual highway agencies, pertinent committees of the American Association of State

Highway and Transportation Officials (AASHTO) and the Transportation Research Board (TRB), industry organizations such as the Precast/Prestressed Concrete Institute, and the National Steel Bridge Alliance, standard-setting organizations such as the American Concrete Institute (ACI) and ASTM International, and university faculty engaged in related work.

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.

Transportation Performance Management and Asset Management
$1,260,000

Program Description:
The Transportation Performance Management and Asset Management (TPM and TAM) Research, Development, and Technology (RD&T) Program is a coordinated and cohesive program of research, development and technology deployment activities focused on providing tools, innovations, technologies and on developing guidance and policies to advance the effective management of highway infrastructure and system performance. Research development and deployment activities include: identification and advancement of specific strategies to enhance TPM and TAM investment decision-making; to improve or preserve the condition of our highway infrastructure assets in a state of good repair and improve the performance of the system; and the development and deployment of TPM and TAM training, technology transfer and support initiatives.

Program Objectives:
FHWA's TPM and TAM Program is guided by the TPM Implementation Plan, which is publicly available on FHWA's [TPM website, and the TPM/TAM Roadmap](#). The Roadmap lays out the implementation activities that will be accomplished in 2021-2023. Investing in these activities will support State DOTs, MPOs, other transportation partners, and industry to implement effective practices to manage the performance and condition of the highway system and with a goal to preserve our assets and minimize the whole life costs; operate in a financially sustainable manner; and provide a framework to improve performance on a long-term basis. In 2022, FHWA's TPM and TAM Program will work to accomplish the activities outlined in the TPM Implementation Plan and Roadmap and will deliver to State DOTs and MPOs a range of technical assistance resources such as data and analytical tools to improve their investment decision-making related to managing system condition and performance. Additional resources such as training, guidance, best practices, and peer exchanges are supported under this program. The objectives of this Program directly support the USDOT's Strategic Goals by improving the condition of infrastructure assets, address risks associated with current and future environmental conditions to improve system resilience and enable the efficient and safe and equitable movement of people and goods.

Anticipated Program Activities:
In FY 2022, the Transportation Performance Management and Asset Management R&T Program will continue to identify specific strategies to enhance TPM and TAM. This includes creating resources to benefit end users and providing training and technical assistance.

Key FY 2022 FHWA Transportation Performance Management and Asset Management R&T Program Activities.

Activity	Period of Performance
TPM and Asset Management training and educational resource development & delivery and peer exchanges.	2022-2023
Enhance and augment TPM data processing tools	2022-2023
Data Visualization to support state and national performance storytelling	2022-2023
TPM and Asset Management case studies and note-worthy practices including long-term goals and short-term targets	2022-2023
Develop a handbook, case study & undertake workshops focused on the application of a metric for resilience (risk) for development of asset management investment strategies	2022-2023
Develop resources on the application of a State DOT's Asset Management Plan to address the planned recovery from 2020 National Emergency that has affected the influx of funds to State DOTs and the work undertaken.	2022-2023
Provide technical support and guidance specific to TPM and Asset Management needs of Federal Lands Management Agencies.	2022-2023

Expected Program Outcomes:
Investments in 2022 will modernize data extract and load processes used to complete the Integrated Transportation Information Platform (ITIP) tool needed to support State performance data collection, processing and analysis; improve data visualization to communicate state and national performance; and develop guidance and deliver training and educational resources to support State and MPO implementation of TPM and Asset Management principles and practices to improve or preserve asset condition and system performance, including address risks to improve system resiliency. The program makes significant contributions toward all the USDOT Strategic Goals through the efficient investment of Federal transportation funds across national transportation goals; the increased transparency of the Federal-aid highway program; and the improvement of program and project decision-making through performance-based planning and programming. Specific outputs and advancements are as follows: Advancing risk analysis to directly address system resiliency; the application of short term TPM targets and long term goals for improved long term system performance, improve asset life-cycle planning; improved communication, understanding, and application of performance data for developing investment strategies for managing the NHS.

Collaboration Partners:
FHWA is committed to supporting effective implementation of TPM to ensure States and MPOs are using a performance-based approach in their transportation planning and programming, setting meaningful targets for the TPM measures, and reporting at a level of detail needed for a national conversation on transportation performance. FHWA aims to provide State DOTs, MPOs, and other stakeholders with the information and resources they need to implement TPM and achieve a performance-based transportation system. The FHWA TPM and TAM programs routinely engage internal and external stakeholders though established networks and forums

that foster information exchange, technology and innovation deployment, and input into resource development and program objectives. Examples include, but are not limited to, the TPM/Asset Management Expert Task Group, the TPM roundtable, and the TPM pooled-fund study for building professional capacity for TPM and Asset Management. Program assessments through customer and stakeholder surveys are also routinely conducted to identify resource needs and track program performance.   In addition, participation with stakeholder organizations and interaction with State DOTs and organizations including AASHTO, TRB, AMPO, and others.

Safety

Safety Program Delivery
$2,500,000

Program Description:
Through Safety Program Delivery, FHWA assists partners and stakeholders in making the best use of the programs and services available to them to optimize their safety investments and to maximize their safety contributions to realize our shared zero vision. Safety Program Delivery provides support for the $2.6 billion Highway Safety Improvement Program (HSIP), a core Federal-aid highway program with the purpose to achieve a significant reduction in fatalities and serious injuries on all public roads.

FHWA works with States to align the HSIP, and its various components, with the Safe System Approach to enable progress on meeting the five safety performance targets. The program assists states with the administration of the HSIP by building the proficiency of roadway safety professionals to understand risk factors, including those affecting disadvantaged communities, identify solutions, and effectively solve problems. We provide training, policy guidance and technical assistance to FHWA's partners and the public on proven, efficient, cost-effective safety programs and activities and encourage and support partnerships with private and public safety stakeholders.

Program Objectives:
FHWA's Safety Program Delivery ensures that stakeholders have the tools and resources needed to address emerging and existing roadway safety issues and advance a Safe System Approach, by providing new tools and innovations, research, and training. The program will build understanding and use of a Safe Systems Approach among Federal and State safety professional; forge and sustain productive external partnerships with national, State, and local transportation agencies and other stakeholders; and help partners identify disparate safety risks and address them through transportation infrastructure improvements.

Anticipated Program Activities:
FHWA Safety Program Delivery will implement FHWA safety program's legislative requirements; strengthen States' abilities to implement a safety program that is data driven by sharing information, training, and assistance, and provide national leadership to agencies as they design, operate, and maintain roadways that fully integrate safe system principles; improve the technical capacity of transportation safety professionals at all levels of government; and evaluate and assess road owners' capabilities, which will enable targeted training and technical assistance to fill knowledge and or technical gaps.

Key FY 2022 FHWA Safety Program Delivery R&T Program Activities.

Activity	Period of Performance
Implement FHWA Safety Programs' legislative requirements	2022-2024
Strengthen States' abilities to implement a safety program that is data driven by sharing information, training, and assistance, and provide national leadership to agencies as they design, operate, and maintain roadways that fully integrate Safe System principles and provide safety for all road users	2021-2022
Improve the technical capacity of transportation safety professionals at all levels of government	2021-2022
Evaluate the results of FHWA Safety Program Delivery implementation efforts	2021-2022

Expected Program Outcomes:
The Program will fulfill FHWA Safety Programs' legislative requirements, including communicating the laws, regulations, and funding eligibility for the HSIP (23 USC § 148 and 23 CFR § 924). The program will help States save more lives and prevent more serious injuries by helping States integrate Safe System principles into their safety projects and programs. FHWA will assist States in focusing their resources on activities that address their most critical safety challenges. In 2022 this will include effective methods to address risk in disadvantaged communities and among non-motorized travelers and will also address infrastructure-based speed reduction. The Program will sustain a proficient and skilled safety professional workforce that will help us deliver a state-of-the-art safety program that keeps up with innovation and best practices. The Program also will evaluate the effectiveness of the programs, identify gaps, and provide insights into the future direction of the program.

Collaboration Partners:
FHWA's Safety Program Delivery Research Program is built upon focus areas identified from safety data provided by States, as well as stakeholder input and assessment of stakeholder capabilities via their annual HSIP reports. The US DOT Safety Council serves to tackle the most critical transportation safety issues we face in a coordinated fashion. The DOT Traffic Records Coordinating Committee (TRCC) is an interagency group charged with coordinating the support and improvement of safety data collection, management, and analysis within DOT, among State and Federal partners, and across different State-level traffic records systems. The Program Delivery Research Program is represented on the USDOT Equity Working Group, which is coordinating initiatives to elevate equity across USDOT programs including safety. The Safe System and Safety Culture Cross-Office Working Group and intermodal Safe System Work Group collaborate on research and outreach projects to support transformation of safety programs to drive down fatalities and serious injuries. Safety Program Delivery collaborates on the Road to Zero (RTZ) initiative with associations such as AASHTO, ATSSA, ARTBA, National Safety Council, Operation Lifesaver, ITE, and GHSA. The Program will continue collaboration with the

NTSB and other stakeholders on noteworthy practices in promoting the Safe System Approach.

Safety Design and Operations
$4,290,000

Program Description:
The Safety Design and Operations program encompasses core safety engineering work that overlaps traffic engineering, geometric roadway design, transportation planning, and system management and operations, and aims to help stakeholders reduce fatalities and serious injuries on all public roadways. The program focuses on roadway departure; intersection crashes; and, pedestrian/bicycle crashes; speed management; and integrating safety decision-making into project selection and delivery.

Program Objectives:
The main purpose of the Safety Design and Operations program is to improve safety and, ultimately, to save lives. Because the Federal-aid program is a State-administered and Federally-assisted program, the success of our efforts depends on working with stakeholders (e.g., State Departments of Transportation and local and tribal road owners).

The program aims to: identify innovative road safety solutions and develop effective safety countermeasures; strengthen States' abilities to implement a performance-driven safety program by sharing information, training, and assistance; improve the technical capacity of transportation safety professionals at all levels of government to advance safety programs; and, evaluate the results of FHWA Safety Implementation efforts

Anticipated Program Activities:
The Safety Design and Operations program is leading and collaborating a number of activities in the areas of traffic engineering, geometric roadway design, transportation planning, system management and operations, vulnerable road user safety, speed management, data driven safety analysis, and connected and automated vehicles. The program provides national leadership to agencies as they design and operate roadways in order to fully integrate the needs of all users, accommodate human error, and minimize injury severity. Activities under this program include the promotion of certain infrastructure-oriented safety treatments and strategies, chosen based on proven effectiveness and benefits, to encourage widespread implementation by State, tribal, and

local transportation agencies to reduce serious injuries and fatalities on American highways.

Key FY 2022 FHWA Safety Design and Operations R&T Program Activities.

Activity	Period of Performance
Identify innovative road safety solutions and develop effective safety countermeasures	2019-2024
Strengthen States' abilities to implement a performance-driven safety program by sharing information, training, and assistance	2019-2024
Improve the technical capacity of transportation safety professionals at all levels of government to advance safety programs	2019-2024
Evaluate the results of FHWA Safety Implementation efforts	2019-2024

Expected Program Outcomes:
The outcomes from the Safety Design and Operation program include variety of targeted technical assistance and resources to States, tribal, and local transportation agencies to address the Nation's most critical safety challenges. Agencies are assisted in addressing fatality and injury reductions in any one or all of three critical focus areas: roadway departure, intersection crashes, and pedestrian/bicycle crashes. Another outcome of this program provides insights on the contributing factors of roadway deaths and injuries related to roadway design and operations through data driven safety analysis, with a focus on speed management. Finally, the program will continue to develop and promote tools that will lead to the safe integration of connected and automated vehicles into our roadway system.

Collaboration Partners:
The Safety Design and Operations program relies on its established network of partners in other public agencies, membership organizations, and in academia. Some technical areas have used stakeholder input to develop strategic plans (e.g., a strategic plan to improve pedestrian safety based on stakeholder-identified gaps and needs). FHWA also gains input on research needs from our stakeholders using a multitude of vehicles including but not limited to peer exchanges, conducting presentations and webinars that are open to the public, and seeking other means of sharing information with Federal, state, regional, and local transportation agencies, academic institutions, foundations, or private firms. Non-government groups have been and continue to be collaborators. For example, FHWA worked with the National Association of Counties to conduct outreach on rural road safety to county officials. FHWA also works closely with the Institute of Transportation Engineers to learn of and disseminate noteworthy practices with this key constituency. In addition, the FHWA Safety in Federal Aid Cross-Office Working Group, and the FHWA Complete Streets Working Group are working to integrate safety and safe access across FHWA program areas.

Safety Data and Analysis
$3,920,000

Program Description:
The Safety Data and Analysis program area focuses on the use of safety data to inform highway investment decision making through a systemic safety approach based on crash experience, crash potential, crash rate, or other data-supported means. The scope of the program includes research, development, and technology (RD&T) to improve State and local safety data systems commonly used to record crash, roadway inventory, and traffic volume data, as well as integration of other data sources (such as census and health data) to improve data analysis and identify disparate safety impacts on underserved communities. The program directly supports the USDOT Strategic Safety Goal by enhancing State and local partners' capability to use safety data systems for analysis and evaluation supporting highway investment decision making to help ensure efficient and timely detection of critical safety hazards. The program also includes analyses supporting FHWA safety policy decision making, providing a foundation for systemic, performance-based approaches to improving safety. This is reinforced via the Roadway Safety Data Program, which helps States and local agencies advance their data capabilities through resource development, technical assistance, data management, training, and data analysis.

Program Objectives:
The Safety Data and Analysis Program reflects a key FHWA theme of employing data-driven methods and technologies to support highway infrastructure investment decision making. The main goal of the program 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.

The Safety Data and Analysis Program aims to: Research and develop new methodologies and tools for safety data collection, management, analysis, and evaluation; increase the utilization of proven methodologies and tools for safety data collection, management analysis, and evaluation; broaden the integration of safety data and analysis into planning, programming, and project development processes; improve understanding of the benefits of safety data-driven decision making; determine economic and other benefits of safety investments, and, advance safety data and evaluation as a means of supporting Transportation Performance Management.

Anticipated Program Activities:
The Safety Data and Analyses anticipated program activities mirror the program objectives. The Research and Develop New Methodologies and Tools activities will develop and evaluate potential safety countermeasures utilizing information from the Second Strategic Highway Research Program (SHRP2) Naturalistic Driving Data (NDS) data and the Roadway Inventory Database (RID), the Motorcycle Crash Causation Study and other Realistic Artificial Datasets for research and validation of Crash Modification Factors. The program will also provide technical assistance to State and local agencies to improve their

data collection, analysis, and management practices with particular focus on meeting the Model Minimum Roadway Inventory of Roadway Elements Fundamental Data Elements (MIRE-FDE) 2026 deadline, and on improving data collection and analysis to inform and support Transportation Performance Management.

Key FY 2022 FHWA Safety Data and Analysis Program R&T Activities.

Activity	Period of Performance
Research and develop new methodologies and tools	2022-2026
Increase the utilization of proven methodologies and tools	2014-2024
Broaden the integration of safety data and analysis into all processes	2017-2026
Improve understanding of the benefits of safety data-driven decision making	2016-2023
Advance safety data and evaluation as a means of supporting Transportation Performance Management.	Ongoing

Expected Program Outcomes:
It is expected that six Phase 2 proof of concept studies in the areas of safety, planning, and operations using the SHRP2 Safety data will be completed indicating the feasibility of conducting a full study that will yield implementable results. Continued technical support of the IHSDM to practitioners will further promote faithful implementation of the Highway Safety Manual. FHWA will coordinate with the AASHTO to explore future opportunities regarding IHSDM. The updated and revised Pedestrian and Bicycle Crash Analysis Tool (PBCAT) logic reflecting current and emerging roadway conflicts such as micro-mobility conflicts will be implemented into PBCAT version 3. Work with local partners to advance their capabilities with collecting and transferring safety data on non-federal roads will improve data sharing and completeness. The Highway Safety Information System program is increasing accessibility, expanding to different platforms, and streamlining data quality processes.

Collaboration Partners:
The Safety Data and Analysis program relies on its established network of internal and external partners in other public agencies and in academia. The FHWA staff engaged in this program are active participants in national and international committees such as the World Road Association, the Transportation Research Board, the Association of Transportation Safety Information Professionals the Institute of Transportation Engineers, and the American Association of State Highway and Transportation Officials. FHWA tracks the input from partners through regular reporting on program status with the DOT Traffic Records Coordinating Committee, TRB, and other venues.

Human Factors Analytics
$1,570,000

Program Description:
The purpose of the Human Factors Analytics program is to better understand human behavior and the relationship between roadway users, infrastructure, and vehicles. This research looks at how people respond to highly visible, easy to read signs, improved pavement markings, vehicle automation technology, innovative operational changes, and safer streets with improved walkability. The Human Factors Analytics program includes the Highway Driving Simulator (HDS), two Field Research Vehicles, the Highway Sign Design and Research Lab (also known as the Sign Lab), the MiniSim™ driving simulator, and the Virtual Reality Lab, which includes a pedestrian and bike VR simulator.

Program Objectives:
The Human Factors Analytics program aims to: Improve the effectiveness of safety countermeasures as well as tools that promote operational efficiency; Understand how connected and automated vehicles can be safety 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 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; and, Identify how human factors for safety may guide safety programs and enable innovative approaches to improving safety.

The Human Factors Analytics program provides a range of research products and guidance that includes guidelines, experimental studies, and visualizations, that result in informed decision-making to help improve roadway design, evaluate safety countermeasures, and provide technology assessments to improve safety. Human Factors staff work regularly with other offices within FHWA, including the Office of Safety, the ITS Joint Program Office, the Office of Operations, and Operations R&D.

Anticipated Program Activities:
The Human Factors Program is leading and collaborating on a number of activities in the areas of connected and automated vehicles, traffic control device design and evaluation, pedestrian and vulnerable road user safety, and enhancing and upgrading Human Factors Lab capabilities. Many of these activities focus on empirical research using human participants, that participate in studies in the Highway Driving Simulator, field research vehicles (FRVs), and the sign laboratory. These studies provide valuable quantitative and qualitative safety and human performance data, that provide a sound basis for developing guidelines and design recommendations for our different stakeholders. The work will help to promote better and safer traffic control devices and signing, increase pedestrian and bicyclist safety, and accelerate and facilitate the safe integration of people with emerging automated driving systems technology into our roadway system.

Key FY 2022 FHWA Human Factors Analytics R&T Program Activities.

Activity	Period of Performance
Improve the effectiveness of safety countermeasures as well as tools that promote operational efficiency	2019-2024
Improve roadway designs that meet the needs of drivers, pedestrians, and vulnerable road users	2018-2024
Understand how people respond to signs and markings, emerging vehicle technology, innovative operational changes, and other new roadside innovations	2018-2024

Expected Program Outcomes:
The outcomes from the Human Factors Analytics Program include a better understanding of human behavior and the relationship between roadway users, infrastructure, and vehicles. This increased understanding will allow us to consider how drivers, pedestrians, and vulnerable users' needs can be met through improved roadway designs, countermeasures, and technological innovations. Our research program will produce data, guidelines, and recommendations that help improve the safety and operational efficiency of our roadway system in a number of areas including traffic control devices research, pedestrian and bicycle safety, and improve automated and vehicle safety and acceptance. In addition, we will also be enhancing our research capabilities to allow us to better meet the needs of our stakeholders, by better supporting our current roadway system, while looking ahead to the more automated roadway and vehicle systems of the future.

Collaboration Partners:
The Human Factors Analytics program collaborates internally and externally to develop research activities and to exchange information among peer organizations. More close coordination occurs with NHTSA on human factors activities. The USDOT Human Factors Coordinating Committee meets monthly to coordinate activities and provide project updates across the modal agencies. Every year the Human Factors Analytics program is actively engaged in human factors workshops convened through the Transportation Research Board Annual Meeting. We manage the Traffic Control Devices Pooled Fund Study to work with State DOTs and associations like the American Traffic Safety Services Association to research items that are considered in the Manual of Uniform Traffic Control Devices. A Trilateral Working Group of the US, European Union, and Japan aligns research for a broad set of human factors issues, including driver distraction, Human-Machine Interaction (HMI), and human factors considerations in automation.

Operations

Transportation Systems Management and Operations
$5,930,000

Program Description:
The U.S. has invested billions of dollars in building our existing transportation infrastructure, however when these facilities are congested, the efficient movement of people and goods is disrupted, causing impacts to the economy, the climate, and the quality of life. Facilities need to be operated well so that we use them efficiently and effectively to maximize the value of these investments. Because of the need for alternatives to capacity projects -- due to limited resources, growing customer expectations, emergence of real-time decision support systems and on-demand mobility applications, and an emphasis on performance-based programs -- there is an increasing focus on Transportation Systems Management and Operations (TSMO) in U.S. urban and rural areas. In addition, resources were further constrained as a result of the pandemic, so there is an even greater need to look for solutions that are lower cost and still offer a good return on investment. 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 and safety impacts on urban areas and allow for increasing freight transportation, especially with a growing awareness of the needs of underserved communities. As consumer technologies (smart phones, apps, GPS, etc.) progress, the traveling public expects that transportation agencies will find creative ways to apply these advances to improve their travel experience. The TSMO R&T Program helps State and local agencies, and other partners, do that.

Program Objectives:
The TSMO R&T Program primarily supports the USDOT RD&T Strategic Goals of Economic Strength and Modernization and Climate and Sustainability by enabling 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. The objectives of the TSMO R&T Program are to equip State and Local transportation agencies to effectively manage and operate the multimodal transportation system to gain the most from their existing infrastructure and technology investments, thus supporting the USDOT RD&T Strategic Goal of Transformation. This results in enhanced safety and mobility, reduced emissions and fuel consumption, expanded mobility services to underserved communities, economic improvement through improved passenger and freight movement. TSMO leverages and integrates various modes, such as transit, bicycle, and pedestrian, to develop a more holistic solution to solve congestion issues and provide options for all users. The program supports the development of strong agency organizational and workforce capabilities to plan for, deploy,

and manage TSMO technologies and operational strategies and to strengthen the key institutional underpinnings and linkages that are needed for effective TSMO.

In addition, the TSMO Program also ensures that the MUTCD is maintained and is updated in a timely manner to reflect current and forthcoming needs of practitioners and road users, and that it accommodates automated driving systems. Other program objectives include the Road User Charge effort to develop and pilot test alternate funding mechanisms to the gas tax for financing transportation infrastructure improvements and supporting the tolling program to ensure compliance with Section 129 and the ISRRPP.

Anticipated Program Activities:
The key FY 2022 FHWA Transportation Systems Management and Operations R&T Program Activities are broken up into five categories. Foundation for Successful Operations continues the development of outreach and training materials and conducts targeted outreach and technology transfer to advance the state-of-the-practice and improve the capabilities of agencies for developing and delivering TSMO programs. Data-Driven Operations Decision-Making continues the enhancement of tools and decision support systems for operational/tactical and executive/organizational TSMO decisions by adding functionality for emerging technologies. Implementing Operations Strategies continues the development of capabilities, tools, and guidance to enable more proactive, dynamic, integrated and performance-driven management and operations to proactively advance the adoption of ATDM and ICM solutions and strategies. The Surface Transportation System Funding Alternatives (STSFA) Program continues the previous outreach efforts including broad dissemination of State pilot implementation results. The activities involving the Manual on Uniform Traffic Control Devices (MUTCD) continue the development of Staff Reference Handbook; development of procedures and guidance to FHWA Divisions on reviewing and approving State MUTCDs, Supplements, and supplemental documents; and continues the development of Transfigured MUTCD or Supplement for CAV. Finally, there will be support for the tolling program to ensure compliance with Section 129 and the ISRRPP.

Key FY 2022 FHWA Transportation Systems Management and Operations R&T Program Activities.

Activity	Period of Performance
Foundation for Successful Operations	2020-2025
Data-Driven Operations Decision-Making	2018-2024
Implementing Operations Strategies	2020-2024
Surface Transportation System Funding Alternatives (STSFA) Program	2021-2022
Manual on Uniform Traffic Control Devices (MUTCD)	2021-2022
Tolling Program	2021-2022

Expected Program Outcomes:
The expected outcomes for Foundation for Successful Operations are 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. Data-Driven Operations Decision-Making will support the storage, management and utilization of data acquired from operations projects, improving consistency and making them accessible to the public. Implementing Operations Strategies will provide practitioners with tools and techniques for traffic management at various levels and an understanding of how and when to apply different tools. The expected outcome for the STSFA Program is to support the grant program with program administration, independent evaluation, and dissemination of research results. Research activities in the MUTCD area ensure that the MUTCD is maintained and updated in a timely manner to reflect current and forthcoming needs of practitioners and road users, and that it accommodates automated driving systems. Support for the tolling program enables administration of Section 129 and the ISRRPP, independent evaluation, and dissemination of research results.

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 results of research and encourage its implementation, and providing real-world feedback on implementation results. Input is gained from external partners through conference sessions and discussions (e.g., TRB, ITE, AASHTO annual conferences), technical committees and working groups (e.g., TRB committees, AASHTO subcommittees), technical project panels, review of partner research reports and plans, workshops and technical assistance to States, MPOs, and regional agencies, and through 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.

Automation and Connectivity
$5,800,000

Program Description:
FHWA, in collaboration with the ITS Joint Program Office, other USDOT modes, State and local public agencies, Academia, industry, and other surface transportation stakeholders, will conduct an Automation and Connectivity research program to address the challenges of integrating vehicles with Automated Driving Systems (ADS) with the road infrastructure system, and to take advantage of connectivity to improve the safety, efficiency, and equity of the highway transportation system. Successful integration of ADS with road infrastructure and industry adoption of Cooperative Driving Automation (CDA) will revolutionize Transportation Systems Management and Operations (TSMO) strategies, transform the Nation's surface transportation system through deployment of emerging technologies that address safety, equity and the environment challenges, and provide seamless integration between all transportation modes. Many of the activities in this program are jointly funded by, and closely coordinated between, FHWA and the ITS Joint Program Office, and conducted in partnership with other Departmental modes.

Program Objectives:
The Automation and Connectivity research program has five major activities that explore different aspects of safely, efficiently, and effectively integrating ADS with road infrastructure and Traffic Management Systems (TMSs). Research in FY 2022 will: develop capabilities and practices that support stakeholders' moves toward safe and effective operational readiness for, and equitable and sustainable results of ADS-Roadway integration; advance Analysis, Modeling, and Simulation (AMS) tools that are applicable to the operations of ADS-equipped vehicles in traffic; develop and test Cooperative Driving Automation (CDA) functions that enable shared maneuvers by AVs in support of TSMO use cases; and assess opportunities to revolutionize TMSs through testing, evaluation, and pilot activities that lead to advances in roadway design, control, and operations. These efforts support the USDOT RD&T Strategic Goals for Safety, Climate and Sustainability, and Transformation of the surface transportation system through collaborative public/private efforts to stimulate and rapidly deploy innovation while ensuring that automation brings significant safety and environmental benefits across all sectors of the public.

Anticipated Program Activities:
ADS-Roadway Integration will be advanced through the development of new strategies and capabilities that can be applied by stakeholders to enable a collective understanding on how to jointly move forward to address challenges to safe and efficient integration. Activities include work to expand stakeholder collaboration and to establish roadway environment management capabilities that are focused on ADS-roadway integration, such as the access and exchange of data between of ADS and roadways. AMS tools will be advanced through the collection and dissemination of new and existing datasets of on-road observations and experimental data on the behavior of AVs in traffic for future integration into microsimulation programs and analytical processes. Smart infrastructure functions

for CDA to improve pedestrian safety and reduce emissions at intersections will be tested and validated on closed-course facilities, and an independent evaluation of benefits will be conducted. Finally, work will continue on a "toolbox" of materials for use by Infrastructure Owners and Operators (IOOs) to plan for the modernization of their TMS including insights into decision support subsystems, developing concepts of operation, and preparing for transitions from legacy systems.

Key FY 2022 FHWA Connected and Automated Vehicles R&T Program Activities.

Activity	Period of Performance
ADS-Roadway Integration	2019-2026
ADS-Roadway Integration: Transfiguration of the *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD) for Connected and Automated Vehicles.	2021-2025
Analysis, Modeling, and Simulation (AMS)	2019-2024
Cooperative Driving Automation (CDA)	2019-2026
Next Generation Traffic Management System (TMS)	2019-2026

Expected Program Outcomes:
Current and planned program efforts will: 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. In the near-term, the program will provide extended testing and evaluation capabilities, establish a joint vision for ADS integration, advance data and digital infrastructure, and provide information to IOOs to support investment decisions for the next generation of TMSs.

Collaboration Partners:
The Automation and Connectivity R&T Program collaborates internally with the ITS Joint Program Office, other USDOT modes, and other Federal agencies, and externally with State, local, and tribal agencies, the American Association of State and Highway Transportation Officials (AASHTO), Academia, industry, and other surface transportation stakeholders to develop and conduct research activities. The program also collaborates and shares information with international researchers and transportation ministries in areas of common interest. The input obtained through these interactions is considered by program staff as they identify and formulate a program of research and technology initiatives that, in accordance with 23 U.S.C. 502(a)(3).

Managing Disruptions to Operations
$2,800,000

Program Description:
The Managing Disruptions to Operations program is a specialized aspect of transportation management focused on mitigating the impact non-recurring events have on the surface transportation system. Non-recurring events present themselves in three primary ways: adverse weather, work zones, and traffic incidents or other anomalies. The disruptive nature of non-recurring events accounts for roughly half of all delays, creates conditions that are associated with a higher crash risk, and contributes to unfavorable public perception regarding the capability of Infrastructure Owner/Operators (IOOs) to manage public investment in infrastructure. The program's goal is to facilitate the research, development and deployment of innovative technologies, solutions, and strategies. The tools developed will improve the resiliency of the surface transportation system and enable agencies to mitigate the impact these events have on the infrastructure. The scope of the program is broad, starting with applied research (from concept development to field testing and evaluation) and continuing through knowledge and technology transfer, community outreach and solution deployment support to ensure successful implementation by the operating agencies.

Program Objectives:
The primary objective of the Managing Disruptions to Operations program is to improve resiliency and organizational preparedness to deal with non-recurring events and associated disruptions to transportation operations. This requires specialized attention to: understanding the operational impacts of non-recurring event disruptions to develop predictive and real-time decision support systems that facilitate proactive operations; comprehending the opportunities and challenges advanced technologies, such as connected and automated vehicles, present to the program; ensuring coordination across all agencies that play a part in roadway safety and mobility; and building the capability and capacity for operating agencies to optimize safety and system performance through outreach strategies such as capability maturity models, communications strategies and technology transfer. In FY 2022, the Managing Disruptions to Operations program will actively research, develop and deploy projects in road weather management, work zone management, traffic incident management, and non-recurring event data framework management. Together, these efforts support the USDOT RD&T Strategic Goals for Safety, Economic Strength and Modernization, Equity, Climate and Sustainability, and Transformation and help provide better traveler choices and safer streets and infrastructure.

Anticipated Program Activities:
There are several activities being conducted in FY 2022 as part of the Managing Disruptions to Operations Program. The activities list is broken down into the four categories of: Road Weather Management, Work Zone Management, Traffic Incident Management, and Non-Recurring Event Data Strategic Plan and Framework.

Key FY 2022 FHWA Managing Disruptions to Operations Program Activities

Program Activities	Period of Performance
Road Weather Management: Research, Development and Outreach	
Research and develop tools and strategies to enable more effective system management under adverse weather, including use of road weather data (WxDE), climate solutions and resiliency planning, and weather-responsive decision support tools (IMRCP, ARO) that build upon technology advancements and effectively change driver/operator behavior.	2019-2026
Develop and apply performance measures and analysis tools for road weather management and develop strategies that consider resilience and long-term changes in weather trends.	2019-2022
Conduct targeted outreach and tech transfer of RWM products via Road Weather Management Stakeholder meetings, WRMS, Pathfinder and IMO workshops, website, webinars, develop/deliver NHI RW courses, and support pooled fund programs and peer exchanges on RWM (Aurora, Clear Roads, TRB, SICOP).	2019-2024
Work Zone Management: Research, Development and Outreach	
Advance work zone management by focusing on work zone event data collection, developing related analysis tools and use cases, application of performance measures to promote data driven decision-making, and consideration of vehicle-based and other technology advancements such as use of unmanned aerial systems (UAS) in work zones.	2019-2024
Analyze increase in work zone crashes, fatalities, and injuries, its impact on operations, develop strategic plan and execute it, identify best practices, and conduct WZM research to reduce work zone impacts. Manage work zone grants to ensure products are effective and meet stakeholders' needs.	2019-2024
Advance WZM state-of-the-practice through a range of stakeholder engagement activities that focus on gaps in implementation (e.g., commercial motor vehicle safety in work zones, state-specific Capability Maturity Framework and targeted engagement workshops, process reviews, regional round tables, etc.)	2019-2024
Traffic Incident Management: Research, Development and Outreach	
Use multi-discipline responder crash and other data and integrate it with emerging technologies such as connected and automated vehicle, Traffic Management Centers integrated Computer Aided Dispatch, use of Unmanned Aircraft Systems to meet responders' needs and improve incident response and safety during incidents.	2019-2022
Promote continued deployment of state and local traffic incident management (TIM) programs including extensive coordination across the TIM community	2019-2024

Continue to provide leadership to advance the capability of responders towards safe quick clearance of roadway incidents through information transfer and the use new and emerging technologies.	2019-2024
Non-Recurring Event Data Strategic Plan and Framework	
Leverage prior efforts in developing data management platforms for non-recurring events (including the Work Zone Data Initiative & Work Zone Data Exchange, the Road Weather Data Environment, and TIM data strategies information on work zones) to assist development of an operational framework to address management of disruptions from non-recurring events in the context of traditional and emerging transportation management business processes. Technical assistance will be provided to assist IOO-led coalitions in further development and in deploying this framework in stakeholder workflows and integration with enterprise information systems.	2019-2026

Expected Program Outcomes:

The program's current and planned activities are expected to yield the following outcomes: improve roadway system safety through advanced predictive modeling and decision support system tools and training; increase multi-model communication strategies to inform system users of disruptions; support application of performance measures and analysis tools due to disruptions; inform transportation agencies of environmental impacts due to operations and how to mitigate those impacts; and provide an overall smarter, cleaner, and safer transportation network through road weather, work zone, traffic incident and data management strategies.

Collaboration Partners:

The Managing Disruptions to Operations program collaborates internally through coordination between the Office of Operations, the ITS Joint Program Office, the Office of Operations R&D, as well as with the Office of Safety, the Office of Infrastructure, and the Office of Safety R&D. Work on climate solution and resiliency improvement is done in close coordination with the Office of Environment, Planning and Realty, and the Office of Policy. External collaboration takes place with State, local, and tribal transportation agencies, academia, law enforcement and first responder communities, private contractors and industry, as well as with international committees such as the PIARC World Road Association. Within these groups, the Managing Disruptions to Operations program solicits active engagement and input with interested stakeholders through workshops, site demonstrations, strategy meetings, and technology transfer.

Freight Management and Operations
$3,400,000

Program Description:
FHWA's Office of Operations Freight Management and Operations Research, Development and Technology (RD&T) Program aims to ensure safe, durable, and high performing infrastructure, identify solutions to mitigate or address the negative impacts of freight transportation, research the resiliency of the freight transportation system, and improve the physical components of the highway system that support economic strength through goods movement, including roads, bridges, pavement, parking facilities, and other components. Freight Management and Operations RD&T Research areas include freight performance management, improve the physical components of the highway system that support goods movement, assess the condition and performance of key freight infrastructure, developing data-driven tools that States/other stakeholders can use to better assess the freight system, and to provide guidance that permits States and other stakeholders to incorporate freight infrastructure improvement projects into transportation program delivery and development of State Freight Plans. Equity and inclusion topics will be given consideration as the program searches for ways to incorporate those concerns in its research and products.

Program Objectives:
The Freight Management and Operations RD&T Program supports FAST Act NHFP-related goals and requirements and national policy on National Multimodal Freight Network condition, safety, security, efficiency, productivity, resiliency, and reliability. The program seeks to better the highway system physical components - including roads, bridges, pavement, parking facilities, and other elements - that support goods movement. This research area strives to better grasp how freight movement impacts—and is impacted by—this infrastructure.

The Freight Management and Operations RD&T Program seeks to improve the reliability of travel and freight movement on the Nation's transportation systems by working with State DOTs and other stakeholders to identify data sources and developing freight mobility tools and performance data to target policies, programs and resources with a goal of driving overall system reliability. The program also seeks to assess the condition and performance of key freight infrastructure, and to provide resources that permit States and other stakeholders to incorporate freight infrastructure improvement projects into transportation program delivery. The Freight Management and Operations RD&T Program seeks to enhance a number of freight analytical tools and data resources, such as the Freight Analysis Framework (FAF), freight data visualization tools, Vehicle Inventory and Use Survey (VIUS), State Freight Plan Toolkit, Freight and Fuel Transportation Optimization Tool (FTOT) and improve ability to measure current and future conditions and operation of the freight transportation network through the incorporation of more accurate, real-time, and localized freight data. Objectives include ensuring safe, durable,

and high performing infrastructure, as well as identify solutions to mitigate or address the impacts of freight transportation.

Anticipated Program Activities:
Key FY 2022 FHWA Freight Management and Operations R&T Program activities include the Freight Data Integration and Visualization, Freight Flow Models and Tools, Freight Infrastructure Needs Identification and Analysis, Freight Program Delivery and Technology Transfer activities, and Freight Performance and Mobility Trends.

These key activities will be pursued to improve supply chain information, enhance the integration of multimodal freight data sources, improve the understanding of local, regional, and national freight flows, explore analytical tools for considering connected and automated freight trucks, including enhancements to FAF and VIUS. Additionally, improvements include the development and testing of new tools like the FTOT that can be applied to freight planning and corridor analysis needs. Freight Infrastructure Needs Identification and Analysis activity includes understanding how freight flows impact the transportation system condition and performance, supports critical highway-rail grade crossings needs, truck parking needs and designating critical urban, rural intermodal connectors, and safe operations in mixed use urban and suburban environments. Finally, it includes developing tools for integrating resiliency considerations into freight transportation planning, asset management, and project development. The Freight Program Delivery and Technology Transfer activity includes communication and development of educational and professional development materials/events; noteworthy practices; and tools and technical assistance resources. In also includes the monthly Talking Freight webinar series, development of a State Freight Plan Update and Implementation Toolkit to help States identify effective and notable practices in freight plan development and implementation. Freight Performance and Mobility Trends program enhance understanding of freight mobility and performance data for driving system improvements. Activities supports transportation performance management requirements and system planning research, bottlenecks analysis, and development of Freight Mobility Trends (FMT) tool to presents national freight statistics.

Key FY 2022 FHWA Freight Management and Operations Program Activities

Activity	Period of Performance
Freight Data Integration and Visualization	2015-2023
Freight Flow Models and Tools	2015-2023
Freight Infrastructure Needs Identification and Analysis	2016-2023
Freight Program Delivery and Technology Transfer	2015-2023
Freight Performance and Mobility Trends	2018-2023

Expected Program Outcomes:
The Freight Management and Operations RD&T Program addresses multiple needs both for DOT and for external stakeholders and leads to enhanced freight data and models that facilitate performance-based, data-driven analysis and decision-making, helping

stakeholders more effectively incorporate freight infrastructure considerations into transportation planning and project development. Results from the research activities identified in the program will assist in developing and bettering freight data analytical tools and data collection techniques and standards, and industry data analysis methods. It will improve assessing the condition and performance of key freight infrastructure and improve understanding of the impact of freight movement on this infrastructure and vice versa. Initiating stakeholder forums and outreach, peer exchanges, pilot implementations, and technology transfer will facilitate information sharing between public sector freight transportation professionals and provides technical assistance on an as-needed basis.

Collaboration Partners:

FHWA Freight Management and Operations R&T programs have developed internal and external stakeholder groups or leveraged stakeholder associations to engage the various transportation and program area communities and modal partners in gathering input through methods such as in-person meetings, peer exchanges, virtual meetings, and web-based events. The program collaborates with internal partners such as the FHWA Office of Safety to identify strategies for reducing collisions at highway-rail grade crossings. The Performance Management Data Program (PMDP) is a joint effort with the FHWA Office of Infrastructure. Ongoing USDOT research in this area includes continuation of Exploratory Advanced Research (EAR) Projects, collaboration with HRDO on several efforts focused on freight performance measures, freight trucks automation, and innovations in freight data collection, analysis, modeling, and dissemination. Collaboration also continues with other USDOT modal agencies, such as MARAD, FRA, NHTSA, and FMCSA, and other stakeholders, such as the National Coalition on Truck Parking, and Transportation Research Board (TRB) to identify opportunities to improve Freight Management and Operations.

Truck Size and Weight
$1,100,000

Program Description:
The Truck Size and Weight (TSW) Research, Development and Technology (RD&T) Program funds initiatives to provide Congress, States, and other stakeholders with information to create safe and efficient networks and systems for freight movement across the nation and International borders. Activities will continue to address matters of safety, economic strength, and preservation of core assets. New initiatives have the potential to support transformation and future proofing, climate, and resilience. Research on effective TSW use supports States in their efforts to better harmonize oversize and overweight (OS/OW) permitting requirements and to reduce the incidence of trucks striking bridges and tunnels. Additional TSW RD&T activities will include implementing the highest priority elements of the TSW Implementation Plan. This includes the implementation of a TSW research knowledge management strategy as well as beginning scoping work on Weigh-In-Motion projects, research and analysis, data and modeling.

Section 5502 of the Fixing America's Surface Transportation (FAST) Act required the Department of Transportation to create an Emergency Route Working Group (ERWG). The research program area will carry out research related to the recommendations and to the best practices advice the ERWG provided to the Secretary of Transportation on expeditious State approval of special permits for vehicles involved in emergency response and recovery.

In addition, in accordance with 23 U.S.C. § 127, each State shall certify to the Federal Highway Administrator, before January 1 of each year, that it is enforcing all State laws respecting maximum vehicle size and weight permitted on what, prior to October 1, 1991, were the Federal-aid Primary, Secondary, and Urban Systems, including the Interstate Highway System. The States must also certify that they are enforcing and complying with the Intermodal Surface Transportation Efficiency Act of 1991 freeze on the use of longer combination vehicles and other multi-unit vehicles. The certification shall be supported by information on activities and results achieved during the preceding 12-month period ending on September 30 of each year. FHWA is responsible for certifying state compliance with Federal standards.

Finally, a series of Appropriations Acts in recent years have directed US DOT to continue research efforts to answer the questions raised by the Comprehensive Truck Size and Weight Limits Study of 2016, release implementation and research plans, and to work with the States and private sector to gather all necessary data.

Program Objectives:
TSW research primarily supports strategic goals related to improving safety and supporting economic strength and modernization. Emerging areas of focus offer opportunity to support climate solutions and reduce emissions, and generally prepare the

transportation sector for technology-based/tech-driven transformation. Some examples of research areas to be advanced in FY 2022 include ongoing support for State Pilot Car Certification. Some States use FHWA-developed guidelines to support their certification requirements, however, these requirements vary and there is no Federal standard or requirement. Failure in pilot car procedures can lead to bridge strikes and other safety incidents. FHWA research in this program area will support harmonization among States on oversize/overweight State and local permits. The work outcome will improve safety on the national highways as well contribute to infrastructure preservation. Activities will include research, review, and analysis of existing pilot/escort vehicle operator (P/EVO) training materials and case studies and other information focused on the oversize loads movement.

Bridge strikes by oversized vehicles is the second most frequent reason for bridge failure. These incidents cause injuries and fatalities, secondary crashes, traffic delays and have large economic costs in terms of response, repair, and recovery. The TSW RD&T Program research seeks to reduce the incidence of trucks striking bridges and tunnels. Areas of exploration include bridge/tunnel strike data, countermeasures, practices, and systems for preventing bridge/tunnel strikes, driver training, and stakeholder involvement. Additionally, there is an effort to identify key TSW-related research needs relating to pavement, bridge, mode shift, safety, and enforcement. The combination of these activities will lead to improved technical and implementation resources for stakeholder decision-making and analysis.

Anticipated Program Activities:
Key FY 2022 FHWA TSW RD&T Program Activities include those related to the Completion and Execution of FHWA Truck Size and Weight Research Implementation Plan and scoping work on Weigh-in-Motion research projects, harmonization and automation of State Oversize/Overweight (OS/OW) permitting systems, research and review of pilot/ escort vehicle operator (P/EVO) training, bridge strike research, and establishment of communication platform to inform drivers of temporary changes to allowable vehicle weights on the interstate system during an emergency. The FHWA Truck Size and Weight Research Implementation Plan will be used to guide advancement of the highest priority research elements. This includes the implementation of a TS&W research knowledge management strategy as well as beginning scoping work on Weigh-In-Motion research projects. Other activities could include development of enhanced bridge deterioration models that can account for impacts of alternative truck configurations, development of more accurate models that States and others can use to identify impacts of heavy trucks on pavements, analysis of truck types, bridge strike research, and safety impact assessments.

Key FY 2022 FHWA Truck Size and Weight Program Activities

Activity	Period of Performance
Execution of FHWA Truck Size and Weight Research Implementation Plan and related research projects	2019-2023

Analysis and Dissemination of Truck Size and Weight Data and Research	2018-2023
Research, resource development and outreach efforts on bridge strike prevention	2021-2024
Permitting and emergency response activities including website development for declarations, permitting systems and harmonization, and related size and weight analysis.	2021-2023
Trucking operations research and outreach, including pilot car certification	2022-2023

Expected Program Outcomes:
The TSW RD&T Program will develop roadmaps and syntheses, research results, improved analytical tools, resources on methods to prevent bridge strikes by oversized vehicles, establishment of definitive online resource on the changes to allowable weights during emergency declarations, best practices, stakeholder forums and outreach, peer exchanges, and pilot implementations. The TSW RD&T Program will support practitioners to plan for, prioritize, and implement projects that benefit goods movement. TSW RD&T Program activities include producing resources on what information is needed for analysis of freight vehicle size and weight and examining methods for inventorying and applying these data. Activities will also include research on effective truck size and weight data use across States and supporting States in their efforts to better harmonize OS/OW permitting requirements.

Collaboration Partners:
For bridge strike work on a NCHRP project, panels will be convened with a range of experts from the public and private sector. International engagement will occur via web meetings. FHWA will convene a peer-to-peer meeting with States on automated permitting systems. Websites on enforcement data and on emergency declarations offer opportunities for feedback. A FHWA Truck Size and Weight Research Implementation Proposal will be cleared for public release. Under the knowledge management strategy, a USDOT subject matter expert group has been convened and will provide research topic updates and guide knowledge sharing and collection in TSW research. FHWA program offices and other modal agencies, including MARAD, FRA, and FMCSA are involved.

Environment and Planning

Accelerating Project Delivery
$3,000,000

Program Description:
The Accelerating Project Delivery research program helps FHWA expedite project delivery while ensuring sound environmental stewardship, robust public participation, and compliant real property acquisition. This program supports improving the National Environmental Policy Act (NEPA) process and improves coordination and communication between Federal and State agencies, the public, and other stakeholders. Additionally, this program supports capacity building for environmental practitioners, integrating planning and environment processes, and disseminating information about environmental sustainability and community engagement.

Program Objectives:
The main objective of the Accelerating Project Delivery program is to build tools and collaborate on studies to expedite project delivery while ensuring sound stewardship, robust public participation, and compliant real property acquisition. In FY 2022, FHWA will continue building on research areas with proven success while expanding to meet the Administration's priorities. This program will support the new Executive Orders, reauthorization implementation, rulemaking, guidance, Planning and Environment Linkages (PEL), virtual public involvement, enhancements to integrating NEPA and permitting collaboration tool (INPCT) and the Project and Program Action Information System (PAPAI), programmatic approaches, NEPA assignment program support, Eco-Logical, national resource agency liaison program support, and the Environment Discipline Support System.

FHWA is committed to building a transportation system that is sound and sustainable, and promoting a responsive and inclusive environmental review process. The Accelerating Program Delivery program will support any needed updates to regulations, guidance, policy, or capacity-building materials regarding transportation equity, complete streets, and climate change in project development. This program will help FHWA develop research and policy materials, while disseminating information to environmental practitioners around the country.

Anticipated Program Activities:
The Accelerating Project Delivery program will support wide ranging activities to promote environmental stewardship, robust public participation, and compliant property acquisition. Activities will include support for new Executive Orders, reauthorization implementation, rulemaking, guidance, Planning and Environment Linkages (PEL), virtual public involvement, enhancements to integrating NEPA and permitting collaboration tool (INPCT) and the Project and Program Action Information System (PAPAI), programmatic approaches, NEPA assignment program support, Eco-Logical, national resource agency liaison program support, and the Environment Discipline Support System. These activities

collectively help address the administration's priorities in climate and sustainability, equity, safety, and transformation.

Key FY 2022 FHWA Accelerating Project Delivery R&T Program Activities:

Activity	Period of Performance
Accelerating Project Delivery Services	2022-2023
Permitting and Mitigation, including the National Liaison Program	2022-2023
Project and Program Action Information System (PAPAI)	2022-2023
Interagency NEPA & Permitting Collaboration Tool (INPCT)	2022-2023
NEPA Assignment Program	2022-2023
Planning and Environment Linkages (PEL)	2022-2023
Center for Environmental Excellence	2022-2023

Expected Program Outcomes:
This program will support the development of regulation and policy, reauthorization implementation support, project development tools, and collaboration on programs and studies that promote stewardship and equity in project development. The Council on Environmental Quality (CEQ) issued revised regulations in September 2020 and is expected to take additional regulatory action in the coming year. In response, FHWA will develop regulation, policy, and guidance to align with the CEQ's latest position. 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), virtual public involvement, programmatic agreements, and NEPA assignment support. This program will fund national liaison programs with other Federal agencies to improve cross-agency efficiency and collaboration. Finally, this program 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.

Collaboration Partners:
FHWA works closely with Federal partners, State DOTs, non-governmental entities, and public stakeholders to achieve the objectives of the Accelerating Project Delivery program. The Volpe National Transportation Systems Center 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 (ACHP), the National Marine Fisheries Service (NMFS), the US Army Corps of Engineers (USACE), the US Coast Guard (USCG), the US Environmental Protection Agency (USEPA), and the US Fish and Wildlife Service (USFWS). These agencies provide dedicated staffing positions that serve as national liaisons to develop policy, guidance, and programmatic approaches to improve environmental programs. Non-governmental input on this program comes from public comments and stakeholder engagement related to projects and draft policies,

guidance, and rulemaking. Additionally, transportation organizations such as the AASHTO, Transportation Research Board (TRB), and University Transportation Centers (UTCs) contribute to this program by providing in-kind services or by funding research that compliments the Federal side of the program. AASHTO and TRB also support stakeholder engagement in the program to facilitate technology transfer between FHWA, its Federal partners, and the transportation industry.

Performance-Based Planning and Equity
$2,100,000

Program Description:
FHWA will work with States and Metropolitan Planning Organizations (MPOs) to provide a strategic and data-driven approach to transportation decision-making that allows agencies to implement performance-based planning and programming (PBPP) while efficiently allocating limited resources, maximizing the return on investments, and achieving desired performance goals. This will also increase accountability and transparency to the public. PBPP connects performance measures and performance target levels that lead to effective data-driven transportation solutions. These measures and targets are connected through long-range transportation plans and transportation improvement programs developed at the statewide and metropolitan levels.

Program Objectives:
FHWA's mission is to promote safety, mobility, and economic growth, while enhancing the quality of life of all Americans. This is done through FHWA's leadership, innovation, oversight, and stewardship that ensures our roads and highways continue to be among the safest and most technologically sound in the world. PBPP will further this through the application of performance management within the transportation planning and programming processes and work with States and MPOs to achieve desired performance outcomes for a multimodal transportation system. PBPP 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 transportation decision-making that improves transportation planning, programming, operations, and coordination.

FHWA will conduct research to collect quality data; analysis; and information for FHWA Divisions, States, MPOs, transportation partners, and decision-makers to use in the planning decision-making process. FHWA will continue to work with other Federal, State, and local agencies to develop methods and tools to analyze system performance to identify effective transportation solutions. This will create strategies and activities that will advance comprehensive international, statewide, metropolitan, non-metropolitan, rural, regional, multimodal, and tribal planning processes. Other planning research initiatives that will support performance-based planning and links planning data to the National Environmental Policy Act (NEPA) includes: environmental justice, public involvement, planning for operations, safety planning, forecasting project benefits and impacts, exploratory modeling, transportation land use, and scenario planning.

Anticipated Program Activities:
Implementing PBPP necessitates that States and MPOs develop data-driven plans, collect and maintain data, conduct studies, establish priorities, and evaluate the effectiveness of

transportation improvements. This research will provide tools, technologies, guidance, and training to support States, MPOs, and other transportation agencies (including rural communities) to achieve desired performance outcomes for the multimodal transportation system and improve mobility while preserving the natural and human environments. PBPP will also help transportation planners to evaluate and recommend strategies, projects, and programs to policymakers based on anticipated system-wide impacts and goals.

Key FY 2022 FHWA Performance-Based Planning and Equity R&T Activities.

Activity	Period of Performance
Enhance coordination with States and MPOs to detect notable practices that prioritize multimodal projects to enhance equity, accessibility, and connectivity for all users.	2022-2024
Identify innovative visualization methods to effectively analyze, map, present, and report equity information to transportation practitioners, elected officials, and the public.	2022-2024
Evaluate planning needs in partnership with key stakeholders to identify opportunities and risks of existing procedures to support the 3-C planning process.	2022-2024
Monitor the effectiveness PBPP in transportation planning and programing at the State and regional levels. Coordinate with key stakeholders to ensure consistent monitoring and documentation of performance measures, targets, and decision-making for PBPP.	2022-2024
Promote opportunities for peers that demonstrate new planning innovations and allow for tools and strategies to enhance traditional public involvement techniques for all transportation users.	2022-2024
Partner with key agencies (domestic and international) to market emerging products and technologies to meet planning research needs.	2022-2024
Partner with key agencies to develop and deploy best practices, case studies, and other capacity building activities that support enhanced small, rural, and mid-sized communities and regions	2022-2024
Continue delivery of customer service and technical support to key FHWA stakeholders through the development of trainings, peer reviews, peer exchanges, workshops, virtual forums, and other mediums that promote planning best practices.	2022-2024
Apply state of the art analytical tools and data resources in the transportation planning decision-making process.	2022-2024
Distribute State and MPO best practices for making investment decisions based on a data driven PBPP and estimate the economic benefits and other cost savings resulting from PBPP.	2022-2024

Expected Program Outcomes:

This research will provide examples of effective practices to help practitioners advance performance based planning approaches; promote and maintain the highway infrastructure asset system in a state of good repair; identify tools, technologies, and guidance for States and MPOs; offer capacity building opportunities that plan and prioritize investments, accelerates project delivery; and effectively improve connectivity, accessibility, safety, and convenience for all users, including those in rural areas. Additionally, this research will allow for the consideration of 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. Potential regional investment strategies for the planning horizon include packages of investments in transit, highway capacity, Intelligent Transportation Systems (ITS), and travel demand management strategies.

Collaboration Partners:
Collaboration on performance-based planning and programming involves FHWA's engagement with key stakeholders in both formal and informal settings to gather input on planning opportunities and challenges. Key stakeholders include State DOTs, MPOs, Regional Transportation Planning Organizations(RTPO), pertinent planning committees of the American Association of State Highway and Transportation Officials (AASHTO), American Association of Metropolitan Planning Associations (AMPO), National Association of Regional Councils (NARC), National Association of Development Organizations (NADO), National Association of Counties (NACO), Transportation Research Board (TRB), universities engaged in planning 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). Non-government groups also partner with FHWA to support performance-based planning through planning conferences, symposiums, and relevant workshops.

Modeling and Analysis Tools
$2,100,000

Program Description:
The "Modeling and Analysis Tools" research program focuses on the development of new analytical tools and refines existing tools to help decision makers understand how highway projects improve the performance of our nation's highway system in terms of equitably improving air quality, mitigating greenhouse gas emissions, reducing noise, and addressing congestion caused by the high demand to travel on the highway system. This research supports the opportunity for communities to fully participate in the highway project decision making process 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 goal of the research program is to provide stakeholders at State departments of transportation

(DOTs), metropolitan planning organizations (MPOs), and the public with the best tools, data, and regulatory framework to protect human health and the environment.
The research program also explores and adapts modeling methodologies for transportation planning to allow State DOTs and MPOs to better understand their transportation systems and to provide decision-makers 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.

Program Objectives:
This research program supports the mission of the Federal Highway Administration and its strategic goals to promote economic strength and modernization, equity, climate and sustainability, and the transformation of our Nation's transportation infrastructure.

Improving current air quality and noise modeling tools to produce more accurate and reliable results will provide decision makers with the best possible information to understand the air quality and noise impacts of proposed highway projects when making 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 for air quality and noise impacts is required by law and regulations. Additionally, 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 protection of the human and natural environment.

New and refined analytical tools, data, and other research products will be disseminated to stakeholders for application in a timely manner to assess air quality and noise impacts and the performance of the highway system and to support evidence-based decisions making. These new tools can take advantage of technological advancements and use the latest scientific information to improve accuracy.

The research program will also identify and assess effective mitigation and abatement strategies to alleviate impacts for communities near major corridors who face disproportionate exposure to air quality and noise pollution from vehicular traffic.

Anticipated Program Activities:
FY 2022 will also focus on the deployment of models and analytical tools that were completed in FY2021. These models and 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 posting, etc. Documents such as research reports, case studies, model sensitivity and

validation analyses, and technical guidance will be posted online and marketed at industry events.

Key FY 2022 FHWA Modeling and Analytical Tools R&T Program Activities.

Activity	Period of Performance
Develop and deploy state-of-the-art **models and analytical tools** and to improve data collection methods to enhance air quality, noise, and greenhouse gas analyses	2022-2023
Conduct research to extend the understanding of potential noise and air quality benefits of **advanced vehicle technologies**, such as connected and autonomous vehicles (C/AVs); low and zero emission vehicles (LEVs, ZEVs); and electric vehicles/charging infrastructure. Research includes both light duty and heavy-duty vehicles.	2022-2023
Catalyze research on social determinants of **health and equity impacts** to inform FHWA in the development of approach, recommendations and best practices for our stakeholders and project sponsors.	2022-2023
Identify and develop **effective mitigation strategies** with demonstrated air quality, noise, and greenhouse gases benefits including traditional strategies and new innovative strategies, such as sustainable pavements/barriers.	2022-2023

Expected Program Outcomes:
Air quality and noise analyses are required by law and must consider a project's air quality and noise level changes effects on health, equity, and environmental justice. The regulatory models for these analyses can be complex and difficult to use. Our research aims to develop and update tools and methods that will make the models simpler to use 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. This research will develop data-driven tools and methodologies to evaluate and demonstrate adequate environmental protections. By having 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. Our research will develop tools to measure the amount of emission and noise level reductions from existing standard and future innovative mitigation strategies.

Collaboration Partners:
Collaboration on modeling research regularly involves engagement with key stakeholders

in both formal and informal settings to gather input concerning challenges and opportunities that might be addressed through the program, as well as information on work undertaken by other organizations both nationally, and internationally.   We regularly partner with offices within FHWA and other operating administrations within USDOT. We also routinely engage stakeholders including representatives of individual State DOTs, MPOs, regional planning agencies, pertinent committees of the American Association of State Highway and Transportation Officials (AASHTO), the Association of Metropolitan Planning Organizations (AMPO) and the Transportation Research Board (TRB), universities engage in related work, and professional organizations such as the Institute of Transportation Engineers, and the American Planning Association. 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 other non-government 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.

Resiliency
$1,300,000

Program Description:
The Resiliency research program focuses on development and deployment of 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 lifecycle cost 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 exposure of infrastructure to climate change and extreme weather events, including changes in precipitation patterns, temperature, sea level rise, and cyclonic storm surge and waves. FHWA will conduct research and development activities to better inform decision making regarding greenhouse gas 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.

Program Objectives:
The goal of this program is to integrate consideration of climate change, extreme event and natural disaster resiliency, greenhouse gas emissions and sustainability into the transportation planning, project development and design processes. The program objectives include developing and deploying tools and methods, promoting best practices and developing and delivering training to help decision makers incorporate climate change resiliency, greenhouse gas reduction and sustainability in transportation plans, projects, and programs; accelerating the adoption of electric and alternative fueled vehicles by supporting the deployment of fueling and charging infrastructure; conducting training and technical assistance to state DOTs and MPOs; conducting research on best practices, usage, behavior, stakeholder needs; and designating alternative fuel corridors; and exploring opportunities to use highway right-of-way to enhance sustainability and reduce greenhouse gas emissions, generate additional benefits, and reduce costs, that are consistent with operational and safety concerns.

This research program directly supports the Climate and Sustainability strategic research goal.

Anticipated Program Activities:
FY 2022 program activities will focus on the development and deployment of tools and methods, training and technical assistance to enhance climate resiliency, reducing greenhouse gas emissions, supporting and enhancing alternative fuel and charging

corridors and infrastructure, and the deployment of renewable energy generation in the highway right of way.

Key FY 2022 FHWA Modeling and Analytical Tools R&T Program Activities.

Activity	Period of Performance
Partner with State DOTs and others to improve processes, tools and methods through developmental and applied research and demonstration projects for incorporating climate change, extreme event and natural disaster resilience	2022-2025
Create training and technical assistance on climate change, extreme event and natural disaster resilience for highway planning, design, construction, operations and maintenance, and asset management.	2022-2025
Develop tools and techniques to better inform decision making on greenhouse gas emission reductions and sustainability.	2022-2025
Support expansion of alternative fuels and electric vehicle charging infrastructure by designating alternative fuel corridors, providing technical assistance and training, and conducting research.	2022-2025
Support innovative, alternative right-of-way uses, including installation of renewable energy generation and provision of broadband to provide additional societal benefits, which are consistent with highway operational and safety concerns.	2022-2025
Research and support implementation of highway construction and materials that reduce environmental impacts and emissions and maximize material efficiency and recycling.	2022-2025

Expected Program Outcomes:
Expected program outcomes include new partnerships with State DOTs and others to reduce greenhouse gas emissions, expedite the transition to electric and alternative fuel vehicles, improve resiliency and sustainability processes, tools and methods, and the develop and deliver of technical assistance and training on climate change, emission reduction, energy efficiency, sustainability and resilience. Outcomes would also include training and technical assistance developed and delivered on alternative fuels and electric vehicle charging, resulting in expanded national designations of alternative fuel corridors, and the generation of renewable energy in the highway right of way.

Collaboration Partners:
Collaboration on climate resiliency, greenhouse gas 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 program, as well as information on work undertaken by other organizations both nationally, and internationally. Primary stakeholders include representatives of individual State DOTs and metropolitan planning organizations, Federal land management agencies (FLMAs), and pertinent committees of the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board (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. Non-governmental groups also partner with this program. In particular, AASHTO provides stakeholder perspective and collaborates on research projects.

Multimodal Connectivity
$1,300,000

Program Description:
The goals of this program are to improve safety, facilitate equitable economic growth, address racial equity and economic inclusion, promote resiliency and address climate change, and transform transportation infrastructure. The program will improve the connectivity of the multimodal transportation system, lower the number of pedestrian and bicyclist fatalities and injuries, and improve mobility options for all users. The program will support equitable outcomes in multimodal transportation planning and project development, by promoting rebalanced investments to address inequalities in access to opportunity, improve accessibility and the ability to make Complete Trips, facilitate economic revitalization, achieve safer communities, help implement mobility innovation, and enhance network resiliency. The program will provide emphasis on ensuring traditionally underserved populations are afforded equitable access to convenient transportation options through inclusive and efficient multimodal transportation planning for the National Highway System (NHS).

Program Objectives:
This research program supports the mission of the Federal Highway Administration and RD&T Strategic Goals of the USDOT in the areas of safety, economic strength and modernization, equity, climate and sustainability, and transformation. Specifically, this program will develop resources that improve access and mobility for all users, particularly in underserved populations, and implement processes to improve equitable outcomes in multimodal network planning and implementation. This includes ensuring equity in the implementation of accessible multimodal mobility options and integrating efficient and affordable mobility innovation in transportation plans and projects. The research activities will improve economic revitalization and analyze investment strategies to address inequalities to enhance quality of life. The program will develop and promote proven pedestrian and bicycle infrastructure designs that improve safety and reduce fatalities and injuries, including safe routes to school activities. The research will identify and promote effective and successful tools and information necessary to integrate systemic pedestrians and bicycle analysis into transportation planning and project development.

The program will also support research and technology deployment to implement a connected surface transportation system for all users, including micromobility, and other emerging technologies and in manner that is equitable, safe, environmentally sustainable, and supports economic revitalization. Research will identify and promote equity, improving access to opportunity, and meaningful public engagement to strengthen the ability of States and communities to respond to citizens' needs.

Anticipated Program Activities:
In FY 2022, the Multimodal Connectivity Program will develop resources to advance transportation equity, promote economic revitalization, integrate emerging mobility

technology systems in transportation planning, implement safe and connected active transportation networks, promote livability research, and integrate national data systems.

Key FY 2022 FHWA Modeling and Analytical Tools R&T Program Activities.

Activity	Period of Performance
Operate a national pedestrian and bicycle information center (PBIC); and conduct research on implementing equitable active transportation networks, pedestrian and bicycle safety, including safe routes to school activities, accessibility, connectivity analysis, and technology transfer and technical assistance. Address equity in the deployment of emerging technologies such as micromobility, shared mobility, and automation. Study the impact of new transportation providers on the transportation system.	2022-2023
Maintain an Interagency Agreement with the Volpe Center to support delivery of research and resources that address equity, livability, multimodal connectivity, economic development, and mobility innovation. Promote human environment considerations in transportation plans, programs, initiatives, and priorities of FHWA and USDOT related to implementing a connected multimodal transportation system that meets the needs of all users.	2022-2023
Research and implement the integration of pedestrian and bicycle network connectivity performance measurement and scalable risk analysis with transportation planning and project development.	2022
Support cross-modal research to implement Innovative Technology Collaborative Evaluations for road user safety.	2022
Research and deploy innovations to support implementation of multimodal transportation programs and projects that improve connectivity, accessibility, safety, and convenience for all users, including underserved communities.	2022-2023
Conduct research on the costs and benefits of complete streets program implementation and collaborate with States and local agencies in identifying complete streets approaches with the greatest positive impact on safety, accessibility, and emissions reductions.	2022-2023
Conduct research to identify design solutions that ensure new and emerging innovative multimodal facilities are fully accessible, particularly for individuals with a disability or mobility challenges.	2022
Develop resources to support safe integration of micromobility and other emerging technologies in the transportation network.	2022
Develop case studies of transportation agencies using Context Sensitive Solutions and Design principles to plan, design, and implement Complete Streets.	2022
Research the economic benefits of scenic byways and make the report publicly available as required in the 2021 Appropriations Act.	2022-2023

Activity	Period of Performance
Research notable practices for conducting environmental justice and equity analysis at the state and regional level during planning and NEPA. The project will provide information on EJ data analysis and mapping tools to improve equitable outcome in transportation decision making.	2022
Research and deploy innovations to support improved context sensitive solutions and design, community impact assessment, and meaningful public engagement to ensure equitable outcomes in transportation decision-making and improve mobility options for underserved communities.	2022
Administration of the National Highway System (NHS) Official Record and GIS Database to facilitate National Highway Performance Program eligibility determination and NHS system performance tracking.	2022 - 2023
Evaluation of whether National Highway System (NHS) Intermodal Connector threshold criteria established in the 1990s are relevant and valid to meet current NHS stakeholder needs	2022
Support planning and delivery of the International Transportation and Economic Conference (I-TED), to be held in 2023. I-TED discusses approaches and research to integrate mobility to enhance our communities' ability to develop a sustainable economy.	2022-2023
Support a National Accessibility Evaluation Pooled Fund Study to provide ongoing research on multimodal job accessibility and connectivity data that evaluates access to essential destination, including healthcare, education, and healthy food destinations.	2022-2023

Expected Program Outcomes:
This research will improve equitable outcomes in multimodal planning and project development by ensuring safe and efficient mobility options, including more connected pedestrian and bicycle options are implemented for all users, particularly for communities with underserved populations, including low income individuals, minority groups, and persons with a disability. This research will produce strategies for implementing connected active transportation networks that address mobility innovations that involve emerging technology such as micromobility, share mobility, and automation. This research will help ensure inclusive multimodal planning, design, and programming 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 quality of life for all users through strategic highway investments.

Collaboration Partners:

FHWA will coordinate with internal DOT working groups on with regularly basis on environmental justice, bicycle and pedestrian program coordination, micromobility, human environment, economic development, virtual public involvement, planning stakeholders, recreational trails, and transportation alternatives. Partnerships with nongovernment groups on this research will include the American Association of State Highway and Transportation Officials (AASHTO), the Transportation Research Board (TRB), universities (particularly University Transportation Centers) that engage in related work, and professional organizations such as the Institute of Transportation Engineers, the Association of Pedestrian and Bicycle Professionals, the National Association of City Transportation Officials, and the American Planning Association. Interactions with these organizations and key external stakeholders such State DOTs, 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.

Policy

Policy Analysis
$3,990,000

Program Description:
The Policy Analysis program provides decision-makers with empirically-based assessments of future transportation needs and the potential for Federal policies and strategies to effectively address those needs. This program additionally serves as its economic hub for implementing OMB and OST standards for assessing grant, regulatory, and policy cost effectiveness.   The program is broken down into seven key focus areas: A) Conditions and Performance Forecasting; B) Transportation and the Economy; C) Benefit Cost Analysis; D) Highway Costs and Funding Options; E) Emerging Trends and Future Demand; F) Transportation Options Analysis; and G) Policy Development. This research supports the development of policy analyses and analytical tools for assessing the value and cost effectiveness of highway investments; forecasting future highway conditions and performance under various travel and infrastructure funding scenarios; developing the biennial Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance Report to Congress (C&P Report); evaluating the impacts of highway investments on communities, individual economic sectors, and national economic indicators such as gross domestic product (GDP) and employment; conducting economic regulatory impact analyses (RIA) for significant rulemakings; evaluating changing travel patterns and needs across socio-demographic, income, and regional users, including the differing impacts of highway policies across different types of rural and urban communities; assessing highway construction costs and inflation; analyzing vehicle miles traveled (VMT) and other highway revenue sources, their impacts on users, and their relationship to vehicle impacts on highways, congestion, and emissions; and support the FHWA Policy Symposia series and Emerging Trends Symposia series.

Program Objectives:
Ongoing research in the Conditions and Performance Forecasting focus area will support the Economic Strength and Modernization goal by quantifying the backlog of unmet infrastructure investment while research in the Transportation and the Economy focus area will predict the macroeconomic impacts of increasing investment to eliminate the backlog.   These efforts will be supported by research in the Transportation Costs and Options focus area aimed at improving predictions of future pavement performance and the costs associated with infrastructure investments. Under the Transportation Options Analysis focus area, work will support the Transformation goal by continuing the development and refinement of geospatial tools enables analysis of uses of highway rights-of-way for transit, walking, biking, and other modal uses beyond private occupancy vehicles. Research in the Benefit-Cost Analysis focus will include planning for the incorporation of resiliency considerations as part of future analytical tool enhancements.

Research within the Transportation and the Economy focus area will support the Equity goal by exploring areas and subgroups for whom the benefits of infrastructure investments have been outweighed by negative impacts in terms of property values. The Emerging Trends and Future Demand focus area facilitates the understanding of equity from demographic, income, location (e.g., rural/urban) perspectives. The Policy Development focus area is crosscutting in nature, and supports policy dialogue in all goal areas, including the Climate and Sustainability and Safety goals areas. Analysis tools being developed under the Transportation Policy Options focus area can support targeted analyses of safety issues.

Anticipated Program Activities:
The main activities in the Conditions and Performance Forecasting focus area in FY 2022 will be the finalization of the 25th C&P report to Congress, the completion of HERS and NBIAS model development to support the 26th C&P report, and the initiation of new model enhancements aimed for inclusion in the 27th C&P report in 2025. Research in the Transportation and the Economy focus area will include development work on USAGE-Hwy 1.2, a study on the distribution of land value appreciation from highway investment, and a study evaluating the role of transportation investment in support freight movement and trade. Within the Benefit-Cost Analysis focus area, work will continue to support FHWA's regulatory impact analysis needs, the construction of a framework for incorporating infrastructure resiliency considerations, and the exploration of methods for better reflecting the full life cycle cost of transportation infrastructure investments including greenhouse gas and other emissions. In the Highway Costs and Funding Options focus area, work will continue in updating a Federal revenue model, pavement distress analysis and prediction modeling, reviewing and validating construction cost per lane-mile estimates, and estimating the marginal costs of highway infrastructure use by different classes of users, FY 2022 research activities in the Emerging Trends and Future Demand focus area will include the improvement of methods and analysis to estimate the policy implications of emerging trends and intermodal transportation, the development of a Mobility Technologies Policy Research Framework. The Transportation Options Analysis focus area will build upon prior years' work to develop geo-typologies and a multimodal analysis tool that will allow the transportation research community to quantify and understand how policy decisions impact performance measures, such as mobility and accessibility, and how economic factors influence the use and performance of the transportation network. New work in FY 2022 will include the enhancement of the Geo-economic Multimodal Transportation System (GEMS) to capture impacts of investment policies and the development of a prototype interactive tool for use in analyzing different policies. The Policy Development research focus area will continue collaboratively exploring transportation policy topics, supporting Agency and Department efforts to identify and mitigate corporate risk, and enhancing and ensuring the quality production of peer-reviewed innovative research.

Key FY 2022 FHWA Policy Analysis R&T Program Activities.

Activity	Period of Performance
Conditions and Performance Forecasting: 24th & 25th C&P Reports	2019-2021

Activity	Period of Performance
Conditions and Performance Forecasting: 26th & 27th C&P Reports	2022-2023
Conditions and Performance Forecasting: NBIAS Enhancements & Support for 25th & 26th C&P	2019-2022
Conditions and Performance Forecasting: HERS Enhancements & Support for 25th & 26th C&P	2019-2022
Transportation and the Economy: Macroeconomic Impacts	2020-2022
Transportation and the Economy: Community Economic Impacts	2021-2023
Transportation and the Economy: Economic Competitiveness	2021-2023
Benefit-Cost Analysis: BCA methods and applications	2019-2024
Highway Costs and Funding Options: Revenue Forecasting and Policy Options	2020-2023
Highway Costs and Funding Options: Infrastructure & Societal Costs	2021-2025
Highway Costs and Funding Options: Construction Costs	2020-2022
Emerging Trends and Future Demand: Factors Shaping Modal Use and Travel Behavior	2021-2025
Transportation Options Analysis: GEMS Model Development	2018-2023
Transportation Options Analysis: Geospatial Policy Studies	2020-2022
Policy Development: Inform policy conversations	2017-2024

Expected Program Outcomes:
Research activities in the Conditions and Performance Forecasting focus area will support the transmittal to Congress of the 26th C&P report in FY 2022, providing objective data to support decision making in light of the new-normal, post-pandemic travel patterns. Research efforts within the Transportation and the Economy focus area will inform policy discussions through development of a data visualization tool to explore the relationship between transportation infrastructure and residential land value over time and through the application of an upgraded version of the USAGE model and its application to simulate policy scenarios related to recovery from the COVID-19 pandemic. Within the Benefit-Cost Analysis focus area, a Benefit-cost Analysis Evaluation for Transportation Projects course will be completed and offered as a regular NHI course, helping to improve the technical capabilities of FHWA staff to analyze discretionary grant applications and apply economic principles more broadly in program delivery. Research in the Highway Costs and Funding Options focus area will produce new seasonal adjustment factors for the National Highway Construction Cost Index (NHCCI), which will make it easier to recognize and alert leadership of changes in construction inflation that may affect States' ability to meet their performance targets. Research efforts in the Emerging Trends and Future Demand focus area will include the release of a biennial Emerging Trends Report documenting key demographic, geographic, and technological trends impacting system supply, demand, and performance, and the completion of a study on Opportunity for Improved Mobility and safety in Rural Areas, which will shed new light on rural safety, mobility, and accessibility needs. Anticipated FY 2022 accomplishments in the Travel Options Analysis focus area include the completion of GEMS Version 2.1, and the transmittal to Congress of an Interstate Withdrawal Study. Work in the Policy Development focus area will include

hosting a transportation policy symposium to engage stakeholders on a topic to be determined of immediate policy interest to the Department.

Collaboration Partners:
FHWA policy 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, as well as information on work undertaken by other organizations. A key tool for gathering stakeholder input for domestic research are future policy symposia, a dialogue series that facilitates discussion with external experts and practitioners to frame future policy considerations and options. The information gathered via the symposia helps to broaden the relevance of future policy research and to avoid duplication with research being conducted by other entities. Input received via this mechanism is documented in summary reports. Research collaboration is also undertaken through evaluations of proposed modeling improvements and interim research results by technical experts. For example, FHWA is convening an expert panel review of the typical costs per mile for different types of highway improvements; the findings of this panel will help guide future research in this area.

Global Outreach
$670,000

Program Description:
The Global Outreach program has three main program elements: Global Benchmarking, Binational Relations, and Multinational Relations. The three Office of International Programs elements address priority issues in a complementary manner to other ongoing initiatives, focusing on best practices and technologies related to FHWA and DOT high-priority topics. The Global Benchmarking Program seeks out and adapts existing foreign innovations that could significantly improve highways and highway transportation services in the US. Binational Relations facilitates knowledge exchange with a variety of countries by leveraging binational government-to-government partnerships. Multinational relations span a wide range of program and research activities, working with entities such as the World Road Association and the European Union. Through collaboration with international and domestic partners, the three elements address the Secretary's and FHWA's priorities and initiatives. They work together and cross-pollinate, with developments in one area sometimes leading to opportunities in others. For example, a one-time visit to a country for Global benchmarking may lead to a long-term exchange as part of a binational relationship. A successful binational exchange may lead to a multinational research project. Information or developments gleaned during a multinational meeting may attract the interest of FHWA subject matter experts and lead to a Global Benchmarking study. In this way, the programs work in complementary ways to address different aspects of FHWA's international efforts, all while focusing on U.S. priorities and initiatives.

Program Objectives:
Under the Global Benchmarking element, the Acting Administrator will select two new study topics for the Global Benchmarking Program focused on one or more of the five priority areas. The Office of International Programs has solicited proposals within FHWA, but the specific studies will not be determined for some time, though they will address priority areas. The ongoing studies on Unmanned Aerial Systems and Pedestrian Safety will continue, including moving to the report-writing and implementation phases.

Binational Relations will continue safety-related activities, including collaboration with Japan and Korea on road safety. The U.S. and Korea will also collaborate regarding pedestrian safety, as will the U.S. and Sweden. Transformational activities will include exchanges with Korea on bridges, geotechnical topics, inspection techniques, and pavements, and collaboration with Japan on Intelligent Transportation Systems and bridge issues. Several partnerships will address topics related to climate change and infrastructure resilience.

Multinational Relations will continue safety-related efforts, including support of the development and dissemination of the Road Safety Manual for the World Road Association. Transformational activities will include supporting the development and dissemination of World Road Association products in the form of reports, guidelines, and other information

tools, and capturing the U.S. perspectives on topics of interest to the international community. FHWA will also be represented on the newly created Promotion of Gender Inclusion and Diversity Team, addressing issues related to equity and other topics.

Anticipated Program Activities:
Some activities have been postponed from FY 2020 to FY 2021 and again from FY 2021 to FY 2022 due to the global pandemic, leading to more ambitious program in FY 2022. In FY 2022, the Global Benchmarking Program (GBP) will continue its mission of seeking and adapting foreign innovations that directly support DOT strategic goals. Specifically, the GBP plans to schedule two new studies on priority topics that will be identified by FHWA's leadership. Additionally, implementation of findings and recommendations from GBP studies on *Electrically Isolated Tendons in European Transportation Structures* and *Building Information Modeling for Transportation Infrastructure* will be completed and/underway. GBP will also continue activities related to the study on Unmanned Aerial Systems and Pedestrian Safety. In FY 2022, the Binational Relations Program will continue partnerships with other countries whose advances in highway research and practices are beneficial to FHWA's priorities and initiatives, while supporting Departmental priority relationships and topics, and looking for new opportunities. Examples include the annual U.S. – Korea Roads Workshop, exchanges with Sweden on pedestrian safety, exchanges with Switzerland on bridge technologies, the U.S.-Japan Bridge Workshop, and Twinning research projects with Japan.   We also anticipate exchanges with the Netherlands on cooperative automated driving and activities with several partnerships related to climate change and infrastructure resilience. In FY 2022, the Multinational Relations Program's mission to impart United States' knowledge and experience, and promote ways of doing business on a global scale will include active participation in the World Road Association's World Winter Service and Road Resilience Congress to be held in February 2022.   In addition, the FY 2022 plan includes dissemination to domestic audiences of the technical work produced by state and federal government U.S. representatives for the World Road Association technical committees and task forces. The products, reports, guidelines, and other information tools capture the U.S. perspectives and are invaluable tools for the professional roads community worldwide.

Key FY 2022 FHWA Global Outreach Program R&T Program Activities.

Activity	Period of Performance
Conduct GBP studies on Unmanned Aerial Systems for Road Infrastructure and Reducing Pedestrian Fatalities with Systematic Safety Strategies on Arterial Networks and conduct related follow-on implementation.	2020-2023
Initiate two new GBP studies on priority topics identified by FHWA leadership and conduct related follow-on implementation activities.	2021-2024

Activity	Period of Performance
Continue activities to implement findings and recommendations from 2019 GBP studies on Building Information Modeling for Infrastructure and Electrically Isolated Tendon Technology for Bridges.	2019-2022
Engage with the World Road Association (WRA), the European Union/European Commission (EU/EC), the Forum of European National Highway Research Laboratories (FEHRL), and, the International Transport Forum (ITF) as well as strategically targeted collaborations, such as the EC-USDOT Transportation Research Project Twinning Initiative.	2016-2023
Continue FHWA's prioritized binational engagements which cover topics such as pedestrian safety, cooperative automated driving, innovative financing, freight, infrastructure resilience, safety, bridges, binational planning and coordination, and pavement, among others. Binational partnerships currently include: Japan, Korea, the Netherlands, Switzerland, Chile, Australia, Canada, Mexico, and Brazil.	2018-2022

Expected Program Outcomes:
Three main international program elements, Global Benchmarking, Multinational Relations, and Binational Relations facilitate the exchange of innovative ideas, best practices and technologies that can have a direct and practical impact on improving the U.S. highway system. The Global Benchmarking Program (GBP) provides a dedicated mechanism for obtaining and adapting proven foreign innovations that can help FHWA respond to challenges facing the U.S. highway system. The GBP plans to schedule two new studies on priority topics that will be identified by FHWA's leadership. Additionally, activities to initiate implementation of findings and recommendations from previous GBP studies will be completed, and the ongoing studies on Unmanned Aerial Systems and Pedestrian Safety will move to their next phases. It is anticipated that in FY 2022, the Binational Relations Program will continue FHWA's prioritized binational engagements to facilitate knowledge exchange that supports Departmental and Agency priorities, initiatives, and US foreign and trade policy. Anticipated topics include pedestrian safety, cooperative automated driving, innovative financing, freight, infrastructure resilience, safety, bridges, and binational planning and coordination, among others. For FY 2022, the Multinational Relations Program will continue to support the FHWA Executive Director and the Director of International Programs in the World Road Association's Strategic Planning, Finance, and Communications Commissions and Executive Committee and will provide assistance to U.S. representatives to the Association's Technical Committees and Task Forces for the 2020-2023 cycle, including active participation in the 2022 World Winter Service and Road Resilience Congress. Additionally, domestic dissemination of the technical work produced by the technical committees and task forces will continue. The products will capture the U.S. perspectives and are invaluable tools for the professional roads community worldwide.

Collaboration Partners:
While the Global Outreach Program focuses on many of the issues addressed by the working groups, its three program elements do not directly interact with the working groups. However, there is an indirect connection to the extent that Turner-Fairbank Highway Research Center and the FHWA Program Offices contribute to these working groups.

Highway Data and Information
$6,440,000

Program Description:
The Highway Data and Information (HDI) program is a set of initiatives to collect, process, analyze, model, visualize and disseminate data and information by working with Federal, State, local transportation agencies, private businesses, and research communities through an active and advanced RD&T program. The HDI program offers both the foundational data enabling the delivery of the Federal-aid highway program and cost-effective and efficient data analytics and methodologies to the community. Key HDI initiatives include: a) FHWA 500 Series Data, covering fuel consumption (gasoline and special fuel), licensed drivers, registered vehicles, and highway financing (local, State and Federal spending, revenue, tolls, and bonds); b) Policy Information Data Portal (PIDP), delivering form-based data and information from its State agency partners and stakeholder including the Transportation Performance Management (TPM) and Emergency Relief (ER); c) Highway Performance Management System (HPMS), gathering and analyzing highway inventory, traffic, and condition and performance data; d) Integrated Transportation Information Platform (ITIP), enabling data integration and agency wide data sharing; e) Data Visualization Center, offering agency wide data visualization service for effective communication; f) Traffic Monitoring, delivering advanced traffic data technologies and weekly/monthly traffic data; g) National Household Travel Survey (NHTS), providing the only national-level demographic, behavior, and origin/destination transportation data for the entire transportation community; and h) National Performance Dataset (NPD), delivering the National Performance Management Research Dataset (NPMRDS) and the Performance Vehicle Occupancy data on an annual basis. These data and information provide a strong foundation for the Department's priorities such as safety, equity, economic strength and modernization, climate and sustainability, and transformation and datively "Future Proofing."

Program Objectives:
The overall objective of the FHWA HDI program is three-fold. First, the HDI program enables the delivery of Federal-aid to States according to the legislative data-based formulas or other computation methods and the evaluations of the effectiveness of the Federal-aid highway program. Second, the HDI program offers both the analytical and data capability to the Administration and Congress on priorities and legislative actions. And third, the HDI program provides consistent and credible past, present, and future highway-related data for the entire transportation community, promoting accountability, transparency, economic developments, and advanced research and development.

Specifically, the HDI program offers insight into (a) safety strategy development in areas of human factors and behavior, (b) racial equity in areas of data and information, (c) climate through data and data analytics, and d) transformation and equitable economic strength through quality past, present and future data. In addition, the HDI program provides national leadership on transportation data through the development of national specifications and guidance with ongoing support and training for State data providers as

well as internal and external customers. The program's research addresses weaknesses and gaps in relevant technologies, knowledge, and analyses due to a lack of capabilities and/or interest from private entities.

Anticipated Program Activities:
The HDI program will be focused on delivering the 2022 data cycle data and information covering 500 Series data (e.g., fuel, driver, vehicles, and finance), traffic data (e.g., volume, class, weight, speed), highway performance and condition data (e.g., traffic density, reliability, pavement roughness), highway infrastructure inventory data (e.g., location, length of highways and bridges), traveler behavior data (e.g., why and how people travel), and the projection of future highway demand data (e.g., VMT) through a broad range of planned activities. These planned activities include a) the continued maintenance, operations, and improvement of data system such as the Highway Performance Monitoring System, the Traffic Monitoring Analysis System, the Policy Data Portal, the Fuel and FASH System, the Vehicle Traveler Information System (Weigh-in-motion) where State highway agencies can submit their data with security and dependability, b) continued development and deployment of new data analytics concerning data integration and visualization, c) continued technical assistance to States and local transportation agencies on data acquisition, collection, analysis, sharing, and submittal, and d) new effort to develop and deploy alternative data collection and analysis methods to reduce cost, increase the timeliness, and improve quality.

Key FY 2022 FHWA Highway Data and Information R&T Program Activities.

Activity	Period of Performance
500 Series Data: Activities for the 500 Series data program consist of the operations and maintenance of the current version of the Fuels and FASH (v3.5) system to ensure that the 2021 and beyond data can be collected and processed per the established workflows and schedules. In addition, the program will continue to provide training/technical assistance to State agency partners, and develop new reporting guidance, program documentation, training, and analytical tools. Lastly, the program will continue to pursue the transition from State reporting of aggregate motor vehicle registration and licensed driver data to bulk reporting of unaggregated vehicle identification number (VIN) and license driver data.	2019-2024
Policy Information Data Portal (PIDP): PIDP activities include the operations, maintenance, and enhancements of the form-based data collection system to ensure: a) data required to be reported annually by States, via the Performance Measures Forum (PMF), can be processed, reviewed, and approved by FHWA, b) the continued migration of existing 500 Series forms and analytical procedures to PIDP for program and workflow improvement purposes, and c) the design, development, and deployment of Fuels and FASH v4.0 to improve data quality, and implement new data management capabilities and processes.	2019- 2024

Activity	Period of Performance
Highway Performance Monitoring System (HPMS) v8.0**:** HPMS V8 work will ensure 2020 HPMS data in 2021 can be submitted by States via the online system, and that FHWA can process the data in a timely manner by a) maintaining and operating the online system and b) continued National Data Quality Initiative through D A T.	2019-2022
Highway Performance Monitoring System (HPMS) v9.0: HPMS V9 is to replace the legacy V8 system with new system designs to meet technology, security, and performance needs for states to submit HPMS data and FHWA to process the HPMS data. Activities include the continued design implementation of the V9 system, the piloting of the HPMS 9.0 system with states, and the actual 2021 data reporting and processing in 2022.	2020-2023
Integrated Transportation Information Platform (ITIP): ITP will deploy all Commercial Off-the-Shelf (COTS) software acquired for data management and continue the development and deployment of data dissemination solutions. Maintenance and operations of the system to ensure its continued availability to all agency users will also occur.	2020 -2024
Data Visualization Center (DVC) 2.0: DVC will continue the current services offered to the entire FHWA for effective data visualization and analysis.	2019 – 2023
National Performance Data (NPD): The NPD program will a) integrate the 2021NPMRDS data with the latest 2020 HPMS data enabling integrated analysis and b) compute vehicle occupancy factors, supporting FHWA's transportation performance management program.	2019 – 2023
Traffic Monitoring and Traffic Data: The traffic monitoring activities include a) the critical IT operations and maintenance of the online Traffic Monitoring and Analysis System (TMAS) system to ensure its availability for States to submit traffic data and FHWA to process the data for its weekly and monthly traffic volume trends reports, b) the start of the TMAS 2.9 enhancement to handle new data formats per State DOT technologies and additional analytical function needs, c) the forecasting and publishing of FHWA 2022 future traffic demand (future VMT projection), d) carrying out the 2022 national traffic monitoring exhibition workshop, and e) continuing technical support to state and local agencies and the acquisition of vehicle data.	2019-2023
National Household Travel Survey (NHTS): NHTS will process and release the 2021 passenger and truck origin-destination data, deliver 2022 national core behavior data, including bicycle network data tools, provide technical assistance to State DOTs and MPOs on the usage of NHTS data for information extraction and modeling usages	2021-2024

Expected Program Outcomes:

Data and information as related to FHWA 500 Series, Highway Performance and Monitoring, Traffic and Travel data, National Household Travel data, National Performance Data will be gathered, analyzed, and published to meet the Federal-aid fund distribution needs, performance measurements and management schedules, and other needs in a timely and quality manner. In addition, timely data and data analytics will be provided to meet the needs of the Administration for agency priorities and special topics (e.g., safety, equity) and Congressional inquiries (e.g., funding status, travel crossing state boundary data). The HDI program will lead to more efficient, cost-effective, timely, and quality data, technical procedures, data collection methods, and advanced data analytics that the entire transportation community will benefit from.

Collaboration Partners:
The HDI 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, as well as information on work undertaken by other organizations, both nationally and internationally. Broad stakeholders include representatives of individual highway agencies (State DOTs), metropolitan planning organizations (MPOs), pertinent committees of the American Association of State Highway and Transportation Officials (AASHTO) and the Transportation Research Board (TRB), industry organizations, such as the American Trucking Associations, American Bus Association, and others, and private businesses, such as GOOGLE, Inrix, Streetlight, CitiLabs, Caliper, SAS., and Teralytics. The HDI program staff also partner with researchers from universities and other public and private entities. Formal interactions with AASHTO, TRB, and industry organizations generally occur at regular intervals (at least annually and as often as quarterly). Interactions with states and MPOs tend to be on a more frequent but ad hoc basis. Inputs obtained through these interactions are considered by program staff as they identify and formulate the research program and technology initiatives. As a result of such partnerships, core programs are formulated with strategic focus and supported by pooled resources from not only the Federal, State, and local transportation agencies but also private entities.

Transportation Workforce Development and Technology

Every Day Counts (EDC) Program
$6,500,000

Program Description:
The Every Day Counts (EDC) program is a State- and Local-based Program that identifies and rapidly deploys proven yet underutilized innovations to enhance roadway safety, shorten the project delivery process, reduce roadway congestion, and integrate automation. Proven innovations promoted through EDC facilitate greater efficiency at the State and local levels, saving time, money, and resources that can be used to deliver more projects.

Program Objectives:
The objective of the EDC program is for innovations that enhance safety, accelerate project delivery, improve mobility, and integrate automation to become incorporated into the State and local transportation agencies' business practices. The Program has made a significant positive impact in accelerating the deployment of innovations and building a culture of innovation within the transportation community.

The current portfolio of innovations in EDC-6 directly supports the strategic goals and mission of the agency and economic recovery efforts. For example, the Strategic Workforce Development initiative spotlights new resources and innovative strategies for identifying, training, and placing individuals in the transportation Contractors' workforce. In addition, Targeted Overlay Pavement Solutions can help State and local highway agencies maximize the investment of transportation funding by ensuring safer, longer-lasting roadways that will improve pavement performance, lessen traffic impacts, and reduce the cost of pavement ownership.

Anticipated Program Activities:
FY 2022 program activities include the continued deployment of the EDC-6 innovations through December 2022 and determining the best programmatic approach to continue strategic innovation deployment beyond the sixth cycle of EDC, including due consideration of how best to integrate and highlight Departmental priorities.

Key FY 2022 FHWA Every Day Counts Program Activities.

Activity	Period of Performance
EDC-6 Innovation Deployment	2021-2022
Identification of programmatic approach and initiatives for advancement in EDC-7	2021-2022

Expected Program Outcomes:

The EDC program essentially is an agency-wide T2 effort. FHWA Program Offices and the FHWA 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. These plans include performance measures and metrics specific to each innovation. Each FHWA Division office has EDC Coordinators that monitor and track their respective states' progress in achieving their self-identified implementation goals, with this implementation being the primary program outcome. The State and local highway agencies who receive targeted technical assistance and training through the Program are the primary beneficiaries of the EDC program. Other outputs include but aren't limited to supporting education materials, case studies, and other products.   The EDC-6 Baseline Report summarizes each current innovation and documents the national implementation goals for each innovation.

Collaboration Partners:
Every two years, FHWA seeks input and suggestions from State Transportation Departments, local governments, tribes, private industry, and other stakeholders (e.g., AASHTO, ARTBA ACEC, AGC) to identify a new collection of innovations to champion that merit accelerated deployment.   FHWA refines the list of suggestions received to include the innovations with the greatest potential to have a transformative impact on transportation while also addressing priorities of the Agency and Department. FHWA engages with these key transportation organizations to ensure the list of innovations is most reflective of stakeholder demand. After selecting the EDC innovations for each new round, FHWA convenes transportation leaders and champions to discuss and identify opportunities for implementing the innovations that best fit the needs of their respective State transportation programs. Following this rollout, States and Locals finalize their selection of innovations, establish performance goals for the level of implementation and adoption over the upcoming two-year cycle, and begin to implement the innovations with the assistance of the Deployment Teams established for each innovation.

State Transportation Innovation Council (STIC) Incentive
$5,600,000

Program Description:
The FHWA STIC Incentive program provides resources to help foster a culture for innovation and make innovations standard practice in their States. Through the Program, funding up to $100,000 per State per Federal fiscal year is made available to support or offset the costs of standardizing innovative practices in a State transportation agency or other public sectors STIC stakeholder. Because each State operates its STIC based on its unique business needs and approaches to meeting those needs, the STIC puts the transportation community in each State in the driver's seat to comprehensively and strategically consider sources of innovation, select those innovations that best fit its unique program needs, and then quickly put those innovations into practice.

Program Objectives:
States with a strong culture of innovation leverage the transportation community's resources to get the appropriate innovations into practice quickly. Establishing a well-organized STIC, defined processes and procedures, and engaged leadership serve as the foundation for fostering a culture of innovation within a state. In addition, the STIC structure is essential to ensure that innovation deployment remains a State-based initiative; each STIC has established a Charter to define its mission, scope, membership, and administration.

Anticipated Program Activities:
FY 2022 program activities for the STIC Incentive program include awarding projects commensurate with the funding available for the Program; continued national-level outreach and stakeholder engagement with the National STIC Network through no fewer than two virtual meetings (typically Fall and Spring during the FY); and conduct of the 2022 STIC Excellence Awards Program in partnership with the AASHTO Innovation Initiative.

Key FY 2022 FHWA State Transportation Innovation Council Program Activities.

Activity	Period of Performance
STIC Incentive project awards	Ongoing
Regional and National STIC Network Meeting(s)	2021-2022
2022 STIC Excellence Awards Program	2022

Expected Program Outcomes:
Each STIC self-defines the outcome being sought by implementing the innovations and monitoring performance to ensure those outcomes are met. By setting goals, the STIC communicates the expected outcome and results from innovation deployment and encourages successful implementation. A list of output (STIC Incentive Projects) is available at: https://www.fhwa.dot.gov/innovation/stic/incentive_project/;

The STIC Incentive program's outputs include but aren't limited to delivering job aids and technical resources, training and education materials (webinars, workshops, etc.), and peer-to-peer information exchanges, all of which are designed to support workplace learning for building essential skills.

Collaboration Partners:
Each STIC is comprised of a diverse membership; the broader the diversity of the transportation industry represented on the STIC, the greater the opportunity to be comprehensive in performing the actions noted above. Specifically, FHWA continues to encourage the participation of the academic/research community in the STIC to build linkages between transportation research and practice. A Template Charter which identifies potential STIC membership is available [here.](#)

Accelerated Innovation Deployment Demonstration
$6,500,000

Program Description:
The objective of the AID Demonstration program is to accelerate the deployment and adoption of proven innovative practices and technologies, and through enhanced technology transfer encourage a more widespread rate of adoption. FHWA established the AID Demonstration program to provide transportation agencies the resources to mitigate risks associated with first-time or early adoption of innovations on transportation projects. The AID Demonstration Program helps infrastructure owners overcome the conservative culture found within the transportation industry by offsetting some of the financial risks associated with first-time adoption of new technologies or practices. Funds are available to cover the full cost of implementation of an innovation on a project, up to the maximum amount of $1 million per each individual award, in areas such as planning, financing, operations, pavements, structures, materials, environment, and construction.

Program Objectives:
The AID Demonstration Program provides funding to State DOTs, federal land management agencies, tribal governments, metropolitan planning organizations, and local governments to offset the risks associated with the initial deployment of an innovation by that agency. Innovations funded by the Program can be those promoted by FHWA through the EDC program, or other topics of the applicant's choosing provided they are a new use case to the applicant. The AID Demonstration Program is designed with sufficient flexibility to encourage applicants to consider these and other priorities as determined by the Agency and Department.

The AID Demonstration Program provides funding to support the pilot/demonstration of innovations on projects by State DOT, federal land management agencies, tribal governments, metropolitan planning organizations, and local governments. Funding recipient reports on experiences and lessons learned from each innovation deployment are shared via the program web site to provide technology transfer.

Anticipated Program Activities:
FY 2022 program activities include the issuance of a Notice of Funding Opportunity (NOFO) for the Program to continue solicitation and award of grants based on the applications received and commensurate with the funding available for the Program.

Key FY 2022 FHWA Accelerated Innovation Deployment Demonstration Program Activities.

Activity	Period of Performance
Issue a Notice of Funding Opportunity (NOFO) to enable continuation of Program in FY 2022	2022

Award the maximum number of grants commensurate with the available funding	Ongoing

Expected Program Outcomes:

The key output and performance indicator of the AID Demonstration program is the award of project grants. FHWA constantly monitors the progress towards awarding grants in accordance with the funding available. This information is available at https://www.fhwa.dot.gov/innovation/grants/projects/. Trend data such as the rate of grant awards over the life of the Program is also available at this site. The target for the AID Demonstration Program for FY 2022 will be to award the maximum number of grants commensurate with the available funding. The key outcome goal of the Program is a completed project report (see above link) which documents the impact the innovation had on the delivery of the overall transportation projects, along with other project-related information exchange.

Collaboration Partners:

State DOTs, federal land management agencies, tribal governments, metropolitan planning organizations, and local governments submit applications for funding to support deployment of innovations on projects of their choosing.   Depending on the nature of the individual AID Demonstration projects, consultants and contractors are engaged through their services provided (e.g., design, construction, inspection, operations, etc.).

Accelerating Market Readiness Program
$2,500,000

Program Description:
The AMR program is intended to address longstanding challenges that exist in the transportation industry that impede the integration of new innovations into widespread practice. The initial "hand off" of innovative products from the research community to implementers, and the subsequent adoption of these products into practice, can take many years. Once in the domain of the implementers, the products may be piloted, and the results of the pilot documented, but the benefit data compiled is often limited at best and the dissemination of the findings has not traditionally occurred in a fashion that encourages wider piloting (and later adoption) of a product in the transportation community. The AMR program supports promising innovations that have the potential to be considered for accelerated deployment. The AMR program provides resources for the rapid, national assessment of emerging innovations and for the development of objective, written documentation of these assessments.

Program Objectives:
The AMR program 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. The innovations to be supported by AMR program resources are those that significantly advance conventional practice, address knowledge and technology gaps, significantly advance the state-of-the-art, or constitute a sea change in the development and delivery of transportation projects and programs. The AMR program is designed and administered with sufficient flexibility to successfully support the Agency and Department's strategic goals.

Anticipated Program Activities:
FY 2022 program activities include the issuance of a Broad Agency Announcement to solicit for projects, and award grants commensurate with the funding available for the Program. Another key activity will be monitoring progress with the projects awarded in May 2021 and sharing these findings and lessons learned as appropriate with the greater transportation community.

Key FY 2022 FHWA Accelerating Market Readiness Program Activities.

Activity	Period of Performance
Monitor projects awarded in May 2021 under first AMR program Broad Agency Announcement	2021-2023
Issuance of Broad Agency Announcement for 2nd AMR project solicitation	2022
Communications and Marketing of AMR program	Ongoing

Collaboration Partners:
FHWA used considerable stakeholder input in the development of the AMR Program as one that identifies and potentially supports topics from throughout the transportation community.   FHWA committed to working with its transportation partners to enhance ways for emerging innovations to be fairly evaluated and more rapidly accelerated into use in transportation programs and projects. The initial Broad Agency Announcement solicited and received proposals from all concerns (e.g., State DOTs, academic institutions, and the private sector) indicating a strong interest in the Program from all transportation stakeholders.

Innovative Finance

Innovative Finance
$890,000

Program Description:
Innovative Finance (IF) provides tools, training and technical assistance that support the transportation community's use of cutting-edge financial and procurement strategies to deliver critical infrastructure projects. FHWA's efforts in this area are primarily led by the Center for Innovative Finance Support (CIFS), whose products are often marketed and delivered in coordination with the DOT's Build America Bureau. These research and technology deployment efforts focus on revenue generation (tolling and value capture), procurement (public-private partnerships (P3s) and other alternative contracting methods), and innovative finance (Federal project finance tools such as GARVEE Bonds and State Infrastructure Banks). Support for our partners include: (1) technical resources, guidebooks, and analytical tools; (2) capacity building and outreach; and (3) technical assistance for project implementation.

Program Objectives:
The Innovative Finance program begins with the recognition that public infrastructure resources at all levels of government are continually under stress, and thus demand effective project finance and delivery practices. These practices, in turn, must constantly evolve to exploit the opportunities of a dynamic economy. Given the sprawling number of public agencies in the United States, a potential "market failure" exists each time a project sponsor fails to look beyond its local environs for beneficial new practices. Federally-sponsored research and technology (R&T) deployment can open State and local jurisdictions to opportunities tested elsewhere by their peers. Specific objectives that require R&T support include consideration of innovative finance project revenue options, such as user fees and value capture, via research, training and technical assistance; consideration of the P3 delivery option for major projects by providing the U.S. transportation community with the most complete, up-to-date body of knowledge on P3s; and supporting the accrual of P3 knowledge by industry practitioners and advisors in the areas of planning/evaluation, procurement, and monitoring/oversight.

Anticipated Program Activities:
Anticipated Innovative Finance activities in FY 2022 include Rural Projects/SIBs where, project-specific assistance is provided to public sponsors seeking access to Transportation Infrastructure Finance and Innovation Act (TIFIA) credit assistance for rural infrastructure projects; Rural Electric Vehicle (EV) Charging, which provides technical assistance to public and private entities seeking to provide EV charging stations to rural locations; public policy research into potential organizational structures for newly-established P3 offices within State DOTs; P3, value capture, and project finance training; Project Delivery Benchmarking, as required by the FAST Act; and a Center for Excellence in Project Finance (CEPF).

Key FY22 FHWA Innovative Finance R&T Program Activities.

Activity	Period of Performance
Rural Projects/SIBs	2021-2022
Rural EV Charging	2021-2022
State DOT P3 Program Offices	2021-2022
P3 Training	2021-2022
Value Capture Training	2021-2022
Project Finance Training	2021-2022
Project Delivery Benchmarking	2021-2022
Center for Excellence in Project Finance (CEPF)	2021-2022

Expected Program Outcomes:
With its emphasis on applied research and ongoing deployment, the CIFS measures its program impact by monitoring innovative finance activities across the States. In each year since FY2018, 16 or more States have employed at least one innovative finance tool.

Collaboration Partners:
The relevance of the IF program is a direct function of engagement with its stakeholders, the State and local public sponsors seeking the needed technical resources, capacity, and information to deliver critical infrastructure. Whether in response to structured CIFS inquiries or via informal, but frequent dialogue with FHWA, these practitioners largely shape the research and deployment agenda. This engagement is often facilitated by the network of FHWA Division Offices, which interact daily with public sponsors throughout the nation. The IF program partners provide regular communication channels, again both formally and informally:

Corporate

Research Infrastructure, Technology Transfer and Partnerships
$14,000,000

Program Description:
The FHWA Research Infrastructure, Technology Transfer, and Partnerships Program supports the goals of the USDOT Strategic Plan by supporting 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 the Turner Fairbank Highway Research Center, organizes strategic Research and Technology (R&T) investment, and provides marketing and communications. This Program also supports the FHWA Office of Technical Resources and the FHWA Resource Center's technology transfer activities. FHWA's Office of Research, Development, and Technology is located at the Turner Fairbank Highway Research Center (TFHRC), a federally owned and operated national research facility in McLean, Virginia. At the TFHRC, staff conducts research and development activities in the areas of infrastructure, operations, and safety. Research in areas of Intelligent Transportation Systems (ITS), policy, innovative finance, planning, and the environment is conducted or administered by FHWA offices located at USDOT Headquarters.

Program Objectives:
The primary role of the Research Infrastructure, Technology Transfer, and Partnerships Program is to provide leadership, coordination, and support in the administration of the FHWA R&T program in support of the USDOT Strategic Goals. To accomplish this 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.

Additionally, the Research Infrastructure, Technology Transfer, and Partnerships Program will maintain and support the operation of the TFHRC. The highway research and development relating to emerging highway technology that occurs at TFHRC is focused on addressing research gaps not addressed by FHWA's partners. TFHRC specifically focuses on long-term, high-risk research to improve the materials used in highway infrastructure; the development of tools and techniques that provide solutions to complex technical problems; and the development of innovative highway products and practices. The program also invests in new research infrastructure to support research in emerging areas such as efforts to create capabilities for advanced research data analytics to enable novel methods to assess transportation issues.

Anticipated Program Activities:
In FY 2022, the Research Infrastructure, Technology Transfer, and Partnerships Program will undertake a number of activities. These activities primarily focus on supporting

technology transfer across the entirety of the FHWA R&T program; conducting program evaluations; providing marketing, communication, and publication services; maintaining critical corporate partnerships; and supporting the Tuner-Fairbank Highway Research Center.

Key FY 2022 Research Infrastructure, Technology Transfer, and Partnerships Program Activities.

Activity	Period of Performance
Support Technology Transfer of R&T Innovations	2018-2022
Invest in laboratory and research infrastructure improvements and maintenance	On-going
Conduct R&T Program Performance Evaluation	On-going
Provide administrative support services for the R&T program	On-going
Provide marketing, promotional, social media, and strategic planning support.	On-going
Develop newsletters and periodicals and manage distribution	On-going
Develop technical communications, writing, and printing	On-going
Develop websites and provide maintenance	On-going
Support technical symposia and meetings (e.g. TRB Annual Meeting)	On-going
Provide library staffing and maintenance	On-going
Facilitate the Research and Technology Coordinating Committee (RTCC)	2019-2022
Support TRB Core Program Services for a Highway Research, Development, and Technology Program	2020-2025
SPR-B Program Activities	On-going
Conduct Instructional webinars and participate in Peer Exchanges	On-going
Update FHWA R&T Portfolio Website	2020-2021
Provide IT services and improvements	On-Going
Develop and deliver training, technical assistance and technology deployment assistance for transportation partners	On-Going

Expected Program Outcomes:
The FHWA Research Infrastructure, Technology Transfer and Partnerships Program aims to 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 critical research publications, supporting marketing and communication 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 includes investing core research infrastructure at the TFHRC to ensure that critical experimental and analytical tools are available to successfully achieve the objectives of the FHWA RD&T program. Development of new research capabilities allows FHWA to investigate and develop emerging technologies to the benefit of the nation's highway transportation system. Additionally, 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 reduces duplication and strategically invests FHWA's research funds where they are needed most.

Collaboration Partners:
The FHWA Research Infrastructure, Technology Transfer, and Partnerships Program will continue to support critical research partnerships. The program will continue to coordinate research program information with the Transportation Research Board and the AASHTO Special Committee on Research and Innovation. Furthermore, through this program, FHWA will continue to coordinate research activities through input into the AASHTO National Cooperative Highway Research Program (NCHRP); through engagement with academic research community, including University Transportation Centers; and through international partnerships. Finally, the program will continue to work with State and local partners to coordinate research agendas, particularly through management of the Transportation Pooled Fund Program.

Small Business Innovation Research

Small Business Innovation Research
$2,000,000

Program Description:
The SBIR program is a highly competitive, awards-based program that encourages domestic small businesses to engage in research and development addressing high priority research areas within USDOT. The SBIR program 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. The program is administered by the Volpe Transportation Center. The SBIR Program Office publishes one or two solicitations each fiscal year for proposals on specific research topics of interest to USDOT operating administrations, including the FHWA.

Program Objectives:
The objective of this program is to encourage small businesses to engage in research and development (R&D) that has the potential for commercialization and meets federal R&D objectives. The SBIR program is uniquely positioned to support both the interests of FHWA as well as the small business. In this respect, the SBIR programs aims to provide essential funding to small businesses with aim toward commercialization of products that align with FHWA and Departmental Strategic goals. Given that the SBIR program is available to all FHWA RD&T programs, all USDOT Strategic goals are supported.

The SBIR program offers unique services to the small businesses to aid in their technical and commercial development. Specifically, the SBIR program offers a Technical and Business Assistance program to provide consulting services to the SBIR participants to help conduct market research, commercialization plans, and other services. In addition, in FY 2022 the FHWA SBIR program will continue with a Technology Readiness Level (TRL) assessment program to help the Small Businesses conduct an independent assessment of the technological status of the innovations developed through the SBIR program.

Anticipated Program Activities:
In FY 2022, the Small Business Innovation Research program will participate in the annual solicitation of topics and support current Phase I, II, and IIB projects. Additionally, the FHWA SBIR program will continue with the Technology Readiness Level (TRL) Assessments at the end of Phase II.

Key FY 2022 FHWA Small Business Innovation Research Program Activities

Activity	Period of Performance
Technology Readiness Level (TRL) Assessments	2022
Annual Solicitation of Topics	2022

Expected Program Outcomes:
FHWA aims to advance technologies and make problem-solving innovations available to the end user. FHWA will accomplish this by identifying the most promising new innovations, advancing Phase I and Phase II projects that have a clear path to commercialization, and focusing on market-driven needs. This creates a win-win-win opportunity for the Federal Government, the small business, and the traveling public. The Federal Government advances their strategic goals by investing in promising innovations; the 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 new innovations in the marketplace that enhance the travel experience.

Collaboration Partners:
The FHWA SBIR program is coordinated internally within USDOT and methods and practices are shared with other modes through the Volpe center, which administers the SBIR programs for USDOT.

Exploratory Advanced Research

Exploratory Advanced Research
$4,740,000

Program Description:
The EAR Program addresses the need for longer-term, higher-risk research in highway transportation. Funding of exploratory advanced research has a direct impact on 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 Program applies proven deliberative and open processes to engage experts within and outside the Department to identify potential research topics among new discoveries in science and technology that may address current and emerging needs of the highway transportation industry.

Program Objectives:
The EAR Program conducts investigations across disciplines and program to identify three or four topics annually where a government investment has the potential for transformative results. The Program conducts regular screening of results from the active investment portfolio and actively supports efforts to transition results that demonstrate high potential for applied research programs. The Program engages experts inside and outside government to ensure efforts reflect the most recent advances in science and technology.

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

Anticipated Program Activities:
The EAR Program conducts initial stage investigations, supports early-stage extramural research and intramural research through placement of postdoctoral researchers in FHWA, and actively works to transition research results towards transformative changes in transportation practice.

Key FY 2022 FHWA Exploratory Advanced Research R&T Program Activities.

Activity	Period of Performance
Conduct initial stage investigations to identify topics for Program investment	2022
Support new research awarded in response to a Broad Agency Announcement	2022-2025

Activity	Period of Performance
Leveraging broader federal investments through interagency agreements	2022-2023
Evaluate and transition research results	2022
Supporting novel intramural research through placement of NRC Research Associates in FHWA	2022-2025

Expected Program Outcomes:

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

Collaboration Partners:

The EAR Program regularly works with technical experts from across the Department (BTS, FMCSA, FAA, FTA, ITS JPO, and NHTSA) and other agencies from participating in scoping activities, through serving on technical review panels for EAR Program investments, technical working groups reviewing ongoing EAR Program-funded research, and Technology Readiness Level assessment panels that provide input into the transition of results. Coordination across the Department enhances the opportunity for EAR Program-funded results to benefit multiple modes. The EAR Program and the NSF Computer Science and Engineering Directorate signed an MOU in 2019 to coordinate on research leveraging expertise across different research communities on critical transportation research issues. The EAR Program also coordinates with Defense, Energy, and NASA laboratories and the Department of Commerce National Institute of Standards and Technology on specific research topics where there are potential joint benefits.

Designated Grant Programs

Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Program
$39,000,000

Program Description:
The Advanced Transportation and Congestion Management Technologies Deployment Initiative (ATCMTD) Program is intended to provide funding for eligible entities to develop model deployment sites for large scale implementation and operation of a diverse set of technologies in various geographic regions. As the program is aimed at the rapid deployment of advanced technologies, limited expenditures for infrastructure construction is anticipated in grant application. The stated purpose is to reduce costs and increase return on investments; deliver environmental benefits through increased mobility; enhance transportation system operations; improve safety; improve collection and dissemination of real-time information; monitor transportation assets; deliver economic benefits; and accelerate deployment of connected and autonomous vehicle technologies. Successful proposals will contain quantifiable system performance objectives, use innovative technologies and strategies, and a plan for long term operation and maintenance of the deployed technologies. The USDOT encourages partnering among the private sector, public agencies, research institutions, technology leaders, and other transportation stakeholders.
Fixing America's Surface Transportation (FAST) Act Section 6004 instructs the DOT to ensure that the selection of grant recipients represent diverse geographic areas of the United States, including urban and rural areas.

Program Objectives:
The DOT's vision for the ATCMTD initiative is the deployment of advanced technologies and related strategies to address issues and challenges in safety, mobility, sustainability, economic vitality, and air quality that are confronted by transportation systems owners and operators. The advanced technologies are integrated into the routine functions of the location or jurisdiction and play a critical role in helping agencies and the public address their challenges. Management systems within transportation and across other sectors (e.g., human services, energy, and logistics) share information and data to communicate among agencies and with the public. These management systems provide benefits by maximizing efficiencies based on the intelligent management of assets and the sharing of information using integrated technology solutions. USDOT shares the advanced technology solutions and the lessons learned from their deployment with other locations, scaled in scope and size, to increase successful deployments and provide widespread benefits to the public and agencies.

Anticipated Program Activities:
Program activities will consist of the selection of FY21 ATCMTD grant awards which would prompt working with the Divisions and grant recipients to ensure cooperative agreements

are executed and projects are obligated. Simultaneously, program oversight will continue for FY 2016 -FY 2020 ensuring that grant recipients are providing quality deliverables and that each project is meeting goals and objectives.

Key FY 2022 FHWA Advanced Transportation and Congestion Management Technologies Deployment Program R&T Program Activities.

Activity	Period of Performance
Selection of FY21 grant awards and timely implementation of projects.	FY21 to project closeout
Continue to manage FY16-20 projects.	To project closeout (varies)
Publish ATCMTD annual report as mandated by the FAST Act.	FY20 to closeout of all projects.

Expected Program Outcomes:
ATCMTD Program goals are directly linked to DOT's Strategic Goals and include:
- Reduced costs and improved investment returns, including through the enhanced use of existing transportation capacity (Economic Strength and Modernization)
- Delivery of environmental benefits that alleviate congestion and streamline traffic flow (Climate and Sustainability)
- Measurement and improvement of the operational performance of the applicable transportation networks (Economic Strength and Modernization)
- Reduction in the number and severity of traffic crashes and an increase in driver, passenger, and pedestrian safety (Safety)
- Collection, dissemination, and use of real-time transportation-related information to improve mobility, reduce congestion, and provide for more efficient and accessible transportation, including access to safe, reliable, and affordable connections to employment, education, healthcare, freight facilities, and other services (Economic Strength and Modernization, Equity)
- Monitoring transportation assets to improve infrastructure management, reduce maintenance costs, prioritize investment decisions, and ensure a state of good repair (Economic Strength and Modernization)
- Delivery of economic benefits by reducing delays, improving system performance and throughput, and providing for the efficient and reliable movement of people, goods, and services (Economic Strength and Modernization, Equity)
- Accelerated deployment of vehicle-to-vehicle, vehicle-to-infrastructure, and automated vehicle applications, and autonomous vehicles and other advanced technologies (Transformation)
- Integration of advanced technologies into transportation system management and operations (Transformation)
- Demonstration, quantification, and evaluation of the impact of these advanced technologies, strategies, and applications towards improved safety, efficiency, and sustainable movement of people and goods (Safety, Equity, Climate and Sustainability)

- Reproducibility of successful systems and services for technology and knowledge transfer to other locations facing similar challenges (Economic Strength and Modernization, Transformation)

Collaboration Partners:
ATCMTD is not a research program, rather it is a discretionary grant program established in the FAST Act, however, public and stakeholder input is considered in the development of the annual Notice of Funding Opportunity (NOFO). Fixing America's Surface Transportation (FAST) Act Section 6004 instructs the DOT to ensure that the selection of grant recipients represent diverse geographic areas of the United States, including urban and rural areas.

To be selected for an ATCMTD award, eligible applicants are State or local governments, transit agencies, metropolitan planning organizations (MPO) representing a population of over 200,000, or other political subdivisions of a State or local government (such as publicly owned toll or port authorities), or a multijurisdictional group or consortia of research institutions or academic institutions. Partnership with the private sector or public agencies, including multimodal and multijurisdictional entities, research institutions, organizations representing transportation and technology leaders, or other transportation stakeholders, is encouraged.

Typically, a consortium is a meaningful arrangement with all members involved in planning the overall direction of the group's activities and participating in most aspects of the group; the consortium is a long-term relationship intended to last the full life of the grant. Any application submitted by a sole research or academic institution and that is not part of a consortium will not be considered for selection.

DOT encourages partnerships with the private sector or public agencies, including multimodal and multijurisdictional entities, research institutions, organizations representing transportation and technology leaders, or other transportation stakeholders. Numerous ATCMTD awardees include non-governmental partners that traditionally have provided non-Federal matching funds in the form of technical services, hardware, and software.

Surface Transportation System Funding Alternatives
$20,000,000

Program Description:
The Surface Transportation System Funding Alternatives (STSFA) Program purpose is to provide grants to States to demonstrate user based alternative revenue mechanisms that utilize a user fee structure to maintain the long-term solvency of the Highway Trust Fund. The program seeks to identify strategies that could supplement or replace the gas tax. The intent is that gas tax revenues finance the highway trust fund. The federal gas tax rate has not kept pace with needs as vehicles have become more fuel efficient and automakers have introduced electric vehicles (EVs), which do not pay a gas tax.

Program Objectives:
Test the design, implementation, and acceptance of functional future user-based alternative revenue mechanisms that minimize administrative costs, increase public awareness of the need for and possible approaches for alternative funding sources for surface transportation programs, and to provide recommendations on various approaches. Economic strength and modernization is a key strategic goal the pilots will address through the STSFA which has the potential to supplement or maintain the long-term solvency of the Federal Highway Trust Fund. State partners seek to identify strategies that will reduce operation and administrative costs and improve return on investments. Pilots will demonstrate how charging by the mile reveals to users how much they drive, which could influence driver behavior. When people pay attention to the number of miles they drive it could lead to some people driving less which addresses the strategic goal of climate and sustainability. The additional environmental benefit would be reduced greenhouse gas emissions as a result of the reduction in congestion and streamlined traffic flow. Safety improvements could also be realized as traffic improvements would reduce crash risks. Research also suggests that while the gas tax is regressive, paying by the mile could reduce costs for low income drivers.

Anticipated Program Activities:
The Headquarters team will work with Division office staff to oversee State pilot partners who will administer and support the delivery of the STSFA grant program, evaluate program outcomes, and conduct outreach and technology transfer. The team will release the FY21 Notice of Funding Opportunity (NOFO) in 2021. An outreach webinar will be broadcast within 30 days of the release of the NOFO. Proposals will be due 90 days after release of the NOFO. Once the technical review team completes the evaluation process and makes funding recommendations, it is anticipated that funding awards will be announced within 90 days of submitting recommendations to the Administration.

Key FY 2022 FHWA Surface Transportation System Funding Alternatives Program R&T
Program Activities.

Activity	Period of Performance
Advertise and Award FY 2021 STSFA Grants	2022-2025

Expected Program Outcomes:
By launching new pilots exploring road usage charge and mileage-based usage fee
strategies this statutory program will provide user perspective and experience with
implementing an array of user based approaches to fund surface transportation
infrastructure. Participating States will serve as laboratories for lessons learned from
which others across the nation can learn.

Collaboration Partners:
FHWA headquarters works closely with its Division Offices to provide technical support to
States deploying STSFA demonstration projects. State transportation and revenue agencies
are the program's primary stakeholders, so they are the target audience for most activities.
Each pilot project develops its own outreach process. FHWA staff from headquarters and
our Division Offices work with partner organizations in a variety of ways, such as
supporting the execution of demonstration projects, conducting webinars, workshops and
roundtable discussions; developing written resources, providing technical assistance and
support to assist with deployments. The Program office sponsored research that explores
the potential impacts of launching a national pilot and developing a framework that could
be used for a pilot. The FHWA Office of Policy is leading that project. Some of the States
that deployed pilots recruited state and local government officials as pilot participants.
FHWA currently collaborates with staff from the National Conference of State Legislatures
to disseminate information about the pilots to increase awareness and understanding
about road user charges.

Chapter 3 – FY 2023 RD&T Programs

Infrastructure

Accelerated Implementation and Deployment of Pavement Technologies

Program Description:
In 2023, FHWA will continue to conduct an Accelerated Implementation and Deployment of Pavement Technologies (AIDPT) program that is closely coordinated with the Pavement & Materials R&D program. The program will continue to focus on demonstrating new technologies directly to States, highlighting the benefits to the user. Advancing tools to increase overall pavement performance and reducing overall risk to owners will be a key goal. Providing education resources and training on fundamentals for pavement quality will also be addressed. FHWA will continue its focus on implementing best practices and tools for topics such as conducting life cycle assessments to evaluate environmental impacts and implementing strategic preservation techniques and protocols for evaluating pavement foundation condition and designing inverted pavements. Efforts will further encourage and deploy best practices for the implementation of recycled materials in pavements. Exploration and deployment of best practices for pavement resiliency will continue 2023.

Program Objectives:
In 2023, the AIDPT program will continue to directly support the strategic goals relating to transformation and climate and sustainability. Specific contributions to the strategic goals and the key program objective to optimize pavement performance are as follows.

Transformation: The AIDPT Program supports the Department's Transformation Goal by accelerating the deployment of innovative pavement technologies. The Program will highlight deployment projects conducted by States under the FHWA led pooled fund "Demonstration to Advance New Pavement Technologies Pooled Fund" (TPF-5(478)). Anticipated activities and deliverables to further deploy targeted solutions for both asphalt and concrete pavement overlays under the Every Day Counts Initiative is underway to further improve and maintain the nation's pavement assets. It is anticipated that non-destructive testing technologies will continue to advance at a fast pace and information sharing, demonstrations, and training will be used to support State adoption. It is also anticipated that pavement design guidance will be updated to reflect the pavement life cycle concept. These efforts will provide increased education and awareness, technical assistance, and demonstration project opportunities to States. There will also be emphasis on non-destructive testing to gather real-time measurement of pavement quality. Tangible outcomes in these areas are expected in 2023 and beyond.

Climate and Sustainability: The AIDPT Program will support the Climate and Sustainability Goal by promoting best practices and lesson learned for quantifying embodied carbon

through pavement design, construction, and materials. The Program will support advancements for implementing EPDs for pavements, recycled materials, as well as techniques for addressing impacts of climate change.

Anticipated Program Activities:
In 2023, FHWA will continue to conduct an AIDPT program that is closely coordinated with the Pavement & Materials R&D program. It will continue to drive implementation of innovative pavement technologies, with a focus on improving pavement performance. It is anticipated that the program will focus on more demonstration initiatives, providing funds to States to advance key FHWA technologies under the AIDPT program.

Construction and Project Management

Program Description:
FHWA's Construction and Project Management R&T Program seeks to strategically advance innovative technologies and best practices to accelerate construction and improve quality and durability of as-constructed infrastructure. The program is aligned with and supports achievement of the Department's Strategic Goals. The program's mission is to improve the effectiveness and efficiency of highway construction and project management by transforming infrastructure project delivery. This increased efficiency will help minimize the impact of construction on the public. The program contributes to improving the nation's infrastructure by improving system performance in support of the Nation's economy, as well as speeding up project delivery. It facilitates the development of a modern and digitally integrated approach to construction in both rural and urban communities that foster more efficient and collaborative advanced construction techniques. By promoting the idea of liberating data from proprietary systems and increasing data integration throughout a project life cycle, the Program enables access to data for all who need and supports the Goal of Equity.

Program Objectives:
FHWA's Construction and Project Management R&T Program seeks to strategically advance innovative technologies and best practices to accelerate construction and improve quality and durability of as-constructed infrastructure. The program is aligned with and supports achievement of the Department's Strategic Goals. Through its effort to increase work zone safety, the Goal of Safety is supported. In support of the Economic Strength and Modernization Goal, the program contributes to improving the nation's infrastructure by improving system performance in support of the Nation's economy, as well as accelerating project delivery.

The Goal of Transformation is facilitated through the development of a modern and digitally integrated approach to construction in both rural and urban communities that foster more efficient and collaborative advanced construction techniques. The program is promoting the idea of liberating data from proprietary systems and increasing data integration throughout a project life cycle. This supports the Goal of Equity by enabling access to data for all who need it. A mantra of the data integration effort is the principle that data should be collected once and used often. This minimizes the need for additional resources to collect data and indirectly supports the Climate and Sustainability Goal.

Anticipated Program Activities:
Key activities will be to advance digital project management and construction techniques to increase the efficiency of highway construction. By working with owner agency partners, FHWA's Construction and Project Management R&T Program will advance the integration of data throughout a project's life cycle from design to construction to operations and asset management. It will help foster the increased use of technology such as UAS that can enable greater efficiencies in the program while ensuring that federally supported programs are effectively managed.

Geotechnical and Hydraulics

Program Description:
The Geotechnical and Hydraulics Research and Technology (R&T) Program provides a coordinated and cohesive approach to research, development and technology activities to improve the geotechnical and hydraulic performance (e.g., safety, efficiency, durability, resiliency and cost-effectiveness) of the highway and transportation system. Generally, while there are many overlaps, the Geotechnical and Hydraulic R&T Programs are ultimately solving different problems and issues. The following describes these specific program issues.

In FY 2023, the FHWA Geotechnical R&T Program will continue to enhance cross-discipline and inter-agency collaboration to address risks to effective program delivery. The primary goals include improving the state of the practice for geotechnical characterization of project sites and advancing design methods and procedures to meet innovations and evolution in geotechnical construction.

Likewise, the FY 2023 FHWA Hydraulic R&T Program will build on its successful partnerships and outcomes for all interstices of water, highways, society, and the environment. The Program's Scour and Rivers and Roads initiatives seeks to improve and evolve understandings among the scientific, planning, engineering, and programmatic practices.

Program Objectives:
The Program aligns with and supports the Department's Strategic Goals. It is anticipated that in FY 2023, the Program will continue to support such goals; for example, the Department's Transformation Goal through research and development in technologies and tools that provide more reliable and cost-effective project designs, and follow-on technology deployment initiatives to see that the resulting innovations are put into practice. However, the Program's forward thinking and flexible nature allows it to readily incorporate changing and additional research needs and directions.

Anticipated Program Activities:
In FY 2023, the FHWA Geotechnical and Hydraulics R&T Program anticipates continuing work in several areas, including development of design specifications and guidance addressing hydraulic and geotechnical issues such as bridge scour and embankment erosion, highway and pavement drainage, hydroplaning risk, climate change impacts on rainfall and flood frequency, flow modeling for bridges and culverts, coastal highways impacted by extreme events, geohazards, optimization of base materials for pavement structures, pavement and subgrade infiltration, evaluation of corrosion for buried metallic elements in new and in-service infrastructure, performance metrics for bridge approach transitions, quality assurance methods for large diameter foundation elements, and geotechnical asset and performance management. Deployment efforts will focus on implementing research and development results in these areas. New areas of investigation planned for pursuit in FY 2023 include development of a real-time 3-dimensional

automated scour simulation and prediction tools to monitor bridge scour during storm events, evaluation of the use of NDE technologies to assess the condition of in-service pavement and bridge foundations, and findings on the durability and strength-deformation characteristics of virgin and recycled backfills for retaining walls, foundations, and pavement base courses.

Long-Term Infrastructure Performance

Program Description:
The Long-Term Infrastructure Performance (LTIP) Programs include the Long-Term Pavement Performance (LTPP) Program and the Long-Term Bridge Performance (LTBP) Program. These programs, conducted in close collaboration with the State DOT infrastructure owners, provide for characterization and monitoring of in-service highway pavement test sections (LTPP) and bridges (LTBP) to assemble the data needed to improve infrastructure design and advance the understanding of highway infrastructure performance required to effectively manage transportation assets. The collected data are disseminated to the public through web-based portals. FHWA's investment in obtaining and disseminating the data is leveraged by both public and private sector research organizations that apply the data to address a variety of infrastructure performance needs of local, State, regional, and national interest.

Program Objectives:
FHWA's LTIP Programs seek to advance understanding of how and why highway pavements and bridges perform as they do, knowledge that will enable the improved durability and extended infrastructure life as called for in the most recent transportation bill, the FAST Act. The LTIP research is central to FHWA's work as it pertains to advancing highway safety through the identification of effective infrastructure design and long lasting construction materials reducing maintenance intervals and consequently necessitating less traffic intrusion; maintaining a high performing highway infrastructure to enable furthering economic growth by providing an efficient system for moving goods and people; and validating existing and new resilient construction materials to enhance the Department capacity to provide climate solutions to future natural disasters.

Anticipated Program Activities:
In 2022 the LTIP programs will continue collection, processing and analysis of pavement and bridge data required to achieve Program objectives. The LTPP InfoPave and LTBP InfoBridge web portals will be updated with additional data to more fully document the long-term performance of the infrastructure under study. New analysis projects will be undertaken to develop bridge performance models and address to-be-selected objectives identified in an updated LTPP Data Analysis Plan.

Pavement and Materials

Program Description:
FHWA's Pavement and Materials RD&T Program provides a coordinated program consisting of research, development, and technology activities to improve the safety, performance, sustainability, and assessment of the highway system. This is aligned with the Advanced Materials, Designs and Technologies objective within the State of Good Repair topic area.

Program Objectives:
The FY 2023 Pavement and Materials Research and Technology Program aligns and supports the USDOT RD&T Strategic Goals through the conduct of innovative research in pavement materials, design, evaluation, and management practices to enhance the performance for longer lasting, durable, and innovative pavements while shifting some of the risk and rewards for performance.

The Program contributes to the Department's Safety, Economic Strength and Modernization, and Climate and Sustainability Goals. Contributions to improved safety come about through work toward improved pavement friction, as well as more durable materials that will decrease the risk of work zone accidents and fatalities through less frequent maintenance, preservation, and replacement. Economic growth is supported by research to advance performance engineered mixtures that will provide contractors with greater flexibility in the materials used in pavement construction, and through durability improvements that reduce highway agency maintenance and rehabilitation expenditures and the costs that users incur as a result of highway work zones. Research to enhance the assessment and selection of materials, mixtures and pavements to advance low carbon footprint solutions will investigate and develop test procedures and analysis methodologies for the engineering and environmental performance of innovative and recycled materials (e.g. RAP, RAS, recycled plastics, ground tire rubber) for use in pavements as an environmentally beneficial pathway for the use these waste materials to reduce use of virgin resources and minimize environmental and Green House Gas (GHG) impacts. Performance specifications and test methods will be advanced that address the clarity of their relationship to performance, improve their accuracy, and for some tests, greatly reduce the time to conduct the test. Consequently, guidance will be provided to enhance the reproducibility and rapidity of conducting the tests. Utilization of these developments will improve the pavement design, provide better assurance of construction materials and quality, and ultimately enhance the durability of the pavements consisting of recycled materials. Research on novel pavement assessments and performance prediction for cost effective maintenance and preservation over the pavement life cycle and maintain state of good repair to provide pavements that require fewer maintenance activities and resulting construction related GHG emissions. The Program will also continue to develop approaches for incorporating climate change impacts as part of pavement materials selection, design, maintenance, and management activities.

Anticipated Program Activities:

The FY 2023 FHWA Pavement and Materials RD&T Program will build upon previous achievements which enable more rapid and accurate testing of materials, and address sustainability issues. The Program anticipates continuing work in several areas, including the application of artificial intelligence concepts as part of the overall development of specifications and guidance for material selection, mixture design of asphalt and concrete mixtures, and pavement assessment and management; the development of guidance for the use of local materials, and the development of methods to assess pavement functional and structural condition. FHWA will coordinate and move innovative pavement technologies toward implementation. New areas of investigation for FY 2023 will include: a pavement resiliency study which evaluates the influence of mix type and base and subbase parameters, and evaluation of methods for incorporating up to 100% reclaimed asphalt pavement (RAP) and recycled plastic in asphalt pavements.

Structures

Program Description:
The Structures Research and Technology (R&T) Program is a coordinated and cohesive program of research, development and technology activities focused on providing tools, technologies and guidance, and supporting updated policies, to improve the safety, structural integrity, longevity, construction processes and cost-effectiveness of highway bridges, tunnels and other structures. Consistent with the Department's Transformation Strategic Goal, FHWA's FY 2023 Structures R&T Program will include work addressing advanced materials, designs, and technologies; risk-based asset management; infrastructure system resilience; advanced inspection tools; and effective application of best practices.

Program Objectives:
FHWA's 2023 Structures R&T Program will continue to support the Department's Transformation, Safety, and Economic Strength and Modernization Goals. It will contribute directly to highway safety by providing tools, technologies, guidance and training to support infrastructure owners in ensuring that highway bridges, tunnels and other structures are designed, constructed, inspected, evaluated, and maintained to safely carry traffic loads and withstand the forces of nature. It will support infrastructure owners in effective design, construction, and management of highway bridges, tunnels, and other structures. The program supports training to ensure that personnel responsible for bridge and tunnel inspection have the knowledge and skills required to effectively and efficiently carry out this vitally important responsibility. The Structures R&T Program contributes to transformative solutions by undertaking research to address highway structural engineering challenges. Ultimately, the resulting innovations will improve the state of the practice and result in resilient and adaptable systems to mitigate the impact of hurricanes, floods, and other extreme events on bridges and other structures. Additionally, the Program contributes to economic growth through training and technology transfer initiatives.

Anticipated Program Activities:
In 2023, FHWA's structures R&D program will complete several projects initiated in 2022 and will initiate additional projects consistent with the Department's strategic goals. Advancement in the use of robotics for bridge inspection will be facilitated. Structural design concepts for ultra-high performance concrete will be extended and refined, supporting use of this transformational material in bridge components. Novel bridge repair and rehabilitation solutions will be packaged for use by bridge maintenance teams across the country. Anticipated new starts in 2023 include advancement of 3D printing for steel bridges, and the development of training on the inspection and testing of tunnel functional systems.

Transportation Performance Management and Asset Management

Program Description:
FHWA's TPM and TAM Program is guided by TPM/TAM Roadmap. The Roadmap lays out the implementation activities that will be accomplished in 2021-2023. Investing in these activities will support State DOTs, MPOs, other transportation partners, and industry to implement effective practices to manage the performance and condition of the highway system and with a goal to preserve our assets and minimize the whole life costs; operate in a financially sustainable manner; and provide a framework to improve performance on a long-term basis. The focus for 2023 includes advancement in State DOT processes and analysis in their Asset Management Plans as well as more comprehensive analysis leading to development of their 2023 targets. Additionally, efforts will be undertaken to advance an enhanced understanding of addressing risk and resilience, asset life-cycle planning, and the application of system performance, performance targets, and network investment strategies.

In 2023, FHWA's TPM and TAM Program will work to accomplish the activities outlined in the new TPM Implementation Plan and roadmap and will deliver to State DOTs and MPOs a range of technical assistance resources such as data and analytical tools to improve their investment decision-making related to managing system condition and performance. Additional resources and activities such as training, guidance, best practices, peer exchanges, etc., will be undertaken. The objectives of this Program directly support the U.S. DOT's Strategic Goals by improving the condition of infrastructure assets, addressing risk and network resiliency, and enable the efficient and safe movement of people and goods in an equitable manner.

Program Objectives:
Investments in 2023 will continue to support the Integrated Transportation Information Platform (ITIP) tool; improve data visualization to communicate state and national performance, and develop and deliver training and educational resources to support State and MPO implementation of TPM and Asset Management principles and practices. The program makes significant contributions toward all the USDOT Strategic Goals through the efficient investment of Federal transportation funds across national transportation goals; the increase in transparency of the Federal-aid highway program; and the improvement of program and project decision-making through performance-based planning and programming. Specific contributions are as follows. Improved investment strategies implemented for NHS bridge and pavement condition in a state-of-good-repair at the least practicable cost, for both the short and long term, and improved safety and reliability of the transportation system.

Anticipated Program Activities:
It is anticipated that the 2023 TPM & AM R&T Program will be focused on supporting the development of next generation performance measures; the advancement of benefit cost and trade off analysis tools and methodologies; more comprehensive asset life-cycle planning and risk analysis with a greater focus on system resilience; data collection,

management, analysis and integration best practices; identifying and using leading and lagging indicators to better predict and forecast condition and performance; and advancing state of the art data visualizing tools and methods to better communicate the national performance story. The application of TPM tools and data will be enhanced for DOT decision-making resulting in improved system performance

The advancement of asset management will result in more comprehensive analysis of their pavement, bridge, and other asset condition and analysis with a structures sequence of construction, preservation, and maintenance activities to have the NHS network in a state of good-repair at least practicable cost for their whole life.

Safety

Safety Program Delivery

Program Description:
Through Safety Program Delivery, FHWA assists partners and stakeholders in making the best use of the programs and services available to them to optimize their safety investments and to maximize their safety contributions to realize our shared zero vision. Safety Program Delivery provides support for the $2.6 billion Highway Safety Improvement Program (HSIP), a core Federal-aid highway program with the purpose to achieve a significant reduction in fatalities and serious injuries on all public roads. FHWA will continue to work with States to align the HSIP, and its various components, with the Safe System Approach to enable progress on meeting the five safety performance targets and long-term safety goals. The program assists States with the administration of the HSIP by building the proficiency of roadway safety professionals to understand risk factors, including those affecting disadvantaged communities, identify solutions, and effectively solve problems. FHWA will provide training, policy guidance and technical assistance to FHWA's partners and the public on proven, efficient, cost-effective safety programs and activities and encourage and support partnerships with private and public safety stakeholders. FY 2023 programs will increase a focus on assisting States in achieving safety for all road users through integrated infrastructure improvements.

Program Objective:
In 2023, FHWA will continue to conduct a coordinated Safety Program Delivery Program focused on providing guidance, policies, tools, and technical assistance to improve safety. Through the HSIP and other efforts, FHWA will continue to encourage a data-driven, performance-based approach to save lives. Efforts in 2023 will build upon the 2022 activities and ensure alignment with the DOT and FHWA's strategic plans. The main goal of Safety Program Delivery Program is to reduce the number of motor vehicle fatalities and serious injuries on our nation's roads. A focus on improving safety for vulnerable road users will help address equity considerations and provide greater low- or no emission travel options to address climate change.

Anticipated Program Activities:
To achieve its objectives in FY 2023, FHWA's Safety Program Delivery will continue assess 2021 State safety performance targets to determine which States met or made significant progress toward their safety targets. The program will provide technical assistance to help State and local agencies effectively use a Safe System Approach to manage and administer the HSIP, including Strategic Highway Safety Plans (SHSPs), Safety Performance Management, and other safety programs mandated by Congress. The program will perform program assessments, prepare annual reports, evaluate safety products and tools to identify gaps in existing safety efforts and opportunities for enhancement. FHWA will develop the annual HSIP National Summary Report to determine the aggregate number and

type of projects funded under the HSIP. FHWA will compile information to determine the aggregate number and type of projects funded under the HSIP and tell the HSIP story.

Safety Design and Operations

Program Description:
The Safety Design and Operations program encompasses core safety engineering work that overlaps traffic engineering, geometric roadway design, transportation planning, and system management and operations, and aims to help stakeholders reduce fatalities and serious injuries on all public roadways. The program focuses on roadway departure; intersection crashes; and, pedestrian/bicycle crashes; speed management; and integrating safety decision-making into project selection and delivery.

Program Objective:
In 2023, FHWA will continue to research how to improve infrastructure to reduce fatalities and serious injuries and will continue to build our knowledge base of safety improvements and fill information gaps. Efforts in 2023 will build upon the 2022 activities and ensure alignment with the DOT and FHWA's strategic plans.

Anticipated Program Activities:
The Safety Design and Operations program is leading and collaborating a number of activities in the areas of traffic engineering, geometric roadway design, transportation planning, system management and operations, vulnerable road user safety, speed management, data driven safety analysis, and connected and automated vehicles. The program provides national leadership to agencies as they design and operate roadways in order to fully integrate the needs of all users, accommodate human error, and minimize injury severity. Activities under this program include the promotion of certain infrastructure-oriented safety treatments and strategies, chosen based on proven effectiveness and benefits, to encourage widespread implementation by State, tribal, and local transportation agencies to reduce serious injuries and fatalities on American highways.

Safety Data and Analysis

Program Description:
The Safety Data and Analysis program area focuses on the use of safety data to inform highway investment decision making through a systemic safety approach based on crash experience, crash potential, crash rate, or other data-supported means. The scope of the program includes research, development, and technology to improve State and local safety data systems commonly record crash, roadway inventory, and traffic volume data, as well as integration of other data sources (such as census and health data) to improve data analysis and identify disparate safety impacts on underserved communities. The program directly supports the USDOT Strategic Safety Goal by enhancing State and local partners' capability to use safety data systems for analysis and evaluation supporting highway investment decision making to help ensure efficient and timely detection of critical safety hazards. The program also includes analyses supporting FHWA safety policy decision making, providing a foundation for systemic, performance-based approaches to improving safety. This is reinforced via the Roadway Safety Data Program, which helps States and local agencies advance their data capabilities through resource development, technical assistance, data management, training, and data analysis.

Program Objectives:
Data-driven technologies and decision making is a key theme for all FHWA programs. This is especially true for Safety. The Safety Data and Analysis Program reflects this priority for supporting highway infrastructure investment decision making. The main goal of the program 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 2023 will build upon the 2022 activities and ensure alignment with the DOT and FHWA's strategic plans.

Anticipated Program Activities:
It is anticipated that the program activities for 2023 will continue the work from 2022, and will expand research to identify and collect data to support creation of performance metrics to measure the efficacy of infrastructure in providing safety for all users at a corridor level.

The Safety Training and Analysis Center (STAC) will continue to manage development of video analytics tools that can de-identify personally identifiable information (PII) and extract data elements from video. Additionally, STAC will be expanded as a virtual lab supporting Safety Research through use of cutting-edge Artificial Intelligence and Machine Learning tools. The program will continue to explore new analysis methodologies such as interrupted time series and novel data sets such as synthetic data like the realistic artificial data.

Human Factors Analytics

Program Description:
The purpose of the Human Factors Analytics program is to better understand human behavior and the relationship between roadway users, infrastructure, and vehicles. This research looks at how people respond to highly visible, easy to read signs, improved pavement markings, vehicle automation technology, innovative operational changes, and safer streets with improved walkability. The Human Factors Analytics program includes the Highway Driving Simulator (HDS), two Field Research Vehicles, the Highway Sign Design and Research Lab (also known as the Sign Lab), the MiniSim™ driving simulator, and the Virtual Reality Lab, which includes a pedestrian and bike VR simulator.

Program Objectives:
The Human Factors Analytics program aims to: Improve the effectiveness of safety countermeasures as well as tools that promote operational efficiency; Understand how connected and automated vehicles can be safety 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 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; and, Identify how human factors for safety may guide safety programs and enable innovative approaches to improving safety.

Anticipated Program Activities:
The anticipated program activities for FY 2023 will be similar to the activities in FY 2022. The Human Factors Program will continue to lead a number of activities and collaborate in the areas of connected and automated vehicles, traffic control device design and evaluation, pedestrian and vulnerable road user safety, and enhancing and upgrading Human Factors Lab capabilities. Many of these activities focus on empirical research using human participants, that participate in studies in the Highway Driving Simulator, field research vehicles (FRVs), and sign laboratory. The work with help to promote better and safer traffic control devices and signing, increase pedestrian and bicyclist safety, and facilitate and accelerate the safe integration of emerging automated driving systems technology into our roadway system, in a manner that is safe and acceptable for all roadway users.

Operations

Transportation Systems Management and Operations

Program Description:
The U.S. has invested billions of dollars in building our existing transportation infrastructure. When these facilities are congested, the efficient movement of people and goods is disrupted, causing impacts to the economy and quality of life. Facilities need to be operated well so that we use them efficiently and effectively to maximize the value of these investments. Due to limited resources, growing customer expectations, emergence of real-time decision support systems and on-demand mobility applications, and an emphasis on performance-based programs, there is an increasing focus on TSMO in U.S. urban and rural areas, resulting in the need for alternatives to capacity projects. The need continues to grow for a transportation system that provides travel options for the effective movement of people and goods that will mitigate as 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 (smart phones, apps, GPS, etc.) progress, the traveling public expects that transportation agencies will find creative ways to apply these advances to improve their travel experience. In addition, resources have been further constrained as a result of the pandemic, so there is an even greater need to look for solutions that are lower cost and still offer a good return on investment. The TSMO R&T Program helps State and local agencies, and other partners, do that.

Program Objectives:
The overall FY 2023 Objectives are the same as the FY 2022 Objectives, with some key differences being in the implementation of the training and other products developed in FY 2022. The objectives of the TSMO R&T Program are to equip State and Local transportation agencies to effectively manage and operate the multimodal transportation system to gain the most from their existing infrastructure and technology investments. This would result in enhanced safety and mobility, reduced emissions and fuel consumption, expanded mobility services to underserved communities, economic improvement through improved passenger and freight movement. This would involve leveraging and integrating various modes, such as transit, bicycle, and pedestrian, to develop a more holistic solution to solve congestion issues and provide options for all users. This would also involve supporting the development of strong agency organizational and workforce capabilities to plan for, deploy, and manage TSMO technologies and operational strategies and strengthen the key institutional underpinnings and linkages that are needed for effective TSMO.

In addition, this program also includes ensure that the MUTCD is maintained and is updated in a timely manner to reflect current and forthcoming needs of practitioners and road users, and that it accommodates automated driving systems. Other objectives include the Road User Charge effort to develop and pilot test alternate funding mechanisms to the

gas tax for financing transportation infrastructure improvements and supporting the tolling program to ensure compliance with Section 129 and the ISRRPP.

Anticipated Program Activities:
The overall FY 2023 Objectives are the same as the FY 2022 Objectives, with some key differences being in the implementation of the training and other products developed in FY 2022. The key FY 2023 FHWA TSMO R&T Program activities will be broken up into categories. Foundation for Successful Operations continues the development of outreach and training materials and conduct targeted outreach and technology transfer to advance the state-of-the-practice and improve the capabilities of agencies for developing and delivering TSMO programs.   Data-Driven Operations Decision-Making continues the enhancement of tools and decision support systems for operational/tactical and executive/organizational TSMO decisions by adding functionality for emerging technologies.   Implementing Operations Strategies continues the development of capabilities, tools, and guidance to enable more proactive, dynamic, integrated and performance-driven management and operations to proactively advance the adoption of ATDM and ICM solutions and strategies. The STSFA Program continues the previous outreach efforts including broad dissemination of State pilot implantation results. The activities involving the MUTCD continue the development of Staff Reference Handbook; develop procedures and guidance to FHWA Divisions on reviewing and approving State MUTCDs, Supplements, and supplemental documents. Continue development of Transfigured MUTCD or Supplement for CAV.   Finally, there will be support for the tolling program to ensure compliance with Section 129 and the ISRRPP.

Automation and Connectivity

Program Description:
FHWA, in collaboration with the ITS Joint Program Office, other USDOT modes, State and local public agencies, Academia, industry, and other surface transportation stakeholders, will continue research and development efforts under the Automation and Connectivity research program to address the challenges of integrating vehicles with Automated Driving Systems (ADS) with the road infrastructure system, and to take advantage of connectivity to improve the safety, efficiency, and equity of the highway transportation system.

Program Objectives:
The objective of the Automation and Connectivity research program is to develop and assist Infrastructure Owners and Operators (IOOs) in deploying strategies and technologies to effectively integrate vehicles equipped with ADS with road infrastructure and Traffic Management Systems (TMSs). These efforts support the USDOT RD&T Strategic Goals for Safety, Climate and Sustainability, and Transformation of the surface transportation system through collaborative public/private efforts to stimulate and rapidly deploy innovation while ensuring that automation brings significant safety and environmental benefits across all sectors of the public.

Anticipated Program Activities:
Planned program efforts will continue the research and development 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

Program Description:
In FY 2023, several activities from FY 2022 will continue to complete research, development, and deployment under the Managing Disruptions to Operations program. There will be continued engagement of stakeholders, training, technology transfer and other outreach activities to better manage disruptions to operations and advance state-of-the-practice in the areas of road weather management, work zone management, traffic incident management and non-recurring event data strategic planning and framework development.

Program Objectives:
The primary objective of the Managing Disruptions to Operations program is to improve resiliency and organizational preparedness to deal with non-recurring events and associated disruptions to transportation operations. This requires specialized attention to: understanding the operational impacts of non-recurring event disruptions to develop predictive and real-time decision support systems that facilitate proactive operations; comprehending the opportunities and challenges advanced technologies, such as connected and automated vehicles, present to the program; ensuring coordination across all agencies that play a part in roadway safety and mobility; and building the capability and capacity for operating agencies to optimize safety and system performance through outreach strategies such as capability maturity models, communications strategies and technology transfer.

Anticipated Program Activities:
In FY 2023, the Managing Disruptions to Operations program will continue to actively research, develop and deploy projects in road weather management, work zone management, traffic incident management, and non-recurring event data framework management. Together, these efforts support the USDOT RD&T Strategic Goals for Safety, Economic Strength and Modernization, Equity, Climate and Sustainability, and Transformation and help provide better traveler choices and safer streets and infrastructure.

Freight Management and Operations

Program Description:
FHWA's Office of Operations Freight Management and Operations Research, Development and Technology (RD&T) Program aims to ensure safe, durable, and high performing infrastructure, identify solutions to mitigate or address the negative impacts of freight transportation, research the resiliency of the freight transportation system, and improve the physical components of the highway system that support economic strength through goods movement, including roads, bridges, pavement, parking facilities, and other components. Freight Management and Operations RD&T Research areas include freight performance management, improve the physical components of the highway system that support goods movement, assess the condition and performance of key freight infrastructure, developing data-driven tools that States/other stakeholders can use to better assess the freight system, and to provide guidance that permits States and other stakeholders to incorporate freight infrastructure improvement projects into transportation program delivery and development of State Freight Plans. Equity and inclusion topics will be given consideration as the program searches for ways to incorporate those concerns in its research and products.

Program Objectives:
The Freight Management and Operations RD&T Program seeks to better the highway system physical components - including roads, bridges, pavement, parking facilities, and other elements - that support goods movement. The program seeks to improve the reliability of travel and freight movement, assess the condition and performance of key freight infrastructure, and provide resources that permits States and other stakeholders to incorporate freight infrastructure improvement projects into transportation program delivery. Program activities will continue to support FAST Act NHFP-related goals and requirements and national policy on National Multimodal Freight Network condition, safety, security, efficiency, productivity, resiliency, and reliability. The Freight Management and Operations RD&T Program seeks to enhance a number of freight analytical tools and data resources and improve ability to measure current and future conditions and operation of the freight transportation network through the incorporation of more accurate, real-time, and localized freight data.

Anticipated Program Activities:
The Freight Management and Operations RD&T Program seeks to improve the ability to measure current and future conditions and operation of the freight transportation network through the incorporation of more accurate, real-time, and localized freight data. In FY 2023, the Freight Management and Operations RD&T Program will continue enhancing freight-focused performance measures tools, 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 and researching the resiliency of the freight transportation system through initiatives such as implementation of the recommendations of the USDOT Emergency Route Working Group. The program will continue 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.

Truck Size and Weight

Program Description:
In FY 2023, FHWA will continue to implement activities described in 2022. As in 2022, 2023 activities will include a range of research initiatives supporting effective truck size and weight use. The Truck Size and Weight (TSW) Research, Development and Technology (RD&T) Program funds initiatives to provide Congress, States, and other stakeholders with information to create safe and efficient networks and systems for freight movement across the nation and International borders. Activities will continue to address matters of safety, economic strength, and preservation of core assets.

Program Objectives:
Program objectives will be to continue and conclude (as appropriate) research initiatives started or advanced in FY 2022. TSW research primarily supports strategic goals related to improving safety and supporting economic strength and modernization. Emerging areas of focus offer opportunity to support climate solutions and reduce emissions, and generally prepare the transportation sector for technology-based/tech-driven transformation. State Pilot Car Certification solutions and bridge strike prevention initiatives are intended to reduce incidences of bridge strikes and improve safety. By preserving bridge assets, and better understanding TSW impacts on pavements and bridges, the program can support economic growth. Additionally, these solutions may yield transformational technologies. TSW research and improved tools can aid in reducing emissions, increase productivity (supporting economic growth), and lead to better protection of the environment in the effort to address climate concerns.

Anticipated Program Activities:
Key FY 2023 FHWA TSW RD&T Program Activities include those related to the Completion and Execution of FHWA Truck Size and Weight Research Implementation Plan and Analysis and Dissemination of Truck Size and Weight Data and Research. The Truck Size and Weight Research Implementation plan will continue to guide specific resources towards TSW research projects that are topically cross-cutting and impact multiple agencies and departments. As a critical area for both SMEs and as identified in the TRB Research Roadmap, Weigh-In-Motion research proceeds with further problem statement development. In addition, FHWA will produce resources to determine needed information for freight vehicle size and weight analysis and supporting harmonization and automation of State OS/OW permitting systems. FHWA is partnering with stakeholders in the US and internationally on studies to prevent bridge strikes by trucks. FHWA research on preventing bridge strike will continue by establishing a framework for collecting bridge strike data and using that data to support operational changes and develop bridge strike countermeasures.

Environment and Planning

Accelerating Project Delivery

Program Description:
In FY 2023, the Accelerating Project Delivery research program 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 program will promote capacity building for practitioners, integration of planning and environment processes, and information dissemination. It will also support implementation of FWHA's real estate acquisition program under the Uniform Act.

Program Objectives:
The main goal of the Accelerating Project Delivery program is to build tools and collaborate on studies to expedite project delivery while ensuring sound environmental stewardship, robust public participation, and compliant real property acquisition. In FY 2023 FHWA will continue to promote existing successful practices such as Planning and Environment Linkages (PEL), enhancements to integrating NEPA and permitting collaboration tool (INPCT), virtual public involvement, programmatic approaches, NEPA assignment program support and audit support, Eco-Logical, resource agency liaison program support, and the Environment Discipline Support System. The Accelerating Project Delivery program will support updates to regulation, policy, and guidance, particularly as the CEQ and other Federal agencies make reforms to their regulations. This program may also be used to meet the administration's priorities including transportation equity and climate and sustainability.

Anticipated Program Activities:
In FY 2023, Office of Planning and Environment anticipates developing new activities to meet requirements under a re-authorization act for FHWA. The current Authorization for FHWA, Fixing America's Surface Transportation (FAST Act), will end in FY 2022. FHWA anticipates that re-authorization will trigger a need for policy changes, rulemaking, guidance, and tools to meet new requirements. FHWA also expects a heightened need for research and outreach related to equity and climate change. As in past re-authorizations, our office will leverage the resources of its partner agencies to meet many of these needs, including but not limited to liaisons in other Federal departments, State agencies, and the Volpe Center in USDOT. Additionally, as appropriate, we will contract for services in the private sector to accomplish tasks that are not inherently governmental.

Performance-Based Planning and Equity

Program Description:
FHWA will continue to work with States and Metropolitan Planning Organizations (MPOs) to provide a strategic and data-driven approach to transportation decision-making that allows agencies to implement performance-based planning and programming (PBPP) while efficiently allocating limited resources, maximizing the return on investments, and achieving desired performance goals. This will also increase accountability and transparency to the public. PBPP connects performance measures and performance target levels that lead to effective data-driven transportation solutions. These measures and targets are connected through long-range transportation plans and transportation improvement programs developed at the statewide and metropolitan levels.

Program Objectives:
Implementing PBPP principles necessitates that States and MPOs develop data-driven plans, collect and maintain data, conduct studies, establish priorities, and evaluate the effectiveness of transportation improvements. FHWA will continue advocating the application of PBPP principles within the transportation planning and programming processes and work with States and MPOs to achieve desired performance outcomes for a multimodal transportation system. PBPP 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 transportation decision-making that improves transportation planning, programming, operations, and coordination. Performance-based planning and programming will also help transportation planners to evaluate and recommend strategies, projects, and programs to policymakers based on anticipated system-wide impacts and goals.

Anticipated Program Activities:
FHWA will continue to conduct research to collect quality data; analysis; and information for FHWA Divisions, States, MPOs, transportation partners, and decision-makers to use in transportation planning and decision-making processes. FHWA will continue to work with other Federal, State, and local agencies to develop methods and tools to analyze system performance to identify effective transportation solutions. This will support our strategies and activities that will advance comprehensive international, statewide, metropolitan, non-metropolitan, rural, regional, multimodal, and tribal planning processes. Other planning research initiatives that will support performance-based planning and links planning data to the National Environmental Policy Act (NEPA) includes: environmental justice, public involvement, planning for operations, safety planning, forecasting project benefits and impacts, exploratory modeling, transportation land use, and scenario planning.

Modeling and Analytical Tools

Program Description:
For FY 2023, the "Modeling and Analysis Tools" research program will continue its focus on the development and deployment of new and refined analytical tools to improve efficiencies and accuracy in support of the delivery of highway projects in consideration of the needs of the traveling public and adjacent communities. We will also continue the research on identifying new data sources to ensure necessary analyses remains up to date and protective of the environment.

Program Objectives:
The research goal is to identify, develop, and deploy technologies, tools, analysis methods, and performance management approaches 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 our communities, and stimulating economic growth.

Anticipated Program Activities:
Develop and deploy state-of-the-art models, tools, data, and methods to enhance air quality and noise analyses and to support infrastructure investment decision-making, the highway project development and 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, peer exchanges etc. 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

Program Description:
The FY 2023 Resiliency research program will continue with the same main goals as the FY 2022 program, which is to focus on the development and deployment of tools, techniques, strategies and methodologies for assessing the climate resiliency, greenhouse gas emissions, efficiency, and sustainability of transportation plans, projects and programs. However, the FY 2023 program will build on these goals in important ways. Alternative fuels research and corridor designation activities will continue to shift focus to new technology that is becoming available, particularly higher level (faster) chargers, inductive dynamic charging, and on filling in the remaining gaps in the nationwide system of alternative fuel corridors. New areas of research examining the usage of alternative fuel stations and the fuel and energy impacts of CAVs will be continued. Climate resiliency efforts will continue to focus on improving resiliency in post-disaster decision making. Efforts to institutionalize hydraulic best practices in drainage manuals and other standard design manuals at State DOTs will be continued Also, an increased emphasis on tool development, technical assistance and training to better assist State DOTs and MPOs in assessing and evaluating greenhouse gas emissions and strategies to reduce emissions.

Program Objectives:
Consistent with the program objectives of this program in FY 2022, the objectives for FY 2023 include developing and deploying tools and methods, promoting best practices and developing and delivering training to help decision makers incorporate climate change resiliency, greenhouse gas reduction and sustainability in transportation plans, projects, and programs; accelerating the adoption of electric and alternative fueled vehicles by supporting the deployment of fueling and charging infrastructure; conducting training and technical assistance to state DOTs and MPOs; conducting research on best practices, usage, behavior, stakeholder needs; and designating alternative fuel corridors; and exploring opportunities to use highway right-of-way to enhance sustainability and reduce greenhouse gas emissions, generate additional benefits and reduce costs that are consistent with operational and safety concerns.

Anticipated Program Activities:
In FY 2023, the Resiliency Program expects to build new and expanded partnerships with State DOTs and others to institutionalize hydraulic best practices standard design manuals, implement resilience improvements such as nature-based solutions, continue to improve processes, tools and methods through developmental and applied research and demonstration projects for incorporating resiliency and sustainability, update and enhance technical assistance on resilience for all stages of highway planning, design, construction, operations and maintenance, and asset management, and support expansion of alternative fuels through designation of alternative fuel corridors, technical assistance, training, and research, continuing to shift focus to new and emerging technologies. The program will also continue to explore opportunities and support deployment of alternative uses of the highway right-of-way and research and support implementation of highway construction and materials that reduce environmental impacts and emissions, and maximize material

efficiency and recycling.

Multimodal Connectivity

Program Description:
The goals of the FY 2023 Multimodal Connectivity Program support the USDOT priority areas of safety, economic strength and modernization, equity, climate and sustainability, and transformation of the transportation infrastructure as noted below.

The research program will address equity and economic inclusion by promoting equitable transportation outcomes. It will produce resources to implement a connected multimodal transportation system that provides travelers with improved innovative mobility options, particularly in underserved communities. The program will facilitate economic strength and modernization by documenting best practices of how highway investments support positive economic development outcomes, as well as the distributional effects of overall growth. Research will cover both U.S. and international examples of highways and economic development. The program will also support safety by producing resources and providing technical assistance to address multimodal conflict areas and lower the number of pedestrian and bicyclist fatalities and serious injuries. Research will address climate change impacts through production of multimodal network resiliency planning and project development resources. Research activities will support transformation of transportation infrastructure by implementing Complete Streets on a national scale and ensure system performance and modifications to the National Highway System reflect emerging social, demographic, and economic changes in the United States.

Program Objectives:
The program will promote policy and technical resources that support delivery of a nationally connected multimodal transportation system that is safe, equitable, and facilitates economic growth. The program research will help transportation agencies build capacity to support and implement an equity focused network that is resilient and integrates multiple modes of travel convenient for all transportation system users. This program will support economic growth and improve multimodal mobility options, particularly for lower income populations, minorities, and persons with disabilities.

Anticipated Program Activities:
In FY 2023, the Multimodal Connectivity RD&T Program will support the USDOT priority areas of safety, economic strength and modernization, equity, climate and sustainability, and transformation of the transportation infrastructure. The research will include activities such as pilot demonstrations, peer exchanges, state of practice synthesis, case studies, data collection tools, and development of training resources to support in-person and virtual learning in the areas of multimodal network connectivity, mobility innovation, Complete Streets, environmental justice, accessibility, context sensitive design solutions, community impact assessment, and equitable economic development.

The activities will further advance transportation equity, promote economic growth, integrate emerging mobility technology systems in transportation planning and project

development, and promote rebalancing of multimodal investments to address inequalities in underserved communities.

Policy

Policy Analysis

Program Description:
The Policy Analysis program provides decision-makers with empirically-based assessments of future transportation needs and the potential for Federal policies and strategies to effectively address those needs. This program additionally serves as its economic hub for implementing OMB and OST standards for assessing grant, regulatory, and policy cost effectiveness.   The program is broken down into seven key focus areas: A) Conditions and Performance Forecasting; B) Transportation and the Economy; C) Benefit Cost Analysis; D) Highway Costs and Funding Options; E) Emerging Trends and Future Demand; F) Transportation Options Analysis; and G) Policy Development. This research supports the development of policy analyses and analytical tools for assessing the value and cost effectiveness of highway investments; forecasting future highway conditions and performance under various travel and infrastructure funding scenarios; developing the biennial Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance Report to Congress (C&P Report); evaluating the impacts of highway investments on communities, individual economic sectors, and national economic indicators such as gross domestic product (GDP) and employment; conducting economic regulatory impact analyses (RIA) for significant rulemakings; evaluating changing travel patterns and needs across socio-demographic, income, and regional users, including the differing impacts of highway policies across different types of rural and urban communities; assessing highway construction costs and inflation; analyzing vehicle miles traveled (VMT) and other highway revenue sources, their impacts on users, and their relationship to vehicle impacts on highways, congestion, and emissions; and support the FHWA Policy Symposia series and Emerging Trends Symposia series.

Program Objectives:
New research in the Transportation and the Economy focus area will support the Equity goal by enhancing the USAGE-Hwy general equilibrium model to disaggregate households by income levels and geography. A new initiative to improve the External Costs of Highway Users Analytical Tool (ECAT), will contribute to Transformation by providing a quantitative basis for evaluating negative societal impacts associated with infrastructure investment. FY 2023 would be the final year of the 5-year GEMS development effort, aimed at evaluating alternative uses of highway rights-of-way for transit, walking, biking, and other modal uses beyond private occupancy vehicles, providing a valuable tool for analysis of policy options associated with the Transformation goal.

Anticipated Program Activities:
A significant portion of the resources directed to this program area would support continuations of core model development and research activities initiated in prior years. Two new efforts would be initiated within the Conditions and Performance Forecasting focus area, including the recalibration of the NBIAS software using NBI element level data for more accurate analyses and reporting, and NBI element level data calibration for more

accurate analyses and reporting, and updates to the HERS cost matrix including resiliency costs and costs associated with complete streets conversions. Two new efforts would be initiated within the Transportation and the Economy focus area, one focused on enhancing the USAGE-hwy model, and the other on evaluating the impacts of highway investments on urban sprawl and induced travel demand. A new study in the Highway Costs and Funding Options focus area would update, expand the coverage, improve methodologies, and enhance the model structure and user interface of the External Costs of Highway Users Analytical Tool (ECAT). New efforts in the Emerging Trends and Future Demand focus area would involve accounting for significant emerging trends in travel demand forecasts and developing improved methods for "what if" analysis and analysis of alternatives to support policy and decision making. Work in the Transportation Options Analysis focus area would emphasize the development of the final interactive GEMS tool, and piloting GEMS for selected policy analyses (such as complete streets).

Global Outreach

Program Description:
In FY 2023, the Global Outreach Program will continue to gather, promote, and disseminate global policy, best practices, and technical innovations to ensure a safe and efficient U.S. Highway transportation infrastructure. Three main international program elements, Global Benchmarking, Multinational, and Binational, will facilitate the exchange of innovative ideas, best practices, and technologies that can have a direct and practical impact on improving the highway system.

Program Objectives:
The Global Benchmarking Program (GBP) will continue its mission of obtaining and adapting foreign innovations that directly support DOT and agency priorities, initiatives, and critical RD&T areas. The GBP will facilitate the acquisition and adoption of technologies and best practices already available and used abroad. In FY 2023, the Office of International Programs through the Binational Relations Program, will continue its work with FHWA Leadership, FHWA Program Offices, and the Office of the Secretary of Transportation to ensure that international topics and activities are geared to the DOT and agency priorities and initiatives. In FY 2023, the specific areas addressed by each binational relationship will depend the interests of our partners, both internal and international. Expected topics include climate change and infrastructure resilience, connected and automated vehicles, bridge and seismic issues, safety, and green procurement, among others. In FY 2023, the Multinational Relations Program will continue to support domestic dissemination of the technical work produced by the World Road Association technical committees and task forces.

Anticipated Program Activities:
For the Global Benchmarking Program, FY 2023 work will focus on coordinating two new studies as determined by FHWA leadership, as well as follow up implementation activities related to the FY 2019-2022 studies. For the Binational Relations Program, a U.S.-Korea Roads Workshop will take place in FY 2023. Furthermore, professional exchanges are anticipated in FY 2023 as well. Other types of exchanges, including webinars and on-site visits, will also take place in relation to climate change, bridges, safety, connected and automated vehicles, and other topics. For the Multinational Relations Program, the FHWA will focus on the technical committees and task forces for the 2020-2023 work cycle.   As in the past, the expectation is that the U.S. will continue to influence the technical work produced by the Association's technical committees and task forces with the support of U.S. representatives. It will also provide support to FHWA's Executive Director and Director of International Programs' participation in the Association's governing bodies and to U.S. representatives to the Association's technical committees and task forces as they prepare to launch products of the 2020-2023 cycle that will be presented at the World Road Congress to be held in Prague, Czech Republic in October 2-6, 2023.

Highway Data and Information

Program Description:
The Highway Data and Information (HDI) program is a set of initiatives to collect, process, analyze, model, visualize and disseminate data and information by working with State, local transportation agencies, private businesses, and research communities through an active and advanced RD&T program. The HDI program offers a national perspective on the state of our highway transportation system through coverage of 1) State, local, and federal highway financing information, registered vehicles, licensed drivers, and fuel consumption, 2) travel condition (vehicle type, # of vehicles, vehicle speed, truck weights on the road by hour of the day, day of the week, and month of the year), 3) travel migration (both passenger and truck travel origins destinations by travel purpose), 4) infrastructure condition (pavement condition and overall congestion), 5) infrastructure inventory (length by various dimensions), and 6) future travel demand (projection). The HDI program enables an efficient, effective, nationally consistent, and affordable data program by developing and deploying new methods, new approaches, new analytics, and new models for Federal, State, and local governmental agencies and private businesses to adopt and use.

Program Objectives:
The goal of FHWA HDI program is to serve the needs of national surface transportation data both within and outside of the USDOT. It provides the USDOT, Congress, and the transportation community with quality information in a timely manner for the development and implementation of programs, policies, and legislation. The HDI's RD&T effort strives to improve the efficiency and effectiveness of data collection and analysis on travelers and the physical, operational, and financial conditions of our highway transportation system. Specifically, the HDI offers insight into (a) Safety strategy development in areas of human factors and behavior, (b) racial equity through HDI's quality data, c) climate issue with past, present, and future data, d) equitable economic strength through accelerated project delivery, risk-based asset management, and system resilience, and e) transformation through innovation in areas of technology transfer, technology deployment, and data. In addition, the HDI provides national leadership on transportation data through the development of national specifications and guidance with ongoing support and training for State data providers as well as internal and external customers. The program's research addresses weaknesses and gaps in relevant technologies, knowledge, and analyses due to a lack of capabilities and/or interest from private entities.

Anticipated Program Activities:
The FY 2023 HDI program will continue its path of collecting data, developing new methods and analytics, and offering technical training and assistance promptly with a renewed emphasis on cost-effectiveness. The 500 Series Data activity will continue to advance program and process improvement efforts by automating data collection and data quality control processes and developing and disseminating guidance. The PIDP program

will continue the deployment of forms with improved analytics to reduce respondents' burden. The HPMS program will be focused on the full deployment of its V9.0 software, where States can submit data with reliability and speed needs. The HPMS program will also continue to deliver the training to States on the usage of the HPMS v9 system. The Integrated Transportation Information Platform program will be deployed to FHWA division offices. The Data Visualization Center (DVC) will explore more efficient and effective ways to provide agency-wide service on data visualization. The traffic monitoring program will continue the weekly and monthly traffic data collection and processing. In addition, the traffic monitoring program will update its vehicle miles traveled forecasting tool to reflect Post the COVID-19 travel behavior changes. The National Household Travel Survey (NHTS) will deliver the 2021 core data and the 2022 origin-destination data. The National Performance Dataset (NPD) will seek to integrate and disseminate quality travel time data to support the Transportation Performance Management needs. Partnerships with private businesses and industries will be explored to achieve the data goal. Research activities will be focused on big data and big data analytics to derive such data vs. traditional data collection methods, which are through installing sensors on the highway.

Transportation Workforce Development and Technology

Every Day Counts Program

Program Description:
The Every Day Counts (EDC) Program is a State- and Local-based Program that identifies and rapidly deploys proven, yet underutilized innovations to enhance roadway safety, shorten the project delivery process, reduce roadway congestion, and integrate automation. Proven innovations promoted through EDC facilitate greater efficiency at the State and local levels, saving time, money, and resources that can be used to deliver more projects.

Program Objectives:
The primary objective is the continuation of the Program in FY 2023 with the identification and rollout of a portfolio of topics that support of the strategic goals and mission of the Agency and Department.

Anticipated Program Activities:
As deployment of the EDC-6 initiatives concludes in December 2022, launch of the next cycle of the Program is expected to occur in the Fall of 2022 with deployment activities commencing January 2023.

State Transportation Innovation Council (STIC) Incentive Program

Program Description

The FHWA STIC Incentive program provides resources to help foster a culture for innovation and make innovations standard practice in their States. Through the Program, funding up to $100,000 per State per Federal fiscal year is made available to support or offset the costs of standardizing innovative practices in a State transportation agency or other public sector STIC stakeholder

Program Objectives

The STIC Incentive Program provides resources to advance innovations into standard practices in a State transportation agency or other public-sector stakeholder and foster a culture of innovation. FHWA intends to continue the STIC Incentive program in FY 2023 and continue to support a nationwide culture of innovation through the National STIC Network.

Anticipated Program Activities:

Key FY 2023 program activities for the STIC Incentive program include awarding projects commensurate with the funding available for the Program; continued national-level outreach and stakeholder engagement with the National STIC Network thru no fewer than two virtual meetings (typically Fall and Spring during the FY); and conduct of the 2023 STIC Excellence Awards Program in partnership with the AASHTO Innovation Initiative.

Accelerated Innovation Deployment (AID) Demonstration Program

Program Description:
The AID Demonstration Program provides funding to State DOTs, federal land management agencies, tribal governments, metropolitan planning organizations, and local governments to offset the risks associated with the initial deployment of an innovation by that agency. The Program supports the pilot/demonstration of innovations on projects; funding recipient reports on experiences and lessons learned from each innovation deployment are shared to provide technology transfer opportunities.

Program Objectives:
FHWA intends to continue the AID Demonstration program in FY 2023. This program impacts and is of benefit to transportation agencies throughout the nation. It is anticipated that the Program will be leveraged to support and advance the Agency's and Department's Strategic Goals.

Anticipated Program Activities:
The key FY 2023 program activity is the continued award of grants based on the AID Demonstration program applications received and commensurate with the funding available for the Program.

Accelerating Market Readiness (AMR) Program

Program Description:
The Accelerating Market Readiness (AMR) Program supports promising innovations that have the potential to be considered for accelerated deployment. The AMR program provides resources for the rapid, national assessment of emerging innovations and the development of objective, written documentation of these assessments. The AMR Program is intended to help advance the innovations to a more complete market-ready status, which in turn should accelerate the adoption of the innovations by transportation agencies under the EDC Program or by other initiatives.

Program Objectives:
The AMR program 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. The innovations to be supported by AMR program resources are those that significantly advance conventional practice; address knowledge and technology gaps; significantly advance the state-of-the-art; or constitute a sea change in the development and delivery of transportation projects and programs.

Anticipated Program Activities:
The key FY 2023 program activity is the continued award of grants based on the AMR program applications received through Broad Agency Announcements and commensurate with the funding available for the Program. Because FY 2023 also will be the timetable when final results from first BAA awards made in May 2021 will be documented, another key activity will be sharing these findings and lessons learned with the greater transportation community.

Innovative Finance

Innovative Finance

Program Description:
Innovative Finance (IF) provides tools, training and technical assistance that support the transportation community's use of cutting-edge financial and procurement strategies to deliver critical infrastructure projects. FHWA's efforts in this area are primarily led by the Center for Innovative Finance Support (CIFS), whose products are often marketed and delivered in coordination with the DOT's Build America Bureau. These research and technology deployment efforts focus on revenue generation (tolling and value capture), procurement (public-private partnerships (P3s) and other alternative contracting methods), and innovative finance (Federal project finance tools such as GARVEE Bonds and State Infrastructure Banks). Support for our partners include: (1) technical resources, guidebooks, and analytical tools; (2) capacity building and outreach; and (3) technical assistance for project implementation.

Program Objectives:
The Innovative Finance program begins with the recognition that public infrastructure resources at all levels of government are continually under stress, and thus demand effective project finance and delivery practices. These practices, in turn, must constantly evolve to exploit the opportunities of a dynamic economy. Given the sprawling number of public agencies in the United States, a potential "market failure" exists each time a project sponsor fails to look beyond its local environs for beneficial new practices. Federally-sponsored research and technology (R&T) deployment can open State and local jurisdictions to opportunities tested elsewhere by their peers. Specific objectives that require R&T support include consideration of innovative finance project revenue options, such as user fees and value capture, via research, training and technical assistance; consideration of the P3 delivery option for major projects by providing the U.S. transportation community with the most complete, up-to-date body of knowledge on P3s; and supporting the accrual of P3 knowledge by industry practitioners and advisors in the areas of planning/evaluation, procurement, and monitoring/oversight.

Anticipated Program Activities:
Anticipated Innovative Finance activities in FY 2023 include Rural Projects/SIBs where, project-specific assistance is provided to public sponsors seeking access to Transportation Infrastructure Finance and Innovation Act (TIFIA) credit assistance for rural infrastructure projects; Rural Electric Vehicle (EV) Charging, which provides technical assistance to public and private entities seeking to provide EV charging stations to rural locations; public policy research into potential organizational structures for newly-established P3 offices within State DOTs; P3, value capture, and project finance training; Project Delivery Benchmarking, as required by the FAST Act; and a Center for Excellence in Project Finance (CEPF).

Research Infrastructure, Technology Transfer, and Partnerships

Program Description:
The FHWA Research Infrastructure, Technology Transfer, and Partnerships Program supports the goals of the USDOT Strategic Plan by supporting 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 the Turner Fairbank Highway Research Center, organizes strategic Research and Technology (R&T) investment, and provides marketing and communications. This Program also supports the FHWA Office of Technical Resources and the FHWA Resource Center's technology transfer activities. FHWA's Office of Research, Development, and Technology is located at the Turner Fairbank Highway Research Center (TFHRC), a federally owned and operated national research facility in McLean, Virginia. At the TFHRC, staff conducts research and development activities in the areas of infrastructure, operations, and safety. Research in areas of Intelligent Transportation Systems (ITS), policy, innovative finance, planning, and the environment is conducted or administered by FHWA offices located at USDOT Headquarters.

Program Objectives:
The primary role of the Research Infrastructure, Technology Transfer, and Partnerships Program is to provide leadership, coordination, and support in the administration of the FHWA R&T program in support of the USDOT Strategic Goals. To accomplish this 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.

Additionally, the Research Infrastructure, Technology Transfer, and Partnerships Program will maintain and support the operation of the TFHRC. The highway research and development relating to emerging highway technology that occurs at TFHRC is focused on addressing research gaps not addressed by FHWA's partners. TFHRC specifically focuses on long-term, high-risk research to improve the materials used in highway infrastructure; the development of tools and techniques that provide solutions to complex technical problems; and the development of innovative highway products and practices. The program also invests in new research infrastructure to support research in emerging areas such as efforts to create capabilities for advanced research data analytics to enable novel methods to assess transportation issues.

Anticipated Program Activities:
The Research Infrastructure, Technology Transfer, and Partnerships Program will continue to provide services to the overall R&T program. These include R&T Program support and administration to develop and execute the R&T program strategic direction, policies, and

budget to further USDOT and FHWA initiatives; communications, publishing, and marketing services; development of publications, periodicals, and technical reports; administration of the TFHRC laboratory capacity building efforts; continue the R&T Evaluation Program; Transportation Pooled Fund Program; coordinate with domestic and international partnerships; and provide knowledge management for the FHWA RD&T program.

Small Business Innovation Research

Small Business Innovation Research

Program Description:
The SBIR program is a highly competitive, awards-based program that encourages domestic small businesses to engage in research and development addressing high priority research areas within USDOT. The SBIR program 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. The program is administered by the Volpe Transportation Center. The SBIR Program Office publishes one or two solicitations each fiscal year for proposals on specific research topics of interest to USDOT operating administrations, including the FHWA.

Program Objectives:
To encourage small businesses to engage in research and development (R&D) that has the potential for commercialization and meets federal R&D objectives. The SBIR program is uniquely positioned to support both the interests of FHWA as well as the small business. In this respect, the SBIR programs aims to provide essential funding to small businesses with aim toward commercialization of products that align with FHWA and Departmental Strategic goals. Given that the SBIR program is available to all FHWA RD&T programs, all USDOT Strategic goals are supported as a result.

The SBIR program offers unique services to the small businesses to aid in their technical and commercial development. Specifically, the SBIR program offers a Technical and Business Assistance program to provide consulting services to the SBIR participants to help conduct market research, commercialization plans, and other services. In addition, in FY 2023 the FHWA SBIR program will continue with a Technology Readiness Level (TRL) assessment program to help the Small Businesses conduct an independent assessment of the technological status of the innovations developed through the SBIR program.

Anticipated Program Activities:
FHWA will continue to support an annual solicitation of new Phase I topics and will support the most promising solutions through Phases II and IIB when a path to commercialization exists and if the impact of the innovation aligns with USDOT Strategic Goals. Additionally, FHWA will continue to utilize the TRL assessment process as a tool for determining next steps and technological maturity.

Exploratory Advanced Research

Exploratory Advanced Research

Program Description:
The EAR Program addresses the need for longer-term, higher-risk research in highway transportation. Funding of exploratory advanced research has a direct impact on 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 Program applies proven deliberative and open processes to engage experts within and outside the Department to identify potential research topics among new discoveries in science and technology that may address current and emerging needs of the highway transportation industry.

Program Objectives:
The EAR Program conducts extensive investigations across disciplines and program to identify three or four topic areas where a government investment has the potential for transformative results. The Program conducts regular screening of results and supports active efforts to transition results that demonstrate high potential to applied research programs. The Program engages experts inside and outside government to ensure efforts reflect the most recent advances in science and technology.

Anticipated Program Activities:
The EAR Program plans to support research that can transition from basic advances in science and technology towards transformations in transportation practice across different areas – materials science, connected systems, human behavior, and new technologies for assessing performance.

Designated Grant Programs

Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) Program

Program Description:
The Advanced Transportation and Congestion Management Technologies Deployment Initiative (ATCMTD) Program is intended to provide funding for eligible entities to develop model deployment sites for large scale implementation and operation of a diverse set of technologies in various geographic regions. As the program is aimed at the rapid deployment of advanced technologies, limited expenditures for infrastructure construction is anticipated in grant application. The stated purpose is to reduce costs and improve return on investments; deliver environmental benefits through increased mobility; enhance transportation system operations; increase safety; improve collection and dissemination of real-time information; monitor transportation assets; deliver economic benefits; and accelerate deployment of connected and autonomous vehicle technologies. Successful proposals will contain quantifiable system performance objectives, use innovative technologies and strategies, and a plan for long term operation and maintenance of the deployed technologies. DOT encourages partnering among the private sector, public agencies, research institutions, technology leaders, and other transportation stakeholders is encouraged.

Program Objectives:
The DOT's vision for the ATCMTD initiative is the deployment of advanced technologies and related strategies to address issues and challenges in safety, mobility, sustainability, economic vitality, and air quality that are confronted by transportation systems owners and operators. The advanced technologies are integrated into the routine functions of the location or jurisdiction and play a critical role in helping agencies and the public address their challenges. Management systems within transportation and across other sectors (e.g., human services, energy, and logistics) share information and data to communicate among agencies and with the public. These management systems provide benefits by maximizing efficiencies based on the intelligent management of assets and the sharing of information using integrated technology solutions. USDOT shares the advanced technology solutions and the lessons learned from their deployment with other locations, scaled in scope and size, to increase successful deployments and provide widespread benefits to the public and agencies.

Program activities will consist of the selection of FY 2022 ATCMTD grant awards which would prompt working with the Divisions and grant recipients to ensure cooperative agreements are executed and projects are obligated. Simultaneously, program oversight will continue for FY16 -FY21 ensuring that grant recipients are providing quality deliverables and that each project is meeting goals and objectives.

Surface Transportation System Funding Alternatives

Program Description:
The STSFA Program purpose is to provide grants to States to demonstrate user based alternative revenue mechanisms that utilize a user fee structure to maintain the long-term solvency of the Highway Trust Fund.

Program Objectives:
Test the design, implementation, and acceptance of functional future user-based alternative revenue mechanisms that minimize administrative costs, increase public awareness of the need for and possible approaches for alternative funding sources for surface transportation programs, and to provide recommendations on various approaches.

Anticipated Program Activities:
The program seeks to identify strategies that will reduce operation and administrative costs and improve return on investments. Demonstrate how charging by the mile reveals to users how much they drive, which could influence driver behavior. Current research suggests that if people pay attention to the number of miles they drive it could lead to some people driving less which is an environmental benefit that alleviates congestion and streamlines traffic flow and improves travel which reduces crash risks. Strategies explore innovation as pilots utilize a variety of mileage-based user fee technologies to collect data and identify payment options.

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