United States Department of Transportation
Annual Modal Research Plans FY 2023
Program Outlook FY 2024

National Highway Traffic Safety Administration
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Office of Vehicle Safety Research
Associate Administrator, Cem Hatipoglu

Office of Behavioral Safety Research
Associate Administrator, Nanda Srinivasan

Executive Summary

Introduction

The National Highway Traffic Safety Administration (NHTSA) was established by the Highway Safety Act of 1970, as the successor to the National Highway Safety Bureau, to carry out safety programs under the National Traffic and Motor Vehicle Safety Act of 1966 and the Highway Safety Act of 1966. NHTSA works every day to help Americans drive, ride, and walk safely. The Agency does this by promoting vehicle safety innovations, identifying vehicle safety defects, setting safety standards for cars, trucks, buses, motorcycles, and other motor vehicle equipment, establishing guidance, and educating Americans to help them make safer choices. Throughout its more than 50-year history, NHTSA has remained grounded in data, scientific research, and sound engineering to fulfill its mission to save lives, prevent injuries, and reduce economic costs due to road traffic crashes through education, research, safety standards, and enforcement. Both vehicle safety and behavioral safety research, are critical components in supporting NHTSA policy decisions and programs. NHTSA performs a wide array of studies, producing scientific findings and data to inform the Agency's safety programs and identify countermeasures that have led to hundreds of thousands of lives saved on our Nation's roadways throughout its existence.[1] Increasingly, and reflected in this fiscal year (FY) 2023 AMRP and 2024 Program Outlook, research efforts are mindful of the need to address the increasing numbers of vulnerable road user fatalities, identification and evaluation of disparities in crash safety, and meet the needs of underserved populations more broadly in our programs.

The Bipartisan Infrastructure Law (BIL) is helping to accelerate the transition to a safer, more environmentally friendly, equitable transportation system. In turn, this will help maintain the U.S.'s economic strength and global competitiveness.

NHTSA Research and DOT Strategic Goals

NHTSA contains two main safety research offices: Vehicle Safety Research (VSR) and Behavioral Safety Research (BSR).[2] NHTSA's research programs support the U.S. Department of Transportation's (USDOT's) programmatic strategic goals and objectives established under its FY2022-2026 Strategic Plan of Safety, Economic Strength and Global Competitiveness, Equity, Climate and Sustainability, and Transformation.[3] While contributing to each of these strategic goals, NHTSA's research primarily focuses on the strategic goal of safety.

Additionally, NHTSA conducts research to assess equity and associated barriers, as well as improve data related to equity, particularly for those in communities of color, underrepresented communities, and people with disabilities. Equity considerations are considered and addressed

[1] http://www-nrd.nhtsa.dot.gov/Pubs/812069.pdf
[2] BSR is within NHTSA's Office of Research and Program Development.
[3] See https://www.transportation.gov/mission/us-dot-strategic-plan-fy-2022-2026

throughout the process. In addition, transformative research on the development of advanced safety technologies, including advanced driver assistance systems (ADAS), Automated Driving Systems (ADS), and scientific advancements to prevent impaired driving, have the potential to save thousands of lives every year.

NHTSA accomplishes its safety mission by continuously assessing alternative approaches and technologies that could expedite life-saving improvements in vehicles. As new vehicle designs and technologies are under development and introduced into the market, the VSR research program evaluates their safety enhancing potential. Likewise, when a potential real-world safety need is identified for a new Federal motor vehicle safety standard (FMVSS), NHTSA conducts research to understand the safety need in detail, develops and/or evaluates safety countermeasures, and establishes objective, repeatable, and reproducible performance tests that aim to address safety needs.

In addition to the FY 2022 – FY 2026 USDOT Strategic Plan, in January 2022, the Department released the National Roadway Safety Strategy (NRSS),[4] embracing the Safe System Approach. This approach puts people first – where the system serves the needs of its users. NHTSA and USDOT adopted the Safe System Approach, as well as State and local governments across the country. It establishes a framework for safe road users, safe roads, safe speeds, safe vehicles, and effective post-crash care with the goal of achieving zero traffic-related deaths and serious injuries.

Critical RD&T Programs

VSR and BSR share the mission to provide national leadership in planning, implementing, and communicating research programs to continually further NHTSA's goals in the reduction of crashes, fatalities, and injuries. NHTSA's research targets all motor vehicle classes and associated original equipment, including heavy and light trucks, light passenger vehicles, buses, multi-purpose passenger vehicles, low-speed vehicles, and motorcycles, as well as alternative fuel vehicle platforms (e.g., electric vehicles).

Consistent with the USDOT's strategic goals, NHTSA's FY 2023 research plans prioritize vulnerable road user safety, including pedestrians, bicyclists, motorcyclists, and people with disabilities. The broad scope of research activities supports USDOT safety goals, which include researching emerging technology, as well as conventional safety systems including driver controls, tires, lighting, and occupant and nonoccupant (e.g., pedestrian) crash protection systems. The Agency's work spans the full crash timeline, including crash avoidance, crash energy mitigation and injury reduction, and post-crash safety. NHTSA conducts crash data analyses, monitors market trends, evaluates countermeasures, develops test procedures, and engages in extensive stakeholder outreach and feedback to identify priority safety areas and

[4] See https://www.transportation.gov/NRSS

potential emerging safety risks and opportunities related to motor vehicles and motor vehicle equipment.

VSR's Vehicle Research and Test Center (VRTC), located in East Liberty, Ohio, conducts applied research in support of USDOT programs and goals to reduce crashes, fatalities, and injuries on the nation's roadways. This is accomplished by supporting the Agency's policy decisions and regulatory agenda, safety defect investigations, developing performance test metrics and methods for existing and new vehicle technologies, providing quick engineering assessments of urgent concerns, such as newly reported cyber vulnerabilities, and other applied research.

In FY 2023, major VSR research areas will focus around: vehicle electronics and cybersecurity, Automated Driving Systems (ADS), advanced safety technologies which includes heavy vehicle technologies, crashworthiness research which includes human injury mechanisms, and alternative fuels safety.

FY 2023 research will focus on a variety of areas pertaining to ADAS system performance characterization that have potential to reduce light and heavy vehicle crashes with other vehicles, as well as injuries and fatalities involving vulnerable road users such as pedestrians, pedal-cyclists, and motorcyclists. ADAS efforts will involve exploring critical studies to understand human interactions with vehicle technologies, identify accessibility considerations, conduct system performance studies, and conduct test track research to develop test procedures and performance criteria. Research will also support functional safety of vehicle electronics, investigate new methods and tools to assess vehicle cybersecurity, address ADS research needs by researching ADS safety assessment methods and metrics as well as developing tools and simulation models to support ADS alternative seating design safety.

Crashworthiness research will further include enhancing occupant protection for current and future vehicle designs, crash testing to support Agency regulatory efforts, crash test dummy development and testing, studies to quantify and address female injury risk, and safety considerations for alternative fuel technologies. Funding will also allow NHTSA to enhance and expand its testing capabilities for electric vehicles and vehicles equipped with advanced technologies at VRTC.

For FY 2024, VSR's major research areas will continue with an emphasis on electrification, electromagnetic interference/compatibility, transportation equity considerations in the development of research projects (e.g., safety evaluation studies, test procedures, and crash test dummies), accessibility and inclusiveness, distraction, and vulnerable road user safety. New projects will continue to address open safety research questions, emerging trends, and support the execution of Agency priorities. VSR also plans on expanding the capabilities of its applied research lab – VRTC.

Highway safety research provides an evidence-based foundation for State and community traffic safety programs. One objective of BSR is to improve State-based safety programs carried out under the Highway Safety Grant (23 U.S.C. 402) and the National Priority Safety Grant (23 U.S.C. 405) programs. The research program is designed to find effective ways to influence the behavior of drivers and other roadway users to increase safe behavior (e.g., seat belt use, child seat use, protective gear use by motorcycle riders), as well as reduce unsafe behavior (e.g., alcohol- and drug-impaired driving, texting, speeding) that are critical to prevent motor vehicle crashes, deaths, and injuries.

BSR focuses on unsafe driving behaviors that contribute significantly to death and injury from crashes on the Nation's roadways, thus supporting Department and Agency safety goals. BSR assesses existing and emerging highway safety problems and conducts evaluation research to document the relative effectiveness of programs to reduce motor vehicle fatalities and injuries. Results are distributed to the States to use in identifying effective traffic safety countermeasures for implementation under various grant programs.

In FY 2023, BSR plans to focus on four priority areas: preventing alcohol- and drug-impaired driving, improving pedestrian safety, preventing distracted driving, and improving novice driver safety. BSR will continue to collaborate with VSR's Automated Driving Systems and Advanced Safety Technologies research programs to address human factors issues including behavioral adaptation and child-specific safety considerations related to vehicle technologies. Examples of these issues include the use of child restraint systems in shared mobility situations and human factors concerns involving unattended children in ADS-equipped vehicles.

Likewise, BSR will further its efforts to identify more effective and efficient countermeasures for existing traffic risks such as speeding, nonuse of seat belts, nonuse and misuse of child restraint systems, and develop new solutions for emerging and resurgent problems.

In FY 2024, BSR will use problem identification and research needs to determine emphasis areas. Continued efforts are expected in preventing drug-impaired driving and addressing the effects of new technologies on behavioral safety. In these emphasis areas, BSR plans to conduct foundational research to understand the nature or scope of the problem, developmental research that helps refine the delivery of solutions, and a hybrid that combines research into big ideas and potential ways to develop those ideas into safety programs.

Collaboration Efforts

NHTSA's research programs primarily produce technical reports, data, information, and tools for use by the Agency, motor vehicle equipment suppliers, motor vehicle manufacturers, the technology industry, test facility operators, test equipment developers, academia, consumer organizations, State, local, and tribal governments, as well as other Federal agencies. With

electrification and driving automation at the forefront of the automotive industry, battery and technology companies have become increasingly prominent stakeholders. The role of safety on top of the technical complexities of vehicle integration may present unfamiliar challenges for some of the new entrants.

NHTSA works closely with stakeholders in academia, which use the Agency's information to conduct complementary research or develop new materials, test methods, or test devices. Consumer organizations incorporate the Agency's research into their own programs in order to deliver safety messages, improve information to the public, and incorporate NHTSA research outcomes into strong strategic programs. State, local, and tribal governments may use information to make decisions, such as whether or how to allow for testing of ADS-equipped vehicles on their roadways.

Research products are also used within NHTSA to support continued efforts in rulemaking and consumer information programs, to support data-driven policy decisions, to deliver equitable safety benefits to the public, and in effective safety program development. They are similarly used within other agencies for supporting research and implementing policies, practices, and standards development.

VSR activities often result in the development of test procedures, test devices and injury criteria used industry-wide for crash testing, as well as standardized performance tests and technology evaluations that either lead to improved safety and performance or provide the means to further encourage promising safety advancements. VSR research activities have also resulted in voluntary guidance and best practices for industry to utilize, as well as research to inform Agency policy decisions for nascent innovation and futuristic technological safety advancements.

BSR primarily produces information and programs for use by States, communities, and nongovernmental organizations that have a direct role in implementing traffic safety programs. It provides information to these users on emerging highway safety problems and effective and promising traffic safety countermeasures for implementation through the Highway Safety Grant (23 U.S.C. 402) and National Priority Safety Grant (23 U.S.C. 405) programs.

NHTSA also partners and coordinates with other USDOT modal agencies, such as the Federal Highway Administration (FHWA), the Federal Motor Carrier Safety Administration (FMCSA), and the Federal Transit Administration (FTA), on research activities that have multimodal applications. Other specific collaboration efforts are detailed under individual program areas.

Evaluation and Performance Measurement

Performance measures are set for each specific project and are reviewed throughout the lifecycle of the project. NHTSA's research offices work with the Agency's Offices of Government Affairs and Strategic Planning and Budget to set performance goals and indicators that align with the Government Performance and Results Modernization Act of 2010 (GPRA Modernization Act). These are living documents that are updated annually, and targets are usually set for the next 3-5 years and revisited and revised as necessary based on performance data and trends, with documentation to explain any changes. These are then reflected in all Agency planning and reporting documents (e.g., budget submissions, strategic and performance plans, etc.). Longer term (5-10 years) performance measures are usually set as Department/Agency visionary goals.

The Agency also actively participates in the Departmental Evaluation/Performance Measurement Working group to monitor and evaluate the contribution of research, development, and technology activities toward the achievement of USDOT strategic goals and objectives, such as equity and climate solutions.

When new vehicle safety countermeasures are developed by the Agency through regulation, NHTSA's National Center for Statistics and Analysis (NCSA) typically performs a retrospective review of Agency regulatory actions to assess the real-world effectiveness. The number of injuries/fatalities due to motor vehicle crashes are part of USDOT's and NHTSA's short- and long-term performance metrics.

Similarly, for traffic safety countermeasures, NHTSA continuously monitors whether States and communities adopt programs it has identified as successful and through program evaluations. The Agency further reviews the programs post-implementation to verify that safety increases are achieved. These program evaluations, as well as evaluations conducted by others, inform the effectiveness ratings in *Countermeasures That Work: A Highway Safety Countermeasure Guide for State Highway Safety Offices*. Now on its 10th Edition, *Countermeasures That Work* is a basic reference guide to assist State Highway Safety offices in selecting effective, evidence-based, behavioral strategies for traffic safety problem areas. Likewise, the Agency continually monitors traffic safety for emerging issues, including seeking input from NHTSA regional offices, State highway safety offices, and nongovernmental stakeholder organizations such as Transportation Research Board standing committees. This information is used by the Agency to develop new programs or to modify current programs and practices to increase efficiency and effectiveness, as well as to address emerging trends.

Additionally, in assessing behavioral changes, including seat belt use, correct child safety seat use, speeding, hand-held mobile phone use, as well as others, the Agency often conducts observations to measure behaviors before and after program implementation. In other cases, the Agency measures the change in the number of crashes that occur after a program is implemented.

At the Departmental level, surface transportation safety is measured through its annual overall outcome performance measures of reducing the fatality rates of passenger vehicle occupants, non-occupants (pedestrians and bicyclists), motorcycle riders, and large truck and bus occupants. NHTSA tracks and reports on these outcome measures through data collected by the NCSA. NHTSA's research offices do not individually track such performance measures. Tracking and reporting are conducted in coordination with OST.

On a routine basis, OST meets with each modal administration to review its progress toward meeting performance targets and indicators under its internal Performance Management Review process. The Agency uses this channel to discuss trends that may impact meeting strategic goals, objectives, and planned approaches. NHTSA completes near-term estimates for the effectiveness of new programs in reducing injuries and fatalities for the associated crash/road user types. Long-term, NHTSA also completes retrospective regulatory analyses to evaluate the actual effectiveness of programs (generally about 10 years after introduction to allow for fleet penetration and for the collection of sufficient field data to support analysis).

Technology Transfer (T2)/Deployment Activities

Technology Transfer (T2) refers to handing off and sharing research information and results to stakeholders. Outcomes from VSR's research include publicly accessible information that allows external stakeholders to perform test procedures, manufacture test devices, and develop evaluation tools. BSR works to develop sound data by which to develop and verify countermeasures to affect or change road user behaviors and provide local communities with information and tools to initiate and administer safety programs.

NHTSA research outcomes are often in the form of written research result papers and packages of materials designed for public consumption rather than physical devices or materials intended for market. T2 and deployment activities are focused on opportunities and methods for providing materials in public forums: document databases (National Transportation Library (NTL) and USDOT Research Hub), internet (NHTSA website, Github), NHTSA public meetings, NHTSA rulemaking dockets, national conferences (e.g., Lifesavers, SAE International Government/Industry), international conferences (International Technical Conference on the Enhanced Safety of Vehicles (ESV)), journal publications, public speaking engagements, and presentations.

Table 1 - FY 2023 RD&T Program Funding Details

RD&T Program Name	FY 2023 President's Budget Request* ($000)	Applied ($000)	Technology Transfer ($000)	Facilities ($000)	Experimental Development ($000)	Major Equipment, R&D Equipment ($000)
BASE						
Vehicle Safety Research	49,781	49,281		500		
Behavioral Safety Research	18,000	14,000			4,000	
SUPPLEMENTAL						
Vehicle Safety Research	60,000	60,000				
Behavioral Safety Research	13,200	5,950			7,250	
Totals	**140,981**	129,231		500	11,250	

The AMRP reflects funding as found in the FY 2023 President's budget request per 49 U.S.C. Chapter 65 Sec. 6501 Research Planning. The FY 2023 enacted numbers will be posted as part of the FY2024 President's budget request.

Table 2 - FY 2023 RD&T Program Budget Request by DOT Strategic Goal

RD&T Program Name	FY 2023 President's Budget Request* ($000)	Safety ($000)	Economic Strength and Global Competitiveness ($000)	Equity ($000)	Climate and Sustainability ($000)	Transformation ($000)	Organizational Excellence ($000)
BASE							
Vehicle Safety Research	49,781	$49,781					
Behavioral Safety Research	18,000	9,000		5,000		4,000	
Total	67,781	58,781		5,000		4,000	
Supplemental							
Vehicle Safety Research	**60,000**	$60,000					
Behavioral Safety Research	**13,200**	$5,950				7,250	
Total R&D Funding, All Appropriations	**140,981**	124,731		**5,000**		**11,250**	

The AMRP reflects funding as found in the FY 2023 President's budget request per 49 U.S.C. Chapter 65 Sec. 6501 Research Planning. The FY 2023 enacted numbers will be posted as part of the FY2024 President's budget request.

Chapter 1 – FY 2023 RD&T Programs
Office of Vehicle Safety Research (VSR)
$109,781

Vehicle Safety Research explores all levels of emerging technology, as well as conventional systems. The office activities target all motor vehicle classes and covers the full crash timeline, including crash prevention, crash severity reduction, injury reduction and mitigation, as well as post-crash safety. VSR conducts crash data analyses, develops tests procedures, assesses relevant technologies, builds tools and capabilities to improve testing of new automotive technologies, monitors market trends, and engages in stakeholder outreach to identify priority safety areas and potential emerging safety risks.

In addition to traditional research contracting mechanisms, Vehicle Safety Research utilizes its own applied research laboratory in East Liberty, Ohio—the Vehicle Research & Test Center (VRTC). Research and testing activities conducted at VRTC support agency decisions and actions with respect to new vehicle systems and issues (including an anthropomorphic test device (ATD-crash test dummy) and cybersecurity laboratory); agency consumer information programs; test dummy development; injury criteria development; advanced research into cutting-edge technologies; and safety issues that require quick reaction or are sensitive in nature, including defect investigations. The full range of testing and applied research capabilities available to NHTSA at VRTC allows the agency to maximize its testing capabilities to study emerging safety issues more rapidly and provide benefits to the American public more quickly.

Program Names and Descriptions:

- Vehicle Electronics and Cybersecurity. This research program area broadly covers the functional safety of vehicle electronics and vehicle cybersecurity. The functional safety of Vehicle Electronics is an important part of overall systems safety that deals with safety risk management associated with potential failures in sensors, components, systems, and software implementation, as well as operator errors and environmental changes. Vehicle Cybersecurity research deals with safety risk management associated with intentional manipulation of software, hardware, sensors, and associated communication networks onboard the vehicle.

- Automated Driving Systems. This research program area includes the following foci: system level safety, safety metrics and safety assessment methods, crashworthiness considerations for alternative vehicle designs, and ADS human factors research, including accessibility considerations in ADS-equipped vehicles.

- Advanced Safety Technologies. This research program area focuses on motor vehicle technologies and systems that assist drivers in avoiding crashes in passenger vehicles, large trucks, and buses, commonly referred to as advanced driver assistance systems (ADAS). This research program area covers conventional crash avoidance technologies (e.g., tires, brakes, mirrors), technologies targeted to improve the safety of motorcyclists and pedestrians and studies the potential role and impacts of connectivity in vehicle safety.

- Crashworthiness. This research program area is responsible for developing and upgrading test procedures for the evaluation of motor vehicle safety, and for developing the test devices (e.g., crash test dummies and human body computer models) and appropriate injury metrics. Crashworthiness research encompasses new and improved vehicle design, biomechanics and injury causation, field data collection and analysis of serious injury cases, safety countermeasures, and vehicle equipment to enhance occupant safety. The Crashworthiness research program conducts real-world data collection and analysis together with experimental and computer modeling-based research.

- Alternative Fuels Safety. The Alternative Fuels Safety research program area gathers information from all sources regarding the safety of emerging transportation fuels including battery, natural gas, hydrogen, and fuel cell technologies. This advanced knowledge is helping to direct the research projects, refine safety assessments, and develop performance tests. NHTSA is partnering with industry and other federal agencies to develop appropriate safety best practices for alternative fuels vehicles and necessary fueling and charging infrastructures. This program will focus on safety of vehicle interfaces for wireless charging applications for fleet and personal use. NHTSA will also coordinate with the Department of Energy's research program to understand the safety of solid-state battery systems and begin consideration of the need for developing new performance test procedures.

- Vehicle Research and Test Center (VRTC). VRTC is NHTSA's in-house applied research, development, test, and evaluation laboratory located in East Liberty, Ohio. Research and testing activities conducted at VRTC support Agency decisions and actions with respect to new vehicle systems and issues, Agency consumer information programs, test dummy development, injury criteria development, advanced research into cutting-edge technologies, and safety issues that require quick reaction, including defect investigations. The full range of testing and research capabilities available to NHTSA at VRTC allows the Agency to maximize its testing capabilities to more rapidly study emerging safety issues and more quickly provide benefits to the American public.

Major Program Objectives:

NHTSA's research programs directly support the Agency's mission in reducing crashes, injuries, and fatalities on U.S. roadways, continuously assessing the potential of various approaches (e.g., guidance, best practices, research performance tests, procedures, and protocols, and criteria) that could expedite the maturation and deployment of cost-effective, lifesaving technologies. NHTSA's research provides the engineering knowledge to support agency decisions and actions over the establishment or updating of Federal motor vehicle safety standards, as well as in establishing consumer information programs, safety guidance, safety defects determinations, and vehicle safety compliance matters. NHTSA also reviews and evaluates agency research programs to determine gaps, emerging needs, and capabilities in addressing Congressional directives, oversight organization recommendations, and public safety concerns.

Anticipated Program Activities:
In FY 2023, NHTSA expects to continue programmatic efforts on the following:

Vehicle Electronics and Cybersecurity

*Vehicle Electronic*s

- Extend functional safety assessments to new capabilities that Automated Driving System (ADS) are introducing such as ADS support systems for remote manual operation of the vehicle (i.e., teleoperations).
- Research to characterize functional safety requirements for key heavy vehicle support systems, such as electronic controlled braking and electronic power steering systems for heavy vehicles.

Vehicle Cybersecurity

- Conduct research for enhanced cybersecurity of vehicle electronics, software, and related vehicle control systems in the context of motor vehicle safety. NHTSA plans to perform applied research on the application of tools and methods for understanding cyber issues with vehicles and how their architectures have evolved.
- Conduct targeted research on how the automotive industry addresses the full lifecycle of cybersecurity risks including identifying, protecting, detecting, responding, and recovering from cybersecurity threats.
- Conduct cybersecurity evaluations on electric vehicle battery management systems.
- Conduct a survey and analysis of leading and emerging onboard communications concepts for enhancing cybersecurity.
- Support the development and piloting of a vehicle-focused cybersecurity training program in collaboration with the Auto-ISAC.
- Support the interpretation and application of automotive-focused cybersecurity standards by vehicle manufacturers, and suppliers. These include but are not limited to standards/recommendations being released by ISO, SAE, Auto ISAC, and other organizations.

Automated Driving Systems (ADS)

ADS Safety Performance

- Continue to explore methods, metrics, and tools for assessing the performance of ADS-equipped vehicles. These include modeling and simulation, closed-course testing, and on-road naturalistic testing.
- Continue research to support development and description of ADS test scenarios, and methods for selecting specific test scenarios to test ADS capabilities or attributes of interest.
- Conduct independent research on methods to measure, collect, and evaluate ground truth performance for both light and heavy vehicle ADS.
- Assess performance measurement methods for ADS perception and path planning systems ADS-equipped vehicle subsystems, including methods for examining performance of ADS perception, localization, path planning, and control execution systems.

Crashworthiness of ADS-Equipped Vehicles

- Apply Human Body Models to evaluate occupant restraints for the range of seating conditions expected in new ADS designs and refine understanding of human response and injury metrics for various alternative seating conditions.
- Adapt anthropomorphic test devices (ATDs) for use in forward- and rear-facing reclined seating configurations.
- Develop best practices for safe interaction of non-occupied ADS-equipped vehicles with existing vehicles, roadside hardware, pedestrians, cyclists, and motorcyclists.
- Develop and validate testing tools and methods that consider all ages, sizes, and sexes of occupants and vulnerable road users.

Human Factors

- Continue to investigate emerging ADS human factors topical areas and to research different methods for transferring control from the ADS to the driver/operator during a takeover request to improve situation awareness.
- Further the execution of research to better understand the human factors considerations relating to equity, accessibility for people with disabilities, and remote manual operations.

Advanced Safety Technologies

Advanced Driver Assistance Technologies (ADAS)

- Perform focused research on effectiveness of modern crash avoidance technologies to support policy decisions for rulemaking and/or inclusion in NHTSA's New Car Assessment Program (NCAP) updates.
- Continue research on light and heavy duty safety technologies to support agency regulatory initiatives aimed at automatic emergency braking, pedestrian automatic

emergency braking, and continue research into the effectiveness of lane keeping assist technology, and the performance of L2 ADAS features.

Human Factors

- Advance the safety of vehicles with ADAS, focusing on human factors research issues related to partial driving automation.
- Continue research support of priority agency initiatives to advance development and deployment of safety countermeasures. A focus will be on SAE Level 2 driving automation research, focusing on examining a driver's engagement in the driving task when Level 2 technology is used.
- Expand research into the effectiveness of driver monitoring system strategies at mitigating driver distraction.
- Continue to examine ADAS-related human machine interface (HMI) effectiveness and design issues.
- Evaluate emerging in-vehicle HMI technologies, such as gesture-based inputs, and augmented reality displays, as well as behavioral adaptation to ADAS.

ADAS Innovation and Deployment

- Conduct targeted research to accelerate promising vulnerable road user safety technology advancements, such as system performance at nighttime and under other low light circumstances, through updates to performance assessment test procedures and associated tools.
- Continue to assess emerging ADAS technologies in new production vehicles (e.g., cross-traffic alert systems, that have potential to address some 32 types of intersection crashes and opposite direction (head-on) collision avoidance systems), through computer simulations, closed-course testing, and/or naturalistic roadway evaluations.

Crashworthiness

- Continue the development and documentation of upgraded anthropomorphic test devices and human body models and integrate these tools into new test procedures with enhanced injury metrics targeting inclusiveness considerations (THOR 50th, WorldSID 50th, LODC, BioRID).
- Focus research on female crash safety, including refreshing analyses with newer data, advancing advanced female crash dummy development to facilitate policy considerations, and model-based simulation analyses of vehicle design countermeasures (THOR 5th, WorldSID 5th).
- CIREN: Continue to collect real-world injury data from in-depth investigations of motor vehicle crashes involving occupants and pedestrians through the Crash Injury Research and Engineering Network (CIREN).

- Database Modernization: Improve the utility and usability of NHTSA's Vehicle, Biomechanics, and Component test databases, which include over 22,000 NHTSA-funded or acquired tests. These results are used by the Agency, academia, industry, safety advocates, research groups, and the public for vehicle performance assessment and countermeasure development, injury assessment, test procedure and injury criteria development, and consumer information.
- Human Body Modeling: Continue to support development and application of Human Body Models to investigate safety of occupants and pedestrians of various demographics beyond existing anthropomorphic test devices.
- Pedestrian Protection: Continue to support the development and application of pedestrian test procedures to assess how vehicle design countermeasures mitigate pedestrian injuries.

Alternative Fuels Safety

- Research the safety of electric and hydrogen drive vehicle systems—including the potential fire and shock risks to Emergency Medical Services (EMS) personnel and other first responders associated with the use of lithium-ion batteries in electric vehicles.
- Evaluate diagnostic methods to monitor the health and safety of battery systems.
- Conduct and evaluate performance tests to enhance battery safety for future electric and other alternative fuels vehicles.

Vehicle Research and Test Center (VRTC)

- VRTC will perform applied research in the areas outlined (electronics, cybersecurity, automatic driving systems, advanced driving assistance systems, crashworthiness, and biomechanics). VRTC will also perform testing of vehicle defects to support the agency's Office of Defects Investigation.
- VRTC will conduct a study to develop expansion plans, with a main focus on alternative fuels/battery electric research facilities and equipment.

Potential Program Outputs, Outcomes and Impacts:

The primary **output** of this research program is the production and dissemination of research reports related to the program objectives described above. The research findings are assessed in other parts of NHTSA to determine whether the results can inform program development or suggest more broad-scale use of a program. For example, **outcomes** of the research could be a multi-site demonstration project that includes a process evaluation of countermeasure deployment in actual practice, or it could inform the assessment of the effectiveness of a countermeasure in *Countermeasures that Work*. This in turn affects the practical implementation of behavioral traffic safety countermeasure selection and deployment by State, local, and tribal governments, as well as other entities that can influence the use of proven safety

countermeasures. The **impact** of this research is a cumulative reduction of deaths and serious injuries from traffic crashes.

Potential Economic or Societal Impacts:

(Provide descriptions of at least a paragraph for each FY 2023 RD&T Program.)

Provide an assessment of the potential impact of the program on economic or societal impacts, including any impacts related to equity.

The Vehicle Safety Research program is committed to ensuring transportation safety for the transition from internal combustion to electric powertrains in the U.S. fleet. NHTSA research will monitor the evolving safety concerns for new powertrain designs. NHTSA will work with industry and Federal partners to develop best practices for safety of new powertrain designs.

Potential Progress Made Toward Achieving Strategic Goals:

The Vehicle Safety Research program is safety focused. However, its projects and subsequent activities coincidingly impact and address Equity, Climate Sustainability, Transformation, and Economic Strength and Global Competitiveness. An example of this includes the effort to combat drunk driving-related fatalities through technology with the research and potential implementation of an in-vehicle alcohol detection system. This is a Transformative project aimed at vehicle safety, but undeniably could shift individual driver behaviors.

Similarly, the increase in the availability of electric vehicles in households and on roadways has heightened VSR's focus on the importance of battery safety, not just while on the move, but also during a crash situation, periods of storage, charging, and disposal. These are fundamental safety considerations, in building consumer trust, ensuring emergency responder safety, and eventually moving towards the potential replacement of internal combustion engine vehicles with electric vehicles leading to the goal of increased Climate Sustainability.

The current Administration enacted numerous Executive Orders addressing Equity in underserved communities and populations. NHTSA Vehicle Safety Research efforts to increase the safety of persons with disabilities in personal vehicles, through wheelchair tie-down improvements, as well as access and usability of ADS-equipped vehicles and services, not only assists the safety end-to-end movement of persons with disabilities but provides an avenue to increased access to health care, employment opportunities, and community involvement. And, as the world increases its reliance on technology, the importance of ensuring that all aspects of that technology in vehicles functions safely and as intended will increase consumer trust which leads to demand, manufacture, purchase, and use. The Economic Growth in the transportation sector is based on trust of safe goods.

Collaboration Partners: NHTSA Research partners with the other USDOT modal agencies to accomplish broad research goals. For example, NHTSA regularly collaborates with the Federal Highway Administration (FHWA), the Federal Motor Carrier Safety Administration (FMCSA), and the Federal Transit Administration (FTA), on research activities with multimodal applications. NHTSA works in conjunction with the Office of the Secretary's (OST) Highly Automated Systems Safety Center of Excellence (HASS COE) on appropriate shared topics and research areas. Additionally, members from NHTSA Research represent the Agency on numerous Topical Research Working Groups within the Department and assist on Task Forces and Councils to support Equity and Gender Executive Orders. Each of these collaborative areas assists NHTSA and modal partners through information sharing.

NHTSA coordinates battery safety research efforts with Pipeline and Hazardous Materials Safety Administration (PHMSA), Department of Homeland Security, and the Department of Energy to develop safety best practices for emergency response to electric vehicle systems. Further battery safety extends to first responder collaboration to ensure NHTSA is communicating with and understanding the needs of first responders in the incidence of a crash with alternative fuels vehicles.

External collaboration includes cooperative Agreements, memorandums of understanding (MOUs), public meetings, and comment requests to better inform Agency decisions. Additionally, frequent stakeholder research meetings are held with industry, academia, standards organizations, and safety and other advocates to stay abreast of new technological developments, as well as concerns, that may better direct planned research.

Office of Behavioral Safety Research
($31,200)

Program Name: Highway Safety Research

Program Description: Highway Safety Research provides the scientific basis for the development of effective behavioral countermeasures to reduce the occurrence and severity of traffic crashes. Highway Safety Research also evaluates the effectiveness of programs to reduce fatalities and injuries on our highways, which is critical to assist States in allocating resources effectively and achieving national performance targets. In addition, Highway Safety Research monitors and measures both safe and unsafe driving behaviors to track progress and identify emerging safety problems.

NHTSA's Highway Safety Research program supports the Department's safety efforts through behavioral research, demonstrations, technical assistance, and national leadership activities emphasizing alcohol and drug countermeasures, occupant protection, distracted driving, speeding and speed management, traffic law enforcement, emergency medical and trauma care systems, driver licensing, State and community evaluations, motorcycle rider safety, pedestrian and bicyclist safety, pupil transportation, and young and older driver safety programs.

This research program also supports the Department's equity mission by conducting research on populations that are at increased risk of injury or of crashes. This includes research on pedestrian and bicyclist safety, child passenger safety, younger, and older drivers. Beyond research on at-risk populations, the Highway Safety Research Program aims to assess and improve data to ensure that research participants are broadly representative of the public at large, with a particular focus on those who may be at increased risk.

Highway Safety Research also funds the Driver Alcohol Detection System for Safety (DADSS) project. Despite progress over the past three decades, drunk driving claims approximately 10,000 lives each year. The DADSS project is researching a first-of-its-kind technology that holds the greatest potential we have seen to reverse this trend. The technology will automatically detect when a driver is intoxicated with a BAC at or above 0.08% — the legal limit in all 50 states except Utah — and prevent the car from moving. Once it has met rigorous performance standards, it will be voluntarily offered as a safety option in new vehicles, like automatic braking, lane departure warning, and other advanced driver assist vehicle technologies.

Lastly, Highway Safety Research funds the Behavioral Traffic Safety Cooperative Research Program (BTSCRP). BTSCRP, which is administered by the Transportation Research Board, is a forum for coordinated and collaborative research to address issues integral to traffic safety professionals at all levels of government and the private sector. BTSCRP provides practical, ready-to-implement solutions to save lives, prevent injuries, and reduce costs of road traffic crashes associated with unsafe behaviors.

Major Program Objectives:
The primary goal of the Highway Safety Research program is to increase the return on investment from NHTSA's Highway Traffic Safety Grant Program. The research will support five overlapping strategic categories:

- Preventing destructive traffic safety behaviors
- Encouraging positive traffic safety behaviors
- Leveraging public safety to improve traffic safety
- Protecting vulnerable road users
- Exploring advanced technologies to address traffic safety issues

Highway Safety Research develops and evaluates safety countermeasures to reduce alcohol- and drug-impaired driving, improve young and novice driver behavior, protect pedestrians and other vulnerable road users, and prevent distracted driving. NHTSA seeks more effective and efficient countermeasures for existing traffic risks such as motorcyclist safety, speeding, nonuse of seat belts, and misuse of child restraints. Highway Safety Research also conducts human factors research to explore how people use and misuse vehicle technology, including factors that may affect and predict driver engagement with new technologies, and to develop and evaluate associated countermeasures to reduce crash-related injuries and fatalities.

BTSCRP products are developed in response to problems faced by traffic safety stakeholders. BTSCRP aims to produce a series of research products that traffic safety stakeholders, government agencies, and other interested parties will be able to quickly use or implement in their traffic safety practices.

Anticipated Program Activities:
In FY 2023,NHTSA expects to continue efforts to prevent drug-impaired driving and to understand the effects of new technologies on behavioral safety. Additional research will focus on protecting vulnerable road users, such as pedestrians and bicyclists, and exploring how to prevent distracted driving. In these emphasis areas, NHTSA plans to conduct foundational research to understand the nature or scope of the problem, developmental research to help refine delivery of solutions, and a hybrid that combines research into the big ideas and ways to develop those into safety programs.

Human factors research, particularly related to ADAS and ADS technologies, will likely remain a focus. Highway Safety Research will continue to collaborate with NHTSA's Automated Driving Systems and Advanced Safety Technologies research programs to address human factor issues, including behavioral adaptation and child-specific safety considerations related to ADS.

Equity will continue to be considered and addressed as a foundational part of the research process in 2023. Highway Safety Research will work to assess differences in risk among different members of the public, and where gaps are evident, work will be conducted to improve equity. Highway Safety Research also will consider how different countermeasures may affect different populations.

DADSS technologies will continue undergoing rigorous field testing and systemic improvements as the Agency prepares to move from research to program development.

In 2023, NHTSA expects four to six discrete BTSCRP projects to be selected that will result in applied research products that highway safety stakeholders will be able to use immediately upon

the completion of the research. TRB will prepare requests for proposals and will assemble panels to select contractors to perform the work and will publish and disseminate the products.

Potential Program Outputs, Outcomes and Impacts:

The Highway Safety Research program maintains a heavy focus on countermeasures that are relevant to State highway safety offices and the way that they support NHTSA's highway safety grant programs. The primary **output** of this research program is the production and dissemination of research reports related to the program objectives described above. The research findings are assessed in other parts of NHTSA to determine whether the results can inform program development or suggest more broad-scale use of a program. For example, **outcomes** of the research could be a multi-site demonstration project that includes a process evaluation of countermeasure deployment in actual practice, or it could inform the assessment of the effectiveness of a countermeasure in *Countermeasures that Work*. This in turn affects the practical implementation of behavioral traffic safety countermeasure selection and deployment by State, local, and tribal governments, as well as other entities that can influence the use of proven safety countermeasures. The **impact** of this research is a cumulative reduction of deaths and serious injuries from traffic crashes.

A practical example of this cycle is the research that was conducted in 2010 to help understand the reach and public perception of NHTSA's paid media campaigns to deter impaired driving. The findings from survey research informed the design and deployment of subsequent campaigns, and the communications strategies that States used to reach those at highest risk of driving impaired. The research helped NHTSA reduce impaired driving by changing drivers' perceptions of the likelihood of being stopped by police if the driver had been drinking. In 2023, NHTSA plans to conduct similar research to understand the effectiveness of the messaging.

Potential Economic or Societal Impacts:

The Highway Safety Research program has a large potential to influence the safety of all road users. Investigations that aim to facilitate safer road users, safer speeds, and improvements to post-crash care will contribute to the Department's ability to realize the goals of National Roadway Safety Strategy (https://www.transportation.gov/NRSS). For example, a fully deployed alcohol detection system has the potential to save thousands lives each year, in addition to billions of dollars in economic losses that result from deaths and injuries related to impaired driving crashes.

At the same time, it is vitally important to conduct research that fills gaps in our understanding of disparities in the effects, outcomes, use of, and access to the safety benefits of behavioral safety countermeasures so that those disparities can be remedied. The framework set out in the Executive Order on Advancing Racial Equity and Support for Underserved Communities Through the Federal Government (EO 13985) requires that we 1) assess equity, 2) address

barriers to equity, 3) engage underserved communities, and 4) assess and improve data. This framework is considered at the project level for each project. In addition, there are planned projects to explicitly explore disparities and ways to remedy them. (EO 13985) requires that we 1) assess equity, 2) address barriers to equity, 3) engage underserved communities, and 4) assess and improve data. This framework is considered at the project level for each project. In addition, there are planned projects to explicitly explore disparities and ways to remedy them.

Potential Progress Made Toward Achieving Strategic Goals:
The primary goals of Highway Safety Research are Safety and Equity, as described above. Each project explicitly considers both goals and how the research will be translated into practice by others. The goal of Transformation is addressed through the DADSS program. As mandated by Congress, NHTSA will continue to advance this important research in the hopes that it can be used to prevent the needless losses caused by impaired driving.

Collaboration Partners:
In addition to the partners that are described in earlier sections of this document, NHTSA works collaboratively with the Governors Highway Safety Association (GHSA) to administer the Behavioral Traffic Safety Cooperative Research Program (BTSCRP) a research program that aims to quickly conduct high-priority behavioral safety research with practical applications that, if effective, State Highway Safety Offices (SHSO) can deploy or promote through their programs.

NHTSA's partnership with the Automotive Coalition for Traffic Safety (ACTS) leverages efforts of researchers, automotive industry partners, and other traffic safety advocates as the development and testing of the DADSS technology advances. This engagement is critical to the successful development of the technology and the public's acceptance of its use.

Chapter 2 – FY 2024 RD&T Programs

The AMRP FY 2024 outlook year chapter in the annual plan is not developed in alignment with the President's budget request of the same year due to the AMRP development schedule per 49 U.S.C. Chapter 65 Sec. 6501 Research Planning.

Office of Vehicle Safety Research (VSR)

Program Name: Vehicle Electronics and Cybersecurity

Program Description: With the increasing proliferation of computer-based control systems, software, connectivity, and onboard data communication networks, modern vehicles need to consider additional failure modes, vulnerabilities, and threats. Additionally, connectivity and safety technologies that can intervene to assist drivers with control of their vehicle could also raise the cybersecurity stakes, and without proactive measures taken across the vehicle lifecycle, risks could rise accordingly. Methodical identification of potential issues and proactive management of increased risks related to advanced electronic and software-controlled systems are essential to designing vehicle architectures that will respond safely even when there are electronic system failures, software errors, or malicious software attacks. In FY 2024, the Vehicle Electronics and Cybersecurity research program will continue coverage of two major research areas: *Electronics Functional Safety* and *Vehicle Cybersecurity*.

Program Objectives: Program objectives support enhanced reliability and resiliency of vehicle electronics, software, and related vehicle control systems to both mitigate safety risks associated with failure and/or cybersecurity compromise of such systems, as well as safeguarding against public concerns that may pose public acceptance barriers for proven safety technologies and emerging ADS. The program seeks to support improvements in the cybersecurity posture of motor vehicles, and understand and promote contemporary methods in software development, testing practices, and requirements management to address underlying hazards and risks across the vehicle life cycle. These activities include close collaboration with industry to promote a strong cybersecurity risk management culture and associated organizational and systems engineering processes.

Anticipated Program Activities: *Functional Safety.* For FY 2024, the research scope continues to extend to new capabilities ADS developers are introducing including using wireless communications to facilitate remote manual operations (or intervention) of the vehicle (i.e., teleoperations). Research will continue to characterize functional safety requirements for key heavy vehicle support systems, such as electronic controlled braking and electronic power steering systems for heavy vehicles.

Cybersecurity. In FY 2024, VSR will conduct targeted research on how the auto industry addresses the full lifecycle of cybersecurity risks including identifying, protecting, detecting, responding, and recovering from cybersecurity threats. Further, NHTSA's research will continue to support the interpretation and application of automotive-focused cybersecurity standards by vehicle manufacturers and suppliers.

VSR will also conduct research on Electromagnetic Interference (EMI) and general sensor interference risks: EMI is managed through industry standards that date back decades ago. Newer vehicles featuring many new technologies and sensors result in substantially increased emissions. This research will evaluate if EMI testing and validation methods are capturing real risks in modern vehicles. This work will include evaluating interference aspects for various sensors that operate in close proximity in spectrum.

Program Name: Advanced Safety Technology

Program Description: Advanced Safety Technology research focuses on both traditional motor vehicle crash avoidance technologies (i.e., tires, brakes, lighting) and ADAS features (collectively SAE driving automation Levels 0-2) that assist drivers in avoiding crashes. The research program covers passenger vehicles, medium and large trucks, buses, motorcycles, and vulnerable road users. Research will seek to reduce motor vehicle fatalities through a focus on target technologies that have the potential to reduce high frequency crashes.

Program Objectives: The principal objective of this program is to lead national safety research to advance and accelerate the responsible deployment of ADAS across the U.S. automotive fleet. This program will continue to focus on harnessing emerging technologies and innovative safety systems that directly map to crashes. Research is conducted with the objectives of attaining a comprehensive understanding of all ADAS-enabling technologies and trends, such as underlying sensor technologies and strategies. Research also encompasses quantifying ADAS performance, capabilities, limitations, effectiveness, and risks for all classes of vehicles and all roadway users.

Anticipated Program Activities: *ADAS Innovation and Deployment*: Innovative technologies considered for research include active safety systems, such as cross-traffic alert systems, that have potential to address some types of intersection crashes and opposite direction (head-on) collision avoidance systems.

Accessibility and inclusiveness research: Perform research to acquire data for a wide range of manual, power, and scooter wheelchairs. Use the data to encourage automotive designers to consider a wide range of assistive devices when designing automotive interiors.

Human factors:

- *Driver Distraction from in-Vehicle Technology Interfaces*: Perform research to evaluate distraction aspects of new in-vehicle devices and applications and associated secondary tasks. Substantial changes have occurred in the marketplace over the last several years. These changes include the introduction of touchscreen controls (including menu driven offerings for traditional driving related tasks such as to turn on high beams), voice controls, passenger-side video streaming, privacy screens, converging trends in dashboards and infotainment displays, gaming options, e-commerce, and mobile device integration.
- *ADAS Human-Machine Interface (HMI)***:** In FY 2024, NHTSA's research program will continue to examine ADS-related HMI effectiveness and design issues and may include evaluation of emerging in-vehicle HMI technologies.
- *Driver Engagement and ADAS*: In FY 2024, SAE Level 2 driving automation research will continue to focus on examining a driver's readiness to resume control when an ADAS issues a request to intervene that is critical to safety. Human factor challenges and benefits for these new technologies will continue to be evaluated. Research into the effectiveness of driver monitoring system strategies at mitigating driver distraction will continue.

Safety Performance Research of ADAS Technologies: Safety performance assessments of ADAS technologies deployed in new production vehicles will continue in FY 2024 and will include computer simulations, closed-course testing, and/or naturalistic roadway evaluations.

A significant focus is expected to be on light and heavy vehicle technologies that map to significant safety crash problems to support agency regulatory decisions and actions.

Program Name: Automated Driving Systems (ADS)

Program Description: Vehicles equipped with ADS remain in the development and testing phase. While limited ride-hailing deployments are beginning to emerge and are open to the public, such deployments are highly monitored demonstrations focused on testing and refinement of the technology. A vehicle equipped with ADS, when engaged, can perform the full driving task without an expectation of an engaged driver. ADS-equipped vehicles hold the potential to improve safety beyond levels achievable with ADAS alone. As a result, ADS research continues to be an important emphasis area for NHTSA.

Program Objectives: This program objectives of the ADS research area include the following tracks primarily focused on supporting the safe deployment of ADS-equipped vehicles:

- ADS safety performance research to develop and apply tools and methods to assess the safe performance of ADS-equipped vehicles
- Human factors research to support safe and effective communications between ADS-equipped vehicles, passengers, and other road users.

- Crashworthiness research to address restraint designs for new seating arrangements and other novel design elements anticipated with ADS-equipped vehicles.

Anticipated Program Activities:

Research on ADS safety performance: In FY 2024, research will continue to explore methods, metrics, and tools for assessing the safety of ADS-equipped vehicles. These include modeling and simulation, closed-course testing, and on-road naturalistic testing. The research will also include development of a common "language" for describing ADS test scenarios, and methods for selecting specific test scenarios to efficiently test ADS capabilities or attributes of interest. Additional research will focus on evaluating the application of leading-edge analytical methods that leverage operational data (or results) from various testing venues to develop safety performance metrics. Research will continue related to ADS-equipped vehicle subsystems, including methods for examining performance of ADS perception and execution systems. Methods to assess pedestrian recognition performance across a diverse population of road users will be utilized to encourage equity and inclusiveness during the design process. Research will also evaluate a vehicle's ability to accurately follow path-planning instructions from the ADS decision support system.

Crashworthiness of ADS-equipped vehicles: In FY 2024, research will apply Human Body Models (HBM) to evaluate occupant restraints for the range of seating conditions expected in new ADS designs. In FY 2024, research will refine understanding of human response and injury metrics for various alternative seating conditions. Anthropomorphic test devices will be adapted for use in forward- and rear-facing reclined seating configurations. The Agency will also continue to develop best practices for safe interaction of non-occupied ADS-equipped vehicles with existing vehicles, roadside hardware, pedestrians, cyclists, and motorcyclists.

Human factors research to support safe and effective communications between ADS-equipped vehicles, passengers, and other road users: ADS-equipped vehicles and ADS-DV designs will influence humans' interactions with vehicles. In 2024, the Agency will continue to investigate emerging ADS human factors topical areas (e.g., external HMI, driver-vehicle interface, communication of intent, etc.) and to research different methods for transferring knowledge from the ADS to the driver/operator to improve situation awareness. Since in some situations, it may be necessary for a remote operator to take over control of an ADS-DV, the Agency will continue to execute research to better understand the human factors considerations associated with remote operation.

Program Name: Crashworthiness

Program Description: Crashworthiness research focuses on vehicle safety countermeasures to reduce the number of fatalities and serious injuries that result from motor vehicle crashes in the

United States each year. This research program is responsible for developing and upgrading test procedures for the evaluation of motor vehicle safety, and for developing evaluation tools (e.g., crash test dummies and human body computer models) and appropriate injury metrics. Crashworthiness research encompasses new and improved vehicle designs, equipment and safety countermeasures; biomechanics and injury causation; real-world field data collection and analysis of serious injury cases; and computer modeling based research all aimed at enhancing outcomes for motor vehicle occupants and vulnerable road users. The program directly supports the Department's goal of reducing transportation-related fatalities and serious injuries across the transportation system.

Program Objectives: The purpose of the Crashworthiness research program is to investigate the problems of vehicle crash safety and associated factors (e.g., vehicle design, human response/injury tolerance) that contribute to serious injuries and fatalities. The near-term goal is to identify fatality and injury trends and to enhance safety requirements and best practices to improve crash outcomes for vehicle occupants and vulnerable road users. This program supports the Department's critical research priority to improve safety.

Biomechanics research makes significant contributions to safety by developing publicly available data, tools, performance measures, and procedures that NHTSA and industry use, both to understand how vehicle occupants and vulnerable road users are injured in crashes and for assessment of vehicle safety countermeasures. Biomechanics research also works with trauma centers to understand the detailed nature of injuries. The causes of these injuries are evaluated through laboratory test programs and computer simulations. The new knowledge that is gained through injury research is applied towards the development, evaluation and refinement of crash test dummies and associated injury measures as well as towards the enhancement of computer models (e.g., human body models). These tools are then utilized to support vehicle safety countermeasure development for occupants of all ages, size, and sex.

In 2024, Biomechanics research will continue to focus on completing the development, evaluation, and documentation associated with advanced testing and simulation tools (ATDs, human body models). The application of these enhanced tools will increase both the Agency's and industry's ability to assess occupant protection safety in frontal, side, oblique, and rear impact crash modes. Included in these efforts is research supporting the completion of testing, evaluation, and documentation associated with a new small female frontal impact crash test dummy (Test Device for Human Occupant Restraint or THOR 5th percentile). Related to both the THOR 5th and human body models, there will continue to be an emphasis on researching differences in injury risk between males and females. Research supporting the development and documentation of the THOR 5th will continue to include efforts to develop and utilize female-specific response and injury data for use in developing injury criteria. Research concerning human body models will include the development and application of a 50th percentile female.

Additionally, the program focuses on vulnerable populations (e.g., pedestrians, children, and older occupants). Pedestrian research will focus on completing and evaluating test tools to assess vehicle countermeasures addressing pedestrian safety. Older occupant research focuses on evaluating leading injury mechanisms for older occupants: brain injuries (subdural hematoma) and thorax injuries. The CIREN program will continue to collect real-world field data on injuries to occupants and pedestrians to support retrospective data analyses and help inform on future research needs.

Safety Systems research is responsible for evaluating new crash safety concerns and for developing safety concepts, test procedures, and performance measures. Safety Systems research examines existing designs, new and improved vehicle designs, safety countermeasures, materials, and equipment to enhance safety for all occupants in the event of a crash. In 2024, Safety Systems research will continue to use the tools and criteria developed through Biomechanics research to develop strategies for achieving equitable safety for occupants with diverse body sizes and shapes. Child safety will continue to be a major focus area, with research toward improving the frontal crash performance of child restraints, including larger children in booster seats. Occupant safety in front and side crashes will be assessed using new, advanced crash test dummies. Frontal crash protection will also focus on improving safety for rear seat occupants, occupant injury and seat back strength in rear impacts will also be evaluated.

The Crashworthiness research program supports the entire private sector rather than benefitting any single company. Research on evolving crash injury mechanisms and the development of safety assessment tools is intended for widespread use in automotive design.

Anticipated Program Activities: Safety Systems will support research to evaluate new test dummies and injury metrics in current and future crash conditions, develop or revise test procedures, and assess the effectiveness of occupant protection systems. Research will evaluate heavy truck rear underride, limousine safety, and seat back strength. Biomechanics will fund research to develop tools (crash test dummies, mathematical models) and injury metrics that can be applied towards the assessment of advanced vehicle safety countermeasures; human body modeling studies to assess safety and develop countermeasures to protect varying ages, sizes, and sexes of occupants and vulnerable road users; and real-world data field data collection for occupants and pedestrians.

Program Name: Alternative Fuels Vehicle Safety

Program Description: NHTSA is gathering information from all sources regarding the safety of emerging transportation fuels including battery, stored gas, and fuel cell technologies. This advanced knowledge is helping to direct the research projects, refine safety assessments, and develop performance tests. NHTSA is partnering with industry and other federal agencies to develop appropriate safety performance considerations for these alternative fuel vehicles.

These technologies should all involve research between the DOE national laboratories, the automotive original equipment manufacturers (OEMs) and their suppliers. The planned research will also apply past research on charging safety to new battery designs and consider both commercial and residential applications.

Program Objectives: NHTSA has worked with the Department of Homeland Security to document standards and best practices for emergency medical responders. This study will be extended to research capabilities to address difficulties EMS responders encounter in responding to battery electric vehicle crashes, fires and stranded energy situations. NHTSA will continue to partner with industry, standards organizations, and other Federal agencies to develop appropriate safety performance for new alternative fuel vehicles.

Anticipated Program Activities: NHTSA will continue to collaborate with other agencies on funding and other research programs to develop and investigate best practices for vehicle safety for these emerging systems. The program meets the annual funding Appropriations Act's requirement to conduct alternate fuels vehicle safety research.

Program Name: Vehicle Research and Test Center (VRTC)

Program Description: VRTC is NHTSA's in-house applied research, development, test, and evaluation laboratory located in East Liberty, Ohio. Research and testing activities conducted at VRTC support Agency decisions and actions with respect to new vehicle systems and issues, Agency consumer information programs, test dummy development, injury criteria development, advanced research into cutting-edge technologies, and safety issues that require quick reaction, including defect investigations. The full range of testing and research capabilities available to NHTSA at VRTC allows the Agency to maximize its testing capabilities to more rapidly study emerging safety issues and more quickly provide benefits to the American public.

Program Objectives: VRTC supports a broad range of critical safety areas including:

- Crash avoidance research (light and heavy vehicles), including support for updating existing Agency safety tests and research of new emerging ADAS technologies. This program area also examines human factors related to vehicle system and technology use and supports development of foundational tests, methods, and safety metrics to enable future Agency evaluation and policy decisions for emerging ADS technologies and includes human factors research to ensure that advanced technologies are used by drivers in ways that successfully reduce crashes;
- Crashworthiness research, including support for updating existing Agency tests and test procedures as well as research on new occupant protection topics to enable deployment of innovative new technologies;
- Biomechanics research, including adapting and upgrading existing tools (crash test dummies) for compatibility with new technologies such as ADS;
- Lab and in-field support for safety defects investigations; and

- Research into complex areas such as ADS and cybersecurity to support development of safety approaches, methods, and tests.

Research in these areas directly supports the Department's goal to reduce transportation related fatalities and serious injuries across the transportation system. This aligns with NHTSA's mission and the Department's goals to deploy new and innovative technologies.

Anticipated Program Activities:

- Perform research and testing to support a broad range of critical safety areas including advanced safety technologies research to evaluate new technologies that help drivers prevent crashes, crashworthiness research to improve occupant protection in crashes, biomechanics research to develop, evaluate, maintain, and improve the Agency's vehicle crash test dummies, lab and in-field support for safety defects investigations, and research into complex new areas such as ADS-equipped vehicles, electric-powered vehicles, and cybersecurity. The FY 2024 funding will be used to procure equipment needed to maintain a well-equipped and dedicated center to test, monitor, and investigate these and other emerging safety issues.
- Pursue expansion of laboratory capabilities with a focus on alternative fuel/battery electric facilities and equipment.

Office of Behavioral Safety Research

Program Name: Highway Safety Research

Program Description: Highway Safety Research provides the scientific basis for the development of effective behavioral countermeasures to reduce the occurrence and severity of traffic crashes. Highway Safety Research also evaluates the effectiveness of programs to reduce fatalities and injuries on our highways, which is critical to assist States in allocating resources effectively and achieving national performance targets. In addition, Highway Safety Research monitors and measures both safe and unsafe driving behaviors to track progress and identify emerging safety problems.

NHTSA's Highway Safety Research program supports the Department's safety efforts through behavioral research, demonstrations, technical assistance, and national leadership activities emphasizing alcohol- and drug-impaired driving countermeasures, occupant protection, distraction, traffic law enforcement, emergency medical and trauma care systems, driver licensing, State and community traffic safety program evaluations, motorcycle rider safety, pedestrian and bicyclist safety, pupil transportation, and young and older driver safety programs. Further, the program aims to increase understanding of the disparities that exist in access to safe travel, the barriers that help perpetuate disparities, and the data needs associated with understanding the disparities with the goal of increasing equity.

Highway Safety Research also funds the DADSS project. Despite progress over the past three decades, drunk driving claims approximately 10,000 lives each year. The DADSS project is researching a first-of-its-kind technology that holds the greatest potential we have seen to reverse this trend. The technology is being designed to automatically detect when a driver is intoxicated with a BAC at or above 0.08% — the legal limit in all 50 states except Utah — and prevent the car from moving. Once it has met rigorous performance standards, it will be voluntarily offered as a safety option in new vehicles.

Lastly, Highway Safety Research funds the BTSCRP, which is administered by the Transportation Research Board, is a forum for coordinated and collaborative research to address issues integral to traffic safety professionals at all levels of government and the private sector. BTSCRP provides practical, ready-to-implement solutions to save lives, prevent injuries, and reduce costs of road traffic crashes associated with unsafe behaviors.

BTSCRP products are developed in response to problems faced by traffic safety stakeholders. Emphasis areas are alcohol-impaired driving, autonomous vehicles, bicyclists and pedestrians, child passenger safety, distracted driving, drowsy driving, drug-impaired driving, law enforcement, mature drivers, motorcyclist safety, seat belts, speed and safety cameras, speeding

and aggressive driving, teen driver safety, and traffic records. BTSCRP will produce a series of research products that traffic safety stakeholders, government agencies, and other interested parties will be able to quickly use or implement in their traffic safety practices.

Major Program Objectives:

The research will support five overlapping strategic goals:

- Preventing destructive traffic safety behaviors;
- Encouraging positive traffic safety behaviors;
- Leveraging public safety to improve traffic safety;
- Protecting vulnerable road users; and,
- Exploring advanced technologies to address traffic safety issues.

Anticipated Program Activities:

In FY 2024, NHTSA will emphasize various areas based upon problem identification and research needs although continued efforts are expected in preventing drug-impaired driving and the effects of new technologies on behavioral safety. In these areas, NHTSA plans to conduct foundational research to understand the nature or scope of the problem; developmental research that helps refine delivery of solutions; and a hybrid that combines research into the big ideas and potential ways to develop those into safety programs. Research to explicitly explore disparities in traffic safety associated with age, race, sex, and mode of travel will be conducted.

Human factors research, particularly related to ADAS and ADS technologies, will likely remain a focus. Highway Safety Research will continue to collaborate with NHTSA's Automated Driving Systems and Advanced Safety Technologies research programs to address human factors issues including behavioral adaptation and child-specific safety considerations related to ADS. DADSS technologies will continue undergoing rigorous field testing and systemic improvements as the Agency prepares to move from research to program development.

In FY 2024, NHTSA plans for four to six discrete BTSCRP projects to be selected that will result in applied research products that highway safety stakeholders will be able to use immediately upon the completion of the research. TRB will prepare requests for proposals and will assemble panels to select contractors to perform the work.

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