United States Department of Transportation
Annual Modal Research Plans FY 2024
Program Outlook FY 2025

National Highway Traffic Safety Administration
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Office of Vehicle Safety Research
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Executive Summary

Supporting Departmental Strategic and Research Goals

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's mission is to "Save lives, prevent injuries and reduce economic costs due to road traffic crashes, through education, research, safety standards and enforcement activity."

Research at NHTSA focuses on the vehicle, road users both inside and outside of the vehicle, and the interaction of each as a part of the surface transportation system. In addressing roadway safety, NHTSA research is in full support of the Department of Transportation's Office of the Assistant Secretary for Research and Technology and their mission to facilitate the transformation of the U.S. transportation system – making it safer, more efficient, competitive, accessible, and sustainable. In carrying out this mission, the Research, Development, and Technology Strategic Plan Fiscal Year 2022-2026 (transportation.gov) outlines a national transportation research vision to guide America's research priorities while improving coordination of transportation research.

Activities supporting the Agency's and Department's missions include, but are not limited to, advanced vehicle safety technologies that help prevent crashes or mitigate the severity of a crash; Automated Driving Systems that have the potential to transform the road transportation system; crashworthiness of the vehicle when in a crash and occupant protection for those passengers involved in a crash; vulnerable road user safety such as bicyclists, motorcyclists. and older drivers; human factors research to better understand how people interact with vehicle technologies and the transportation system; equitable crash safety such as reducing the risk of injury and death to female passengers; cybersecurity; alternative fuels safety such as battery-electric vehicle safety; research into the effects of drug- and alcohol-impairment; countermeasures to reduce risky driver behaviors such as speeding, drowsy driving, and distracted driving; and programs to facilitate greater protection of child passengers.

NHTSA Research, performed through Programs in both the Offices of Vehicle Safety Research and Behavioral Safety Research support the RD&T Strategic Plan and the Research Priorities and Objectives therein. These Research Priorities and Objectives are laid out in accordance with the DOT Strategic Goals: Safety, Economic Strength & Global Competitiveness, Equity, Climate & Sustainability, and Transformation. Given the safety mission of NHTSA, the majority of activities in NHTSA's Research Programs are focused on the goal of Safety. NHTSA Research Programs touch on *all* of the Research Priorities laid out for this goal including: Human Factors with objectives of safety culture and behavior and human-technology interactions; Data-Driven System

Safety with objectives of safe design, safety data, safe technology, and hazardous material safety; and Cybersecurity with objectives of cybersecurity risk analysis and cybersecurity standards. The Grand Challenge associated with Safety is Zero Fatalities which strives to have zero fatalities in the transportation system as a whole. NHTSA's Research Programs work to achieve zero fatalities through efforts to create safer motor vehicles and motor vehicle equipment, improve road-user behaviors, protect road users when a crash occurs, and prevent malicious behavior in a growing connected environment to name but a few.

Although most of the Program activities in this Annual Modal Research Plan fall under the Safety Strategic Goal, the Programs and activities simultaneously address additional DOT Strategic Goals through their Research Priorities. NHTSA Research Programs support the Equity Research Priorities of Equity and Accessibility Assessment as well as Mobility Innovation through activities such as universal safety of occupants that have disabilities and access to innovative technologies such as Automated Driving Systems and inclusion of research into the needs and safety of older drivers and passengers. NHTSA Alternative Fuel Safety Program supports the Decarbonization Research Priority for the Climate and Sustainability Strategic Goal through efforts on both electrification and alternative fuels. The DOT Strategic Goal of Transformation has a Research Priority of Integrated System of Systems with an objective of system architecture and the development of standards to support interoperability, data-sharing, and security across the transportation system. NHTSA Research is thoroughly involved with standards development in varying components of the automotive industry. Activities in driver alcohol detection support the Transformation Research Priority of New & Novel Technologies.

In February 2023, the U.S. Department of Transportation released a *Call to Action* with our partners on the one-year anniversary of the *National Roadway Safety Strategy* (NRSS), a comprehensive roadmap for addressing the national crisis in roadway fatalities and serious injuries. The *Call to Action* and the NRSS provide concrete steps that the Department and our stakeholders will take to address this crisis systemically and prevent these tragic and avoidable deaths and serious injuries. Institutionalizing a Safe System Approach (SSA) is part of DOT's NRSS – including safer people, safer speeds, safer roads, safer vehicles, and post-crash care – leading to innovative work to protect vulnerable road users, including pedestrians, bicyclists, people who use wheelchairs and other mobility devices, and those in underserved, disadvantaged, rural, and communities of color.

Program Highlights

NHTSA Research maintains six Program Areas discussed in the President's Budget and mirrored in this AMRP: Vehicle Electronics and Cybersecurity, Automated Driving Systems, Advanced Safety Technologies, Crashworthiness, Alternative Fuels Safety, and Highway Safety Research. All are deemed by the Agency as critical programs. Within these Programs lie essential Program Activities, which are the grouped areas, that contain projects to advance NHTSA's mission. Critical Program Activities include efforts

set forth in the Bipartisan Infrastructure Law, emphasis through Departmental priorities, and specific requests for increased funding. Examples of such research include driver distraction from in-vehicle technologies, development and testing of female crash test dummies, foundational research into safety and accessibility for people with disabilities, and driver alcohol detection systems.

Successful execution and completion of research efforts is a collaborative practice. External to the Agency, NHTSA continually works with original equipment manufacturers, suppliers, and technology companies for knowledge sharing and information on new technologies, standards organizations in the development of voluntary standards and best practices, research institutions such as the Transportation Research Board, higher learning institutions, international counterparts, and external government organizations. NHTSA Research also interacts regularly with local and State organizations such as the Governors Highway Safety Association and the American Association of State Highway and Transportation Officials. NHTSA Research regularly interacts with other DOT modal administrations in collaborative efforts on projects and information-sharing, especially its surface transportation counterparts (e.g., the Federal Highway Administration (FHWA), the Federal Motor Carrier Safety Administration (FMCSA), and the Federal Transit Administration (FTA)).

Other key information sharing and collaboration activities include: NHTSA's annual safety research portfolio public meeting; Collaborative efforts with SAE International to plan, execute, and present research information at the annual SAE government-industry meeting; Planning, executing, and presenting research information on a bi-annual basis at the International Technical Conference on the Enhanced Safety of Vehicles (ESV - conference rotates between the North American, European, and Asia-Pacific regions); Stapp Car Crash Conference on impact biomechanics and human injury tolerance; International Research Council on Biomechanics of Injury (IRCOBI), ITS America and associated annual meeting, Automotive Information Sharing and Analysis Center, including their annual Cybersecurity Symposium; Lifesavers National Conference on Highway Safety Priorities; and Transportation Research Board meetings.

Post-output information sharing, which is foundational to NHTSA Research Technology Transfer activities, takes place throughout each fiscal year. NHTSA Research is not engaged in the development of T2 programs and is rarely in a position to develop technology to commercialize or license. Those are not within the purview of the Research programs at the agency. However, publication of research materials to further encourage development of safer technologies, practices, or countermeasures is the primary output. Transferring that knowledge occurs through publication of reports, presentation of materials at meetings and conferences, publications in journals, development of test procedures, etc. These materials are available in the public realm for which they are specifically designed. NHTSA Research also submits research reports to the National Transportation Library, posts information on the agency's website in a consumer-friendly and accessible manner, submits documentation to the public docket through regulations.gov, and hosts public meetings.

As stated, outputs of NHTSA Research are primarily reports, technical papers, presentations, test procedures, and other data to support policy decisions on agency actions, new safety countermeasures, and other safety programs and activities. The outcomes of these efforts are often carried out external to NHTSA Research seen through decisions on regulatory activity, development of crash test dummies, incorporation of technologies into NHTSA's New Car Assessment Program, the development of criteria for roadside evaluations, and the development of national public safety educational campaigns. Outcomes derived from and developed within NHTSA Research include best practices, guidelines, and countermeasures for safe driving behaviors.

Evaluation and performance measurement for NHTSA Research occur through various Departmental and Agency efforts. NHTSA has revised performance goals in order to more effectively track program-specific efforts. The Offices of Vehicle Safety Research and Behavioral Safety Research have developed individual performance goals which will be reported through the Department's Performance Management Review. Additionally, various NHTSA Research activities are being tracked through the Equity Council pertaining to gender equity (female crash safety) and Mobility Justice (accessibility to and within vehicles), through the Learning Agenda for drug-impaired driving and pedestrian and cyclist safety, and through new evaluation materials pertaining to the Foundations for Evidence-Based Policymaking Act of 2018. NHTSA Research actively participates in Research Reviews with the Office of the Assistant Secretary for Research and Technology to assess status, completion, and success of activities.

Funding Explanation

Base funding for Programs in the Office of Vehicle Safety Research is found under "Research and Analysis" in the President's Budget Request and totals $58,145,000. Base funding for Programs in the Office of Behavioral Safety Research is found in "Research & Program Development" and totals $13,567,000. Supplemental funding from the Bipartisan Infrastructure Law is stated as "Vehicle Safety and Behavioral Research" and include $60,000,000 for Vehicle Safety Research Programs and $20,200,000 for Behavioral Safety Research Programs.

Table 1.a. - FY 2024 RD&T Program Funding Details, Base Funding

Budget Language	Program Name	FY 2024 President's Budget Request* ($000)	Applied Research ($000)	Technology Transfer ($000)	Facilities ($000)	Experimental Development ($000)	Major Equipment, R&D Equipment ($000)
Research and Analysis	Vehicle Electronics and Cybersecurity	6,000	6,000				
Research and Analysis	Automated Driving System (ADS)	12,172	12,172				
Research and Analysis	Advanced Safety Technologies	27,145	27,145				
Research and Analysis	Crashworthiness	10,514	10,514				
Research and Analysis	Alternative Fuels Safety	2,314	2,314				
	Total Base Funding (VSR)	**58,145**					
Research & Program Development	Highway Safety Research	13,567	9,317			4,250	
	Total Base Funding (BSR)	**13,567**					
	Total Base Research Funding	**71,721**					

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

** In previous budget tables, NHTSA's research laboratory, the Vehicle Research and Test Center, was separately accounted for with $500,000 in Facilities funding. The funding for VRTC is now embedded in each Program Area.

Table 1.b. - FY 2024 RD&T Program Funding Details, Supplemental Funding

Budget Language	Program Name	FY 2024 President's Budget Request* ($000)	Applied Research ($000)	Technology Transfer ($000)	Facilities ($000)	Experimental Development ($000)	Major Equipment, R&D Equipment ($000)
Vehicle Safety and Behavioral Research	Vehicle Electronics and Cybersecurity	5,000	5,000				
Vehicle Safety and Behavioral Research	Automated Driving System (ADS)	8,000	8,000				
Vehicle Safety and Behavioral Research	Advanced Safety Technologies	25,000	25,000				
Vehicle Safety and Behavioral Research	Crashworthiness	14,000	14,000				
Vehicle Safety and Behavioral Research	Alternative Fuels Safety	8,000	8,000				
Vehicle Safety and Behavioral Research	Highway Safety Research	20,200	13,200			7,000	
	Total Supplemental Research Funding	**80,200**					
	Total Research Funding (Tables 1.a. and 1.b.)	**151,912**					

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

** In previous budget tables, NHTSA's research laboratory, the Vehicle Research and Test Center, was separately accounted for with $500,000 in Facilities funding. The funding for VRTC is now embedded in each Program Area.

Table 2.a. - FY 2024 RD&T Program Budget Request by DOT Strategic Goal, Base Funding

Budget Language	Program Name	FY 2024 President's Budget Request* ($000)	Safety ($000)	Economic Strength & Global Competitive-ness ($000)	Equity ($000)	Climate and Sustaina-bility ($000)	Transfor-mation ($000)	Organiza-tional Excellence ($000)
Research and Analysis	Vehicle Electronics and Cybersecurity	6,000	6,000					
Research and Analysis	Automated Driving System (ADS)	12,172	12,172					
Research and Analysis	Advanced Safety Technologies	27,145	27,145					
Research and Analysis	Crashworthiness	10,514	10,514					
Research and Analysis	Alternative Fuels Safety	2,314	2,314					
	Total Base Funding (VSR)	**58,145**						
Research & Program Develop-ment	Highway Safety Research	13,567	7,317		2,000		4,250	
	Total Base Funding (BSR)	**13,567**						
	Total Base Research Funding	**71,721**						

*Activities in the Vehicle Electronics and Cybersecurity, ADS, Advanced Safety Technologies, Crashworthiness, and Alternative Fuels Safety Programs are classified as Safety, given this is the primary mission of the Agency. However, many of the activities in the Program Areas also support other strategic goals such as Equity, Climate and Sustainability, and Transformation. To avoid double-counting on this table, investments are categorized within the primary strategic goal of Safety.

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

Table 2.b. - FY 2024 RD&T Program Budget Request by DOT Strategic Goal, Supplemental Funding

Budget Language	Program Name	FY 2024 President's Budget Request* ($000)	Safety ($000)	Economic Strength & Global Competitive-ness ($000)	Equity ($000)	Climate and Sustaina-bility ($000)	Transfor-mation ($000)	Organiza-tional Excellence ($000)
Vehicle Safety and Behavioral Research	Vehicle Electronics and Cybersecurity	5,000	5,000					
Vehicle Safety and Behavioral Research	Automated Driving System (ADS)	8,000	8,000					
Vehicle Safety and Behavioral Research	Advanced Safety Technologies	25,000	25,000					
Vehicle Safety and Behavioral Research	Crashworthiness	14,000	14,000					
Vehicle Safety and Behavioral Research	Alternative Fuels Safety	8,000	8,000					
Vehicle Safety and Behavioral Research	Highway Safety Research	20,200	13,200				7,000	
	Total Supplemental Research Funding	**80,200**						
	Total Research Funding (Tables 2.a. and 2.b.)	**151,912**						

*Activities in the Vehicle Electronics and Cybersecurity, ADS, Advanced Safety Technologies, Crashworthiness, and Alternative Fuels Safety Programs are classified as Safety, given this is the primary mission of the Agency. However, many of the activities in the Program Areas also support other strategic goals such as Equity, Climate and Sustainability, and Transformation. To avoid double-counting on this table, investments are categorized within the primary strategic goal of Safety.

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

Chapter 1 – FY 2024 RD&T Programs

Vehicle Electronics and Cybersecurity
$11M (Base funding $6M + Supplemental $5M)

Program Description:
For FY 2024, this research program covers the functional safety and safety of the intended functionality (SOTIF) 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. Analyses related to SOTIF use industry standards (such as ISO 21448) for assessing reliability, safety and potential unintended consequences associated with advanced vehicle electronic control systems, software, and electro-mechanical systems due to misuse and/or misapplication of the systems beyond their intended functionality and operating domain. Vehicle Cybersecurity research deals with safety risk management associated with intentional manipulation of software, hardware, sensors, and associated communication networks onboard the vehicle. 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 cybersecurity attacks.

Major Program Objectives:
The main objective of this program is to research electronics issues (functional safety and SOTIF) as well as cybersecurity issues that may have potential to impact vehicle safety through compromise of vehicle control (accelerator, throttle, and braking control). Given the rapid, accelerated pace of vehicle technology advancement and the related issues that result, such as cybersecurity, this program conducts the critical research activities that are necessary to maximize the safe deployment of emerging advanced driver assistance system technologies (ADAS – SAE Levels 0-2), vehicle telematics, and Automated Driving Systems (ADSs - SAE Levels 3-5), to ensure that key electronics and cybersecurity issues are addressed. In FY 2024, the Vehicle Electronics and Cybersecurity program will build upon research completed in FY 2023 and initiate new projects to close identified gaps in support of agency decisions on vehicle automation, as well as electronics reliability and cybersecurity.

Anticipated Program Activities:
- *Vehicle Electronics:* Research will extend to new capabilities ADS developers are introducing including using wireless communications to facilitate remote assistance (or intervention) of the vehicle (i.e., teleoperations).
- *Sensor Interference Risks*: Interference risks are generally managed through industry standards that were developed decades ago. Newer vehicles featuring many new technologies and sensors result in substantially increased emissions.

This research will evaluate if known testing and validation methods are capturing the real interference risks in modern vehicles. This work will include evaluating co-existence of various sensors that operate in close proximity in the spectrum.

- *Cybersecurity:* NHTSA 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.

Potential Program Outputs, Outcomes, and Impacts on Technologies and Practices:
The potential program outputs of this effort will be to develop research findings and data to support and facilitate industry's safe testing, development, and deployment of vehicles equipped with ADAS technologies, vehicle telematics systems, and ADS, including addressing cybersecurity issues resulting from increased connectivity of modern vehicles (including wireless remote assistance or teleoperations), and identifying new interference risks that may arise in emerging vehicle electronics before they are in production. Through advanced, proactive, and collaborative research, the program outcomes will address these challenges in a timely manner such that transformative ADAS, and ADS-equipped vehicles with potential safety benefits can be introduced sooner. Potential impacts from this program area may also include information for use in investigating potential defects in electronics and software that may result in a safety recall, identification of unintended safety risks, or other consumer complaint issues. This research potentially informs incident response when cybersecurity issues are reported or learned by the Agency from vehicle manufacturers, media outlets, or otherwise. Agency data gathering and strategic planning efforts as well as incoming research results will continue to guide agency decision-making on potential policy decisions in this area.

Below is a listing of Vehicle Electronics and Cybersecurity Research anticipated program outputs for FY 2024:

- *Vehicle Electronics*: Publication of report(s)/data on functional safety and SOTIF analyses of teleoperation system concepts for Level 4 Automated Driving Systems. Complete and publish a report on the functional safety of heavy vehicle electronic brakes and electronic steering systems.
- *Sensor Interference Risks*: Continued work in exploring potential congestion and interference of emerging sensor systems, including lidar.
- *Cybersecurity*: Publication of reports(s)/data on efforts that include cybersecurity considerations for modern electric vehicle battery management systems; and examination of the evolutionary changes in vehicle Electrical/Electronic architectures over time and the associated cybersecurity considerations. Completion of a cybersecurity training pilot curriculum with the Auto-ISAC.

Potential Economic or Societal Impacts:
The potential economic impacts of this effort could be in the mitigation of vehicle electronics failures of safety critical systems that could lead to defect investigations across

multiple vehicle makes/models that use the same components, leading to economic costs due to motor vehicle crashes, financial impacts to the auto industry for developing and distributing a remedy, and lost time for consumers to seek-out remedies. The potential societal impacts could include consumer mistrust in ADAS and ADSs due to risk of cybersecurity issues either from the original equipment manufacturers, suppliers, technology companies, or any entities immersed in the supply chain. Research needs to be conducted in a pro-active manner to stay ahead of potential cybersecurity risks, as well as prevention of equity biases that might be embedded in machine learning algorithms for safety critical sensing systems, including driver monitoring systems, for example.

Potential Progress Made Toward Achieving Modal Strategic Goals:
The Vehicle Electronics and Cybersecurity research program has the potential to advance the safety of modern vehicle software and architectures, including electric vehicles, from hacking and other potential risks. To date, there has been only one vehicle safety recall due to a cybersecurity issue. In part, NHTSA's research program has facilitated introduction of vehicle cyber resilient systems on the part of manufacturers through issuance of cybersecurity best practices, encouragement of an Auto-ISAC, collaboration on the development of a cybersecurity workforce curriculum, and by conducting research to increase the agency's understanding of electronics and cybersecurity issues, enabling it to evaluate issues quickly and accurately and provide information to guide agency policy decisions. This program also has the potential to evaluate the functional safety of safety critical components in emerging crash avoidance technologies and driving automation systems. This work primarily contributes to the strategic goal of safety within NHTSA and the Department.

Collaboration Partners:
FY2024 external collaboration partners in the area of vehicle cybersecurity include the Auto-ISAC, original equipment manufacturers and suppliers, technology companies, standards development organizations, other government agencies, other modes within the Department of Transportation, and potential institutions of higher education, including historically black colleges and universities for sustained cybersecurity education programs. FY2024 external collaboration partners in the area of vehicle electronics include original equipment manufacturers and suppliers, technology companies, standards development organizations, other domestic and international government agencies, other modes within the Department of Transportation (FMCSA, FHWA, OST, ITS-JPO), and potential institutions of higher education.

Automated Driving Systems
$20.172M (Base funding $12.172M + Supplemental $8M)

Program Description:
This research program area includes the following focus areas: 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. Note: specific crashworthiness ADS research projects are cross-referenced under the Crashworthiness program area. NHTSA works to research and identify safety assessment methods for the agency to effectively oversee the safety of ADSs as they hold the potential to improve safety of the traveling public.

Major Program Objectives:
The major program objectives of the ADS research program area continue to focus on: building the knowledge to support Agency decisions with respect to regulatory updates needed to enable innovative concepts, developing the necessary tools and knowledge to evaluate the safety of these systems, and performing the research necessary to determine if current tools and test procedures can properly evaluate the safety of new vehicle designs (from passenger vehicles to commercial motor vehicles). The program will conduct core research in the areas of ADS safety performance, crashworthiness, and human factors. Research activities are consistent with the strategic safety research and policy objectives of the Department of Transportation.

Anticipated Program Activities:
- *ADS Safety Performance*: 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 scientific 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 evaluate and compare existing safety performance metrics, as part of research looking at a broad array of safety evaluation frameworks that have been developed by government, academic, and industry stakeholders. Research will continue related to ADS-equipped vehicle subsystems, including methods for examining performance of ADS sensor, perception, and execution systems. 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*: See Crashworthiness Research program section for summary of this activity area.
- *Human Factors*: ADS-equipped vehicles and ADS-dedicated vehicle (ADS-DV) designs will likely influence humans' interactions with vehicles. In 2024, the Agency will continue to investigate emerging ADS human factors topical areas (e.g.,

transition of control between human and computer drivers, issues related to telltales, controls, and indicators for ADS-equipped vehicles, driver vigilance, etc.).

- *Safety and Accessibility for People with Disabilities*: This activity will address safety research for accessible design to improve securement for people who use wheelchairs. Research will look at enhancing safety in rear impact crashes for occupants in manual and power wheelchairs. This work will also continue to explore ADS-equipped vehicles, vehicle electrification, and other human factors design needs for people with disabilities. As vehicle automation (and technology in general) progresses, NHTSA has an opportunity to lay the groundwork for accessible design in a way that has not previously been afforded. Until present, those with disabilities have been put in a position to retrofit their own vehicles with expensive modifications. As ADS-equipped vehicles deploy and/or enter the consumer marketplace, there is an opportunity to perform the foundational research to understand how to design vehicles that are both accessible and safe (both for personal ownership and shared mobility options). Such forward looking and innovative designs may ultimately lead to people in wheelchairs being secured as occupants in a way that is as safe as non-chair users.

Potential Program Outputs, Outcomes, and Impacts on Technologies and Practices: NHTSA's research program is focused on providing the technical information and tools needed to advance the safe testing, development, and deployment of ADS-equipped vehicles. ADS-equipped vehicles may offer access to mobility for previously underserved communities of individuals unable to acquire a driver's license, including older adults and people with disabilities –cognitive, physical, and/or sensory. It is envisioned that ADS technologies could be utilized to provide safe transportation options for the traveling public at large. In FY 2024, NHTSA plans to produce research reports that are supportive of Agency considerations about potential updates to the Federal Motor Vehicle Safety Standards (FMVSSs) and associated test procedures to accommodate non-standard vehicle design concepts. Research will also be sponsored and conducted that supports improved transparency, development of objective safety performance evaluation methods, and a data-driven approach to safety assessments of this new promising technology.

Below is a listing of Automated Driving Systems Research anticipated program outputs for FY 2024:

- *FMVSS Considerations for ADS-dedicated vehicles*: Publication of additional research report(s) on FMVSS considerations for ADS-dedicated vehicles for outstanding standards, as well as supporting research options for compliance test procedures.
- *ADS Subsystems*: Publication of research associated with a sensor characterization study for ADS-equipped vehicle perception systems; an introductory report on artificial intelligence, specific to driving automation systems; a report on operational safety concepts for Level 4 ADS fleets.
- *On-Road Testing and Data Collection*: Publication of a report describing the development and testing of a ground truth trip recorder tool for light vehicles equipped with ADS. Completion of a report on development and testing of a ground truth trip recorder tool for heavy vehicles.

- *Human Factors Considerations:* Continued research on gathering human subject data on driver seating preference in ADS-equipped vehicles. Publication of a report on trust and mental models in ADS-equipped vehicles. Publication of a report reviewing legacy telltales used to communicate information to the driver or other occupants in a vehicle for their applicability to vehicles equipped with ADSs. Publication of a report evaluating transition of control and post-transition driver performance in SAE Level 3. Publication of a report on methods of remote operation following a system failure with ADS vehicles in shared mobility applications.
- *Safety and Accessibility of ADS-Equipped Vehicles for People with Disabilities*: Publication of a report on considerations for making ADS-equipped vehicles accessible for all.

Potential Economic or Societal Impacts:
The potential economic impacts of this research may lead to advancing the safe introduction of ADS-equipped vehicles that could ultimately result in a significant reduction in motor vehicle crashes and associated costs. This could further result in other economic reductions in hospitalizations, needed emergency medical services (EMS), automotive repairs, insurance premiums, etc. The potential societal impacts could include safer mobility, reduced congestion from motor vehicle crashes, improved accessibility options for older persons and persons with disabilities, as well as environmental improvements.

Potential Progress Made Toward Achieving Modal Strategic Goals:
ADS research activities and outputs, such as the development of on road testing tools for ADS-equipped vehicles, primarily address NHTSA/Department strategic goals related to safety. Additionally, numerous planned research activities and outputs also address equity and accessibility for all in ADS-equipped vehicles.

Collaboration Partners:
FY2024 external collaboration partners in the area of ADSs include original equipment manufacturers and suppliers, technology companies, standards development organizations, other domestic and international government agencies (including the Access Board, the National Institute of Standards and Technology, etc.), respective modes within the Department of Transportation (FMCSA, FHWA, OST, ITS-JPO), and potential institutions of higher education.

Advanced Safety Technologies
$52.145M (Base funding $27.145M + Supplemental $25M)

Program Description:
This research program area focuses on motor vehicle technologies and systems that aim to prevent crashes and assist drivers in performing the driving task, commonly referred to as advanced driver assistance systems (ADAS). ADAS technologies covered in this program primarily include SAE Level 0 systems (active safety systems such as automatic emergency braking – AEB) through SAE Level 2 systems, which can provide both longitudinal and lateral operational control with the expectation that the driver will monitor and supervise system performance. SAE Level 2 systems are a significant, emerging safety area within driving automation technologies. The research covers a wide range of motor vehicles from passenger vehicles to large trucks and buses to motorcycles. This research program area continues to cover advancements in conventional crash avoidance technologies (e.g., tires, brakes, mirrors), as well as more advanced vehicle technologies targeted to improve the safety of vulnerable road users (e.g., pedestrian AEB). It also studies the potential role and impacts of connectivity in vehicle safety.

Major Program Objectives:
The main program objectives are to lead national safety research to advance and accelerate the deployment of safety beneficial ADAS across the U.S. automotive fleet. The program is focused on safety systems and innovations that directly map to crashes involving light and heavy vehicles, pedestrians, bicyclists, motorcyclists, and other vulnerable roadway users. Research is conducted with the objectives of attaining a comprehensive understanding of all ADAS enabling technologies, such as underlying sensors and algorithms. Research also encompasses quantifying ADAS performance, capabilities, limitations, effectiveness, and potential new risks for all classes of vehicles and all roadway users. The program will continue to focus on applied research that develops test procedures and supports agency policy decisions on market ready/deployed technologies, as well as more advanced research on emerging technologies and innovative safety systems that show potential to address real world crashes and improve vehicle safety performance, including those that detect and react to vulnerable road users, such as pedestrians, bicyclists, and motorcyclists.

Anticipated Program Activities:
- *ADAS Innovation and Deployment:* Research on emerging, innovative crash avoidance technologies that have the potential to address a wide range of challenging real-world crash scenarios resulting in fatalities and serious injuries involving light and heavy vehicles, pedestrians, bicyclists, motorcyclists, and other vulnerable road users. Research on operational design domain (ODD) specific behavioral competencies of driver assistance (SAE Level 1) and partial driving automation (SAE Level 2) systems focusing on nominal and critical scenarios for safe deployment. Research on other new and advanced safety technologies supporting the U.S. DOT NRSS and Vision for Roadway Safety such as intelligent speed assistance (ISA) and connected vehicles (V2X).

- *Driver Distraction from In-Vehicle Technology Interfaces:* In FY 2024, NHTSA will fund new research examining the impact on driver distraction from in-vehicle technology interfaces. Since NHTSA's original distraction guidelines were issued, the proliferation of touchscreen controls (including menu driven offerings for traditional driving related tasks), voice controls, passenger-side video streaming, converging trends in dashboards and infotainment displays, gaming options, e-commerce, mobile device integration, etc., research has evolved to frame vehicle system-influenced distraction differently, in the form of driver attention management. This research will explore safety benefits related to monitoring and measuring drivers' visual gaze and implement mitigation strategies to direct attention back to the roadway as necessary for the driving environment.
- *Driver Engagement and ADAS*: Continue SAE Level 2 driving automation research focusing on examining drivers' state of vigilance to resume control when necessary. Human factors 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. It will also include performance testing for emerging ADAS technologies such as lane keeping assist. Development of draft research test procedures will begin to better understand the performance of technology that can detect alcohol from a passive breath and detect impairment from indirect driver monitoring systems.
- *Vehicle Size and Weight Impacts on Pedestrian Safety:* In FY 2024, NHTSA will conduct research to advance pedestrian safety and examine how it is impacted by vehicle size and weight. NHTSA will study how vehicle size, weight, and shape affect fatality and injury in struck pedestrians. This study should isolate and understand the effects of vehicle weight and geometry on pedestrian crash risk and develop targeted research, conduct data collection, analysis, simulation and testing to improve understanding of how vehicle characteristics affect injury outcomes for struck pedestrians.

Potential Program Outputs, Outcomes, and Impacts on Technologies and Practices: The potential program outputs of this effort will be research findings and data on advanced safety technologies that can enhance motor vehicle safety and support the U.S. DOT NRSS and Vision for Roadway Safety. Through proactive and collaborative research with internal and external stakeholders, deployment of state-of-the-art advanced safety technologies can be accelerated to significantly reduce crashes, fatalities, and injuries. A potential outcome for ADAS technologies is that key hardware (e.g., perception sensors) eventually becomes standard equipment on motor vehicles such that future safety enhancements (e.g., new requirements representing real-world crash scenarios) can be addressed through highly cost-effective software updates. Further, ADAS hardware and software may be at, or approaching, the required capabilities to effectively address many of these crash scenarios based on relevant industry advancements with Automated Driving Systems (ADS, SAE

Levels 3-5) which are intended to perform the entire dynamic driving task. Although voluntary guidelines and commitments from industry are potential mechanisms to accelerate deployment, it is expected that rulemaking actions, and consumer information programs will be additional key implementation approaches for these advanced safety technologies. Potential impacts from this program area may also include key technical information for use in investigating potential defects in hardware and software and assisting in safety recalls or other consumer complaint issues.

Below is a listing of Advanced Safety Technologies anticipated program outputs for FY 2024:

- *Bipartisan Infrastructure Law (BIL) Requirements*: Publication of report(s)/data on continuing research to support light and heavy vehicle Automatic Emergency Braking (AEB) rulemakings, including motorcycle and bicycle AEB testing, high-speed and head-on AEB testing, and heavy vehicle AEB driver consultation, as well as additional testing on AEB repeatability/reproducibility and research testing on pedestrian AEB for heavy vehicles. Publication of report(s)/data on continuing research to support automatic shutoff rulemaking on carbon monoxide poisoning, rollaway prevention, illegal school bus passing technology, driver distraction mitigation, and a technological scan covering the state-of-the-art landscape of advanced drunk and impaired driving prevention technologies.
- *ADAS Innovation and Deployment*: Publication of reports(s)/data on motorcycle crash avoidance technologies, smart tire ID durability, ADAS data logging research, and results from a field operational study of L2 technology.
- *Driver Monitoring Systems*: Publication of a report on driver monitoring systems, a technology that is becoming more prevalent in vehicles, especially to support SAE Level 2 driving automation systems.
- *Collision Warning Systems*: Publication of a report exploring heavy vehicle collision warning interfaces.
- *Lane Keeping:* Publication of research on Lane Keeping Assist systems building on past research from Lane Departure Warning research.

Potential Economic or Societal Impacts:

The potential economic impacts of this program area are expected to be positive and based on reduced crashes, fatalities, and injuries through the deployment of advanced safety technologies. Many of these technologies have hardware and software components that may allow future safety enhancements (e.g., new requirements) to be addressed through software updates without required changes to the hardware equipped on the vehicle. This may enable more positive economic impacts through software-driven implementation of new safety requirements at relatively lower cost. Further, some of these software updates could potentially be applied to existing vehicles in the fleet through voluntary commitments. The potential societal impacts of this program area are expected to be positive and based on equitable access and performance of advanced safety technologies. Research activities in this program area will facilitate and accelerate the development and deployment of crash avoidance technologies which may reduce system costs through economies of scale.

Potential Progress Made Toward Achieving Modal Strategic Goals:
The primary goal of this program area is to advance the safety of motor vehicles and support the U.S. DOT NRSS and Vision of Roadway Safety. Advanced safety technologies are important enablers to achieving zero roadway fatalities, as the systems are intended to collectively address a wide range of real-world crash scenarios, driver distraction and engagement, speeding, and other crash contributors. A secondary goal of this program area is equity, as the technologies must be capable of performing equitably across the diverse population of drivers, occupants, and vulnerable road users to be effective in significantly reducing crashes, fatalities, and injuries.

Collaboration Partners:
Collaboration partners in the areas of advanced safety technologies include NHTSA research contractors, original equipment manufacturers, technology suppliers and developers, standards development organizations, other domestic and international government agencies, industry associations, respective modes within the Department of Transportation (FMCSA, FHWA, OST, ITS-JPO), and academia, including equitable institutions of higher education. Collaboration with key industry players will be essential in understanding and evaluating the capabilities and limitations of state-of-the-art advanced safety technologies to accelerate deployment and reduce crashes, fatalities, and injuries.

Crashworthiness
$24.514M (Base funding $10.514M + Supplemental $14M)

Program Description:
The Crashworthiness Research Program at NHTSA supports agency deliberations on motor vehicle crash safety and associated occupant and road user injury causation and outcomes. The program considers how vehicle crashworthiness countermeasures can reduce fatalities and injuries resulting from motor vehicle crashes. Research first seeks to understand the causes and consequences of crash-induced injuries. This understanding in part comes from the real-world data and in-depth investigations of occupant and pedestrian injury cases done by NHTSA's Crash Injury Research and Engineering Network (CIREN). Given data-driven safety needs, the Crashworthiness Research program explores both experimental biomechanics efforts to study human injury response and efforts to develop advanced crash testing tools such as anthropomorphic test devices (crash dummies) and human body models (HBMs). Finally, these testing tools often get applied in new crash test protocols along with enhanced injury metrics, both of which are also significant outputs of this program. Current efforts include an emphasis on equity in crash safety (i.e., considerations for different sex, size, and age). This emphasis includes the development, evaluation, and documentation of advanced female crash test dummies. Research will also support the development and application of pedestrian test procedures to assess how vehicle design countermeasures mitigate pedestrian injuries. The crashworthiness considerations of ADS-equipped vehicles, including occupant response in nonconventional seating configurations, is also a topic of research.

Major Program Objectives:
NHTSA's Crashworthiness Research Program directly supports the Agency's mission in reducing motor vehicle crash-related injuries and fatalities on U.S. roadways, continuously assessing the potential of various approaches (e.g., collection and analysis of real-world crash data, development and evaluation of new testing tools, development and demonstration of new crash test procedures and protocols, and injury criteria) that can be deployed for use in encouraging (e.g., NHTSA's New Car Assessment Program or NCAP) and/or requiring (e.g., FMVSS) advancements in the development of crashworthiness safety technologies.

Anticipated Program Activities:
- *Bipartisan Infrastructure Law (BIL) Requirements*: BIL crashworthiness research requirements include evaluating the effectiveness of rear guard designs on semi-trailers to prevent underride at high speeds; research into the development of safety standards for side impact protection, roof crush resistance, and airbag systems for the protection of occupants in limousines as well as safety features and standards that aid evacuation; conducting research to support a NHTSA advanced notice of proposed rulemaking to update the standard to mitigate occupant injuries of vehicles by evaluating test procedures and performance metrics for dynamic assessment of seat strength in moderate-to-higher speed rear impacts; and research to identify circumstances leading to pediatric vehicular heatstroke, development of

test protocols mimicking those scenarios, evaluating tools to assess both alerts and detection systems, and deriving performance requirements for rear seat reminder systems.

- *Advanced Crash Test Dummies and Experimental Biomechanics Research*: Research will continue the development and documentation of advanced anthropomorphic test devices (ATDs) (THOR 50th percentile adult male, THOR 5th percentile adult female, WorldSID 50th percentile adult male, LODC – large omnidirectional child, BioRID – biofidelic rear impact dummy). In FY 2024, efforts will include a specific focus on the development and testing of the WorldSID 5th percentile adult female side impact ATD. Efforts include integration of these tools into test procedures with enhanced injury metrics. Crashworthiness Research also supports the collection and analysis of human response and injury tolerance associated with motor vehicle crashes.
- *Equity in Crash Safety*: Crashworthiness Research is emphasizing female crash safety, including updated analyses of real-world injury and fatality data. Efforts include collection of small and average-sized female-specific impact response and injury risk in simulated motor vehicle crash environments; collection and application of anthropometry and seating preference data; efforts to develop, document and demonstrate the use of advanced female crash test dummies; and computer model-based studies of vehicle safety countermeasures to supplement physical testing. Equity efforts also consider other affected road users including those considered more vulnerable (e.g., older or obese).
- *Real-world Crash / Injury Data Analysis / CIREN Program*: Research activities include collecting, reconstructing, analyzing, and publishing 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); and completing analyses of injury outcomes using real-world crash data, including risk and injury odds modeling as well as projections for future crash data-based estimates.
- *Crashworthiness of Vehicles with Automated Driving Systems*: In FY 2024, research will continue to refine the understanding of human response and injuries for various-sized occupants in forward- and rear-facing reclined seating conditions and consider side-facing seating currently available in limousines. Efforts will use HBMs to evaluate occupant restraints for the range of seating conditions expected in new ADS designs, while also evaluating effects of restraint type on occupant outcomes in a side-facing configuration, informing on restraint design considerations for limousines. ATDs, including the THOR-50M, are being adapted under this effort for use in forward- and rear-facing reclined seating configurations. Research will also include assessments of the injury risk posed to children by a deploying airbag when seated in the traditional driver's seating position in an ADS-equipped vehicle. Finally, research will continue to evaluate best practices for safe interaction of non-occupied ADS-equipped vehicles with existing vehicles, roadside hardware, pedestrians, cyclists, and motorcyclists.
- *Database Modernization*: Database-related research activities include implementation of a data loading portal to allow crash test facilities to upload data,

photos, videos, and reports directly to NHTSA's Vehicle, Biomechanics, and Component test databases; implementation of a Crash Avoidance database and incorporation into NHTSA's existing Crash Test Database website and data loading portal; and development of a modernized web-based interface to existing signal analysis tools to facilitate analysis of data in the NHTSA Crash Test Database.

- *Virtual Testing / Computational Biomechanics / Machine Learning*: Crashworthiness research supports development and application of HBMs to investigate occupant and pedestrian crash safety, occupant demographics, and injury outcomes not well represented in current regulatory or consumer information crash testing programs; and demonstrating machine learning-based crashworthiness applications including predicting head kinematics and real-world crash characteristics using video and image data. In FY 2024, research efforts will include a focus on the development and demonstration of virtual testing protocols that include HBMs, culminating in a safety rating that combines physical and virtual testing.
- *Vulnerable Road Users*: In FY 2024, Crashworthiness Research will investigate the applicability and objectivity of pedestrian test procedures for applications in FMVSS and NCAP, including the evaluation of new test devices. Research efforts will also include an assessment of occupant-less delivery vehicle interaction with pedestrians, injury outcomes, and influential vehicle structural design characteristics; examination of how the size of a vehicle affects the risk of injuries to pedestrians; real-world data analysis examining the degree to which vehicle crashworthiness designs and requirements for pedestrian crash safety affect injury outcomes; and conducting tests on motorcycle helmets using both established (FMVSS No. 218 – Motorcycle Helmets) and novel test conditions.
- *Child Safety*: Crashworthiness Research will support updates to FMVSS No. 213 (Child Restraint Systems) child restraint evaluation test procedures, including implementation of advanced child ATDs, development of seating procedures, and updates to the restraint configuration to better reflect today's vehicle rear seat environment.
- *Occupant Protection*: Crashworthiness occupant protection activities include testing to evaluate head protection (FMVSS No. 201 – Occupant Protection in Interior Impact) in lower interior areas of the rear seat occupant compartment including front seat back and b-pillars; development of seating procedures and evaluation of advanced ATDs for use in frontal and oblique crash testing (FMVSS No. 208 – Occupant Crash Protection/NCAP); investigating the use of the ECE R16 (Seat Belts) dynamic test configuration as an option to current quasistatic FMVSS No. 209 (Seat Belt Assemblies) test condition in assessing belt elongation performance; development of seating procedures and evaluation of advanced ATDs for use in side crash testing (FMVSS No. 214 – Side Impact Protection/NCAP); and investigating barrier designs to improve objectivity in an offset-oblique frontal crash test suitable for an NCAP or regulatory occupant safety assessment.
- *Vehicle Structural Integrity*: Research activities include evaluating vehicle glass technologies using various test configurations that assess penetration/fracture resistance (FMVSS No. 205 – Glazing Materials); examining large sunroof systems to determine whether current structural integrity requirements for roof crush (FMVSS

No. 216 – Roof Crush Resistance) or occupant ejection (FMVSS No. 226 – Ejection Mitigation) need to be altered; and developing a motorcoach rollover test configuration to conduct FMVSS No. 227 – Bus Rollover Structural Integrity compliance testing.

Potential Program Outputs, Outcomes, and Impacts:

Crashworthiness Research produces various outputs that support modal priorities (e.g., considerations for development and application of new crash test dummies in FMVSSs and/or NCAP). The outputs under the respective Crashworthiness research activities aim to provide data, knowledge, tools, and/or test procedures that can impact motor vehicle safety efforts aimed at reducing injuries and fatalities associated with motor vehicle crashes.

Below are the Crashworthiness Research anticipated program outputs for FY 2024:

- *Bipartisan Infrastructure Law (BIL) Requirements:* Publication of report(s)/data on efforts that include evaluation of rear impact guards designed to prevent truck underride; modelling of a stretch and a van-based limousine; limousine crash test results; test procedures for vehicle rear seat reminder systems designed to prevent pediatric heat stroke; and testing to develop a dynamic seat back strength procedure.
- *Advanced Crash Test Dummies and Experimental Biomechanics Research*: Publish advanced ATD technical documentation, including injury criteria development reports/data, and vehicle crash test data/reports; publish data/reports covering various experimental biomechanics research efforts (midsize male, small female, and obese occupants in upright and reclined seats; small female occupants in rear-facing upright and reclined seats; small female neck and thorax response in various test conditions).
- *Equity in Crash Safety:* Publish series of technical reports describing field data case studies/injury risk analysis, assessment of variability/research findings regarding considerations for an average female crash test dummy.
- *Real-world Crash/Injury Data Analysis/CIREN Program:* CIREN annual findings report, research project publication/presentation and publication of case data.
- *Crashworthiness of Vehicles with Automated Driving Systems*: Publish technical documentation for reclined THOR 50th male dummy; publish report documenting risk of children sitting behind steering wheel in ADS-equipped vehicles; publish report on pedestrian safety in crashes with occupant-less ADS-equipped delivery vehicles.
- *Database Modernization*: Launch web-based portal to facilitate test data upload to NHTSA's Vehicle, Biomechanics, and Component test databases; publish source code for modernized web-based interface to existing signal analysis tools to facilitate analysis of data in the NHTSA Crash Test Database.
- *Virtual Testing/Computational Biomechanics/Machine Learning:* Publish report(s) summarizing a framework and demonstration for virtual testing as a supplement to

physical crash testing; report to include considerations for the number of HBMs and crash conditions to evaluate using virtual testing based on real-world data.
- *Vulnerable Road Users*: Publish reports on repeatability and reproducibility assessment of pedestrian headform and legform impact test procedures; Library of Congress meta-data on studies of vehicle size and pedestrian injury risk, vehicle design trends, and pedestrian crash data sources; and data associated with testing of motorcycle helmets in various configurations.
- *Child Safety*: Publish data on comparison of FMVSS No. 213 (Child Restraint Systems) surrogate retractor performance with OEM rear seat retractors
- *Occupant Protection*: Publish reports/data on topics that include comparison of static FMVSS No. 209 (Seat Belt Assemblies) and dynamic ECE R16 (Seat Belts) test methods for belt elongation evaluation; motorcoach rollover test fixture to conduct FMVSS No. 227 (Bus Rollover Structural Integrity) compliance tests; evaluation of vehicle glass performance using various test methods; and design of a progressive moving deformable barrier for use in an offset-oblique frontal crash test.

Potential Economic or Societal Impacts:
The economic and societal impacts of Crashworthiness research is with respect to the potential benefits of the application of research outputs (e.g., new tools and test procedures) in efforts that aim to mitigate injuries and fatalities associated with motor vehicle crashes.

Potential Progress Made Toward Achieving Modal Strategic Goals:
Crashworthiness research activities and outputs such as advanced crash test dummies and new vehicle and safety equipment testing protocols primarily address NHTSA/DOT strategic goals related to safety. Additionally, numerous planned research activities and outputs also address equity in motor vehicle crash safety.

Collaboration Partners:
FY2024 external collaboration partners in Crashworthiness Research include original equipment manufacturers and suppliers, technology companies, standards development organizations, other domestic and international government agencies, industry associations, respective modes within the Department of Transportation (FMCSA, FHWA, OST, FRA, and FTA), and numerous academic partners that NHTSA Crashworthiness often partners/contracts with to execute many of the Crashworthiness research activities described in this plan.

Alternative Fuels Safety
$10.314M (Base funding $2.314M + Supplemental $8M)

Program Description:
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 develop research projects to refine safety assessments and develop performance tests. Partnering with industry, other federal agencies, and the first responder community will assist NHTSA in the development of safety best practices for alternative fuels vehicles. This program will coordinate with the Department of Energy's research efforts to understand and enhance the safety of emerging energy storage systems.

Major Program Objectives:
NHTSA's Alternative Fuels Safety Research supports Federal efforts to ensure the safe introduction of electric vehicles in the US fleet. This program seeks to enhance in use and post-crash safety. This program considers safety for vehicle operators, emergency personnel, and the traffic incident management community (e.g., towing and salvage yard personnel).

Anticipated Program Activities:
- *Safety of Post Flood Electric Vehicle Systems:* Compare post flood vehicle inspections against specimens from submersion tests.
- *Advanced and Prototype Sensor Systems:* Evaluate the health and safety of vehicle battery systems.
- *Hydrogen Fuel Systems:* Conduct and evaluate performance tests to enhance hydrogen vehicle systems to evaluate safety for future vehicles.

Potential Program Outputs, Outcomes, and Impacts on Technologies and Practices:
- Publication of report(s)/data on efforts including evaluation of sensors for lithium-ion battery diagnostics, safety analysis for saltwater damaged battery electric vehicles, and heavy-duty vehicle battery crush test standards.
- *Report: Proceedings and recommendations from electric vehicle workshops.*
- *Report:* Development of heavy-duty vehicle battery crush test standards.

Potential Economic or Societal Impacts:
The automotive industry is experiencing a generational change in powertrain systems. This research is to inform agency decisions for a safe transition for the automotive fleet. This research directly supports the safety of emergency response and traffic incident management personnel and is advising the Federal Emergency Management Agency in response to saltwater flooding conditions.

Potential Progress Made Toward Achieving Modal Strategic Goals:

NHTSA is collaborating with the US Fire Administration to enhance best practices for responding to battery electric vehicle fires. NHTSA is updating its guidance for emergency response and traffic incident management personnel for dealing with battery electric vehicle incidents.

Collaboration Partners:

NHTSA is working closely with the Department of Energy, particularly Sandia National Laboratory, Idaho National Laboratory, and the National Renewable Energy Laboratory. NHTSA meets regularly with automotive original equipment manufacturers and battery manufacturers to discuss safety best practices and common areas of research. Internal to the Department, NHTSA collaborates with PHMSA.

Highway Safety Research
$33.767M (Base funding $13.567 + Supplemental $20.2M)

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 strategic goal through behavioral research 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.

This research program also supports the Department's Equity strategic goal 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, and young and older drivers. Further, the program aims to increase understanding of the disparities that exist in access to safe travel and the barriers that help perpetuate disparities, with the goal of increasing equity. The Highway Safety Research Program also aims to assess the data needs associated with understanding disparities 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 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 available as a safety option in new vehicles, like automatic emergency braking, lane departure warning, and other advanced driver assistance system (ADAS) technologies.

Lastly, Highway Safety Research funds the Behavioral Traffic Safety Cooperative Research Program (BTSCRP). BTSCRP, which is administered by the Transportation Research Board (TRB), 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 primary goal of the Highway Safety Research program is to increase the return on investment from NHTSA's Highway Safety Grant Program. 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.

The Highway Safety Research program 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. The Highway Safety Research Program also 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 conducts human factors research to explore how people use and misuse vehicle technology, including factors that may affect driver engagement with the driving task, 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:

- *Continuing and Emerging Areas:* In FY 2024, NHTSA expects to continue efforts to prevent drug- and alcohol-impaired driving, including exploring new ways to quickly identify emerging issues related to drugs, driving, and crash risk. Additional research will focus on conducting evaluations of existing national, State, and community behavioral countermeasures, including messaging, State laws, behavioral programs, and alternatives to traditional traffic safety enforcement. NHTSA also expects to conduct research on improving motorcyclist safety, protecting vulnerable road users like pedestrians, and preventing speeding. 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. DADSS technologies will continue undergoing rigorous field testing and systemic improvements as the Agency prepares to move from research to program development.

- *Human Factors:* Human factors research, particularly related to distraction, will 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.
- *Equity:* Equity will continue to be considered and addressed as a foundational part of the research process in FY 2024. Highway Safety Research will work to assess differences in risk among different members of the public, and, where gaps are evident, research will be conducted to determine ways to improve equity. Highway Safety Research will also consider how different countermeasures affect different populations and can be implemented in a fair, just, and impartial way.
- *BTSCRP Projects*: In 2024, 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, assemble panels to select contractors to perform the work, and 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 (SHSOs) and the way that they support NHTSA's highway safety grant programs. The primary **output** of the Highway Safety 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 research could be a multi-site demonstration project that includes a process evaluation of countermeasure deployment in actual practice, or the research could inform the assessment of the effectiveness of a countermeasure in *Countermeasures That Work*. Contributions to the body of evidence in *Countermeasures That Work,* in turn, affect 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 process is a cumulative reduction of deaths and serious injuries from traffic crashes.

A practical example of this research cycle is research that was conducted in 2010 to help understand the reach and public perception of NHTSA's paid media campaigns to deter impaired driving. 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 2024, 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. Research will 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 of 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) and reinforced in EO 14091 (*Executive Order on Further Advancing Racial Equity and Support for Underserved Communities Through the Federal Government*), 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 behavioral safety research project.

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 DADSS program primarily aligns with the transformation goal. 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 described in earlier sections of this document, NHTSA works collaboratively with the Governors Highway Safety Association (GHSA) to manage BTSCRP, a research program administered by TRB that aims to quickly conduct high-priority behavioral safety research with practical applications that, if effective, SHSOs 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.

Within the Department, NHTSA coordinates behavioral traffic safety research efforts with FHWA, FTA, FMCSA, and to a lesser extent, FRA through efforts such as the Human Factors Coordination Working Group and other informal activities.

Chapter 2 – FY 2025 RD&T Programs

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

Vehicle Electronics and Cybersecurity

Program Description:
This research program covers the functional safety and safety of the intended functionality (SOTIF) 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. Analyses related to SOTIF use industry standards (such as ISO 21448) for assessing reliability, safety and potential unintended consequences associated with advanced electronic control systems, software, and electro-mechanical systems due to misuse and/or misapplication of the systems beyond their intended functionality and operating domain. Vehicle Cybersecurity research deals with safety risk management associated with intentional manipulation of software, hardware, sensors, and associated communication networks onboard the vehicle. 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.

Major Program Objectives:
Given the rapid, accelerated pace of vehicle technology advancement and the related issues that result, such as cybersecurity, this program conducts the critical research activities that are necessary to maximize the safe deployment of both ADAS (SAE L0-2) and Automated Driving Systems (ADSs - SAE Levels 3-5) and ensure that key electronics issues such as cybersecurity are addressed. In FY 2025, the Vehicle Electronics and Emerging Technologies program will build upon research completed in FY 2024 and initiate new projects to close identified gaps in support of agency decisions on automated vehicle technologies, as well as electronics reliability and cybersecurity.

Anticipated Program Activities:
- *Functional Safety*: Research will examine the functional safety of interior driver monitoring systems that are designed to detect driver drowsiness, inattention, and incapacitation.
- *Cybersecurity – Zero Trust Models*: Publish cybersecurity research report on examination of zero trust cybersecurity methods and technologies in motor vehicle architectures.
- *Cybersecurity – Vehicle Infotainment Systems*: Publish research report on cybersecurity characterization of in-vehicle infotainment systems paired with mobile devices.

Automated Driving Systems

Program Description:
This research program area includes the following Automated Driving System focus areas: system level safety, safety metrics and safety assessment methods, considerations for alternative vehicle designs, and ADS human factors research, including accessibility considerations in ADS-equipped vehicles. NHTSA works to research and identify safety assessment methods for the agency to effectively oversee the safety of ADSs as they hold the potential to improve safety of the traveling public.

Major Program Objectives:
The major program objectives of the ADS research program area continue to focus on: building the knowledge to support Agency decisions with respect to regulatory updates needed to enable innovative concepts, developing the necessary tools and knowledge to evaluate the safety of these systems, and performing the research necessary to determine if current tools can properly evaluate the safety of new vehicle designs (from passenger vehicles to commercial motor vehicles). The program will conduct core research in the areas of ADS safety performance and human factors. Research activities are consistent with the strategic safety research and policy objectives of the Department of Transportation.

Anticipated Program Activities:
- *ADS preventative maintenance*: Complete research and publish report on preventive maintenance techniques for ADS-equipped vehicle safety.
- *ADS Test Methods*: Complete research and publish report on the development of test methods for vehicle localization systems.
- *ADS Seating Preference Research*: Complete research and publish report on ADS seating preference study.
- *ADS Perception Systems*: Complete research and publish report on ADS perception systems.
- *On-Road Testing and Data Collection*: Continued research on the light vehicle ground truth trip recorder for use with vehicles equipped with ADS.
- *Safety and Accessibility of ADS-Equipped Vehicles for People with Disabilities*: Complete follow-on study regarding considerations for making ADS vehicles accessible for all.

Advanced Safety Technologies

Program Description:
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.

Major Program Objectives:
The main program objectives are to lead national safety research to advance and accelerate the responsible deployment of safety beneficial ADAS across the U.S. automotive fleet. The program is focused on safety systems and innovations that directly map to crashes involving light and heavy vehicles, pedestrians, bicyclists, motorcyclists, and other vulnerable roadway users. Research is conducted with the objectives of attaining a comprehensive understanding of all ADAS enabling technologies, such as underlying sensors. Research also encompasses quantifying ADAS performance, capabilities, limitations, effectiveness, and potential new risks for all classes of vehicles and all roadway users. This program also encompasses safety technologies that may be able to monitor driver behavior and encourage fully attentive driving. The program will continue to focus on harnessing emerging technologies and innovative safety systems that show potential to address real world crashes and improve vehicle safety performance, including those that detect and react to vulnerable road users, such as pedestrians, bicyclists, and motorcyclists.

Anticipated Program Activities:
- *Crash Avoidance*: Research on emerging, innovative crash avoidance technologies that have the potential to address a wide range of challenging real-world crash scenarios resulting in fatalities and serious injuries involving light and heavy vehicles, pedestrians, bicyclists, motorcyclists, and other vulnerable road users.
- *Advanced Driver Assistance Systems*: Research on operational design domain (ODD) specific behavioral competencies of driver assistance (SAE Level 1) and partial driving automation (SAE Level 2) systems focusing on nominal and critical scenarios for safe deployment.
- *Other Advanced Safety Technologies*: Research on other new and advanced safety technologies supporting the U.S. DOT NRSS and Vision for Roadway Safety such as intelligent speed assistance (ISA) and connected vehicles (V2X).
- *Automatic Emergency Braking (AEB)*: Complete research and publish report on truck trailer target for assessment of automatic emergency braking systems. Continue research on heavy vehicle pedestrian automatic emergency braking systems.
- *Driver Distraction and Attention Management:* Continue research exploring the ability to objectively measure driver visual attention during the driving task and explore the influence of vehicle human machine interfaces (HMIs e.g., touch screens vs. knobs and dials) and increased vehicle information displays. This work also intends to explore ways in which drivers may be encouraged or incentivized to keep

attentive to the driving task (e.g., enclosed phone charging or driver performance gamification).

- *SAE Level 2 Driver Data:* Continue to gather naturalistic driver performance in a variety of production SAE Level 2 systems and prepare partial subsets of these data for sharing with other researchers.

Crashworthiness

Program Description:
The Crashworthiness Research Program at NHTSA supports agency deliberations on motor vehicle crash safety and associated occupant and road user injury causation and outcomes. The program considers how vehicle crashworthiness countermeasures can reduce fatalities and injuries resulting from motor vehicle crashes. Research first seeks to understand the causes and consequences of crash-induced injuries. This understanding in part comes from the real-world data and in-depth investigations of occupant and pedestrian injury cases done by NHTSA's Crash Injury Research and Engineering Network (CIREN). Given data-driven safety needs, the Crashworthiness Research program explores both experimental biomechanics efforts to study human injury response and efforts to develop advanced crash testing tools such as anthropomorphic test devices (crash dummies) and human body models (HBMs). Finally, these testing tools often get applied in new crash test protocols along with enhanced injury metrics, both of which are also significant outputs of this program. Current efforts include an emphasis on equity in crash safety (i.e., considerations for different sex, size, and age). This emphasis includes the development, evaluation, and documentation of advanced female crash test dummies. Research will also support the development and application of pedestrian test procedures to assess how vehicle design countermeasures mitigate pedestrian injuries. The crashworthiness considerations of ADS-equipped vehicles, including occupant response in nonconventional seating configurations, is also a topic of research.

Major Program Objectives:
NHTSA's Crashworthiness Research Program directly supports the Agency's mission in reducing motor vehicle crash-related injuries and fatalities on U.S. roadways, continuously assessing the potential of various approaches (e.g., collection and analysis of real-world crash data, development and evaluation of new testing tools, development and demonstration of new crash test procedures and protocols, and injury criteria) that can be deployed for use in encouraging (e.g., NCAP) and/or requiring (e.g., FMVSS) advancements in the development of crashworthiness safety technologies.

Anticipated Program Activities:
- *Bipartisan Infrastructure Law (BIL) Requirements*: In 2025, Crashworthiness Research will continue research in the following areas: evaluating the effectiveness of rear guard designs on semi-trailers to prevent underride at high speeds; development of safety standards for side impact protection, roof crush resistance, and airbag systems for the protection of occupants in limousines as well as safety features and standards that aid evacuation; research to support a NHTSA advanced notice of proposed rulemaking to update the standard to mitigate occupant injuries of vehicles by evaluating test procedures and performance metrics for dynamic assessment of seat strength in moderate-to-higher speed rear impacts; and identifying circumstances leading to pediatric vehicular heatstroke, development of test protocols mimicking those scenarios, evaluating tools to assess both alerts and

detection systems, and deriving performance requirements for rear seat reminder systems.

- *Advanced Crash Test Dummies and Experimental Biomechanics Research*: Research will continue the development and documentation of advanced ATDs and integration into new test procedures coupled with enhanced injury metrics. Crashworthiness Research will also continue supporting the collection and analysis of human response and injury tolerance associated with motor vehicle crashes.
- *Equity in Crash Safety*: Crashworthiness Research will continue to emphasize female crash safety research activities in FY 2025. Efforts will include the collection of small and average-sized female-specific impact response and injury risk in simulated motor vehicle crash environments; collection and application of anthropometry/seating preference data; efforts to develop, document and demonstrate the use of advanced female crash test dummies; and computer model-based studies of vehicle safety countermeasures to supplement physical testing. Equity efforts will continue to consider a wide range of occupants/road users.
- *Real-world Crash/Injury Data Analysis/CIREN Program*: In FY 2025, research will continue to collect, reconstruct, analyze, and publish real-world injury data from in-depth investigations of motor vehicle crashes involving occupants and pedestrians through the CIREN program and support analyses of injury outcomes using real-world crash data; activities involve risk modeling/assessment.
- *Crashworthiness of Vehicles with Automated Driving Systems*: In FY 2025, research will continue to refine the understanding of human response in forward- and rear-facing reclined and side-facing seating currently available in limousines. Efforts will use HBMs to evaluate occupant restraints for the range of seating conditions expected in new ADS-equipped vehicle designs, while also evaluating effects of restraint type on occupant outcomes in a side-facing configuration, informing on restraint design considerations for limousines. ATDs, including the THOR-50M, will continue being adapted under this effort for use in forward- and rear-facing reclined seating configurations. Research will continue assessments of the injury risk posed to children by a deploying airbag when seated in the driver's seat in an ADS-equipped vehicle.
- *Database Modernization*: Efforts will continue to support development of new web-based signal analysis tools to facilitate analysis and presentation of data in the NHTSA Crash Test Database, including THOR ATD post-processing and injury calculation, load cell wall analysis, and pedestrian protection hood area calculations.
- *Virtual Testing/Computational Biomechanics/Machine Learning*: In 2025, research will continue to support the development and application of HBMs to investigate occupant and pedestrian crash safety, occupant demographics, and/or injury outcomes not well represented in current regulated and/or consumer information crash testing programs. After demonstration of virtual testing protocols in 2023/2024, research will focus on the selection and continued development and demonstrated application of HBMs representing a wide range of motor vehicle occupants. Demonstration of machine learning-based applications in crashworthiness will continue in 2025.

- *Vulnerable Road Users*: In FY 2025, Crashworthiness Research will continue investigating the applicability and objectivity of pedestrian test procedures for applications in FMVSS and NCAP, including the evaluation of new test devices. Research efforts will also continue assessments of occupant-less delivery vehicle interaction with pedestrians, injury outcomes, and influential vehicle structural design characteristics; examination of how the size of a vehicle affects the risk of injuries to pedestrians; and real-world data analysis examining vehicle crashworthiness designs and requirements on pedestrian crash safety affect injury outcomes. Finally, in 2025 research will explore rotation-based test methods and performance criteria for motorcycle helmets.
- *Child Safety*: Continue research to support updates to FMVSS No. 213 (Child Restraint Systems), child restraint evaluation test procedures, including implementation of advanced child ATDs, development of seating procedures, and updates to the restraint configuration to better reflect today's vehicle rear seat environment.
- *Occupant Protection*: Occupant protection research in 2025 will continue to include testing to evaluate head protection in lower interior areas of the rear seat occupant compartment; development of seating procedures and evaluation of advanced ATDs for use in frontal and oblique crash testing; continue efforts to develop new methods to assess seat belt performance; continue development of seating procedures and evaluation of advanced ATDs for use in side crash testing; and continue investigating barrier designs to improve objectivity in an offset-oblique frontal crash test suitable for an NCAP or regulatory occupant safety assessment.
- *Vehicle Structural Integrity*: Research activities in 2025 targeting various FMVSSs will continue to include evaluating vehicle glass technologies using various test configurations that assess penetration/fracture resistance; examining large sunroof systems to determine whether current structural integrity requirements for roof crush or ejection mitigation need to be altered; and developing a motorcoach rollover test configuration.

Alternative Fuels Safety

Program Description:
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 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.

Major Program Objectives:
Alternative Fuels Research will continue to support Federal efforts to enhance safety for electric vehicles during operation, crash and post-crash. This research will continue to study the safe, design, use, repair and recycling of these evolving vehicle technologies.

Anticipated Program Activities:

- *Submersion:* Safety analysis of post-submersion battery systems.
- *Diagnostics:* Evaluation of sensors for early diagnosis of battery safety.
- *Solid State Battery Safety:* Failure mode analysis for emerging solid state battery systems.

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 available as a safety option in new vehicles.

Lastly, Highway Safety Research funds BTSCRP, administered by TRB, 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

- *Continuing and Emerging Areas*: In FY 2025, NHTSA will emphasize various areas based upon problem identification and research needs. Continued efforts are expected in preventing drug-impaired driving, speeding, child passenger safety, 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*: Human factors research, particularly related to drivers' use of technology, and the development and evaluation of other technology-based tools to improve driver safety, will 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 related to distraction. Feasibility research on the use of technology to influence older drivers' safe driving behavior will be initiated.
- *Alcohol Detection*: DADSS technologies will continue undergoing rigorous field testing and systemic improvements as the Agency prepares to move from research to program development.
- *BTSCRP Projects*: In FY 2025, 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