ANNUAL REVIEW

Stories of Transportation Innovation from the U.S. DOT Volpe Center

January
2025

U.S. Department of Transportation
Volpe Center

Contents

Cover photo Dave Burk © SOM

January 2025

Happy New Year!

I am pleased to share our annual update on the work of the U.S. Department of Transportation's John A. Volpe National Transportation Systems Center. This publication illustrates some of our more notable project work of the past year and underscores the Volpe Center's steadfast commitment to advancing U.S. DOT's mission and supporting its programs. Our extensive cross-modal, cross-agency partnerships have led to innovative solutions that advance a safer, more efficient, sustainable, resilient, convenient, and accessible national transportation system.

During 2025, the Volpe Center marks its 55th year of service to the nation. Since its establishment on July 1, 1970, the Volpe Center has proudly served 10 U.S. Presidents and 18 U.S. Secretaries of Transportation. As each administration worked to address the most compelling issues of the day, the Volpe Center emerged as a catalyst for innovation and a trusted federal partner, working to objectively address the most challenging issues facing our nation's transportation system. As a result, the Volpe Center maintains a unique historical perspective and institutional memory that positions us to meet the nation's transportation needs.

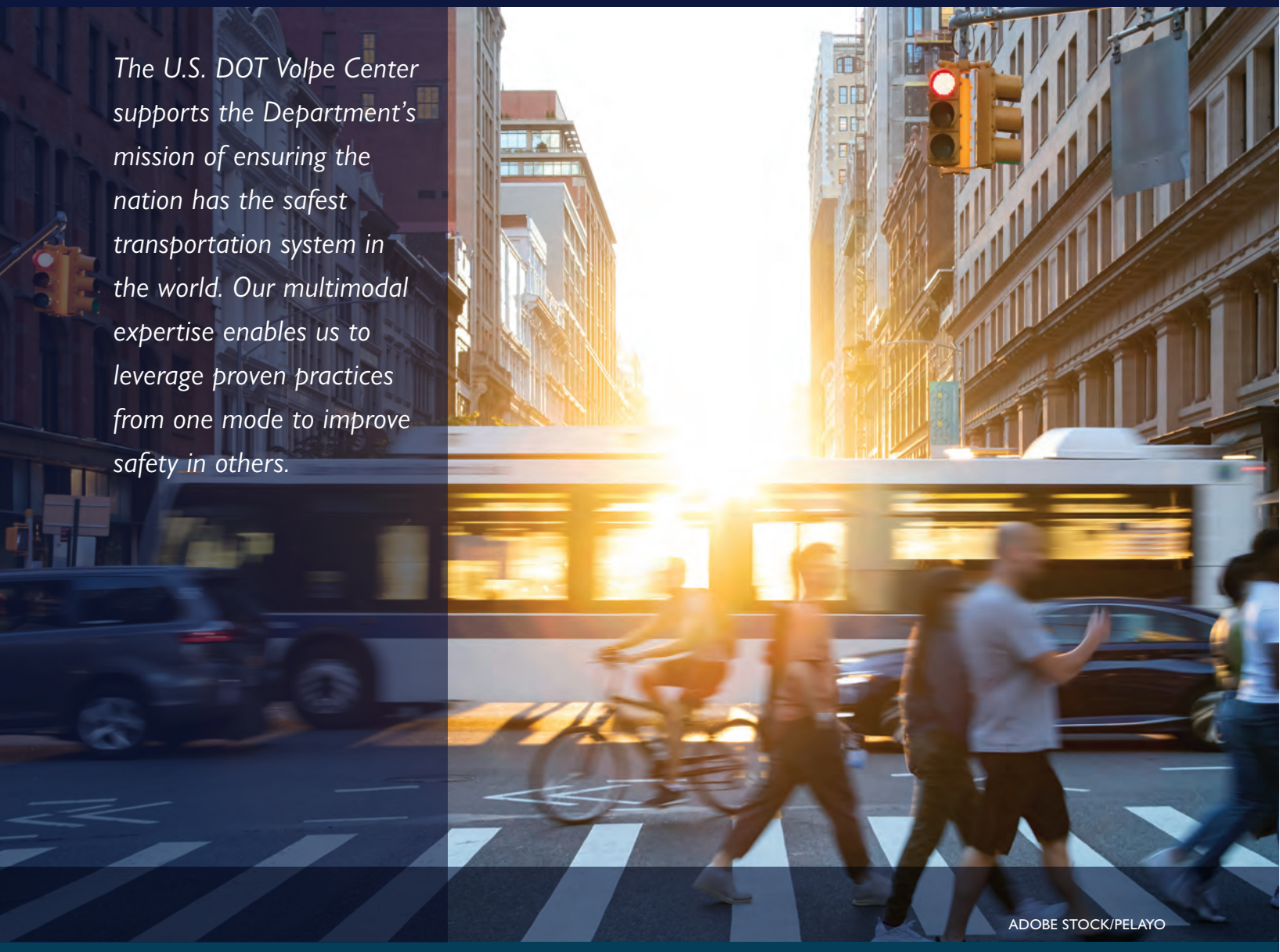
This year also marks my first year as Volpe Director. I never imagined when I joined the Volpe Center as a junior engineer over 30 years ago, that I would one day be asked to lead it. It is an honor and privilege to be given this opportunity, and I look forward to collaborating with our talented, multimodal, multidisciplinary workforce, our sponsors, both old and new, and all of you to advance the nation's transportation system for the public good.

Best wishes for a happy and healthy 2025!

Gregg G. Fleming
Director
U.S. DOT Volpe Center

Safety

The U.S. DOT Volpe Center supports the Department's mission of ensuring the nation has the safest transportation system in the world. Our multimodal expertise enables us to leverage proven practices from one mode to improve safety in others.



ADOBE STOCK/PELAYO

Analysis of Operational Data to Understand Pilot Response to Aircraft System Failures and Malfunctions in Air Carrier Operations

Enacted in December 2020, the Aircraft Certification, Safety, and Accountability Act (ACSAA) requires Federal Aviation Administration (FAA) to develop research requirements and goals for relevant areas of study. The FAA NextGen Human Factors Division (ANG-C1) engaged the U.S. DOT Volpe Center to address one such area: the analysis of operational data on air carrier pilot response to system failures, malfunctions, and systems not functioning as expected. The work completed by the Volpe Center will inform FAA personnel who develop and update guidance relevant to air carrier pilot training, operations, and procedures. This work also satisfies one of the important objectives described in the ACSAA, which was to build a research foundation for better integrating human factors findings into FAA regulatory processes and material.

ANG-C1 manages multiple research programs that produce scientific and technical information to support the human factors needs of FAA organizations. ANG-C1 and the Flight Standards Service Air Transportation Division, Training and Simulation Group engaged U.S. DOT Volpe Center human factors experts to compile and analyze research reports, operational data from safety incidents, and operational data from NASA's Aviation Safety Reporting System public database.

Data from normal flight operations show that airline pilots are regularly exposed to situations with system failures, malfunctions, and systems not functioning as expected. These were the types of situations faced by the flightcrews of the Lion Air 610 and Ethiopian Airlines 302 incidents (in 2018 and 2019, respectively) and other incidents such as US Airways 1549 (2009). For this research, the U.S. DOT Volpe Center team analyzed five public crash reports (Qantas 72, US Airways 1549, Qantas 32, Lion Air 610, and Ethiopian Airlines 302) as well as 20 curated records from the NASA database. Topics of interest to FAA included flightcrew procedures and checklists, flightcrew training, and flight deck alerts. The work included a comprehensive review of research literature about aircraft system problems, alerts and checklists, pilot training, and pilot response.

The U.S. DOT Volpe Center prepared a final report of its findings, Flightcrew Response to Aircraft System Failures, Malfunctions, and Systems Not Functioning as Expected. This report provides important context and perspective related to air carrier pilot response.

How do Flightcrews Respond to Aircraft Systems Failures?

ANALYZING OPERATIONAL DATA SHOWS HOW PILOTS HANDLE REAL SITUATIONS

FAA asked the **U.S. DOT Volpe Center** to study the pilot response of five air carrier accidents with major aircraft system failures. This work will help to integrate human factors findings into FAA regulatory processes and materials. One task was to conduct a comprehensive review of literature about:

- AIRCRAFT SYSTEM PROBLEMS,
- ALERTS AND CHECKLISTS,
- PILOT TRAINING, AND
- PILOT RESPONSE.

The Volpe Center Aviation Human Factors Team analyzed **five public accident reports** and 20 records from the **NASA Aviation Safety Reporting System** (ASRS) public database.

The U.S. DOT Volpe Center's Transportation **Human Factors team** prepared a final report that can inform **training, policy,** and **procedures** for air carrier training.

Flightcrew Response to Aircraft System Failures, Malfunctions, and Systems Not Functioning as Expected

U.S. Department of Transportation Volpe Center

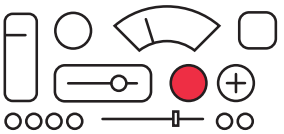
- The team developed a method for extracting and summarizing data about pilot response from operational reports and explored the limits of this method.
- They partitioned the research space (e.g., training, alerts, failure types) to understand the connections between unexpected system behaviors and pilot response.

WHAT ARE SOME KEY INSIGHTS FROM THE ACCIDENT ANALYSES?

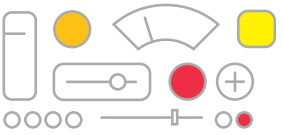
- Pilots are regularly exposed to aircraft system failures, malfunctions, and **unexpected behavior**.
- Many technological problems can be addressed, but **human behavior is much more difficult to change**.
- **Pilot experience** with unexpected situations in modern aircraft varies and will continue to evolve as the pilot workforce changes.

FIVE KEY OBSERVATIONS FROM THE ASRS RECORDS:

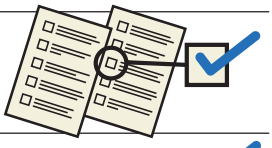
1. Determining **whether or not a malfunction has actually occurred** can be challenging.



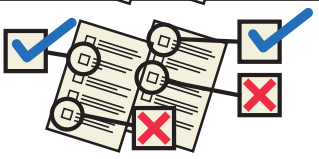
2. Diagnosing malfunctions can be difficult, **especially when there are conflicting indications** or intermittent malfunctions.



3. **Checklists** and standard operating procedures are often helpful.



4. However, checklists may be **insufficient** for diagnosing and resolving **multiple malfunctions**.



5. It is challenging for pilots to decide when to **stop troubleshooting the malfunction** and **begin planning to divert**.

01/2025

Transportation human factors experts pioneer new research focused on the relationships between humans and policies, processes, automation, and technologies to improve transportation safety, security, and productivity with due concern for unintended consequences.

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The U.S. DOT Volpe Center presented data from the incident reports at three levels of detail. First, a short summary of basic facts introduced the reader to the malfunctions and pilot responses that occurred. Second, a bulleted summary that focused on the flightcrew perspective, what they experienced, and how they responded to the malfunction and overall situation. Finally, detailed quotes gathered from the incident reports to support the summaries were provided in an appendix for readers to help them understand the full context of the accidents.

Volpe's aviation human factors experts made key observations about pilot response from the operational data and considered all aspects of pilot response, including its timeline relative to alerts and cues, detection/awareness, diagnosis and assessment, decisions, actions, communications, workload, task and resource management, coordination and communication, and even emotional responses. Volpe's research found that flightcrew responses involve decisions and actions under uncertainty. Operational factors such as time pressure and stress also affect pilot response.

The Volpe Center continues to support FAA and its efforts to continuously improve air carrier training, policy, and procedures. *(Sponsor: NextGen Human Factors Division, ANG-C1, FAA)*

The U.S. DOT Volpe Center's aviation human factors experts considered all aspects of pilot response, including its timeline relative to alerts and cues, detection/awareness, diagnosis and assessment, decisions, actions, communications, workload, task and resource management, coordination and communication, and even emotional responses.

Modernizing Aviation Safety by Building a Safety Assurance System Mobile Application for FAA Aviation Safety Inspectors

An estimated 2.9 million passengers fly into and out of U.S. airports every day.[1] To ensure the highest level of safety for the traveling public, FAA safety inspectors conduct oversight of airline operators, repair stations, and other regulated organizations. Since 2016, the Safety Assurance System (SAS) has been used to standardize data collecting, recording, analyzing, and risk-based decision-making to mitigate aviation safety-related risks.

SAS was created as a web-based desktop application. In many cases, safety inspectors print out data collection forms from a workstation, complete the analog forms at an airline location, repair station, or other inspection location, return to an office, log into the application, and record the data and findings into the SAS desktop application, which can be a long and cumbersome process.

1 FAA's Air Traffic Organization (ATO) fiscal year 2023 data.

FAA partnered with the U.S. DOT's Volpe Center to develop a SAS mobile application made available on government-furnished mobile devices. The SAS mobile application gives FAA safety inspectors the ability to capture real-time data while conducting their oversight at various locations.

During the initial phase of this project, which started in November 2021, U.S. DOT Volpe Center software developers focused on a custom mobile application for data collection. Developers collaborated with members of the U.S. DOT Volpe Center human factors team to ensure the application was developed using a human-centered design. Additionally, the team improved on current features such as incorporating the ability to add images and video media of observed incidents to data collection. Other improvements include a "Sticky Note" feature for notetaking, Offline Mode, an intuitive user interface (UI) designed specifically for Apple iOS devices, Dark Mode feature designed with cockpit visibility in mind, and more.

In support of FAA, the U.S. DOT Volpe Center has been involved with every aspect of developing the SAS mobile application which gives FAA safety inspectors the ability to capture real-time data.

The image below shows mock-ups of screen designs created by U.S. DOT Volpe Center experts for a specialized Data Collection Tool (DCT) inspection type called a "Custom DCT." The screens show questions inspectors might see when conducting oversight.

The U.S. DOT Volpe Center has been involved with every aspect of developing the SAS mobile application, from planning, conducting focus groups and interviews, and proposing the application's design to

developing the application's requirements and writing code. The team also managed the quality assurance and approval testing processes, engineered the software's release, and provided troubleshooting for user issues.

Last summer, the team "soft" deployed the SAS mobile application to 88 aviation safety inspectors who volunteered to field test the application. Volunteers were given 90 days to test and submit issues and feedback to the SAS Mobile Team. The feedback received helped the team adjust the application for final release. The application functioned well during beta-testing; only eight tickets/issues were logged by the volunteer testers.

In early 2025, the SAS Data Collection Mobile Application will be deployed for use by all 4,000 ASIs.

U.S. DOT Volpe Center IT and aviation specialists will continue to work with FAA during FY25 and plan three further releases of the SAS mobile application with the last release planned for summer 2025. *(Sponsor: FAA)*

Wake Turbulence Separation Minima for New Entrants into the National Airspace System

Every aircraft generates wake turbulence while in forward flight. Wake turbulence is the rotational movement of air created behind any aircraft under lift generation. The aviation industry is experiencing rapid pace in introducing new aircraft of both traditional as well as innovative and non-traditional designs into the National Airspace System (NAS). As a result, FAA needs a process to evaluate the effects of wake vortices for these new aircraft, particularly for Advanced Air Mobility (AAM) and Uncrewed Aircraft Systems (UAS).

The U.S. DOT Volpe Center has provided wake turbulence measurement and analysis expertise to FAA's Wake Turbulence Research and Development Program (WTR&DP), which has been instrumental in enabling FAA to make positive operational changes in the NAS. A Volpe team has supported research that ranges from weather-based dynamic wake turbulence separation involving existing (aircraft in service) fixed-wing vehicles to wake assessment of new aircraft entering service of both traditional and non-traditional designs. Examples of non-traditional aircraft studied by Volpe engineers includes DOD Group 5 UAS (such as MQ-9 Reaper) and AAM vehicles of different propulsion configurations. Wake turbulence research is particularly important because minimum separation required for safety between aircraft is determined by wake separation, not navigation or collision risks.

In 2022, the U.S. DOT Volpe Center substantially revised and updated a wake separation assessment analysis framework for FAA on new aircraft designs entering service in the NAS. Volpe engineers developed a data-driven and physics-based methodology to evaluate the wake turbulence hazards new aircraft may impose on other following aircraft and characterized the wake turbulence vulnerability of new aircraft following other aircraft. This methodology leveraged the large amount of wake turbulence data available from existing fixed-wing aircraft and fundamental aerodynamic laws to address the wake integration topic of new aircraft of diverse designs.

Last year, the Volpe Center team evaluated several traditional fixed-wing aircraft and provided separation recommendations to WTR&DP. These assessments provided the basis for FAA's WTR&DP's interdepartmental communications and for the global harmonization of wake separation of new entrants at the International Civil Aviation Organization level. Results were published and operationalized in phases, as reflected in FAA JO 7360.1H (March 2023) and the April 2024 version of JO 7360.1J–Aircraft Type Designators, which will be used by FAA and incorporated into automation systems.

The U.S. DOT Volpe Center also provided preliminary assessment on a number of AAM/electric vertical take-off and landing aircraft based on specific operational scenarios provided by stakeholders and FAA. Since the AAM industry is still evolving in terms of designs, concept of operations, and certification, wake findings are considered preliminary and not immediately operationalizable. However, these preliminary assessments are an essential part of the ongoing discussion on the integration of AAM into the NAS. (*Sponsor: FAA NextGen Wake Turbulence Research and Development Program, NextGen Mobile Technologies Program, NextGen Technology Development & Prototyping Division)*

Measurement equipment used by U.S. DOT Volpe Center engineers to collect the data needed to support a wide range of wake turbulence analyses. *Source: U.S. DOT Volpe Center*

Fire Protection and Life Safety in Airport Traffic Control Facilities

The U.S. DOT Volpe Center provides fire protection and life safety engineering support to FAA. This includes fire protection system and life safety design, testing, upgrade, commissioning, and quality assurance/quality control support at airport traffic control (ATC) facilities nationwide. By ensuring the safety of air traffic controllers and the resiliency of ATC facilities, the U.S. DOT Volpe Center's fire protection team provides expertise that protects occupant life, fulfills the mission of a safe and efficient national airspace, and ensures the safety of the flying public.

The Volpe fire protection team has provided subject matter expertise to various FAA fire protection and life safety projects for more than 20 years. Activities include fire protection system and life safety upgrades, design development and third-party review, standard development, fire life safety code compliance reviews, quality assurance/quality control services during installation, system condition assessments, and quick response to emerging field issues. FAA maintains the Terminal Facilities Design Standard (TFDS), which establishes design standards and technical criteria used in the programming, design, construction, measurement and verification, and documentation of new construction of Airport Traffic Control Towers (ATCTs), Terminal Radar Approach Control (TRACON) facilities, and associated buildings. The Volpe Center developed the fire protection and life safety requirements that are part of the TFDS.

The Volpe Center's fire protection team is currently supporting several FAA projects across the U.S.

- Conducted a fire life safety condition assessment at William J. Hughes Technical Center Building 301 Hangar completed in July 2024.

The U.S. DOT Volpe Center team designed a sprinkler system replacement and a fire/life safety upgrade package for the ATCT at Phoenix Sky Harbor International Airport. *Source: Adobe Stock / brent coulter*

- Designed, reviewed submittal documentation for, inspected the installation of, and participated in commissioning of fire sprinkler and life safety upgrades at Phoenix Sky Harbor International ATCT, which were completed in September 2024.
- Designed, reviewed submittal documentation for, inspected the installation of, and participated in commissioning of fire life safety upgrades at LaGuardia ATCT, which were completed in October 2024.
- Designed fire sprinkler and life safety upgrades at Phoenix P50 TRACON facilities with installation expected to begin in 2025.

FAA conducted a nationwide solicitation in 2021-2022 and selected Practice for Architecture and Urbanism (PAU) to design new airport traffic control towers at municipal and smaller airports across the nation. FAA intends to build 30 new towers by 2030, many of which will be based on the PAU design. The PAU-designed ATCT standard was finalized in 2024, with the U.S. DOT Volpe Center fire protection team providing fire life safety reviews and input on the fire life safety design and features. The Volpe team will continue to review facility designs, develop standards, and perform compliance reviews for new ATCTs and TRACONs in the coming years. *(Sponsor: FAA)*

Cyber Rodeo Considers Risk in the Aviation Ecosystem

The White House released the National Cybersecurity Strategy in March 2023 to secure the full benefits of a safe and secure digital ecosystem for all Americans. The strategy recognizes that robust collaboration, particularly between the public and private sectors, is essential to securing cyberspace. It also outlines two fundamental shifts in how the United States allocates roles, responsibilities, and resources in cyberspace. “Cybersecurity is essential to the basic functioning of our economy, the operation of our critical infrastructure, the strength of our democracy and democratic institutions, the privacy of our data and communications, and our national defense.”

The Aviation Cyber Initiative (ACI) is chartered by the secretaries of Defense, Homeland Security, and Transportation and aims to reduce cybersecurity risks and improve cyber resilience to support safe, secure, and efficient operations of the nation’s aviation ecosystem.

In collaboration with those departments, the U.S. DOT Volpe Center hosted an Aviation Cyber Rodeo to engage stakeholders on activities for reducing cyber risk within the aviation ecosystem. Forty-nine aviation cybersecurity stakeholders from the government, industry, and academic sectors attended the event in July 2024.

The U.S. DOT Volpe Center's Cyber Rodeo focused on adversarial Artificial Intelligence (AI) threats to cybersecurity and impacts on the aviation sector. Participants took part in technical sessions, demonstrations, and laboratory tours.

U.S. DOT Volpe Center research directors and project managers presented three research topics:

AI at the Volpe Center: Introduced the mission of the AI lab to respond to AI-related legislation, review requests, and produce quarterly briefings to share with the U.S. DOT Volpe Center community. The development of a framework for the Research, Development, and Technology Network and collaboration with the Office of the Secretary of Transportation to create a flexible and reusable cloud-based infrastructure was also discussed.

Positioning, Navigation and Timing for Safety Critical Systems, Resilience, and Cybersecurity: This session focused on national policy on position, navigation, and timing services, elevating PNT resilience with cybersecurity, and the baseline of aviation PNT services.

Building a Future Where Everyone Can Ride and Drive Electric: Provided an overview of the U.S. DOT Volpe Center's support to federal electric vehicle (EV) initiatives, current research activities developing EV charging infrastructure, and the related cybersecurity challenges.

The U.S. DOT Volpe Center has been supporting ACI efforts and events since 2016. *(Sponsor: Departments of Homeland Security, Defense, and Transportation)*

FAA's Aviation Cyber Initiative, Deputy Director Veronica Bunn addresses attendees at the Cyber Rodeo. *Source: U.S. DOT Volpe Center*

Testing Forward Collision Warning and Automatic Emergency Braking Systems in Heavy- and Medium-Duty Vehicles to Reduce Rear-End Crashes

More than 35,000 fatal vehicle crashes have occurred in the U.S. annually since 2020.[2] In that time, the numbers of vehicle miles traveled and vehicles registered increased, especially for light and large trucks. This growth in light and heavy truck operation increases the potential exposure of drivers to vehicle crashes.

Advances in vehicle safety technologies have the potential to reduce the likelihood of these crashes, including those attributed to driver behavioral factors (e.g., impairment, distraction, speeding, and inexperience). Forward collision warning (FCW) has the ability to alert a driver to an imminent rear-end crash with the vehicle ahead. If the warning system cannot elicit a sufficient response from the driver to intervene and maneuver to avoid a potential collision, automatic emergency braking (AEB) can intervene to reduce the impact speed or avoid the crash altogether. The deployment and adoption of these technologies in trucks can significantly reduce rear-end crashes.

A recent collaborative research study, Partnership for Analytics Research in Traffic Safety, between the U.S. DOT and car manufacturers indicated that almost half of rear-end crashes were prevented through installation of FCW and AEB in passenger cars. Another study conducted by the Insurance Institute for Highway Safety specific to pickup trucks, found that AEB was associated with a statistically significant 34 percent reduction in the risk of a rear-end-striking crash of any severity and with any injuries and a 76 percent reduction in the risk of a rear-end-striking crash with serious or fatal injuries. This same study indicated that rear-end-striking crashes involving pickups with FCW were significantly less likely to result in any injuries or serious/fatal injuries than those involving pickups without the system. These results provide more data on vehicles, test scenarios, and conditions to help understand the potential safety impact FCW and AEB can provide, specifically in larger commercial motor vehicles (CMVs).

2 National Highway Traffic Safety Administration. Quick Facts 2022. [Online]. Available: https://crash-stats.nhtsa.dot.gov/Api/Public/ViewPublication/813563. Accessed 11/13/2024.

The vehicle interior instrumentation (left to right) to collect warning and braking activation times from the vehicle dashboard; collect test data about the vehicle and its surroundings; safely and accurately repeat throttle and brake conditions. *Source: U.S. DOT Volpe Center*

The Federal Motor Carrier Safety Administration (FMCSA) asked the U.S. DOT Volpe Center to provide engineering expertise to improve the agency's understanding of the current state of FCW and AEB in large vehicles. The Volpe Center's engineering team defined the study's specific technical testing needs, including test procedures and conditions, and the equipment needed to meet FMCSA's data needs. The team helped the test contractor acquire appropriate test vehicles and testing equipment, outfitted the vehicles with proper instrumentation and data collection equipment, and verified and validated test runs and data.

During summer 2023, the study tested three production vehicles (two tractor-trailers and one large pickup truck) in five rear-end conflict scenarios (lead vehicle stopped, moving, decelerating, and two false positive tests), which included 21 dynamic scenarios (vehicle speeds,

These images show the strikable vehicle soft test target and robotic platform. The target replicates real-world vehicle characteristics and dynamics and is placed on the robotic platform. It is built with foam and vinyl pieces to replicate physical vehicle characteristics but is made to withstand higher vehicle impact speeds (by breaking apart). The top right picture shows the vehicle broken down next to the vehicle platform. *Source: U.S. DOT Volpe Center*

headways, and deceleration), resulting in 571 test runs of data. Each run produced 100-Hz data of more than 40 data channels. The vehicles successfully avoided these types of crashes and proved these systems can provide potential benefits. Following data collection, Volpe Center engineers assisted in data analysis to characterize FCW and AEB capabilities.

This work supports FMCSA's Automated CMV Evaluation (ACE) Program, and the U.S. DOT Volpe Center will continue to provide additional engineering and research support, analyzing the data to determine the outcomes surrounding FCW, AEB activation, and overall system performance in crash avoidance and severity mitigation in large trucks. *(Sponsor: FMCSA)*

Ensuring Commercial Motor Vehicle Drivers Are Certified to Operate on Our Nation's Roadways

The Commercial Motor Vehicle (CMV) industry is a major economic driver of the United States. The American Trucking Association's Economic Industry Data report indicates that truck shipments generated $987 billion in gross freight revenues in 2023, which represents 80.7 percent of all U.S. freight. CMVs transport essential goods and carry thousands of passengers across the country every day. One of many critical regulatory responsibilities of FMCSA is overseeing CMV operators and ensuring only qualified individuals drive CMVs on our nation's roadways.

In February 2022, FMCSA took a significant step to enforce compliance with the new Entry-Level Driver Training (ELDT) regulations, which set baseline training requirements for entry-level drivers. As of February 7, 2022, new applicants for Commercial Driver's License (CDLs) and CDL endorsements must complete a training program before taking a CDL test. The new ELDT regulations establish the federal minimum standard for the coursework a driver must complete, as well as the requirements a provider of entry-level driver training must meet.

To help stakeholders comply with the ELDT regulations, FMCSA collaborated with the U.S. DOT Volpe Center to design and implement the ELDT program. The U.S. DOT Volpe Center team provided program implementation planning expertise; engaged with stakeholders to ensure the new regulations were implemented by the February 7 deadline; developed and executed a communication and outreach plan; facilitated education and training sessions; and designed, developed, and launched the Training Provider Registry.

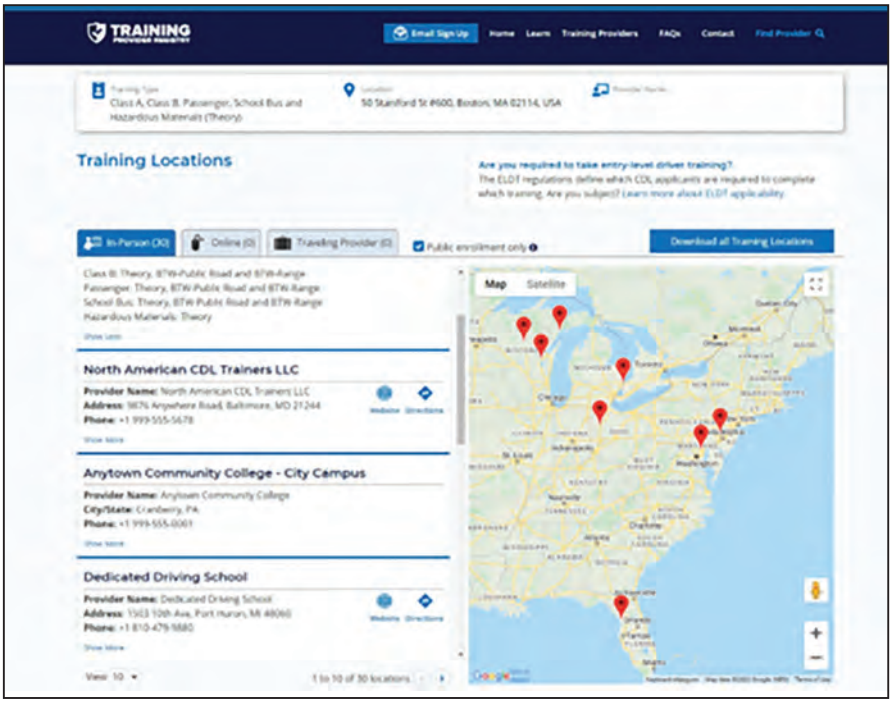
The Training Provider Registry is a web-based system that helps CDL applicants connect with training providers to complete the required entry-level driver training. The Training Provider Registry retains a record, submitted by training providers, of which CDL applicants have completed the required entry-level driver training. State Driver Licensing Agencies (SDLAs) access the Training Provider Registry before administering a CDL test to verify the applicant has completed all the required training.

A lot has happened since the initial launch of the Training Provider Registry in 2022 including the establishment of removal processes, expansion of technical assistance support, and monitoring and evaluation of the program.

As of October 2024:

- 37,743 training locations have been registered by 21,386 companies and organizations since registration opened in June 2021.
- 1,148,072 drivers have completed entry-level driver training and applied for a CDL/endorsement.

In step with the priority to identify and address occurrences of fraud, FMCSA focused on validating the list of training providers on the Training Provider Registry. FMCSA wanted to address when providers either accidentally or maliciously were not in compliance with all the



Example of FMCSA's Training Provider Registry displaying information and location of CDL trainers in the U.S. *Source: U.S. DOT Volpe Center*

requirements to identify as a training provider on the Registry. Removing non-compliant training providers is specified in the regulations.

As of October 2024, the program successfully:

- Removed 46 training providers from the Training Provider Registry.
- Closed 179 complaints regarding training providers.
- Reviewed 100 percent of the new training provider location registrations employing technical experts for adherence to state regulations rather than allowing training providers to self-certify.

The ELDT regulations represent a major milestone for FMCSA as they establish nationwide minimum requirements for individuals who are seeking to obtain a CDL or certain CDL endorsements for the first time. By standing up the Training Provider Registry to equip states with information about CDL applicants, the ELDT program brings together partners across the roadway community to ensure only qualified individuals are issued CDLs. The U.S. DOT Volpe Center will continue to support FMCSA in providing technical assistance, conducting communication and outreach, monitoring and evaluating the program, and providing continuous improvements to the ELDT program. *(Sponsor: FMCSA)*

Funding Regional, Local, and Tribal Initiatives to Prevent Roadway Deaths and Serious Injuries

U.S. DOT's National Roadway Safety Strategy indicates that more than 350,000 people died in roadway transportation incidents between 2011-2020 in the United States. Millions more are injured, sometimes permanently, each year. In response, U.S. DOT established a comprehensive approach to significantly reduce deaths and serious injuries on our roadways through the National Roadway Safety Strategy and a Safe System Approach.

In support of Departmental efforts, the Safe Streets and Roads for All (SS4A) discretionary grant program provides grant funds to regional, local, and Tribal initiatives to prevent roadway deaths and serious injuries. SS4A is exclusively designed to help local communities, and U.S. DOT offers extensive technical assistance to potential applicants, especially first-time federal funding applicants. Over the last three fiscal years, SS4A has provided $2.9 billion to more than 1,600 communities in all 50 states and Puerto Rico. An additional $2 billion is still available for future funding rounds.

The SS4A program includes two types of grants: (1) Planning and Demonstration Grants to develop Comprehensive Safety Action Plans, including supplemental safety planning and demonstration activities to inform an Action Plan. These can help build a pipeline of projects for future funding, including 2) Implementation Grants that put into practice the strategies or projects identified in an existing Action Plan.

U.S. DOT Volpe Center community planners and transportation professionals supported the Office of the Assistant Secretary of Transportation for Policy (OST-P) and Federal Highway Administration (FHWA) in implementing the SS4A discretionary grant program for three years. Working closely with OST-P and FHWA, the U.S. DOT Volpe Center team assisted in developing Notices of Funding Opportunity each year, supported administration of the program once awards were selected, and identified cost-saving process improvements to better serve applicants and meet program goals.

More than 60 U.S. DOT Volpe Center staff served as reviewers and conducted quality assurance on approximately 1,000 applications during the FY24 evaluation cycle. To engage low capacity and communities who would receive federal funding for the first time, the Volpe Center supported OST-P in extensive outreach to potential applicants to spread the word about the program through targeted, individualized conversations and informational webinars about the application process. As a result, many of these communities were better equipped to successfully apply for awards. *(Sponsor: OST-P)*

Photographers documenting traffic safety issues in Austin, TX that will be addressed through a Safe Streets and Roads for All grant. *Source: U.S. DOT Volpe Center/Terra Reed*

Effectively Addressing Transit System Safety Hazards

State agencies are responsible for direct oversight of the nation's rail transit systems to ensure safe and reliable systems for both riders and workers. The Federal Transit Administration (FTA) monitors and increases transit system safety through regulation, policy development, hazard investigation, and data sharing and risk analyses to inform safety-based decision-making.

When FTA identifies escalating safety concerns, including an increase in incidents, injuries, or fatalities, it may intervene with transit systems and State Safety Oversight Agencies (SSOAs). One way FTA does this is by performing a Safety Management Inspection (SMI), an in-depth inspection of a transit agency or SSOA that focuses on processes, procedures, and resources to enable safety decision-making. FTA has used SMIs to identify safety deficiencies and their root causes to correct safety risks swiftly and thoroughly.

In 2022, a U.S. DOT Volpe Center team of safety measurement and analysis experts began supporting FTA in providing federal oversight of the Massachusetts Bay Transportation Authority (MBTA) in the Boston metropolitan area. The MBTA rail transit system had been experiencing higher than the national average number of safety events, including derailments, train collisions, and runaway trains. FTA conducted an SMI of MBTA and its SSOA, the Massachusetts Department of Public Utilities (DPU). As a result, FTA issued special directives requiring the MBTA and DPU to develop and implement corrective action plans to address the SMI findings.

For the past two years, U.S. DOT Volpe Center experts from a wide variety of disciplines including safety measurement, transit infrastructure and technology, employee training, and human factors analysis have been working alongside FTA to ensure the more than 60 MBTA and DPU corrective action plans are implemented and effectively address the identified safety deficiencies.

In 2024, based on an escalating pattern of safety incidents, FTA issued special directives to the transit systems in both New York City and Philadelphia, and their SSOAs, and engaged the Volpe Center to continue delivering the high-impact work it achieved working with the DPU and MBTA.

U.S. DOT Volpe Center engineers assist with a safety inspection of MBTA track and subway cars. *Source: U.S. DOT Volpe Center*

Protecting Transit Workers in New York City

The Metropolitan Transportation Authority New York City Transit (NYCT), which operates subway, bus, and paratransit services in New York City and its five boroughs, is the busiest and largest transit system in the United States providing approximately 5 million trips per day.

FTA Special Directive 24-6 indicates that more than 10,000 workers access the NYCT tracks each day to maintain and inspect infrastructure. This work is inherently risky, even when every situation is considered, and every procedure followed. FTA issued special directives to NYCT and the New York Public Transportation Safety Board, the SSOA in New York, to address an increasing number of safety incidents putting NYCT transit workers at risk.

Boosting Transit Safety in Philadelphia

The Southeastern Pennsylvania Transportation Authority (SEPTA), which operates rail and bus transit in the Philadelphia metro area, also experienced a growing number of incidents, injuries, and fatalities, as well as worker assaults. In 2024, FTA concluded an SMI of SEPTA's heavy rail transit system, six subway-surface trolleys, two suburban trolley lines, and 126-route bus systems. As a result of the SMI of SEPTA and its SSOA, the Pennsylvania Department of Transportation, FTA issued five special directives aimed at both protecting workers and enhancing transit system safety overall by requiring the agencies to develop corrective action plans to strengthen staff training and supervision, improve infrastructure, and ensure more effective implementation and oversight of safety programs.

Transit agencies in Boston, New York City, and Philadelphia operate some of the busiest, largest, and oldest systems in the nation, responsible for providing safe and reliable transportation for millions of riders every day. In support of FTA, the Volpe Center continues to work with rail transit systems and their SSOAs to ensure hundreds of corrective measures responding to required actions of Special Directives are fully implemented and effectively address safety deficiencies. U.S. DOT Volpe Center's multidisciplinary safety oversight teams leverage lessons learned from one system to improve corrective measures and programs across all systems to achieve a strong, sustainable safety culture within each agency. *(Sponsor: FTA)*

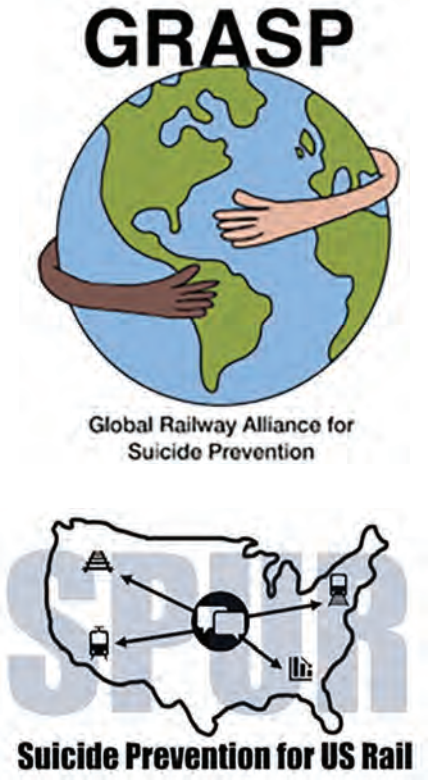
Facilitating Expert Discussions on Railroad Trespassing and Suicide Prevention

The National Strategy for Suicide Prevention (NSSP) was released in 2024 with a first-ever Federal Action Plan. The strategy outlines concrete recommendations for addressing gaps and meeting the needs of at-risk populations. The Federal Action Plan identifies 200 discrete actions to be initiated and evaluated over the next three years. This coordinated, comprehensive whole-of-government approach to suicide prevention at the national, state, Tribal, local, and territorial levels relies upon critical partnerships across the public and private sectors. People with real-world experience are critical to the success of this work.

The two leading causes of rail-related death in the U.S. have nothing to do with operating or riding in a train. Instead, hundreds of people lose their lives every year on train tracks due to trespassing or suicide. The NSSP includes several Federal Railroad Administration (FRA)-specific actions—including recommendations to continue and enhance the FRA/Volpe Center Suicide Prevention for U.S. Rail (SPUR) and Global Railway Alliance for Suicide Prevention (GRASP) working groups. SPUR and GRASP are sponsored by FRA and hosted by the U.S. DOT Volpe Center in collaboration with FRA.

The NSSP highlights the importance of industry partners sharing insights regarding suicide prevention challenges and successes; SPUR offers a forum for sharing this information among U.S. railroad carriers. GRASP provides an opportunity for partner countries (Australia, Canada, Finland, Sweden, the United Kingdom, and the United States) to learn from international experts in railroad suicide prevention. The NSSP Action Plan features examples of valued strategies to help the transportation industry grow in their ability to help prevent suicide.

FRA is a leader in suicide prevention research efforts and relies on the U.S. DOT Volpe Center to provide transportation human factors expertise and lead these working groups. The U.S. DOT Volpe Center gathers insights from experts in the railroad industry through facilitated discussion and actively engages with partners to document and share information. FRA recognizes that suicide is preventable and requires a collaborative approach. SPUR and GRASP meetings help empower stakeholders to make informed decisions about how to address trespassing and suicide in their communities. Meeting online via Zoom or Teams, each group can meet with individuals all over the United States for SPUR and all over the world



The Global Railway Alliance for Suicide Prevention group logo and the Suicide Prevention for U.S. Rail group logo. *Source: U.S. DOT Volpe Center*

for GRASP. Lessons learned from international colleagues in Canada, Europe, and Australia are shared with U.S.-based railroad stakeholders and advancements offered from the team are brought back to GRASP partner countries.

FRA and the U.S. DOT Volpe Center facilitate local trespassing and suicide prevention action through approaches that include keeping current on existing best practices and sharing these insights with stakeholders. The GRASP working group has met every year since 2014 on rail suicide prevention strategies and continues to meet annually.

In 2024, the U.S. DOT Volpe Center led its tenth GRASP meeting. The SPUR working group has held eight meetings since February 2022. In October 2024, SPUR held its first in-person meeting following the DuPage Railroad Safety Council conference in Chicago, Illinois. A significant milestone for both SPUR and GRASP is their inclusion in the 2024 National Strategy for Suicide Prevention Action Plan, an important part of the national suicide prevention response. *(Sponsor: FRA)*

PIPELINES

NEPA Compliance for the Natural Gas Distribution Infrastructure Safety and Modernization Grant Program

Many natural gas pipelines across the U.S. that are made from cast or wrought iron, bare steel, or vintage polyvinyl chloride plastic are leak-prone and long overdue for replacement. According to Pipeline and Hazardous Materials Safety Administration (PHMSA) incident reports from 2005 to 2021, of all injuries associated with gas distribution mains, 36 percent of fatalities and 16 percent of serious injuries are caused by leaking cast-iron pipes, although they comprise only 2 percent of the pipes in gas distribution mains nationwide. According to PHMSA's Natural Gas Distribution Infrastructure Safety and Modernization Grant Program Programmatic Environmental Assessment, over the next 20 years, replacing those aging pipes is expected to reduce methane emissions by 4,166,930 kg.

Aging pipelines are disproportionately located in disadvantaged communities, making pipeline replacement a matter of equity in addition to addressing climate change, increasing safety, and protecting the health of communities. The U.S. DOT Volpe Center's National Environmental

Policy Act (NEPA) team conducts environmental assessments (EAs) to ensure municipalities can replace aging pipelines in disadvantaged communities to improve safety and reduce greenhouse gas (GHG) emissions. Through environmental analysis and partnership with PHMSA the Volpe Center team ensures that pipeline replacement projects center the health and safety of our nation's environment upon which we all depend.

The Bipartisan Infrastructure Law (BIL) provides communities, especially disadvantaged communities, with funding to replace aging natural gas pipes through the Natural Gas Distribution Infrastructure Safety and Modernization (NGDISM) grant program. This legislation provides approximately $200 million per year over five years to replace old, leak-prone pipelines. Over the past two years, the U.S. DOT Volpe Center NEPA team has supported 100+ BIL pipeline replacement projects.

The Bipartisan Infrastructure Law (BIL) provides communities with funding to replace aging natural gas pipes. The U.S. DOT Volpe Center has supported more than 100 BIL pipeline replacement projects.

Prior to funding, authorizing, or initiating an activity, NEPA requires federal agencies to carefully consider the effects a proposed project may have on the environment and the related social and economic impacts. At PHMSA's request, the U.S. DOT Volpe Center performed a Tier 1 EA of the NGDISM program's potential effects. The assessment concluded that replacing aging natural gas pipes would reduce GHG emissions and lower the frequency of incidents related to aging pipeline.

As part of the NGDISM application process, NEPA requires applicants to submit a Tier 2 EA of their proposed project to ensure project delivery and achieve the program's goals of: (1) improving upon the safe delivery of energy by reducing the likelihood of incidents, as well as methane leaks; (2) avoiding economic losses caused by pipeline failures; and (3) protecting the environment by reducing climate impacts by remediating old and failing pipelines and pipes prone to leakage. Volpe Center staff currently conduct Tier 2 EAs for individual NGDISM grant applicants.

The U.S. DOT Volpe Center's expertise in NEPA and associated environmental laws and regulations, along with its proven capacity to connect and coordinate community knowledge, fieldwork, and policy expertise, was particularly important in this work, because of the need to manage differing environmental conditions for more than 100 projects across the U.S. The Volpe Center's team conducted environmental analyses and all necessary resource agency consultation to identify mitigation strategies for potential adverse environmental impacts associated with construction related to pipeline replacement projects. The Volpe Center's subject matter expertise in environmental policy and resource management was integrated into the data analysis of each project to ensure compliance with federal environmental laws and regulations.

When projects posed an adverse environmental impact, the team's expert knowledge on mitigation strategies was applied to address the challenge.

The team recently completed 37 Tier 2 EAs for FY22 grant funded projects, one for each community funded in the NGDISM program's first year. During summer 2024, the Volpe team conducted NEPA analyses for approximately 65 projects. *(Sponsor: PHMSA)*

FEDERAL LANDS

Supporting the National Park Service to Identify, Analyze, and Pilot Safety and Operational Improvements

Washington, D.C., is a major tourism hub, drawing visitors from all over the world to its numerous historic sites, national parks, and museums. It also supports a robust regional commuter population, and many workers travel in and out of the District of Columbia from the greater metropolitan region, which extends to Maryland and Virginia. The simultaneous movement of visiting tourists unfamiliar with the capital region's roadways and the commuting population can lead to safety and operational challenges.

The National Park Service's (NPS) National Capital Region (NCR) unit oversees the daily operation of more than 50 national parks, monuments, battlefields, and other places of interest. In 2023 and 2024, NPS NCR engaged a team of U.S. DOT Volpe Center engineers and planners to assess and provide recommendations on two transportation management challenges related to safety, mobility, and the visitor experience. The first was to conduct a transportation impact assessment of the possible elimination of the reversible traffic flow along Rock Creek and Potomac Parkway. The second was to develop a transportation management plan to better manage the mobility and experiences of the brief but enormous flow of visitors that attend the annual spring Cherry Blossom Festival at the Tidal Basin.

Developing Elimination of Reversible Operations along Rock Creek and Potomac Parkway: Transportation Impact Assessment

Rock Creek and Potomac Parkway is both a roadway and a 180-acre area of linear parkland in Washington, D.C. It serves as a primary thoroughfare between downtown and the northwest quadrant of Washington, D.C. The parkway runs along Rock Creek and the Potomac River waterfront,

between the area south of the National Zoological Park tunnel and Calvert Street NW, to the north, and West Potomac Park at the Lincoln Memorial, to the south. It is administered by Rock Creek Park (ROCR) and the National Mall and Memorial Parks (NAMA), two units of NPS.

Construction of the roadway was completed in 1936. A year later, one-way operations in the predominant direction of commuter travel were established to offer a measure of relief from commuter congestion during peak commuting hours. These peak-hour, reversible one-way operations are still in effect on weekdays, except on federal holidays and weekends.[3]

NPS recognized this strategy placed excessive enforcement demands on the United States Park Police (USPP) and presented a safety risk for NPS staff, USPP staff, and park visitors. Additionally, the situation tends to be confusing and unintuitive for visitors unfamiliar with the roadway's traffic rules.

U.S. DOT Volpe Center planning experts applied a variety of transportation planning and engineering practices to the problem. Transportation data—existing safety data, operational information, visitation trends, and visitor behavior—formed the basis for understanding existing conditions. The U.S. DOT Volpe Center team used both traditional traffic data collection tools and newer, innovative sources (such as StreetLight, Strava Metro, and FHWA's National Performance Management Research Data Set [NPMRDS]) to broaden and deepen the dataset. U.S. DOT Volpe Center planners also applied traffic modeling tools to measure vehicular operations. The team applied engineering and economic tools to analyze safety, understand regional commuting patterns, and propose short- and long-term modifications to the roadways and intersections.

The final report, Elimination of Reversible Operations Along Rock Creek & Potomac Parkway: Transportation Impact Assessment, was delivered in January 2024. Among its conclusions were the rate of crashes that occur during one-way reversed operation is disproportionately higher than the rate of crashes that occur during bidirectional travel, and that eliminating the reversible operation, combined with intersection improvements along the corridor, will improve safety and save money by reallocating staff resources.

Follow-up actions by the U.S. DOT Volpe Center and NPS are underway to help support communication with partners and implement recommendations.

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3 U.S. DOT Volpe Center, *Elimination of Reversible Operations Along Rock Creek & Potomac Parkway: Transportation Impact Assessment*, January 2024, p. iii.

Vehicles traveling outbound using all four lanes along Rock Creek and Potomac Parkway. *Source: U.S. DOT Volpe Center*

Crafting a Transportation Management Plan for the Cherry Blossom Festival

The annual Cherry Blossom Festival along the Tidal Basin draws crowds from around the world to see the explosion of life and color and the beginning of warmer spring weather. Before 2024, an estimated 1.5 million people visited Washington, D.C. annually to see the blooming trees.[4] The popularity of the event causes a high level of congestion that can make navigating the area difficult.

The National Mall and Memorial Parks (NAMA) and NCR units of NPS asked the U.S. DOT Volpe Center to develop a Transportation Management Plan (TMP) for the 2024 Cherry Blossom Festival. The TMP aimed to manage the congestion, promote multimodal trips, improve the visitor experience, and improve safety for visitors.

4 Executive Office of the Mayor, Wednesday March 1, 2023.

Two bicyclists use the designated bus lane along Ohio Drive during the 2024 Cherry Blossom Festival. *Source: U.S. DOT Volpe Center*

During fall 2023, the U.S. DOT Volpe Center team gathered available background data, including Capital Bikeshare usage and transit ridership, and met with NPS to discuss historic transportation strategies and ongoing transportation challenges associated with the event. Over the winter and early spring, the team developed and finalized the official TMP for the March 2024 Cherry Blossom Festival.

The TMP proposed a wide array of targeted options to NAMA and USSP staff that were intended to operationally transform the multimodal transportation network during the festival.[5] Additionally, the TMP identified specific transportation strategies for the peak bloom period, which is dependent upon weather conditions and can therefore change annually. The TMP acknowledged that implementation of these changes would be heavily dependent upon staff availability.

The U.S. DOT Volpe Center team identified strategies to help NPS improve future traffic management plans.

NPS largely implemented the TMP during the 2024 festival, which drew a record 1.6 million attendees.[6] During the event's peak days, the U.S. DOT Volpe Center team conducted an observational and data-gathering site visit to see the effects of the implemented recommendations in real time to support deeper analysis of the situation and solutions and establish the basis for longer-term recommendations for the event's optimal management.

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5 The proposed options encompassed roadway and parking lot closures; vehicle circulation modifications; vehicle detour routes; designated pick-up/drop-off zones; a signage plan and schedule; an authorized vehicles-only lane for the D.C. Circulator bus, tour buses, and other authorized vehicles; bicycle parking; Capital Bikeshare docking locations; and recommended staffing levels.

6 Office of the Deputy Mayor for Planning and Economic Development. Mayor Bowser and the National Cherry Blossom Festival Announce Estimated 1.6 Million People Attended 2024 Festival, Exceeding 2019 Numbers. [Online]. Available: https://dmped.dc.gov/release/mayor-bowser-and-national-cherry-blossom-festival-announce-estimated-16-million-people. Accessed 10/21/24.

In the Lessons Learned Memorandum to NPS in May 2024, the U.S. DOT Volpe Center team concluded that, while the TMP strategies should be considered successful, there was room for improvement. The U.S. DOT Volpe Center team identified immediate modifications and longer-term strategies to help NPS improve the TMP for future years. Lastly, the U.S. DOT Volpe Center delivered a high-level data collection summary and quantitative analysis.

In September 2024, the U.S. DOT Volpe Center team proceeded to scope the next phase of the project. Phase II involves collecting additional data, conducting in-depth analysis of former and new data, connecting with other agencies about TMP strategies for major events, updating the TMP for the 2025 Cherry Blossom Festival, and developing long-term strategies that align with the completion of the Tidal Basin Rehabilitation of the Seawall project.[7] *(Sponsor: NPS National Capitol Region)*

7 National Park Service. Phase 1 Rehabilitation of the Seawalls. [Online]. Available: https://parkplanning.nps.gov/projectHome.cfm?parkID=427&projectID=107662. Accessed 10/21/2024.

Infrastructure, Economic Strength, and Global Competitiveness

The U.S. DOT Volpe Center applies its broad range of multimodal, multidisciplinary expertise from engineering to economic analysis to support key programs and infrastructure initiatives that stimulate economic growth and ensure safety, efficiency, mobility, and accessibility.

SPOKANE INTERNATIONAL AIRPORT

The Freight Logistics Optimization Works (FLOW) Public-Private Partnership Strengthens Supply Chain Agility and Resilience

The 2020 COVID-19 pandemic upended supply chains and logistics operations, resulting in global economic disruption. In February 2021, the White House ordered a whole-of-government approach to improve supply chains in the short-, medium-, and long-term. In response, the U.S. DOT created a government-industry partnership called Freight Logistics Optimization Works (FLOW) to collect and exchange information among logistics companies that provides a forward-looking, integrated view of supply chain conditions in U.S. regions.

U.S. DOT created a government-industry partnership called FLOW to share data on supply chains in order to help goods move quickly and cheaply.

Two years ago, U.S. DOT launched FLOW, the first public-private platform of its kind to share data on supply chains in order to help goods move quickly and cheaply. Federal efforts to strengthen American supply chains have helped reduce inflation from pandemic peaks—a recent analysis from the White House Council of Economic Advisors found that normalizing of supply chains explains more than 80 percent of the inflation reduction the U.S. has experienced since 2022.

FLOW collects Purchase Order (PO) information from importers in addition to logistics supply, demand, and throughput data from beneficial cargo owners, ocean carriers, ports, terminals, railways, and other participants. The FLOW program office resides within the Office of Multimodal Freight Infrastructure and Policy (OST-F) and is administered through a partnership between OST-F and the Bureau of Transportation Statistics (BTS). BTS collects and aggregates the data while protecting the confidentiality of information submitted to the FLOW system. Participants can then receive or view FLOW aggregate data to get a broad, daily view of the current conditions of the entire logistics network, beyond what may be observed in their individual company's operations.

Participants use FLOW data to develop more responsive operations strategies to improve their supply chain throughput and resilience. Because importer POs drive the demand for logistics services, aggregating future demand data (e.g., purchase orders, incoming container volumes, origin, and/or destination regions) coupled with regional supply data across different transportation modes (ocean, truck, or rail) enables participants to forecast how current capacity and throughput can meet future demand.

By sharing aggregated regional data from multiple participants, FLOW provides a broad and timely level of transparency beyond the visibility and scope of any single company's operations. Participants can use this data to better understand how regional logistics capacity can service current and future demand, as well as how demand fluctuations may impact their own utilization of assets and logistics throughput. Because demand data is shared in advance of when respective logistics services would be required, supply-side optimizations such as modifying supply capacity levels, service level mixes, and service expectations can be made by participants in a more proactive and responsive manner. This in turn can help the industry mitigate bottlenecks and service-level volatility.

The federal FLOW team is comprised of several sub-teams including the Industry Engagement Team responsible for recruitment, onboarding, and support of FLOW participants; the Data Collections Team responsible for ensuring accuracy and anonymity of FLOW data; the Data Analysis Team responsible for identifying use cases and forecasting models enabled by FLOW data; and the Platform Development Team responsible for development and support of the information-sharing platform.

U.S. DOT Volpe Center analysts engage members of the shipping and logistics industry to participate in FLOW, ensure the accuracy and anonymity of FLOW data, identify use cases and forecasting models enabled by FLOW data, and develop and support the information-sharing

Below: Industry representatives and federal team members of the FLOW Executive Board in attendance at the FLOW Annual Meeting at U.S. DOT headquarters in May 2024. *Source: U.S. DOT*

platform. The Volpe team provides direct development, analysis, and implementation support to BTS on the Data Collection and Platform Development Teams and expertise to the Industry Engagement Team.

To date, the FLOW program has grown to 76 participants since launching in March 2022, representing supply chain data covering:

- Marine terminal capacity at 5 of the top 5 ports
- Ocean bookings from 6 of the top 11 ocean carriers
- Chassis availability from 4 of the largest Intermodal Equipment Providers (IEPs) plus Motor Carriers (MCs)
- Purchase Orders from 4 of the top 5 importer Beneficial Cargo Owners (BCOs), 9 of top 20

At the FLOW program annual meeting in May 2024, 130 attendees met to refine the FLOW roadmap for the future, generate new ideas for utilizing the aggregated data for supply chain forecasting, and continue to build a sense of community around the FLOW program. *(Sponsor: BTS)*

U.S. DOT Volpe Center staff provide direct development, analysis, and implementation support to the Bureau of Transportation Statistics on the Data Collection and Platform Development Teams and provide expertise to the Industry Engagement Team.

Partnering to Ensure the Delivery of Resilient Positioning, Navigation, and Timing Civil Services

The Global Positioning System (GPS) is an essential part of daily American life and a critical component of the nation's economic and infrastructure systems. The U.S. DOT serves as the lead agency within the U.S. government on matters involving civil (non-military) GPS needs and usage. Due to the importance of these responsibilities, the Office of the Assistant Secretary for Research and Technology (OST-R) directly coordinates with other federal agencies to meet their civil GPS requirements.

Facilitating an understanding of both military and civilian GPS applications is vital. The U.S. DOT and the U.S. Space Force (USSF) maintain a well-established partnership to ensure the delivery of resilient Positioning, Navigation, and Timing (PNT) services for users worldwide. This collaboration supports seamless access to reliable GPS services across civil and military sectors.

For effective communication and coordination, a U.S. DOT Volpe Center expert—working on behalf of OST-R—serves as the Space Operations Command (SpOC) Liaison. This liaison represents federal civilian agencies to the Department of Defense (DOD) and is integrated into the USSF SpOC

Command Staff. The liaison works closely with the PNT Mission Area Team (MAT) at Peterson Space Force Base, Colorado Springs, Colorado, ensuring civil interests are aligned with military operations.

The Interagency Forum for Operational Requirements and the revitalized Information Dissemination Coordination Team exemplify U.S. DOT's dedication to fostering interagency collaboration. This cooperation is essential for developing comprehensive GPS/PNT strategies and advancing U.S. DOT's goal of building integrated and efficient transportation systems. These efforts also play a critical role in protecting U.S. infrastructure against domestic and cyber threats, aligning with the objectives of Presidential Space Policy Directive 7.

The U.S. DOT serves as the lead agency within the U.S. government on matters involving civil GPS needs and usage.

The Next Generation Operational Control System (OCX) represents the future of GPS ground command and control. It is designed to succeed the current Architecture Evolution Plan, overseeing both modernized and legacy GPS satellites. OCX will manage civil signals such as L1, L2C, and L5 and the GPS III satellites, along with L1C and the aviation safety-of-flight signal. This new system will improve cybersecurity, resilience, and interoperability with other PNT systems worldwide.

Transitioning to OCX has posed challenges for the civil community. The SpOC Liaison is actively engaged with multiple agencies to address these hurdles, ensuring minimal disruption to the civil operating environment during the transition. U.S. DOT plans to conduct a preliminary test with four satellite vehicles to detect any issues the OCX system might introduce.

As with any new satellite control system, operational acceptance of OCX involves addressing uncertainties. The Government Accountability Office

Karen Van Dyke, Director, Positioning, Navigation, and Timing at U.S. DOT and other panelists take part in the Space Symposium held in April 2024 in Colorado Springs, Colorado. *Source: U.S. DOT Volpe Center*

(GAO) has identified potential challenges, including meeting operational capability timelines, monitoring new civil signals, and achieving mission assurance objectives.

To address these challenges, U.S. DOT has convened working groups involving DOD and civilian infrastructure agencies that rely on GPS signals for precise timing. OCX will introduce groundbreaking technological improvements and new security protocols to the GPS enterprise. U.S. DOT, in partnership with civil agencies, will coordinate with DOD to ensure a seamless transition, maintaining uninterrupted GPS services for both civilian and military users. *(Sponsor: U.S. Space Force)*

MARINE

Opportunities for Maritime Highway Transportation in the Gulf of Mexico, Puget Sound, and Salish Sea System

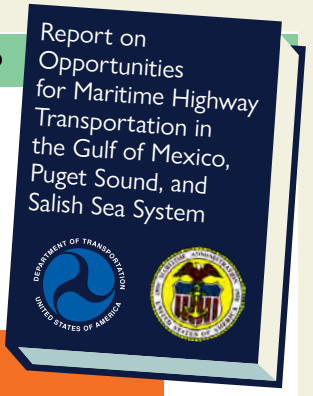
The United States Marine Highway System consists of thousands of miles of navigable channels, waterways, rivers, bays, coasts, the Great Lakes, and the Saint Lawrence Seaway. The goal of the Maritime Administration's (MARAD's) U.S. Marine Highway Program (USMHP) is to expand the use of the nation's navigable waters to relieve landside congestion, reduce emissions, and generate other public benefits by increasing the efficiency of the surface transportation system. The USMHP currently includes 31 Marine Highway Routes (MHRs) designated by the Secretary of Transportation that span 26,291 miles of navigable waterways, are roughly parallel to existing landside routes, and serve as extensions of the surface transportation system.

The FY23 National Defense Authorization Act (NDAA), broadened the definition of marine highway transportation to include: 1) bulk, liquid, and loose cargo, in addition to previously eligible types of freight, including intermodal cargo containers, roll-on/roll-off cargo, unitized freight, and freight vehicles carried aboard commuter ferry boats; and 2) shipments of eligible cargo from U.S. ports to/from ports in Canada and Mexico. The legislation directed MARAD to submit a report to Congress on opportunities for maritime highway transportation, with a focus on the Gulf of Mexico, Puget Sound, and Salish Sea System regions, known as the "study regions." The report also considered maritime connections in Canada and Mexico.

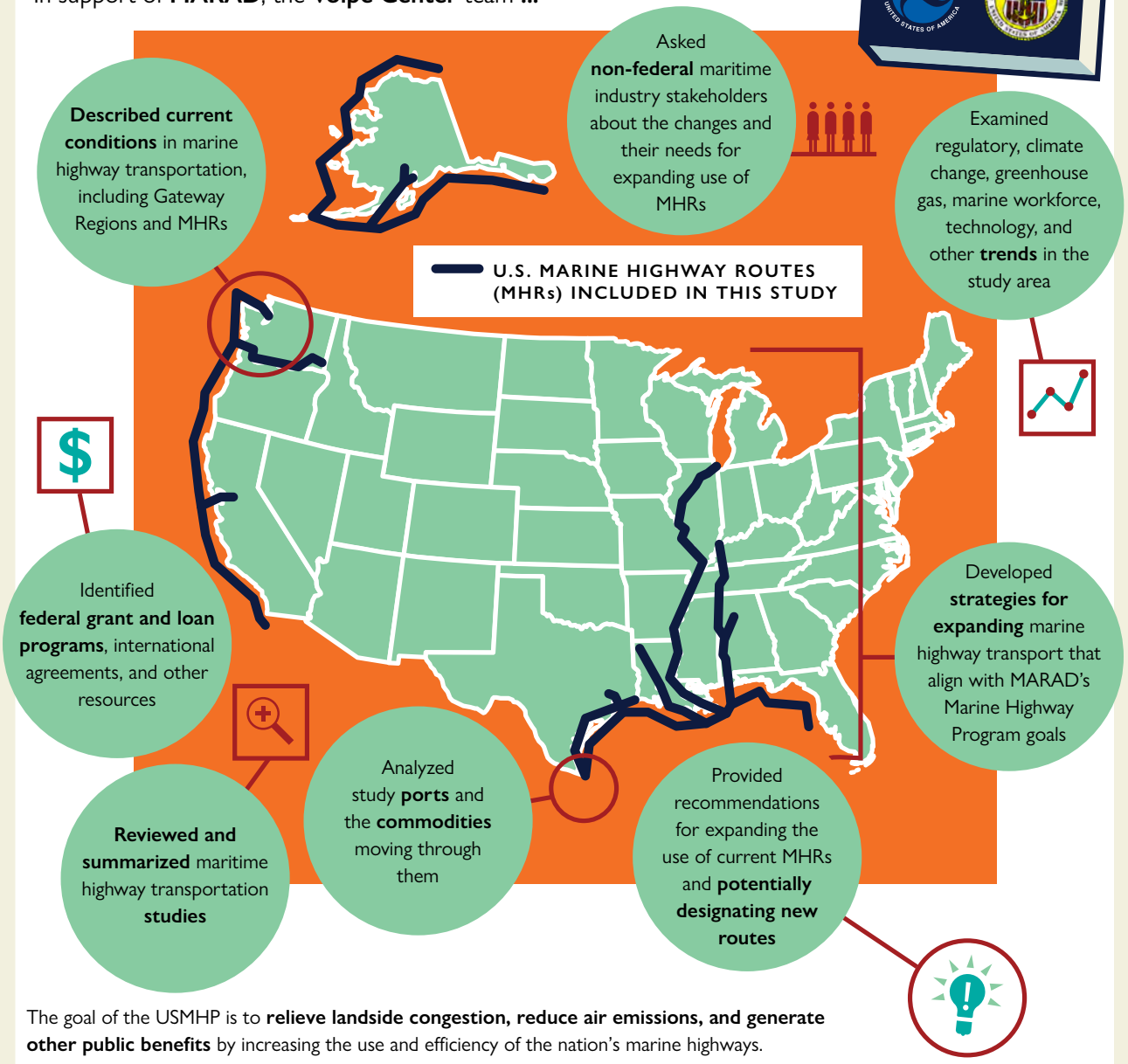
Increased Use of U.S. Marine Highway Routes Studied

NEW REGULATION INCLUDES SHIPMENTS TO AND FROM CANADA AND MEXICO

The **National Defense Authorization Act** further expanded eligibilities of the **U.S. DOT Maritime Administration's (MARAD's) United States Marine Highway Program (USMHP)** to include all types of freight as well as shipments to and from Canada and Mexico. The U.S. DOT Volpe Center's research efforts served as the basis for **MARAD's** final report to Congress.



In support of **MARAD**, the **Volpe Center** team **...**



The goal of the USMHP is to **relieve landside congestion, reduce air emissions, and generate other public benefits** by increasing the use and efficiency of the nation's marine highways.

U.S. Department of Transportation Volpe Center

01/2025

MARAD relies on the U.S. DOT Volpe Center's multidisciplinary freight expertise to support its mission of working with the nation's port operators, cargo carriers, and shippers to ensure a functional, robust, and profitable maritime industry. The Volpe Center assembled a team of operation research analysts, maritime experts, geographic information system (GIS) specialists, economists, planners, and engineers to support MARAD's report to Congress.

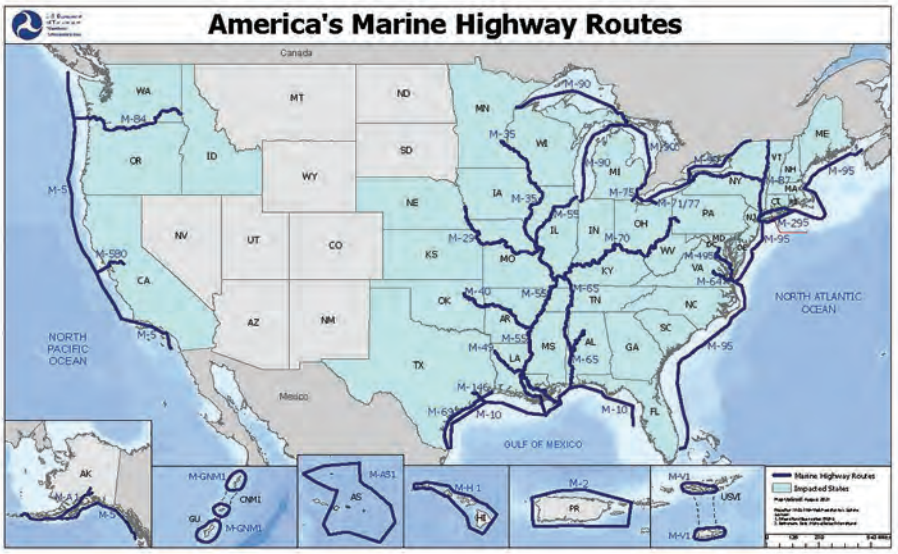
MARAD relies on the U.S. DOT Volpe Center's multidisciplinary freight expertise to support its mission of working with the nation's port operators, cargo carriers, and shippers to ensure a functional, robust, and profitable maritime industry.

Working in close collaboration with MARAD's Office of Ports and Waterways Planning, the U.S. DOT Volpe Center researched and summarized the history of the USMHP. The team also analyzed applicable grant programs, cargo transport data, and available infrastructure and equipment at the study ports; developed detailed data on the commodities transported to and from the 48 study ports (38 in the U.S., 5 in Canada, and 5 in Mexico); reviewed and synthesized maritime study reports; prepared marine highway and port location GIS maps; and created a stakeholder questionnaire and facilitated discussions with key stakeholders.

The U.S. DOT Volpe Center conducted its research in three phases, each with its own report:

- Phase I assessed current conditions and trends in maritime highway transportation and the impact of the 2023 NDAA legislative changes on the U.S. Marine Highway Program;
- Phase II produced objectives and strategies for expanding the use of the existing MHRs and for potentially developing new ones. The objectives measure progress toward achieving the USMHP goals;
- Phase III built upon the Phase II activities and identified opportunities MARAD can pursue to implement the objectives and strategies.

MARAD's final report used the research provided in the phase reports to identify opportunities for using the nation's waterways more consistently, thereby creating greater public benefits and incentivizing shippers to use these critical transportation channels. The opportunities include exploring partnerships with the public and private sectors to improve and expand maritime highway transportation; investigating opportunities presented by the United States-Mexico-Canada Agreement to develop maritime highway transportation and to foster efficient and sustainable trade in North America; integrating MHRs into the nation's multimodal transportation network; continuing to promote public and environmental benefits offered by maritime highway transportation; encouraging the use of the Marine Highway System to transport federally owned, procured, financed, or generated cargo; and continuing to use and identify information



United States Marine Highway Routes. *Source: MARAD*

technology tools to support maritime highway transportation initiatives and decisions. *(Sponsor: MARAD)*

RAIL

Innovative Tools to Track and Respond to Freight Rail Disruptions

The COVID-19 pandemic posed several significant challenges for the freight rail network. As freight rail capacity initially fell and then spiked with increased e-commerce, cascading challenges across the supply chain network resulted in acute rail service issues—including low on-time performance, low train speeds, congestion at freight terminals, and low network fluidity. Moreover, disrupted consumer demand for goods, railroad labor disputes, crew shortages, and intermodal operational challenges such as coordination with ports and trucks combined to create unique problems in the freight sector. In short, numerous issues created a domino effect negatively impacting pandemic freight rail operations and contributing to the broader supply chain issues experienced since 2021.

In its oversight of the rail network, the Federal Railroad Administration (FRA) asked U.S. DOT Volpe Center's economists to capture the performance of the freight rail network using data available in the new Surface Transportation Board (STB) reports. STB is an independent federal agency that oversees the economic regulation of various modes of surface transportation, specifically freight rail. STB required freight rail carriers to provide a series of new data metrics so it could track rail service quality.

Track and Respond to Disruptions in Rail Freight

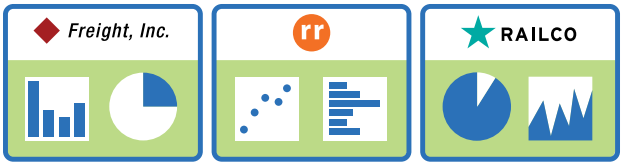
FOUR TOOLS WILL TRACK MANY DIFFERENT ASPECTS OF THE FREIGHT RAIL NETWORK.

The **Federal Railroad Administration** asked U.S. DOT Volpe Center's economists to capture the performance of the freight rail network using recently released data from the the Surface Transportation Board.

The Volpe team created **four tools** to present and analyze the data:

1

INDIVIDUAL METRICS FOR EACH OF THE LARGEST FREIGHT RAILROADS:
An interactive dashboard of **key performance indicators** for each Class I railroad, tracking aspects of their operational performance.

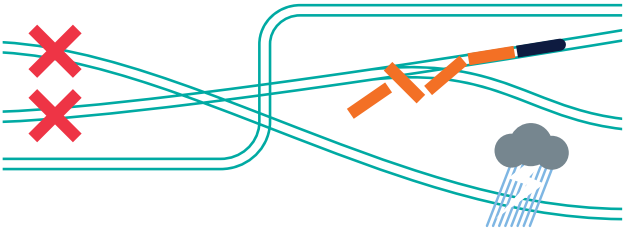


2

EMPLOYMENT TRENDS:
A monthly analysis of freight railroad **employment trends** including the changing composition of each railroad's labor force through the pandemic and after the resolution of a national labor dispute.

3

EMBARGOES:
A monthly analysis of **temporary restrictions or closures** used by railroads to control the flow of traffic over parts of their rail network.



4

TYPES OF CARGOES:
An interactive dashboard tracking the weekly volumes of **22 types of cargoes** (commodities) by each freight railroad.

The four tools created by the U.S. DOT Volpe Center inform FRA's efforts to **strengthen the safety and efficiency of the U.S. freight network and the supply chain.**

U.S. Department of Transportation Volpe Center

01/2025

These new measures included rail operational service metrics as well as employment metrics at the railroads.

The Volpe Center created four data solutions to track different aspects of the freight rail network:

- An interactive dashboard tracking each Class I railroad's self-identified key performance indicators, tracking aspects of their operational performance relative to a target.
- A monthly analysis of freight railroad employment trends, including the changing composition of each railroad's labor force throughout the pandemic and after the resolution of a national labor dispute.
- A monthly analysis of railroad embargoes used by railroads to restrict the flow of specified commodities over parts of their rail network.
- An interactive dashboard tracking the weekly volumes of 22 types of cargoes by each freight railroad.

The U.S. DOT Volpe Center, in support of FRA, created four data solutions to track different aspects of the freight rail network.

The four data tools incorporate new data as it becomes available and give FRA the ability to track and respond to multiple aspects of possible disruptions in the freight rail network and strengthen its role in the broader supply chain. The team of Volpe economists developed written analysis from these tools to inform numerous senior FRA requests, including testimony before Congress and written comments submitted to STB. Combined, the four data tools and analyses help FRA understand challenges facing the industry and its role in the supply chain and inform FRA's oversight of the freight rail network, a key component of the national supply chain, improving the national transportation system. *(Sponsor: FRA)*

Developing Motive Power Solutions for Aging Department of Defense Railroad Inventories

The U.S. Department of Defense (DOD) has numerous railroad operations located at U.S. Army and U.S. Navy installations across the nation. Much of the aging railroad infrastructure at these locations offers similar track layout design as originally installed. The historical nature of the facilities do not allow the rail to be moved or altered. The DOD rail fleet is in critical need of new, modern equipment to increase efficiency, reliability, and safety of operations. As commercially available locomotives and railcars have increased in size and weight over time, the requirement to find equipment that will operate safely and efficiently at these DOD locations is becoming increasingly difficult.

In collaboration with DOD, the U.S. DOT Volpe Center manages and provides systems engineering to the DOD Motive Power and Equipment (MP&E) Modernization Program. In this capacity, the Volpe Center assesses current conditions and provides information and support that encompasses the entire DOD MP&E inventory. The information provided by the Volpe Center enables better management of modernization strategies, lowers the age of the MP&E inventory, reduces harmful greenhouse gas (GHG) emissions, and assists with creating more efficient, modern, and manageable assets that strengthen DOD's shore mission capabilities.

In support of DOD, the U.S. DOT Volpe Center manages and provides systems engineering to the DOD Motive Power and Equipment (MP&E) Modernization Program.

The Volpe Center has been successful in replacing overaged and declining MP&E inventory by utilizing government acquisition strategies. In addition, the Volpe Center provides clean emissions technologies with every new locomotive placement. A major challenge to this work is the extreme track curvatures the rail equipment must negotiate. As a result, this work involves designing and implementing special locomotive and railcar coupler devices which are unique to industrial plant railroad operations.

The DOD rail fleet contains more than 120 locomotives with an average life span of 50 years. By replacing old and non-regulated diesel locomotives with modern, highly efficient, and ultra-low emitting locomotives, the U.S. DOT Volpe Center continues to lower toxic emissions. For each locomotive the Volpe Center replaces, particulate matter is reduced by 94 percent, hydrocarbons by 96 percent, and oxides of nitrogen by 94 percent. To date, the Volpe Center has replaced 38 locomotives and is currently assessing the remaining locomotives to determine the best strategy moving forward.

USAX 6515 is a three-engine 2,100-horsepower GenSet Road-switcher locomotive built to meet the requirements at Fort Liberty in North Carolina. This U.S. Army locomotive will be used to transport wheeled and tracked vehicles and other equipment maintained at this location. *Source: U.S. DOT Volpe Center*

In 2024, the Volpe Center finalized the design for a new heavy-duty flatcar for military use, which will go into production in the next few years. The Volpe Center team is currently providing technical expertise and support on 29 locomotives with plans to increase this support to 102 locomotives at 28 different locations in the United States. *(Sponsors: U.S. Army Tank-Automotive and Armaments Command (TACOM); U.S. Navy Facilities Engineering and Expeditionary Warfare Center (NAFVAC EXWC); U.S. Air Force Life Cycle Management Center, Support Equipment and Vehicles)*

AVIATION

Maintaining Aviation Communications Reference Data to Ensure Quality and Usability

One of FAA's primary modernization goals is to implement communication programs and projects that ensure the agency's 1,230 facilities enable robust Air Traffic Control (ATC) services to meet air traffic demand requirements in a safe and efficient manner. Reference data describes key aviation concepts like flight, airport, airline, asset, and passengers. Examples include airport codes, airline codes, aircraft types, flight codes, and others. It provides context for data and reviewing and maintaining high-quality, reliable reference data is critical to the integrity of information being exchanged between aviation partners.

The U.S. DOT Volpe Center's telecommunications team maintains the FAA's telecommunication enterprise management tool (TEMT) and other common reference data (CRD) management systems. In 2024, engineers performed a financial and technical quality assurance review of Telecommunication Requests (TRs) prior to their submission.

The work includes verifying accuracy, completeness, and consistency of data prior to submitting an order to the General Services Administration. In addition, Volpe Center engineers conducted a similar technical and financial review of Draft TRs intended for submittal to the Defense Information Technology Contracting Organization (DITCO)/Defense Information Systems Agency Direct Order Entry (DDOE). The team also maintains and updates the master list of location identifier (LID)/facility (FAC) codes, program designator codes (PDC)/service (SVC) values, facility addresses, and Telsite details within the TEMT.

This year, U.S. DOT Volpe Center information technology specialists processed approximately 2,300 requests, added approximately 40

Screengrab of the secure, web-based Telecommunications Enterprise Management Tool (TEMT). *Source: FAA*

new facilities, and decommissioned more than 250 facilities. This work enables the FAA to make data-driven decisions and improve stakeholder experience. *(Sponsor: FAA Program Management Office, Communications, Information, and Network Program Office (AJM-31))*

INTERNATIONAL

Transportation Workshops to Support Ukraine Recovery and Economic Development

Transportation is critically important for Ukraine's ability to import goods, including life-saving humanitarian assistance, and export Ukrainian products, and is a lifeline for people traveling in and out of the country.

The OST Office of International Transportation and Trade (OIT&T) asked the U.S. DOT Volpe Center to plan and deliver three workshops for Ukraine in 2024. A team of U.S. DOT Volpe Center planners identified priority topics, developed workshop agendas, constructed and delivered workshop content, identified subject-matter experts within and outside of U.S. DOT to present on their experiences, developed discussion questions and engagement activities, and facilitated panel discussions for each workshop. This work required close coordination with OIT&T, Senior Transportation Advisor to the Ukraine Ministry for Communities,

Territories, and Infrastructure Development Robert Mariner, U.S. DOT modal administrations, other federal agencies, and representatives from local and regional transportation agencies. The U.S. DOT Volpe Center relied on its multidisciplinary expertise in international relations, border transportation planning, metropolitan planning, port sustainability and development, instructional design, and event planning to develop and deliver the workshops.

The objective of the workshops was to support Ukraine by providing training and technical assistance on critical transportation topics to Ukraine and some neighboring countries. Specifically, U.S. DOT sought to ensure that Ukraine's investments in rebuilding its transportation systems would result in high-quality, green, and resilient infrastructure. The three workshops developed and delivered by the U.S. DOT Volpe Center team in 2024 included:

Transportation is critically important for Ukraine's ability to import goods, including life-saving humanitarian assistance for people traveling in and out of the country.

A virtual workshop on metropolitan transportation planning. (April 24-25)

Focus: A framework for planning and prioritizing the recovery of surface transportation in Ukraine in a post-war environment. Approximately 100 participants attended the workshop, including representatives from the Ministry for Communities, Territories, and Infrastructure Development as well as local and regional governments and academia. Participants expressed interest in the U.S. metropolitan transportation planning framework for use in recovery and rebuilding efforts in Ukraine once hostilities have ceased.

Ukraine-Romania Port Development and Sustainability Workshop Participants. *Source: U.S. DOT Volpe Center*

An in-person workshop on port development and sustainability, in Constanța, Romania, in coordination with the Government of Romania and the Port of Constanța. (June 25-27)

Focus: How Ukraine and Romania can cooperate to export grain from Ukraine in wartime, and considerations for restoring and improving full port operations in Ukraine post-war. Approximately 40 participants, representing the central governments and port agencies of Romania and Ukraine, attended the workshop. This included leadership from Ukraine's Ministry for Communities, Territories and Infrastructure Development as well as two Romanian State Secretaries. Participants shared best practices on port modernization and digitization. The Romanian and Ukrainian delegation also discussed ways to create and enhance communication channels to continue collaborating to address shipping concerns along the Danube River.

Participants of the Poland-Ukraine workshop in Rzeszów (including the U.S. DOT Volpe Center's Sheliza Bhanjee). *Source: U.S. DOT Volpe Center*

An in-person workshop on border crossing planning and operations in Rzeszów, Poland, in coordination with the Government of Poland. (July 24-26)

Focus: Managing the movement of goods and people across the Ukraine-Poland border. Approximately 40 Ukraine and Poland ministry and state department officials participated in the workshop. Participants presented the state-of-practice and upcoming border wait time improvement technologies in both Poland and Ukraine and discussed possible pathways of synergy to improve and coordinate customs and border operations toward greater efficiency, given the current challenges. The discussions led to clarity on the need to improve communication between the countries,

share best practices, and collaborate more frequently on matters of border safety and customs operations to facilitate the flow of people and goods and to reduce border wait times. *(Sponsor: U.S. DOT Office of Aviation and International Affairs (OST-X) and OIT&T)*

U.S. DOT, FHWA, Tetra Tech, and U.S. Customs and Border Protection participants taking a tour of the Poland-Ukraine border area, guided by customs and border security officials of Poland. *Source: U.S. DOT Volpe Center*

WORKFORCE

Development of a Mariner Workforce Strategic Plan

The Maritime Administration (MARAD) is facing a critical shortage of credentialed merchant mariners available to operate the U.S. flag fleet of commercial ships and strategic sealift vessels. These mariners—serving aboard vessels of all types—provide transportation services essential to domestic and international commerce. Additionally, the Department of Defense relies on experienced mariners to crew vessels of the nation's Ready Reserve Force (RRF) to support national security operations and sustain global military operations.

It is vital to national security that an adequate number of actively sailing U.S. merchant mariners are appropriately trained and credentialed to sustain a surge in delivering military cargo during an extended conflict

overseas. To meet this need, a sufficient number of U.S. commercial vessels must be available to keep these mariners proficient during times of peace. However, the U.S. deep-sea commercial fleet, which traditionally employs such mariners, has declined from 1,100 ships in 1950 to fewer than 200 ships today. The decline in fleet size combined with increased mariner training requirements and more attractive shore-side employment opportunities has led to a decrease in the number of active, fully qualified mariners available to crew U.S. vessels in the event of a national emergency.

Any federal initiatives that could augment training and education, provide financial assistance to support initial and ongoing mariner training, or otherwise increase accessions into the workforce would improve the United States' ability to respond to and sustain global military operations and strengthen the nation's maritime industry. MARAD asked the U.S. DOT Volpe Center to apply its maritime expertise to assist in the development of a comprehensive strategic plan that could strengthen the existing mariner workforce. The Volpe Center crafted the Mariner Workforce Strategic Plan to strengthen or expand existing programs and identified potential new initiatives to target gaps in mariner recruitment, training, and retention.

Merchant mariners receiving training in lifeboat handling and other safety-of-life skills. *Source: Photo used with permission of Seafarers International Union*

Published in March 2024, the strategic plan established 6 goals, 13 objectives, and 38 strategies. The plan's intended outcomes improve transportation safety aboard U.S.-flag vessels operating on the nation's inland, coastal, and ocean waters. By increasing the mariner workforce, MARAD also seeks to strengthen the U.S. maritime industry and the nation's economy by improving access to good-paying jobs for American workers. The strategic plan will also help address inequities by improving education and training opportunities and access to jobs for individuals from historically underserved or underrepresented communities.

MARAD asked the U.S. DOT Volpe Center to apply its maritime expertise to assist in the development of a comprehensive strategic plan that could strengthen the existing mariner workforce.

Some of the principal strategies include:

- Increasing promotion of the Military to Mariner Program, a multi-agency effort to support the recruitment of skilled military veterans into the mariner profession.
- Promoting the use of U.S.-flag vessels in the development of offshore wind energy. A fleet of specialized vessels will be needed to install and maintain offshore wind facilities; these ships represent a potential source of mariner jobs.
- Working with the Department of Education to expand the eligibility of both students and maritime training and educational institutions to participate in federal student aid programs.

Merchant mariners crew the ships of the nation's Ready Reserve Force and Military Sealift Command. *Source: U.S. Navy photo by Mass Communication Specialist 2nd Class Corey Hensley/Released*

- Working with federal and industry stakeholders to ensure a positive shipboard climate, free of sexual assault and sexual harassment (SASH) of women and men.

These strategies will help MARAD ensure recruitment, training, and retention meets the nation's need for a highly trained mariner workforce that can crew our commercial fleet and strategic sealift vessels. *(Sponsor: MARAD)*

Sustainability and Resilience

The U.S. DOT Volpe Center is lending key support to federal initiatives to build a more sustainable and resilient transportation system.

ADOBE STOCK/BILANOL

New CMAQ Tools for Estimating Emissions Benefits from Parking-Pricing and Telework Programs

The Federal Highway Administration's (FHWA) Congestion Mitigation and Air Quality Improvement (CMAQ) Program provides a funding source for state and local agencies to support transportation projects and programs that help meet requirements of the Clean Air Act. CMAQ funds can be used for a wide range of highway and transit projects that reduce mobile source emissions for at least one of five specified air quality pollutants.

The CMAQ Emissions Calculator Toolkit (CMAQ Toolkit) is a suite of spreadsheet-based tools[1] that help agencies estimate emissions benefits of their projects. FHWA provides the toolkit as an optional resource to state and local agencies, many of which may not have the capacity or expertise to generate emissions data themselves. The CMAQ Toolkit provides default values for many inputs but allows users to bring in location-specific data, if available.

Since 2015, the U.S. DOT Volpe Center has supported FHWA's Office of Natural Environment in developing the CMAQ Toolkit. As lead developer, the Volpe Center team works closely with FHWA to design, test, and publish new tools. The U.S. DOT Volpe Center's in-depth knowledge of and expertise in emissions and traffic modeling, as well as deep understanding of FHWA's priorities and practices, have enabled the development of user-friendly tools for a wide range of stakeholders. The Volpe Center and FHWA periodically evaluate the CMAQ Toolkit and develop new modules in response to recent legislation, emerging technologies, and administrative priorities.[2] For example, the Bipartisan Infrastructure Law added new CMAQ project eligibilities for shared micromobility projects and cities and local agencies are increasingly turning to vehicle-to-infrastructure (V2I) technologies to alleviate traffic congestion and improve safety. These types of changes may spur new tool development activities.

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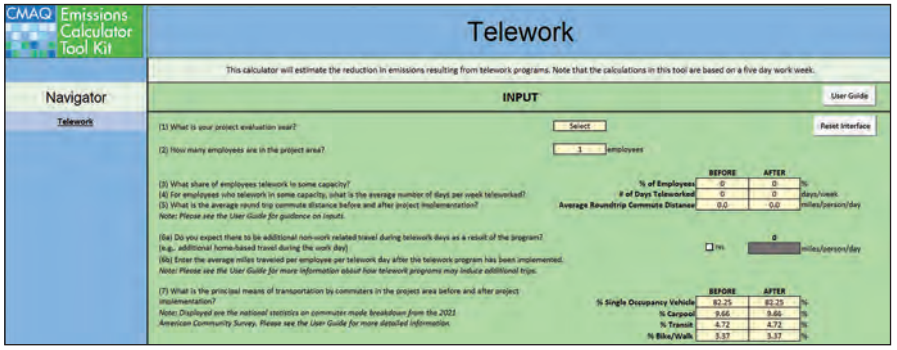
1 To date, Volpe has developed the CMAQ Toolkit in Excel, using Visual Basic. FHWA is interested in offering the tools in a web-based version, which would enable more efficient database management and tool updates. Using Python, Volpe is currently working with FHWA to bring this about.

2 Previous accomplishments in CMAQ Toolkit development were described in the January 2021 and January 2022 issues of the Volpe Center's *Annual Accomplishments* publication.



The CMAQ Toolkit Telework module user interface. *Source: FHWA/U.S. DOT Volpe Center*

Over the past few years, demand-responsive parking-pricing programs and related pricing projects have become increasingly widespread as ways to reduce vehicle miles traveled, reduce emissions, and relieve congestion on roadways and at curbs. For example, the SFpark demand-responsive parking-pricing pilot program in San Francisco, California encouraged drivers to park in underutilized blocks and garages to relieve congestion during peak periods. Results from the pilot evaluation showed the program reduced the amount of time most people spent cruising for parking by 43 percent and subsequently reduced the level of cruising-associated missions by 30 percent or more. Now a permanent program, SFpark uses in-ground sensors and other V2I technology to adjust parking rates in real-time.

Additionally, telework programs, already in place before 2020, became almost universal during the COVID-19 pandemic. Since then, many employers have continued to allow their workers to perform remotely for some portion of the work week, sustained by advancements in technology. When deployed strategically across a city or region, telework programs can substantially reduce commute-related emissions.[3]

The CMAQ Toolkit aligns closely with U.S. DOT's climate and sustainability strategic goals and priorities. The tools help project sponsors demonstrate that state and local projects and programs reduce emissions from highway sources and improve local air quality. The toolkit is also an excellent resource for transportation agencies to meet the CMAQ performance management and annual reporting requirements. The individual tools in the CMAQ Toolkit, along with their documentation and user training, are available for download at https://www.fhwa.dot.gov/environment/air_quality/cmaq/toolkit/. *(Sponsor: FHWA Office of the Environment)*

3 For example, see https://www.sciencedirect.com/science/article/pii/S1361920918301226?casa_token=9zvybxC_JykAAAAA:9pa5i410vuroRXptCdbZ5kGA-037QURZzoAIjSWFn5h0jKMY-NhasEG6G1I5iQwAKXWBWLZWB6w.

Participant-Funded U.S. DOT Volpe Center Aviation Environmental Design Tool Training Program

As aviation demand increases, it is essential for aviation professionals to evaluate different aircraft operational scenarios and their environmental impacts to inform decision-making on possible mitigation strategies. Aviation Environmental Design Tool (AEDT) is a software system developed by the U.S. DOT Volpe Center for FAA that models aircraft performance to estimate fuel consumption, noise, and air quality consequences.

AEDT facilitates environmental review activities required under the National Environmental Policy Act (NEPA) by consolidating the modeling of these environmental impacts in one tool.[4] AEDT is used not only for U.S. regulatory studies required by NEPA, but by government agencies around the world that have their own regulatory requirements. Helping users understand AEDT's full capabilities is a priority for U.S. DOT and FAA.

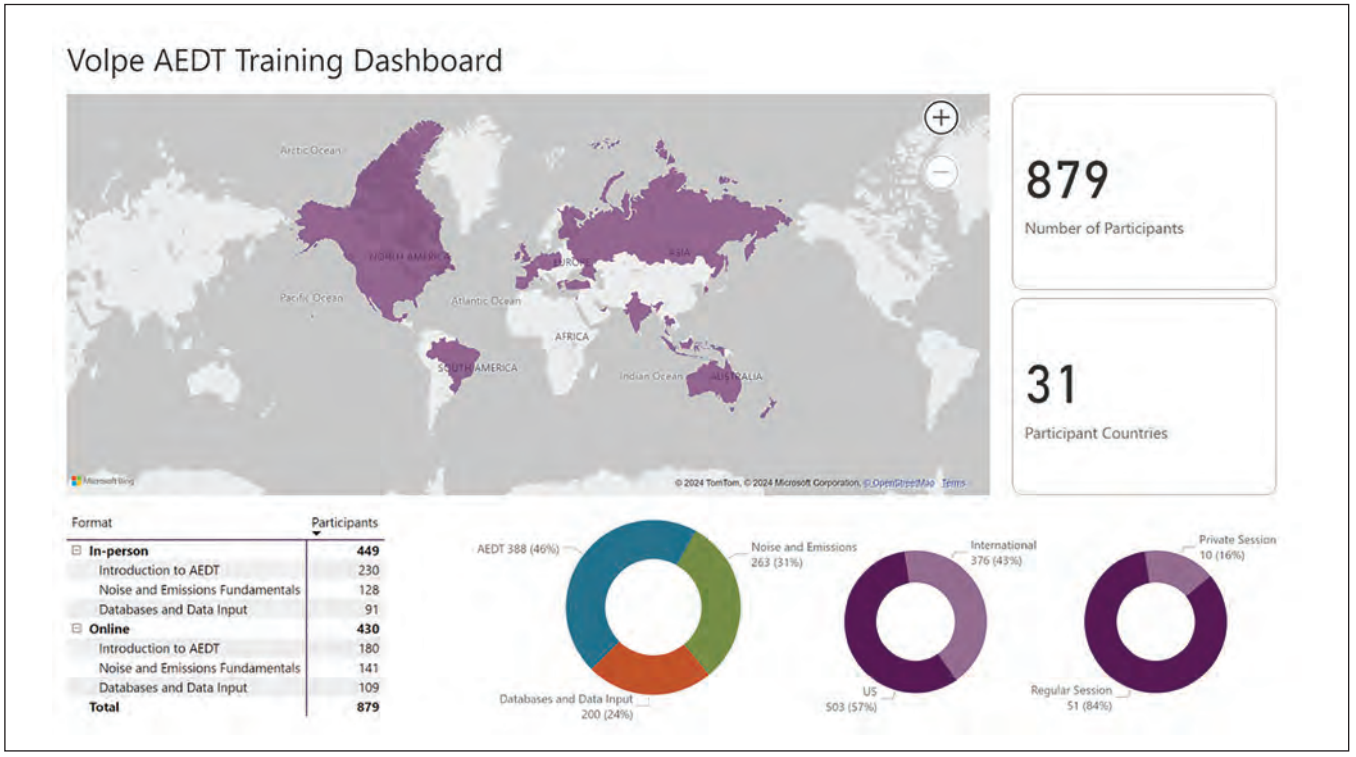
FAA offered AEDT training from 2011-2013, when budget constraints resulted in discontinuation of the training and outreach program. The U.S. DOT Volpe Center recognized the learning gap and developed a solution by shifting the program to a participant-funded activity. Because of its history with AEDT and ongoing role in updating the software, the Volpe Center could be both nimble and cost-effective in developing training materials. Additionally, the training developers could have direct interactions with the AEDT user base, enhancing the quality and accuracy of the training.

The U.S. DOT Volpe Center AEDT Training Program is open to beginners, advanced modelers, reviewers, and managers in the U.S. and abroad.

The U.S. DOT Volpe Center AEDT Training Program is open to both domestic and international participants, ranging from beginners to advanced modelers, reviewers, and managers. Volpe Center staff on the AEDT training team also support FAA with ongoing AEDT development, so users can learn directly from the noise and emissions experts involved with developing the model. The content is updated with each version of AEDT.

The U.S. DOT Volpe Center AEDT Training Program is unique in that it is funded directly by the participants, rather than by a sponsor; the Volpe Center oversees the program in its entirety. Since the program began in 2016, 879 participants from 31 countries have been trained.

4 Federal Aviation Administration. Aviation Environmental Design Tool. [Online]. Available: https://aedt.faa.gov/. Accessed: September 3, 2024.



Above: Since the AEDT Training Program began in 2016, 879 participants from 31 countries have been trained and $526,000 has been brought directly into the U.S. DOT Volpe Center. *Source: U.S. DOT Volpe Center*

The U.S. DOT Volpe Center team transitioned to online training during the H1N1 pandemic and provided the first online version of AEDT training to users in 2022. In May 2024, the U.S. DOT Volpe Center team conducted a virtual training session, and in fall 2024 the team conducted the first in-person session in four years. Recognizing the benefits of each format, it is anticipated that an in-person and remote training program will be offered each year moving forward. *(Sponsor: Participant-funded)*

Monitoring Fuel Efficiency and Greenhouse Gas Production of U.S. Aviation

Reducing aviation-related greenhouse gas emissions in the U.S. remains a key challenge for the U.S. DOT, as well as increasing resiliency for the overall energy market. In 2022, 9 percent of transportation-related GHGs produced in the U.S. originated from aviation. While GHGs decreased during the COVID-19 pandemic, aviation-related emissions have since increased to near pre-pandemic levels. FAA established the reduction of GHGs as one of its objectives in the FY23 Corporate Goals for Organizational Success Increase/Measures and Corporate Short-Term Incentive Goals memorandum.

FAA's Office of Environment and Energy (AEE) organized a comprehensive accounting of all aviation-related fuel consumption and resultant emissions production. AEE has maintained a longstanding working relationship with the U.S. DOT Volpe Center, developing and improving aircraft performance and environmental analyses for over three decades. As such, the Volpe Center was in a unique position to implement this capability and produce a nationwide inventory to better understand the overall impact of aviation in 2022. The Fuel & Emissions Inventory (FEI) was developed as a result.

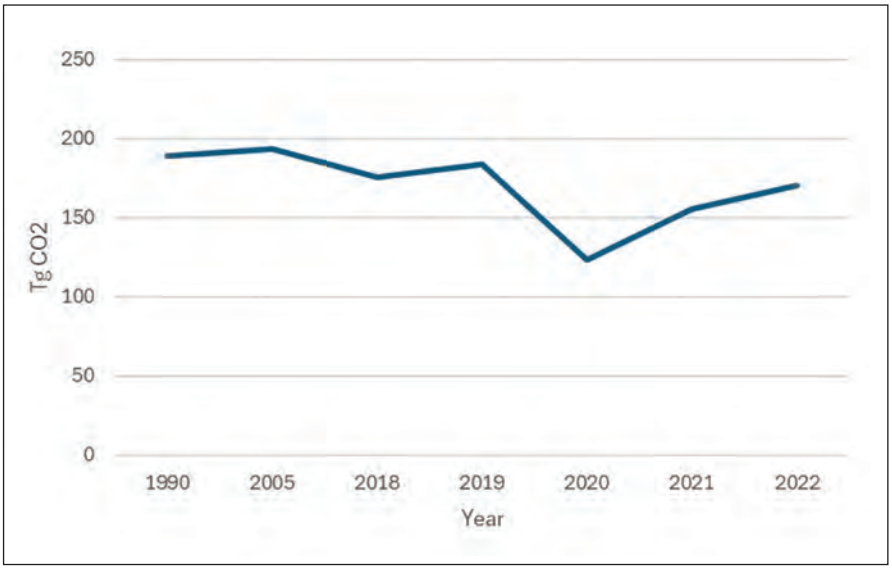
FAA's Office of Environment and Energy has maintained a longstanding working relationship with the U.S. DOT Volpe Center, developing and improving aircraft performance and environmental analyses for more than three decades.

The Volpe team was responsible for data collection sourcing and cleaning, constructing data input for the Aviation Environmental Design Tool (AEDT) model, processing the data through AEDT, quality assurance/quality control of results, and finally organization/presentation of NAS-wide results. Additionally, project leads worked with AEE to coordinate and provide updates to the sponsor.

The U.S. DOT Volpe Center provided critical steps in producing the FEI, including ongoing research and development activities of AEDT; establishing the architecture and design of the FEI, with multiple data streams to develop the final deliverable; executing the steps and procedures to produce the analysis; and reviewing and assessing final results.

The FEI incorporates the highest fidelity aviation data available:

- Flight schedule information covering 99 percent of the commercial fleet, as well as general aviation and military flights operating under instrument flight rules.



CO_2 production from aviation operations 1990 to 2022. *Source: EPA*

- Aircraft position updates as frequently as every three seconds.
- Aircraft performance data provided by the high-fidelity Base of Aircraft Data Family 4 model, itself a cornerstone of FAA's AEDT, as well as other performance models.
- Emissions values, such as nitrogen oxide and particulate matter provided by the International Civil Aviation Organization and incorporated into AEDT.
- Measured meteorological data provided by NASA in its "MERRA2" product, a 4-dimensional (3-dimensional space as well as time) data set.

FEI data products include a readily query-able dashboard on top of a relational database of flight and phase-of-flight summaries. University and governmental partners work with a large set of detailed 4-dimensional results as they preserve frequent position updates of each flight.

The FEI is currently undergoing advancements and updates. In 2023, the U.S. DOT Volpe Center took a step closer toward a real-time data product by generating the FEI on a quarterly basis. By leveraging cloud-based architecture, the U.S. DOT Volpe Center was able to develop on-demand comprehensive aviation data for FAA as well as for third-party researchers. *(Sponsor: FAA Office of Environment and Energy)*

By leveraging cloud-based architecture, the U.S. DOT Volpe Center was able to develop on-demand comprehensive aviation data for FAA as well as for third-party researchers.

Evaluating General Aviation Lead (Pb) Emissions Dispersion Modeling

In the United States, lead (Pb) additives for gasoline were phased out for on-road motor vehicles in January 1996. Piston-engine aircraft still use leaded aviation gasoline and now account for approximately 70 percent of Pb-based emissions in the U.S.[5] The human health risks associated with Pb exposure are wide ranging, including impacts on the neurological, cardiovascular, immune, and reproductive systems, as well as an increased risk of cancer.[6] Pb exposure can also result in anemia, elevated blood pressure, and kidney damage. Children are particularly vulnerable to the harmful effects of Pb which, when inhaled or ingested at low levels, can impede physical growth, cause neurodevelopmental harm, behavioral

5 U.S. Environmental Protection Agency, *2017 National Emissions Inventory*. At https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data.

6 U.S. Environmental Protection Agency, *2017 Integrated Science Assessment (ISA) for Lead (Final Report)*, Washington, DC, EPA/600/R23/375, 2024. At https://ordspub.epa.gov/ords/eims/eimscomm.getfile?p_download_id=548355.

Inside the cockpit of a piston-engine Cessna 172 with a U.S. DOT Volpe Center employee pilot lining up to land at Fitchburg Municipal Airport in Massachusetts. *Source: U.S. DOT Volpe Center*

issues, and learning deficits. These pediatric effects are irreversible, underscoring the critical importance of primary prevention.[7]

In October 2023, the Environmental Protection Agency (EPA) announced its final determination that emissions of Pb from aircraft that operate on leaded fuel cause or contribute to air pollution that may reasonably be anticipated to endanger public health and welfare under the Clean Air Act.[8] The EPA, as obligated by the Clean Air Act, has been working with FAA to consider regulatory options to address aircraft Pb emissions.

Due to these ongoing health concerns, FAA asked the U.S. DOT Volpe Center to add a new feature to FAA's Aviation Environmental Design Tool to model Pb emissions and dispersion from aviation sources. AEDT is a software system that models aircraft performance in space and time to estimate fuel consumption, emissions, noise, and air quality impacts.

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7 Centers for Disease Control and Prevention, *CDC Response to Advisory Committee on Childhood Lead Poisoning Prevention Recommendations in "Low Level Lead Exposure Harms Children: A Renewed Call of Primary Prevention" 2* (2012). At https://stacks.cdc.gov/view/cdc/37586

8 "EPA Determines that Lead Emissions from Aircraft Engines Cause or Contribute to Air Pollution", News Release, October 18, 2023. At https://epa.gov/regulations-emissions-vehicles-and-engines/regulations-lead-emissions-aircraft.

The analysis undertaken by the Volpe Center consisted of using AEDT to model piston-engine aircraft operations at a general aviation airport for the entire year of 2021. The modeled Pb concentrations were compared to measured Pb concentrations at a nearby EPA monitor. Dispersion modeling was conducted using the most recent version of the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). The main objective of this project was to evaluate the new AEDT Pb-modeling feature and create a final report documenting those findings as well as providing guidelines for airport modelers to consider when modeling Pb emissions from piston-engine aircraft.

The evaluation demonstrated that AEDT performed well at estimating 24-hour Pb concentrations at a nearby EPA monitor relative to EPA measured values. The evaluation also underscored the substantial contribution preflight runups can have on total ambient Pb concentrations at ground level on airports and surrounding areas.

Results were presented at the Air & Waste Management's Air Quality Models Conference in November 2024. A final report will be posted to the FAA AEDT website in conjunction with the next release of AEDT planned for 2025. *(Sponsor: FAA Office of Environment and Energy)*

Traffic Noise Model Version 3.2 Streamlines Noise Impact Analysis

The U.S. DOT Volpe Center, in support of FHWA, began developing FHWA's Traffic Noise Model (TNM) in the mid-1990s to predict roadway noise levels and design noise walls that shield communities from the burdens of surface transportation noise. There are 160,000 miles in the national highway system containing more than 3,800 miles of noise barriers with a cost to build of over $10 billion.[9]

In January 2024, TNM version 3.2 was released and allowed for use on highway projects to meet the requirements of 23 CFR 772. This new version integrates the Roadway Construction Noise Model (RCNM), which allows users to predict construction noise levels. The RCNM module in TNM 3.2 incorporates data from the National Cooperative Highway Research Program (NCHRP 25-49) into the existing TNM 3.1 interface and file structure. TNM 3.2 also includes several software fixes and usability improvements over TNM 3.1 such as expanded sorting and filtering

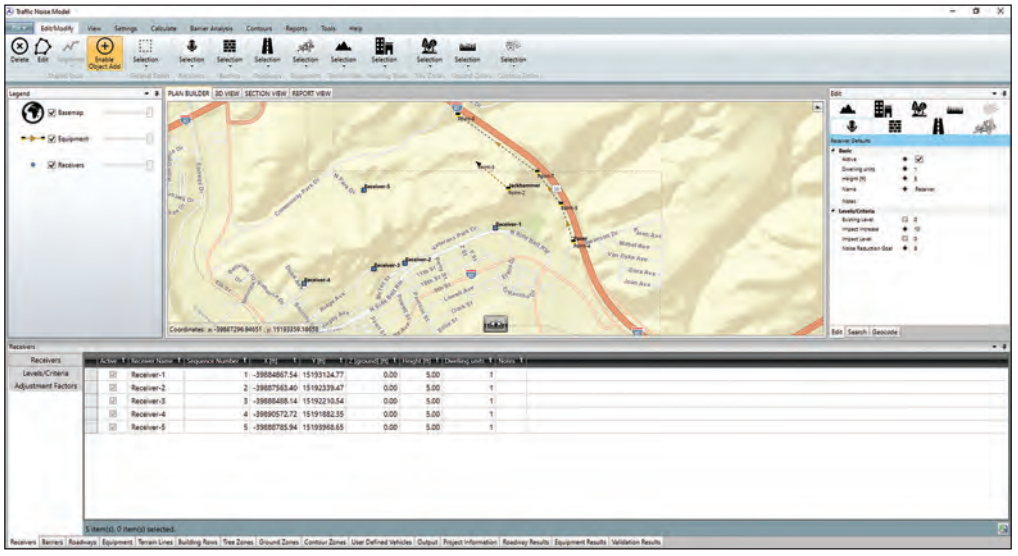
9 FHWA. Summary of Noise Barriers Constructed by December 31, 2022. [Online]. Available: Inventory - Noise Barriers - Noise - Environment - FHWA (dot.gov). Accessed 9/9/2024.

capabilities in the data tables, increased maximum zoom resolution in the maps, and smoother object segmentation.

In early 2024, FHWA and the Volpe Center held a public webinar on the release of TNM 3.2. The Volpe Center provided a live demonstration of the model, including the new acoustical capabilities, user interface updates, and software fixes made since the release of version 3.1. The webinar was well-attended with over 100 participants. In addition, U.S. DOT Volpe Center staff regularly assist with live and virtual trainings from the FHWA Resource Center by answering participants' technical questions and obtaining critical feedback to guide the future development of TNM.

The TNM development team is comprised of staff from FHWA's Office of National Environment (HEPN) and U.S. DOT Volpe Center acoustics experts and software developers. HEPN staff provide direction and overall requirements to the Volpe team to support the agency's agenda, policies, and priorities. The U.S. DOT Volpe Center has supported FHWA for more than 30 years in developing TNM. Software development work includes acoustical computational algorithm development, user interface design, functional and performance enhancements, testing, bug replication and remediation, acoustic measurements for validation of results, acoustical technical research to improve modeling capabilities, and planning for the development of future versions. The U.S. DOT Volpe Center also supports FHWA in providing technical support to the user community, managing user group membership, facilitating webinars, developing user guides, and providing technical documentation, FAQs, tutorial videos, and other training materials.

TNM 3.2 software and updated documentation are publicly available and can be accessed from FHWA's HEPN Noise website. TNM development



Screenshot of the TNM 3.2 graphical user interface displaying a project file containing receiver and construction equipment objects. *Source: U.S. DOT Volpe Center*

is ongoing; the U.S. DOT Volpe Center is currently working on TNM 3.3, which will focus on additional usability and performance improvements. *(Sponsor: FHWA)*

Dispersion Model Performance Evaluation for Near-Road Air Quality Estimation

A significant portion of the U.S. population spends time at home, work, or school within a few hundred meters of a major roadway.[10] A growing concern about human exposure and related adverse health effects near roadways led the EPA to improve dispersion modeling to more accurately capture the temporal and spatial variability of vehicle-based air pollutants in near-road environments. Better estimates of near-road air quality is essential for regulatory compliance with EPA's National Ambient Air Quality Standards, which are in place to protect public health and the environment.

The U.S. DOT Volpe Center supports FHWA's Office of Natural Environment with performance evaluations of dispersion models. This work aims for a better understanding of model performance specifically in the near-road environment. Recently, the Volpe Center conducted a performance evaluation of the most recent version of the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) in estimating near-road air quality by comparing modeled to measured results.

In October 2023, EPA proposed an update to the Guideline on Air Quality Models to have RLINE, which is a line source within AERMOD that represents vehicle emissions and is applicable for regulatory modeling of mobile sources. FHWA asked the U.S. DOT Volpe Center team to evaluate the latest version of AERMOD with the proposed RLINE update. In addition to RLINE, the evaluation also examined AREA and VOLUME source types. AREA and VOLUME source types can also represent vehicle emissions, either as rectangular area sources or point sources with an initial plume, respectively. The evaluation conducted by the Volpe Center indicated that AERMOD generally performed well, including the RLINE source type under most conditions and often performed better than both AREA and VOLUME source types.

The U.S. DOT Volpe Center was involved in all aspects of the model performance evaluation and final reporting. In support of FHWA staff,

10 U.S. DOT. Proximity to Major Roadways. [Online]. Available: https://www.transportation.gov/mission/health/proximity-major-roadways. Accessed 9/25/2024.

Example U.S. highway with mobile source emissions. *Source: Adobe Stock/rzocky2803*

Volpe Center environmental modeling experts contributed air quality dispersion modeling, data analysis, and technical writing. Within the data analysis component, the Volpe Center team leveraged their skillsets in scripting R code and creating impactful data visualizations.

The U.S. DOT Volpe Center team also evaluated the performance improvements of RLINE over time to model highway emissions. The latest iteration of RLINE showed substantial improvements in model performance since the source type was first made available in 2019. Results were presented at the Air & Waste Management's Air Quality Models conference in November 2024. The final report (*Performance Evaluation of AERMOD for Estimating Near-Road Air Quality*; DOT-VNTSC-FHWA-24-04) was posted to the FHWA website in late 2024. *(Sponsor: FHWA Office of Natural Environment)*

Locomotive Emissions Comparison Tool for Rail Grant Applicants

The U.S. diesel locomotive fleet is dominated by older, highly polluting engines. FRA's Consolidated Rail Infrastructure and Safety Improvements (CRISI) locomotive replacement initiative (LRI) facilitates upgrades to

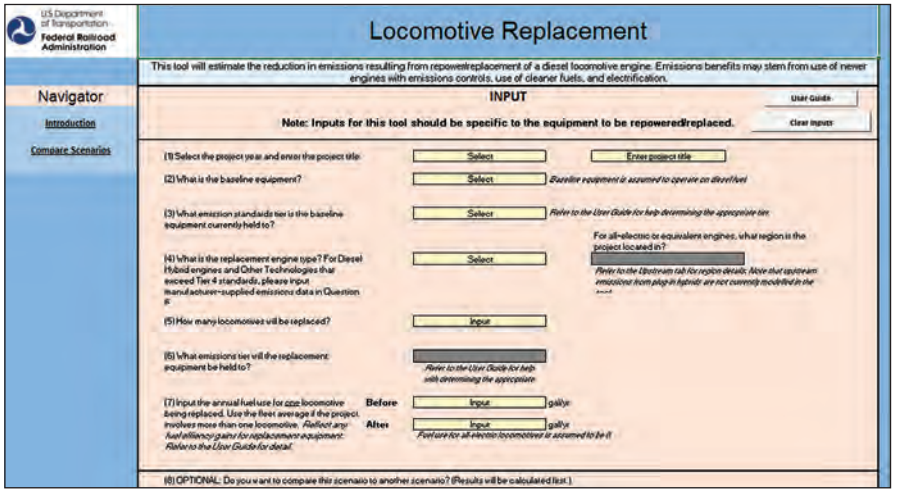
locomotive stock that meet or exceed EPA's more stringent Tier 2, 3, and Tier 4 emissions standards. CRISI applicants are required to submit data on the estimated emission reduction benefits of their proposed projects. During the first year of the CRISI program in FY22, the LRI supported the replacement of 39 locomotives, including 15 new battery-electric locomotives. These locomotive replacement projects will significantly reduce toxic pollutant and GHG emissions and reduce impacts on railyard workers and communities adjacent to yards.

The Locomotive Emissions Comparison Tool (LECT) provides users with a standardized, easy-to-use approach to estimate emissions reductions for locomotive replacement projects being considered for funding under the CRISI grant program. The LECT outputs include estimated emissions reductions for three GHGs—CO_2, CH_4, and N_2O—and five air pollutants—CO, NO_x, $PM_{2.5}$, PM_{10}, and VOC. In addition to operational emission reductions, the tool also outputs emissions associated with diesel fuel extraction, production, and transport, and upstream emissions from electricity production. Both operational emissions (released in engine exhaust) and upstream emissions (released during fossil fuel or electricity production) are included in tool outputs. The LECT also allows users to save and compare locomotive replacement scenarios and sum emissions benefits across projects and arranges the information in an organized format. FRA recommends CRISI grant applicants use the tool not only for their application packet but also for their NEPA documentation.

The U.S. DOT Volpe Center, working closely with the FRA and its stakeholders, was the lead developer of the Locomotive Emissions Comparison Tool. The tool provides users with an easy-to-use approach to estimate emissions reductions for locomotive replacement projects being considered for funding.

The U.S. DOT Volpe Center was the lead developer of the LECT, working closely with FRA and its stakeholders in summer 2023 to design the Excel-based tool. The LECT was based on FHWA's CMAQ Emissions Calculator Toolkit, also developed by the Volpe Center. A beta version of the LECT was tested by FRA staff and the California Air Resources Board (CARB) in September and October 2023, revised to incorporate beta tester feedback, and then published online in January 2024. Once the tool was published, the U.S. DOT Volpe Center team received additional feedback and minor bug fixes from railroads and CRISI grant applicants using the tool to estimate the emissions benefits of their projects.

The following example demonstrates emissions reductions from a typical locomotive replacement project involving switcher locomotives (switchers are used to assemble trains in railyards or make short transfer runs; they typically remain in service for a long time and are therefore older and more polluting than newer locomotives). A railyard operator proposes to replace three 1980s-era switchers, each typically consuming approximately 30,000 gallons of diesel fuel annually, with new electric battery-powered versions. LECT outputs show CO_2 emissions reductions of over 950 metric tons per



This screenshot shows the LECT interface.
Source: FRA/U.S. DOT Volpe Center

year for each of the three replacements. In context, a passenger vehicle emits approximately 4-5 metric tons of CO_2 annually. Removing three old switcher locomotives from service equates to removing roughly 630 passenger vehicles from the road.

FRA's Climate and Sustainability Program coordinates agency activities and initiatives that improve air quality, reduce GHG emissions, and promote the sustainability and resiliency of the rail network across multiple FRA offices. FRA is required by Executive Order 14057 to decarbonize and "green" its own actions and facilities. Data outputs from the LECT help FRA and U.S. DOT track progress toward reducing emissions from rail transport to achieve overall net zero transportation GHG emissions by 2050. Since many railyards are located in disadvantaged areas, the U.S. DOT Volpe Center's efforts in LECT development also align with the White House's Justice40 Initiative to reduce the disproportional environmental impacts of transportation on low-income and minority communities.

The U.S. DOT Volpe Center will conduct regular maintenance and updates to the tools for example, when new emissions data become available. The U.S. DOT Volpe Center also tracks suggested improvements and bug fixes submitted by tool users, including FRA grant applicants and grant recipients.

The LECT, user guide, and emissions data documentation are available on FRA's website at https://railroads.dot.gov/elibrary/fra-locomotive-emissions-comparison-tool. *(Sponsor: FRA Climate and Sustainability Program)*

Supporting the New $2B Low-Carbon Transportation Materials Discretionary Grant Program

The transportation sector is one of the largest contributors to anthropogenic U.S. GHG emissions, accounting for nearly one-third of overall emissions. That contribution is largely composed of vehicle emissions, but mining and processing of roadway and infrastructure construction materials also play a significant role.

To address the climate impacts associated with construction materials such as concrete and asphalt, the Inflation Reduction Act (Pub. l. 117-169) established the U.S. DOT's Low-Carbon Transportation Materials Discretionary Grant Program. The program does not fund entire construction. Instead, it reimburses state and local agencies with incentive awards or covers the incrementally higher cost (delta cost) associated with using construction materials and products that have substantially lower levels of embodied GHG emissions. The funding will have a measurable, positive impact and is vital to achieving climate and sustainability goals.

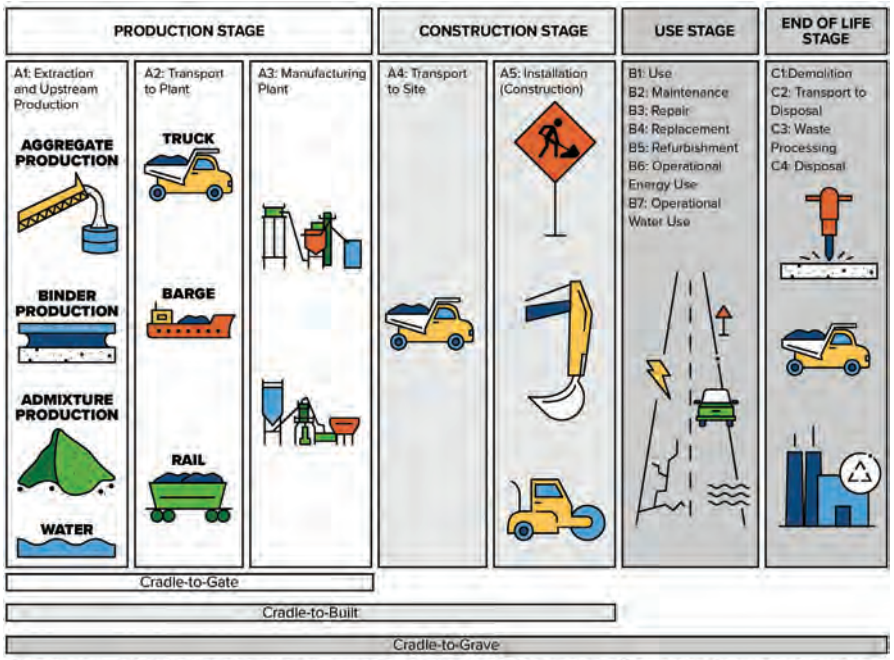
The program is "cradle to gate" and addresses the production stage, including extraction, manufacturing, and processing of low-carbon transportation materials for federal-aid funded highway projects. It will also help eligible transportation agencies update or develop specification language for future contracts and conduct research to identify materials that are appropriate for use on federal-aid construction projects.

U.S. DOT Volpe Center planners, engineers, and analysts are supporting FHWA's Office of Construction, Preconstruction, and Pavements (HICP) to stand up many aspects of the grant program, including outreach, intake, evaluation, and reporting.

The two-phased implementation first includes a Request for Applications for state DOTs followed by a Notice of Funding Opportunity (NOFO) for non-state jurisdictions. To ensure efficiencies and help applicants engage with the program, U.S. DOT Volpe Center planners developed application templates, and designed and set up the systems and practices necessary to ensure the evaluation and selection of projects and materials are compliant.

State DOTs and local agencies across the U.S. will benefit from greater access and use of low-carbon transportation materials in their construction projects, reducing GHG emissions and improving climate resilience. To that end, the U.S. DOT Volpe Center team is creating a tracking database that will facilitate the review and approval of applicants' "Implementation Process Reports" by FHWA's Division Office, HICP, and external cooperative agreement partners. This database, along with a public-access one, will be essential for long-term tracking and reporting, and will document benefits that can be adopted by other transportation agencies.

In fall 2024, program managers announced and publicized the availability of $800 million to non-state applicants through a NOFO–the second phase of the effort. Announcements regarding awards to state applicants who responded to the Request for Applications–the initial phase of the program–are scheduled for late 2024. *(Sponsor: FHWA Office of Preconstruction, Construction, and Pavements)*



Common Life Cycle Stages and Informational Modules for Asphalt/Concrete Pavement Systems

Low-carbon transportation material programs focus on the production stage of low-carbon transportation materials, including asphalt, concrete, steel, and glass. *Source: FHWA/ApTech*

Technical and Programmatic Support to PROTECT Climate Resilience Grant Program and Development of Resilience Metrics

According to the Fifth National Climate Assessment, weather-related disasters currently generate at least $150 billion per year (in 2022 dollars) in direct damage to the U.S., a cost that is expected to increase significantly due to climate change.

The nation's roads, bridges, and transit systems are increasingly vulnerable to the impacts of climate change and extreme weather. Extreme weather events pose a threat to infrastructure, human health, and our economy, and disproportionately impact low-income communities and communities of color. Historically, significant federal funding has not been available for state and local transportation agencies to plan for and implement strategies to improve resilience to climate change. The Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Discretionary Grant Program, established by the Bipartisan Infrastructure Law (BIL), funds projects that address the climate crisis by improving the resilience of the surface transportation system. The PROTECT Discretionary Grant Program provides $1.4 billion over five years (FY22-26) through competitive grants to state DOTs, metropolitan planning organizations, local governments, tribes, and other eligible entities for both planning and construction projects.

The U.S. DOT Volpe Center supported FHWA's development of a set of resilient metrics for the Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Grant Program.

The U.S. DOT Volpe Center supports FHWA in grant program development and implementation, including coordinating the grant review process and training reviewers, analyzing and presenting data to inform award selections, and developing communications materials and webinars. The U.S. DOT Volpe Center managed the intake/eligibility screening of over 300 applications, and a team of 10 U.S. DOT Volpe Center reviewers provided technical evaluation of applications. In addition, the U.S. DOT Volpe Center provided technical assistance and program support on benefit-cost analysis and resilience improvement plans developed by states and regions.

The U.S. DOT Volpe Center team supported FHWA's development of a set of resilience metrics for the PROTECT program. Measuring the impact of resilience investments in the transportation sector is an emerging area of research, with no widely agreed-upon set of metrics. BIL specifies that FHWA must evaluate the effectiveness and impacts of projects supported by the grant program (see 23 U.S.C. 176(f)). The law also stipulates that FHWA establish procedures for monitoring and evaluating projects based on a set of metrics developed with input from the public. The U.S. DOT

Volpe Center conducted a literature review on resilience frameworks and metrics and assisted in interviewing over 20 FHWA resilience subject matter experts. Interview topics included: pavements, hydraulics, wildfires, seismic vulnerabilities, nature-based solutions, emergency response, operations, and resilience planning. After gathering input, FHWA and the U.S. DOT Volpe Center developed draft PROTECT program metrics that were published for public comment in the Federal Register on March 21, 2024, with a comment period extending to May 20, 2024.

On April 11, 2024, under the first round of the program (FY22 and FY23), FHWA awarded $829.6 million in grant funding to 80 recipients across 37 states, the District of Columbia, and the U.S. Virgin Islands, including seven Tribal projects. The U.S. DOT Volpe Center is currently supporting the second round of the program, incorporating lessons learned and improvements from the first year, and continues to develop final metrics and prepare for future data collection. *(Sponsor: FHWA Office of Natural Environment)*

Planning and Implementing New Sustainable Air Traffic Control Towers

The Bipartisan Infrastructure Law provided $2.5 billion to replace numerous airport traffic control towers (ATCTs) across the United States by 2030. This scale of construction is unprecedented for FAA, creating challenges for existing work processes and stressing the capacity of the workforce. To meet BIL's goal, FAA needed a new, sustainable design for ATCTs that could be rapidly constructed across the United States.

"These new airport traffic control towers will mean that smaller airports can handle more flights, more sustainably and more affordably", said Transportation Secretary Pete Buttigieg. He added that the new ATCTs will "[help] our nation's airports support more travelers, grow their local economies, and prepare for the future of low-carbon aviation."

The U.S. DOT Volpe Center has prior experience conducting terminal facilities modernization and replacement work, and, in alignment with FAA's Sustainable Tower Design Initiative, stepped up to develop implementable plans to replace towers that are functioning beyond their intended design life.

The U.S. DOT Volpe Center's Aviation Facilities and Business Services team provided direct technical support to FAA by developing economic models and project cost plans (PCPs) for programmatic decisions. The cost estimating tools are based on FAA historical cost data and allow estimates to be developed based on the size of the facility and the number

U.S. DOT Volpe Center staff who are part of the Terminal Facilities Support team, include Heer Patel and John Hadley at OWD ATCT in Norwood, MA. U.S. DOT Volpe Center staff member and part of FAA's Small Tower Design Team, Stephen Bransfield, PhD received the 2024 DOT Sustainability Award. *Source: U.S. DOT Volpe Center*

of operational positions in the facility. The PCPs allow project teams to effectively manage their project budget and program managers to understand their finances across their portfolio of projects.

U.S. DOT Volpe Center subject matter experts participated on the FAA's source selection committee for the Sustainable Tower Design Initiative competition, conducted site surveys of potential construction sites, and developed various financial reporting tools. The team performed site surveys of facilities prior to replacement to understand their system architecture needs, and when new facility construction begins, the Volpe Center will provide financial status updates and assist in the commissioning of new towers by facilitating safety risk management efforts. *(Sponsor: FAA Terminal Facilities Planning and Execution Office (AJW-244), Technical Operations, FAA)*

In support of FAA, the U.S. DOT Volpe Center developed implementable plans to replace airport traffic control towers that are functioning beyond their intended life design.

MULTIMODAL RESILIENCY

Strengthening Transit Systems through a Resilience Planning Framework

Whether communities are large or small, urban or rural, the American public depends on public transportation to access jobs, schools, healthcare, and other critical services. Weather events and natural hazards are threatening public transit agencies and the transit systems they manage at increased frequencies and intensities. Since 2012, the Federal Transit Administration (FTA) has provided $11 billion in emergency relief funding to transit agencies to assist with recovery from—and enhance resilience to—natural disasters, emergencies, or significant events that disrupt transit services.[11]

Efforts to make transit systems more resilient to the impacts of current and future natural hazards are imperative to ensuring transit fulfills the critical role it plays across American communities. By proactively embedding resilience into all aspects of decision-making, transit agencies can increase rider safety and day-to-day reliability in an increasingly unpredictable climate, ensure services continue during emergency situations, and save money on maintenance, repair, and disaster recovery activities.

U.S. DOT Volpe Center transportation planning and policy professionals, in collaboration with the FTA Office of Environmental Policy and Programs

11 This figure does not include funding associated with preventing, preparing for, or responding to the COVID-19 pandemic.

led the development of the Transit Resilience Guidebook, published in May 2024.

A literature review helped the team understand the current state of resilience planning in the transit industry; interviews conducted with transit agencies yielded examples of how transit agencies from across the country are addressing resilience in practice. The U.S. DOT Volpe Center team conducted interviews with the Massachusetts Bay Transportation Authority, Los Angeles County Metropolitan Transportation Authority, New Jersey Transit, Southeastern Pennsylvania Transportation Authority, and the Metropolitan Atlanta Rapid Transit Authority, among others. The U.S. DOT Volpe Center team drew upon its expertise in resilience planning and the information gathered in the literature and interviews to develop the Transit Resilience Guidebook.

The Guidebook presents recommendations and examples on how to identify and address vulnerabilities and build resilience to current and future extreme weather events, natural disasters, and climate change impacts while ensuring priority is given to protecting vulnerable populations.

It presents resilience planning as an iterative process to identify and address weather events, natural hazards, and risks that threaten an agency. It acknowledges that resilience cannot be achieved through the actions of any one department within a transit agency. Instead, resilience efforts must be considered and implemented, as appropriate, throughout an agency's decision-making and project life-cycle processes.

The Guidebook offers a phased approach to building resilience throughout a transit project's lifecycle:

Phase 1: Assess provides an overview of the steps involved in recognizing vulnerabilities and the climate risks they pose. This section of the Guidebook identifies the relevant transit assets, common natural hazards to consider, and industry-standard data sources and tools to understand and assess changing climate conditions. It also showcases example approaches that transit agencies have taken to better understand which of their assets were most vulnerable to current and future extreme weather events, natural disasters, and climate stressors. Lastly, this phase provides an overview on how to incorporate assessment results into decision-making, and introduces four categories of resilience strategies: avoid, maintain and manage, strengthen and protect, and enhance redundancy.

Phase 2: Plan outlines opportunities to incorporate resilience into agency planning efforts, including emergency preparedness and recovery efforts, to align planning priorities and ensure actions at the various levels of transit planning and project selection increase resilience.

The resilience planning framework is an iterative process to consider resilience strategies and integrate the U.S. DOT guiding principles for adaptation and resilience throughout the six phases of assess, plan, design and construct, manage, maintain, and monitor. *Source: U.S. DOT Volpe Center*

Phase 3: Design & Construct provides recommendations on how to consider potential hazards as part of the design and development of new capital projects, as well as smaller retrofits, and how to evaluate potential adaptation measures that would reduce possible damage to the newly constructed assets.

Phase 4: Manage outlines best practices for integrating resilience into transit asset management to reduce costly damage, prevent service disruptions, and extend the assets' useful lives for a more resilient transit system.

Phase 5: Maintain presents opportunities to integrate resilience considerations into operations and maintenance activities to enhance the agency's ability to prepare for and respond to weather events and natural hazards.

Phase 6: Monitor provides information on the importance of and how to establish a monitoring and evaluation approach to track progress toward resilience goals and to assess the impact of resilient strategies.

The Guidebook recommends climate data sources and community vulnerability screening tools that can be used to inform a vulnerability assessment. It also provides references to detailed primers, step-by-step

guidance on conducting a vulnerability assessment, and information on available training and potential funding sources for supporting resilience planning and project implementation. *(Sponsor: FTA Office of Environmental Policy and Programs (TPE-30))*

MARINE ECOSYSTEMS

Evaluating the Cost and Effectiveness of Ballast Water Treatment Systems: A Retrospective Cost Analysis of the 2012 Ballast Water Discharge Rule

The unintentional introduction of nonindigenous invasive species (NIS) into U.S. waters via hull fouling and ballast water discharge continues to pose a serious risk to coastal areas and facilities and threatens biodiversity. Current U.S. regulations require ballast water management (BWM), and vessel-specific biofouling management plans to prevent introduction of NIS in U.S. waterways. The Vessel Incidental Discharge Act (VIDA) of 2018 requires the EPA and U.S. Coast Guard (USCG) to develop and implement performance standards and compliance and enforcement protocols for 23 discharges, including ballast water and hull fouling related to the operation of large commercial vessels. The U.S. DOT Volpe Center provides expertise to USCG by evaluating policy and new BWM regulations.

The U.S. DOT Volpe Center provides USCG with information on the current state of knowledge about aquatic NIS to support the implementation of performance standards and regulatory analysis related to VIDA. A team of U.S. DOT Volpe Center ballast water experts revisited the 2012 USCG Final Regulatory Analysis required for the Standards for Living Organisms in Ships' Ballast water Discharged in U.S. Waters rule to assess the accuracy of the analysis over the last 10 years. The U.S. DOT Volpe Center team also conducted a literature search to update the current understanding of the costs associated with various types of NIS and the probability of future NIS invasions and spread resulting from shipping activity given the current state of ballast water and biofouling management practices.

USCG also asked the U.S. DOT Volpe Center for an overview of the available technology and strategies for preventing NIS introduced by ballast water and hull fouling. USCG will study the risks associated with the spread of NIS within the Great Lakes system and the role U.S. flagged ships may play in the intra- and inter-lake spread of NIS and the effectiveness of technologies and protocols for preventing the spread of NIS in the Great

Lakes. The U.S. DOT Volpe Center estimated the range of annual costs associated with different categories of NIS in U.S. waters, including fish, invertebrates, and aquatic plants; estimated the probability of new NIS invasions and the spread of existing NIS given current conditions; and evaluated the role of U.S.-flagged vessels on the Great Lakes in spreading NIS and the associated costs and effectiveness of current NIS prevention protocols and technologies.

The U.S. DOT Volpe Center delivered a draft report and presentation to the USCG in July 2024. The report provided a review of economic benefits and the effectiveness of the Standards for Living Organisms in Ships' Ballast water Discharged in U.S. Waters rule. The U.S. DOT Volpe Center team will continue to support USCG REG-1 economists in this work in the coming years. *(Sponsor: Environmental Standards Division (CG-0ES-3), Standards Evaluation & Analysis Division (REG-1) and U.S. Coast Guard Headquarters)*

In support of the U.S. Coast Guard, the U.S. DOT Volpe Center estimated the range of annual costs associated with different categories of nonindigenous invasive species (NIS) in U.S. waters.

ORGANIZATIONAL EXCELLENCE

Report to Congress Highlights National Environmental Policy Act Process Success and Improvements

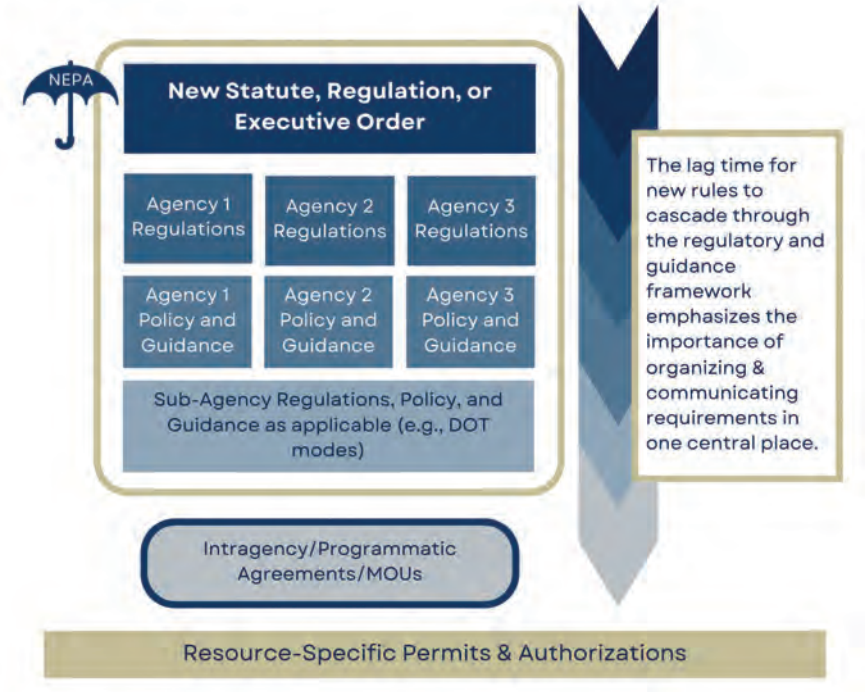
In April 2024, the U.S. DOT's Infrastructure Permitting Improvement Center (IPIC) released the Surface Transportation NEPA Process Improvements Report to Congress. The report fulfills the U.S. DOT's requirement under Section 11301 of the BIL to submit a report to Congress that describes the strategies to ensure efficient NEPA processes for surface transportation projects under 23 United States Code § 139. U.S. DOT has worked for decades to improve and streamline NEPA implementation and has made considerable progress by applying provisions in congressional reauthorizations and other process improvements across the Department.

A priority of U.S. DOT has been to understand NEPA permitting timelines to reduce permitting constraints and delays on critical infrastructure projects. IPIC's report to Congress highlighted seven key strategies U.S. DOT is undertaking to reduce impediments and facilitate an efficient NEPA process for surface transportation programs. The strategies to accelerate the NEPA process enhance the set of permitting improvement actions already in progress by U.S. DOT.

1. Broaden the Liaison Program.
2. Catalog, update, and implement more programmatic agreements.
3. Encourage interactive, web-based platforms for NEPA documents.
4. Consolidate NEPA rules and guidance in a central resources page.
5. Establish a concierge program.
6. Encourage robust planning efforts prior to initiating NEPA.
7. Leverage $100 million in Inflation Reduction Act (IRA) funding.

U.S. DOT has made strides to improve environmental review and permitting to ensure the delivery of well-designed infrastructure projects, including those enabled by BIL. In preparing this report to Congress, the U.S. DOT Volpe Center team conducted interviews with operating administrations (OAs) that conduct NEPA work and oversee NEPA processes. U.S. DOT Volpe Center policy analysis experts relied on data analysis and social science skills to conduct this work. The U.S. DOT Volpe Center team also collected and analyzed project timeline data from the Permitting Dashboard and conducted interviews with modal partners, interpreted and fulfilled statutory requirements, incorporated and synthesized feedback from the OAs, and reviewed historical legislation and statutory requirements.

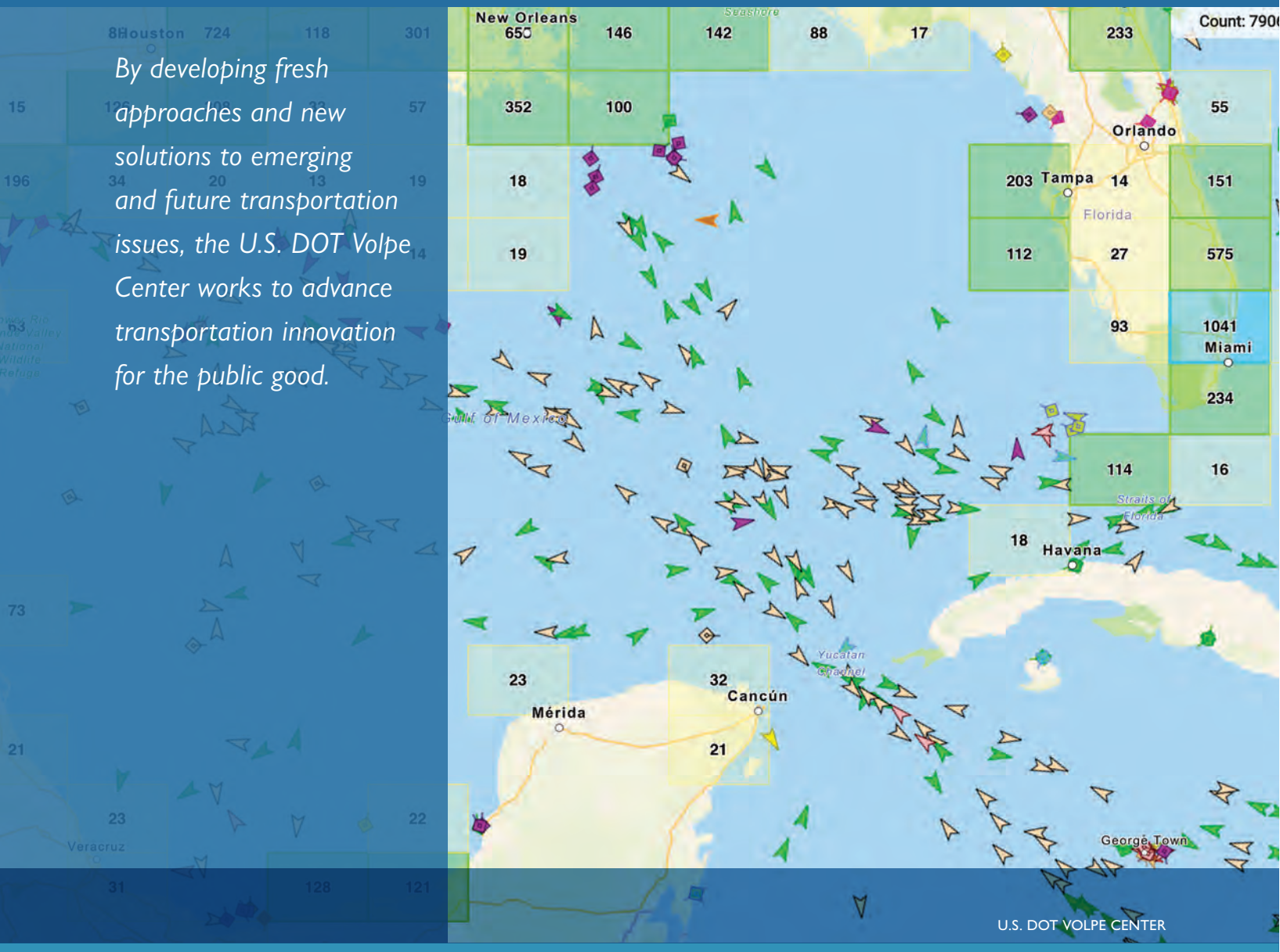
The U.S. DOT's IPIC promotes positive community outcomes and time-saving measures when implementing NEPA, and tracks transportation permitting by coordinating with OA staff and the Permitting Council. IPIC also acts as U.S. DOT's liaison to the White House Council on Environmental Quality on issues related to permitting and project delivery. The report to Congress identifies impediments to NEPA that, once addressed, will continue to improve infrastructure project timeframes while protecting communities and the environment. *(Sponsor: OST-P30, Infrastructure Permitting Improvement Center)*



Framework for NEPA rules, guidance, and permits. *Source: U.S. DOT*

Transformation

By developing fresh approaches and new solutions to emerging and future transportation issues, the U.S. DOT Volpe Center works to advance transportation innovation for the public good.



Executing the U.S. DOT Complementary Positioning, Navigation, and Timing (CPNT) Action Plan and Driving User Adoption

The primary and most recognizable PNT service supporting critical infrastructure is the Global Positioning System (GPS) utilized for all modes of transportation, including aviation, maritime, rail, and road. In addition to transportation applications, use of GPS is foundational through many sectors of the economy such as surveying, the financial sector, machine control, precision agriculture, science missions, and space applications. However, because GPS relies on signals broadcast from satellites in medium Earth orbit (MEO), the signal strength at the receiver is low and thus vulnerable to intentional and unintentional disruptions.

In response to increasing threats to GPS, Executive Order (EO) 13905 Strengthening National Resilience through Responsible Use of Positioning, Navigation, and Timing Services was issued by the White House on February 12, 2020. EO 13905 seeks to ensure the disruption or manipulation of PNT services does not undermine the reliability or efficiency of critical infrastructure services by: a) Raising awareness of the extent to which critical infrastructure depends on PNT services; b) Ensuring critical infrastructure can withstand disruption or manipulation of PNT services; and c) Engaging public and private sectors to promote responsible use of PNT services.

U.S. DOT's Office of the Assistant Secretary for Research and Technology (OST-R) is responsible for overseeing civil PNT activities. The U.S. DOT Volpe Center works on initiatives to promote EO 13905, and Space Policy Directive 7, which defines the U.S. policy on space-based PNT.

With a commitment to advancing the PNT resilience landscape, the U.S. DOT Volpe Center on behalf of OST-R developed and is implementing a CPNT Action Plan with the primary goal to encourage the adoption of Complementary PNT solutions throughout the nation's transportation system, including federal and critical infrastructure sectors. The CPNT Action Plan describes actions U.S. DOT is pursuing over the next several years, including engaging PNT stakeholders; monitoring and supporting the development of CPNT specifications and standards; establishing resources and procedures for CPNT testing and evaluation; and creating a Federal PNT Services Clearinghouse. Taken together with the efforts of other federal partners, these initiatives will strengthen the resilience of the

All modes of transportation and critical infrastructure applications rely on GPS and PNT. *Source: Complementary PNT Action Plan DOT Actions to Drive CPNT Adoption* https://www.transportation.gov/pnt/complementary-pnt-action-plan

nation's PNT-dependent systems, resulting in safer, more secure critical infrastructure. Recognizing the plan's alignment with the goal of enhancing transportation system safety, the Deputy Assistant Secretary (DAS) for Research and Technology formally approved the CPNT Action Plan for public release in September 2023. An update was released in March 2024.

Following the release of the CPNT Action Plan, the U.S. DOT Volpe Center developed an acquisition strategy to get CPNT technology vendors under contract quickly. This included release of a Request for Information (RFI) which found: 1) there are mature and commercially available technologies that can support PNT function for critical infrastructure, 2) that the landscape has changed since the 2020 U.S. DOT CPNT Demo, with new "players" and several mergers and partnerships formed, and 3) the acquisition should be conducted using simplified acquisition procedures under a fully open and competitive marketplace.

In addition, the team supported an interagency meeting in early 2024 to share and exchange CPNT initiatives with other federal partners and identify possible partnerships. Representatives from 17 agencies attended the meeting and presentations were made by the Department of Homeland Security, Department of Commerce, Department of Energy, U.S. DOT/FAA, U.S. Air Force, and U.S. Space Force.

In February 2024, the U.S. DOT Volpe Center team developed and released the Combined Synopsis Solicitation or Request for Quotation (RFQ) to

identify qualified vendors who are willing to participate in DOT CPNT Rapid Phase I for testing and evaluation of high (8 or higher) Technical Readiness Level (TRL) technologies. The RFQ closed at the end of March 2024, and an overwhelming number of proposals showcasing a diversity of CPNT technologies and use cases were received.

In June 2024, the U.S. DOT Volpe Center awarded contracts to nine CPNT technology vendors. These awards will enable U.S. DOT to conduct real-world field tests of commercial PNT technologies to facilitate adoption into systems that depend on secure and reliable PNT services. In addition, the contracts provide funding for instrumentation, testing, and evaluation of CPNT technologies at field test ranges in conjunction with critical infrastructure owners and operators. A key aspect of the CPNT Rapid Phase I contract awards is for the field test ranges to be instrumented within six months.

Due to the quality of the proposal responses and having received more proposals than could be funded under Simplified Acquisition Procedure guidelines, the U.S. DOT Volpe Center intends to move expeditiously to issue a Complementary PNT Rapid Phase II solicitation to expand the set of CPNT technologies to be evaluated. *(Sponsor: OST-R)*

Pilot Projects Test Resilience of Positioning, Navigation, and Timing Services

Positioning, Navigation, and Timing services support critical communications, energy, finance, information systems, and transportation infrastructure across the United States to sustain national and economic security. To this end, in early 2020 the President signed Executive Order 13905, Strengthening National Resilience Through Responsible Use of Positioning, Navigation, and Timing Services.

The primary and most recognizable PNT service supporting critical infrastructure in the U.S. is GPS. GPS relies on signals broadcast from a constellation of satellites in medium Earth orbit, so signal strength at the user receiver is low and vulnerable to intentional and unintentional disruptions. Jamming and spoofing disruptions around the globe threaten safety-critical applications as well as daily civil and commercial use of GPS. Additionally, natural and manmade obstructions to GPS signals, including urban canyons and mountainous terrain, impact the reliable operation of safety technology used for railroad, transit, and highway systems.

Engineers at the U.S. DOT Volpe Center, on behalf of OST-R, have collaborated since 2022 on a two-part pilot program with the Maritime

Antenna configuration on top of the U.S. DOT Volpe Center's Sprinter van prior to deployment. *Source: U.S. DOT Volpe Center*

Administration (MARAD) and Federal Railroad Administration (FRA) to understand their GPS challenges and explore solutions.

The U.S. DOT Volpe Center's PNT subject matter experts continue to work to develop a risk management framework for systems, assets, and networks that depend on PNT service by:

- identifying equipment receiving or generating PNT data, and assets dependent on PNT services via stakeholder engagement and equipment inventories;
- detecting the disruption and manipulation of PNT services, in actual and simulated environments, through testing PNT system equipment;
- identifying protection equipment and complementary PNT technologies capable of mitigating risk to the modal systems; and
- sharing the framework with key stakeholders.

The U.S. DOT Volpe Center's PNT subject matter experts, in support of the Office of the Assistant Secretary for Research and Technology, continue to work to develop a risk management framework for systems, assets, and networks.

For the MARAD pilot program, the U.S. DOT Volpe Center PNT team spearheaded a sea trial aboard a Ready Reserve Fleet (RRF) vessel to collect Global Navigation Satellite System data using a variety of antenna and receiver pairs and study their response to any disruptions during a live mission. The MARAD Phase II sea trial occurred aboard an active vessel that traveled from the United States to the Mediterranean Sea, collecting PNT data for over 100 days.

Working with FRA and Amtrak, the U.S. DOT Volpe Center team identified PNT equipment–multiple candidate antennas and an industry-representative receiver–to support their use case. Along with antennas identified for maritime use, the equipment was deployed in May 2024 at NAVFEST, a live sky GPS jamming and spoofing event run by the U.S. Air Force's 746th Test Squadron held at White Sands Missile Range in New Mexico. Antennas with multiple elements to determine jamming direction were most successful in this arena. The NAVFEST results will inform recommendations for equipment selections for MARAD and Amtrak. However, end users should consider the specific needs, operating environment, restrictions and installation requirements, integration into existing platforms, and other requirements aboard their ships, trains, or other vehicles when finalizing their decision. *(Sponsor: OST-R)*

ENERGY TRANSFORMATION

Building an Accessible and Reliable National Electric Vehicle Charging Network

As part of the Bipartisan Infrastructure Law (BIL), the White House announced new actions to lower the cost of electric vehicles (EVs) for every American and build a convenient, reliable, made-in-America EV charging network. In October 2024, the Joint Office of Energy and Transportation (Joint Office) celebrated a milestone goal of reaching 200,000 public EV charging ports available nationwide. Decarbonizing the transportation sector by reducing harmful GHG emissions will address the growing climate crisis and move the Biden-Harris Administration closer to its goal of a net-zero emissions economy by 2050. A decarbonized transportation system can mobilize a sustainable economy that benefits everyone.

BIL has invested $7.5 billion to build a national EV charging network and created the Joint Office to study, plan, coordinate, and implement issues of joint concern between the U.S. DOT and Department of Energy. One of BIL's goals is to invest in EV charging infrastructure, and a large portion of BIL funding is dedicated to making EVs accessible to all Americans for both local and long-distance trips. The U.S. DOT Volpe Center supports the

development of new EV charging infrastructure by providing expertise to the Joint Office and through support to FHWA.

Since the inception of BIL's National Electric Vehicle Infrastructure (NEVI) formula program in 2022, the U.S. DOT Volpe Center has supported the Joint Office in working with federal, state, and local officials, as well as private industry, to plan and promote a national network of charging/fueling stations with a focus on filling gaps in rural, disadvantaged, and hard-to-reach locations.

This work expanded with BIL's Charging and Fueling Infrastructure (CFI) competitive grant program launch in March 2023, and FHWA's Electric Vehicle Charger Reliability and Accessibility Accelerator (EVC-RAA) grant program in September 2023.

The U.S. DOT Volpe Center supports the Joint Office's work related to the NEVI, CFI, and EVC-RAA programs through strategic planning; program guidance development; state plan and proposal reviews/evaluations; stakeholder coordination, outreach, and resource development; technical assistance for state DOTs, communities, and Tribal nations; program evaluations; and coordination efforts with Justice40 and labor and equity workforce initiatives. In addition, the U.S. DOT Volpe Center facilitates coordination between FHWA and the Joint Office.

During 2024, the U.S. DOT Volpe Center provided dedicated staff support for the Technical Assistance Team, which focused on technical assistance to state DOTs and other key state agencies for the implementation activities of NEVI, and to communities, Tribes, and other funding recipients for the implementation of CFI and Joint Office Funding Opportunity Announcement (FOA) grants.

In support of Bipartisan Infrastructure Law implementation and the Joint Office of Energy and Transportation, the U.S. DOT Volpe Center has been supporting the build out of a convenient, reliable made-in-America electric vehicle charging network.

U.S. DOT Volpe Center Support to the Joint Office of Energy and Transportation's Initiatives and Activities

Other key U.S. DOT Volpe Center support related to this transformational initiative includes:

NEVI Infrastructure Deployment Plan: Participating in the reviews of the NEVI EV Infrastructure Deployment Plan updates for $885 million in FY25 funding. U.S. DOT Volpe Center staff led review teams and consensus meetings which provided recommendations for approval to Joint Office and FHWA leadership. U.S. DOT Volpe Center staff also developed tools and dashboards to track and visualize review findings.

CFI Discretionary Grant Program: Providing technical, policy, and administrative support for the CFI Discretionary Grant Program. Assisted

with the CFI Round 1b selection process for $521 million in new charging and alternative fueling infrastructure projects and provided coordination and technical reviewer support for the CFI Round 2 evaluation process soliciting $800 million in new project funding.

EV Working Group: Providing support to the Electric Vehicle Working Group (EVWG), which consists of 25 stakeholders that will provide recommendations to the Secretaries of Energy and Transportation on the development, adoption, and integration of EVs into the energy and transportation systems of the U.S.

Community Charging: Developed and released Community Charging: Emerging Multifamily, Curbside, and Multimodal Practices in February 2024 and delivered a webinar on the new resource. Intended for use by public officials, property and vehicle owners, utilities, and other stakeholders, the paper includes strategies that go beyond installing private onsite EV chargers at multifamily properties, including charging in the public right-of-way and technical and cost-saving solutions to common barriers.

Communities Taking Charge: Scoping, helping write, and publicizing the Communities Taking Charge FOA with key organizations such as the National Association of City Transportation Officials and the International Parking and Mobility Institute. Reviewing concept papers and full applications, including serving on the Federal Consensus Board.

Curbside Charging: Developing a series of briefings for Joint Office leadership on various EV charging solutions for multifamily housing residents. U.S. DOT Volpe Center staff also delivered a public webinar on curbside charging strategies.

Right-Sizing E-Mobility: Scoping and issuing a whitepaper and webinar on Right-Sizing E-Mobility, investigating barriers and recommendations for unlocking innovative "middle mobility" form factor options that can help extend the reach and accelerate the timeline of vehicle electrification.

Cybersecurity: Coordinating federal cybersecurity research to reduce NEVI cyber risks, including ongoing work on an incident reporting framework, cybersecurity assessment of Title 23 standards, and also chaired an EV and charging infrastructure security working group. Additionally, served as the Joint Office's delegate to the Office of The National Cyber Director's Senior Steering Group on Cybersecurity and the Clean Energy Transition.

Tracking Progress: Providing varied data analysis support, including by rebuilding a spreadsheet tool to track and project award and operational

dates for NEVI stations. Outputs from the projection tool were used in regular White House briefings on NEVI implementation progress.

Engagement with Tribal Governments: Providing technical assistance to several Tribes including community engagement, route analysis, microgrid capacity analysis for EVSE deployment, and partnering with Clean Cities and Communities Coalitions to hold Ride and Drive events in Tribal communities and at Tribal events. The Volpe team also developed and maintained the Powering Progress Tribal Nations Monthly Newsletter that includes highlights about EV-related Tribal resources, technical assistance opportunities, Tribal funding award announcements, funding opportunities, and events.

Alternative Fuel Corridors Certification: Leading a working group to consider various aspects of how states will approach certifying their alternative fuel corridors (AFCs) are "fully built out," which enables them to spend federal formula funding away from the corridors.

EV Carsharing: Researching business models and mechanisms that can make EV carsharing financially viable in underserved communities given the documented air quality and quality of life improvements. The next phase of work will involve developing a financial scenario tool and convening researchers engaged on the topic to increase coordination and impact.

Anna J. Siefken, Deputy Director, Federal Energy Management Program (FEMP), Stephen Popkin, PhD, Director of Research and Innovative Technology, Mike Scarpino, Principal Technical Advisor for Ground Vehicle Alternative Fuels, Electrification, and Deployment, Heather Richardson, Community Planner, U.S. DOT Volpe Center, Mary Sotos, Director, Federal Energy Management Program, and Creshona Armwood, Supervisor, FEMP Agency Services and Federal Engagement. *Source: U.S. DOE FEMP*

These activities directly support the creation of a convenient, reliable, and Made-in-America EV charging network, so the great American road trip can be electrified by building a national network of 500,000 EV chargers along America's highways and in our communities.

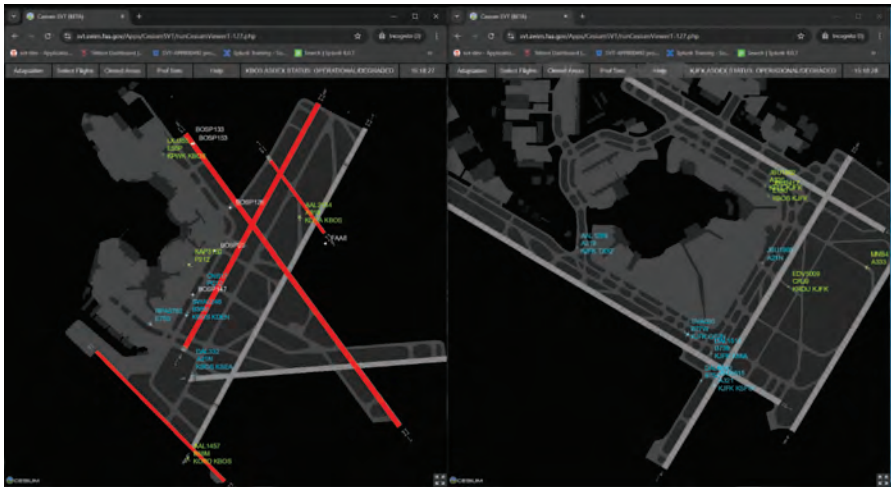
U.S. DOT Volpe Center Team Recognition

The U.S. DOT Volpe Center's support of the Joint Office was acknowledged by the Department of Energy's Federal Energy Management Program with a 2024 FEDS Spotlight Award for Professional Achievement. The U.S. DOT Volpe Center team was recognized as "federal employees going above and beyond typical day-to-day responsibilities to achieve mission success while also cutting energy waste, reducing costs, optimizing performance, and advancing America's progress toward energy independence, resilience, and security." *(Sponsor: Joint Office of Energy and Transportation)*

BUILDING DATA AND TECHNOLOGY CAPACITY

Improving Airport Operations by Migrating Surface Situational Awareness Tool to Cloud Environment

FAA's mission is to provide the safest, most efficient aerospace system in the world. This requires delivering the highest level of situational awareness to the facilities that regulate aircraft movement to maintain safe separation between aircraft, vehicles, and equipment on airport tarmacs, roadways, and other surfaces.



Screengrab of SWIM data visualization at two different U.S. airport facilities. *Source: U.S. DOT Volpe Center*

Major airports are equipped with systems and sensors that surveil aircraft and other vehicles on or near the airport surface. Historically, this data was only available on-site at each airport. To expand visibility of the data, U.S. DOT Volpe Center engineers were integral to the development of the System Wide Information Management (SWIM) Visualization Tool (SVT) to allow FAA personnel at other operational locations such as terminal approach control facilities (TRACONs) and air route traffic control centers (ARTCCs) to visualize an airport's SWIM data.

This year, the Volpe Center played a pivotal role in migrating SVT from an on-premises environment to the FAA's cloud environment, enabling greater availability and scalability of the SWIM application, and leveraging industry-standard cloud offerings for application monitoring, security, and user authentication.

Key aspects of the migration included:

- Adapting existing software code into software containers;
- Developing all security related artifacts needed to receive a security authorization to operate from FAA's Air Traffic Organization (ATO) Cyber Security Group (ACG);
- Testing the system to make sure all functionality was working as designed; and
- Collaborating with the users to set up training and a transition plan.

FAA's Government Community Cloud (GCC) version of SVT is now accessible at all 19 FAA facilities where it was previously available, this includes eight TRACONs, five ARTCCs, five airports (PHL, SDF, HOU, IAH, PDX), and FAA's Air Traffic Control System Command Center (ATCSCC).

FAA and the aviation community are pursuing a goal of zero serious close calls on or near the airport surface. According to FAA, in the first three months of 2024 the rate of serious runway incursion incidents (Category A and B) decreased by 59 percent from the same period in 2023, from 0.56 per one million airport operations to 0.23 per one million operations. Continued enhancements to airport situational awareness tools such as SVT can help reduce the frequency of these incidents and, ultimately, help reach the goal of zero serious close calls. *(Sponsor: FAA System Wide Information Management Program (AJM-316))*

Facilities currently running the new SWIM SVT in the cloud:

Air Traffic Control System Command Center (ATCSCC)

Anchorage ARTCC (ZAN)

Anchorage TRACON (A11)

Boston ARTCC (ZBW)

Boston TRACON (A90)

Chicago TRACON (C90)

Houston ARTCC (ZHU)

Houston Bush Intercontinental Airport (IAH)

Houston Hobby International Airport (HOU)

Houston TRACON (I90)

Los Angeles ARTCC (ZLA)

Louisville International Airport (SDF)

New York ARTCC (ZNY)

Northern California TRACON (NCT)

Philadelphia International Airport (PHL)

Portland International Airport (PDX)

Potomac Consolidated TRACON (PCT)

Seattle TRACON (S46)

Southern California TRACON (SCT)

Improving Air Traffic Surveillance Data Monitoring through Human Factors Evaluation

FAA regularly invests in infrastructure to improve the safety, efficiency, and sustainability of the National Airspace System (NAS). The agency's Mode Select Beacon Replacement System (MSBRS) program is integrating new types of technology into the NAS, while rebalancing existing services and modernizing air traffic control (ATC) infrastructure, to enable reduced costs and increased efficiency.

The Mode Select (Mode S) radar system, along with other ground-based cooperative radar systems, continue to be required for FAA air traffic surveillance. These systems provide aircraft position and altitude information to ATC automation systems, which is critical for maintaining safe and efficient flight operations for the flying public.

The objective of the MSBRS program is to replace rather than refurbish outdated and obsolete physical components of the 25-year-old legacy Mode S radar system. The MSBRS program will implement a new design that integrates contemporary surveillance interfaces, safeguards against cybersecurity risks, and includes necessary modifications to maintain the system's support and longevity. In addition, the MSBRS intends to consolidate and reduce the number of cooperative radar systems in the NAS.

The MSBRS program introduced three new desktop software applications to be used by FAA Airway Transportation Systems Specialists (ATSS) who monitor and maintain the radar systems. Each application has different functions and features. The main application is used to monitor the status of the radar and remotely control which radar channel is providing data to the ATC systems. The other applications are used to change radar parameters and view live radar targets, respectively. Before these applications could be implemented, they had to be evaluated for their safety and effectiveness.

The objective of this work was to evaluate the user interfaces of the ATSS' new software applications against the FAA's Human Factors Design Standard (HFDS; HF-STD-001B) and conduct an expert usability analysis to ensure the applications sufficiently minimized the risk of human errors. Meeting these standards is a critical step for FAA programs to receive approval to put new systems into service.

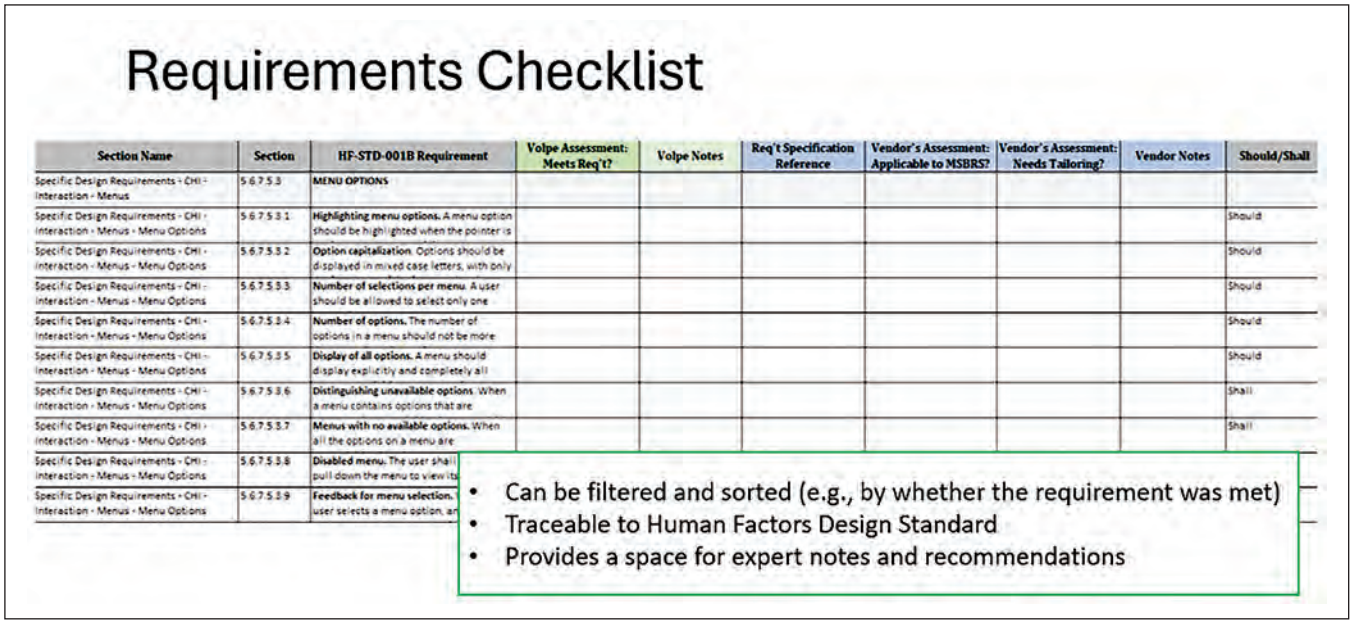
To prepare for the onsite evaluation, U.S. DOT Volpe Center transportation human factors experts compared the software vendor's FAA-approved design plans and requirements specifications for each user interface

against over 1,700 potentially relevant requirements in the HFDS to narrow down a set of over 850 applicable requirements per application, tailored to each application. The Volpe Center team created a checklist to conduct the onsite evaluation and document MSBRS compliance with each of the identified relevant requirements per application.

The U.S. DOT Volpe Center team conducted the onsite evaluation in 2023 at the FAA William J. Hughes Technical Center for Advanced Aerospace in New Jersey. The human factors experts assessed the user interfaces of each of the three software prototypes against the checklist and applied human factors expertise to recommend improvements to the user interface design.

The 1,700-item requirements checklist can be easily adapted to other FAA programs and user interfaces. For example, the checklist was designed so that user interface designers and human factors evaluators can easily filter out inapplicable requirements and sort/filter requirements by HFDS section/topic (e.g., menu options or color-coding). The Volpe Center also developed a coding scheme with standard language to use during an evaluation to indicate whether each requirement was met or whether it needed to be tailored to the particular user interface. This allowed the checklist user to filter out requirements that were not met or needed to be tailored, and to easily view the evaluator's notes and recommendations.

In March 2023, the U.S. DOT Volpe Center provided the MSBRS program with a report and briefing on the evaluation findings and recommendations



Screenshot of the requirements spreadsheet and checklist tool developed by the U.S. DOT Volpe Center for the MSBRS human factors UI evaluation. *Source: U.S. DOT Volpe Center*

to improve the usability of each user interface. The U.S. DOT Volpe Center's recommendations included, for example, clarifying labels for buttons and status information, consistent use of color coding, and strategies to avoid losing unsaved inputs. The report and briefing fulfilled a critical success criterion for the MSBRS program's Acquisition Program Baseline milestone. The MSBRS program made modifications to the user interfaces based on the Volpe Center's recommendations. *(Sponsor: FAA Surveillance Program Control Team, AJM-4130)*

Intelligent Transportation Systems (ITS) Deployment Tacking Survey Expands Geographic Coverage to Provide Nationwide ITS Data

The Intelligent Transportation Systems Joint Program Office (ITS JPO) collaborates across modal administrations to plan and implement multimodal ITS technology research, deployment, and evaluation programs. The objective is to improve transportation safety, mobility, and efficiency and enhance productivity through the deployment of innovative technologies.

The U.S. DOT Volpe Center, in support of the Intelligent Transportation Systems Joint Program Office (ITS JPO), administers the ITS Deployment Tracking Survey to freeway management, arterial management, and transit management agencies to track ITS deployment.

Under ITS JPO sponsorship, the U.S. DOT Volpe Center administers the ITS Deployment Tracking Survey to freeway management, arterial management, and transit management agencies to track ITS deployment (see Deployment Statistics | ITS Deployment Evaluation (dot.gov). The ITS JPO and other stakeholders may use the resulting data to inform strategic planning and investment decisions, identify opportunities to accelerate the deployment of ITS, establish baseline deployment for newer ITS technology deployments, document shifts in ITS deployment patterns and ITS market evolution, and identify opportunities for knowledge transfer and technical assistance.

Since 1999, the ITS Deployment Tracking Survey has collected information about the extent of ITS deployment in a subset of large metropolitan areas across the United States. The surveys are administered to state and local transportation agencies, including freeway, arterial, and transit management agencies. The ITS JPO initially developed the ITS Deployment Tracking Survey to track and manage progress toward a 10-year ITS deployment goal announced by the U.S. Secretary of

Transportation in 1996.[1] The goal focused on tracking ITS deployment rates in large metropolitan areas. At the time, ITS was a relatively new set of technologies that tended to be deployed in large metropolitan areas to address congestion, safety, and other transportation issues. Following the goal measurement period, the surveys have been conducted on a roughly 3-year cycle to continue monitoring the deployment of ITS.

In the years following the goal period, it became clear the ITS Deployment Tracking Survey no longer provided the most complete picture of where ITS was deployed across the nation. ITS technologies were becoming more mainstreamed and, as such, were increasingly deployed outside of large metropolitan areas. For example, the ITS JPO's Benefits, Costs, and Lessons Learned databases[2] showed increasing numbers of examples of ITS deployments in smaller urban (i.e., small metropolitan and micropolitan) and rural areas. The ITS JPO's 2019 Small Urban and Rural Transit Provider Survey further demonstrated the high rates of deployment of some ITS among smaller urban and rural transit providers.

Based on these trends, the ITS JPO determined that an update to the survey methodology was necessary to address these important gaps in survey coverage and better reflect a fuller range of communities and situations where ITS technologies are deployed.

In addition to providing more comprehensive data about the extent of ITS deployment nationwide, the new Deployment Tracking Survey methodology positions the ITS JPO to baseline and, over time, track the ITS deployment projects funded by the BIL.

Starting around 2016, ITS JPO asked the U.S. DOT Volpe Center to begin initial investigations into the development of a new survey approach and methodology for the ITS Deployment Tracking Survey, a multi-year redesign effort. To inform the expanded sampling approach, the Volpe team pursued extensive research into how ITS assets are managed on freeways and arterials across the country. The findings revealed variations in designated responsibility for arterial management, sometimes to state DOTs, and sometimes to local agencies—necessitating added complexity to the sampling methodology.

Working with survey statisticians outside of U.S. DOT, ITS JPO and the Volpe Center developed a new sampling approach, tailored to each

1 U.S. Transportation Secretary Peña's goal stated that the 75 largest metropolitan areas should be outfitted with an integrated ITS infrastructure in the next 10 years.

2 For more information about the ITS Benefits, Costs, and Lessons Learned Databases, see: https://www.itskrs.its.dot.gov/

population, greatly expanding the geographic coverage of the ITS Deployment Tracking Survey to have a more complete picture of ITS deployment nationwide.

In 2022, the U.S. DOT Volpe Center survey team conducted a Pilot Survey of State DOT districts and smaller urban and rural agencies that manage arterial roadways, to test different aspects of the new methodology. The findings revealed that smaller urban and rural local arterial management agencies were willing and able to participate in the ITS Deployment Tracking Survey.

The table below summarizes the methodological changes.

Comparison of Previous and 2023 Deployment Tracking Survey Sampling Methodologies

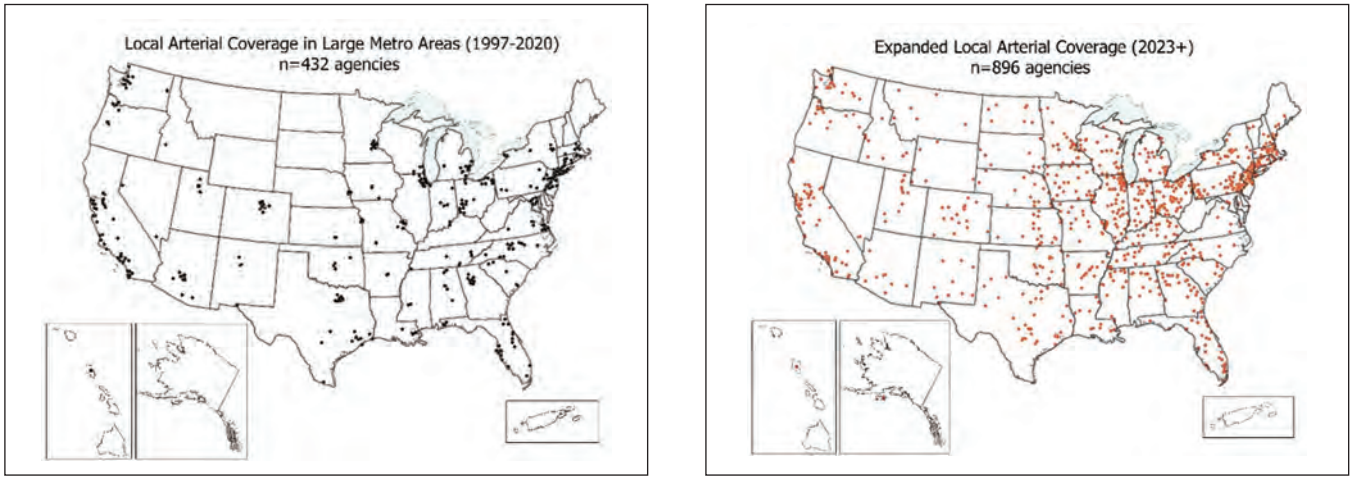
Survey Type	Previous Methodology (1999-2020)	New Methodology (2023+)
Freeway Management Survey	State DOT districts[1] and toll authorities from a subset of large metropolitan areas only	Census of all State DOT districts and tolling authorities that manage freeways (nearly tripled the number of surveyed agencies, compared to previous Deployment Tracking Surveys).
Arterial Management Survey: State Department of Transportation Districts	State DOT districts that manage arterial roads in the subset of large metropolitan areas only	Census of all State DOT districts that manage arterial roads (more than four times the number of surveyed agencies compared to previous Deployment Tracking Surveys).
Arterial Management Survey: Local Agencies[2]	Local agencies that manage arterial roads in the subset of large metropolitan areas only	Random stratified sample of places and counties from the 2020 Census[3] (doubled the number of surveyed agencies compared to previous Deployment Tracking Surveys).
Transit Management Survey	Transit agencies in the subset of large metropolitan areas	Random stratified sample of transit agencies from the National Transit Database (NTD)[4] (more than tripled the number of surveyed agencies compared to previous Deployment Tracking Surveys).

1 A few state DOTs refer to their agencies as "regions" or "divisions" rather than districts. For ease of reporting and consistency, the term "district" is used throughout this summary.
2 The term "local agencies" is used to collectively refer to place agencies and county agencies. The term "places" is used by the Census to define cities, towns, villages, townships, and boroughs.
3 The sampling frame was stratified by metropolitan, micropolitan, and rural census designations, and each of these groups were sub-stratified by county population size. Places within each county strata were sub-stratified by local population size. Only counties and places with populations greater than 5,000 qualified for the survey.
4 The sampling frame was stratified by large urban, small urban, and rural/Tribal area types according to the NTD reports. Only rural/Tribal transit agencies with more than 10 vehicles were qualified for the survey.

For the 2023 Deployment Tracking Survey, in a significant effort over several months, the U.S. DOT Volpe Center survey team sampled, identified, and contacted over 2,500 state DOT districts, toll authorities, local agencies, and transit agencies. Simultaneously, the survey team worked with subject matter experts within ITS JPO, FHWA, and FTA to update and finalize the three ITS Deployment Tracking Survey questionnaires.

On behalf of the ITS JPO, the Volpe Center team (which included subcontractor Ipsos) conducted the 2023 ITS Deployment Tracking Survey in October 2023 through January 2024 and managed overall survey administration. There were 1,474 completed surveys submitted, representing an overall response rate of 62 percent.

The U.S. DOT Volpe Center team completed data cleaning and data analysis and prepared and submitted the four final reports to FHWA Publications in October 2024. *(Sponsor: ITS JPO)*



The map on the left illustrates the geographic coverage of local arterial management agencies included in the Deployment Tracking Survey from 1999-2020, when the survey was administered to agencies in a subset of large metropolitan areas. The map on the right shows the expanded geographic coverage of local arterial management agencies in the 2023 Deployment Tracking Survey, using the new methodology.
Source: U.S. DOT

U.S. DOT Volpe Center Supports the VOICES Demonstration Project

U.S. DOT's Office of the Assistant Secretary for Research and Technology (OST-R) and the Office of the Assistant Secretary of Policy (OST-P) initiated the Virtual Open Innovation Collaborative Environment for Safety (VOICES) project in 2020 to transform the transportation industry by creating a more open system of systems. VOICES creates a platform that facilitates collaborative research, development, and testing of innovative technologies among participating entities including federal, state and local agencies, private sector, and academic institutions. It also encourages equitable access to research, resources, and partnerships by reducing barriers to entry currently encountered by organizations working to bring new products and services to market.

The VOICES project was created to protect the intellectual property of diverse stakeholders engaged in designing, building, testing, and evaluating the safety, performance, and interoperability of transportation automation and connectivity technologies. VOICES significantly improves the safety, mobility, efficiency, and environmental impacts of transportation across the country. VOICES enables distributed testing via connectivity that will permit organizations nationwide to conduct research, development, and testing regardless of their physical location.

Early VOICES development called upon subject matter experts at the U.S. DOT Volpe Center to plan the project, transfer technology from DOD to U.S. DOT, and apply rigorous systems engineering methods to help create the system and demonstrate the capabilities of distributed testing. Later, the Volpe Center's role shifted to management of the overall program.

Early VOICES development called upon subject matter experts at the U.S. DOT Volpe Center to plan the project, transfer technology from DOD to U.S. DOT, and apply rigorous systems engineering methods to help create the system and demonstrate the capabilities of distributed testing.

The Volpe team worked collaboratively on the VOICES concept of operations with OST-R, OST-P, and the Turner Fairbank Highway Research Center (TFHRC). The Volpe Center guided the systems engineering, technology transfer, and program management of VOICES in its early phase, to the point of completing the platform and demonstrating its initial capabilities. The team completed several early demonstrations of VOICES at TFHRC.

The U.S. DOT Volpe Center managed the technology transfer of VOICES to the MITRE Corporation to complete a Minimally Viable Product (MVP) demonstration between MITRE, dSpace Inc., the University of Arizona, and U.S. DOT's Highly Automated Systems Safety Center of Excellence (HASS). The MVP demonstration proved that geographically distributed testing is feasible and possible between organizations with vastly different goals and purposes to advance the safety and efficiency of surface transportation as a whole. VOICES connected teams from Massachusetts,

Virginia, Michigan, Arizona, and California to conduct the real-time demonstration.

The demonstration incorporated autonomous driving, pedestrian, and traffic light simulated components from separate geographic locations across the U.S. In fall 2023, the VOICES MVP demonstration was completed successfully, meeting all documented test criteria. The report documenting the VOICES MVP Demonstration was published in January 2024 and can be found at https://portal.voices.mitre.org/mvp-demo-report. *(Sponsor: OST-P, OST-R)*

ARTIFICIAL INTELLIGENCE

U.S. DOT Senior Leadership Artificial Intelligence (AI) Threat Tabletop Exercise

The Executive Order on Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence (EO 14110) commits to safe, trustworthy, and responsible deployment of AI technologies. AI holds immense potential to help solve urgent challenges while making our world more prosperous, productive, innovative, and secure. But it also comes with significant challenges that we must be prepared to address. Serious threats to the transportation sector may come from adversaries leveraging AI to attack our transportation systems.

U.S. DOT must prepare for how to respond to these potential AI threats and disruptions to the U.S. transportation system. To help prepare, the U.S. DOT held a Transportation Systems Sector AI Threat Tabletop Exercise (TTX) in July 2024. The mission of the exercise was to examine how an AI threat use case can introduce potential threats and disruptions to the U.S. transportation system and identify mitigation strategies and gaps. The use case focused on an adversarial attack that leverages AI and machine learning to create a GPS spoofing signal that impacts at least four modes of transportation.

The objectives of the DOT AI TTX were to:

- Examine how use of AI can introduce potential threats and disruptions to the transportation system.
- Evaluate the potential impacts of identified threats on transportation operations, safety, and reliability.
- Better understand what mitigation strategies could be taken to reduce the impacts of identified threats or disruptions and gaps that exist in mitigation strategies.

U.S. DOT Senior Leadership attend the DOT AI Threat Tabletop Exercise in July 2024. *Source: U.S. DOT Volpe Center*

- Assess DOT roles for internal and external communication related to AI threats and incidents.

The U.S. DOT Volpe Center played a critical role in developing, coordinating, preparing, and conducting the DOT AI TTX including the development of scenarios and materials for senior leadership.

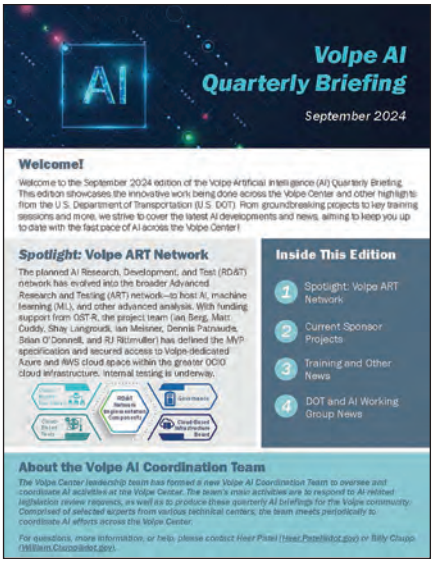
The Volpe team pitched the tabletop exercise for senior leadership approval, conducted weekly planning team meetings, developed AI tabletop scenarios and meetings, created rapid turnaround material for senior leadership, and conducted technical pre-exercise preparation meetings.

The AI TTX was co-sponsored by Cordell Schachter, DOT CIO, and Robert C. Hampshire, PhD, Principal Deputy Assistant Secretary for Research and Technology and Chief Science Officer. *(Sponsor: U.S. DOT OCIO and OST-R)*

U.S. DOT Volpe Center AI Coordination Team

The U.S. DOT Volpe Center leadership team has formed a new Volpe AI Coordination Team (VAICT) to oversee and coordinate AI activities at the U.S. DOT Volpe Center. Comprised of selected experts from various technical centers, the team meets periodically to coordinate AI efforts across the U.S. DOT Volpe Center. VAICT's main activities are to respond to AI-related legislation review requests, as well as to produce quarterly AI briefings for the U.S. DOT Volpe Center community.

For the AI-related legislation review, VAICT has reviewed and provided comments on draft documents as requested by U.S. DOT leadership. These included OMB memos, draft legislation, and pledges for signature by



The VAICT produces quarterly updates on AI work at the U.S. DOT Volpe Center and across U.S. DOT. The briefing provides information on the interesting work going on at the U.S. DOT Volpe Center. *Source: U.S. DOT Volpe Center*

appointed officials. VAICT also provides a coordination mechanism and distribution pathway for trainings and conferences focused on AI or related topics.

The quarterly AI briefings provide summaries of current work and activities related to AI both within and outside of the U.S. DOT Volpe Center and U.S. DOT. VAICT has published two issues of the quarterly AI briefings to date. *(Sponsor: Volpe Center Management)*

AUTOMATION

Cybersecurity Analysis of Two Cooperative Driving Automation Based Systems: Cooperative Perception and Traffic Optimization for Signalized Corridors

The FHWA-developed CARMA Program encourages collaborative research on the available technology, tools, and frameworks for cooperative driving automation (CDA) that can improve transportation system mobility, safety, and efficiency. CDA aims to improve the safety of road users and operators as well as the flow of traffic through information-sharing via machine-to-machine (M2M) communications. CDA-based transportation systems management and operations concepts include traffic incident management, road weather management, work zone management, and eco-approach and departure. Cybersecurity is critical for ensuring shared information is trustworthy, and the systems are secured from various threats to maintain the safety of all road users both inside and outside the vehicle.

In 2022, the U.S. DOT Volpe Center performed a cybersecurity analysis of M2M communications using the industry standard ISO/SAE 21434: Road Vehicles—Cybersecurity Engineering on two transportation systems management and operations (TSMO) applications based on CDA concepts. The two CDA-based TSMO applications analyzed were a general Cooperative Perception concept and the specific Traffic Optimization for Signalized Corridors (TOSCo) concept developed by the Crash Avoidance Metrics Partners (CAMP) consortium. Cooperative Perception extends the perception range of a cooperative automated driving system (C-ADS) equipped vehicle beyond its field of view and the sensors' line of sight by exchanging information with infrastructure elements or other C-ADS-equipped vehicles. TOSCo is a system that optimizes traffic flow and minimizes vehicle emissions at signalized corridors by determining a

C-ADS-equipped vehicles' optimal speed to minimize braking when approaching connected intersections.

The U.S. DOT Volpe Center's cybersecurity analysis consisted of three main components for both Cooperative Perception and TOSCo: system definition, threat analysis and risk assessment (TARA), and cybersecurity goals and considerations. The system definition described the system architecture, system functions, and the scope of the cybersecurity analysis. TARA is the heart of the cybersecurity analysis where the U.S. DOT Volpe Center team identified potential damage and threat scenarios and attack paths, assessed impact and risk based on attack feasibility, and identified possible risk treatment options.

Applying its cybersecurity skillset and knowledge of advanced vehicle systems and communications, the U.S. DOT Volpe Center team performed the cybersecurity analysis on Cooperative Perception and TOSCo, allowing the team to identify possible scenarios, attack paths, and their impact and feasibility based on the system architecture system. The team's skillset and expertise also yielded several potential high-level cybersecurity mitigations for Cooperative Perception and for TOSCo.

The U.S. DOT Volpe Center conducted its cybersecurity analysis from August 2023 to February 2024. Major deliverables included a final report for both the Cooperative Perception and TOSCo CDA-based TSMO applications along with their ISO/SAE 21434: Road Vehicles—Cybersecurity Engineering TARAs. The Cybersecurity Analysis of CDA project highlights the expanding cybersecurity landscape as vehicles become more interconnected and advanced. *(Sponsor: FHWA–Turner Fairbank Highway Research Center)*

Applying its cybersecurity skillset and knowledge of advanced vehicle systems and communications, in support of FHWA, a U.S. DOT Volpe Center team performed the cybersecurity analysis on Cooperative Perception and Traffic Optimization for Signalized Corridors (TOSCo), allowing the team to identify possible scenarios, attack paths, and their impact and feasibility based on the system architecture.

Evaluating the Automated Electric Bus at Sleeping Bear Dunes National Lakeshore

The State of Michigan and the National Park Service (NPS) are studying how the next generation of Automated Driving System (ADS) technology performs in an outdoor recreational setting, and whether ADS-equipped electric transit buses have the potential to improve safety, the visitor experience, and environmental sustainability. A pilot at Sleeping Bear Dunes National Lakeshore (SLBE) in Leelanau County, Michigan was one of the first pilot projects to use a full-size, ADS-equipped, battery-electric bus in an outdoor recreational environment. The U.S. DOT Volpe Center assisted with all aspects of the pilot project, including route and timetable planning, selection and procurement of the charging station, developing the bus wrap, signage, and other communications that supported the pilot launch and operations, and conducting data analysis to support the pilot evaluation.

NPS park staff and passengers prepare to board an ADS-equipped electric bus for a tour through Sleeping Bear Dunes National Lakeshore in Michigan. *Source: U.S. DOT Volpe Center*

The pilot operated from August through September 2024 along the Pierce Stocking Scenic Drive at SLBE. The 21-passenger bus operated like a tour, running two route options: a 4.3-mile short route with two stops (90 minutes) and a 7.4-mile-long route with three stops (120 minutes). Visitors were able to participate in the pilot by registering online to ride the ADS-equipped, battery-electric bus during one of four scheduled trips running each day of operation. The bus stopped and waited for passengers to get out and view the scenic vistas located at each stop before continuing to the next stop.

Operated by ADASTEC, an ADS technology company with North American headquarters in East Lansing, Michigan, the pilot utilized a Vicinity Motors Lightning battery-electric bus—a medium-duty, accessible, fully electrified, low-floor transit bus, outfitted with ADASTEC's ADS technology. The Michigan Office of Future Mobility and Electrification funded the pilot through its National Parks Michigan Mobility Challenge (NPMMC), a cooperative initiative with NPS and the State of Michigan.

The bus made a total of 91 trips (67 short-route trips and 24 long-route trips). Approximately 58 percent of the 91 trips (53 trips) were completed with passengers onboard (35 short-route trips and 18 long-route trips), while the remaining 38 trips ran without passengers. The total number of people on each trip ranged from 1 to 16 passengers, with a combined total of 201 passengers participating throughout the pilot. The bus operated primarily in clear weather conditions, with most days having little-to-no rain and an average temperature of 71°F (ranging from 52°F to 87°F).

The battery electric system performed well during the pilot. Overnight charging was sufficient to power the four scheduled trips each day

as well as transportation to and from the overnight storage location (approximately eight hours of operation, including waiting time at stops). On average, 33 percent of the battery capacity was used each day, although usage varied by trip (ranging from 12 percent to 46 percent). Only one trip was missed due to a problem when the bus did not charge properly overnight. There were several mechanical issues with the bus, which took time to repair. Most of the issues occurred during the mapping and testing phase, but some occurred during operations. A few trips were missed while the issues were being fixed.

The ADS also performed well during the pilot, but there were a few challenges. Overall, the bus operated in auto mode approximately 95 percent of the time, with the safety driver taking over operations the other 5 percent of the time. These disengagements were typically due to the driver choosing to switch to manual mode as the bus approached or left stops, but on multiple occasions the ADS-equipped bus encountered challenges such as a wrong-way driver on the one-way road, vehicles parked along the shoulder encroaching the right-of-way, or bicyclists passing very close to the vehicle.

The remote environment of the Pierce Stocking Scenic Drive presented novel challenges for the ADASTEC team, including operating in an environment with no cellular data connectivity and low GPS signal. Solutions to these issues were developed during the testing and mapping phase, prior to operations with passengers. The ADASTEC team indicated the lessons learned will inform future pilots and operations elsewhere.

The U.S. DOT Volpe Center, in support of the National Park Service (NPS) and in collaboration with the State of Michigan, supported a pilot program on how the next generation of Automated Driving System (ADS) technology performs in an outdoor recreational setting.

Results from the demonstration will be used to inform future NPS work to improve safety, the visitor experience, and environmental sustainability and provide a use case for companies developing and testing ADS in transit buses.

Lake Michigan Overlook on the Pierce Stocking Scenic Drive, Sleeping Bear Dunes National Lakeshore. *Source: NPS*

Passengers expressed positivity and optimism about the technology in comment forms and in conversations with the ADASTEC team. No passengers expressed feeling unsafe and many commented they enjoyed the experience. Several passengers noted the bus braking in automated mode was harsher than a human-driver, which caused some discomfort. ADASTEC was aware of this issue, which is why they did not allow passengers to stand while the bus was in motion.

Results from this demonstration will be used to inform future NPS work and to provide an additional use case for companies developing and testing ADS in transit buses. The pilot was useful in gaining experience with a full-sized ADS-equipped bus, operating in a low-connectivity environment. While some aspects worked well, challenges were also identified. Further refinements and testing are needed before ADS-equipped transit buses would be ready for full-scale deployment in National Parks. The U.S. DOT Volpe Center continues to work with NPS to explore the integration of ADS technology in park settings and is helping NPS stay abreast of advancing technology by designing tests and pilots to evaluate their performance in a park setting. *(Sponsor: NPS; with the State of Michigan as partner)*

MOBILITY

U.S. DOT Volpe Center Team Improves Transportation Information for Visitors at National Parks

Over the past several years, the U.S. DOT Volpe Center and NPS have made significant progress applying innovative technologies to provide enhanced transportation information to visitors, as part of the Emerging Mobility Working Initiative.

On November 17, 2021, Department of the Interior (DOI) Secretary Deb Haaland and U.S. DOT Secretary Pete Buttigieg signed a memorandum of understanding (MOU) between U.S. DOT and DOI on Transportation Innovation in the National Park System. The MOU strengthens the collaboration between NPS and DOT to continue working together to proactively experiment with emerging technologies to address transportation trends on public lands. In 2024, NPS published the National Transportation Strategy, which recommends continuing the Emerging Mobility Initiative, including piloting new technologies that provide real-time and predictive transportation information to visitors.

Vehicles stuck in traffic due to bison jam at Yellowstone National Park. Public lands experience unique road closures and incidents, which can lead to safety challenges for visitors and wildlife. *Source: NPS*

In support of NPS, the U.S. DOT Volpe Center is enhancing traveler information in the following areas:

- **General Transit Feed Specification (GTFS):** The U.S. DOT Volpe Center created and shared 16 static and two real-time GTFS feeds, covering approximately 85 percent (23 million) of total ridership (27 million) at NPS park units in 2022. The goal of this effort is to add NPS park transit system information to third party navigation applications, like Google and Apple Maps, to make transit information more accessible to visitors. A summary of the first phase of this project can be found in the National Transportation Library. In 2024, the U.S. DOT Volpe Center expanded their support of this work to create static feeds for the 30 highest ridership systems and shared GTFS real-time feeds.
- **Road closure and incident data feed:** The U.S. DOT Volpe Center is supporting the creation and expansion of data feeds on road closures and incidents, extending the WZDx (Work Zone Data Exchange) standard, which communicates real-time road status information to third party navigation applications. The U.S. DOT Volpe Center team presented on this transformative digital infrastructure work at ITS America in April 2024.
- **Travel forecasting:** The U.S. DOT Volpe Center supported the creation of a travel forecasting tool that allows park units to forecast visitation levels by season, month, week, day of week, and calendar days. The U.S. DOT Volpe Center is now supporting the expansion of this effort to create travel forecasts and communicate this traveler information for visitors at national park units across the country.

This portfolio of work continues to grow as park visitors increasingly receive their trip planning information via digital sources. Upcoming traveler information projects include standardizing transportation planning information on NPS park websites, a review of current ITS applications at parks, and exploring other transportation-focused digital infrastructure, such as road restrictions. *(Sponsor: NPS Washington Support Office)*

Designing a New Passenger and Cargo Ferry for Isle Royale National Park

Established in April 1940, Isle Royale National Park is an archipelago wilderness located in Lake Superior that is comprised of 450 smaller islands, more than 160 miles of trails, and is the second largest island in the Great Lakes. NPS operates the vessel *Ranger III* between Houghton, Michigan and Isle Royale. *Ranger III* is the largest passenger ferry providing service to and from Isle Royale National Park, serving visitors and park staff, supplying fuel for power generation, and transporting food, small boats, construction materials, and other bulk cargo. It is also the largest moving piece of equipment owned and operated by NPS. Built in 1958, *Ranger III* is past its 50-year lifespan. Changes in maritime regulations and park operations mean the ship now requires expensive and unscheduled operations and maintenance costs. A replacement ferry is critical to maintaining a reliable transportation network for the park.

The U.S. DOT Volpe Center has been working since 2015 to support NPS and Isle Royale National Park's maritime transportation needs. A U.S. DOT Volpe Center team analyzed current and future transportation system needs at Isle Royale National Park, identified and evaluated alternative vessels and service models to meet those needs, and identified measures to streamline and reduce the cost of park operations. The U.S. DOT Volpe Center team also participated in a value analysis to recommend a preferred action, which was to design and build a replacement vessel, *Ranger IV*.

Working with NPS, professionals in the U.S. DOT Volpe Center's Infrastructure Engineering and Deployment Division developed a preliminary design for a replacement vessel, *Ranger IV*, with contract support. The new vessel will modernize the park's transportation system by accommodating more passengers, more cargo, and additional types of cargo while also providing an increased level of safety, implementing environmental sustainability features, and reducing the ferry's environmental impact.

The U.S. DOT Volpe Center analyzed current and future transportation system needs at Isle Royale National Park, identified and evaluated alternative vessels and service models to meet those needs, and identified measures to streamline and reduce the cost of park operations.

Computer rendering of the Ranger IV design. *Source: NPS*

U.S. DOT Volpe Center marine engineers developed the original specifications, mission requirements, and operating profile and identified applicable regulatory requirements for *Ranger IV*. The U.S. DOT Volpe Center engineering team reviewed and provided comments on all preliminary design deliverables for compliance with the requirements document and ensured the design meets NPS's needs. The U.S. DOT Volpe Center is working with NPS to determine the best path forward for ship construction, including having discussions with other federal agencies to leverage their shipbuilding experience.

Ranger IV's design is a "spiral" process where designers go through several iterative cycles to converge on a final design. For example, changing the hull form slightly changes the powering requirements, which changes the engines, which changes the structure, which changes the weights; each element must ultimately work together. U.S. DOT Volpe Center naval architects provided decision support to analyze potential solutions based on a range of criteria, such as purchase cost, fuel use, maintenance burdens, and local repair capacity. In May 2024, U.S. DOT Volpe Center engineering experts took part in a Final Design Assessment and the final preliminary/contract design was completed in September.

Ranger IV is on track to begin operations in 2028. *(Sponsor: NPS–Isle Royale National Park)*

Accessibility and Equity

The U.S. DOT Volpe Center is supporting federal programs and initiatives that will make travel more accessible and safer for people with disabilities; increase mobility, connect communities, and engage stakeholders in the transportation process.

ADOBE STOCK/SARBINAZ MUSTAFINA

Volpe Human Factors Study Informs Rule for Air Travelers with Disabilities

For the estimated 5.5 million Americans who use a wheelchair, travel by air can be a significant challenge with the risk of damage to their wheelchair or injury during enplaning and deplaning. To address these challenges, U.S. DOT recently issued a rule to improve the safety and dignity of airline passengers who use wheelchairs, Ensuring Safe Accommodations for Air Travelers with Disabilities Using Wheelchairs. The rule advocates for those with disabilities and would represent the largest expansion of rights for airline passengers who use wheelchairs since 2008. In February 2024, at a public announcement for the proposed rule, U.S. Transportation Secretary Pete Buttigieg was joined at the White House by Assistant to the President and White House Office of Public Engagement Director Stephen Benjamin, U.S. Senator Tammy Duckworth (D-IL), advocates for people with disabilities, aviation workers, and other stakeholders for a fireside chat and town hall. In announcing the final rule on December 16, 2024, Secretary Buttigieg stated, "With the new protections we're announcing today, we're establishing a new standard for air travel—with clear and thorough guidelines for airlines to ensure that passengers using wheelchairs can travel safely and with dignity."

The need to address the disability community's concerns was emphasized by hundreds of people who participated in the U.S. DOT's Public Meeting on Air Travel by Persons Who Use Wheelchairs, held virtually in 2022, and the many others who submitted written comments to the meeting's docket. An individual from the disability community commented during the announcement of the proposed rule that he did not believe a rule of this nature would be proposed in his lifetime.

The rule addresses a critical need in aviation accessibility for passengers who fly with a wheelchair or scooter and/or require transfer assistance by requiring hands-on recurrent training for personnel who perform these functions. The Office of Aviation Consumer Protections collects data on wheelchair mishandlings. During the last month of 2023, almost 1,000 wheelchairs and scooters were reported as mishandled by carriers. In 2023, 11,527 wheelchairs and scooters were mishandled by carriers that are required to report this data to the U.S. DOT. Passengers also faced the risk of injury that can occur from being without their wheelchairs due to mishandling or delays that can occur during improper physical transfer assistance.

A passenger in a wheelchair receives transfer assistance through an airport terminal. *Source: Adobe Stock/Annatamila*

The rule will, among other things, require airlines operating aircraft of 60 seats or greater to expand the implementation of onboard wheelchairs that meet a set of enhanced performance requirements found in the Accessible Lavatories on Single-Aisle Aircraft (RIN 2105-AE89) rule; require carriers to provide individuals with disabilities safe and dignified assistance, including prompt connecting, enplaning, and deplaning assistance; require airlines to notify passengers when their wheelchair has been loaded or unloaded onto aircraft or if the wheelchair is not able to be loaded; and provides remedies when carriers mishandle or delay wheelchairs and assistive devices, including making such mishandlings a per se regulatory violation subject to administrative penalties, requiring airlines to notify passengers of their rights in the event of any mishandling, and requiring airlines to provide loaner wheelchair accommodations.

A multidisciplinary team of experts at the U.S. DOT Volpe Center informed the development of the rule, the regulatory analysis, and other research included in the rulemaking docket. U.S. DOT Volpe Center economists provided expertise for the rulemaking effort by conducting a Regulatory Impact Assessment (RIA), which is a systemic approach to critically assessing the positive and negative effects of proposed regulations. Activities of the U.S. DOT Volpe Center team included interviews, a literature review, public data collection, and an economic analysis of the provisions including a benefit-cost analysis. U.S. DOT Volpe Center transportation human factors experts conducted a literature review of wheelchair handling and physical transfer assistance procedures in aviation and associated training, and documented current policies and

procedures at airlines, major organizations, and academic centers that are involved with air travel for wheelchair users. The final product informed the rulemaking language in terms of the components of the training required, as well as informing the RIA. *(Sponsor: OST)*

HIGHWAY

Evaluating the Effects of Transportation Decision Making on Communities

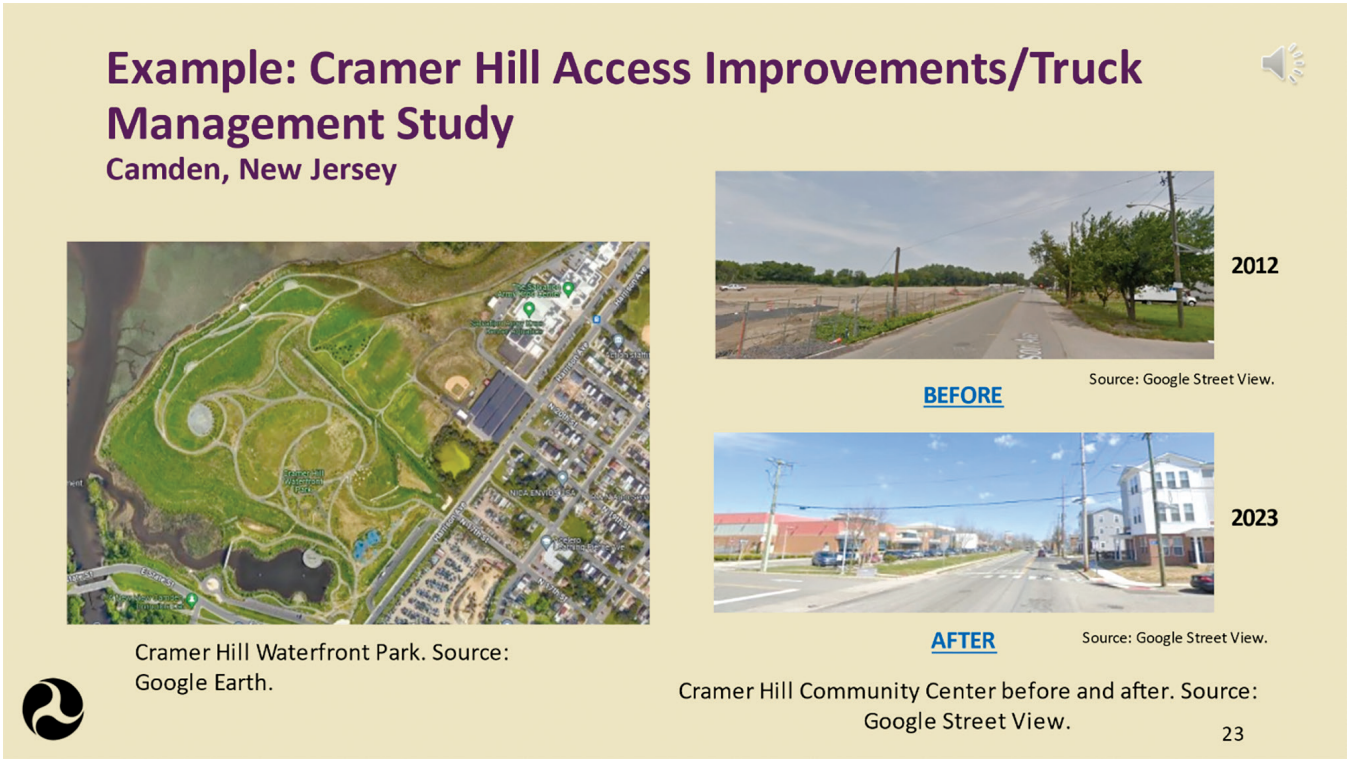
The Justice40 Initiative made it a goal that 40 percent of the overall benefits of certain federal climate, clean energy, affordable and sustainable housing, and other investments flow to disadvantaged communities that are marginalized by underinvestment and overburdened by pollution. For its part, U.S. DOT has prioritized reconciling and addressing the disproportionate impacts of legacy transportation infrastructure projects on disadvantaged and under-represented communities.

Highway and other transportation projects are delivered through a comprehensive and coordinated planning process. The Community Impact Assessment (CIA) process is a scalable, flexible approach to visioning, planning, project development, and implementation. CIA focuses on meaningful public involvement, dynamic community characterization, quantitative and qualitative data collection, and analysis to shape transportation decisions and monitor benefits and burdens.

The process can inform project alternatives, design, and implementation, and it places a particular emphasis on understanding the needs of, and addressing impacts on, underserved communities. When fully incorporated into the transportation decision-making process, a CIA can benefit not only members of the impacted communities but also the planning and project development process itself by strengthening transportation agency credibility with the community, reducing delays, improving coordination with other plans like land use plans, and achieving nondiscrimination.

FHWA is committed to providing state and local transportation agencies with the training, technical assistance, and guidance needed to better integrate equity considerations and leverage the CIA process for project planning.

To that end, the U.S. DOT Volpe Center's planners, policy analysts, and project managers coordinated with FHWA subject matter experts, the Transportation Research Board Standing Committee on Community



The web-based, self-paced training includes examples highlighting before-and-after benefits of Community Impact Assessment implementation for learners. *Source: U.S. DOT Volpe Center*

Resources and Impacts (AME80), the National Highway Institute, and other project partners to develop a compelling web-based training course Fundamentals of Community Impact Assessment.

By considering course objectives, key messages, user experience and interactivity, the U.S. DOT Volpe Center team successfully created the digital course content, resource guide, participant workbook, and knowledge assessments. The iterative process featured multiple demonstrations, pilot tests, and engagement with FHWA experts, and yielded a web-based course delivered through the FHWA's National Highway Institute to transportation professionals across the U.S.

This course informs transportation practitioners from state DOTs, metropolitan planning organizations, regional and local agencies, and partners about resources and techniques to prepare for and conduct CIAs, act on their findings, and monitor results.

The U.S. DOT Volpe Center continues to support FHWA in its efforts to ensure planning, project selection, design, and mitigation processes reflect inclusive input from disadvantaged and under-represented groups, and its

commitment to provide training and resources to encourage planners and policy makers to improve their understanding of diverse and underserved communities and their historic context. *(Sponsor: FHWA Office of Human Environment (HEPH) in partnership with FHWA's National Highway Institute (NHI) and Office of Planning (HEPP))*

Public Engagement Workshops for Transportation Professionals and Community Leaders

In 2024, the U.S. DOT Volpe Center supported OST's Office of Public Engagement (OPE) in planning and delivering Public Engagement Workshops in Phoenix, Arizona; Atlanta, Georgia; and Chicago, Illinois, in addition to a workshop held virtually. The workshops had two primary audiences: staff who work for transportation agencies that engage with the public, and community leaders and members of the public who seek to engage in the transportation process. These workshops inspired transportation professionals to provide opportunities for meaningful public engagement in their processes and educated community leaders and members of the public about the transportation process and how to have their voices heard.

The U.S. DOT Volpe Center and OST's OPE conceived these workshops by incorporating content from the Promising Practices for Meaningful Public Involvement in Transportation Decision-Making Guide and Transportation Decision-Making: A Guide to Getting Involved. A team from the U.S. DOT Volpe Center developed workshop agendas and content, coordinated with U.S. DOT modal regional and division offices to identify attendees, and collaborated with guest speakers and panelists to present information. This BIL-funded work relied on the U.S. DOT Volpe Center's expertise in instructional design, equity, and public engagement.

Transportation professionals that attended the workshops learned effective practices for understanding how to match public engagement techniques with the needs of specific groups and communities, and how to ensure that input provided is meaningfully considered in the decision-making process. Community leaders and members of the public that attended the workshops left with a greater understanding of how the transportation process works and how to ensure their input is directed to the appropriate agency to have the greatest impact.

During the "Key Takeaways" portion of the Atlanta workshop, one participant remarked, "In attending this workshop, I can tell U.S. DOT isn't

U.S. DOT Volpe Center and Office of Public Engagement (OPE) team for the Atlanta workshop. L-R: Kristina Benjamin (OPE), Kelsey Wingo (Volpe), Jared Fijalkowski (Volpe), Kala Wright (OPE), Dawn Tucker (OPE), Hoamy Tran (Volpe), Drew Quinton (Volpe), Derek Lo (Volpe), and Mirna Providence (Volpe). *Source: U.S. DOT*

Workshop participants learn from Shari Schaftlein, FHWA, about how to address equity through meaningful public engagement at the Chicago Workshop in July 2024. *Source: U.S. DOT Volpe Center / Jared Fijalkowski*

just talking the talk [about meaningful public engagement], they are also walking the walk." This feedback exemplifies the fundamental elements of meaningful public engagement.

Over 600 transportation professionals, community leaders, and members of the public representing 49 states, Washington D.C., and Puerto Rico participated in one or more of the virtual and in-person workshops. The U.S. DOT Volpe Center team is anticipating delivering additional similar workshops in the future to continue to promote meaningful public engagement in the transportation decision-making process. *(Sponsor: OST's OPE)*

Community leaders and members of the public learn from Joanna Waszczak, FTA, about the transportation decision-making process and how to get involved in their communities at the Phoenix workshop in May 2024. *Source: U.S. DOT Volpe Center / Jared Fijalkowski*

More than 150 participants listened to Kala Wright, Director of the OST Office of Public Engagement, welcome them to the Atlanta Public Engagement Workshop in June 2024. *Source: U.S. DOT Volpe Center / Jared Fijalkowski*

MULTI-AGENCY

A Whole-of-Government Approach to Federal Coordination of Place-Based Technical Assistance

The Bipartisan Infrastructure Law and the Inflation Reduction Act created once-in-a-lifetime levels of funding in federal infrastructure grants that are available to communities around the nation. Applying for federal grants is a resource-intensive effort with significant risk—not only for U.S. DOT, but for multiple federal agencies. The required labor and associated risk could result in historically disadvantaged and under-resourced communities missing out on opportunities to receive transformative infrastructure funding.

Technical assistance (TA) programs that support communities in both applying for federal grants and administering large infrastructure projects can help move the needle to ensure disadvantaged communities receive their fair share of funding. The Thriving Communities Network (TCN) is a recently launched program co-chaired by U.S. DOT and the EPA that coordinates TA programs across 12 federal agencies. TCN is designed to help federal agencies coordinate strategy, collaborate across initiatives, and target deployment of a full range of place-based technical assistance and capacity-building resources to urban, rural, and Tribal communities experiencing economic distress and systemic disinvestment. The TCN effort is directly related to the Justice40 Initiative, which ensures at least 40 percent of federal investments in certain categories benefit historically disadvantaged communities.

The U.S. DOT Volpe Center participates in the TCN and provides expertise in working group management, data, communications, and mapping. The Volpe Center staff provide policy analysis and strategic planning expertise and advise U.S. DOT and EPA on ideas for charting a path forward for TCN.

Over the last year, the U.S. DOT Volpe Center has supported core TCN activities including a Capacity Builder Community of Practice Learning Series, a monthly peer-learning session for providing TA; a TCN quarterly newsletter; regular interagency coordinating committee meetings; developed an online TCN map; expanded and launched a TCN website; worked with Esri on a StoryMap to tell the TCN story; hosted an in-person capacity builder convening event at the Department of Housing and Urban Development (HUD) in November 2023, and another at U.S. DOT

Participants brainstormed solutions after reading technical assistance case studies. *Source: U.S. DOT*

headquarters in October 2024. As a result of this collaborative work, TCN's partner agencies have grown, and additional federal agencies are on board to join the network. The TCN map illustrates the full extent of national coverage, reaching all 50 states across 12 agency programs.

In July 2024, the Volpe Center team facilitated a TCN event in Manchester, New Hampshire that brought together numerous northern New England community members and stakeholders to share opportunities and successes. Representatives from U.S. DOT, the Department of Energy, General Services Administration, the Federal Emergency Management Agency, HUD, and the U.S. Department of Agriculture attended, as did dozens of leaders from community-based organizations, state and local government, philanthropic groups, and technical assistance providers. During breakout sessions, attendees learned about the federal grantmaking process and how to access available funds. In sessions like "Planning Your Housing Project," "Registering for SAM.GOV and Universal Employee Identification," and "Planning and Building an Equitable Infrastructure for Rural Communities," attendees heard from federal officials and technical assistance providers about the issues most relevant to their communities. There were numerous opportunities for networking and attendees could ask questions about current programs.

TCN's work acknowledges that infrastructure problems are more easily solved with interagency collaboration. Under the related Thriving Communities Program (TCP), numerous communities apply for assistance to solve a transportation issue, but their existing infrastructure challenges are typically much broader. Of the 52 selected TCP communities in FY 2023, 15 (nearly a third) were already part of other TCN programs at other agencies, demonstrating the importance of interagency collaboration to solve challenging infrastructure issues that span energy, environment, housing, healthcare, and many other concerns. *(Sponsor: EPA)*

Small Business Innovation Research

The U.S. DOT's highly competitive Small Business Innovation Research (SBIR) program, administered by the U.S. DOT's Volpe Center, awards contracts to U.S. small businesses to develop innovative solutions to our nation's transportation challenges. SBIR enables small businesses to explore their technological and commercialization potential.

ADOBE STOCK/JOYFOTOLIAKID

Using State-of-the-Art Sensor Technologies to Improve Road Safety and Save Lives

The U.S. DOT Volpe Center, through its role in administering the SBIR program, works with AIWaysion, CLR Analytics, and other SBIR awardees to meet the research needs of the U.S. DOT while developing outcomes that can make our transportation systems safer and more efficient. Both of these companies are developing cutting-edge tools that use sensors to gather new types of real-time data about roadways using AI-powered edge computing systems.

Leveraging AI-Powered Technology to Gather Traffic Safety Data

The Challenge

Traffic safety is an urgent concern for the Confederated Tribes and Bands of the Yakama Nation. Since 2021, dozens of residents have been killed and hundreds of others seriously injured on the stretch of US-97 running through the Yakama Indian Reservation in Washington State. The Yakama territory also faces many infrastructural challenges. Roads are often in need of continued maintenance, roadways frequently experience challenging weather conditions, and most rural roads lack pedestrian and bike facilities or adequate lighting. As a result, pedestrians are forced to share unlit roads at night with vehicles on curvy, steep roads with narrow shoulders, creating an extremely dangerous mix for vulnerable road users and drivers alike.

Mobile Unity for Sensing Traffic (MUST) deployment at Yakama Nation for traffic and road conditions monitoring and hazardous events detection. *Source: AIWaysion*

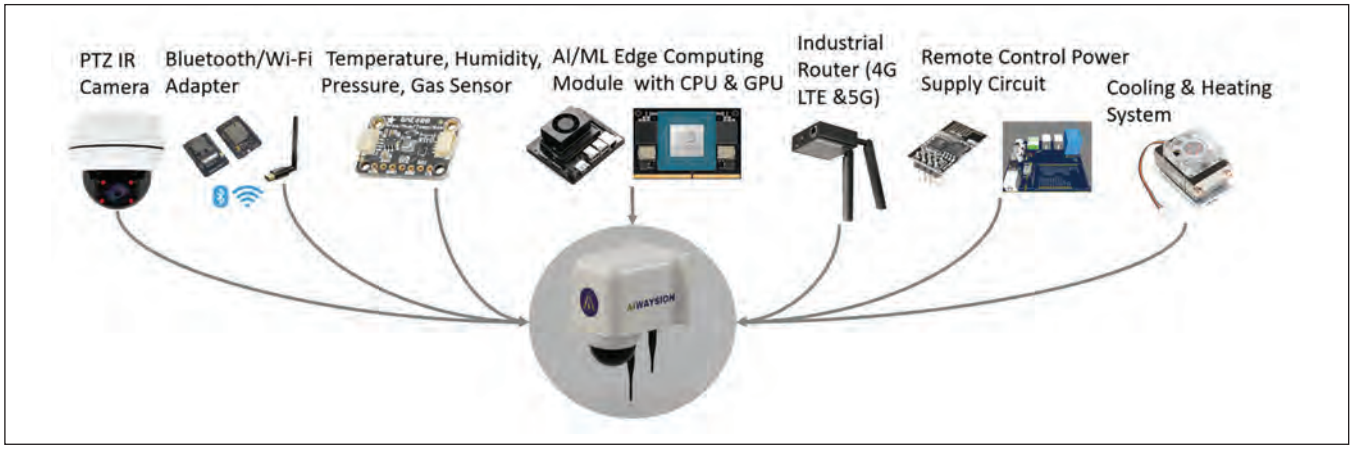
AIWaysion, a small business that focuses on using AI to provide smart mobility solutions, has worked with the Yakama Nation through a series of Phase I and Phase II SBIR awards funded by FHWA to develop new technology to collect and analyze traffic and road data that will help the Tribe address serious road safety problems. The Yakama Nation partnered with AIWaysion to apply for and be selected to receive a highly competitive U.S. DOT Strengthening Mobility and Revolutionizing Transportation (SMART) grant to expand their deployment of this technology developed under SBIR.

The Yakama Nation partnered with AIWaysion to receive a highly competitive U.S. DOT SMART grant to expand deployment of this technology developed under SBIR.

The Technology

Gathering basic traffic safety data is essential to address the disproportionate burden of traffic deaths and injuries in communities like the Yakama Nation. This federally recognized Tribal nation faces major challenges in collecting and using traffic data. In many rural areas, broadband access is still limited. Technologies like AI-powered tools that monitor traffic and road conditions in real time depend on high-speed Internet remain out of reach for many rural communities.

AIWaysion has been developing an edge computing traffic sensor and analysis device with funding from the U.S. DOT SBIR program. Through two FHWA SBIR awards, AIWaysion has developed sensor technology that can detect traffic conflict events as well as traffic and road condition data in real time using edge computing. "Both types of data are desperately needed, especially in rural areas like Yakama nation," said AIWaysion CEO Dr. Wei Sun. The technology can also communicate in real time with infrastructure such as traffic control devices and variable message signs to provide lifesaving safety alerts. "Facts are important—we are utilizing



Mobile Unity for Sensing Traffic (MUST): sensing, analysis, and communications all-in-one unit. *Source: AIWaysion*

the data to tell us what the reality is that we are facing," HollyAnna Littlebull, former Traffic Safety Coordinator of the Yakama Nation, told the University of Washington.

SBIR'S Role

AIWaysion, co-founded by Dr. Yinhai Wang and Dr. Wei Sun, grew out of the Smart Transportation Applications & Research (STAR) Lab at the University of Washington (UW). SBIR funding from FHWA helped AIWaysion leverage their existing algorithms and improve the hardware system that could be used in a rural context like the Yakama Nation.

The Future

Although just a little over two years old, AIWaysion is beginning to build on the research they developed through their SBIR contracts to field test and deploy the technology on a larger scale. The company is now partnering with the Yakama Nation on a competitive national SMART grant that will allow them to expand and deploy edge computing technology along the entire US-97 corridor in the Yakama Nation.

Edge computing technology has enormous potential, particularly for rural communities. In the future, edge computing may have the potential to replace expensive traffic signal controller boxes, said FHWA Contracting Officer's Representative Dr. Wei Zhang. The low-latency technology could also be a critical piece in allowing vehicle-to-infrastructure technology, allowing traffic signals and other road infrastructure to communicate directly with automated cars and cellular devices.

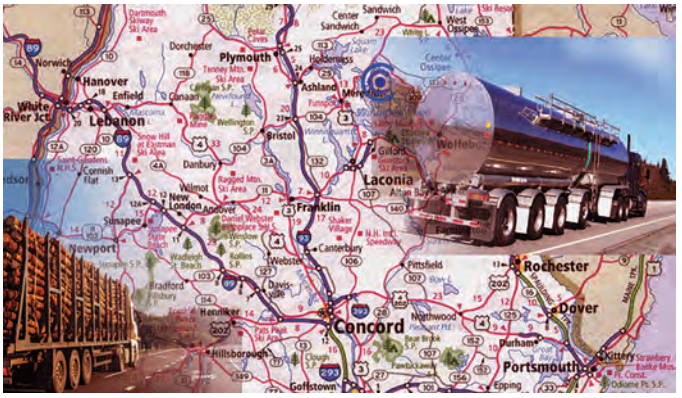
Using Vehicle-Sensing Technology to Evaluate Road Safety

The Challenge

Every day, trucks, construction vehicles, and other Commercial Motor Vehicles (CMVs) carry out essential services and deliver goods across the country. The State of New Hampshire identified a need for more accurate and reliable traffic data, particularly about trucks and other CMVs, which form the backbone of goods shipping in the state. Road safety is a pressing issue in New Hampshire, which has experienced an unprecedented increase in traffic fatalities. Between 2019 and 2022, New Hampshire saw a disturbing 47 percent increase in traffic fatalities according to NHTSA data.

Road safety is a pressing issue in New Hampshire, which has experienced an unprecedented increase in traffic fatalities.

The heavy presence of CMVs on the state's highway system is leading to concerns not only about road safety, but also pavement damage and air pollution. Overweight trucks can be at risk of tipping over and can damage bridges and other road infrastructure. Understanding vehicle type, weight and spacing on the road system is critical for assessing safety risks. CMVs also emit different amounts of pollution, and in New Hampshire there is concern that disadvantaged communities are bearing the brunt of this pollution. Accurate data about truck type, weight, travel speed, routing, and pollution emissions are needed to better understand and plan around safety, health, and environmental concerns.

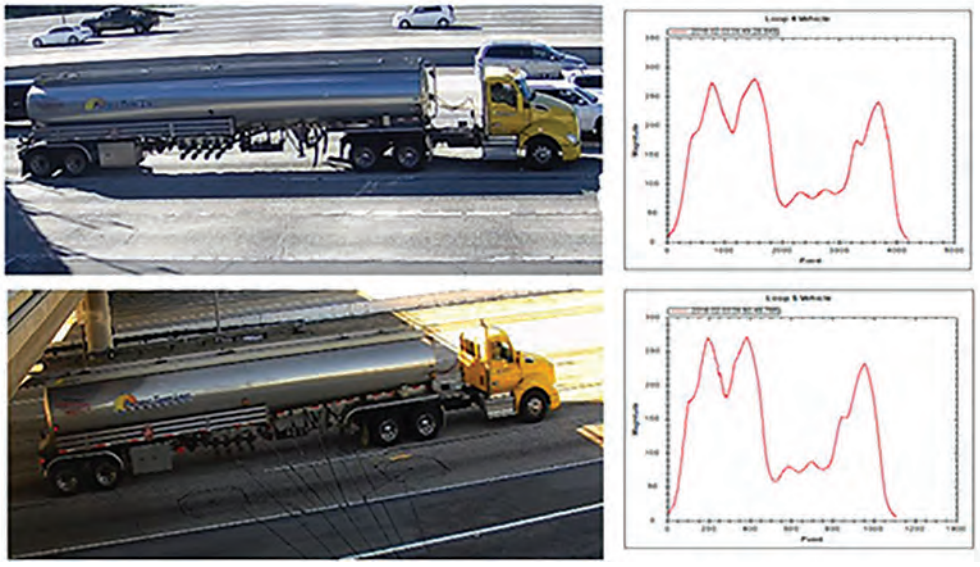


A variety of commercial motor vehicles overlaid onto a map of New Hampshire. *Source:* [OnTheWorldMap]

The Technology

CLR Analytics developed AI-based sensor technology through two rounds of DOT SBIR Phase I and Phase II award funding sponsored by FHWA. This technology takes advantage of existing induction-loop detectors that are already embedded in the pavement of many roads to gather novel Induction Loop Signature (ILS) data about vehicles at a low cost.

New Hampshire currently does not have granular vehicle data collection methods, so the New Hampshire Department of Transportation (NHDOT) partnered with CLR Analytics to apply to the U.S. DOT's SMART Grants Program. The SMART program was established to provide grants to eligible public sector agencies to conduct demonstration projects focused on advanced smart community technologies and systems to improve



ILS technology includes a series of wires across the pavement's surface at different points on the highway that capture the type of vehicle that crosses over them. The wavelength data can capture the same tanker truck crossing over a series of wires looped on the pavement surfaces at different points on the highway. *Source: CLR Analytics*

transportation efficiency and safety. NHDOT's proposal to use smart sensors to capture granular data about CMVs on New Hampshire's highway system was selected for award in March 2024. NHDOT and CLR Analytics also plan to integrate new sensors with ILS data to gather pollution, temperature, and humidity data to better assess air quality and road safety.

SBIR'S Role

Lianyu Chu, President of CLR Analytics, noted that when the company started working on this sensor technology, there was a fundamental lack of high-quality data that researchers and state DOTs could use to understand vehicle traffic at a granular, individual vehicle level. "SBIR gave us a chance to solve that problem from the root, and develop technology to provide an accurate, usable data source end users can analyze," noted Chu.

"SBIR really made CLR Analytics change from a consulting company to an R&D company and allowed us to do something we really think helped change the industry," said Chu. "Without SBIR, basically, we couldn't develop the kind of technology that we got because no hardware to support our technology existed." SBIR funding from FHWA allowed CLR Analytics to first conduct a feasibility study in Phase I, and then develop the necessary hardware and software systems in Phase II, said Chu.

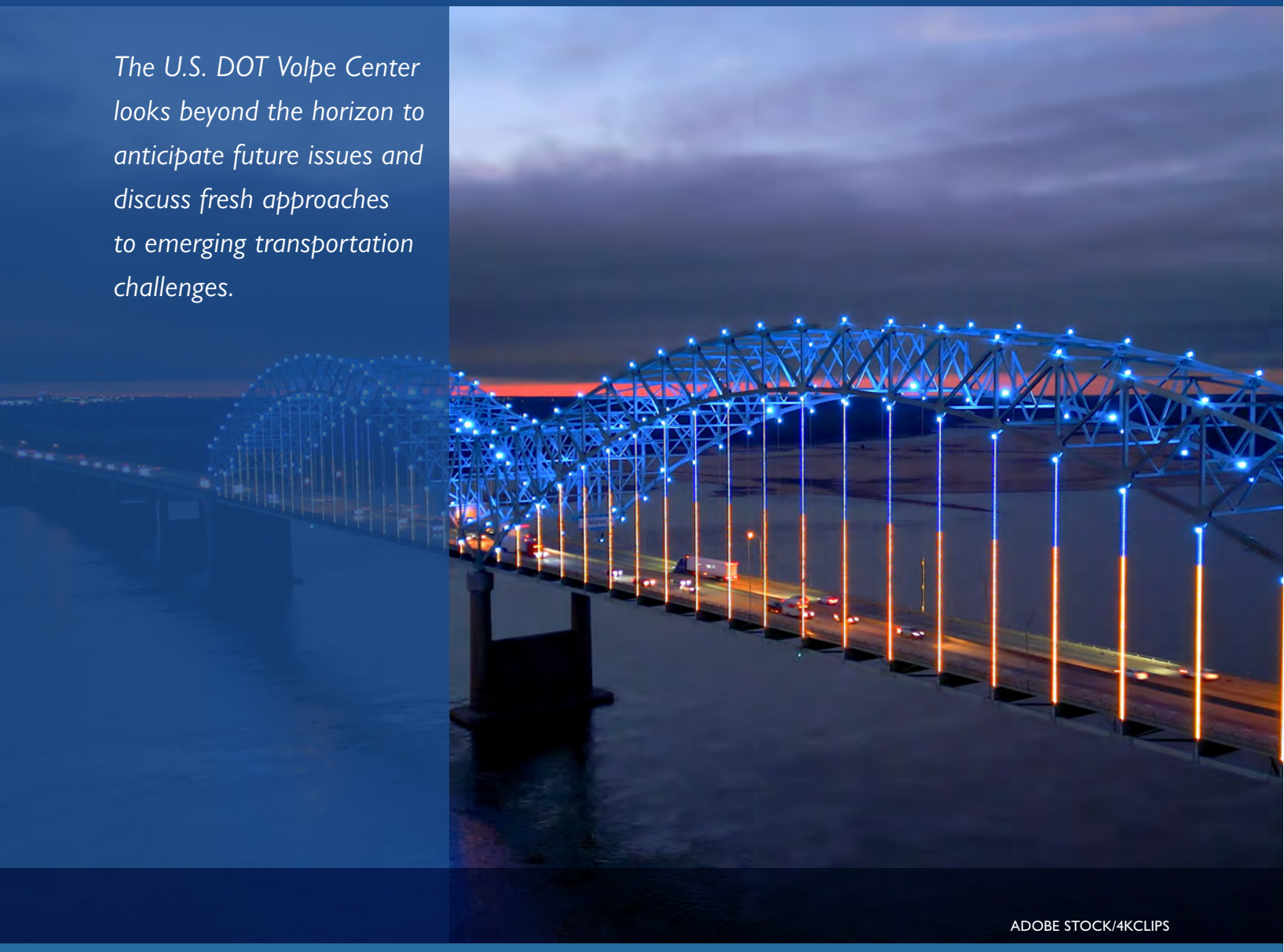
The Future

Moving forward, Chu says CLR Analytics plans to continue to look for partnerships with state DOTs, such as the collaboration with NHDOT through the SMART Grants Program. Additionally, the ILS technology developed in CLR's SBIR research is now being piloted in an FHWA transportation pooled fund study with 20 state DOTs to demonstrate applications of the technology. The company is conducting early-stage research on smart sensors that use video or thermal cameras and artificial intelligence through another SBIR award. "We are trying to utilize our knowledge regarding what we've developed and also use our background in Artificial Intelligence … to find more solutions," said Chu.

The U.S. DOT Volpe Center administers the SBIR program on behalf of the U.S. DOT and partners with funding operating administrations and small businesses alike in working toward a successful outcome that can benefit the nation's transportation system.

Thought Leadership

The U.S. DOT Volpe Center looks beyond the horizon to anticipate future issues and discuss fresh approaches to emerging transportation challenges.



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Making Good on the Potential of the Bipartisan Infrastructure Law Thought Leadership Series

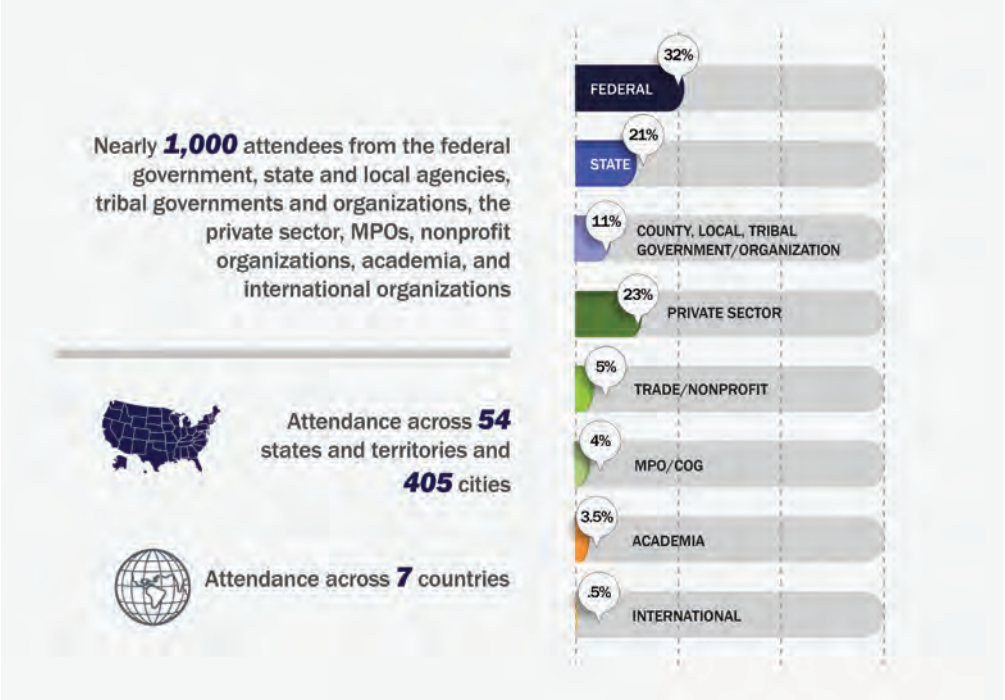
The U.S. DOT Project Delivery Center of Excellence at U.S. DOT's John A. Volpe National Transportation Systems Center supports the successful implementation of the historic Bipartisan Infrastructure Law (BIL) by enabling BIL funding recipients to accelerate completion of local transportation infrastructure investments—on time, on task, and on budget. In 2024, the Center of Excellence sponsored its second thought leadership series on *Making Good on the Potential of the Bipartisan Infrastructure Law (BIL)*. The series complemented the *Delivering the Benefits of the BIL*, an eight-part thought leadership program launched by U.S. Secretary of Transportation Pete Buttigieg in July 2023.

The three-part *Making Good on the Potential of the BIL* series was designed for BIL project sponsors and other members of the transportation community working to help deliver infrastructure projects. The virtual series featured 10 transportation thought leaders focusing on:

- Project Delivery Lessons Learned from Emergency Response Following an Infrastructure Catastrophe
- Best Practices to Get Big Infrastructure Projects off the Ground
- Project Acceleration for the Public Good

Each speaker discussed an infrastructure project completed or currently underway and shared best practices in project delivery across a spectrum of issues.

The series engaged nearly 1,000 stakeholders from the federal government, state and local agencies, Tribal governments and organizations, the private sector, Metropolitan Planning Organizations (MPOs) or Councils of Governments (COGs), trade organizations, academia, and international organizations.



The following provides a brief overview of the series.

PROJECT DELIVERY LESSONS LEARNED FROM EMERGENCY RESPONSE FOLLOWING AN INFRASTRUCTURE CATASTROPHE

September 18, 2024

Session moderated by Anne Aylward, U.S. DOT Volpe Center Director (now former director).

U.S. DOT Office of the Secretary Coordinator for Project Delivery Stephanie Pollack delivered opening remarks at the kickoff event of the series: Project Delivery Lessons Learned from Emergency Response Following an Infrastructure Catastrophe.

Pollack reflected on how infrastructure crises, such as the reconstruction of the Francis Scott Key Bridge, in Baltimore and I-95 in Philadelphia, PA often prompt faster and more collaborative project delivery, raising important questions about how these approaches could be applied more broadly.

> *"Methodologies that bring contractors in earlier [e.g., design-build or progressive-design-build] and that align the interests of the owner with the contractors have application beyond the emergency."*
>
> - Stephanie Pollack

Opening Remarks

Stephanie Pollack,
Coordinator for Project Delivery, Office of the Secretary, U.S. DOT

Pollack also shared highlights of BIL's progress and emphasized the importance of delivering projects efficiently, noting the U.S. DOT's Project Delivery Center of Excellence is a crucial resource for best practices, tools, and innovation in project management.

FHWA Associate Administrator for the Office of Infrastructure Hari Kalla and California Department of Transportation (Caltrans) Deputy Director for Project Delivery and Chief Engineer Donna Berry discussed strategies for responding to natural disasters and catastrophes, with a focus on rapid recovery and coordination.

Speaker

Hari Kalla, *Associate Administrator, Office of Infrastructure, Federal Highway Administration*

Kalla shared lessons learned from the 2023 collapse of a section of Interstate 95 (I-95) in northeast Philadelphia, PA, due to a gasoline-carrying tanker truck catching fire beneath the I-95 overpass. The response was prompt, with six temporary lanes of I-95 reopening within 12 days. Kalla stressed the importance of public and stakeholder engagement, partnering and coordination, and learning from past events to enhance future emergency responses and infrastructure resilience.

> *"Coordinating and building partnerships beforehand and having those partners on the same page is very, very important."*

> *"We are really putting a lot of emphasis on making sure that the structure when they're rebuilding this infrastructure is more resilient than what was in place to begin with."*
>
> - Hari Kalla

Berry discussed the rapid response and recovery efforts following a significant fire that damaged the I-10 freeway in Los Angeles County, CA in November 2023. Caltrans collaborated with various agencies for rapid recovery efforts. They were able to reopen all lanes of the freeway in just 8 days. Berry highlighted the importance of robust emergency plans and effective interagency communication, ongoing assessment of infrastructure resilience, effective public outreach and transparency, and post-incident analysis and improvement in enhancing future emergency responses.

Speaker

Donna Berry, *Deputy Director for Project Delivery, Chief Engineer, California Department of Transportation*

> *"The incident demonstrated the importance of effective interagency collaboration between Caltrans and other agencies. Caltrans worked with local transit operators to communicate quickly to assess the impact on bus routes. Bus and regional rail agencies provided additional services and anticipated the impact to drivers throughout Los Angeles County."*

> *"As we look at these big incidents that happen, we look at what worked, how can we utilize that, and how can we move forward with that?"*
>
> - Donna Berry

BEST PRACTICES TO GET BIG INFRASTRUCTURE PROJECTS OFF THE GROUND

October 8, 2024

Session moderated by Stephanie Pollack, U.S. DOT Office of the Secretary Coordinator for Project Delivery.

U.S. DOT Acting Under Secretary of Transportation Policy Christopher Coes delivered opening remarks at the second event of the series: Best Practices to Get Big Infrastructure Projects off the Ground. The session highlighted the importance of strategic planning, partnering, community involvement, and effective funding in modernizing and expanding essential transit infrastructure.

Opening Remarks

Christopher Coes,
Acting Under Secretary of Transportation Policy, U.S. DOT

Acting Under Secretary Coes highlighted the approaching third anniversary of BIL and U.S. DOT's commitment to delivering transformative infrastructure projects. Coes emphasized DOT's focus on impactful, complex infrastructure and the importance of delivering these projects on time, on budget, and with lasting benefits for communities—from job creation to enhanced equity and sustainability.

> *"It's really been an all of DOT effort to deliver on this promise of what is a generational investment to rebuild America's infrastructure and our communities and enhance our competitiveness. In short, getting ready to create the next American century."*
>
> *"The projects we're building are in some of America's smallest communities and largest cities, in rural towns and Tribal communities. Some are nationally or regionally significant—but every one of them matters to the communities that have often waited far too long for the infrastructure investments that will improve their community, economy, and quality of life."*
>
> - Christopher Coes

Gateway Development Commission Chief of Public Outreach Stephen Sigmund outlined the Commission's efforts to deliver the Hudson Tunnel Project, a crucial infrastructure initiative aimed at modernizing and expanding the tunnel system between New York and New Jersey. The project involves constructing two new rail tracks and rehabilitating the existing North River Tunnel to alleviate congestion and improve rail traffic on the Northeast Corridor that serves 800,000 daily rail passengers. Sigmund emphasized the importance of persistence, bipartisan political engagement, and ensuring a consistent flow of work despite changing political and economic conditions to keep complex, long-term projects on track.

"Keep progressing and keep moving forward, because ultimately, this is a really complicated, long, expensive project that takes a long time, and so you just have to keep moving, and eventually it will be finished."

"Engage your elected representatives, particularly those who represent the constituents who experience those delays and quality-of-life problems, and work with them even during the bad times."

- Stephen Sigmund

Speaker

Stephen Sigmund, *Chief of Public Outreach, Gateway Development Commission*

Valley Metro Chief Executive Officer Jessica Mefford-Miller shared Valley Metro's best practices in developing its regional transit system, focusing on funding strategies, partnerships with federal entities like the Federal Transit Administration, and community engagement. Valley Metro operates a diverse transit system in the Phoenix, AZ metropolitan region, including bus routes, light rail, and streetcar systems. Mefford-Miller highlighted recent projects such as the Northwest Phase 2, South Central Extension, and Tempe Streetcar expansion that are moving the 30-mile system to over 35 miles of light rail, adding 3 miles of streetcar operations, and being delivered ahead of schedule and within budget.

"It's not Valley Metro's projects. These projects belong to the communities we serve."

"With respect to the federal process, you got to carefully plan each project stage. And for aspiring project sponsors who don't have a lot of experience delivering federally funded programs, use your partners in your federal agencies, and engage your peers in the industry to learn more about best practices."

- Jessica Mefford-Miller

Speaker

Jessica Mefford-Miller, *Chief Executive Officer, Valley Metro*

PROJECT ACCELERATION FOR THE PUBLIC GOOD

October 22, 2024

Session moderated by Gregg Fleming, U.S. DOT Volpe Center Director.

U.S. DOT Principal Deputy Assistant Secretary for Policy Mariia Zimmerman delivered opening remarks at the final event of the series: Project Acceleration for the Public Good. The session discussed key insights on best practices in project scheduling, community engagement, sustainability, National Environmental Policy Act streamlining, and more.

Zimmerman highlighted U.S. DOT's commitment to advancing equity in public infrastructure, reflecting on Secretary Buttigieg's aim to invest in not only "shovel-

ready" but also "shovel-worthy" projects that deliver on public good. She stressed the importance of public engagement, not only in planning but throughout project delivery, to ensure that infrastructure projects align with diverse community needs.

Opening Remarks

Mariia Zimmerman, *Principal Deputy Assistant Secretary for Policy, U.S. DOT*

> *"Something that is really an important through line is to think about the activities and the commitment to public engagement."*
>
> *"We are also in the process of really trying to better understand and kind of create a baseline of understanding of how state departments of transportation and metropolitan planning organizations are thinking about equity and are approaching public involvement in their planning and project delivery."*
>
> - Mariia Zimmerman

Arizona Department of Transportation (ADOT) Deputy Director/State Engineer Gregory Byres provided an overview of the Wild Horse Pass Corridor Project on I-10 in Arizona, emphasizing the project's potential to significantly enhance public access, reduce congestion, and improve safety. The $909 million project, a collaboration between ADOT and the Gila River Indian Community, addresses a critical 26-mile corridor that links Phoenix and Tucson. Byres emphasized this unique partnership and the pivotal role it plays in advancing transportation and economic opportunity for both Arizona and the Gila River Indian Community.

Speaker

Gregory Byres, *Deputy Director/State Engineer, Arizona Department of Transportation*

> *"I cannot overstate how important it has been to have an open and honest dialogue with partners, stakeholders, the community, the project team members. Communication has been critical at all stages of the I-10 expansion project."*
>
> *"It's important to remind the public, officials, and stakeholders that just because we've been awarded millions of dollars, it doesn't mean the project is going to construction overnight. The process still has to be followed.… The importance of managing expectations is a lesson that's definitely been learned not necessarily on this project, but really on any projects that are funded in part by federal grant money."*
>
> - Gregory Byres

Governor Stephen Roe Lewis of the Gila River Indian Community shared insights into the transformative transportation partnership between his community, the State of Arizona, and federal agencies in making the Wild Horse Pass Corridor Project a success. He emphasized the importance of collaboration, federal support, and Tribal leadership in advancing transportation projects on reservations, as well as the critical role of BIL in addressing systemic transportation issues affecting the Gila River Indian Community and broader Arizona.

"Federal support for a Tribal transportation project is essential, even in the states that respect valued tribal partnerships. There must be a federal component to Tribal transportation projects on an Indian reservation, especially if it is completely within a reservation's boundaries, as ours was."

"Tribes must seek not just to be a partner, but to lead. If I had not taken the risk of jumping ahead to seek a path forward after our initial failed submission, I'm certain we would have never succeeded. We would never have gotten to this point. And as with so many other things, from water to new government buildings, Tribes can and are leading. And as Tribal leaders, we must embrace both the possibilities that open up and the responsibilities that come with it."

- Stephen Roe Lewis

Speaker

Stephen Roe Lewis,
Governor, Gila River Indian Community

Colorado Department of Transportation Project Director Kurt Kionka shared insights from the Floyd Hill Project, which aims to address bottlenecks, improve safety, and enhance travel experiences along Colorado's I-70 corridor, a vital east-west route in the region and across the nation. The project aims to add a third travel lane that will serve as a toll express lane, enhance safety by flattening curves to meet a 55 mile-per-hour design speed, and improve overall traffic flow. Kionka stressed the importance of starting with a base scope mindset with big projects to control costs and avoid scope creep, identifying risks early, and engaging in constant communication and stakeholder engagement.

"Start with a base scope mindset with these big projects. It is very easy for the scope to creep, and there's a big wish list that is wanted for a project. And the wish lists are great and they're a benefit. But, if you want to deliver a project on a budget and on a schedule, you need that base scope mindset."

"Look at the number of meetings that we've had with stakeholders on the project and just how involved the different stakeholders have been throughout the project, and I think that's led to a successful project. It's led to less controversy as we move forward in the project. It's led to us being able to better address the concerns of the stakeholders."

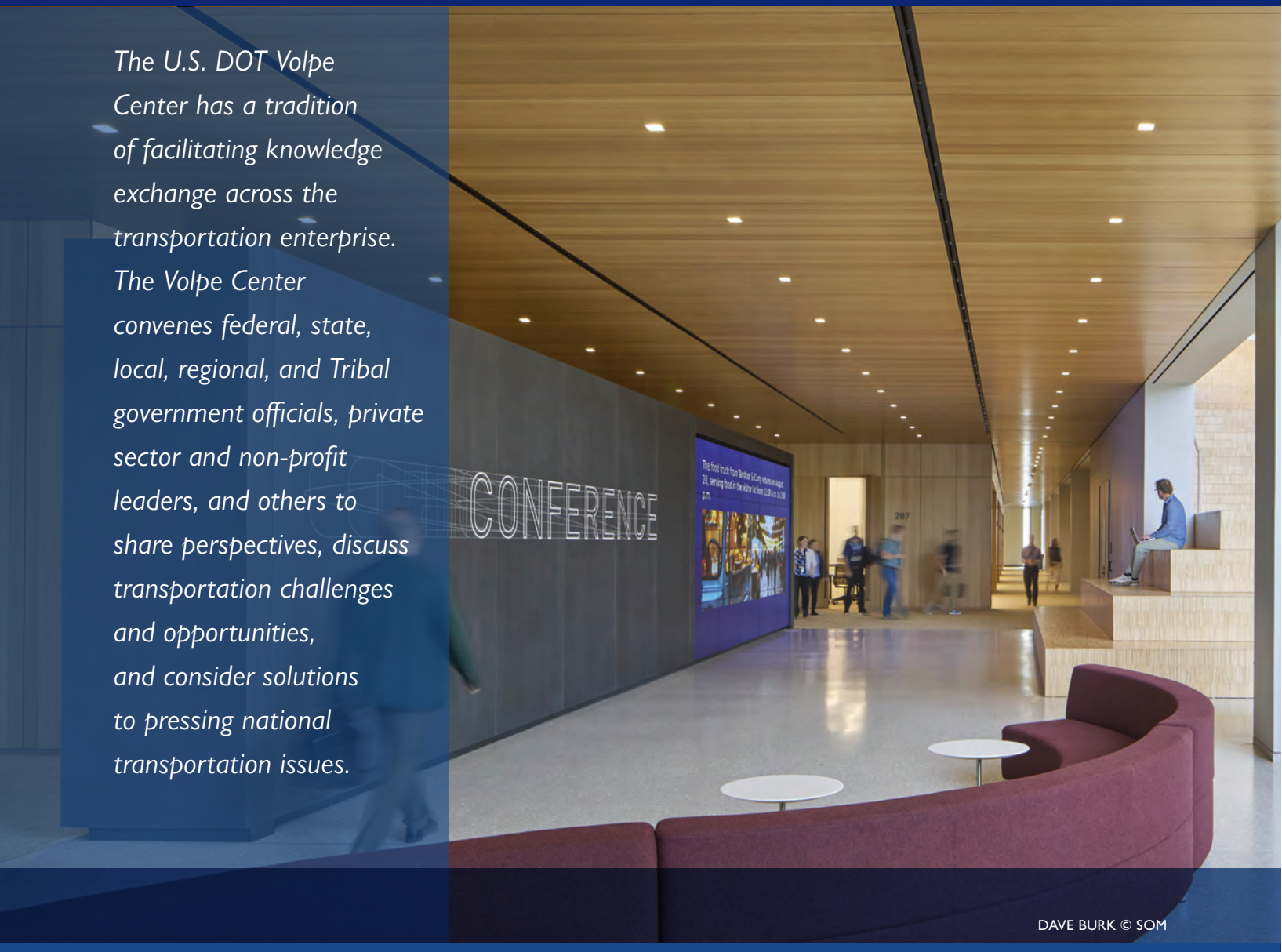
- Kurt Kionka

Speaker

Kurt Kionka, *I-70 Floyd Hill Project Director, Colorado Department of Transportation*

The Power of Convening

The U.S. DOT Volpe Center has a tradition of facilitating knowledge exchange across the transportation enterprise. The Volpe Center convenes federal, state, local, regional, and Tribal government officials, private sector and non-profit leaders, and others to share perspectives, discuss transportation challenges and opportunities, and consider solutions to pressing national transportation issues.



DAVE BURK © SOM

The Power of Convening: A State-of-the-Art Conference Center in a Strategic Location

A centerpiece of the U.S. DOT Volpe Center's new state-of-the-art building is 17,000 square feet of conference and meeting space for carrying out Volpe's tradition of convening the transportation enterprise on issues of importance to the nation. The U.S. DOT Volpe Center has welcomed over 5,000 visitors and hosted more than 120 events since the official opening of its premier conference center in February 2024.

The new space provides multiple options to convene conferences and events both large and small, including a main conference room, smaller meeting rooms, and classroom-style training rooms. The Volpe Conference Center can accommodate events of up to 800 people and is available to

The U.S. DOT Volpe Center has a 55-year history of welcoming U.S. DOT leadership to our home in Kendall Square where they hear more about our work and engage with staff. U.S. Transportation Secretary Pete Buttigieg and Deputy Transportation Secretary Trottenberg held Town Halls with U.S. DOT Volpe Center and Region 1 staff in 2024.

Dr. Robert Hampshire, Principal Deputy Assistant Secretary for R&T and Chief Science Advisor to the Secretary opened the Town Hall with the Secretary and Volpe Director Gregg Fleming moderated the Q&A period.

U.S. DOT Volpe Center staff asked questions on a range of topics including freight system planning; universal securement systems for wheelchair travelers; support to Tribal governments on infrastructure priorities; transportation system resilience, and modernizing air traffic systems and networks. At left, Anne Aylward, Volpe Director prior to her October 2024 retirement, moderated the session with the Deputy Secretary.

U.S. DOT Volpe Center staff and U.S. DOT regional staff members, other government groups, and the public.

Throughout 2024, the Volpe Conference Center was a bright, vibrant hub for collaboration, discourse, technical exchanges, thought leadership, knowledge-sharing, and dissemination of best practices and new approaches.

In the opening year of the U.S. DOT Volpe Conference Center, we welcomed visitors from agencies and organizations here and abroad, including meetings and events with our federal partners including the Federal Aviation Administration (FAA); Federal Highway Administration (FHWA); Federal Motor Carrier Safety Administration (FMCSA), Federal Transit Administration (FTA), Federal Railroad Administration (FRA), the National Highway Traffic Safety Administration (NHTSA); Maritime

Snapshots from 2024:

MARAD Administrator Rear Admiral Ann C. Phillips and NOAA Assistant Administrator Nicole LeBoeuf joined us to learn more about our maritime energy, noise, and emissions work—and hear about our maritime portfolio, including Maritime Safety and Security Information System.

U.S. DOT Volpe Center hosted FAA's UAS Integration Office Executive Director Jeffrey Vincent, Deputy Executive Director Angela McCullough, & Senior Advisor Ebonni Wright to demonstrate our NextGen and MSSIS Labs and learn about some of our recent UAS work.

Administration; the Office of the Secretary of Transportation; Joint Office of Energy and Transportation, NASA, Amtrak, and others.

The U.S. DOT Volpe Center also hosted the All Wheels Up Global Forum, Transportation Research Board Committee Meetings; an International Organization for Standardization Technical Committee meeting; SAE International Aircraft Noise Measurement Aviation Emission Modeling Committee meetings; U.S. Army Natick Soldiers System Center, the Human Factors and Ergonomics Society New England Chapter; the Army Rail Summit; the Association of Unmanned Vehicles Systems International (AUVSI) New England Chapter Unmanned Aircraft Systems (UAS) and Advanced Air Mobility (AAM) Summit; the Kendall Square Association; MIT Mobility Initiative Vision Day; the Lunch Buddies Reading Program, a collaborative effort between the U.S. DOT Volpe Center and the neighboring Kennedy-Longfellow Elementary School and others!

FAA held its Eastern Area Governance Council and Stakeholder Engagement Forum at the Volpe Conference Center.

U.S. DOT Volpe Center Principal Technical Advisor Kristin Lewis, PhD presented some of our work for the FAA Office of Environment and Sustainability at the FAA Eastern Governance event at the Volpe Conference Center.

FHWA Directors of Field Services North's 2024 leadership meeting was held at the new Volpe Conference Center. FHWA Administrator Shailen Bhatt and FHWA Executive Director Gloria Shepherd, spoke at the meeting.

The 2024 SMART Grant Summit was hosted at the new Volpe Conference Center in July 2024.

2024 Transportation Research Board (TRB) AEP80 Summer Meeting of noise and vibration experts held at the new Volpe Conference Center. The TRB AEP80 committee discussed the latest acoustics research over three days and toured our human factors labs.

Aaron Hastings, Physical Scientist in the Volpe Center's Environmental Measurement and Modeling division presented at the conference.

In our 10th year of providing an annual global maritime domain awareness training workshop, the U.S. DOT Volpe Center hosted 12 Navy and Coast Guard officials from the southeast Asian nations of Philippines, Malaysia, Sri Lanka, Thailand, and the African nation of Togo in July 2024. For the first time, the workshop included participants from the European nation of Bulgaria.

The U.S. DOT Volpe Center hosted the Department of Homeland Security, U.S. Department of Transportation, Department of Defense, and Aviation Cyber Initiative's (ACI) Cyber Rodeo Event. Participants from government, industry, and academia participated in the event, which featured several exhibits, technical sessions, and demonstrations. The theme was Adversarial Artificial Intelligence (AI) Threat to Cybersecurity.

FRA Administrator Amit Bose, U.S. DOT Volpe Center Director Gregg Fleming, Director of Research and Innovative Technology Stephen Popkin along with our rail safety experts in October 2024.

U.S. DOT Volpe Center and Region 1 staff attend the Town Hall in November 2024.

The U.S. DOT Volpe Center recognizes and appreciates our partners who have sponsored our work and collaborated with us to advance the national and global transportation system.

Our Sponsors

U.S. DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Federal Highway Administration

Federal Motor Carrier Safety Administration

Federal Railroad Administration

Federal Transit Administration

Great Lakes St. Lawrence Seaway Development Corporation

Maritime Administration

National Highway Traffic Safety Administration

Pipeline and Hazardous Materials Safety Administration

Office of the Secretary of Transportation

- Office of the Under Secretary of Transportation for Policy
- Build America Bureau
- Office of Multimodal Freight Infrastructure and Policy
- Office of the Assistant Secretary for Aviation and International Affairs
- Office of the Assistant Secretary for Research and Technology
- Bureau of Transportation Statistics
- Highly Automated Systems Safety Center of Excellence
- Intelligent Transportation Systems Joint Program Office
- Office of Positioning, Navigation, and Timing (PNT) and Spectrum Management
- Office of Research, Development & Technology
- Transportation Safety Institute
- University Transportation Centers

Office of the Assistant Secretary for Administration

Office of Intelligence, Security and Emergency Response

Office of the Chief Information Officer

Office of Civil Rights

Office of Drug & Alcohol Policy & Compliance

Office of Facilities Information and Asset Management, Energy, and Resource Efficiency Program

Office of General Counsel

Office of Public Engagement

OTHER FEDERAL AGENCIES

Department of Agriculture

- Agricultural Marketing Service
- Office of Property and Environmental Management
- U.S. Forest Service

Department of Commerce

- National Oceanic and Atmospheric Administration

Department of Defense

- Air Mobility Command
- Defense Threat Reduction Agency
- Naval Air Systems Command
- Naval Education and Training Security Assistance Field Activity (NETSAFA)
- Naval Facilities Engineering and Expeditionary Warfare Center
- Office of the Secretary of Defense
- United States Transportation Command
- Surface Deployment and Distribution Command (SDDC)
- U.S. Air Force
- U.S. Air Force Civil Engineer Center
- U.S. Army
- U.S. Army Corps of Engineers
- U.S. Navy
- Naval Facilities Engineering Systems Command Pacific
- U.S. Transportation Command

Department of Energy

- Office of Energy Efficiency & Renewable Energy (EERE)
- Hydrogen and Fuel Cell Technologies Office
- Bioenergy Technologies Office
- National Energy Technology Laboratory (NETL)

Department of Homeland Security

- Federal Emergency Management Agency
- Science and Technology Directorate
- U.S. Coast Guard
- U.S. Customs and Border Protection

Department of Housing and Urban Development

- Office of Chief Information Officer
- Office of Policy Development and Research

Department of the Interior

- Bureau of Land Management
- Bureau of Reclamation
- National Park Service
- U.S. Fish and Wildlife Service
- U.S. Geological Survey

Department of Justice

Department of State

- Office of Western Hemisphere Programs

Environmental Protection Agency

Federal Permitting Improvement Steering Council

Joint Office of Energy and Transportation

Millennium Challenge Corporation

National Aeronautics and Space Administration

Presidio Trust

U.S. Access Board

Surface Transportation Board

STATE AND LOCAL

City of Boston, MA

City of Cambridge, MA

City of New York, NY

Colorado Parks and Wildlife

Delaware Department of Transportation

Massachusetts Department of Transportation

New Mexico Department of Transportation

Pitkin County, Colorado

Port of Seattle-Airport Operations

Rhode Island Department of Transportation

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Boston University, School of Public Health

City of Boston-Vital Strategies

Columbia River Pilots

Pennsylvania State University

Oregon State University

Safe Roads Alliance

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State-Amtrak Intercity Passenger Rail Committee (SAIPRC)

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Multimodal Modeling for a Sustainable Transportation System

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	January 2025	Final Report

4. TITLE AND SUBTITLE
U.S. DOT Volpe Center Annual Review – January 2025

5a. FUNDING NUMBERS
YAB10500/G228A

6. AUTHOR(S)
Prepared by the U.S. DOT Volpe Center's Office of Strategic Initiatives for Research and Innovation in collaboration with the leadership and staff of the U.S. DOT Volpe Center's Technical Centers for Safety Management and Human Factors; Policy, Planning and Environment; Infrastructure Systems and Technology; and Communications, Navigation, Surveillance Systems and Engineering. The publication team includes Nathan B. Grace, publication coordinator and project manager, writer; Tess Perrone, lead technical writer; Chris Dunham, graphic design; and Rebecca Hovey, editing — Communication and Knowledge Management Office; Andrea Easton, writer— V-334, and Philip Thornton, publication art director (including cover/infographics); Cassandra Oxley and Ingrid Bartinique, editing/ writing support—SCOAR contract.

5b. CONTRACT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Office of Strategic Initiatives for Research and Innovation
U.S. Department of Transportation
John A. Volpe National Transportation Systems Center
220 Binney Street
Cambridge, MA 02142-1093

8. PERFORMING ORGANIZATION REPORT NUMBER
DOT-VNTSC-OSTR-25-01

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Department of Transportation
John A. Volpe National Transportation Systems Center
220 Binney Street
Cambridge, MA 02142-1093

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
Prepared under the direction of Ellen Bell, Director of Strategic Initiatives for Research and Innovation.

12a. DISTRIBUTION/AVAILABILITY STATEMENT
This document is available to the public on the Volpe website: https://www.volpe.dot.gov.

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)
The U.S. DOT Volpe Center's Annual Review publication highlights our best work of the past year and illustrates the sustained impact the Center and its workforce has on advancing innovation for the public good on behalf of U.S. DOT and other sponsoring agencies. The book is divided into chapters that align with U.S. DOT's major goals and objectives: safety; infrastructure, economic strength and competitiveness; sustainability and resilience, climate and sustainability; transformation; accessibility and equity; and includes sections on the Small Business Innovation Research (SBIR) program; thought leadership and the power of convening.

14. SUBJECT TERMS
U.S. DOT Volpe Center, 2025 annual review, multimodal, transportation safety, infrastructure, economic strength, global competitiveness, sustainability, resilience, transformation, innovation, Bipartisan Infrastructure Law; Inflation Reduction Act, accessibility, equity, SBIR, , aviation safety; automation, automated vehicles, advanced air mobility, unmanned aircraft systems, UAS, freight rail, supply chain, highway safety, road safety, infrastructure, terminal facilities improvement, project delivery, marine highways; data and technology; mobility; energy transformation, electric vehicles, charging network, telecommunications, environmental modeling, human factors, international partnerships, motor carrier safety, commercial motor vehicles, public transit safety; environmental analysis, fuel efficiency, noise mitigation, transformation, hazmat, rail trespass and suicide, intelligent transportation systems, new entrants; airport operations, Positioning, Navigation and Timing, PNT, CPNT, Global Positioning System, GPS, NEPA, natural gas pipelines; pipeline safety; Freight Logistics Optimization Works (FLOW) Partnership, ballast water, Isle Royale National Park, passenger ferry, air travelers with disabilities, artificial intelligence, machine learning, transportation cybersecurity, project delivery, thought leadership.

15. NUMBER OF PAGES
140

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT

U.S. DEPARTMENT OF TRANSPORTATION

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