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Mind the Gap: Freight and Rail System Resilience between Planning and Practice

A Synthesis of Freight Plan Best Practices and Survey Results from U.S. Transportation Professionals



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14. ABSTRACT Freight and rail networks across the United States face mounting risks from weather-related hazards and other systemic disruptions that threaten operational continuity, economic stability, and community well-being. While state freight plans are federally mandated, local and metropolitan freight planning varies widely, leaving gaps in how resilience is addressed across scales. This study examines how resilience is being integrated into freight and rail planning through a two-part approach: (1) a content analysis of 43 recent state and metropolitan freight plans, and (2) a nationwide survey of 56 transportation professionals engaged in freight and rail planning. Findings show broad consensus on the importance of resilience, with shared goals around infrastructure modernization, system reliability, and emergency preparedness. However, state and local governments differ in approach: states emphasize compliance and long-term coordination, while cities and MPOs focus on community-driven innovation, mobility access, and priorities. Despite ambitious goals, survey responses reveal persistent implementation barriers, including limited funding, fragmented governance, and challenges in aligning public and private sector interests. Emerging best practices include integrating weather and hazard data into project selection, leveraging public-private partnerships, advancing multimodal connectivity, and piloting equity-centered local initiatives. The study concludes that resilience cannot remain a secondary objective—it must be embedded into core planning, evaluation, and investment processes. Recommendations include flexible federal funding mechanisms, stronger interagency and cross-sector collaboration, and targeted support for smaller and rural jurisdictions. Together, these steps can help bridge the gap between planning and practice, build a more resilient, reliable, and economically competitive freight system in the U.S.					
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Contents

Acknowledgments.....	iii
Executive Summary	1
1. Introduction.....	4
1.1 Background.....	4
1.2 Objectives.....	4
1.3 Overall Approach.....	4
1.4 Scope.....	5
1.5 Organization of the Paper	5
2. Literature Review	6
2.1 Range of Risks and Disruptions	6
2.2 The Importance of Intermodal Systems	6
2.3 Geographic and Institutional Contexts.....	7
2.4 Frameworks for Building Resilience	7
2.5 Gaps and Opportunities	8
3. Methodology	9
3.1 Data Collection	9
3.2 Data Analysis.....	10
3.3 Limitations.....	11
4. Findings	12
4.1 Overview of Best Practices across States.....	12
4.2 Overview of Best Practices across Metro Areas.....	19
4.3 Overview of Survey Results	23
4.3.1 Planning Insights.....	23
4.3.2 Implementations Insights.....	26
4.3.3 Future Actions Insights.....	23
4.4 Results for Best Practices according to Transportation Planners.....	23
5. Key Takeaways: Comparative Discussion of Freight Plans and Survey Results.....	35
6. Recommendations	39
7. Conclusion	41
References	42
Appendices	46

Appendix A: Codebook for Freight Plans	46
Appendix B: States' Best Practices.....	50
Appendix C: Cities and MPO's Best Practices	97

Illustrations

Figure 1. Key Goals of U.S Freight and Rail Transportation Planners (N=56)	23
Figure 2. Key Barriers to Implementing Resilience Policies (N=56).....	30
Figure 3. Federal Governments’s Role in Supporting State Freight Plans (N=54)	31
Figure 4. Investment Priorities for Improving Resilience (N=53)	33

Tables

Table 1. Best Practices for Environmental, Social, and Community Resilience.....	12
Table 2. Best Practices for Infrastructure Resilience	14
Table 3. Best Practices for Operational Resilience	16
Table 4. Best Practices for Innovation	16
Table 5. Best Practices for Environmental Sustainability and Innovation.....	19
Table 6. Best Practices for Efficient Economic Development and Safety.....	20
Table 7. Best Practices for Infrastructure and System Resilience	22
Table 8. Prioritized Risks Reported by US Freight and Rail Transportation Planners (Weather vs. Non-Weather) (N= 56)	24
Table 9. Key Evaluation Criteria for Resilient Freight and Rail Operations (N= 53)	25
Table 10. Metrics Used to Measure Resilience in Freight and Rail Operations (N= 52).....	26
Table 11. Top Priorities for Ensuring Operational Resilience to Weather- and Non-Weather-Related Risks (N= 56)	27
Table 12. Perceived Effectiveness of Organizational Collaboration Efforts in Promoting Freight and Rail Resilience (N=56).....	29
Table 13. Ranked Usefulness of Federal Funding Mechanisms for Advancing Freight Plans (N=52).....	32

Executive Summary

The research team, led by Dr. Serena Alexander, Associate Professor in the School for Public Policy and Urban Affairs and Environmental Engineering, and Carmella Uwineza, a PhD Candidate in the School for Public Policy and Urban Affairs, conducted this study between August 2024 and April 2026 at Northeastern University in Boston, Massachusetts. Over the duration of the project, the team investigated how state and local agencies across the United States are integrating resilience into freight and rail planning.

Justification for Research: Freight and rail infrastructure faces growing risks from weather- and non-weather-related disruptions that threaten operational continuity, economic stability, and human well-being. While the Fixing America's Surface Transportation (FAST) Act mandates state freight planning, limited research examines how these plans translate into action. Local governments, though not federally required to produce freight plans, develop their own strategies, which vary widely. This research addresses a critical gap by surfacing best practices across multiple jurisdictions and capturing practitioner perspectives on planning and implementation. The resulting insights support planners and other affected actors in improving resilience efforts for freight and rail through more informed and coordinated approaches.

Methodology: The research team used a mixed methods approach, combining the following:

- 1. Content Analysis of Freight Plans (Phase 1):** A qualitative review of 43 recent freight plans (34 state and 9 local/MPO-level), selected based on availability and recency. Using NVivo software, these were coded using a framework focused on six thematic areas: environmental, social, and community resilience; infrastructure and operational resilience; technology and innovation; environmental sustainability; economic development; and human safety.
- 2. Nationwide Survey (Phase 2):** An online survey of 56 transportation professionals involved in freight and rail planning, distributed across 50 states and the District of Columbia. The survey explored practitioner insights on planning priorities, implementation enablers and barriers, and future actions related to building resilience in freight and rail systems.

Key Findings

- 1. Shared priorities and commitment to resilience:** Both state and local freight plans reflect broad consensus on the importance of resilience planning in the freight and rail sector. Key shared goals include infrastructure modernization, improving system reliability, and emergency preparedness in response to weather-related disruptions.
- 2. State and local governments operate with distinct planning approaches:** State freight plans often prioritize compliance with federal requirements, long-range planning, and systemic coordination. Conversely, city or metro freight plans tend to emphasize context-specific innovation, community needs, and bottom-up strategies with stronger integration of transportation access, operational efficiency, and air quality considerations into planning.

3. **Persistent gaps between planning and implementation:** Despite ambitious goals, survey data revealed that transportation professionals face persistent constraints including funding limitations, fragmented industry ownership structures, siloed agency structures, and other governance challenges. These barriers hinder efforts to plan for resilience in the sector.
4. **Best practices were identified across both state and local levels:** These include but are not limited to 1) integrating resilience into project prioritization and selection; 2) using weather and hazard data to assess current and future vulnerabilities in rail systems; 3) cross-sector and inter-jurisdictional coordination and collaboration; 4) leveraging public-private partnerships to increase investments for infrastructure resilience; and 5) innovation in multi-modal planning and technology applications.

Conclusion: Freight and rail planning goals and strategies across the U.S. reflect the urgent need and shared commitment to adapt to both weather and non-weather-related disruptions. However, achieving these goals will require targeted policy interventions to address structural barriers and resource disparities. To advance resilience planning for freight and rail systems in the U.S., the researchers propose the following recommendations, which have been informed by the report's findings.

Recommendations

1. **Strengthen federal-subnational coordination and offer flexible funding mechanisms.** Federal freight and rail policies must better reflect subnational agencies' experiences with implementation. This includes designing funding mechanisms that are not only sustainable, but also flexible enough to support varying local priorities, particularly for jurisdictions with fewer resources and limited administrative capacity.
2. **Improve interagency coordination and cross-sector collaboration.** Resilience planning cannot occur in silos, especially when disruptions have system-wide and nationwide implications. Stronger coordination across agencies, sectors, and jurisdictions is critical to prevent fragmented efforts, and ensure that infrastructure, operations, and policy are aligned across the freight network.
3. **Scale-up local innovation and community-driven strategies.** Some of the most creative, ambitious, and community-centered approaches are emerging at the local level. These efforts should gain more visibility and support, especially when pilot programs demonstrate impact. Platforms for knowledge sharing and peer exchange, tools for replication, and federal incentives, could help scale up effective and/or promising local best practices to broader implementation.
4. **Support scalability and capacity-building for smaller and rural jurisdictions.** While many innovative resilience strategies emerge from larger metropolitan areas, smaller cities, towns, and rural jurisdictions often face unique capacity and resource constraints that limit implementation.
5. **Invest in weather and non-weather risk modelling and data systems.** Reliable, real-time data is essential for identifying vulnerabilities, guiding investments, and tracking progress over time. Developing data systems that assess both weather-related

and non-weather-related risks—such as supply chain shocks, cyber-attacks, and extreme weather events—will improve decision-making and enable transportation planners to prioritize impactful projects.

- 6. Mainstream resilience in planning and project evaluation.** Resilience should be embedded into the core functions of freight and rail planning, rather than treated as a standalone objective. Integrating resilience into project selection, evaluation, and funding criteria—particularly through federal performance measures and grant scoring systems—can help institutionalize these goals across agencies. Federal guidance and model frameworks should encourage agencies to align resilience with existing policy objectives such as safety, operational continuity, and system reliability.
- 7. Build capacity to plan and deliver on resilience goals.** State and local government agencies are tasked with advancing ambitious goals with increasingly constrained resources. To achieve these goals, they need targeted support including technical assistance and staffing.
- 8. Leverage public–private partnerships to expand investments in system resilience.** The private sector plays a critical role in freight operations and infrastructure. Public–private partnerships can help mobilize new and varied funding sources, pilot and scale innovations, and reinforce shared responsibility for managing risks and improving infrastructure resilience across the freight and rail network.

1 Introduction

The researchers examined how state and local governments across the United States are integrating long-term resilience into freight and rail planning to prepare for growing weather and non-weather-related risks.

1.1 Background

Evolving environmental conditions—including sea-level rise, coastal storms, landslides, extreme temperatures, wildfires, and inland flooding—pose a significant risk to the North American freight and passenger rail network. When these events affect a rail line, this could lead to disruption of service, economic losses to the rail industry and the communities they serve, as well as injuries and fatalities. To address this issue, this research project aims to examine how state and local governments across the United States (US) are planning for resilience in their rail and freight operations.

Resilience is defined in numerous ways and considers a myriad aspects including infrastructure, human, socioeconomic, and environmental. Overall, resilience in freight and rail transport network is defined as the ability of the system to provide effective services, as well as to resist, absorb, accommodate and recover from the impact of disruptive events (Bešinović, 2020; Misra & Padgett, 2022; Wang, 2015). A resilient system should work effectively and efficiently during a crisis, such as one brought about by an extreme weather event (Schofer et al., 2022). By examining how state and local governments are addressing transportation networks that are vulnerable to disruptions, we are considering potential anthropogenic and natural threats facing the rail freight system. As such, it is important to consider all key risks as well as all major points of exposure and sensitivity to these threats. It is also important to consider both static and dynamic elements of resilience planning. An analysis of static elements involves examining existing system capabilities and resources that contribute to resilience. Dynamic elements, on the other hand, focus on actions to prepare for and respond to threats. These elements are the focus of the research.

1.2 Objectives

The research aims to address two key objectives. The first objective is to fill critical knowledge and practice gaps in freight and rail adaptation and resilience planning across U.S. state and local jurisdictions. The second objective is to develop a public-facing, interactive portal—the *Sustainable and Resilient Rail and Freight Portal Map*—that catalogs and visualizes subnational resilience strategies, enabling transportation professionals and decision-makers to explore and comprehensively assess best practices and innovative approaches.

1.3 Overall Approach

To achieve this goal, the researchers conducted an analysis of current practices and challenges of freight and rail planning to address weather-related risks. This technical report presents a compilation of key findings from our analysis on best practices across 43 freight plans (including 34 states, 9 local), which will inform the development of the *Portal Map*. It also presents findings from a nationwide survey of transportation professionals.

1.4 Scope

This report examines how state and local governments in the U.S. are planning for resilience within freight and rail transportation systems. The focus is on understanding how these systems are being prepared to withstand, adapt to, and recover from increasing weather-related disruptions such as sea-level rise, wildfires, extreme heat, and flooding, as well as non-weather related risks. Given the critical role freight and rail networks play in the U.S. economy and human safety, this research aims to examine and reveal current best practices, challenges, and opportunities for advancing resilience planning for freight and rail systems.

1.5 Organization of the Paper

This report is structured into six main sections (excluding the Introduction), followed by references and appendices, to provide a comprehensive analysis of how resilience is being integrated into freight and rail planning across the United States.

[Section 2:](#) Literature Review summarizes existing research on freight and rail resilience, identifies key conceptual frameworks, and highlights current gaps in knowledge and practice that this study seeks to address. [Section 3:](#) Methodology details the mixed-methods approach, including data collection (freight plan analysis and nationwide survey), data analysis techniques, and limitations of the study. [Section 4:](#) Findings presents results from the analysis, organized into three subsections: [4.1 Overview of Best Practices across States](#); [4.2 Overview of Best Practices across Metro Areas](#); and [4.3 Overview of Survey Results](#).

[Section 5:](#) Key Takeaways synthesizes insights from both the freight plan review and the survey results, offering a comparative discussion that highlights shared priorities, implementation gaps, and opportunities. [Section 6:](#) Recommendations outlines eight actionable strategies for policymakers to strengthen resilience, bridge gaps between planning and practice, and support scalable, community-driven implementation. [Section 7:](#) Conclusion provides a narrative summary of the study's overarching insights.

The report concludes with [Section 8:](#) References, followed by [Appendices](#) that offer supplementary materials, including the Codebook for Freight Plans (Appendix A), State Best Practices (Appendix B), and City and MPO Best Practices (Appendix C).

Together, these sections offer a comprehensive understanding of current practices, challenges, and pathways for advancing resilience in U.S. freight and rail systems.

2 Literature Review

Resilience is commonly understood as the capacity of a system to withstand disruptions and recover functionality following a disturbance (Bešinović, 2020; Misra & Padgett, 2022). In the context of freight and rail transportation, resilience often refers to the system's ability to maintain or quickly restore operational performance—such as freight volume or service capacity—after an event like an extreme weather disaster or infrastructure failure.

However, traditional interpretations of resilience as simply “bouncing back” to a previous state have been increasingly critiqued. Scholars and practitioners are increasingly advocating for a more progressive notion of “bouncing forward” (Schofer et al., 2022). This approach emphasizes not only recovery, but also transformation toward a more adaptable, future-ready system. “Bouncing forward” acknowledges existing operational and infrastructure challenges within freight systems and focuses on creating networks that are better prepared for future disruptions.

This study builds on that evolving understanding. We draw from both **static resilience**, the ability of a system to absorb shocks and continue functioning using existing resources, and **dynamic resilience**, the ability to prepare, adapt, recover, and transform after disruption (Holling, 1973). Together, these perspectives help us think about resilience as both a state and a process, which can be built, strengthened, and improved over time.

2.1. Range of Risks and Disruptions

Freight and rail systems face a wide variety of threats ranging from hurricanes, floods, and wildfires to pandemics, security incidents, and economic shocks. Some studies focus on particular events to draw lessons for the future. For example, research on the Port of Houston after Hurricane Harvey (Arabi, Hyun, & Mattingly, 2021) highlights how proactive and reactive responses can help lessen economic losses. Others (Borca, Putz, & Hofbauer, 2021), take a broader view, comparing how different crises—from the COVID-19 pandemic to global financial instability—have affected freight systems. Together, these studies show that resilience planning needs to account for multiple, overlapping hazards rather than focusing on a single risk.

2.2 The Importance of Intermodal Systems

A common thread across the literature is the interdependence of transportation modes. Freight rarely moves on one mode alone, since rail connects to trucks, ports, terminals, and warehouses. This means vulnerabilities in one part of the system can ripple across others. Studies of intermodal systems (e.g., Nair, Avetisyan, & Miller-Hooks, 2010; Pant et al., 2014) assert that enhancing resilience often involves building redundancy—such as alternative routes or backup facilities—and strengthening coordination between modes. Some research even explores collaborative approaches, such as port coalitions that share capacity or jointly invest in protective infrastructure.

2.3 Geographic and Institutional Contexts

Resilience also looks different depending on the scale and the actors involved. Some studies focus narrowly on a single facility, while others take a global supply chain perspective (Yang, Pan, & Ballot, 2017). Still others emphasize the critical role of state and local governments (Ta, Goodchild, & Ivanov, 2010), which are often responsible for planning and maintaining the infrastructure most exposed to risk. Scholars like Potter, Soroka, and Naim (2022) also point to the importance of understanding regional linkages because rail resilience doesn't exist in isolation, but as part of a larger network of actors, agencies, and communities.

2.4 Frameworks for Building Resilience

Across the literature, a few common frameworks emerge to guide resilience planning. Many scholars approach resilience through a risk management lens, which views resilience as a continuous process rather than a single outcome (Pitera & Goodchild, 2009; Ta, Goodchild, & Ivanov, 2010). This process typically begins with risk assessment, where planners identify potential disruptions and evaluate their likelihood and impact. From there, attention shifts to preparedness, or the evaluation of existing resources and the development of plans to address those risks before they occur. Mitigation strategies then aim to reduce the severity of damage, often through infrastructure upgrades, protective policies, or operational changes. Once a disruption happens, response efforts focus on restoring operations, whether by using alternative routes, reconfiguring logistics, or deploying emergency resources. Finally, recovery involves rebuilding and improving systems, often with the goal of not just returning to normal but emerging stronger and more adaptive. Some scholars categorize resilience strategies more broadly into two types: **strategic actions** and **enabling actions** (Pitera & Goodchild, 2009). Strategic actions include tangible measures such as adding redundancy to the network, varying freight routes, or shifting operations to off-peak times to reduce vulnerability. Enabling actions, on the other hand, create the conditions for those strategies to succeed. For example, improving communication systems, adopting innovative technologies, or building stronger partnerships across agencies and sectors. Together, these categories recognize that resilience is not only about physical infrastructure, but also about the institutional and technological capacity to anticipate and respond effectively to disruptions.

Recent research also underscores the growing role of big data and intelligent decision-making technologies in resilience planning (Liu et al., 2023; Shoman et al., 2023; Nagy & Foltin, 2022). Predictive analytics, for instance, can identify early warning signals for disruptions, while machine learning models can help decision-makers choose the most effective response and recovery strategies. These tools are increasingly seen as essential for navigating complex, interconnected freight systems where disruptions can spread quickly across modes and regions. For rail systems specifically, Chan and Schofer (2016) outline three main strategies that capture different aspects of resilience including (1) hardening, which focuses on strengthening physical infrastructure; (2) redundancy, which ensures there are alternative routes or modes available when disruptions occur; and (3) elasticity, which emphasizes flexibility and adaptive management in operations. Taken together, these frameworks highlight that resilience is multi-dimensional as it involves not only strong infrastructure, but also smart operations, reliable data, supportive institutions, and coordinated relationships across the entire freight and rail system.

2.5 Gaps and Opportunities

While the literature on freight and rail resilience is growing, several important gaps remain. First, much of the existing research focuses on conceptual definitions or modeling approaches for resilience (Bešinović, 2020; Misra & Padgett, 2022; Wang, 2015), but fewer studies examine how these ideas are being translated into real-world planning and policy, particularly at the subnational levels of government. This creates a disconnect between theory and practice. While scholars have proposed robust frameworks and strategies, it is less clear how transportation agencies are incorporating these concepts into their freight and rail policy and plans (Ta, Goodchild, & Ivanov, 2010; Potter, Soroka, & Naim, 2022). These agencies are central actors in implementing resilience strategies, yet their planning approaches remain understudied. Additionally, many resilience studies are narrowly focused on particular modes—such as ports, terminals, or corridors (Nair, Avetisyan, & Miller-Hooks, 2010; Pant et al., 2014)—rather than examining integrated and multimodal systems. In practice, freight and rail networks operate within complex intermodal systems that depend on coordination across infrastructure, agencies, and jurisdictions. The lack of comprehensive, system-wide analysis limits our understanding of how resilience can be achieved holistically.

Furthermore, much of the existing work emphasizes “bouncing back” (restoring systems to their pre-disruption state) rather than “bouncing forward” toward more community-driven, future-ready, and adaptive systems (Schofer et al., 2022). This forward-looking perspective is especially important as emerging economic and operational stressors create both sudden disruptions and long-term pressures that require systemic adaptation rather than short-term recovery. Finally, there is a need for practical, comparative tools that allow practitioners and researchers to explore how resilience is being operationalized across different regions and contexts. While there are disseminated examples of best practices, there is no centralized resource compiling state and local efforts, making it difficult to assess trends, identify innovative strategies, or learn from peer agencies.

These gaps present several opportunities. By analyzing a broad set of state and local freight plans and surveying transportation professionals, this study helps bridge the divide between conceptual frameworks and on-the-ground practices. It offers insight into how agencies define and pursue resilience, what challenges they face, and where innovation is occurring. Moreover, by developing a public-facing, browsable database, this research contributes a practical tool to support knowledge sharing and capacity building across jurisdictions. Together, these efforts move the conversation beyond abstract definitions and toward actionable strategies for a community-serving, resilient, and forward-looking freight and rail system.

3. Methodology

Guided by the theoretical insights outlined in the literature, this study adopts a multiphase mixed-methods approach to explore how resilience is defined, planned for, and implemented in the U.S. freight and rail system. The literature emphasizes that resilience is both static (rooted in existing system capacities) and dynamic (involving adaptive and forward-looking actions) (Hollings, 1973; Schofer et al., 2022). It also asserts that resilience planning follows a risk management framework encompassing assessment, preparedness, mitigation, response, and recovery (Pitera & Goodchild, 2009; Ta, Goodchild, & Ivanov, 2010). To examine how these concepts are operationalized in practice, our study combines (1) a content analysis of state and local freight plans, which captures how agencies articulate resilience goals and strategies in formal planning documents, and (2) a nationwide survey of transportation professionals, which provides insights into the lived challenges, priorities, and innovations shaping resilience planning and implementation. This mixed-methods design directly addresses gaps identified in the literature, particularly the lack of empirical evidence on how resilience frameworks are being adopted at subnational levels and the limited integration of practitioner perspectives.

We combined these two complementary methods to assess both the strategic framing of resilience and the practical realities of implementation across various geographic and institutional contexts.

3.1 Data Collection

Content Analysis: In 2015, President Obama signed into law the Fixing America's Surface Transportation (FAST) Act. At the time, it was the first federal law in over ten years to provide long-term funding certainty for surface transportation. The FAST Act also mandated each State that received funding under the National Highway Freight Program to develop a State Freight Plan, providing a comprehensive plan for the immediate and long-range planning activities and investments of the State (USDOT, 2016, p.1). While there is no federal law mandating local governments to have formal freight plans, several cities and metropolitan planning organizations (MPOs) have developed comprehensive plans for their immediate and long-range freight planning and investment activities.

Using these plans, we conducted a content analysis to examine how state and local governments approach resilience and adaptation in freight and rail planning and to identify best practices. In addition, insights from the content analysis informed the development of the survey instrument, proving particularly useful for identifying trends, challenges, and goals related to freight and rail planning.

Since States were required to develop a freight plan by the USDOT, data for this analysis was publicly available. Data was found and collected through the United States Department of Transportation (USDOT) online website, which includes plans from all 50 states and the District of Columbia. We also collected data from each individual State's Department of Transportation Website to ensure we had the most recent State Freight Plans. We created a database on Excel of all the State Freight Plans that were publicly available and noted the year they were published. To focus on the most current planning practices, and avoid doing a similar analysis done years ago, we excluded State Freight Plans published prior to September 2022.

Similarly, the most recent freight plans from nine local governments and Metropolitan Planning Organizations (MPOs) were collected directly from their websites and compiled into an Excel database. The selection of freight plans from Atlanta, Boston, Houston-Galveston, Los Angeles County, Miami-Dade County, New York City, Portland, the San Francisco Bay Area, and Seattle was intentional and based on their roles as major national and international freight hubs. These metropolitan areas represent a wide range of geographic regions, economic structures, and transportation systems, allowing for meaningful comparison of planning approaches. Their freight plans were chosen because they are recent, comprehensive, and publicly available, and they showcase emerging best practices in resilience, multimodal connectivity, and zero-emission freight strategies, providing valuable insight into innovative and forward-looking freight planning.

Survey: The nationwide survey administered via Qualtrics, a web-based survey platform, over a three-month period. The survey targeted transportation planners working in state DOTs and local transportation government agencies across all 50 states and the District of Columbia. They were identified through purposive sampling, using professional networks and publicly available agency directories to select individuals actively working in freight and rail planning.

We distributed the survey to 414 transportation professionals and received 84 responses (a 13.5% response rate). Of these, 56 were between 56% and 100% complete. In several cases, planners indicated via email that they forwarded the survey to the freight planner within their department, often resulting in one response per transportation agency.

3.2 Data Analysis

Content Analysis: Data was primarily analyzed through NVivo, a qualitative analysis software. Each Freight Plan was coded on NVivo to identify best practices. The codebook ([Appendix A](#)) was informed by existing literature on resilience and the *Guidance on Multimodal State Freight Plans and State Freight Advisory*. This document, published by the USDOT in 2016, provides States with updated information on the statutorily required elements of State Freight Plans under the FAST Act and recommends approaches and information that States may include in their Plans. It indicates that States should address various issues in their Plans, such as but not limited to: 1) significant freight system trends, needs, and issues; 2) their freight policies, strategies, and performance measures guide freight-related transportation investment decisions; 3) innovative technologies and operational strategies that improve safety and efficiency; and 4) strategies and goals to decrease the impacts of extreme weather and natural disasters on freight mobility (USDOT, 2016, p. 2-4). Freight plans were coded accordingly, and themes emerged that provided insights on key trends, challenges, opportunities, and best practices.

For the local government-level freight plans, we also used the developed codebook as a foundational framework. However, the subsequent analysis was specifically tailored to comparatively examine four main areas: 1) temporal relevance of strategies, by contrasting newer and older plans; 2) the identification of best practices in freight planning; 3) the prevalence of common strategies among different cities using them; and 4) the emergence of innovative approaches being implemented.

Survey: The survey included 21 questions organized into three thematic sections: (1) **Planning**, which explored key concerns, priorities, and institutional goals related to freight and rail resilience; (2) **Implementation**, which examined perceived barriers,

opportunities, and strategies for achieving resilience objectives; and (3) **Future Actions**, which invited reflections on the emerging innovations and strategic outlooks for the freight and rail industry. Most of the survey questions were closed-ended (primarily multiple choice), enabling us to capture broad patterns in the analysis and facilitate comparison across responses. A smaller number of open-ended questions yielded rich qualitative insights from respondents. Using Qualtrics and Excel, survey data was analyzed through descriptive statistics and cross-tabulations. The combination of closed- and open-ended questions was designed to balance comparability and contextual depth, while also mitigating respondent fatigue and encouraging more deliberate, reflective answers.

3.3 Limitations

There are several limitations to this study that should be noted. Seventeen states—Florida, Iowa, Kentucky, Maine, Maryland, Michigan, Mississippi, Missouri, Montana, Nevada, New Hampshire, Ohio, Rhode Island, South Carolina, Virginia, Vermont, and Wyoming—do not currently have a recent (post-September 2022) freight plan and were therefore excluded. This was confirmed by e-mailing staff at the U.S. Department of Transportation.

Similarly, our analysis on freight plans at local government levels also has several limitations. Most notably, due to the focus on larger metropolitan areas, there is a lack of representation of smaller urban areas and rural regions. The planning processes and level of resources dedicated to freight planning may be significantly different from those of major metros. The selection of metropolitan areas also leans towards coastal and generally more economically developed areas, which may introduce a bias in understanding challenges and priorities in freight planning in a different economic or geographic context.

Furthermore, regarding the survey, the 13.5% response rate aligns with similar expert surveys but introduces potential for nonresponse bias. Respondents may be more engaged or informed about resilience, potentially overrepresenting proactive practices. In addition, survey findings indicate that rural agencies often face distinct barriers such as limited funding, staff capacity, and technical resources, which should be interpreted within this broader context.

Together, these limitations highlight areas where future research could expand including incorporating more rural perspectives, examining underrepresented regions and cities, and exploring ways to support resource-constrained agencies in resilience planning.

4 Findings

Below are the key findings from the analysis of State Freight Plans of 33 States and the District of Columbia (DC). The more extensive findings and list of best practices can be found in [Appendix B](#).

4.1 Overview of Best Practices across States

These tables summarize best practices implemented across different states, categorized by their focus on 1) environmental, social, community, resilience; 2) infrastructure resilience, 3) operational resilience, and 4) opportunities for innovation. These are based on the coding categories for the qualitative analysis of State Freight Plans (seen in the Codebook, [Appendix A](#)). Each table demonstrates which states have best practices addressing specific planning priorities. A checkmark indicates that the State has a strategy or policy that has been considered a best practice for a particular priority (e.g., environmental sustainability).

Table 1. Best Practices for Environmental, Social, and Community Resilience

State	Mitigation	Adaptation	Cross-Cutting Strategies	Environmental Protection	Wildlife	Resource Access	Human Safety	Rural or Remote Considerations	Co-Benefits
Alabama		✓					✓		
Alaska		✓		✓	✓			✓	
Arizona	✓	✓		✓	✓	✓			
Arkansas		✓		✓	✓		✓		
California	✓	✓	✓	✓		□	✓		
Colorado	✓	✓	✓	✓	✓		✓		✓
Connecticut	✓	✓	✓			✓	✓		
Delaware	✓	✓	✓	✓			✓		
District of Columbia*	✓	✓		✓		✓			
Georgia		✓		✓	✓		✓		
Hawaii	✓	✓	✓	✓			✓		✓
Idaho	✓	✓		✓	✓		✓	✓	
Illinois	✓	✓		✓	✓	✓	✓		
Indiana	✓	✓					✓	✓	
Kansas	✓			✓			✓	✓	✓
Louisiana	✓	✓			✓	✓	✓	✓	
Massachusetts	✓	✓				✓			
Minnesota	✓			✓		✓	✓	✓	✓
Nebraska	✓						✓	✓	
New Jersey	✓					✓	✓		
New Mexico	✓	✓		✓		✓	✓	✓	✓
New York	✓	✓		✓	✓	✓	✓	✓	✓
North Carolina	✓	✓		✓	✓	✓	✓	✓	
North Dakota	✓	✓		✓	✓	✓	✓	✓	
Oklahoma	✓	✓				✓			
Oregon	✓	✓				✓	✓		
Pennsylvania	✓					✓			
South Dakota		✓		✓	✓				
Tennessee						✓			✓
Texas	✓	✓		✓	✓	✓			
Utah	✓	✓				✓	✓		
Washington	✓	✓					✓		✓
West Virginia							✓		✓
Wisconsin	✓	✓		✓		✓	✓		

This table shows which states have best practices addressing economic, social, and community resilience. Many states have developed policies and strategies primarily targeting mitigation, adaptation, and human safety. Fewer states have policies related to cross-cutting strategies (adaptation & mitigation) and do not explicitly reference socioeconomic co-benefits. Although many States mention the importance of community support in their Plans, several lack documented strategies, especially related to social and community resilience planning. Some examples include:

- California's *Community Air Protection Program (CAPP)*: Established under *Assembly Bill 617*, CAPP focuses on improving public health by reducing air pollution in communities heavily impacted by freight operations through air monitoring, emission reduction projects, and cleaner technology deployment (Caltrans, 2023, p. 238).
- New Jersey's *Freight Management System (FMS)*: Assists the state in prioritizing the needs of freight at highway locations on the statewide highway network. Ongoing revisions to the FMS include improvements to current datasets, the expansion of the database to include additional roadway links, and the inclusion of data to prioritize locations in communities with socio-economic need (NJDOT, 2023, p. 54).
- New Mexico's *Wildlife Corridor Action Plan*: Integrates crash and ecological data to prioritize wildlife-vehicle collision mitigation, balancing freight safety and natural resource preservation (NMDOT, 2023, p.105).

Table 2. Best Practices for Infrastructure Resilience

State	Multimodal Connectivity	Economic Competitiveness	Infrastructure Resilience	Intermodal Freight Connectivity	Redundancy	Critical Infrastructure
Alabama	✓			✓		
Alaska	✓	✓	✓	✓		
Arizona	✓	✓	✓	✓		
Arkansas			✓			
California		✓	✓		✓	
Colorado	✓			✓		✓
Connecticut		✓	✓			
Delaware			✓			
District of Columbia*						
Georgia	✓	✓	✓		✓	
Hawaii	✓					✓
Idaho	✓			✓		✓
Illinois			✓			
Indiana	✓		✓		✓	
Kansas	✓		✓		✓	✓
Louisiana	✓	✓	✓		✓	
Massachusetts	✓		✓			✓
Minnesota	✓		✓	✓		
Nebraska	✓		✓		✓	
New Jersey	✓		✓			✓
New Mexico	✓					✓
New York	✓			✓	✓	✓
North Carolina	✓					✓
North Dakota	✓			✓	✓	✓
Oklahoma	✓			✓		✓
Oregon	✓		✓	✓		✓
Pennsylvania	✓	✓	✓			
South Dakota	✓				✓	✓
Tennessee	✓	✓	✓			✓
Texas	✓	✓	✓		✓	✓
Utah	✓	✓	✓	✓		
Washington	✓			✓	✓	✓
West Virginia	✓		✓	✓		
Wisconsin		✓	✓		✓	

Table 2 highlights States that are developing or implementing practices to address infrastructure resilience. Common strategies target improving multimodal connectivity and critical infrastructure protection, with states such as Arizona, Georgia, Kansas, and Louisiana leading across multiple priorities. However, redundancy and intermodal freight connectivity seem to be less commonly prioritized. Key examples include:

- Nebraska's *Transportation Asset Management Plan (TAMP)*: Prioritizes investments in inspecting and maintaining freight-heavy corridors in good condition (NDOT, 2023, p.110).
- Louisiana's *New Orleans Rail Gateway Project*: Aims to increase rail capacity, reduce congestion, and improve freight interchange flow through partnerships with

Class I railroads, Amtrak, and the New Orleans Public Belt Railroad (LaDOTD, 2024, p. 46-47).

- Georgia's *Resiliency Committee*: The committee aims to assess and prioritize infrastructure projects based on resilience needs, especially considering extreme weather events. It collaborates with Georgia Tech to evaluate weather-related risks, document the effects of extreme weather events, and implement resilience improvements across transportation systems (GDOT, 2023, p. 5-30).
- Arizona's *Resilience Program*: Addresses transportation infrastructure vulnerabilities (including stormwater infrastructure) associated with threats from extreme weather, stormwater runoff, flooding, wildfires and other hazards (ADOT, 2022, p. 72).

Table 3. Best Practices for Operational Resilience

State	Transportation Security	Supply Chain Security	Emergency Preparedness	Technological Integration	Freight Optimization	Risk Assessment and Mitigation
Alabama	✓		✓	✓	✓	✓
Alaska						✓
Arizona				✓	✓	
Arkansas	✓			✓		
California	✓			✓	✓	
Colorado			✓	✓	✓	
Connecticut				✓	✓	
Delaware				✓	✓	
District of Columbia*				✓	✓	
Georgia	✓		✓	✓	✓	
Hawaii				✓		
Idaho		✓			✓	
Illinois	✓			✓	✓	
Indiana	✓		✓		✓	✓
Kansas				✓		
Louisiana	✓				✓	
Massachusetts					✓	
Minnesota		✓		✓	✓	✓
Nebraska	✓		✓	✓		
New Jersey	✓	✓	✓		✓	
New Mexico		✓	✓		✓	
New York		✓	✓	✓	✓	
North Carolina	✓	✓	✓		✓	✓
North Dakota			✓	✓		✓
Oklahoma				✓		✓
Oregon			✓	✓		✓
Pennsylvania	✓			✓	✓	
South Dakota				✓	✓	
Tennessee		✓		✓	✓	✓
Texas		✓	✓	✓		✓
Utah	✓		✓	✓		✓
Washington			✓	✓	✓	
West Virginia					✓	
Wisconsin	✓	✓	✓	✓		

Table 3 shows which States have best practices for operational resilience. States are focusing on doing so primarily by improving transportation security, integrating technologies, optimizing the flow of freight, and developing systems to prepare for emergencies and disruptions. Key examples include:

- Alabama: Identified congestion bottlenecks primarily along their Interstates using the *Mid-Period Freight Bottleneck Report* and the *FHWA Freight Mobility Trends Tool and Database*. These bottlenecks are being targeted for capacity expansion and maintenance projects to improve freight mobility, based on volume-to-capacity ratios and truck traffic percentage (ALDOT, 2023, p. 92).
- Georgia: Planning to use Unmanned Aerial Vehicles (UAV) to assess damage after severe weather events. These UAVs will be able to assess damage to the state's

transportation system in a more efficient manner to assist first responders in their rescue and cleanup efforts (GDOT, 2023, p. 5-31).

- Indiana's *INDOT4U* Customer Service Initiative: Aims to strengthen local engagement and customer service, offering tools such as the *Next Level Construction Map* and mobile applications to keep the public and freight stakeholders informed and connected. It is also used as an emergency response tool (INDOT, 2023, p. 54).
- North Carolina's *SmartWay* Program: Promotes fuel-saving practices in freight carriers and shippers to reduce air pollution from their operations. North Carolina truck carriers, including Old Dominion Freight Line Inc. and Eagle Transportation Corporation, are recognized leaders in supply chain and energy efficiency (NCDOT, 2022, p. 4).

Table 4. Best Practices for Innovation

State	Innovation and Advanced Technologies	Workforce Development	Predictive Data and Modeling Systems	Regional Collaboration
Alabama			☑	
Alaska	☑			
Arizona			☑	
Arkansas		☑	☑	
California	☑		☑	
Colorado		☑	☑	
Connecticut				☑
Delaware	☑		☑	☑
District of Columbia*	☑			☑
Georgia		☑		
Hawaii	☑		☑	
Idaho				
Illinois				☑
Indiana	☑			
Kansas	☑	☑		☑
Louisiana	☑			☑
Massachusetts	☑	☑	☑	
Minnesota	☑	☑	☑	
Nebraska				
New Jersey	☑	☑		☑
New Mexico	☑	☑		☑
New York	☑	☑	☑	
North Carolina	☑			☑
North Dakota		☑	☑	
Oklahoma	☑			
Oregon	☑		☑	
Pennsylvania				☑
South Dakota			☑	
Tennessee			☑	
Texas	☑		☑	
Utah	☑		☑	
Washington	☑	☑	☑	☑
West Virginia		☑		
Wisconsin	☑		☑	

This table indicates which States have practices that are pursuing opportunities for innovation. States are advancing technologies for freight and rail systems, using predictive data and modelling systems to plan for resilience, preparing their workforce to use new technologies, and collaborating regionally to develop innovative solutions. Key examples include:

- Delaware's *Connected and Automated Vehicles (CAV) Advisory Council*: Tasked with developing recommendations for innovative tools and strategies that can be used to prepare the state's transportation network for CAV. Potential CAV target areas

include: (1) promoting economic development, (2) technology, security, and privacy, (3) transportation network infrastructure, and (4) impacts on public and highway safety (DelDOT, 2023, p. D-6).

- New Jersey’s *Maritime Workforce Development* program: NJCU has partnered with 25 companies and labor unions, and regularly develops and modifies curricula to keep pace with changing industry needs. Students receive “upskill” training in areas such as warehouse operations, supply chain management, inventory cycle counting, and AutoCAD. The program has a 70% placement rate of students in jobs with partnering employers (NJDOT, 2023, p. 127).

4.2 Overview of Best Practices across Metro Areas

Table 5 provides a comparative overview of how nine metropolitan freight plans integrate best practices related to emissions mitigation, freight system efficiency, and technological innovation. These dimensions reflect the “bouncing forward” approach to resilience (Schofer et al., 2022), emphasizing long-term efficiency, adaptability, and modernization. By mapping these strategies, we can see how cities are translating resilience theory into practice, and where gaps remain.

Table 5. Best Practices for Environmental Sustainability and Innovation

City	Air Pollution Reduction	Freight System Optimization and Efficiency	Technological Integration and Innovation
Atlanta (2024)	☑		☑
Boston (2019)		☑	
Houston-Galveston (2023)	☑		☑
Los Angeles County (2020)	☑	☑	
Miami-Dade County (2024)	☑	☑	
New York City (2021)	☑	☑	
Portland (2023)	☑		
San Francisco (2016)		☑	
Seattle (2024)	☑	☑	☑

Overall, this table reveals a clear generational shift in freight planning. Newer plans (2023–2024)—particularly those from Seattle, Miami-Dade County, and Houston-Galveston—demonstrate multi-dimensional approaches that combine air pollution reduction, operational efficiency and smart technologies. Conversely, earlier plans, such as Boston (2019) and San Francisco (2016), emphasize traditional infrastructure upgrades (e.g., rail connections and port access) and congestion management, with less attention to innovation or air pollution reduction.

This shift reflects how natural resource preservation and resilience goals are now a central theme for most cities, especially those facing acute weather risks or strong regional mandates (e.g., Portland, Seattle, Miami-Dade). Technological innovation, while less consistently adopted, is emerging as a key strategy in Seattle and Houston-Galveston, where smart systems and digital tools support freight optimization. Meanwhile, freight efficiency

remains a universal goal, though cities differ in their approaches—from infrastructure upgrades in older plans to data-driven management in newer ones. These evolving priorities reflect a growing recognition that resilience is not only about absorbing shocks, but also about transforming systems to be smarter, more efficient, and more adaptive. Key examples include:

- Miami-Dade County has developed several innovative pilot programs aimed at resolving critical bottlenecks in international trade. These include initiatives such as the *Perishables Coalition*, the *Transshipment Committee*, and *CBP’s Reimbursable Services Authority*, which provide alternatives to federal trade regulations and enhance operational efficiencies. Expanding these pilot programs to improve freight system competitiveness is a key goal of the city’s freight plan (TPO, 2024, p. 9-4).
- Seattle’s *Smart Freight Management Program* uses technologies such as digital curb management, data collection tools, and intelligent traffic systems (ITS) to optimize freight vehicle access and parking. This will help reduce inefficiencies such as trucks searching for loading zones (SDOT, 2024, p. F-36).

Table 6 highlights how metropolitan freight plans are increasingly embedding efficient economic development, safety, and community into their resilience strategies. Taken together, these elements reflect a growing recognition, echoing the literature on “bouncing forward” (Schofer et al., 2022), that resilient freight systems must not only withstand disruptions, but also promote social and economic well-being across communities.

Table 6. Best Practices for Efficient Economic Development and Safety

City	Workforce Development	Human Safety	Community Considerations
Atlanta (2024)	☒	☒	
Boston (2019)		☒	
Houston-Galveston (2023)	☒	☒	
Los Angeles County (2020)	☒		☒
Miami-Dade County (2024)	☒		
New York City (2021)	☒		☒
Portland (2023)	☒	☒	☒
San Francisco (2016)	☒		
Seattle (2024)	☒	☒	

Across the nine cities analyzed, this table indicates that workforce development emerges as the most common best practice, signaling a widespread acknowledgment of the need to prepare workers for a rapidly evolving freight landscape shaped by automation, efficient use of energy, and digital technologies. Human safety initiatives are especially prominent in regions with dense freight networks, where minimizing collisions and improving roadway design are essential for resilience. Finally, community considerations—though less universally adopted—are becoming a defining feature of newer plans. This suggests a shift

from merely referencing community in freight plans to actually measuring impact through programs and metrics.

This evolution in freight planning signals increased alignment with federal Justice40 goals and could guide more efficient implementation practices which explicitly seek to ensure that freight operations benefit, rather than burden, local communities. This evolution also reflects the literature's call for dynamic resilience, emphasizing adaptive capacity and transformation alongside physical robustness (Hollings, 1973; Pitera & Goodchild, 2009). By investing in people and communities, these metropolitan areas are redefining what it means for freight systems to be resilient. Key examples include:

- Atlanta collaborates with universities such as Georgia Tech and Georgia State University to align educational programs with industry needs, particularly in logistics, supply chain management, and transportation technology. These institutions help facilitate workforce development programs, training the next generation of workers to support advanced freight technologies and efficient operations (ARC, 2024, p. 16).
- As part of the broader efforts to modernize food distribution in New York, the *Hunts Point Produce Market Redevelopment* will create modern, temperature-controlled warehouse spaces and improve logistics efficiency. This project will not only support more efficient energy use but also create new jobs in the freight sector, benefiting the local community (NYSDOT, 2021, p. 12).
- Houston-Galveston Area Council's *Vision Zero* includes strategies for eliminating traffic fatalities and severe injuries in the region, aiming to achieve zero traffic deaths and serious injuries by 2030. It is a commitment to creating safe mobility for all road users, including pedestrians, cyclists, and public transit riders. This involves various actions including road redesigns to reduce collisions and vehicle speeds (H-GAC, 2023, p. 84).
- *WIN-Miami Initiative* is a workforce development program designed to support communities in securing employment in the freight and logistics industries. This program targets certain underserved populations, such as homeless individuals and veterans, offering training and placement in the expanding sector. The program aims to build a more resilient workforce (TPO, 2024, p. 6-4).

Table 7 highlights how metropolitan freight plans are increasingly embracing infrastructure resilience, multimodal coordination, and collaborative partnerships as core pillars of long-term freight planning.

Table 7. Best Practices for Infrastructure and System Resilience

City	Infrastructure Resilience	Multimodal & Intermodal Connectivity	Partnerships
Atlanta (2024)	☒	☒	
Boston (2019)	☒		
Houston-Galveston (2023)	☒		☒
Los Angeles County (2020)			☒
Miami-Dade County (2024)	☒		☒
New York City (2021)		☒	☒
Portland (2023)	☒	☒	☒
San Francisco (2016)		☒	☒
Seattle (2024)	☒	☒	☒

While infrastructure resilience has long been a focus—appearing even in older plans such as Boston’s (2019)—its meaning has evolved significantly. Newer plans (e.g., Seattle 2024, Portland 2023, Miami-Dade 2024) move beyond routine infrastructure upgrades toward long-term adaptation, seismic preparedness, and redundancy in critical corridors, reflecting a more anticipatory and systems-based understanding of resilience.

Equally noteworthy is the growing emphasis on multimodal and intermodal connectivity, such as the integration of ports, rail, and road systems to support more flexible and efficient freight movement. Cities such as Portland and Seattle, and Miami-Dade County are leading in this regard, expanding intermodal terminals, enhancing rail access, and strengthening maritime connections. The emphasis on intermodal coordination demonstrates how cities are viewing freight as a systems-level challenge rather than a set of isolated infrastructure projects. These practices may hold important lessons for smaller or inland cities seeking to boost resilience, optimize logistics, and reduce congestion through better network integration.

Finally, public-private partnerships (P3s) are emerging as essential mechanisms for advancing resilience goals. Freight networks rarely align neatly with jurisdictional boundaries; cities such as New York, Seattle, and Houston-Galveston are leveraging partnerships to pool resources, coordinate across regions, and pilot innovative technologies. This trend aligns with the literature’s emphasis on networked governance and collective capacity-building as key enablers of adaptive resilience (Pitera & Goodchild, 2009). Evidently, this collaborative planning strategy demonstrates that freight challenges often extend beyond individual city limits and require multi-actor and/or regional cooperation. Key examples include:

- New York’s *Public-Private Partnership in Brooklyn: The Red Hook Container Terminal* is slated for renovation with the installation of new container cranes and retrofitting of diesel yard equipment to new standards. This project will improve marine freight services, reduce truck congestion, and provide more efficient logistics solutions for e-commerce (NYSDOT, 2021, p. 12).
- Portland’s *Public-Private Freight Infrastructure Partnership Program* supports joint investments in freight infrastructure projects. This program also encourages innovation, such as the development of automated transload facilities and smart port technologies (PBOT, 2023, p. 12).
- Since 2016, the Seattle Department of Transportation (SDOT) has partnered with the *University of Washington’s Urban Freight Lab*, to address urban freight challenges, particularly in downtown neighborhoods (SDOT, 2024, p. F-44).

4.3 Overview of Survey Results

This section presents the key findings from the survey, which was designed to gather insights from transportation planners regarding freight and rail resilience. The survey questionnaire was structured into three main sections to systematically explore different facets of resilience planning and action: (1) Planning; (2) Implementation; and (3) Future Actions. Below, the findings from each of these areas are presented, providing a comprehensive overview of the current landscape and future outlook for freight and rail resilience planning.

4.3.1 Planning Insights

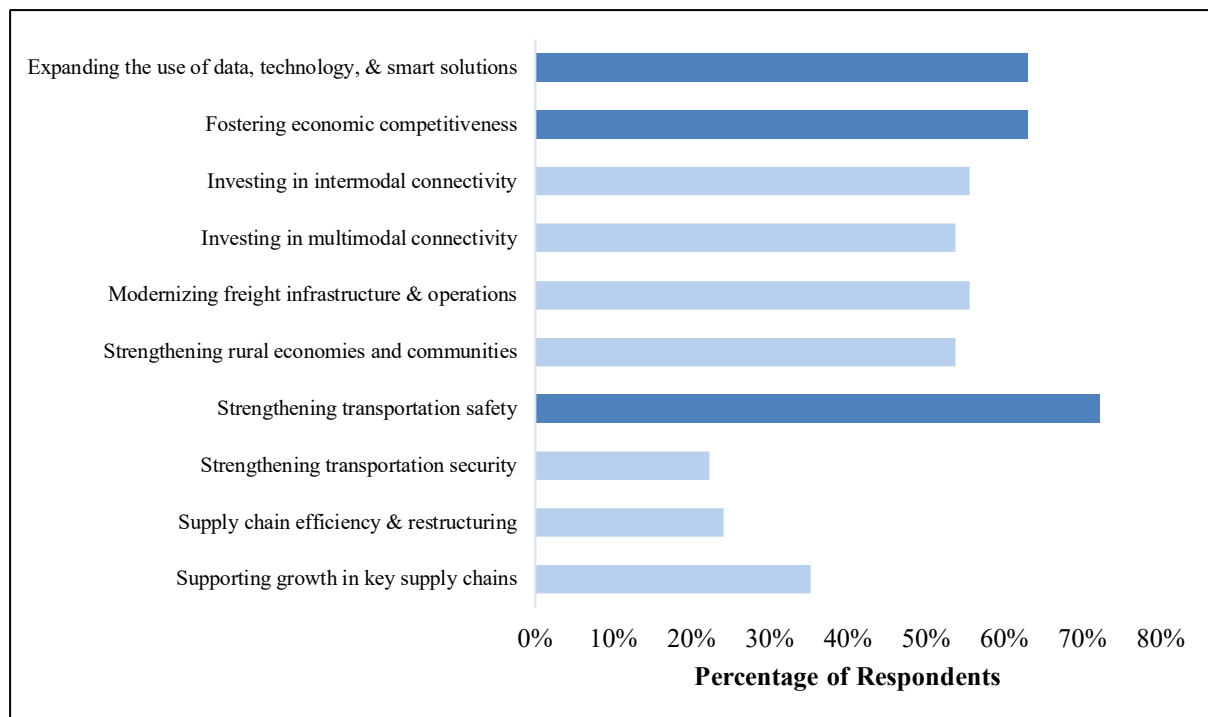


Figure 1. Key Goals of U.S. Freight and Rail Transportation Planners (N=56)

Based on 56 responses, the top planning priorities include **strengthening transportation safety (72%)**, **expanding the use of technology and smart solutions (63%)**, and **fostering economic competitiveness (63%)**. Less emphasized goals include **supply chain restructuring (24%)** and **transportation security (22%)**.

Following the identification of key goals, transportation planners across the U.S. also highlighted a range of risks that informs their planning. Transportation planners across the U.S. are accounting for a wide range of risks that affect freight and rail systems—spanning both operational disruptions and environmental hazards. When combined, the results reveal an emphasis on infrastructure strain and resource vulnerability.

Table 8. Prioritized Risks Reported by US Freight and Rail Transportation Planners (Weather vs. Non-Weather) (N= 56)

Risk	Category	% of Respondents
Congestion	Non-Weather	80%
Cyber attacks	Non-Weather	9%
Droughts	Weather	24%
Extreme weather events	Weather	69%
Flooding	Weather	83%
Global disruptions	Non-Weather	28%
Hurricanes/Storms	Weather	44%
Labor strife/strike	Non-Weather	7%
Landslides	Weather	39%
Other	Non-Weather	13%
Pollution	Non-Weather	24%
Sea Level Rise	Weather	31%
Tornadoes	Weather	30%
Wildfires	Weather	35%

The most cited weather- and non-weather related risks were **flooding (83%)**, **congestion (80%)**, **extreme weather events (69%)**, and **hurricanes and storms (44%)**. A smaller portion of respondents (13%) respondents chose the ‘other’ option and offered open-ended answers, which pointed to more structural and regional challenges, such as aging and shifting workforce demographics, fluctuations in agricultural production, population decline in rural areas, and decreased demand for freight rail services in certain states. A notable risk that respondents shared was winter events, including blizzards, heavy snow, and ice. Similarly, extreme heat was also a weather-related risk transportation planners are accounting for.

Furthermore, a key focus of our questions regarding *Planning* was data collection. Specifically, we asked participants to indicate the types of data their organization is collecting to inform its resilience planning efforts and to select all of which applied. Of the respondents, **21%** reported tracking **truck parking data** and **20%** reported tracking **freight and rail congestion data**, making these the most frequently selected options. Other significant data considerations, selected by respondents, include **vulnerability assessments of environmental impacts (19%)**, **crash data (15%)**, and **data on disadvantaged**

communities (13%). Weather-related hazard data **(6%)** and supply chain risk data **(5%)** were less commonly selected.

Table 9. Key Evaluation Criteria for Resilient Freight and Rail Operations (N= 53)

Evaluation Criteria	Percentage of Respondents
Adaptive Capacity	43%
Cost	51%
Economic Competitiveness	63%
Economic Development	57%
Environmental Impact	47%
Community	43%
Human Safety	59%
Interoperability	14%
Redundancy	41%
Reliability	78%
Risk	43%
Security	16%
Speed	35%
Long-term Sustainability	45%

Beyond understanding the types of data collected, our survey delved into the specific criteria organizations use to evaluate resilient freight and rail operations. As *Table 11* illustrates, **reliability (78%)**, **economic competitiveness (63%)**, **economic development (57%)**, **human safety (59%)**, and **cost (51%)** emerged as the most frequently cited criteria by respondents. Conversely, criteria such as **interoperability (14%)** and **security (16%)** were less commonly cited as primary evaluation factors.

Table 10. Metrics Used to Measure Resilience in Freight and Rail Operations (N= 52)

Evaluation Metrics	Percentage of Respondents (%)
Availability of alternative routes & infrastructure	62%
Average trip duration	42%
Consistency of service schedules	24%
Cost to shippers & carriers	12%
Crash rates	72%
Emissions of greenhouse gases	36%
Other air pollutants	26%
Freight value	36%
Freight volume	72%
Injuries from rail freight operations	24%
Land use impacts	24%
Level of service (LOS)	34%
Noise pollution levels	12%
Quality of data shared between systems	10%
Readiness of emergency response plans	26%
Supply chain diversity	10%
Variability in trip durations due to disruptions	24%
Vehicle miles traveled (VMT)	54%
Vehicle speed on critical corridors	40%

*Building on the identified evaluation criteria, respondents were further asked which specific metrics their organizations used to measure them. As detailed in Table 12, **crash rates (72%)** and **freight volume (72%)** were the most frequently reported metrics, each selected by nearly three-quarters of respondents. Other prominent metrics include availability of **alternative routes & infrastructure (62%)**, **vehicle miles traveled (VMT) (54%)**, and **average trip duration (42%)**. Conversely, metrics such as **supply chain diversity (10%)** and **quality of data shared between systems (10%)** were among the least commonly used by organizations.*

4.3.2 Implementation Insights

Following the planning section, which explored transportation planners' key concerns and priorities for freight and rail planning, the Implementation section delves into respondents' insights on the challenges and opportunities for implementing freight plans and strategies in their state or city.

Survey respondents were asked to identify their organization's top priorities for ensuring operational resilience in response to weather-related risks and non-weather-related risks. They were given the opportunity to select up to four (4) priorities.

Table 11. Top Priorities for Ensuring Operational Resilience to Weather- and Non-Weather-Related Risks (N= 56)

Priority	Category	Percentage of Respondents (%)
Adopting air pollution reduction strategies	Weather-Related	26%
Weather-proofing infrastructure	Weather-Related	36%
Decarbonization strategies	Weather-Related	21%
Emergency preparedness plans	Weather-Related	57%
Efficient infrastructure & stormwater management	Weather-Related	21%
Improving human safety	Non-Weather-Related	69%
Improving inventory management	Non-Weather-Related	18%
Investing in advanced information and technology systems	Non-Weather-Related	55%
Investing in information sharing/technologies	Non-Weather-Related	35%
Last-mile delivery strategies	Non-Weather-Related	27%
Leveraging PPPs to fund adaptation measures	Weather-Related	28%
Mitigating air pollution	Weather-Related	6%
Planning for frontline communities	Weather-Related	9%
Real-time traffic management systems	Weather-Related	47%
Reducing traffic congestion & bottlenecks	Non-Weather-Related	80%
Training & education programs	Weather-Related	6%
Transportation security strategies	Non-Weather-Related	12%
Using weather and hazard projections & data to inform decision-making	Weather-Related	19%
Weather forecasting & monitoring	Weather-Related	9%

When asked about their organization's top priorities for addressing non-weather-related risks to operational resilience, respondents most frequently chose reducing traffic congestion and bottlenecks (**80%**), improving human safety (i.e., workers, communities, and individuals) (**69%**), and investing in advanced information and technology (IT) systems (**55%**). Conversely, transportation security strategies (**12%**)—such as protecting against sabotage or cyber-attacks—and inventory management (**18%**) were less frequently selected as priorities. Regarding weather-related risks, top priorities included developing emergency preparedness and response plans (**57%**) and real-time traffic management systems (**47%**). Conversely, mitigating air pollution (**6%**), investing in training and education programs for workers' environmental preparedness (**6%**), and planning for frontline communities (**9%**) were seemingly lower priority risks.

Furthermore, to better understand the current landscape of resilience efforts, 56 respondents rated the effectiveness of existing policies and programs on a Likert scale with the following range of options: *Both effective and adequate*; *generally effective, but not adequate*; *ineffective and inadequate*; and *other*. Most respondents indicated that existing policies and programs are ‘generally effective, but not adequate’ (**68%**). A smaller proportion (**15%**) considered them to be ‘both effective and adequate,’ while **11%** found them ‘ineffective and inadequate’. Among these, several wrote comments noting their concerns. For instance, one respondent asserted that “investor-owners of the Class I freight rail system only care about operating ratio and not serving as a part of the nation's infrastructure system,” and that “our tools and approach are flawed,” due to a continued focus on other efforts despite opportunities to improve the current system. Another respondent specifically mentioned how difficult it is to incentivize private rail industry owners to invest above state-of-good-repair levels. Finally, **6%** of respondents selected ‘other’. One respondent elaborated on their choice and noted that “federal regulations often lack contextual reference and flexibility for rural application.”

Table 12. Perceived Effectiveness of Organizational Collaboration Efforts in Promoting Freight and Rail Resilience (N=56)

<i>Collaboration Type</i>	<i>Very effective (e.g., collaboration has led to clear measurable improvements in resilience planning and implementation)</i>	<i>Effective</i>	<i>Somewhat effective</i>	<i>Not effective (e.g., misaligned goals, poor communication, lack of coordination)</i>
<i>How effective is your collaboration with local communities in promoting freight and rail resilience?</i>	2%	33%	53%	11%
<i>How effective is your collaboration with local governments in promoting freight and rail resilience?</i>	9%	32%	50%	9%
<i>How effective is your organization's collaboration with the private sector in promoting freight and rail resilience?</i>	17%	21%	60%	2%
<i>How effective is your organization's regional collaboration to promote freight and rail resilience?</i>	6%	42%	52%	0%

Additionally, we also asked respondents to rate the effectiveness of their organizations' collaborative efforts in promoting freight and rail resilience with other groups of actors on a Likert scale ranging from 'very effective' to 'not effective'. Of the 56 respondents, most perceived these collaborative efforts to be at least 'somewhat effective' across all surveyed areas, which included local communities, local governments, private sector actors, and regional partners. Collaboration with local communities was rated 'somewhat effective' by **53%** of respondents, 'effective' by **33%**, 'not effective' by **11%**, and 'very effective' by **2%**. For local governments, **50%** rated collaboration as 'somewhat effective', **32%** as 'effective', **9%** as 'very effective', and **9%** as 'not effective'. Conversely, collaboration with the private sector had the highest 'very effective' rating at **17%**, with **60%** rating it as 'somewhat effective', **21%** as 'effective', and **2%** as 'not effective'. Lastly, regional collaboration was considered 'somewhat effective' by **52%** of respondents, 'effective' by **42%**, and 'very

effective’ by **6%**, with no respondents rating is as *‘not effective’*. Overall, while most partnerships are seen as generally functional, relatively few are viewed as highly effective.

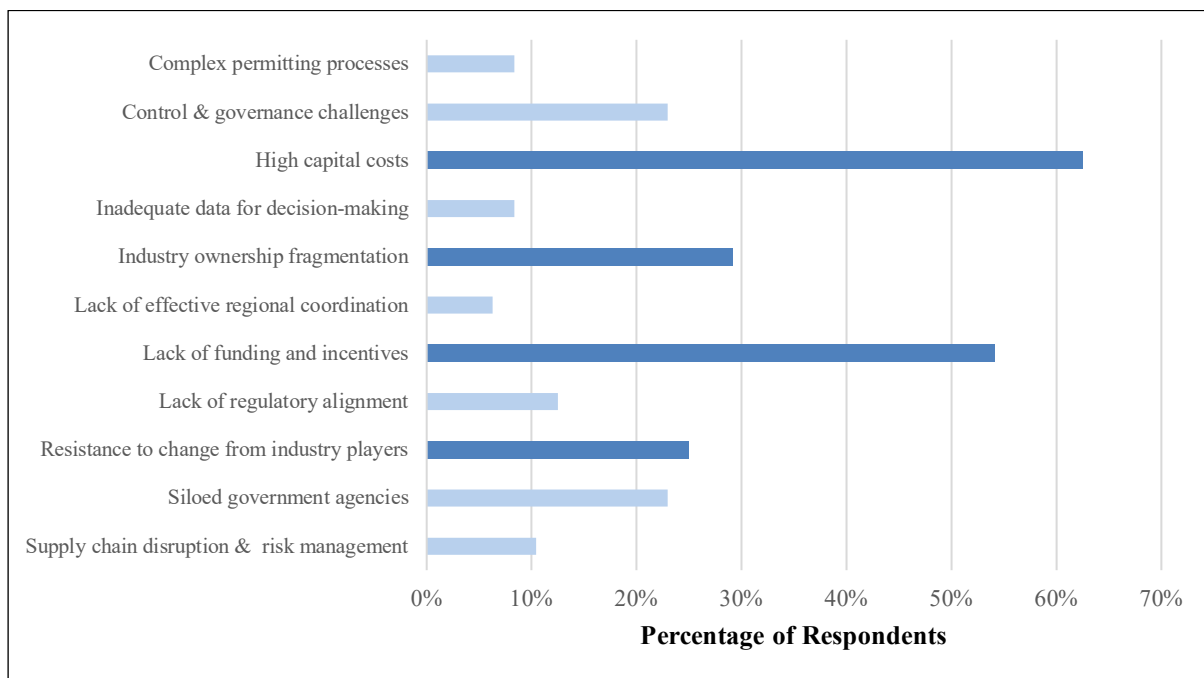


Figure 2. Key Barriers to Implementing Resilience Policies (N=56)

Respondents most frequently identified high capital costs (**63%**), a lack of funding and incentives (**54%**), industry ownership fragmentation (**29%**), and resistance to change from industry players (**25%**) as key barriers to implementing resilience policies. High capital costs were seen as a significant obstacle, particularly related to infrastructure upgrades and resilient technologies. Limited access to consistent funding or policy-driven incentives was also a major barrier. Additionally, industry ownership fragmentation, especially within the rail sector, was noted as a structural challenge posed by the division of rail infrastructure and operations among multiple private companies with conflicting priorities and/or investment strategies. Conversely, lack of regional coordination (**6%**) and regulatory alignment (**13%**) seemed to pose less significant barriers in implementation efforts.

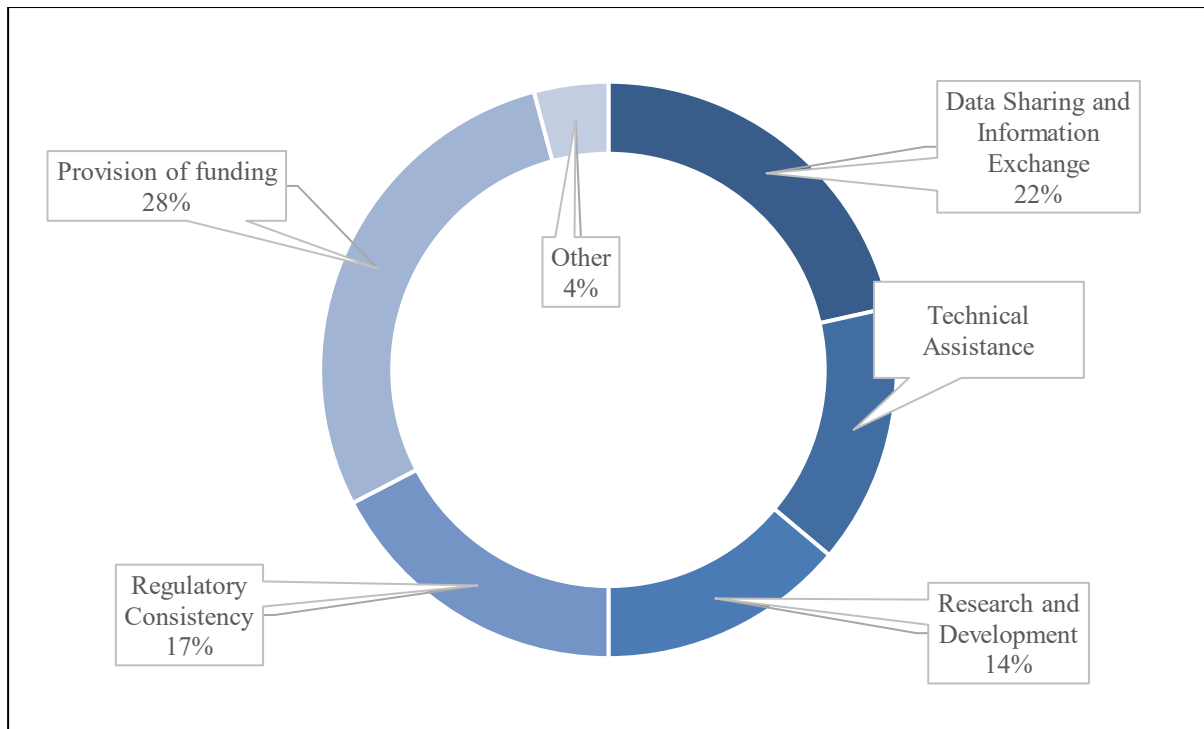


Figure 3. Federal Government's Role in Supporting State Freight Plans (N=54)

When asked about the federal government's role in supporting state freight plans, the most frequently selected option was the *'provision of funding' (28%)*, revealing the need for consistent and substantial financial support. This was followed by *'data sharing and information exchange' (21%)*, including support for data analysis and coordination efforts. *'Regulatory consistency' (18%)* was also emphasized, referring to the need for clear, standardized federal regulations. Respondents also valued support for *'research and development' (14%)* and *'technical assistance' (14%)*, which includes provision of expertise, tools, and/or access to innovative technologies. A smaller portion of respondents (**4%**) selected *'other'* as an option, citing needs such as revising freight plan submission timelines (e.g., extending [them] to five or ten years), expanding multimodal funding opportunities, and maintaining consistency in federal priorities across political administrations.

Table 13. Ranked Usefulness of Federal Funding Mechanisms for Advancing Freight Plans (N=52)

Funding Mechanism Type	Mean	Standard deviation	Range
Funding for Maintenance and Rehabilitation (of existing freight infrastructure)	1.8	0.8	1—4
Funding for Monitoring, Evaluation, and Oversight (of freight systems and programs)	4.0	1.3	1—6
Funding for Operational Improvements (e.g., technology deployment, congestion mitigation)	3.4	1.1	1—6
Grants (e.g., for data collection, planning, project development, and research)	4.3	1.1	1—6
Infrastructure Funding (e.g., for highway and rail projects)	2.2	1.7	1—8
Tax Incentives (e.g., credits for investment in freight infrastructure or equipment)	4.6	0.8	3—7
OtheR	6.9	0.9	1—8

Respondents were asked to rank various federal funding mechanisms in terms of their usefulness for advancing freight planning goals. ‘*Funding for maintenance and rehabilitation of existing freight infrastructure*’ (**Mean: 1.8, SD: 0.8**) and ‘*infrastructure funding for highway and rail projects*’ (**Mean: 2.2, SD: 1.7**) were consistently highly ranked as most useful among funding mechanisms. While the average ranking for ‘*funding for operational improvements*’ was third (**Mean: 3.4, SD: 1.1**), the standard deviation suggests greater variability in respondents’ opinions. Mechanisms such as ‘*funding for monitoring, evaluation, and oversight (of freight systems and programs)*’ (**Mean: 4.0, SD: 1.3**) and ‘*grants (e.g., for data collection, planning, project development, and research)*’ (**Mean: 4.3, SD: 1.1**) were viewed as moderately useful. Conversely, ‘*tax incentives (e.g., credits for investment in freight infrastructure or equipment)*’ received the lowest usefulness ranking among funding mechanisms (**Mean: 5.6, SD: 0.8**). The ‘*other*’ category was also ranked low (**Mean: 6.9, SD: 0.9**), though a few respondents did note specific unmet needs, such as renewed funding for the National Freight Cooperative Research Program (NCFRP) and formula-based funding for rail infrastructure projects to address perceived disparities that favor highway funding programs.

4.3.3 Future Actions Insights

In this final section of the survey—Future Actions—we explored transportation planners’ vision for the future of freight planning and the opportunities that lie ahead. This included understanding their key investment priorities for enhancing resilience in the freight and rail sectors.

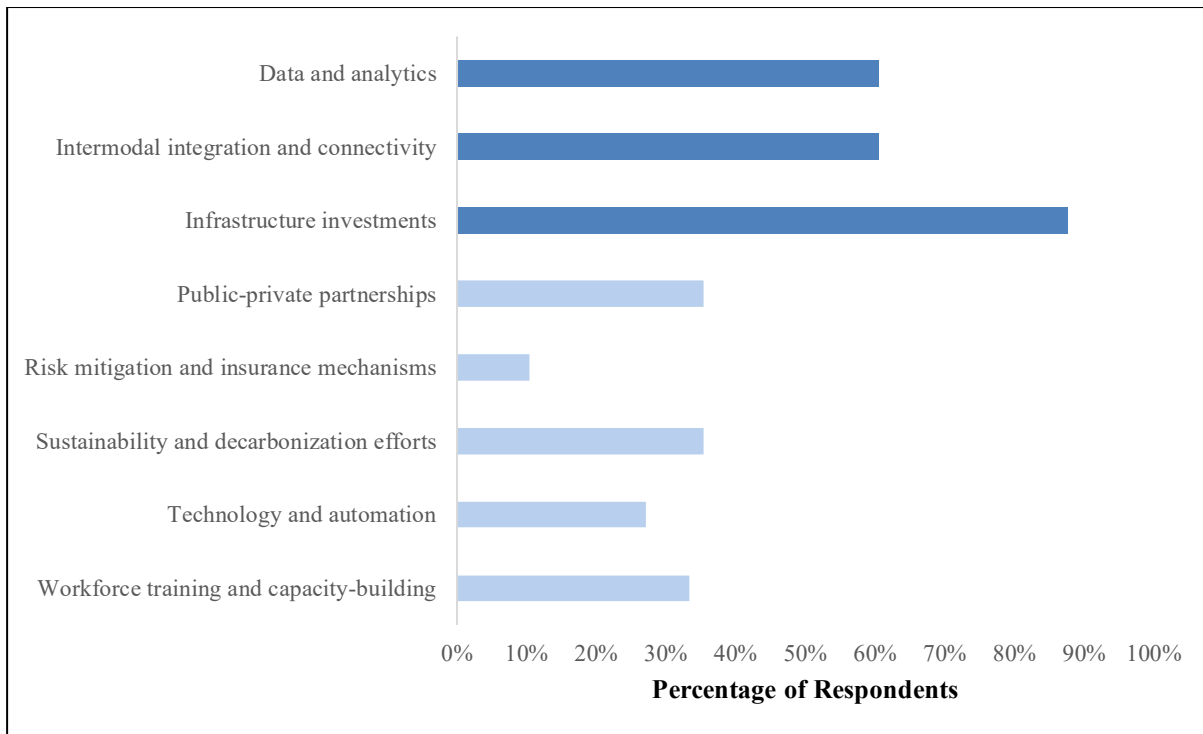


Figure 4. Investment Priorities for Improving Resilience (N=53)

Respondents were asked to identify up to four most critical investment priorities for improving resilience in the freight and rail sectors. The results indicate a clear focus on physical infrastructure and data capabilities as key areas. *Infrastructure investments* (e.g., adaptation infrastructure, storm-resistant tracks) emerged as the top priority, selected by **88%** of respondents. Following closely, *data and analytics* (e.g., real-time monitoring) and improving *intermodal integration and connectivity* were also highly prioritized, each selected by **60%** of respondents. Other notable investment priorities included *public-private partnerships (PPPs)*, and *workforce training and capacity-building*, selected by **33%** of respondents. In contrast, *technology and automation* was selected by **27.1%** of respondents, while *risk mitigation and insurance mechanisms* received the fewest selections, chosen by **10.4%** of respondents. These categories were perceived as less critical investment priorities by this group of respondents.

Following the investment priorities, respondents were asked to identify up to four emerging technologies they believe are most critical for improving freight and rail resilience in their state (N=54). The findings indicate a strong emphasis on data-driven and systemic approaches. The *Intelligent transportation systems* (e.g., freeway speed/road condition monitoring) priority was selected as the most critical emerging technology by **79%** of the respondents. *Data analytics (69%)* closely followed as a top priority, demonstrating the perceived importance of leveraging data to enhance resilience. *Fuel efficiency technologies* (e.g., anti-idling systems, alternative fuels, biofuels) were also highly ranked, chosen by **48%** of the respondents. Examples of other technologies deemed important include *automation (25%, e.g., 3D printing, autonomous vehicles, robots)*. Conversely, *unmanned aerial vehicles (drones)* were selected by the fewest respondents (**8.3%**).

4.4 Results for Best Practices according to Transportation Planners

Finally, respondents were asked to share their insights on best practices that have emerged for building resilience in freight and rail operations. The analysis of the open-ended responses revealed several key themes including:

- 1. Integrated and Continuous Planning:** A prominent theme was the importance of integrating freight and rail resilience efforts into broader transportation plans. Respondents noted that “freight resilience planning is continuous” and should involve “resilience analysis, planning, and integration into business practices,” spanning across modes and areas of planning. The use of comprehensive strategies, such as the FRA Corridor Identification and Development Program studies, was also highlighted as a best practice.
- 2. Collaboration and Partner Engagement:** Maintaining strong relationships and communication across various organizations and agencies were frequently cited as critical. This includes “targeted stakeholder engagement and feedback,” “relationships with private industry, MPOs, RPOs, and other adjacent states for multimodal connectivity,” and “partnering with other agencies and freight operators.” Respondents stressed the need to “build out relationships in typically siloed local governments” and “across silos within agencies, among agencies, across public, private, and non-profit organizations,” with one respondent succinctly stating, “Collaboration is the biggest [best practice].”
- 3. Emergency Management and Hazard Mitigation:** Integrating emergency management practices and hazard mitigation strategies into operations was deemed crucial. Responses asserted the importance of addressing both “short and medium term risks spanning from regular operational safety issues to weather hazards,” emphasizing the need for “capacity building around these topics.” The challenge of engaging small businesses with limited resources in long-term hazard risk planning discussions was also noted.
- 4. Leveraging Technology and Data for Proactive Measures:** Many responses posited technology and data as crucial for increasing resilience. Specific mentions included “data-driven decision making” and “leveraging remote sensing technologies like drones, LiDAR, and automated early warning systems.” These could be used to support “predictive maintenance and resilience, [thus] enabling proactive risk mitigation and environmental adaptation.”
- 5. Infrastructure Investment and Maintenance:** The practice of “identify[ing] critical infrastructure for improvements and adequate funding for maintenance” was discussed, reinforcing the importance of resilient physical infrastructure.
- 6. Funding and Knowledge Gaps:** Some respondents pointed to broader systemic issues. This included the need for “education of politicians who can provide funding and stop urban creep into industrially zoned areas,” and addressing the “misalignment within these [transportation] teams” where “freight is underprioritized and misunderstood by non-freight planners.”

5 Key Takeaways: Comparative Discussion of Freight Plans and Survey Results

Overall, the findings offer valuable insights into national trends, policy priorities, and implementation gaps across state and local governments in freight and rail resilience planning. The following takeaways highlight thematic alignments between the freight plan analysis and survey results, revealing both shared priorities and notable divergences between planning ambitions and practitioner perspectives.

1. **System modernization and efficient performance are shared priorities, but with varying levels of urgency.** Both cities and states prioritize efficient performance and operational improvements in freight planning. Cities often focus on innovative on-the-ground solutions (e.g., updated infrastructure, advanced truck technologies, and micro-distribution hubs) to improve urban air quality, reduce congestion, and support more efficient last-mile delivery. Conversely, states adopt policy-driven, systems-level strategies that scale across broader regional and interstate networks, incorporating freight efficiency and infrastructure modernization into long-range planning (e.g., California's CAPP and North Carolina's EO 246).

Survey Insights: Thirty-six percent of respondents reported using air-pollutant-related metrics in resilience planning. Additionally, while they were not the most frequently selected priorities, respondents identified operational efficiency strategies (26%), modernization of freight operations (21%), and infrastructure improvement initiatives (21%) as important secondary considerations related to long-term system resilience and preparedness.

- *Comparative Takeaway:* Transportation planners show **less urgency around emissions mitigation** than what is emphasized in freight plans. Freight plans are **more proactive and ambitious** on emissions mitigation, while in practice, transportation planners' focus reflects more **immediate operational concerns and pressures**. This suggests a **planning-implementation gap** in the urgency to reduce emissions.
2. **Community and workforce resilience are increasingly central to freight planning, but not fully integrated in practice.** Both levels of government are increasingly integrating community resilience into freight planning frameworks. **Cities** lead with **community-centered** initiatives, including infrastructure changes and targeted solutions in neighborhoods most impacted by freight-related pollution and poor air quality. They also act as incubators for experimentation (e.g., Atlanta's university-industry training pipelines). In addition, cities focus on targeted job access (e.g., WIN-LA in Los Angeles or WIN-Miami in Miami-Dade), with the aim to provide training and employment opportunities to underutilized communities. At the **state** level, efforts focus on creating job opportunities for communities and individuals in urban and rural areas, while also addressing the impact of freight operations on certain groups. States prioritize technology councils, workforce upskilling, and policy-level training programs (e.g., NJCU, NC Clean Energy Plan).
- *Comparative Takeaway:* Freight plans frequently emphasize community impacts and workforce accessibility, while survey data reflects more limited implementation in practice. This suggests a disconnect between planning goals

and operational prioritization, highlighting the need for better funding alignment, interagency coordination, and implementation support.

3. Infrastructure resilience and environmental adaptation are high-priority areas.

With the increasing frequency of extreme weather events and other environmental stressors, both cities and states are prioritizing the resilience of freight infrastructure. Cities, often more vulnerable to localized disasters (e.g., flooding, stormwater runoff) are implementing infrastructure solutions (e.g., permeable pavements and rain gardens) to harden the last-mile delivery system. States, such as Arizona and Georgia, use weather and hazard risk modelling, infrastructure audits, and flood mitigation approaches at corridor and statewide levels, to ensure long-term resilience.

Survey Insights: Flooding (83%), extreme weather (69%), and hurricanes/storms (44%) are top weather-related risks that planners account for. Similarly, infrastructure investments (88%) emerged as the top investment priority for improving resilience. At the same time, real-time traffic management and emergency preparedness were also common key strategies.

- Comparative Takeaway: Infrastructure resilience is a key shared concern across the freight plans and practitioner perspectives. However, survey respondents say most policies are ‘*generally effective but not adequate*’ (68%), indicating potential challenges in implementation, maintenance, and scalability, despite agreement on importance.

4. Technological innovation drives operational and systemic resilience.

Technological innovation is a central theme in both city and state freight plans. **Cities** focus on pilot programs and local experimentation (e.g., V2I technologies, ITS, delivery robots), while **states** aim to scale innovations such as **truck platooning, advanced data analytics, UAV-based infrastructure inspection, and real-time traffic optimization** across corridors.

Survey Insights: Technology and data are **high investment and planning priorities**. Among the respondents, 79% prioritize intelligent transportation systems, 69% prioritize data analytics, and 55% prioritize advanced IT systems. Furthermore, leveraging technology and data for proactive measures was identified as a best practice, emphasizing data-driven decision making. Yet, results for **tracking the quality of data** (e.g., quality of data shared between systems) remains a relatively low priority (10%).

- Comparative Takeaway: There is high enthusiasm for technological advancement, but **data quality, interoperability, and capacity** constraints may limit the impact of technology-oriented strategies unless better integrated into planning and operations.

5. Economic growth and workforce development strategies align with building freight resilience.

Both cities and states are aligning economic development strategies with freight resilience and modernization goals. **Cities** use workforce development programs to target historically marginalized communities and adapt to shifts in logistics, automation, and clean energy freight systems. **States** pursue policy-

level workforce investments, often aligned with resource **digital economy needs**, including training autonomous vehicle technologies.

Survey Insights: While economic development (57%) is a notable evaluation criterion; workforce training and education programs related to resilience are currently a low planning priority (6%). However, 33% of respondents did select workforce training and capacity-building as a future investment priority. This supports the assertion in freight plans regarding workforce development as integral to resilient freight systems.

- Comparative Takeaway: Freight plans are **more intentional** about linking **economic development and resilience** through job creation. Currently, practitioners appear less focused on workforce, but forward-looking data suggests **rising awareness of its importance**, especially as technology and decarbonization goals reshape the freight sector.

6. Regional collaboration is recognized as valuable, but it is limited in practice.

Cities and states alike are increasingly engaged in regional collaboration, seeking innovative solutions to shared freight challenges. Cities benefit from knowledge sharing and best practice exchange (e.g., Seattle-UW Urban Freight Lab), particularly in the implementation of localized technologies and urban freight delivery solutions. Additionally, regional collaboration is increasingly critical, especially in cross-border freight (e.g., Houston-Galveston and multimodal hubs (e.g., Miami-Dade). States often lead **multistate corridor coalitions, data-sharing frameworks, and regional freight strategies**, particularly in areas like the Gulf Coast, Mid-Atlantic, and Great Lakes.

Survey Insights: 42% of respondents say regional collaboration is effective, only 6% say it is very effective. Collaboration with communities and local governments is rated even lower in perceived effectiveness. However, there is recognition among transportation planners that in terms of future actions, fostering public-private partnerships is a priority (35%).

- Comparative Takeaway: While freight plans emphasize regionalism, implementation still lags. There is a discrepancy between the strategic importance placed on collaboration in freight plans and the reality of limited effective implementation in practice. Structural issues such as fragmented industry ownership, siloed governance, and limited institutional capacity continue to pose barriers. Scaling collaborative frameworks is critical to overcoming resource constraints and siloed operations.

7. Operational resilience and risk mitigation are immediate priorities. Cities implement Vision Zero policies, dynamic curb management, smart signals, and emergency freight protocols to ensure continuity under stress. States invest in tools to manage disruption (e.g., Alabama's freight bottleneck detection systems or Georgia's UAV deployment post-storm).

Survey Insights: High priority has been placed on congestion mitigation (80%), human safety (69%), emergency preparedness (57%), and the advancement of

technology and ITS. Additionally, the most-used metrics include crash rates, freight volume, and the availability of alternative routes.

- *Comparative Takeaway:* There is strong alignment and focus on operational resilience in both the freight plans and survey responses. Freight plans take a longer-term, systemic approach, while practitioners tend to be more risk-averse and employ a short-term perspective. Bridging this gap will require aligning performance metrics with broader resilience outcomes.

8. Funding is a fundamental need for making progress in resilience planning, and yet it is also a central challenge. Both cities and states rely heavily on public-private partnerships (P3s) as key tools to bridge public funding limitations and advance freight system resilience and modernization. Cities such as Portland and New York City invest in smart infrastructure upgrades and technology adoption through joint funding mechanisms. States such as Louisiana and New York use P3s to expand rail and marine infrastructure, and intermodal capacity.

Survey Results: When asked about the federal government’s role in supporting state freight plans, the most frequently selected option was the **‘provision of funding’** (28%), revealing the need for consistent and substantial financial support. However, planners also cited federal inflexibility and difficulty incentivizing private investment—particularly for freight rail—as major barriers. In addition, open-ended responses highlighted frustration with misalignment between funding cycles, federal policy requirements, and implementation timelines, which can delay critical resilience efforts.

- *Comparative Takeaway:* While freight plans call for innovative financing models and federal partnership, practitioners report systemic barriers that limit access to timely and flexible funding. Misaligned regulations, lack of incentives, and bureaucratic rigidity constrain the implementation of ambitious freight and rail resilience strategies, especially for projects requiring cross-sector collaboration or long-term investment horizons. Bridging this gap will require not only more funding, but also more adaptable finance mechanisms that align with local and state planning realities.

6 Recommendations

The following eight recommendations build on the findings of Mind the Gap and offer actionable strategies to strengthen freight and rail system resilience across jurisdictions. They are designed to guide policymakers, planners, and practitioners in closing the divide between vision and implementation by advancing flexible funding, targeted capacity-building, and stronger alignment across federal, state, regional, and local levels of government. Collectively, these strategies aim to move resilience planning from aspiration to action—ensuring that freight and rail systems are better equipped to adapt to weather-related and operational disruptions and deliver long-term economic and community benefits.

- 1. Strengthen federal-subnational coordination and offer flexible funding mechanisms.** Federal freight and rail policies must better reflect subnational agencies' experiences with implementation. This includes designing funding mechanisms that are not only feasible long term, but also flexible enough to support varying local priorities, particularly for jurisdictions with fewer resources and limited administrative capacity.
- 2. Improve interagency coordination and cross-sector collaboration.** Resilience planning cannot occur in silos, especially when disruptions have system-wide and nationwide implications. Stronger coordination across agencies, sectors, and jurisdictions is critical to prevent fragmented efforts, and ensure that infrastructure, operations, and policy are aligned across the freight network.
- 3. Scale-up local innovation and community-driven strategies.** Some of the most creative, ambitious, and community-centered approaches are emerging at the local level. These efforts should gain more visibility and support, especially when pilot programs demonstrate impact. Platforms for knowledge sharing and peer exchange, tools for replication, and federal incentives, could help scale up effective and/or promising local best practices to broader implementation.
- 4. Support scalability and capacity-building for smaller and rural jurisdictions.** While many innovative resilience strategies emerge from larger metropolitan areas, smaller cities, towns, and rural jurisdictions often face unique capacity and resource constraints that limit implementation. To ensure that resilience planning and best practices are broadly scalable, federal and state agencies should: (1) provide dedicated funding streams and technical assistance to support smaller and rural agencies in developing and implementing resilience strategies; (2) develop scalable, low-cost tools that can be adapted to different jurisdictional contexts; (3) encourage regional collaboration to pool resources, share expertise, and align freight corridor resilience planning across neighboring areas; and (4) incorporate capacity-building components such as training, peer exchanges, and planning grants into federal and state programs.
- 5. Invest in weather and non-weather risk modelling and data systems.** Reliable, real-time data is essential for identifying vulnerabilities, guiding investments, and tracking progress over time. Developing data systems that assess both weather-related and non-weather-related risks—such as supply chain shocks, cyber-attacks, and extreme weather events—will improve decision-making and enable transportation planners to prioritize impactful projects.

6. **Mainstream resilience in planning and project evaluation.** Resilience should be embedded into the core functions of freight and rail planning, rather than treated as a standalone objective. Integrating resilience into project selection, evaluation, and funding criteria—particularly through federal performance measures and grant scoring systems—can help institutionalize these goals across agencies. Federal guidance and model frameworks should encourage agencies to align resilience with existing policy objectives such as safety, operational continuity, and system reliability.
7. **Build capacity to plan and deliver on resilience goals.** State and local government agencies are tasked with advancing ambitious goals with increasingly constrained resources. To achieve these goals, they need targeted support including technical assistance and staffing.
8. **Leverage public–private partnerships to expand investments in system resilience.** The private sector plays a critical role in freight operations and infrastructure. Public–private partnerships can help mobilize new and varied funding sources, pilot and scale innovations, and reinforce shared responsibility for managing risks and improving infrastructure resilience across the freight and rail network.

7 Conclusion

This research demonstrates a growing and shared commitment among transportation agencies across the United States to build resilience in freight and rail systems amid accelerating weather and non-weather disruptions. Through an integrated analysis of 43 state and local freight plans and a nationwide survey of transportation professionals, the study reveals both encouraging progress and persistent gaps between planning ambitions and implementation realities.

Across jurisdictions, freight and rail resilience has emerged as a cross-cutting priority—embedded in goals related to infrastructure modernization, operational continuity, and long-term system performance. State plans tend to emphasize systems-level strategies, regulatory compliance, and long-term investments, while city and metropolitan plans often focus on localized innovation, community needs, and environmental performance. In short, these efforts reflect an evolving understanding of resilience as not only a technical or infrastructural objective, but also an operational, economic, and community-focused one.

Yet, despite ambitious strategies, significant barriers continue to limit effective implementation. Survey data highlight funding constraints, siloed governance structures, and limited institutional capacity as recurring challenges. Practitioners frequently report that while resilience is a stated priority, operational pressures and resource limitations often delay or dilute its integration into practice. Furthermore, smaller and rural jurisdictions face distinct obstacles, such as lacking the dedicated staff, funding, and data resources needed to plan and act effectively. These disparities reveal the need for scalable, flexible, and well-coordinated approaches that align federal guidance with local realities.

The findings also reveal uneven progress across thematic areas. Environmental adaptation and infrastructure resilience are widely recognized as critical, yet air pollution reduction and community considerations, are less consistently embedded in decision-making and implementation. Similarly, while technological innovation and data-driven tools are broadly prioritized, challenges in data quality, interoperability, and capacity hinder their full potential. Regional collaboration and public–private partnerships are acknowledged as essential but remain underdeveloped in practice, thus pointing to the need for stronger institutional frameworks and incentives.

Overall, these insights reveal a “gap” between the vision articulated in freight plans and the practical constraints faced by agencies on the ground. Bridging this gap requires policy alignment, capacity building, and targeted investments that translate planning objectives into measurable outcomes. The eight recommendations presented in this report provide a roadmap for doing so, emphasizing flexible funding, stronger federal–subnational coordination, support for smaller jurisdictions, integration of resilience into evaluation frameworks, and strategic partnerships to mobilize resources and innovation.

Ultimately, advancing freight and rail resilience will depend on collaborative, multi-scalar action that links federal policy, regional strategy, and local implementation. By fostering shared learning, leveraging technology, and embedding resilience into the core of planning and investment decisions, transportation agencies can transform ambitious plans into tangible progress, thus building freight systems that are not only strong and adaptive, but also community- and economy-driven in the face of future disruptions.

References

- Alabama Department of Transportation (February 2023). *2022 Alabama Statewide Freight Plan*. ALDOT. <https://www.dot.state.al.us/programs/FreightPlanning.html>
- Alaska Department of Transportation & Public Facilities (December 2022). *Alaska Moves 2050: Statewide Freight Plan*. ADOT & PF. https://dot.alaska.gov/stwdplng/areaplans/modal_system/freightplan.shtml
- Arizona Department of Transportation (December 2022). *Arizona State Freight Plan*. AZDOT. <https://azdot.gov/planning/transportation-programs/arizona-state-freight-plan>
- Arkansas Department of Transportation (December 2022). *Arkansas State Freight Plan*. ARDOT. <https://ardot.gov/divisions/planning/multimodal-planning/statewide-planning/>
- Atlanta Regional Commission. (2024). *2024 Atlanta Regional Freight Mobility Plan*. <https://cdn.atlantaregional.org/wp-content/uploads/arc-2024-atlanta-regional-freight-mobility-plan.pdf>
- Bešinović, Nikola (2020). "Resilience in railway transport systems: a literature review and research agenda." *Transport Reviews* 40, no. 4: 457-478.
- Boston Region MPO Freight Planning Action Plan Update*. Boston Region Metropolitan Planning Organization. <https://www.ctps.org/data/html/studies/other/Freight-Planning-Action-Plan-Update/Freight-Planning-Action-Plan-Update.html>
- California Department of Transportation (July 2023). *California Freight Mobility Plan*. Caltrans. <https://dot.ca.gov/programs/transportation-planning/division-of-transportation-planning/strategic-freight-planning/cfmp-2023>
- Colorado Department of Transportation, Division of Transportation Development. (2024, April). *Colorado freight plan*. Colorado Department of Transportation. https://freight.colorado.gov/sites/freight/files/documents/FR1_CODOT_COFrPln_Apr24_ACCESSIBLE.pdf
- Connecticut Department of Transportation (January 2023). *2022-2026 Connecticut Statewide Freight Plan*. CTDOT. https://portal.ct.gov/dot/programs/freight?language=en_US
- Delaware Department of Transportation (December 2022). *2022 Delaware State Freight Plan*. DelDOT. <https://deldot.gov/Business/freight/>
- The District Department of Transportation (August 2024). *2024 District Freight Plan*. Ddot. <https://ddot.dc.gov/publication/2024-district-freight-plan>
- Georgia Department of Transportation (March 2023). *Georgia Freight Plan*. GDOT. <https://www.dot.ga.gov/GDOT/pages/freight.aspx>
- Hawaii Department of Transportation (March 2024). *2023 Hawaii Statewide Freight Plan*. HIDOT. <https://hidot.hawaii.gov/highways/files/2024/04/HDOT-Freight-Plan-Final-Report-2024-03-01.pdf>

- Houston-Galveston Area Council. (2024, November 15). *Transportation Policy Council item 10: 2023 Regional Goods Movement Plan Update*.
- Idaho Transportation Department. (2023, March 24). *Idaho's 2023 Strategic Freight Plan*. <https://apps.itd.idaho.gov/apps/freight/FreightPlan.pdf>
- Illinois Department of Transportation (September 2024). *Illinois 2023: State Freight Plan*. IDOT. <https://idot.illinois.gov/transportation-system/transportation-management/planning/freight/2017-state-freight-plan/2023-state-freight-plan.html>
- Indiana Department of Transportation (May 2023). *Indiana Multimodal Freight and Mobility Plan*. INDOT. <https://www.in.gov/indot/multimodal/freight/>
- Kansas Department of Transportation (February 2023). *Kansas State Freight Plan*. KSDOT. https://www.ksdot.gov/Assets/wwwksdotorg/bureaus/burRail/Rail/Documents/2023/KansasStateFreightPlan_FHWA_Approved.pdf
- Los Angeles County Metropolitan Transportation Authority. (2021, January 20). *2021 Los Angeles County Goods Movement Strategic Plan*. https://libraryarchives.metro.net/DB_Attachments/BP-Links/policy-2021-01-20-final-2021-la-county-goods-movement-strategic-plan.pdf
- Louisiana Department of Transportation and Development (August 2024). *Louisiana State Freight Plan*. LaDOTD. http://wwwsp.dotd.la.gov/Inside_LaDOTD/Divisions/Multimodal/Marine_Rail/Pages/default.aspx
- Massachusetts Department of Transportation (August 2023). *2023 Massachusetts Freight Plan*. MassDOT. <https://www.mass.gov/info-details/freight-plan>
- Metropolitan Transportation Commission. (2016, February). *San Francisco Bay Area Goods Movement Plan*. https://mtc.ca.gov/sites/default/files/RGM_Full_Plan.pdf
- Miami-Dade Transportation Planning Organization. (2024, September). *Miami-Dade County Freight Plan Update 2024*. Parsons Transportation Group Inc. <https://www.miamidadetpo.org/library/studies/mdtpo-freight-plan-update-2024-final-report-2024-09.pdf>
- Minnesota Department of Transportation. (2024, November). *Minnesota State Freight Plan*. <https://www.dot.state.mn.us/planning/freightplan/index.html>
- Misra, Sushreyo, and Jamie E. Padgett (2022). "Estimating extreme event resilience of rail–truck intermodal freight networks: Methods, models, and case study application." *Journal of Infrastructure Systems* 28, no. 2: 04022013.
- Nebraska Department of Transportation (June 2023). *2023 Nebraska State Freight Plan*. NDOT. <https://dot.nebraska.gov/projects/publications/sfp/>
- New Jersey Department of Transportation (June 2023). *Freight Moves New Jersey: 2023 Statewide Freight Plan*. NJDOT. <https://www.nj.gov/transportation/freight/plan/stateplan23.shtm>

- New Mexico Department of Transportation (March 2023). *New Mexico 2045 Freight Plan Update*. NMDOT. <https://www.dot.nm.gov/planning-research-multimodal-and-safety/planning-division/multimodal-planning-and-programs-bureau/technical-and-freight-planning/>
- New York State Department of Transportation. (2024). *New York State Freight Plan 2024*. https://www.dot.ny.gov/portal/page/portal/content/delivery/Main-Projects/projects/P11618881-Home/P11618881-repository/New_York_State_Freight_Plan_2024.pdf
- New York City Department of Transportation. (2021, December). *Delivering Green: A vision for a sustainable freight network serving New York City*. <https://www.nyc.gov/html/dot/downloads/pdf/freight-vision-plan-delivering-green.pdf>
- North Carolina Department of Transportation (October 2023). *North Carolina 2023 Statewide Multimodal Freight Plan*. NCDOT. <https://connect.ncdot.gov/projects/planning/Statewide-Freight-Plan/Pages/default.aspx>
- North Dakota Department of Transportation. (2023, January). *North Dakota State Freight and Rail Plan: Transportation Connection*. https://www.dot.nd.gov/sites/www/files/documents/construction-projects/NDDOT_FinalFRP_Jan2023.pdf
- Oklahoma Department of Transportation. (2023). *Oklahoma Freight Transportation Plan 2023–2030*. https://oklahoma.gov/content/dam/ok/en/odot/programs-and-projects/programs/multimodal/ompt/freightplan/2030freightplan/OKFreightPlan2023-2030_FINAL_FreightPlan_withAppendices-1.pdf
- Oregon Department of Transportation. (2023). *Oregon Freight Plan 2023*. https://www.oregon.gov/odot/Planning/Documents/Oregon_Freight_Plan_2023.pdf
- Pennsylvania Department of Transportation. (2023, May 1). *Freight Movement Plan 2045 (FMP-PUB 791)*. https://www.pa.gov/content/dam/copapwp-pagov/en/penndot/documents/research-planning-innovation/planning/fmp2045/fmp/fmp-pub%20791_web_05.01.2023-compressed.pdf
- Portland Bureau of Transportation. (2023, July 12). *2040 Portland Freight Plan*. <https://www.portland.gov/transportation/planning/2040freight>
- Schofer, Joseph L., Hani S. Mahmassani, and Max TM Ng (2022). "Resilience of US Rail intermodal freight during the COVID-19 pandemic." *Research in Transportation Business & Management* 43: 100791.
- Seattle Department of Transportation. (2024, February). *Freight and Urban Goods Element*. In *Seattle Transportation Plan: Part I – Mayor’s Recommended Plan* (pp. 1–20). https://www.seattle.gov/documents/Departments/SDOT/STP/Feb2024/STP_Part_I_MayorsRecommendedPlan_02_2024.pdf

- South Dakota Department of Transportation. (2022). *South Dakota Freight Plan 2022: Draft for Public Review*. https://dot.sd.gov/media/153048f0/2022draft_PublicAll.pdf
- Tennessee Department of Transportation. (2023, May 30). *Tennessee Statewide Multimodal Freight Plan*. https://www.tn.gov/content/dam/tn/tdot/freight-and-logistics/TDOT_2023_StatewideMultimodalFreightPlan_FullReport_Final,%202023%2005%2030.pdf
- Texas Department of Transportation. (2022, December 1). *Texas Delivers 2050: Texas Freight Mobility Plan*. <https://ftp.txdot.gov/pub/txdot/move-texas-freight/resources/texas-delivers-2050.pdf>
- United States Department of Transportation (2016). *Guidance on Multimodal State Freight Plans and State Freight Advisory Committees*. Transportation.gov., <https://www.transportation.gov/freight-infrastructure-and-policy/SFP>.
- Utah Department of Transportation. (2023). *Utah Freight Plan 2023*. https://maps.udot.utah.gov/wadocuments/Apps/Region4/Storymaps/PIN21486/Utah_Freight_Plan_2023_FINAL.pdf
- Wang, Judith YT (2015). "'Resilience thinking' in transport planning." *Civil engineering and environmental systems* 32, no. 1-2: 180-191.
- West Virginia Department of Transportation. (2023). *West Virginia State Freight Plan 2023*. <https://transportation.wv.gov/highways/Planning/Documents/Freight%20Plan/WV%20State%20Freight%20Plan%202023.pdf>
- Washington State Department of Transportation. (2022, December). *Washington State Freight System Plan 2022*. https://wsdot.wa.gov/sites/default/files/2022-12/WA-State-Freight-System-Plan-2022_0.pdf
- Wisconsin Department of Transportation. (2023). *Wisconsin State Freight Plan 2023*. <https://wisconsin.gov/Documents/projects/sfp/2023-plan.pdf>

Appendices

Appendix A: Codebook for Freight Plans

CODE (CATEGORY)	CODE (SUBCATEGORY)	CODE DESCRIPTION
Freight Plan Development and Content		
	Existing Policy Tool	Policies, strategies, and programs mentioned in the Plans. These could include information provision, strategies, laws, assessments, and/or plans.
	Existing Policy Tool (Best Practice)	Policies explicitly identified as best practices, demonstrating impact, successful implementation or replicable models (e.g., TPIMS).
	Description	Stated objectives and expected outcomes of the Plan.
	Participatory Methods	Engagement of multiple actors to inform strategies included in the Plan (e.g., feedback from Freight Advisory Committees).
	Goals	Overarching statewide objectives, such as improving freight mobility, safety, or reducing emissions.
	Activities	Specific actions the State aims to implement through the Plan.
	Multimodal Network	References to the key specific modes of transport in the State.
	Data-Driven	Inclusion of modeling systems, data analytics, or performance monitoring tools that informed the Plan.
	Challenges	Broad issues identified in the freight/rail network that have informed the Plan's development.
Planning and Implementation		
	State Policies	Reference to state-specific programs and their integration into the freight Plan.
	Federal Policies	Mentions of existing federal policies, especially those that fund and support State programs.
	Strategies	Methods and actions used to achieve goals.
	Measurable Indicators (way to measure implementation)	Metrics or evaluation tools used to assess policy implementation (e.g., emissions reduction or freight corridor performance).

	Level of Government (Jurisdictional Considerations)	Roles and responsibilities of different government levels in policy implementation.
	Responsible Agency/Bureau (Jurisdictional Considerations)	Agencies or departments tasked with executing programs and policies.
	Private-Public Partnerships	References to collaborations with private actors (e.g., rail companies) on programs and mentions of investments or funding from private partners
	Temporal Considerations	Short-term or long-term planning horizons for programs and policies.
	Funding	Discussions on the funding and investments for freight and rail planning and needs in the State, including grants, public-private investments or dedicated State/municipal programs.
	Funding Amount	Details of financial allocations for specific projects or initiatives. How much money is authorized and/or will be allocated for a program?
Community Resilience		
	Mitigation (Mention)	References to trends (opportunities or challenges) in reducing vehicle emissions.
	Adaptation (Mention)	References to trends (opportunities and challenges) regarding addressing weather-related risks through resilience planning (e.g., stormwater management).
	Cross-Cutting Strategies	Initiatives addressing both mitigation and adaptation (e.g., shifting freight from trucks to rail to reduce emissions and increase resilience).
	Adaptation (Action)	Actions aimed at addressing and preparing for potential disruptions due to environmental hazards and building resilience (e.g., flood-resistant designs).
	Mitigation (Action)	Actions for emissions reduction in transportation systems, such as idling reduction strategies.
	Environmental Considerations: Wildlife	Strategies to protect wildlife and natural habitats (e.g., bear underpasses or wildlife corridors).
	Community Considerations (Action)	Specific actions addressing community in freight planning, such as prioritizing

		underutilized populations for workforce development.
	Human Safety	Measures to improve safety for freight/rail operators and the public (e.g., grade separations or safer crossings).
	Rural or Remote Considerations	Discussions on the vulnerability of rural and remote communities, and how to improve access to meet freight needs.
	Co-Benefits	Economic and social opportunities from freight policies, such as job creation or cost savings.
	Long-Term Resilience Planning	Policies that consider weather-related risks, workforce needs, and technological advancements to future-proof freight operations.
Infrastructure Resilience		
	Multimodal Connectivity	Actions related to coordination across freight modes to improve efficiency and reduce bottlenecks (e.g., intermodal rail-truck connections).
	Economic Competitiveness	Strategies related to enhancing supply chain efficiency and attracting investment in the State.
	Infrastructure Resilience	Actions to protect infrastructure from extreme weather and non-weather related disruptions.
	Critical Infrastructure	Identification of essential freight infrastructure and efforts to maintain and protect it.
	Intermodal Freight Connectivity	Integration of multiple freight modes for optimization.
	Redundancy	Investments in backup routes, alternative freight corridors, and intermodal networks to reduce vulnerabilities to disruptions (e.g., inland port development in Nebraska or intermodal facility upgrades).
Operational Resilience		
	Transportation Security	Use of technology and protocols to assess and enhance the safety and resilience of freight operations (e.g., ITS).
	Supply Chain Security	Development of tools, frameworks, or playbooks to handle disruptions, such as pandemics or labor strikes (e.g., NJDOT's Disruption Response Playbook).
	Emergency Preparedness	Plans and tools for maintaining freight mobility and safety during emergencies, such

		as evacuation scenarios or infrastructure failure (e.g., resilience planning for highway networks, monitoring technologies)
	Technological Integration	Use of technologies to improve operational efficiency and resilience, such as autonomous vehicles, connected infrastructure, and unmanned aerial systems (UAS).
	Freight Flow Optimization	Techniques to reduce congestion and streamline freight movement through bottleneck reduction programs, dynamic routing, and predictive traffic analysis.
	Risk Assessment and Mitigation	Incorporation of risk modeling tools for operational decision-making
Opportunities		
	Innovation and Advanced Technologies	Discussions on research and development of innovative technologies and solutions such as Unmanned Aerial Systems, autonomous vehicles, or connected vehicle systems.
	Workforce Development	Programs and partnerships to train workers in freight-related skills or attract new talent to the industry. Programs to upskill workforce for emerging technologies.
	Predictive Data and Modeling Systems	Leveraging data analytics and modeling to anticipate disruptions, optimize freight flows, and plan for environmental impacts (e.g., scenario-based approaches to planning for resilience).
	Regional Collaboration	Multi-state partnerships leveraging shared expertise and funding for innovative freight solutions.
	Proactive Research and Development	Ongoing research to explore innovative freight solutions (e.g., feasibility studies).

Appendix B: States' Best Practices

Alabama

1. Congestion and Bottleneck Reduction

- a. The Alabama Department of Transportation (ALDOT) has identified congestion bottlenecks primarily along Interstates 65, 59, 20, and 85. They've done this using the *Mid-Period Freight Bottleneck Report* and the *FHWA Freight Mobility Trends Tool and Database*. These bottlenecks are being targeted for capacity expansion and maintenance projects to improve freight mobility, based on volume-to-capacity ratios and truck traffic percentage. Key improvement projects are planned to alleviate congestion by increasing road capacity and optimizing traffic flow on these routes (ALDOT, 2023, p. 92).

2. Information and Technology Systems

- a. ALDOT uses ITS technologies, including adaptive traffic signals, dynamic message signs, weigh-in-motion systems, and vehicle detection systems. Five Regional Transportation Management Centers (RTMCs) operate these systems in Birmingham, Mobile, Montgomery, Tuscaloosa, and Huntsville. These centers provide freeway and major arterial management (i.e., traffic signal management), improving traffic flow, incident response, and real-time traveler information (ALDOT 2023, p. 137).

3. Vulnerability Assessments

- a. Alabama uses the Federal Highway Administration (FHWA) vulnerability assessment tools to evaluate risks posed by extreme weather to critical freight infrastructure. This includes assessing exposure, sensitivity, and adaptive capacity to prioritize adaptation measures (ALDOT, 2023, p.142). This includes the Vulnerability Assessment Scoring Tool.
- b. The State also uses the Cascading Effects Model Toolkit, which allows it to identify critical transportation links that could cause cascading economic impacts if disrupted. By highlighting these sensitive links, local planners can better prepare and prioritize resilience planning across Alabama's freight network (ALDOT, 2023, p. 143).

4. Resilience Corridors

- a. Alabama has set up key resilience corridors for major highways, such as I-65, I-20, I-59, and I-85. These corridors have parallel routes (e.g., I-65 with US 31), which enables the ability to reroute traffic to these parallel corridors and thus create redundancy during disruptions, which makes the network more resilient. The State believes that identifying parallel corridors for resilience purposes is the first step in planning for the unexpected (ALDOT, 2023, p. 118).

5. Emergency Preparedness: US Coast Guard Sector Mobile Severe Weather Port Contingency Plan

- a. The Alabama State Port Authority, in collaboration with the US Coast Guard, has contingency plans to mitigate the impact of severe weather (i.e., heavy rain event) on port operations. This contingency plan provides guidance to port facilities and vessels in advance of a severe weather event, noting specific actions that should be undertaken during the prior days and hours. Actions include securing vessels in port and preparing for debris removal to quickly restore operations post-event (ALDOT, 2023, p. 143).

6. Intermodal Connectivity

- a. Key facilities, such as the Port of Mobile and the Port of Huntsville, are strategically connected to Alabama's major highways, rail lines, and airports, promoting efficient intermodal freight movement. The plan includes further expanding port access and improving rail connectivity, especially around industrial hubs (ALDOT, 2023, p. 16-17).

7. Freight Safety Initiatives

- a. ALDOT has made improvements on at-grade railroad crossings and highway-rail intersections to reduce freight and passenger vehicle conflicts. Strategies include the installation of safety gates, raised medians, and warning signs. Additionally, ALDOT's "Our Roads, Our Safety" campaign promotes road-sharing education for commercial and passenger vehicle drivers (ALDOT, 2023, p. 141).

Alaska

1. Innovative Technologies

- a. Alaska is advancing research on and use of Unmanned Aerial Systems (UAS) to reduce the cost of freight delivery to remote and rural airports. The University of Alaska Fairbanks plays a leading role through the Alaska Center for *Unmanned Aircraft Systems Integration*, one of North America's largest operational programs for UAS (Alaska DOT&PF, 2022, p. 45).

2. Alaska Railroad Corporation (ARRC) Collaboration

- a. The Alaska Department of Transportation and Public Facilities (DOT&PF) partners with ARRC to maintain infrastructure and improve safety, focusing on bridge upgrades and at-grade crossing improvements. As a state-owned entity, ARRC provides essential freight services connecting major hubs and rural areas, with barge links to Seattle, offering efficient and environmentally friendly options for bulk goods amid Alaska's isolation from the national rail network (Alaska DOT&PF, 2022, p. 57).

3. Modernizing Infrastructure

- a. The Port of Alaska, handling over half of the state's inbound freight, is modernizing infrastructure to support supply chain resilience. This multimodal port connects to the Alaska Railroad, Alaska Highway System, and ANC, making it a key entry point for statewide goods distribution. The Alaska-Hawaii-Washington route was recently designated as a Marine Highway by U.S. Department of Transportation's Maritime Administration (MARAD), demonstrating its role in providing cost-effective freight transport. This designation enables federal funding for marine projects, ensuring resilient links essential for remote communities, in line with the America's Marine Highway Program's goal to advance waterway-based transport (Alaska DOT&PF, 2022, p. 28).

4. Quality Assessments for Risk Mitigation Planning

- a. Alaska uses assessments to develop targeted adaptation measures, including right-sizing drainage infrastructure, protecting wildlife in sensitive areas, and elevating structures to reduce flood risk (Alaska DOT&PF, 2022, p. 17).

Arizona

1. Truck Parking System

- a. Arizona DOT (ADOT) has expanded truck parking significantly since the release of its 2019 *Truck Parking Study*, adding spaces at key locations like Haviland, Bouse Wash, and Meteor Crater. These expansions aim to alleviate the high demand for parking, with the Truck Parking Availability System (TPAS) planned for major rest areas to inform drivers of available spaces in real time (ADOT, 2022, p. 27).

2. Environment: Wildlife

- a. In 2021, ADOT completed a *Wildlife-Vehicle Conflict Study*. This study addressed the wildlife-vehicle-conflicts on Arizona's state highways that result in fatalities, serious injuries, property damage, and loss of wildlife. The study analyzed information on existing crash data (passenger and freight vehicles included), previously completed studies, wildlife linkage zones, habitat blocks, and industry best-management practices. With assistance from Arizona Game and Fish Department, United States Forest Service and the Arizona Department of Public Safety, the analysis **identified prioritized hotspot locations and recommended projects to mitigate the wildlife-vehicle conflicts**. The potential mitigation projects will compete for funding through ADOT's planning to programming (P2P) process for approval in ADOT's Five Year Transportation Facilities Construction Program (ADOT, 2022, p. 73).
- b. ADOT's additional environmental stewardship goals include managing stormwater and reducing impacts on wildlife habitats. Projects integrate stormwater management practices and use data from the Arizona *Wildlife Linkages Assessment* to minimize ecological disruptions (ADOT, 2022, p. 115)

3. ADOT's Resilience Program

- a. Addresses transportation infrastructure vulnerabilities (including stormwater infrastructure) associated with threats from extreme weather, stormwater runoff, flooding, wildfires and other hazards (ADOT, 2022, p. 72).

4. Key Commerce Corridors (KCC)

- a. Five corridors were identified through the *2014 ADOT Key Commerce Corridor Plan*. These are critical freight routes that ADOT has prioritized for infrastructure investments, which will increase freight mobility and resilience along major interstates like I-10 and I-40. This program aims to reduce bottlenecks and improve freight efficiency by targeting infrastructure upgrades on high-traffic corridors, funded through state and federal resources. The State also believes that upgrades on the KCC would enable great potential commercial and economic benefits in the state (ADOT, 2022, p. 17).

5. Multimodal Connectivity and Rail Integration

- a. Collaborations with BNSF and Union Pacific support Arizona's rail connectivity, particularly for the Southern Transcon and Sunset Route. These partnerships promote multimodal options for long-distance freight, improving efficiency and reducing reliance on highways (ADOT, 2022, p. 29)
 - i. BNSF's principal route in Arizona, the Southern Transcon corridor, is a part of the national freight rail system that connects through Arizona (connecting Los Angeles to Chicago) with connections to Kingman, Williams, Flagstaff, Winslow, and Holbrook; and
 - ii. Union Pacific's Sunset Route crosses the southern part of Arizona passing through Yuma and Tucson as it connects Los Angeles and Houston. The Sunset Route handles approximately 20 percent of the railroad's total traffic.

6. Arizona Management System (AMS)

- ADOT will take advantage of AMS tools such as strategic planning documents, tiered huddle boards, root cause analysis, and problem solving to measure and manage its strategies and projects. This system uses tools such as performance metrics to ensure project accountability and prioritize efficient use of resources across Arizona's freight network. ADOT believes that since AMS has proven beneficial for its major business processes, then can be applied for freight planning (ADOT, 2022, p. 102).

7. Collaboration with Multiple Actors

- Arizona works closely with Tribal Governments, MPOs, and Council of Governments (COGs) to incorporate various perspectives into freight planning, ensuring projects respect tribal lands and address regional needs. ADOT consults with tribal governments to gather input on planning processes that impact their jurisdictions. ADOT asserts that this is a *holistic* approach to governance (ADOT, 2022, p. 113).

Arkansas

1. Data-Driven Safety Improvements

- a. Arkansas is improving safety at critical railway-highway intersections through upgrades at high-risk crossings, signalization, and grade separation projects. Working within its *Strategic Highway Safety Plan*, Arkansas targets high-accident locations and enforces truck safety regulations to reduce crash rates. Funded primarily by the Federal Section 130 Program, Arkansas receives about \$4 million annually to improve 10 crossings with protective devices (e.g., lights, gates) and hazard elimination measures. ARDOT collaborates with railroads, local agencies, and safety stakeholders to implement these data-driven safety improvements (ARDOT, 2022, p. 2-1).

2. 2022-2026 Strategic Highway Safety Plan (SHSP)

- a. The SHSP outlines strategies to improve commercial motor vehicle (CMV) safety, with ARDOT as a key partner. Key strategies include reducing CMV crash risks due to driver fatigue, promoting new safety technology, educating the public and industry on safe CMV operation, encouraging occupant protection use, and addressing high-crash corridors with engineering solutions (ARDOT, 2022, p. 2-3).

3. Workforce Development

- a. The "Be Pro Be Proud" initiative is led by the Associated Industries of Arkansas, which is spearheading the movement to bring a new generation of pride, progress, and professionals to Arkansas' skilled workforce. As the current skilled workforce is at or near retirement age, Be Pro Be Proud seeks to change perceptions of these essential jobs, and offers opportunities for job seekers, skilled professionals, employers, and teachers to be involved through training, workshops and more. Highlighted professions include roles in freight-intensive industries such as automation and robotics, machine operators, construction services, commercial truck drivers, heavy equipment operators, and other skilled professions (ARDOT, 2022, p. 2-5).

4. Environmental Sustainability: Wildlife

- a. Arkansas is considering incorporating air quality, flooding, stormwater, and wildlife impact assessments into freight planning. Informed by the *National Environmental Policy Act (NEPA)* review process for transportation and construction projects, Arkansas plans to evaluate potential impacts on wetlands,

water quality, and habitats, guiding infrastructure improvements to minimize environmental effects (ARDOT, 2022, p. 2-9).

5. Transportation Asset Management Plan (TAMP)

- a. The TAMP outlines how Arkansas will manage its highway system within available funding, focusing on strategic investments to meet pavement and bridge condition targets for a state of good repair. Maintaining these conditions on freight-intensive corridors is crucial, as heavy trucks accelerate pavement and bridge wear. ARDOT is actively implementing the TAMP (ARDOT, 2022, p. 2-6).

6. Statewide Travel Demand Model

- a. ARDOT is updating its statewide travel demand model, including the freight module, to support long-range planning. The model provides corridor and system-level traffic forecasts. Additionally, there are recent advancements in and availability of freight commodity flow data, including location-based data on freight, which provide an opportunity to improve the freight forecasting ability of future travel demand models (ARDOT, 2022, p. 2-7).

California

1. Trade Corridor Enhancement Program (TCEP)

- a. The purpose of TCEP is to provide funding for infrastructure improvements on federally designated Trade Corridors of National and Regional Significance, on California's portion of the National Highway Freight Network, as identified in California Freight Mobility Plan, and along other corridors that have a high volume of freight movement. Supported by Senate Bill 1, TCEP dedicates around \$300 million annually to infrastructure projects aimed at enhancing freight corridors and reducing congestion. It evaluates projects based on freight system factors, including throughput, reliability, velocity, and community impact, aligning with both federal and state goals. In addition to the NHFP formula funds, TCEP includes state funds from the California Trade Corridor Enhancement Account (Caltrans, 2023, p. 277).

2. Community Air Protection Program (CAPP)

- a. Established under *Assembly Bill 617*, CAPP focuses on improving public health by reducing air pollution in communities heavily impacted by freight operations through community air monitoring, emission reduction projects, and technology deployment. This first-of-its-kind statewide initiative provides incentive funding for pollution reduction, supports community participation, and requires accelerated pollution control retrofits and increased transparency in air quality data. CAPP advances air quality planning by integrating community, regional, and state-level programs to improve air quality across California (Caltrans, 2023, p. 238).

3. In-Use Locomotive Regulation

- a. In 2013, CARB passed the "*In-Use Locomotive Regulation*", a rule aimed at reducing emissions from locomotives when they operate within the state. Under the new rule, operators will be required to pay into a spending account, and the amount will be determined by the emissions they create while operating in California (Caltrans, 2023, p. 123).

4. Innovation: Autonomous Trucks

- a. California regulations permit autonomous motor trucks under 10,001 pounds, such as delivery vehicles, to operate on public roads with a DMV-approved permit. The DMV began issuing these permits on January 16, 2020, though vehicles over

10,001 pounds remain excluded from autonomous testing or deployment (Caltrans, 2023, p. 127).

5. Safety

- a. To affirm Caltrans commitment to *Safety First*, California is incorporating a **Safe Systems** approach principles into all work. It works by building and reinforcing multiple layers of protection to both prevent incidents from happening in the first place and minimize the harm caused to those involved when incidents do occur. It is a holistic and comprehensive approach that provides a guiding framework to make places safer for people. This is a shift from a conventional safety approach because it focuses on **both human mistakes AND human vulnerability** and designs a system with many redundancies in place to protect everyone (Caltrans, 2023, p. 160).
- b. Positive Train Control (PTC) systems are integrated command, control, communications, and information systems for controlling train movements with safety, security, precision, and efficiency. PTC systems improve railroad safety by significantly reducing the probability of collisions between trains, casualties to railway workers, damage to equipment, and overspeed accidents. Currently PTC is completely implemented in all Class I railroads in California (Caltrans, 2023, p. 164).

6. Caltrans Community Assessment

- a. The assessment is a screening and evaluation tool that uses multiple transportation-specific and socioeconomic indicators to identify transportation-based priority communities at the Census block level. Caltrans aims to create this index to inform how the Department can best address and mitigate issues exacerbated by the transportation system. The assessment is also designed in a manner to support partner agencies and other entities who may voluntarily use it to analyze impacts and evaluate the effectiveness of various transportation projects and solutions (Caltrans, 2023, p. 222).

Colorado

1. Bottleneck Identification & Reduction Planning

- i) CDOT has conducted a **comprehensive truck bottleneck analysis** to identify critical congestion points that negatively impact freight efficiency. This includes evaluating the costs associated with congestion and developing targeted solutions to reduce delays. Specific areas identified include parts of I-70 and I-25. CDOT uses this analysis to prioritize investments and alleviate bottlenecks, especially on highways where truck traffic is heavy (pp. 23, 24).
- ii) CDOT estimates that **truck-related congestion costs** the state millions of dollars daily, with food and agriculture industries most affected by these delays. To address this, CDOT is focusing on both short-term and long-term solutions to improve congestion management and enhance the movement of goods (pp. 23, 24).

2. Strategic Maintenance of Highway Assets

- a) CDOT has developed a **Drivability Life Index** to assess the remaining usable life of roadways across the state. This index helps prioritize maintenance and repairs based on the condition of the infrastructure, particularly critical freight routes. It also allows CDOT to allocate resources effectively, ensuring that high-priority corridors are preserved and maintained before they deteriorate further (pp. 25, 47).

3. First-/Last-Mile Improvements

- a. CDOT conducted a statewide assessment to identify gaps in truck parking along major freight corridors. This assessment is used to prioritize truck parking projects, ensuring sufficient capacity in key areas like the Denver-Aurora region and I-70 (pp. 29, 30).
- b. In Bennett, CDOT worked with the Town of Bennett and Love's Truck Stop to expand truck parking capacity by 114 spaces. This was made possible by CDOT funding the necessary infrastructure improvements like bridge upgrades (pp. 29, 30).
- c. The state is focusing on improving connectivity between key multimodal facilities in Denver, particularly at the Denver International Airport (DEN) and various rail terminals. Investments are being made to reduce truck congestion by strengthening access to rail services and enhancing intermodal hubs (pp. 34-39).

4. Resilience and Adaptation

- a. *Risk Assessments*: CDOT has incorporated weather-related risks into its freight planning, particularly in flood-prone areas like the Front Range and mountain regions. This includes assessing infrastructure resilience to extreme weather events such as snowstorms and wildfires (pp. 45, 48).
- b. CDOT retrofits highway drainage systems and installs stormwater control measures to protect aquatic habitats. These efforts are part of a broader strategy to mitigate non-point source pollution from freight corridors (pp. 29, 40).
- c. CDOT's *Bridge Program* is focused on reducing flood risk by prioritizing flood-prone areas for infrastructure improvements. This includes strengthening bridges and enhancing flood mitigation measures along freight routes (pp. 47, 48).

5. Environment (Wildlife)

- a. As part of CDOT's environmental sustainability efforts, the state is building wildlife-safe infrastructure such as underpasses, culverts, and fencing on key freight corridors. This is to reduce wildlife vehicle collisions and protect vulnerable species (pp. 40, 43).

6. Multimodal Connectivity & Intermodal Development

- a. Multimodal Freight Infrastructure: CDOT has established a Freight Core Network to prioritize key freight routes and facilities that connect highways, rail, and air cargo systems. This network guides the state's infrastructure investments and helps target multimodal improvements (pp. 10-12).
- b. CDOT's *Priority Freight Network* identifies key corridors for investment, including I-25, I-70, and U.S. 287, which are essential for Colorado's freight movement. The state focuses on enhancing these routes' connectivity, safety, and capacity to support growing freight demand (pp. 17, 18).
- c. CDOT is working on developing **urban delivery zones and pilot programs** for off-peak deliveries in high-density areas. This will help reduce congestion in urban areas and improve the efficiency of last-mile logistics (pp. 9, 45).
- d. CDOT is working to enhance integration between rail and truck systems, particularly in the Denver area. The state is focusing on improving access to major intermodal facilities and reducing the need for truck-based long-haul movements (pp. 39-40).
- e. Although Colorado is landlocked, CDOT is focusing on the development of inland ports and commercial hubs that support multimodal freight. The state is working on improving connections to rail and air facilities to facilitate more efficient freight operations (pp. 33-35).

7. Innovative Technology

- a. CDOT is implementing advanced traveler information systems that provide real-time data to freight operators, including traffic conditions, road closures, and availability of truck parking. By offering this data, the system helps trucks avoid congestion and improves the overall efficiency of freight movement across the state (pp. 45, 47).
- b. CDOT is deploying Weigh-in-Motion (WIM) technology at various points along key freight routes. This allows trucks to be weighed while in motion, without needing to stop for traditional weigh stations. It improves traffic flow and reduces delays for freight operators while ensuring compliance with weight regulations. These systems are also used to collect data that informs decision-making for infrastructure improvements (pp. 19, 47).
- c. *Technology Adoption and Research:* CDOT has developed a Freight Technology White Paper to explore emerging technologies that can improve freight efficiency. The paper highlights potential innovations, such as connected vehicle technology, blockchain for supply chain visibility, and advanced freight communication systems. CDOT is actively working with industry stakeholders to pilot and deploy these technologies in real-world settings (pp. 40, 47).

8. Workforce Development

- a. CDOT partners with local community colleges, vocational schools, and universities to provide workforce training programs that focus on the needs of the freight and logistics sectors. For example, CDOT has collaborated with the Colorado Community College System (CCCS) and the University of Colorado Boulder to develop transportation and logistics curriculums. These institutions offer specialized courses for truck drivers, supply chain managers, and logistics professionals (pp. 45, 47).
- b. CDOT has partnered with local **commercial driver's license (CDL)** schools across the state to provide specialized training programs for the next generation of freight drivers. In collaboration with institutions such as the **Colorado Community College System (CCCS)**, CDOT is helping to provide essential skills to address the truck driver shortage and ensure that the state's workforce is equipped to handle new technologies and complex logistics systems (pp. 45, 47).
- c. *Industry Collaboration:* CDOT is working with freight industry stakeholders, including private companies, labor organizations, and training institutions, to develop programs that support workforce development. These partnerships focus on creating training programs that address the evolving needs of the freight industry, such as automation, logistics management, and supply chain technology (pp. 45, 47).

Connecticut

1. Technology: Virtual Weigh Station Deployment

- a. Connecticut's Department of Motor Vehicles (DMV) and CTDOT have launched a pilot virtual weigh station (VWS) on I-95 in Old Lyme, aiming to replace traditional weigh stations with remote monitoring. This project marks a shift to advanced technology for freight vehicle compliance and roadway safety. The intent of the pilot project is to identify new technologies and applicability to design, build, and maintain one or more VWS sites in the future (CTDOT, 2022, p. 8-16).

2. Safety

- a. Connecticut has invested in protective devices for rail crossings, with a focus on its 353 public highway-rail grade crossings. Recent safety improvements include the installation of flashing lights and gates to reduce accidents at these intersections, a priority under the *Railway-Highway Crossings Program* authorized by the IIA (CTDOT, 2022, p. 3-2).
- b. CTDOT is currently developing the *Connecticut State Rail Plan 2022–2026*. The rail plan updates the state rail goals and objectives, identifies strategies and programs to ensure existing passenger and freight rail infrastructure is maintained, and identifies programmed and proposed rail projects (including costs and associated public benefits) (CTDOT, 2022, p. 3-2).

3. Intelligent Transportation Systems (ITS)

- a. CTDOT is expanding ITS across critical freight routes, including Interstates 84, 91, 95, 384, and 395. This network incorporates real-time traveler information systems (*CT Travel Smart*), variable message signage, and incident management cameras, which aim to optimize traffic flow and increase safety along key freight corridors (CTDOT, 2022, p. 1-4).

4. Highway Use Fee for Heavy Trucks

- a. In 2021, the Connecticut Legislature passed a highway use fee based on the weight of, and distance travelled by, trucks in Connecticut. Since 2023, all tractor-trailer combination trucks weighing more than 26,000 pounds have been subject to an additional per mile fee to operate on highways within Connecticut, helping to offset the damage done to roadways by heavier vehicles and support infrastructure upkeep (CTDOT, 2022, p. 1-4).

5. Collaboration

- a. CTDOT has continued engagement on freight modal issues through an Internal Freight Working Group (CTDOT, 2022, p. 1-5).
- b. CTDOT works regularly with the Connecticut State Police and the CT DMV Commercial Motor Vehicle Safety Division, NASTO Subcommittee on Highway Transport, and industry organizations such as the Motor Transport Association of Connecticut, the Connecticut Construction Industries Association, and the Specialized Carriers & Rigging Association, to improve OS/OW permitting practices and align rules and regulations with neighboring states (CTDOT, 2022, p. 1-5).
- c. Western Connecticut Council of Governments (WestCOG) is currently developing a **Freight Profile**, which will provide an overview of freight in the WestCOG region and to highlight freight stakeholders' importance to the region's overall transportation network (CTDOT, 2022, p. 3-6).
- d. The Eastern Transportation Coalition (previously known as the I-95 Corridor Coalition) represents transportation agencies and toll authorities, as well as public safety and related organizations, from Maine to Florida along the I-95 corridor. Transportation management and operations issues of common interest are addressed through this coalition as **freight often crosses jurisdictional lines**. Through this consensus-driven, volunteer-based organization, key decision makers from state, local and regional member agencies collaborate to improve transportation system performance. **The Coalition is viewed as a successful model for multi-state interagency cooperation and coordination** (CTDOT, 2022, p. 3-8).

- e. The MAP Forum consists of 10 MPOs from New Jersey, New York, Connecticut, and Pennsylvania that coordinate planning activities in the multi-state region (CTDOT, 2022, p. 3-8).

Delaware

1. Delaware First/Final Mile Freight Network Development Study

- a. This 2021 study identified essential first/final mile connections to improve Delaware's freight network resilience, with regular updates planned to address changes in demographics, policy, and traffic. Using new GIS data, the study mapped key truck locations connecting main routes with freight facilities, including manufacturing sites, retail centers, warehouses, ports, and farms. The study evaluated needs and issues across five areas: institutional, land use, mobility, safety, and infrastructure conditions. It also provided recommendations for policies, partnerships, and projects to prioritize network improvements (DelDOT, 2023, p. 1-7; 6-18).

2. System Resilience Planning

- a. The State engages in proactive weather-related resilience planning and preparedness through organizations such as the Delaware Emergency Management Agency (DEMA), and by using best practice resources such as FHWA's *State of the Practice Scan: Freight Resilience Planning in the Face of Climate-Related Disruption*. This resource has enabled the State to assess risks such as sea-level rise (SLR) and natural disasters and plan for how to maintain freight network functionality during extreme weather (DelDOT, 2023, p. E-5).

3. Scenario Planning for Resilience

- a. The State of Delaware has had future SLR scenarios (projecting SLR out to year 2100) in place since 2009 to use in long-term planning activities. Those scenarios were integrated into many town and county plans (DelDOT, 2023, p. D-35).

4. Delaware Senate Resolution 10

- a. *Senate Resolution 10* initiated **a special committee to address truck traffic and community concerns** along SR 41, SR 48, and SR 7 in New Castle County. Key recommendations include **feasibility studies** for a bypass between US 1 and I-95, a rail spur parallel to SR 41, and improvements to the SR 896 corridor, encouraging trucks to use I-95 to SR 896. These long-term freight planning tasks will likely need formal approval from the General Assembly and a recommendation from a Delaware-Pennsylvania working group due to their scope and bi-state impact (DelDOT, 2023, p. D-27).

5. Regional Coordination

- a. Delaware participates in frequent multi-state freight planning discussions with Maryland, Virginia, Pennsylvania, surrounding MPOs, The Eastern Transportation Coalition (TETC), and others. These efforts help to support a broader regional perspective, leverage and share knowledge and experiences, keep up to date with evolving freight industry topics, and help to ensure the smooth transfer of goods between states (DelDOT, 2023, p. D-25).

6. Real-Time Traffic Data

- a. DelDOT gathers information for transportation systems management that is shared with the public. DelDOT provides incident and travel advisory information throughout the state as part of an interactive travel map with access to data layers such as live traffic cameras, travel times, weather advisories, water-on-road

warnings, snow advisories, and more. Maps are available online and on mobile device apps (DelDOT, 2023, p. D-6).

- b. [Interactive Map](#)

7. Innovative Technology

- a. Connected and Automated Vehicles (CAV) use technology to communicate with other vehicles, connected devices, and the transportation system. DelDOT has a **CAV Advisory Council** tasked with developing recommendations for innovative tools and strategies that can be used to prepare Delaware's transportation network for CAV. Potential CAV subject areas include: (1) promoting economic development, (2) technology, security, and privacy, (3) transportation network infrastructure, and (4) impacts on public and highway safety (DelDOT, 2023, p. D-6).

- b. [Website](#)

8. Safety and Federal Funding

- a. On an annual basis, DelDOT performs a data-driven network screening process to identify public highway-rail at-grade crossing locations for study to evaluate the need for, and feasibility of, safety improvements that could be funded with federal *Railway-Highway Crossings Program* (Section 130) funds. Many rail crossing improvements are considered as part of this program including the installation of flashers, cantilevers, automatic gates, signing, striping, and railroad preemption/interconnection. Potential safety improvements are selected and prioritized for design and implementation based on the availability of funding (DelDOT, 2023, p. 1-9).
- b. *DelDOT's Highway-Rail Grade Crossing Safety Program*: provides funding for rail projects through sources such as a rail safety grant (DelDOT, 2023, p. 5-2).

District of Columbia

1. Multimodal Long-Range Transportation Plan (moveDC)

- a. Published in 2021, the plan establishes goals, policies, strategies, and metrics to improve the transportation network in DC. During the development of the moveDC plan, the project team conducted outreach and developed modal priority networks, including a freight priority network. moveDC includes strategies that directly relate to freight by creating a process to implement a curbside management hierarchy (Strategy #26) and providing and maintaining safe routes for trucks (Strategy #28) (DDOT, 2024, p. 14)

2. The Eastern Transportation Coalition

- a. TETC is a partnership of 18 states and DC focused on connecting public agencies across all modes of travel to increase safety and efficiency. It includes more than 200 public agencies working together to address the pressing challenges facing I-95 with a focus on Transportation Management and Operations (TSMO), freight, and innovation. Freight-specific resources include freight data access through TETC's transportation data marketplace; technical assistance on commercial vehicle operations, truck parking, the freight planning activities of member states; and involvement in the M-95 Marine Highway corridor and National Freight Fluidity Program (DDOT, 2024, p. 21).

3. Existing State Environment Policies

- a. *Sustainable DC 2.0* and the Department of Energy & Environment's (DOEE) *Wildlife Action Plan (2015)* aim to protect, restore, and expand aquatic ecosystems by investing in targeted Conservation Opportunity Areas. The District-owned dock, located downstream from these areas, offers potential for

marine freight to improve network resilience if balanced with stakeholder coordination to limit ecosystem impacts. Additionally, Critical Urban Freight Corridors funding can support managed freight movements. Strategies such as delivery microhubs and varied last-mile modes could lower pollution and noise, reducing truck impact on NPS land and benefiting natural habitats (DDOT, 2024, p. 55).

4. Community Considerations

- a. DDOT conducts an equity assessment of its freight projects, as part of its project prioritization process, and already has community-focused projects underway. For example, the delivery microhub feasibility study is evaluating how DC could leverage microhubs to improve community safety. As the study transitions to a pilot program, potential microhub locations will consider demand, access, and community criteria. Looking forward, strategies will be used to better understand 1) how the benefits and burdens of freight are distributed across DC and 2) how to minimize negative impacts such as air pollution (DDOT, 2024, p. 61).

5. Scenario Planning for Resilience

- a. Scenario planning is a key component, allowing DC to prepare for infrastructure impacts due to extreme weather events by incorporating and considering multiple potential future environmental scenarios (DDOT, 2024, p. 61).

6. Freight Corridor Management

- a. The *Positive Truck Signage Study* encourages designated truck routes, aiming to improve air quality by redirecting freight from local streets to arterial roads. The study, completed in 2023, evaluated emissions impacts and estimated a total annual emission benefit of \$80,000 by 2026 if a mandatory route system is adopted (p. 57). This approach could improve air quality for nearby communities and involves investing in signage and educational outreach for industry and public awareness (DDOT, 2024, p. 68).

7. Public Engagement to Identify Key Issues

- a. DC actively engages with industry stakeholders and affected and/or interests individuals of the public to obtain diverse perspectives and feedback for freight planning. This approach ensures that freight operations support economic vitality and community needs while minimizing adverse impacts (DDOT, 2024, p. 18-19).
- b. Industry: DDOT hosted two industry stakeholder meetings, which were attended by representatives of the Downtown Business Improvement District (BID), Georgetown BID, CSX, CVS, Amazon, and the District of Columbia Association of Beverage Alcohol Wholesalers (DCABAW). The invite list included many private sector representatives (including carriers, shippers, and other companies that send, receive, or carry freight) (DDOT, 2024, p. 18).
- c. Public: DDOT hosted a virtual meeting on May 24, 2023, for the general public and distributed an online survey to collect additional feedback. District residents, local Advisory Neighborhood Commissions (ANC) representatives, civic associations, and industry stakeholders attended the meeting. Meeting attendees voted safety mobility as their top priorities and listed truck routes and enforcement, and competition for curbside space as their top needs and issues. Survey and public meeting participants expressed concerns about truck drivers not respecting regulations and infrastructure; they reported incidences of illegal/double parking, idling, blocked lanes and crosswalks, and damaged flexi-posts (DDOT, 2024, p. 19).

Georgia

1. Existing Plans

- a. In addition to this update of this Georgia Freight Plan, the Georgia Department of Transportation (GDOT) has completed a *State Rail Plan*, *Broadband Policy Plan*, *GDOT National Electric Vehicle Infrastructure (NEVI) Plan*, *2050 Statewide Transportation Plan (SWTP)*, *Statewide Strategic Transportation Plan (SSTP)*, *GRAD Site Analysis*, *Savannah River Crossing Feasibility Study*, *Coastal Empire Study*, *Georgia Rail Crossing State Action Plan*, and is participating in the development of Metropolitan Planning Organization (MPO) freight plans across the state (GDOT, 2023).

2. Infrastructure Resilience

- a. GDOT has implemented resilience-focused strategies through its *Resiliency Committee*, which includes management from various offices. The committee aims to assess and prioritize infrastructure projects based on resilience needs, especially in light of extreme weather events. For example, GDOT is collaborating with Georgia Tech to evaluate hazard risks, document the effects of extreme weather events in Georgia, and implement resilience improvements across transportation systems, policies, business processes (i.e., work methods) through by decision-making tools and data (GDOT, 2023, p. 5-30).

3. Stormwater and Flooding Management

- a. GDOT has policies and procedures in place to address potential flooding and stormwater runoff as a part of the *Plan Development Process (PDP)* to ensure standards are met during planning and engineering of projects, including freight projects. GDOT's Office of Environmental Services (OES) has a *Floodplain Toolkit* for assessing impacts and coordinating with appropriate offices within GDOT to design in a way that minimizes impacts to floodplains and therefore mitigate flooding in the PDP (GDOT, 2023, p. 5-32).
- b. GDOT has been issued a *National Pollutant Discharge Elimination System (NPDES)* stormwater permit from the Georgia Environmental Protection Division (EPD) approximately every five years with updates as needed based on regulatory changes. This permit authorizes GDOT to discharge stormwater from a municipal separate storm sewer system (MS4) to the waters of the state of Georgia using appropriate stormwater management (GDOT, 2023, p. 5-32).

4. Emergency Preparedness

- a. GDOT collaborates with the *Georgia Emergency Management and Homeland Security Agency* for unified responses to crises. The state also designates specific hurricane evacuation routes, such as I-16, with reversible lanes to expedite evacuation from coastal areas during emergencies (p. 5-31). I-16 is a key facility for investment in the Freight Plan and in the event of emergencies, it becomes a one way "contra-flow" evacuation corridor from Savannah to Dublin (GDOT, 2023, p. 5-31).
- b. GDOT also created the position of *Manager of Emergency Operations* to implement policies and regulations for when extreme weather events occur and coordinate with other state agencies. Policies are in place with defined roles and responsibilities and a unified response from necessary state agencies (GDOT, 2023, p. 5-31).
- c. GDOT has a *Road Weather Information System (RWIS)* designed to monitor road conditions during severe winter weather (GDOT, 2023, p. 5-31).
- d. A project is being developed to use Unmanned Aerial Vehicles (UAV) to assess damage after severe weather events. These UAVs will be able to assess damage to

the state's transportation system in a more efficient manner to assist first responders in their rescue and cleanup efforts (GDOT, 2023, p. 5-31)

5. Wildlife Protection

- a. The Georgia Department of Natural Resources (GDNR) has a *State Wildlife Action Plan (SWAP)* to conserve populations of species and their habitats. SWAP uses the best available data to provide a comprehensive and adaptable assessment of conservation options, and the best way to implement them. Within the SWAP, GDNR identifies **high priority conservation areas for wildlife**. The SWAP specifically **identifies its partnership with GDOT to minimize impacts to high priority species when developing road construction and maintenance projects** (GDOT, 2023, p. 5-34).
- b. GDOT conducts **ecological surveys and impact assessments for transportation investments to minimize or avoid adverse effects to the natural environment**; this is managed through the Office of Environmental Services. If it is determined through the assessments that mitigation measures are needed for wildlife and/or protected species, these measures are recommended to minimize impact. There are a broad spectrum of measures to limit interaction with wildlife, including but not limited to design features such as wildlife crossing signs to alert drivers, safe passageways for wildlife crossings such as tunnels or overpasses, and minimizing disruption to conservation areas (GDOT, 2023, p. 5-34).

6. Workforce Development

- a. Recognizing the demand for skilled labor in freight-intensive industries, the Georgia Center of Innovation for Logistics works with universities and technical colleges to address workforce shortages in transportation and logistics. The *Georgia Quick Start* program offers training to meet the skill requirements of employers in freight-related industries (GDOT, 2023, p. 2-8).

7. Freight Network Connectivity and Efficiency

- a. Georgia is expanding its inland port network with hubs like the Appalachian Regional Port and the upcoming Northeast Georgia Inland Port, aiming to reduce highway congestion by diverting freight to long-distance rail (GDOT, 2023, p. 4-120).
- b. *Context:* As one of five mega intermodal truck-rail hubs across the United States, Atlanta is the Southeastern U.S. distribution hub for both domestic and international intermodal freight. Metro Atlanta is served by two Class I railroads: CSX and Norfolk Southern. With four intermodal terminals and direct service to the Port of Savannah, Atlanta is where shipments transfer between highway and rail. Georgia's short line railroads also play a role in supporting connectivity across the network. Businesses will continue to make decisions about modal share between intermodal, air, and truck based on a variety of factors (GDOT, 2023, p. 4-62).

8. Information Systems

- a. GDOT uses the *University of Maryland's Regional Integrated Transportation Information System (RITIS)* to identify system bottlenecks, speed, congestion, and travel times, both historically and in real-time. On the arterial network, GDOT uses *Automated Traffic Signal Performance Measures (ATSPM)* to review split failures, arrivals on green, or arrivals on red. ATSPM metrics, RITIS outputs and field observations are used to fine-tune and adjust signal timing for real world conditions and citizen complaints (GDOT, 2023, p. 88).

9. Major Mobility Investment Program (MMIP)

- a. Major Mobility Investment Program (MMIP) projects focus on advancing major freight highways and networks and improving mobility in congested regions of the state, with a vision to boost Georgia's competitiveness (GDOT, 2023, p. 1-6).
- b. As part of the MMIP, GDOT is implementing a managed travel lane solution in the Atlanta Urban area by way of the *Express Lane* project. The tolled lanes, already in operation on I-75 North, I-575, I-85 North, and I-75 South, are optional priced lanes that run alongside Atlanta's major Interstates. Congestion-based pricing maintains free-flowing travel and aims to reduce bottlenecks on the mainline by allowing automobiles to opt for a less congested route. Although trucks are not permitted in Express Lanes, redistribution of vehicles to the paid lanes is more likely to reduce congestion in the general-purpose lanes, creating better travel conditions for freight vehicles (GDOT, 2023, p. 4-102).

10. Highway Emergency Response Operators (HERO) and the Coordinated Highway Assistance & Maintenance Program (CHAMP)

- a. HERO and CHAMP vehicles are dispatched after traffic-related incidents occur and clear roads to allow normal traffic flow to resume. HERO serves metro Atlanta and CHAMP serves interstates outside of metro Atlanta except I-59 and I-24 (GDOT, 2023, p. 4-104).

Hawaii

1. HDOT's Climate Adaptation Action Plan

- a. This plan identifies potential impacts to the highway system and relevant strategies, goals, and actions to improve resiliency of the highway system. These strategies include relocating or reinforcing infrastructure vulnerable to extreme weather impacts (HDOT, 2023, p. 101).

2. Critical Urban Freight Corridors (CUFCs) and Critical Rural Freight Corridors (CRFCs)

- a. These are public roads that provide access and connection to the Primary Highway Freight System (PHFS) and the Interstate with other important ports, public transportation facilities, or other intermodal freight facilities. Hawaii designates these corridors to ensure freight routes serve both urban and rural areas, making them **eligible for federal funding support** (HDOT, 2023, p. 15).

3. Leveraging Federal Funding for Strategies

- a. Through a federal policy—the *Highway Safety Improvement Program (HSIP)*—Hawaii will receive approximately \$15 million in 402 formula funding for highway safety traffic programs, which help states to improve driver behavior and reduce deaths and injuries from motor vehicle-related crashes (HDOT, 2023, p. 125).
- b. Hawaii is expected to receive approximately \$1.5 billion over five years in Federal highway formula funding for highways and bridges from the *Bipartisan Infrastructure Law (BIL/IIJA)* (HDOT, 2023, p. 125).

4. Using Participatory Tools to Identify Freight Needs and Priorities

- a. To inform this plan and subsequent investment decisions, participants in the Freight Advisory Committee were assigned breakout rooms per island/county to discuss specific freight needs and issues. A GIS tool was used to mark the specific location with color-coded markers to indicate the category of the need/issue (HDOT, 2023, p. 4).

5. Innovation: Autonomous Vehicles

- a. The State wants to use Autonomous Vehicles to increase last-mile delivery efficiency for e-commerce, contribute to traffic optimization by leveraging real-time data and machine-learning algorithms, and prioritize safety through advanced sensing technologies.
- b. Hawaii has an open regulatory environment, pilot programs, and is doing extensive research on the issue, for example through the University of Hawaii at Manoa's autonomous vehicle institute. The *Autonomous Vehicle Legal Preparation Task Force* finalized a report of recommendations in December 2020 regarding the legal and insurance regulation of autonomous vehicles in the state. Automated and connected vehicle technology should increase freight efficiency and safety (HDOT, 2023, p. 104).

Idaho

1. Transportation Expansion and Congestion Mitigation (TECM) Program

- a. Established by the Idaho Legislature in 2017, TECM focuses on improving safety and mobility on critical corridors that impact freight. This includes improvements along I-90, SH-16, I-84, and 7 other significant routes that have been identified and designated TECM funding. TECM projects are considered to be directly beneficial for freight flow (ITD, 2023, p. 91).

2. Intermodal Connectivity

- a. The *Lead Idaho 2022 Initiative* allocates \$200 million for local bridge improvements, \$6 million for air facilities, \$8 million for rail-highway crossing upgrades, and \$10 million for the Port of Lewiston. This funding aims to support intermodal connectivity and safety across the state (ITD, 2023, p. 91).
- b. In 2021, Savage Services, in partnership with Union Pacific RR, opened Idaho's first multimodal railport in Pocatello, ID., *Savage Railport* – Southern Idaho. The facility's 12,000 feet of track offer outbound trucks to train container transfer of hay, grain and bulk dry commodities transported by UPRR to the Northwest Seaport Alliance in Tacoma and Seattle, WA. Thus far, Savage's handles an average of 200 20' shipping containers per week. This facility is deemed to enhance multi-modal options for freight movement, thus reducing dependency on truck-only routes (ITD, 2023, p. 50).

3. Safety

- a. In 2021, Idaho received \$2 million from *Building Idaho's Future*, for the specific purpose of growing safety at Rail-Highway crossings throughout the state. Seven new rail-highway at-grade crossing projects were approved [...] (ITD, 2023, p. 51).
- b. Various entities, including Idaho Operation Lifesaver (IOL), provide education to motorists, cyclists, and pedestrians on safe practices at railroad crossings. The Idaho Transportation Department (ITD) supports IOL's educational efforts through an annual state-funded education grant, participation on the IOL Board of Directors, and funding the salary for the IOL State Coordinator (ITD, 2023, p. 51).

4. Environmental Sustainability

- a. ITD's environmental review process for projects is detailed in the *ITD Environmental Process Manual*. This manual provides guidance on the review process of establishing a purpose and need, and determined the most appropriate form of environmental documentation for each project. If projects are on the local system, the local sponsor will coordinate with ITD district where the project is located to complete the environmental review process (ITD, 2023, p. 71).

5. Public-Private Partnerships (P3)

- a. In 2020 Idaho, in partnership with Eastern Idaho Railroad (EIRR), was awarded a ~\$7.49 million FRA *Consolidated Rail Infrastructure and Safety Improvements (CRISI)* grant. This public-private partnership project called the *Magic Valley Rail Safety and Capacity Expansion* is expanding EIRR's Gular Yard facility in Rupert, Idaho. The project consists of extending and upgrading 10,000 feet of yard track and adding new passing track to relocate switching operations that currently block the crossing at State Highway 24/8th Street. It also includes a rail replacement on the main line track, removal of several tracks, and upgrades to a crossing. This project is projected to decrease the SH24/8th Street crossing by 58% from 102 minutes to less than 43 minutes per day, increase carloads by 15% from 30,777 to 35,571 carloads per year and increase the annual average tons per mile by 15% from 3.0 to 3.5M ton miles per year (ITD, 2023, p. 50).

6. Wildlife Protection

- a. ITD has adopted a strategy to mitigate the impact of freight on wildlife by providing wildlife crossing locations. This promotes the creation of corridors which restore the natural migration patterns for native wildlife. Crossing structures can be above the roadway (overpass) while others can include tunnels, or large drainage structures under the roadway which accommodate the movement of wildlife. Additionally, ITD has built numerous miles of wildlife fencing to reduce wildlife vehicle crashes, including portions of US-30 and US-20/26. Currently, ITD is partnering with Idaho Fish and Game to identify numerous wildlife migration patterns. This partnership is informing ITD to find the appropriate location for a wildlife bridge crossing on US20 between Ashton and Osborne Bridge (ITD, 2023, p. 78).

Illinois

1. Illinois Competitive Freight Program (CFP)

- a. This program helped inform the State's Freight Investment Plan (IDOT, 2023, p. 83). Its primary aims were to: (1) operate in accordance with the infrastructure bill (IIJA); (2) support objectivity and transparency in project selection; (3) leverage funds through local or private participation; (4) provide the opportunity for the Illinois State Freight Advisory Council (ISFAC) to provide input into the development and delivery of the program, and; (5) align with the goals of the 2023 Illinois State Freight Plan (IDOT, 2023, p. 89).
- b. *How it works:* State and local applicants submitted projects for funding under the CFP, which were scored and selected using "a robust set of highway, intermodal, and cross-cutting measures" (p. 90). Projects were evaluated based on both qualitative and quantitative factors, and IDOT used the scoring as a basis for selecting the projects most critical to addressing Illinois' freight needs (IDOT, 2023, p. 90).

2. CREATE Partnership (P3)

- a. The *Chicago Region Environmental and Transportation Efficiency (CREATE)* partnership addresses rail congestion and improves multimodal connectivity within the Chicago area, where freight bottlenecks have significant national impacts.
- b. It is an ongoing public-private partnership between the State, local agencies, and Class I railroads to ensure the reliability of rail within the region. Of the 70 CREATE projects, 31 are complete, 20 are in process, and 19 still require action. Outside of Chicagoland, there are multiple short lines and regional railroads that

- require investment to allow for efficient freight movement and connection to key freight facilities (IDOT, 2023, p. 76).
- c. This partnership helps Chicago achieve its goal to: Address issues related to multimodal nodes capacity, including air cargo and marine landside facilities, rail and drayage equipment (chassis, containers and power units) availability, and workforce availability (IDOT, 2023, p. 106)
- 3. Transportation System Management and Operations (TSMO) Plan**
 - a. IDOT uses this plan to guide the integration of ITS to enhance traffic flow, reduce congestion, and improve infrastructure resiliency across the State's Priority Freight Network. This is a targeted approach which aims to tackle a key goal: to address bottlenecks across the modes and at freight nodes (IDOT, 2023, p. 105).
 - 4. Illinois Highway-Rail Grade Crossing Action Plan**
 - a. In partnership with the Illinois Commerce Commission (ICC) and other stakeholders, this plan identifies safety issues at highway-rail intersections across the state and proposes strategies to reduce incidents (p. 109). This plan supports the State's goal to: eliminate or upgrade at-grade highway-railroad crossings and address safety issues created by blocked crossings (IDOT, 2023, p. 109).
 - 5. Resilience Planning**
 - a. One program provides support for resiliency related transportation projects and planning to protect against flooding, extreme heat, and more (IDOT, 2023, p. 67).
 - b. In 2017, IDOT developed the an assessment which defined priority areas for resilience planning within the State.
 - c. The *Long-Range Transportation Plan (LRTP)* has also identified numerous performance measures, strategies and actions that are underway to create resilient transportation systems, including freight, within the State. Additionally, IDOT will undertake a multimodal *Resilience Improvement Plan* that will specifically identify actions to improve the ability of the State to respond to the impacts of extreme weather and natural disasters, prepare for increased flooding risk, and reduce impacts on community assets (IDOT, 2023, p. 50).
 - 6. Wildlife**
 - a. Illinois Department of Natural Resources (IDNR) has developed a Comprehensive Wildlife Conservation Plan and Strategy that is an actionable plan for habitat management within the State. IDOT was involved with and is a partner in implementing this plan (IDOT, 2023, p. 50).
 - 7. Data Driven Decisions (DDD) Tool**
 - a. IDOT has created a Data-Driven Decisions (DDD) Tool to increase transparency and align the selection process of capacity-increasing projects with broader state goals (IDOT, 2023, p. 50).

Indiana

- 1. Planning for Multimodal Linkages on Preferred Freight Corridors (PFC)**
 - a. Promoting using preferred freight corridors is identified as a key planning need in the SFP (p.1). Indiana aims to alleviate bottlenecks and enhance freight movement across highway, rail, air, and water modes on its Preferred Freight Corridors (PFC). These corridors cover key multimodal facilities such as rail-to-flatcar and container-to-flatcar, major ports, cargo airports, and NHS and PHFS connectors (INDOT, 2023, pgs. 17, 34, 41).
- 2. Truck Parking Information Management System (TPIMS)**
 - a. Launched in 2019, TPIMS aggregates real-time data of truck parking availability and communicates it to drivers. It improves parking resource use, safety, and

mobility of truck movements in the State. This system, developed with trucking industry feedback, operates in targeted rest areas along Indiana highways (INDOT, 2023, p.52).

- i. INDOT's TPIMS project development process included a *Stakeholder Engagement Workshop* in April 2016. Attendees from trucking companies and drivers shared feedback on the proposed project and perspectives on the overall truck parking challenges and needs in Indiana. The input helped INDOT determine which rest areas were best to use TPIMS on (INDOT, 2023, p. 50).

3. Extreme Weather Resilience and Flood Mitigation

- a. INDOT incorporates flood-resistant designs and stormwater management in highway projects, especially on frequent flooding routes. INDOT's 2022 *Transportation Asset Management Plan (TAMP)* and *Mobility Asset Team (MAT)* focus on resilience by prioritizing projects on roads prone to extreme weather impacts.
- b. According to TAMP, two of the major weather and resilience risks are changes in extreme temperatures and increased risk of flooding, both of which may require changes in treatments and increased investments in preservation and rehabilitation. To address these risks during life-cycle planning, INDOT uses its **pavement and bridge modeling systems** to consider the impact of more substantial treatments in a resiliency scenario. This scenario includes the need for upsizing culverts to meet current design standards, cleaning or expanding ditches, and increasing the waterway openings for bridges to accommodate higher levels of flooding to meet current design standards (INDOT, 2023, p.62).

4. Environment: Air Quality and Analysis Tool

- a. INDOT has developed an *Air Quality Post-Processor (AQPP)* to support the activities of air quality conformity analysis. This AQPP tool applies emission rates developed in the Motor Vehicle Emissions Simulator (MOVES) to key output data (e.g., traffic volumes, travel distance and times) produced by the travel demand models used in Indiana. The AQPP provides more ease and precision in assessing the air quality benefits achieved by improvements made to the transportation system. INDOT has used this tool to effectively estimate emissions and assess air quality impacts in project development (INDOT, 2023, p. 71).

5. Economic Analysis Tools for Project Development

- a. These tools, such as the *Major Corridor Investment Benefit Analysis System (MCIBAS)* and *Transportation Economic Development Impact System (TREDIS)*, calculate pollutant emissions, monetize these outputs, and estimate a total environmental emission cost for transportation projects and plans. In the State's freight plan, MCIBAS was used to analyze economic impacts, incorporating emission cost savings as part of the project scoring and ranking process for each proposed freight project (INDOT, 2023, p. 71).

6. Industrial Rail Service Fund

- a. This fund supports the rehabilitation of Indiana's smaller railroads, with annual grant funding for projects like rail and tie replacement, bridge work, and new switches to enhance rail capacity. Port Authorities and Class II and III freight railroads compete for funding via an annual grant process. The maximum grant size is \$250,000. Example projects funded through this program include installing new switches, replacing rail, ties, and ballas, and bridge work (INDOT, 2023, p. 74).

7. Railway Highway Crossing Program

- a. INDOT manages railroad crossing safety needs through its *Railway Highway Crossing Program* (referred to as the Section 130 Program). This program, which is coordinated with Indiana's Highway Rail Crossing Safety Action Plan and Strategic Highway Safety Plan, **funds warning device upgrades on state and local highways**. INDOT uses a data-driven approach to assess all public at-grade crossings and prioritize improvements. As a result of this program and other related efforts, rail crossing collisions have steadily declined over the last 20 years (INDOT, 2023, p. 74).

8. Virtual Weigh-in-Motion (VWIM)

- a. This pilot program weighs trucks in motion using sensors and cameras to capture weight information as vehicles travel on a highway. It benefits freight mobility and safety by enabling trucks to be weighed without stopping. Indiana has implemented eight VWIM pilot sites and has plans for 2 more (INDOT, 2023, p. 81).

9. INDOT4U Customer Service Initiative

- a. INDOT4U strengthens local engagement and customer service, offering tools such as the *Next Level Construction Map* and mobile applications to keep the public and freight stakeholders informed and connected. It is also used as an emergency response tool (INDOT, 2023, p. 54).

Kansas

1. Freight Corridors of Significance (FCS)

- a. As part of the Kansas State Freight Plan, KDOT engaged in a process to designate Kansas' highway freight network in 2014. This designated freight network is referred to as Kansas' *Freight Corridors of Significance (FCS)*. KDOT has designated Freight Corridors of Significance that can inform effective investment decisions for the state's freight system and economy. The FCS designation is a crucial aspect of Kansas' long-term freight planning (KDOT, 2023, p. 47).
- b. Key freight routes in Kansas City, Wichita, and Topeka span five to eight lanes, while other major corridors have four or fewer. The FCS designation also aligns with the Strategic Highway Network (STRAHNET) corridors, including I-70, I-35, and I-435, supporting critical military freight movement throughout the state (KDOT, 2023, p. 48).

2. Kansas Truck Parking Information Management System (TPIMS)

- a. Kansas uses TPIMS to provide real-time data on parking availability, which addresses both safety concerns (reducing driver fatigue) and operational efficiency by allowing drivers to better plan for rest periods. TPIMS collects data from 18 truck parking sites in Kansas and crowd-sourced app *TruckerPath*, which reports parking availability as "lots," "some," or "full." (KDOT, 2023, p. 94).
- b. Using ITS devices like cameras and sensors, TPIMS aggregates this data and shares it with drivers via dynamic message signs, online dashboards, mobile apps, and in-cab systems. This streamlined access helps drivers locate parking faster, reducing time spent searching, lowering community impact, and promoting a safer, more efficient freight system (KDOT, 2023, p. 158).

3. Regional Coordination

- a. Mid America Association of State Transportation Officials (MAASTO) have developed a regional Truck Parking Information System (TPIMS) to collect and broadcast real time truck parking availability to drivers in Indiana, Iowa, Kansas, Kentucky, Minnesota, Iowa, and Wisconsin. The project was funded through a

- \$25 million federal Transportation Investment Generating Economic Recovery (TIGER) grant, in combination with matching state funds, with the goal of enabling drivers to proactively plan their routes and make safer, more efficient parking decisions. KDOT led this initiative, informed by their work on TPIMS (KDOT, 2023, p. 94).
- b. As part of Mid-America Freight Coalition (MAFC), Kansas collaborates with other states to strengthen regional freight mobility. This partnership allows Kansas to access shared research, best practices, and funding opportunities, benefiting cross-state freight planning and operations (KDOT, 2023, p. 163).
- 4. Rail Service Improvement Fund (RSIF)**
- a. The *Rail Service Improvement Fund (RSIF)* helps Kansas local governments and rail entities upgrade rail infrastructure, improving safety and resilience, especially in rural areas where freight rail access is vital for economic activity. RSIF grants support projects by local governments, railroads, port authorities, and shippers to improve Kansas' rail network condition and accessibility. Projects must demonstrate a benefit-cost ratio of 1.0 or higher to qualify (KDOT, 2023, p. 173).
 - b. Since 2000, KDOT has funded 95 projects with over \$87 million in RSIF loans and grants, including recent funding for eight short line rail projects and seven shipper projects, totaling \$10.1 million in SFY 2022 (KDOT, 2023, p. 174).
- 5. Short Line Rail Improvement Fund (SLRIF)**
- a. The *Short Line Rail Improvement Fund (SLRIF)* supports projects that maintain, reconstruct, or replace short line rail infrastructure such as tracks, bridges, industrial leads, and sidings, promoting cost-effective and environmentally sustainable freight movement by shifting loads from road to rail and easing congestion. SLRIF allocates \$5 million annually from FY 2021 to 2023. In its first two years, the program awarded over \$9.3 million across 21 projects, including five short line rail projects and six shipper projects in FY 2022 (KDOT, 2023, p. 174).
- 6. Cost Share Program**
- a. Kansas' Cost Share Program offers financial support for projects that improve safety, reduce congestion, and boost economic growth, including upgrades to multimodal freight infrastructure. The program provides matching grants for construction projects across all freight modes—road, rail, and air—that improve safety, access, mobility, condition, or job retention and growth. From 2019 to 2021, it funded 13 roadway projects and one railway project, providing over \$10 million and leveraging more than \$21 million (KDOT, 2023, p. 173).
- 7. Economic Development Program**
- a. The Economic Development Program provides funding to local governments for transportation projects that promote economic development, job growth, and capital investment in Kansas. Between 2019 and 2021, KDOT awarded over \$14.6 million for six roadway projects and \$6.4 million for four rail projects, leveraging more than \$21 million in total funding (KDOT, 2023, p. 173).
 - i. e.g., KDOT granted \$4.25 million to improve roadway access in Shawnee to support current traffic for Holiday Sand and Gravel and Amazon Distribution and accommodate future traffic from the planned Heartland Logistics Park. The total project cost is \$5.8 million.
- 8. Innovation**
- a. Kansas is preparing for autonomous vehicle technology integration with a vision plan focused on enhancing safety and efficiency in freight operations. The *Kansas Statewide Connected and Autonomous Vehicle (CAV) Vision Plan* outlines a

framework for maximizing CAV benefits, including improved freight safety, efficiency, and economic growth. It also highlights the need to develop a CAV-ready workforce (KDOT, 2023, p. 128).

- b. Auxiliary Power Units (APUs) reduce emissions from rail locomotives by providing alternative power for heating, air conditioning, lighting, and appliances while the main engine is off. Kansas railroads, including WATCO and Cimarron Valley Railroad, are deploying APUs to support idling reduction (KDOT, 2023, p. 129).
- c. Kansas' DOT was the first to deploy a statewide Unmanned Traffic Management (UTM) initiative. The *Kansas Unmanned Aerial System Integration Pilot Program* is now one of ten national pilots conducting advanced UAS operations to gather data for federal rulemaking (KDOT, 2023, p. 129).

9. Investments in Workforce Development

- a. Kansas' higher education institutions are investing in specialized training and research to meet manufacturing sector demands. Transportation and warehousing jobs in Kansas are projected to grow by 9.8% by 2028. Rail stakeholders commend KDOT's dedicated rail workforce and rail programs (KDOT, 2023, p. 21).

Louisiana

1. Short Line Infrastructure Investment Program

- a. The *Short Line Infrastructure Investment Program* was established to improve Louisiana's short line railroad infrastructure, enabling it to handle heavy-weight carloads. Louisiana identified key bottlenecks, such as single-track sections and equipment limitations at intermodal facilities, and prioritized investments to address these issues for greater network efficiency. In recent years, \$1.5 million in grants were allocated to projects like the NOPB Transloading Industrial Park and LAS Track upgrades to increase connectivity and capacity for short line networks (DOTD, 2024, p. 46).

2. Railway Improvements

- a. New Orleans Rail Gateway (NORG) improvements are key to resolving rail bottlenecks in one of the largest U.S. rail gateways. NORG projects aim to increase rail capacity, reduce congestion, and improve freight interchange flow through partnerships with Class I railroads, Amtrak, and the New Orleans Public Belt Railroad. Insights from the *Avondale Planning and Environmental Linkages (PEL) Study* are guiding this work (DOTD, 2024, p. 46-47).
- b. The LA 23 New Orleans and Gulf Coast Railway Relocation Project aims to reduce rail congestion and improve safety by relocating railway infrastructure in densely populated areas of Jefferson and Plaquemines Parishes, minimizing at-grade crossings and improving rail mobility (DOTD, 2024, p.124).

3. Avondale Planning and Environmental Linkages (PEL) Study

- a. This study, conducted with federal and local partners, evaluates options for closing roadway-rail at-grade crossings in the Avondale area. Potential grade separations aim to improve safety and traffic flow where the Union Pacific and Burlington Northern Santa Fe railways intersect with local roads (DOTD, 2024, p. 47).

4. 286,000-Pound Rail Weight Standard Upgrades

- a. Louisiana is working toward upgrading short-line railroads to handle 286,000-pound cars, the industry standard for Class I railroads. Approximately 550 miles

of short-line track currently do not meet this standard, limiting efficiency and economic competitiveness (DOTD, 2024, p. 123).

5. Wildlife Considerations

- a. During the Interstate 49 extension upgrade, LA DOTD incorporated bear culverts and underpasses to preserve bear access to natural habitats near the Atchafalaya River. DOTD is committed to protecting wildlife by evaluating environmental impacts for all major projects. Wildlife crossings, added as enhancements or permit conditions through the NEPA process, have effectively safeguarded Louisiana's wildlife and habitats (DOTD, 2024, p. 100-101).

6. Regional Partnerships

- a. Multi-state coalitions such as the Institute for Trade and Transportation Studies (ITTS), a coalition of southeastern state DOTs (of which Louisiana is a member), are an important avenue for tackling resilience issues that cross state lines (DOTD, 2024, p. 111).

7. Automated Vehicle Technology

- a. Louisiana has adopted legislation and formulated policies and guidelines to enable controlled testing and operations of AVs within the state. These regulations address the operation criteria, accident reporting guidelines, and considerations for remote drivers and teleoperation systems in autonomous commercial motor vehicles. Additionally, these guidelines outline specific exceptions for low-speed autonomous vehicles and establish clear rules for platoon operations within the state. As a result, Gatik, a Silicon Valley-based company, is already using automated box trucks to deliver Walmart's goods within the City of New Orleans (DOTD, 2024, p. 108).

Massachusetts

1. Public-Private Partnerships (P3s)

- a. The Industrial Rail Access Program (IRAP) in Massachusetts funds freight rail infrastructure improvements, such as new industrial sidings and reopening branch lines, to support economic development, job creation, and improved logistics for rail-served industries. As a P3, IRAP combines funding to help applicants invest in industry-focused rail projects. Eligible applicants can apply for MassDOT grants to improve efficiency, production, and distribution, ultimately supporting Massachusetts' economy and job growth (MassDOT, 2023, p. 120).

2. Local Bottleneck Reduction Program

- a. This program seeks to fund innovative solutions to address congestion bottlenecks on local roadways to improve traffic flow. Project locations are proposed by municipalities, with the option to partner with a Regional Transit Authority and are considered by MassDOT for funding through a competitive application process. Every municipality in the MA is eligible for this program. Selection is based primarily on bottleneck related congestion and delay metrics. Project design for selected applicants is performed by MassDOT-led consultants funded through the program. Project implementation is conducted entirely by the municipality (MassDOT, 2023, p. 120).

3. 286K-Pound Rail Weight Standard Upgrades

- a. The plan recommends upgrading key rail lines to the 286,000-pound weight standard to increase freight efficiency. Recent projects include rehabilitations of and upgrades to the Massachusetts Coastal Railroad and the New England Central Railroad through an FRA BUILD Grant (MassDOT, 2023, p. 87).

4. Workforce Development

- a. Mount Wachusett Community College, three Central Massachusetts vocational schools, and the Massachusetts Manufacturing Extension Partnership received \$1.57 million for workforce development programs in partnership with local businesses. Massachusetts prioritizes upskilling in freight rail through vocational training to attract new talent to the industry (MassDOT, 2023, p.30).

5. Autonomous Vehicles Working Group

- a. The Commonwealth's *Executive Order 572 (2016)* established the Autonomous Vehicles Working Group and created a process for MassDOT to allow testing of connected and autonomous vehicles (CAVs) on public roads. Since 2021, five autonomous vehicle-related bills were drafted but failed to pass the legislature. Due to regulatory obstacles, drone delivery for freight purposes has not advanced sufficiently enough to compete with other freight modes (MassDOT, 2023, p. 31).

6. Public-Private Partnerships

- a. The state partners with private rail operators to fund rail infrastructure projects, expanding facilities such as the CSX Worcester intermodal terminal and enhancing key routes for intermodal traffic. CSX operates intermodal terminals in Worcester and West Springfield, while PAS runs the Ayer yard for NS, and PW operates an independent terminal in Worcester. These are the only public intermodal terminals in New England, serving both Massachusetts and the broader region (MassDOT, 2023, p. 53-54).

7. Scenario Planning for Resilience

- a. Scenario planning integrates uncertainty and risk into decision-making. For the SFP, scenarios from Beyond Mobility and insights from the COVID-19 Freight Study informed three key scenarios (MassDOT, 2023, pgs. 3-4):
 - i. Hybrid and Varied: Assumes economic shifts due to automation, telework, and flexible scheduling, with employment and commerce adapting to environmental change.
 - ii. Ahead as Before: Follows current growth trends, highlighting a strong knowledge economy amid challenges including high living costs and racial wealth gaps, while manufacturing and energy sectors grow.
 - iii. Close and Connected: Projects a reversion to in-person employment, less reliance on telework/automation, substantial manufacturing growth, and a decline in the information sector.

Minnesota

1. Minnesota Freight Action Agenda

- a. The *Minnesota Freight Action Agenda* (developed with the Minnesota Freight Advisory Committee) outlines 22 strategies within five goal areas: Freight System Stewardship, Safety, Connectivity, Environment, and Economy. Actions include targeted investments in freight bottlenecks, development of a freight investment plan, improved freight data collection, and the preservation of superload and critical rail corridors. The Agenda emphasizes cross-sector coordination, including outreach to tribal nations, regional development commissions, and private-sector freight operators (pp. 98–102).

2. Minnesota Highway Freight Program (MHFP)

- a. The MHFP is the primary mechanism for distributing National Highway Freight Program (NHFP) funds. The program was designed based on stakeholder input and **ensures that freight mobility, first- and last-mile connections, intermodal access, and safety receive funding priority**. Since 2017, MHFP has awarded

funding across three solicitation rounds to projects addressing major freight corridors, such as grade separations, intersection upgrades, and truck access improvements to key logistics hubs. The program supports equity by **encouraging applications from rural areas** (pp. 123–132).

- b. TH 1/169 Freight Improvements (Tower, MN): A \$1.1 million project that serves a historically underinvested, rural area in northeast Minnesota with high proportions of low-income and tribal populations. Involves shoulder widening and intersection redesign for safer truck movement from iron mines and logging sites to ports. Aims to improve rural freight safety and reliability while supporting local economies dependent on heavy industry.

3. Freight Safety and Truck Parking Solutions

- a. MnDOT integrates freight safety into roadway design, with initiatives such as: (1) Incident management planning, (2) freight-specific geometric design (e.g., truck turning radii), and (3) deployment of freight technology (e.g., dynamic signage, camera enforcement) (pp. 99–100).
- b. Minnesota is tackling truck parking shortages via **real-time systems** like the *Truck Parking Information Management System (TPIMS)*, and exploring expansions of truck parking at rest areas, freight hubs, and high-demand corridors. A recent survey revealed that 98% of truck drivers struggle to find safe parking, prompting additional investments (pp. 108–110).

4. Innovative and Connected Freight Technologies

- a. MnDOT is piloting and supporting a wide array of freight innovation pilots to improve efficiency and reduce negative impacts. These strategies align with Minnesota's broader goals of enabling resilient freight mobility across all communities (pp. 45–50).
 - i. *Connected and Automated Vehicles (CAVs)* for freight
 - ii. *Driver-Assistive Truck Platooning (DATP)* for fuel savings and safety
 - iii. *Drone and automated parcel delivery* in rural and urban test corridors
 - iv. *Commercial cargo bicycles* with designated support infrastructure in dense areas
 - v. *Parcel consolidation centers and urban microhubs* to reduce last-mile congestion
 - vi. *Big Data applications* for freight network performance and routing optimization

5. Resilience and Adaptation Planning

- a. Environmental stressors like low-water levels on the Mississippi, seasonal flooding, and freeze/thaw cycles pose challenges to freight. Minnesota incorporates weather resiliency into its freight project selection and design. Strategies include: identifying vulnerable corridors, integrating floodplain and drought data into planning, & assessing alternative routing for critical goods movement (pp. 38–41).
- b. Projects funded through MHFP or other freight programs are evaluated on their ability to enhance network resilience, especially for rural and intermodal corridors (pp. 106–110).

6. Workforce Development

- a. Minnesota Local Technical Assistance Program: jointly led by Minnesota DOT and the University of Minnesota.

Nebraska

1. Nebraska's *Transportation Asset Management Plan (TAMP)*

- a. NDOT's *Transportation Asset Management Plan (TAMP)* reports bridge conditions as Good, Fair, or Poor using National Bridge Inspection data. TAMP outlines how Nebraska's highway system will be managed within available funding, aiming to meet targets for pavement and bridge conditions to achieve a state of good repair. Maintaining these conditions along freight-heavy corridors is crucial but challenging due to the wear caused by large trucks. NDOT will continue implementing the TAMP to address these needs (NDOT, 2023, p. 110).

2. Safety Action Plan

- a. *Nebraska Highway-Rail Grade Crossing Action Plan* aims to improve safety at critical highway-rail crossings, including targeted infrastructure investments and enhanced data collection to better understand and mitigate truck-involved crashes (NDOT, 2023, p. 111).

3. National Electric Vehicle Infrastructure (NEVI) Plan

- a. This plan supports freight-oriented EV corridor charging, aligns with NEVI recommendations, and expands truck parking with integrated EV charging to alleviate congestion in high-traffic areas. With federal approval, Nebraska will receive \$30.2 million of the \$5 billion NEVI funds from FY2022 to FY2026 to deploy EV charging infrastructure. NDOT is focusing these funds on the I-80 corridor and U.S. 6 in the Omaha metro area to enhance commercial vehicle charging on routes with high heavy vehicle traffic. NDOT plans to advance NEVI recommendations to reduce emissions on key freight corridors and continue expanding EV charging infrastructure statewide (NDOT, 2023, p. 116).

4. Proactive Research to Maintain Economic Competitiveness

- a. Nebraska's privately owned freight rail network, managed by Class I and II/III (short line) carriers, is crucial for industries transporting bulk commodities (e.g., agriculture). These studies help assess cost-effective shipping options and enhance the safety and efficiency of freight movement across the state. Nebraska plans to conduct ad hoc studies and analyses on freight rail opportunities as they arise, which will help evaluate the potential for cost-effective shipping across the state of as well as improvements in the safety and efficiency of freight movements (NDOT, 2023, p. 112).

5. *New Inland Port Authority Act under LB156*

- a. This recent legislation supports up to five inland port authorities, creating new growth opportunities for Nebraska's freight network by attracting investment and improving access to intermodal transport. These port authorities will be authorized to engage in marketing activities, issue and sell revenue bonds, and acquire rights-of-way and property (NDOT, 2023, p. 96).

6. Resilience Planning

- a. NDOT has made significant investments in data and tools that can be leveraged to help with scenario planning and resiliency planning for handling truck traffic during an emergency or severe weather event. This will hopefully maximize the value of these investments and provide NDOT with additional resources to plan for and handle disruptions on the highway network (NDOT, 2023, p. 114).

New Jersey

1. Identifying Vulnerable Infrastructure

- a. New Jersey's plan emphasizes resilience for freight facilities, especially in areas at high risk for flooding and sea-level rise, through collaborative planning with FEMA and NJDOT. Specific areas like the I-78 corridor (a critical freight artery) have been identified for flood mitigation measures due to high freight movement in these regions. In total, 50 priority highway segments have been identified, as well as the costs to the State when these are congested by users (NJDOT, 2023, pgs, 27, 200).
- b. *National Performance Management Research Data Set (NPMRDS) Lockdown Analysis*: A review of key routes for essential goods using the NPMRDS. This analysis has reinforced the importance of New Jersey's state highway network in moving critical goods (NJDOT, 2023, p. 50).

2. Wind Port Infrastructure

- a. The Wind Port, currently under development in Lower Alloways Creek, will be a leading offshore wind supply chain hub, serving as a manufacturing center and marshalling launchpad for wind farms along the entire U.S. East Coast. The Wind Port will house several Tier 1 component manufacturers and will support concurrent marshalling activities. By enabling co-location of manufacturing and marshalling, the Wind Port reduces the transportation distance between Tier 1 manufacturing and marshalling operations. The Port is being designed, built, and operated solely for offshore wind—it will not be used for containerized freight or conventional break bulk, but will be capable of receiving components not manufactured onsite via water as well as truck (NJDOT, 2023, p. 97).

3. Workforce Development

- a. NJCU's Center for Workforce and Community Development aims to provide training for middle skill jobs, which according to the program's literature, compose 53% of New Jersey's jobs. The Transportation Logistics and Distribution (TLD) and Maritime Workforce Development programs are housed within the Center for Workforce and Community Development at NJCU. NJCU has partnered with 25 companies and labor unions, and the curricula are developed and modified frequently to keep pace with changing industry needs. Students receive "upskill" training in areas such as warehouse operations, supply chain management, inventory cycle counting, and AutoCAD. The program boasts a 70% placement rate of students in jobs with partnering employers (NJDOT, 2023, p. 127).
- b. As the development patterns of freight uses and generators extend further away from established urban centers, there is a need for tailored transportation solutions. One potential option is the use of employer-launched vanpools operating between employers and employees. To further incentivize employers to manage these services, there are resources available, especially from county transportation management associations (TMAs). For example, the Greater Mercer TMA provides guidance and support to employers looking to develop such a program. This also includes certain subsidies provided by NJ TRANSIT, as well as guidance on tax benefits (NJDOT, 2023, p. 127).

4. Multimodal Connectivity

- a. *Rail Freight Assistance Program (RFAP)*: provides state funding for rail projects that support the advancement of a robust multimodal rail network. Since the 2017 Freight Plan, the state funded RFAP has granted almost \$141 million to the various railroads, leveraged by owner/operator matching funds. Most of the

projects are “state of good repair” and 286K related (p. 41). These efforts are part of NJDOT’s partnership with the Multi-State Freight Working Group to ensure efficient freight movement across state lines (NJDOT, 2023, p. 22).

5. Funding Local Projects

- a. *Local Freight Impact Fund*: a grant program dedicated to assisting local communities (counties and municipalities) in need of funding for transportation projects focused on supporting freight and all users on local roadways. The State plans to leverage the Fund for localized facility improvements, including for last mile solutions (NJDOT, 2023, p. 55).

6. Improving Mobility

- a. In 2019, NJDOT developed the *Integrating Complete Streets and Freight* technical memorandum: it summarizes the desire and need for freight to be incorporated into complete streets planning and design, especially in urban centers like Jersey City and Newark. This integration balances truck access with pedestrian and cyclist needs, creating safer urban freight corridors (NJDOT, 2023, p. 84).

7. Supply Chain Security and Preparing for Disruption

- a. NJDOT has developed a *Disruption Response Playbook* to maintain partnerships and agency relationships for effective response to supply chain disruptions. This was a response to the COVID-19 pandemic. This includes key agencies such as the New Jersey Department of Homeland Security and South Jersey Port Corporation.
 - i. The *Disruption Response Playbook* provides workflows for NJDOT to engage with stakeholders and manage freight system disruptions effectively, addressing challenges seen during crises like COVID-19 and natural disasters (NJDOT, 2023, p. 50).
- b. *Goods Movement Action Program (G-MAP)*: A joint initiative of PANYNJ, NJDOT and NYSDOT, G-MAP aims to create a 21st century goods movement network serving the New York-New Jersey Metropolitan Region, ultimately linking it with domestic and global markets. The program developed an online interactive Core Freight Network Map highlighting the key port terminals, airports, and intermodal facilities of the major freight movements and their intermodal connections (NJDOT, 2023, p. 68).

8. MPO Long Range Transportation Plans

- a. The long-range transportation plan (LRTP) establishes goals and objectives and identifies current and potential projects aimed at improving an MPO’s transportation system. It helps ensure that transportation investment decisions are made strategically and considered in light of their short-, mid-, or long-term effect on an MPO region. Specifically, the LRTP inventories and assesses current land use, transportation patterns, community development, and operations of each transportation mode in the county. An LRTP identifies needed improvements to the multimodal transportation system—**highway/bridge, rail, air, transit, bicycle, and pedestrian** facilities (NJDOT, 2023, p. 69).

9. Pilot Freight Concept Development Program

- a. Through this program, NJDOT assesses high-impact freight projects and develops preliminary designs for efficient implementation, facilitating faster responses to shifting freight demands and supporting economic competitiveness (NJDOT, 2023, p. 60).

New Mexico

1. Resilience Improvement Program

- a. The Resilience Improvement Program—in alignment with the IIJA’s Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Program—provides grants to states or MPOs for resilience projects. NMDOT is developing a Resilience Improvement Plan, focusing on assessing vulnerabilities in critical freight corridors to natural disasters like floods and wildfires. NMDOT is currently conducting a Resiliency Analysis to develop project prioritization methods for projects that will improve transportation network resilience and will be incorporated into the Resilience Improvement Plan (p. 109).
- b. NMDOT can use the resources provided by the IIJA to advance their goals (NMDOT, 2023, p. 63):
 - i. \$33 million over five years to reduce commercial motor vehicle crashes available to New Mexico
 - ii. \$10 billion for rail improvements and safety grants • \$5.5 billion for grade crossing safety improvements
 - iii. \$14 billion for projects of regional or national significance • \$8.7 billion to increase transportation system resilience

2. Leveraging Federal Funding for Feasibility Studies

- a. San Juan County and the Navajo Nation secured a \$2 million Better Utilizing Investments to Leverage Development (BUILD) grant to study the feasibility of a spur rail line that would connect the Farmington area to the national freight network via the BNSF line near Gallup, approximately 120 miles south (NMDOT, 2023, p. 110).

3. Truck Parking Availability System (TPAS) and I-10 Corridor Coalition

- a. The I-10 Corridor Coalition is a voluntary partnership that began in 2016 between the state Departments of Transportation for California, Arizona, New Mexico, and Texas. The coalition aims to leverage shared resources and economies of scale to prepare for and adapt to emerging technologies and challenges while also employing joint expertise to make best practice improvements to the interstate facility (NMDOT, 2023, p. 63).
- b. The I-10 TPAS project aims to help truck drivers and dispatchers make informed decisions about where to park along the corridor. To achieve this goal, the TPAS project will create a system that can detect where truck parking is available at locations along the corridor and disseminate that information to truck drivers and dispatchers in real time. This will reduce the amount of time and fuel spent looking for parking, reduce the risk that drivers will park in unauthorized or unsafe locations, and reduce the likelihood that drivers will continue to drive while fatigued (NMDOT, 2023, p. 104).

4. Strategic Highway Safety Plan (SHSP)

- a. *New Mexico’s Safe Mobility for Everyone Vision* is from the *2021 Strategic Highway Safety Plan (SHSP)*. The SHSP is the plan that guides interagency efforts to reduce fatalities and serious injuries for motorists, truck operators, pedestrians, bicyclists, and users of all other transportation modes. NMDOT utilizes data driven approaches and continues to build on education, enforcement, engineering, and emergency medical services components of traffic safety to improve roadway safety. NMDOT works with partner agencies and transportation safety stakeholders to adopt strategic safety initiatives based on crash data, evidence-based approaches, and best practices (NMDOT, 2023, p. 110).

5. Environment: Wildlife Corridor Action Plan

- a. *The Wildlife Corridors Act*, or *New Mexico Senate Bill 228*, was signed into law by Governor Lujan Grisham in 2019, and directed NMDOT and New Mexico Department of Game and Fish (NMDGF) to develop a *Wildlife Corridor Action Plan* for NMDOT roads across the state (p. 105).
- b. Using crash data, ecological data, and forecast modeling, the Plan identifies wildlife-vehicle collision hotspots that pose a particularly elevated risk to the traveling public and wildlife corridors that bisect roads. It also provides a list of priority projects based on the results of the Plan's analysis (NMDOT, 2023, p. 105).

6. Partnership with Tribal Organizations Freight Planning

- a. Through a Tribal Liaison, NDOT coordinates with local tribes to incorporate tribal land considerations into freight planning. This coordination includes completing Memoranda of Agreements and Joint Powers Agreements with all pueblos and tribal nations in the State. The NMDOT Tribal Liaison conducts outreach, mediates communications between tribal entities and NMDOT, and builds close relationships based on "experience and accountability" (NMDOT, 2023, p. 13-14).

7. Highway-Rail Grade Crossing Safety Improvement Program

- a. NMDOT Rail Bureau collaborates with local agencies and rail companies for this program to identify and improve hazardous rail crossings. This program prioritizes reducing freight-rail conflicts, ensuring safe and efficient rail corridors throughout New Mexico (NMDOT, 2023, pgs. 13, 66)

New York

1. First-/Last-Mile Improvements

- a. *Buffalo-Niagara Trade Gateway*: Cross-border freight facilitation project which includes upgrades to truck corridors and bridge approaches. The goal is to enhance regional intermodal connections and improve access to Canada (pp. 91-97, 126-127).
- b. *NYC Freight Villages & Urban Delivery Zones*: Involves curbside delivery programs, off-peak delivery pilots, and last-mile freight infrastructure in dense areas. The goal is to reduce congestion and improve last-mile logistics in urban areas (pp. 91-93).
- c. *Upstate Warehouse and E-Commerce Access Routes*: The goal is to improve freight facility access in growing rural e-commerce corridors. These warehouses are in Central NY, Western NY, and Finger Lakes (pp. 91-93, 125).

2. Environment : Wildlife Protection

- a. The State aims to protect endangered species and minimize habitat disruption. It has invested in wildlife-safe infrastructure including culverts, barriers, and wildlife signage on rural freight corridors (pp. 69-70, 91).
- b. NYSDOT works to provide signage to alert motorists of high animal traffic areas to protect wildlife from being hit. NYSDOT also works to protect and enhance habitats for endangered and vulnerable species through measures such as installing culvert crossings and fencing to provide safe crossing areas for endangered animals like Eastern Tiger Salamanders under the road (p. 101).
- c. NYSDOT works closely with the US Fish and Wildlife Service and NYSDEC to identify and protect endangered and threatened species within the State. Project

plans are reviewed by experts to avoid and minimize impacts on wildlife and habitats, especially for projects like wind farms (p. 101).

- d. NYSDOT designs and cultivates roadside vegetation to foster wildlife habitats, incorporating low-growing, drought-resistant plants capable of weed suppression, thereby establishing resilient, easily maintainable vegetation ecosystems (p. 101).
- e. NYSDOT retrofits the existing highway drainage systems to improve water quality and constructs stormwater control measures to reduce non-point source pollution that degrades aquatic habitats (p. 101).

3. Resilience and Adaptation

- a. NYSDOT adheres to stormwater management best practices as outlined in guidance documents like the Nonpoint Source Management Program catalogs for roadway maintenance and construction. For example, NYSDOT employs vegetated ditches and swales along highways to reduce stormwater runoff velocities, capture sediments, and enhance water quality before it reaches water bodies. Additionally, NYSDOT mandates stormwater pollution prevention plans that incorporate runoff control measures for its construction projects (p. 102).
- b. Since 2007, NYSDOT has actively assessed extreme weather impacts on its assets through a dedicated statewide working group that conducts ongoing research of national trends and collaborates with federal and state agencies for innovative solutions (p. 114).
- c. NYSDOT's capital program requires all projects to include strategies addressing potential disruptions from extreme winter weather, flooding, and storms. Project selections and engineering decisions at NYSDOT account for past repairs and anticipate future conditions, ensuring asset resilience over their expected lifecycles (p. 114).
- d. NYSDOT has implemented year-round protocols like the *Flood Watch Bridge Program* for critical structures and maintains roadway and drainage systems to mitigate failure during major events (p. 114).
- e. NYSDOT's infrastructure maintenance priorities are determined by assessing risks to public safety, enabling prompt response to urgent needs by NYSDOT crews or emergency contractors using comprehensive risk management and engineering judgment. For instance, NYSDOT's Bridge NY program provides enhanced financial assistance to cities, counties, towns, villages, and other local entities to rehabilitate or replace locally owned bridges and culverts (p. 114).
 - i. This program focuses on reducing flood risk, enhancing structural resilience, and promoting regional economic competitiveness—all contributing to combating the impacts of extreme weather.

4. Multimodal Connectivity & Intermodal Development

- a. *Freight Core Network (FCN)*: established in 2019 by NYSDOT to emphasize multimodal assets and infrastructure that are critical to the State's goods movements. Through work with stakeholders and partners, NYSDOT designated the network to help the department zero in on critical freight assets in the state to which to direct analysis efforts and resources. The FCN is intended to emphasize the importance of infrastructure assets beyond the network identified by other programs, and support the state in targeting investments to key corridors and access routes (p. 24).
- b. *Peace Bridge & Border Modernization*: Peace Bridge is a 5,800-long bridge arched over the Niagara River connecting Buffalo, New York and Fort Erie, Ontario. The Peace Bridge's strategic location and extensive highway network designate it as a key freight route. Yet, commercial trucks often encounter delays

and congestion, notably upon entering Canada. To remedy this, the Bridge Authority is introducing **state-of-the-art screening tech**. This includes facial recognition, advanced X-ray imaging, and vehicle scanning portals to expedite truck inspections and ease congestion (p. 37).

- c. *New York State's Passenger and Freight Rail Assistance Program*: In March 2024, a \$111.1 million investment was announced under this program to support various port and freight rail infrastructure projects across the State. The projects cover a wide range of infrastructure improvements across various regions in New York, including enhancements to rail safety and capacity, upgrades to port facilities, and investments in environmentally friendly technologies. For instance, funds are allocated to projects such as replacing rail and enhancing safety components on key corridors, upgrading port infrastructure to accommodate heavier cargo, and improving rail-to-truck facilities to reduce truck traffic (p. 128).

5. Technology and Innovation

- a. NYSDOT's Freight Technology White Paper identifies several such technologies including but not limited to communication technologies that can improve truck navigation and terminal reservation systems, connected vehicle technologies to improve safety, and blockchain applications for better supply chain visibility (p. 106).

6. Workforce Development

- a. NYSDOT prioritizes workforce development and sponsors transportation industry training programs to foster a robust talent pipeline, enhance productivity, promote safety adherence, and facilitate public-private collaborations. NYSDOT supports professional development opportunities for its entire workforce, including management, leadership, and automation training (p. 123).
- b. NYSDOT's On-the-Job Training Supportive Services (OJT/SS) Unit partners with commercial driver's license schools to provide training programs across the State. There is an opportunity to expand the talent pool by lowering the eligibility age from 21 to 18 years old (p. 123).
- c. The OJT/SS Unit also collaborates with FHWA to offer the National Summer Transportation Institute (NSTI) program, aimed at engaging socially and economically disadvantaged high school students in STEM-related careers. Colleges in New York State can apply to host an NSTI program through NYSDOT (p. 123).

7. Partnerships and Collaboration

- a. *USDOT's Freight Logistics Optimization Works (FLOW)*: FLOW is a public-private partnership launched in March 2022 to create an integrated view of the US supply chain conditions. It helps its industry participants (including beneficial cargo owners, ocean carriers, ports, terminals, railways, and freight forwarders) forecast capacity and throughput against future demand, allowing them to manage supply chain disruptions proactively (p. 94). Key benefits for public agencies like NYSDOT include (p. 94):
 - i. Comprehensive view of supply chain conditions, aiding proactive planning
 - ii. Informed decision-making regarding investments to improve freight movement
 - iii. Collaboration with the private sector for innovation and addressing supply chain challenges
 - iv. Understanding inland freight hubs to enhance supply chain resilience

8. Leveraging Funding

- a. During the period of 2019-2024, NYSDOT has supported numerous projects and initiatives through various programs like the NHFP fund, *Passenger Freight Rail Assistance Program* (PFRAP), Rail Crossing Safety (Section 130) program, and CMAQ. Furthermore, NYSDOT assists local agencies statewide in pursuing federal discretionary grants, including Rebuilding American Infrastructure with Sustainability and Equity (RAISE), Infrastructure for Rebuilding America (INFRA), Consolidated Rail Infrastructure and Safety Improvements (CRISI), Port Infrastructure Development Program (PIDP), and Bridge Investment Program (BIP) (p. 115).

North Carolina

1. 2021 Resilience Strategy Report

- a. The report asserts that high impact weather events and natural hazards disrupt the safety and reliability of NC's multimodal freight transportation network. NCDOT is taking steps to **prepare and respond to the threat of natural hazards and extreme events by focusing more coordinated efforts on transportation resilience**. Numerous projects have been undertaken to address resilience and are detailed in the report (NCDOT, 2023, p. 11).

2. Intermodal Development

- a. *Carolina Connector (CCX) Intermodal Terminal*: Located in Rocky Mount, this terminal connects short lines to larger national terminals, improving connectivity for local industries and increasing the competitiveness of North Carolina's freight network (NCDOT, 2023, p. 3-9).

3. Innovative Technologies

- a. **Connected and Autonomous Vehicles (CAV) Program**: The Triangle Expressway serves as an autonomous vehicle testing site where truck platooning demonstrations have shown fuel savings of 5-20%. Platooning demonstrations have occurred on it, in collaboration with Volvo and Fedex. This action aligns with North Carolina's goals for improving freight efficiency through technological innovations (NCDOT, 2023, pgs. 6, 6-1).

4. Environment: Wildlife

- a. NCDOT evaluates each project to determine how to avoid and minimize impacts on wildlife and protect habitats, such as or projects in known wildlife corridors or prime habitat areas. wildlife crossing under Interstate 40 at Harmon Den Road in Haywood County is currently under construction (NCDOT, 2023, p. 1).
- b. NCDOT has multiple perimeter fencing construction projects in different counties aimed to increase the safety and reduce wildlife (NCDOT, 2023, pgs. 7-39, 7-33, 7-45).

North Dakota

1. Intermodal Development

- a. *Minot Logistics Park (MLP)*: The Logistics Park of North Dakota in Minot provides truck-rail transload services, allowing shippers in central and western North Dakota to access domestic and international markets more competitively. It supports unit train operations, improving supply chain efficiency for agricultural producers and energy firms by offering a vital intermodal option in a rural area with limited rail access. This facility is part of the state's strategy to improve access to Class I railroads and inland port capacity (p. 119).

- b. *Grand Forks Railroad Underpass*: NDDOT is supporting a new underpass near the University of North Dakota to replace an at-grade rail crossing on Demers Avenue. This project will reduce congestion and delay caused by frequent train traffic, improve pedestrian and freight safety, and support smoother truck movements near commercial and educational institutions. The project received \$30M in federal support and is a priority for local intermodal traffic (p. 132).

2. Innovative Technologies

- a. *Transportation Innovation Program (TRIP)*: North Dakota's TRIP encourages local jurisdictions, consultants, and contractors to submit innovative ideas for infrastructure and operational improvements. Focus areas include freight technologies such as intelligent truck routing systems, in-pavement sensors, and ITS applications to improve freight movement. The program fosters a culture of experimentation and performance-based testing to validate next-generation transportation solutions (p. 94).
- b. *Smart Truck Parking and ITS Deployment*: The freight plan supports expanded use of Intelligent Transportation Systems (ITS), including truck parking availability systems and connected signal systems to improve traffic flow on freight corridors. These systems are intended to reduce fuel use, idling, and delivery delays, particularly in bottleneck areas or high-volume corridors (p. 96).

3. Environment: Wildlife

- a. *Integrated Environmental and Cultural Reviews*: NDDOT incorporates environmental, cultural, and wildlife considerations into freight planning and project development. Evaluations include potential impacts on protected species, water quality, and sensitive habitats, ensuring infrastructure minimizes ecological disruption. Projects undergo NEPA and state-level review, with emphasis on early environmental screening during project scoping (p. 90).
- b. *Habitat-Resilient Infrastructure Design*: Bridge and culvert projects on freight corridors are designed to reduce habitat fragmentation and protect aquatic and terrestrial species. These include adaptations to accommodate wildlife movement and prevent barrier effects along stream crossings and prairie ecosystems (p. 90).

4. Tribal Engagement

- a. *Engagement with Tribal Governments*: NDDOT ensures that North Dakota's five Tribal Nations are included in all phases of freight planning. The plan recognizes the unique jurisdictional and cultural considerations of Tribal communities and integrates their feedback into corridor and investment decisions, particularly for rural freight access and safety (p. 93).
- b. *Flexible Transportation Fund (Flex Fund)*: This fund enables local governments, counties, townships, and Tribal entities to apply for funding to support critical freight and multimodal transportation projects. It prioritizes projects that reduce restrictions and improve regional connectivity (p. 93).

5. Resilience and Adaptation

- a. *Weather-Resilient Freight Routing*: Freight system planning accounts for seasonal impacts such as freeze-thaw cycles, spring road restrictions, flooding, and blizzards. NDDOT includes weather-resilient routing plans in freight corridor management to reduce disruptions to supply chains during extreme weather (p. 87).
- b. *Flood-Resilient Design of Freight Infrastructure*: Design standards for culverts, bridges, and roadside drainage systems include criteria for flood resilience. Vulnerability assessments are used to ensure long-term durability of freight

infrastructure along critical rural corridors vulnerable to flash floods or long-term hydrologic changes (p. 93).

6. Safety Improvements

- a. *US 52 Safety and Capacity Enhancements*: NDDOT secured a \$20M INFRA grant to improve 45 miles of the US 52 freight corridor. Upgrades include acceleration/deceleration lanes, bypasses at rail crossings, and turn lanes, all of which aim to enhance truck safety and reduce congestion on one of the state's most important freight routes (p. 132).
- b. *SECURE Rail Project – Red River Valley & Western*: This project received a \$20.7M CRISI grant to replace aging track, construct sidings, and improve safety across 25 miles of the Red River Valley & Western Railroad. These improvements will reduce derailment risks, increase freight capacity, and enhance rural connectivity for grain and energy shippers (p. 132–133).

7. Workforce Development

- a. North Dakota's freight strategy includes workforce planning elements tied to logistics jobs and training pipelines. The plan recommends collaboration with education institutions to ensure the availability of CDL-certified drivers and logistics technicians, particularly in rural and Tribal areas (p. 85).

Oklahoma

1. Intermodal Development and Multimodal Connectivity

- a. *Port 33 Connector Project*: Oklahoma prioritized the SH-412P connector road to Oakley's Port 33 in Wagoner County, linking the inland port directly to the Primary Highway Freight System. This enhances access to the McClellan-Kerr Arkansas River Navigation System (MKARNS), supporting barge-truck connectivity and export efficiency (p. 6-39).
- b. *National Multimodal Freight Network Integration*: ODOT actively identifies rail lines, port facilities, and highway corridors that are essential to Oklahoma's freight network, even when not designated federally. This allows the state to guide funding and planning beyond the National Highway Freight Network (NHFN) limitations (pp. 6-39, 6-40).
- c. *Strategic Corridor Coordination*: Oklahoma collaborates with neighboring states to enhance funding and development of multimodal corridors of economic and security importance (p. 6-3).
- d. *Intermodal Freight Facility Planning*: The plan identifies the need to improve transmodal operations, especially for agriculture, by enhancing access to rail and barge terminals for exports (p. 4-14).

2. Innovative Technologies

- a. *Connected and Automated Vehicle (CAV) Integration*: Oklahoma is preparing for increased automation in trucking through pilot testing and partnerships with tech firms. For example, Kodiak Robotics partnered with Ceva Logistics to conduct automated freight hauls between Texas and Oklahoma City via I-35 (p. 4-14, 4-21).
- b. Predictive cruise control and platooning are other highlighted technologies that improve fuel efficiency and safety (p. 4-14).
- c. *Rail Safety Innovations*: Oklahoma is advancing rail technology with drones for bridge and tunnel inspections, Positive Train Control (PTC), and advocacy for next-gen braking systems to reduce hazardous material risks (p. 4-21).
- d. *Waterway Modernization*: With federal IJA support, the USACE is deepening the Arkansas River navigation channel (MKARNS) to increase barge capacity by

- 40%, improving cost-effectiveness and competitiveness of waterborne freight (p. 4-21).
- e. *OKiePROS Freight Routing Tool*: ODOT provides the Oklahoma Permitting and Routing Optimization System (OKiePROS) to assist OSOW freight carriers in efficiently planning routes while reducing infrastructure wear and enhancing safety (p. 4-21).
- 3. Resilience and Adaptation**
- a. **Resilient Infrastructure Design**: Oklahoma incorporates resilience measures into the planning and design of freight infrastructure to withstand flooding and extreme weather events. These measures were added as new strategies in response to IJIA guidance (p. 6-3).
 - b. **Critical Supply Chain Monitoring**: The state is actively inventorying and evaluating its critical supply chains to assess their reliability and resiliency under evolving conditions (p. 6-3).
- 4. Safety and Truck Parking**
- a. ODOT is updating its statewide rail crossing inventory and using FRA crash risk ratings to prioritize safety investments, including separation projects or improved signalization (p. 6-3).
 - b. **Truck Parking Expansion and Information Sharing**: The state is addressing truck parking shortages through partnerships with the private sector and digital solutions that provide real-time parking availability (p. 6-3). *OKiePROS* assists OSOW vehicle operators with efficient routing (p. 6-3).
- 5. Community Impact**
- a. *Last-Mile Freight Delivery Considerations*: Oklahoma recognizes the challenges posed by growing urban deliveries. The state anticipates increased community feedback on delivery disruptions and plans to improve public understanding of freight's role (p. 4-14).
 - b. *Neighborhood-Friendly Freight Technology*: By adopting technologies that improve visibility and reduce noise, the plan emphasizes making freight operations more acceptable in residential areas (p. 4-14).
- 6. Partnerships and Governance**
- a. **Collaborative Freight Planning**: ODOT works with Class I railroads, private logistics providers, MPOs, and federal entities to coordinate investments, data-sharing, and project prioritization (p. 6-3).

Oregon

- 1. Technological Innovation**
- a. **Freight Emission-Reduction Technologies**: Oregon is implementing several technologies, such as idle reduction programs, port scheduling systems for truck arrival/departure, alternative fuel cargo equipment, and smart driving practices (eco-driving) (p. 5-14).
- 2. Intermodal and Multimodal Freight Development**
- a. **Marine Highway and Port System Modernization**: Oregon's Columbia/Willamette/Snake River system (M-84) and Pacific Coast corridor (M-5) are designated federal Marine Highways. These corridors are eligible for funding to alleviate truck congestion. Major ports (Portland, Coos Bay, Astoria) are pursuing investments, including a \$1.2B project at Coos Bay to develop the Pacific Coast Intermodal Port (pp. 4-5, 4-6).
 - b. **Rail and Short-Line Connectivity**: The plan emphasizes the importance of Oregon's 2,203 miles of rail—including Class I and short-line routes—for bulk

freight and forest products. ODOT encourages investment in short-line infrastructure, which feeds into larger national rail corridors (p. 4-2).

- c. *Over-Dimensional Freight Pinch Point Study*: ODOT's 2016 study identifies and prioritizes 381 infrastructure pinch points that restrict oversized freight movement. These constraints include low-clearance bridges and weight-limited segments, many of which hinder freight flow across state corridors (p. 8-23).

3. Resilience and Adaptation

- a. *Seismic Freight Corridor Strategy*: ODOT has developed a seismic vulnerability program identifying key freight lifeline routes that need retrofitting to ensure access and recovery post-earthquake. Critical bridges and landslide-prone zones are being prioritized using the 2014 "Seismic Plus" framework (p. 8-24).

4. Funding

- a. *Connect Oregon*: a competitive grant program funded by the privilege tax that provides funding for non-highway freight projects including aviation, marine, and rail transportation projects. As such, the program improves or preserves modal alternatives that may reduce GHG emissions, as compared to trucking (p. 5-4).
- b. *Congestion Mitigation and Air Quality (CMAQ)*: The purpose of the CMAQ program is to improve air quality. The Federal Highway Administration awards CMAQ funds to Oregon through ODOT. (p. 5-4).

Pennsylvania

1. Partnerships

- a. *PennDOT Connects*: PennDOT's approach to enhance local engagement and improve transportation-project planning, design and delivery. This policy was launched in December 2016 and expands PennDOT's requirements for engaging local and planning partners by requiring collaboration with stakeholders before project scopes are developed and ensures community collaboration happens early in the process. It certifies that each project is considered in a holistic way for opportunities to improve safety, mobility, and access for all modes and local contexts.
- b. *Regional Operations Plan (ROP)*: A plan which lays out the strategic transportation operations program for the region, including specification of regional projects. The program delineated in the ROP is to be implemented and mainstreamed in transportation planning documents and day-to-day activities.

2. Multimodal Connectivity

- a. *Port of Erie and Inland Marine Strategy*: The Port of Erie provides multimodal access (rail, highway, barge) to Midwest and Canadian markets. Key investments include a rail spur connecting to CSX, integration with Bayfront Parkway, and cargo handling for construction materials and wind energy equipment (p. 41).
- b. *Port of Philadelphia—Container Growth & Incentive Program*: PhilaPort benefits from rail and I-95 connectivity, deepened shipping channels, and the Intermodal Cargo Growth Incentive Program (PICGIP). The program incentivized container throughput at state ports, increasing competitiveness and reducing highway congestion (p. 40).
- c. *Short-Line Rail Enhancements*: Pennsylvania's 57 Class III (short-line) railroads are supported through programs to upgrade aging infrastructure inherited from Conrail, focusing on heavier axle-load compliance and rail-to-truck transload sites (p. 38).

3. Transportation Security

- a. *PennSTART*: In Spring 2018, PennDOT, the **Pennsylvania Turnpike Commission**, and **Penn State University** partnered to develop **PennSTART**, a state-of-the-art training and testing facility to address the transportation safety and operational needs of Pennsylvania and the Mid-Atlantic Region. When completed, PennSTART will address safety training and research needs in six key areas: traffic incident management (TIM); connected and automated vehicles; tolling and intelligent transportation systems (ITS) technology; work zones; commercial vehicles; and transit vehicles (p. 76).

4. Infrastructure Resilience

- a. *Rapid Bridge Replacement Program*: A program that replaced 558 structurally deficient bridges across Pennsylvania under a design-build-finance-maintain (DBFM) public-private partnership (P3) arrangement between PennDOT and Plenary Keystone Partners.

5. Data & Information Systems

- a. *Pavement Asset Management System (PAMS)*: PennDOT software that assists both engineers and planners by providing a recommended list of projects, based on individual or regional input and needs, in accordance with federally mandated lowest life cycle cost (LLCC) methodology. Pavement condition forecasts are generated over 12 years based on current condition data housed in PennDOT databases and the improved conditions expected as a result of future projects.
- b. *Bridge Asset Management System (BAMS)*: PennDOT software that assists both engineers and planners by providing a recommended list of projects, based on individual or regional input and needs, in accordance with federally mandated lowest life cycle cost (LLCC) methodology. Bridge condition forecasts are generated over 12 years based on current condition data housed in PennDOT databases and the improved conditions expected as a result of future projects.
- c. Data sources such as AASHTO forecasting tools, weigh-in-motion data, and vehicle probe datasets are used to predict truck volumes and design infrastructure around freight-intensive developments (p. 32).
- d. PennDOT is expanding Intelligent Transportation Systems (ITS) and exploring public-private technology partnerships, such as for real-time traffic monitoring, weigh-in-motion systems, and CAVs, to improve safety and system efficiency (p. 15).

South Dakota

1. Environment

- a. SDDOT Wildlife Biologists are involved in all stages of project development, conducting habitat surveys, coordination with regulatory (USFWS) and resource agencies (SDGFP), evaluating potential adverse impacts, and recommending impact avoidance or minimization measures (p. 4-13).

2. Data and Information Systems

- a. Some of the ways South Dakota has implemented ITS technology to improve safety and security involve using the following tools (p. 5-2):
 - i. 511 and Safe Travel USA for road and traffic conditions
 - ii. Cameras and weather stations at various locations throughout the state
Cameras at rest areas
 - iii. Dynamic message signs
 - iv. Tire anomaly sensors

- b. South Dakota uses travel time data on the National Highway System to compare expected travel times to observed travel times. South Dakota monitors mainline, intersection, and interchange capacity and geometrics where bottlenecks could occur (p. 5-1, 5-2).
 - c. *Pavement and Bridge Management Systems*: Use pavement and bridge management systems and Transportation Asset Management Plan to prioritize improvements on the freight network. The pavement management system determines the best treatment for pavements to maximize the efficient use of highway funds. The bridge management system manages bridge improvements to maximize the efficient use of highway funds (p. 5-2).
- 3. Partnerships**
- a. A Study Advisory Team (SAT) was assembled from various offices within the South Dakota Department of Transportation, complimented by interested partners from the state's trucking and agriculture industries to collaborate the development of this plan and consider key stakeholders (p. 1-5).
- 4. Resilience and Adaptation**
- a. Winter weather events have the greatest impact on travel time and South Dakota will monitor ways to improve travel time during and after events. **Snow fencing** has been installed in areas of known drift impacts to travel and results will be closely observed for implementation at additional sites (p. 1-2, 5-2).
- 5. Decennial Interstate Corridor Study**
- a. Every 10 years, SDDOT conducts this study which looks at the entire Interstate system including interchanges. South Dakota uses this tool to program projects and identify corridors or interchanges for detailed study. SDDOT's last study was completed in 2020 and is currently working on a study on I29 from the Iowa-South Dakota state line to the Jefferson City, SD, exits 1 through 9. Freight, especially truck and rail freight movements are considered in all other planning studies, though the context may focus on passenger vehicles and pedestrian movements. Regardless, efficient freight movements are considered during the transportation planning process (pp. 5-2, 5-3).

Tennessee

- 1. Funding for Infrastructure**
- a. *State Industrial Access (SIA) Program*: TDOT provides grants for state industrial roadways through the SIA Program, formerly known as the Industrial Highway Act of 1959. It authorizes TDOT to contract with cities and counties for the development of industrial highways throughout the state. These highways are to provide access to industrial sites or industrial parks. This program provides grants for local agencies to design or construct public access roads to these industrial areas based on project type, economic benefit, physical constraints and available funding (p. 38).
- 2. Community Considerations**
- a. The *Short Line Railroad Preservation Grant Program* is managed by TDOT and is designed to preserve rail service to local communities (mostly rural) and expand rail connectivity to sites along existing rail corridors. The primary purpose of the program is to facilitate efficient and economical movement of freight within Tennessee by strengthening the short line railroad network (p. 38).
 - b. *Highway Traffic Noise Abatement* created in accordance with 23 CFR 772 and approved in April 2011. The Policy on Highway Traffic Noise Abatement outlines

the process used to decide on highway traffic noise abatement and the cost-effective expenditure of funds on the state's highway system (p. 37).

3. Coordination and Collaboration

- a. *Corridor Management Agreements (CMAs)*: provide a framework for multi-jurisdictional coordination of transportation and land use planning efforts. Often the goals set for the CMA include the promotion of economic development as well as the preservation of community character (p. 37).
- b. The *Appalachian Regional Commission (ARC)* is an economic development partnership agency of the federal government and 13 state governments focusing on 423 counties across the Appalachian Region. In Fiscal Year 2021, ARC was awarded \$180 million from Congress. Over half of Tennessee's counties are in the ARC and 52 are awarded grants. ARC's Area Development Program (ADP) makes investments in two general areas: critical infrastructure and business/workforce development (p. 39).
 - i. **Tennessee Department of Economic & Community Development (TNECD) manages a grant program** that annually selects and provides ARC funds to the counties in the ARC. The grants are limited to \$1 million for construction projects, \$500,000 for non-construction projects, and require cost sharing or match funding.
 - ii. Specific to freight planning, the infrastructure element of ADP focuses primarily on water/wastewater systems, transportation networks, broadband and other projects anchoring regional economic development and connecting rural and urban communities (p. 40).
- c. The Eastern Transportation Coalition (Formerly the I-95 Coalition): Evolved from a small, highway-focused group to more than 200 public agencies promoting reliable, efficient and balanced intermodal transportation. The ETC is a partnership of 17 states and D.C. The Coalition supports leadership, information technology, and operations that improve intermodal freight movement. The Coalition Freight Program focuses its efforts on the movement of freight across multiple jurisdictions and multiple modes. Through the program's Freight Committee, the Coalition is actively helping states by working on transportation issues that impact goods movement to foster safety, mobility, and economic vitality within states and across the Corridor (p. 47).

4. Statewide Travel Demand Model

- a. TDOT updated and officially approved the latest Statewide Travel Demand Model (TDM), the TSM V4.0, in 2021. The TDM model can be used to forecast freight movements and estimate freight travel behavior. To assist with the TSM V4.0 development, TDOT obtained American Transportation Research Institute (ATRI) data and Transearch data. The freight forecasting shows the effects of roadway congestion due to changes in freight traffic on the Tennessee statewide network. The TSM V4.0 is also capable of estimating future truck trips including short and long-haul trips and commodity flows for 43 commodity categories (p. 37).

5. Research and Development

- a. *The University of Tennessee Center for Transportation Research (CTR)*: oversees various programs associated with the education, research, training, and workforce aspects of the transportation field. CTR, over the years, has assisted TDOT on several freight-related research and policy initiatives including truck lane restrictions, rail transportation research and various transportation and freight-related technology transfer activities. CTR is also an active participant in Tennessee's Freight Advisory Committee (p. 44).

- b. *Vanderbilt University Center for Transportation Research (VECTOR)*: a research center located in Nashville that specializes in transportation research. Intermodal freight transportation, risk assessment, geographic information systems (GIS) and intelligent transportation systems (ITS) are some of VECTOR's key research areas. In the past, VECTOR has conducted freight-related research on trucking operations and safety, inland marine transportation, safety, security, capacity of rail corridors and freight diversion and capacity issues in Tennessee. VECTOR is also a participant in Tennessee's Freight Advisory Committee (p. 44).

Texas

1. Resilience Planning

- a. *TxDOT Transportation Resilience Planning Scorecard and Best Practices*: This study resulted in a framework for incorporating infrastructure resiliency into the project planning process and is available to the Statewide Resiliency Plan team to further integrate with other technical, social, and security attributes along with other TxDOT initiatives and programs (p. 148).
 - i. Link: <https://library.ctr.utexas.edu/Presto/project=7079>.

2. Resilience and Adaptation

- a. Stormwater runoff quantity and quality are coordinated with TCEQ to minimize environmental impacts from infrastructure development. TxDOT considers hydrology and hydraulic activity at every stage of project development, proliferating guidance in its *Hydraulic Design Manual* (p. 150).
- b. During preliminary engineering, drainage agreements, locations and sizes of bridges and culverts, and *Federal Emergency Management Administration (FEMA) Special Flood Hazard Areas* are all considered. Preliminary hydraulic studies are conducted during the environmental stage. This stage **estimates the impacts of a specific project on waterways and floodplains and identifies mitigation measures**. Finally, the Plans, Specifications, and Estimates (PS&E) phase results in **refined design**, geotechnical review of bridge design, drain and pump sizing, and development of **Stormwater Pollution Prevention Plans (SW3Ps)** (p. 150).

3. Environment: Wildlife

- a. TxDOT's *Research and Technology Implementation Office* sponsored a project on incorporating wildlife crossings into TxDOT's project development, design, and operations processes. The study by the Center for Transportation Research (CTR) included observations of installed wildlife crossings in the TxDOT Pharr District. The Pharr District has developed 12 wildlife crossing structures along one highway corridor (p. 149).

4. Research on Nearshoring Opportunities

- a. COVID-19 pandemic illustrated the fragility of complex supply global chains, encouraging some manufacturers to shift production closer to the U.S. market.
- b. *Texas-Mexico Nearshoring Study*: engaged more than 50 private and public sector stakeholders (mostly from Mexico). They helped identify a broad spectrum of industries attractive for **nearshoring** including: automotive, furniture, plastics, textiles, pharmaceuticals, aerospace and aviation, machinery and equipment, and computers and electronics (p. 8).

5. Innovative Technology

- a. Texas has encouraged testing and deployment of autonomous vehicles. The non-restrictive regulatory environment for automated vehicles in Texas contributes to an atmosphere of robust testing (p. 10).

- b. Senate Bill 1308, passed in 2021, called for a study to estimate the benefits and impacts of automated and connected driving systems on congestion at the Texas-Mexico border crossing, drive and public safety and transportation industry workforce (p. 9).
 - c. TxDOT is also leading an effort on **Connected Freight Corridors** that can leverage advances in sensors and data communication to create a “**smart**” **freight network** that allows vehicles to communicate with one another and algorithmically minimize overall delay times and vehicle miles traveled (p. 9).
 - d. TxDOT is currently home to about 40 different deployment demonstrations that include ADS/CDS applications that range across a variety of vehicle types and applications. Major categories include freight-focused applications to add efficiency to long-haul trucking; last-mile delivery, transit, and rideshare applications to support urban mobility; and system communications enhancements to yield greater efficiency and safety from the transportation system (p. 10).
- 6. Multimodal Connectivity**
- a. The **Texas A&M Transportation Institute (TTI)** initiated research on the **Freight Shuttle System (FSS)** to develop a suitable short-haul and high-volume mode that segregates freight from passenger traffic. The most suitable application would be at seaports, landside ports-of-entry and congested transportation corridors. **Integrating this system with rail and trucking could ease congestion and provide secure movement of goods at the border.** This system would use linear induction motors, autonomous transporters and have redundant safety systems. A prototype system is complete and in pilot testing. Future development for design and planning for an actual system is in process. Freight Shuttle Xpress (FSX) is the result of this research and is working to advance the concept in an operational environment (p. 137).
- 7. Infrastructure Resilience**
- a. Weigh-in-motion and vehicle classification (WIM/VC) stations improve TxDOT’s **ability to monitor and manage vehicle weights and types on the highway network to improve planning related to pavement quality and capacity.** Truck drivers also benefit from operational improvements and fuel savings because drivers do not have to come to a stop at weigh stations (p. 134).
 - b. There are 41 permanent WIM/VC stations in Texas, and the *WIM/VC Strategic Plan* prioritized locations for additional sites (p. 134).

Utah

1. Weather-Related Risks, Resilience, & Adaptation

- a. *Risk Management:* Utah’s Freight Plan specifically addresses the state’s **vulnerability to natural disasters.** For instance, **avalanche control** measures on freight corridors, especially in areas like Little Cottonwood Canyon, involve the use of explosives to manage snowpack risks that could disrupt freight movement (p. 28).
- b. *Asset Risk Management:* UDOT incorporates an **Asset Risk Management Process** to evaluate the resilience of key infrastructure, such as bridges and roads, to ensure they can withstand the impacts of extreme weather events like snowstorms or floods. This process helps prioritize projects that protect the transportation network’s ability to handle both everyday traffic and freight during such events (p. 33).
- c. *Flood Mitigation:* The Freight Plan outlines strategies for managing **stormwater runoff**, particularly in areas prone to flooding. UDOT collaborates with the

Department of Environmental Quality (DEQ) to reduce the environmental impacts of flooding on infrastructure, ensuring that freight corridors remain passable during extreme weather events (p. 41).

2. Technological Innovation

- a. *Connected Vehicles*: Utah implements connected vehicle technologies. The Freight Plan promotes the use of **Vehicle-to-Infrastructure (V2I)** systems that allow vehicles to communicate with road infrastructure like traffic lights, signs, and sensors. This improves safety and reduces delays for freight vehicles, allowing them to make better decisions in real-time, such as adjusting speeds to avoid congestion or hazardous conditions (p. 39).
- b. *Real-time Data Systems*: UDOT is deploying **Distributed Acoustic Sensing (DAS) technology**, which uses fiber-optic cables embedded in roadways to monitor real-time conditions such as **pavement health, traffic flow, and vehicle speeds**. This technology helps ensure that the state can manage its freight system efficiently and proactively, enabling faster responses to maintenance needs and potential disruptions (p. 41).

3. Multimodal & Intermodal Connectivity

- a. *Intermodal Freight Facilities*: The plan emphasizes the importance of expanding **multimodal freight hubs**, particularly in **Salt Lake City**, which serves as a critical junction for both **rail** and **truck freight**. UDOT is investing in enhancing **intermodal connectors** that allow easy transfer between different freight modes, thus reducing delays and congestion on highways and improving overall efficiency (p. 38).
- b. *Freight Rail Development*: The state is developing **key rail corridors**, such as those linking **Salt Lake City** with the **Port of Oakland** and other West Coast ports. These efforts are aimed at improving the **integration between rail and highway freight systems**, enabling smoother transitions between freight modes, reducing highway congestion, and improving supply chain efficiency (p. 32).

4. Human Safety

- a. *Truck Safety and Parking*: A significant challenge in Utah is the shortage of **designated truck parking** spaces along major freight corridors. The Freight Plan outlines strategies for expanding truck parking in **high-demand areas**, particularly near **interstate junctions** and **rest areas**. This helps mitigate risks related to **driver fatigue** and **illegal parking**, ensuring safety for both truck drivers and other road users (p. 29).
- b. *Crash Prevention Technologies*: UDOT has been incorporating **safety warning systems along freight corridors**, such as curve speed warnings and collision prevention alerts. These technologies are aimed at reducing accidents, particularly on mountainous routes that are prone to snow or ice during the winter months (p. 31).

5. Transportation Security

- a. *Cross-border Coordination*: Utah coordinates with neighboring states like **Nevada** and **Colorado** to improve the security of cross-border freight. This includes enhancing the screening and monitoring of goods at state borders to reduce smuggling and ensure that shipments comply with safety and environmental standards (p. 44).

6. Economic Development & Goods Movement

- a. *Logistics Center Development*: UDOT is planning a new multimodal logistics center in Southern Utah that will enhance the state's connectivity to major West Coast ports. This facility will serve as a regional distribution point, improving the

efficiency of goods transportation and helping to alleviate congestion on nearby highways (p. 47).

7. Infrastructure Resilience

- a. *Smart Infrastructure*: UDOT is making significant investments in **smart infrastructure** to improve the long-term resilience of Utah's freight system. This includes the installation of **road sensors** that can provide real-time data on road conditions, weather impacts, and traffic volume, enabling better management and maintenance decisions (p. 36).

Washington

1. Freight Mobility and Capacity

- a. *Puget Sound Gateway Program*: A series of critical roadway and bridge projects designed to enhance regional freight mobility and connect key facilities such as the Port of Seattle, Port of Tacoma, and Sea-Tac Airport. This project is expected to be completed by 2028 and aims to reduce congestion caused by freight traffic and improve the movement of goods within the Puget Sound area (pp. 74-75).
- b. WSDOT **addresses bottlenecks on critical freight corridors**, such as I-5, I-90, and the SR 509/167 connections, to improve the efficiency and reliability of freight travel times (pp. 74-75).

2. Truck Parking Solutions

- a. Washington identified key truck parking challenges, particularly around urban areas and freight corridors like I-5, I-90, and I-82. *The Washington State Truck Parking Study (2021)* found that there is a shortage of adequate truck parking, especially around key corridors like I-5 and I-90. This shortage causes economic, safety, and operational challenges, particularly for drivers needing to comply with hours-of-service regulations. This was confirmed through driver surveys, which reported long search times for available spaces (pp. 29-31).
- b. WSDOT is working to **expand truck parking capacity** and enhance safety by improving **designated parking areas** and reducing the need for **undesigned truck parking**, particularly in **urban areas** (pp. 28-31).

3. Resilience and Adaptation

- a. Washington State's freight infrastructure is at risk due to weather-related disruptions, particularly in coastal and flood-prone areas. WSDOT has developed strategies to ensure the resilience of the freight network against extreme weather events, including **flooding, wildfires, and earthquakes**. These efforts involve strengthening vulnerable infrastructure, such as bridges and tunnels, and incorporating **extreme weather projections** into design and maintenance decisions (pp. 55-56).
- b. The plan identifies key regions for targeted investments in **resilient infrastructure**, including the **I-5 corridor** and **SR 520 bridge**. The goal is to minimize disruptions to freight movement caused by extreme weather events (pp. 55-56).
- c. WSDOT is incorporating **disaster preparedness** and **business continuity planning** into the freight system. This includes ensuring that critical freight corridors can remain operational during and after emergencies (pp. 54-55).
 - i. The plan outlines measures for **emergency freight corridors** that prioritize rapid restoration of critical supply chains during and after disasters (pp. 54-55).

4. Safety and Incident Management

- a. **Target Zero program** is Washington's road safety initiative that aims to eliminate traffic fatalities and serious injuries on the state's roads. As part of this effort, WSDOT focuses on improving **truck safety**, especially in areas with high freight traffic such as **I-5, I-90, and I-405** (pp. 74-75).
 - i. The program includes several safety measures such as **advanced truck routing, improved signage** for truck drivers, and targeted **infrastructure improvements** at hazardous spots.

5. Multimodal Freight System and Connectivity

- a. WSDOT's focus is on maintaining these **intermodal connections**, ensuring smooth transitions between **truck-to-rail** and **water-to-rail** operations to boost system efficiency in Seattle and Tacoma. This includes enhancing **intermodal facilities** and promoting the use of **rail for bulk and long-haul goods**, and **waterways** for high-volume, low-value freight (pp. 18-22).

6. Workforce and Training

- a. As part of Washington's efforts to address the growing demand for freight professionals, WSDOT is working closely with educational institutions, including **community colleges** and **vocational schools**, to develop programs that focus on **commercial driver's license (CDL) training** and logistics management (pp. 78).
- b. In addition to educational collaborations, WSDOT also works with **industry groups** and **labor organizations** to ensure that Washington's freight workforce is **well-trained**, and ready to handle modern freight operations (pp. 78).

7. Innovative Technology

- a. Washington is investing in **state-of-the-art freight terminals** and **intermodal facilities** to support modern freight movements. The plan includes investment in **smart port facilities** and **automated warehouses** that can accommodate increased cargo volumes and improve the efficiency of moving goods through the state (pp. 56-57).
- b. **Port of Seattle** and **Port of Tacoma** are key sites for modernizing operations, with plans to expand **automated container handling** and implement **robotics** and **AI-based technologies** in freight operations (pp. 56-57).
- c. One key area of focus is the development of **Freight Technology Corridors** that use data and technology to optimize freight flow, reduce congestion, and improve safety. This includes the testing of **truck platooning** and **autonomous trucks** for specific routes to reduce the cost of freight movement (pp. 64-65).
- d. WSDOT is integrating **data-driven decision-making** into freight planning by using **real-time freight performance monitoring** and **big data analytics** to identify bottlenecks and assess freight system performance. ***The Freight Performance Monitoring Program (FPM)*** tracks key metrics, including **travel time reliability, traffic delays, and safety incidents**, to inform operational decisions (pp. 64-65).
 - i. These metrics help identify areas where operational improvements, like **signal timing** adjustments, or infrastructure upgrades, can be implemented to enhance system performance (pp. 64-65).

8. Regional and Multistate Coordination

- a. ***Pacific Northwest Collaboration:*** WSDOT actively works with neighboring states and Canadian provinces to tackle shared freight challenges, particularly in cross-border freight movement and infrastructure. For instance, Washington has partnered with Oregon and British Columbia to develop integrated solutions for

freight congestion, cross-border trucking regulations, and multimodal facilities (pp. 74-75).

- b. WSDOT supports the **Strategic Highway Network (STRAHNET)**, which ensures that **military freight** and **national security shipments** are prioritized and receive uninterrupted access across the state's freight corridors (pp. 23-24).
 - c. The freight plan aligns closely with other **state policy initiatives**, including the *Statewide Transportation Strategy*, *Climate Action Plan*, and the *Washington Clean Energy Transformation Act* (pp. 20-21). By aligning freight goals with these broader state strategies, Washington ensures that freight investments contribute to the state's overall goals for emissions mitigation, clean energy adoption, and environmental sustainability.
 - d. The plan also integrates freight considerations into **local and regional planning processes**, fostering coordination between WSDOT, **local agencies**, and **regional planning organizations** to ensure that freight infrastructure development supports broader community goals (pp. 21-22).
- 9. Funding**
- a. WSDOT uses various funding sources, including **federal transportation grants**, **state funds**, and **private partnerships** to support freight infrastructure projects. The plan emphasizes the use of **competitive funding mechanisms** such as the **INFRA** and **Rural Surface Transportation Grant programs** to address critical infrastructure needs (pp. 78-79).
 - b. Additionally, WSDOT works to align **state-level funding priorities** with the federal **Freight Investment Plan**, ensuring that the most pressing projects receive adequate resources. This is particularly important for addressing bottlenecks and capacity constraints on key freight corridors (pp. 78-79).

West Virginia

- 1. Infrastructure Resilience**
- a. *Infrastructure Maintenance and Modernization:* West Virginia's Freight Plan emphasizes maintaining infrastructure in a state of good repair, focusing on freight corridors and bridges. The plan includes **performance measures** to track conditions such as bridge and pavement health along designated highway freight corridors, ensuring long-term system sustainability (p. 3-8).
- 2. Human Safety**
- a. *Reducing Fatalities and Serious Injuries:* Safety is a critical focus, with measures to reduce **truck-related fatalities** and injuries, particularly on **high-risk corridors**. West Virginia aims to improve safety through better management of **freight traffic hotspots** and by investing in incident management and work zone management systems (pp. 3-10, 3-11).
- 3. Intermodal Connectivity**
- a. *Intermodal Freight Connections:* The state focuses on improving **intermodal connectivity**, such as **highway-rail connections** and **port access**, to enhance the flow of goods. Specifically, addressing **first- and last-mile challenges** is key to improving the efficiency of freight operations (pp. 2-6, 2-7).
- 4. Multimodal Mobility and Reliability**
- a. *Improving Network Reliability:* The Freight Plan focuses on **reducing delays** and enhancing the reliability of key freight corridors. This involves **reducing incident clearance times** and ensuring that highways are maintained for high-performance freight mobility (p. 3-12).

5. Workforce Development

- a. The state collaborates with universities and vocational schools to **train new freight operators**, ensuring a skilled workforce to meet the growing demand in transportation and logistics (p. 5-3).

Wisconsin

1. Resilience and Adaptation

- a. Wisconsin's Freight Plan emphasizes **identifying high-risk freight corridors** and using **data-driven tools** to guide project prioritization for resilience (p. 101).
- b. WisDOT has incorporated **flood risk assessments** in project planning to address **stormwater runoff** and **minimize flooding** impacts on infrastructure. This also involves **incorporating data** from the National Oceanic and Atmospheric Administration (NOAA) to design for future flood events (p. 102).
- c. WisDOT is investigating the potential of **vegetation barriers** along **right-of-way (ROW)** areas to reduce the spread of **invasive species** and protect local wildlife habitats (p. 102).

2. Technological Innovation

- a. *Emerging Technologies*: The plan outlines Wisconsin's commitment to **monitoring and adopting emerging freight technologies**. This includes tracking innovations in **autonomous vehicles**, **truck electrification**, and **e-commerce delivery solutions**. These technologies are anticipated to improve **safety**, **efficiency**, and **reliability** of the freight system (p. 106).
- b. *Intelligent Transportation Systems (ITS)*: WisDOT is also integrating **ITS technologies**, including **traffic sensors** and **real-time data collection** systems, which allow for better management of freight corridors and the early identification of potential disruptions (p. 105).

3. Human Safety

- a. *Highway Safety Improvement Program (HSIP)*: WisDOT uses this program to fund **safety projects** along highways and local roads with high crash histories. The emphasis is on low-cost options that can be implemented quickly, such as **intersection improvements**, **clear zones**, and **guardrails** (p. 40).
- b. Wisconsin is adopting **safety technologies**, such as **collision warning systems** and **driver behavior monitoring systems**, to reduce truck accidents, particularly in hazardous weather conditions (p. 105).
- c. *Rapid Incident Response*: Wisconsin has a target to clear **90% of intermediate incidents** within **two hours** and **80% of major incidents** within **four hours**, reducing disruptions and **improving safety** for freight transport (p. 40).

4. Transportation Security

- a. The plan highlights WisDOT's partnership with the **Wisconsin Emergency Management (WEM)** to ensure **security and emergency response** for hazardous materials, which is crucial for the safe transportation of goods across the state (p. 103).
- b. The state uses technologies including **cameras**, **sensors**, and the **Traffic Management Center (TMC)** to **monitor and manage incidents** in real-time, improving response times and reducing **secondary crashes** (p. 91).

5. Economic Development and Efficiency

- a. Wisconsin is investing in **logistics centers** to enhance regional connectivity, supporting **economic development** by improving the state's ability to move goods efficiently. These centers will facilitate trade and increase the state's competitiveness in the global market (p. 106).

6. Infrastructure Resilience

- a. Wisconsin is adopting **smart infrastructure** to improve the long-term resilience of its freight system. This includes the installation of **traffic sensors** and **weather detection systems** to improve management and reduce the impact of disruptions on freight flow (p. 101).
- b. Wisconsin coordinates with neighboring states to **streamline permits for oversize and overweight (OSOW)** loads. This allows for **safer and more efficient** transport of large freight loads across state lines (p. 91).

7. Maintenance Improvements

- a. *Performance-based Asset Management*: Wisconsin employs a **performance-based approach** for identifying and addressing **maintenance needs** on the state trunk highway system, ensuring **cost-effective preservation** and efficient use of resources (p. 91).
- b. *Preventive Maintenance*: WisDOT focuses on **preventive maintenance** to **extend the life of infrastructure**, including activities like **crack sealing** and **pavement preservation** (p. 91).

Appendix C: Cities and MPO's Best Practices

Atlanta

1. Transportation Safety and Security

- a. *Dilemma-Zone Detection Systems*: The introduction of **dilemma-zone detection** systems aims to enhance **intersection safety**, particularly where high-speed freight vehicles are present. This system extends yellow light phases based on vehicle speeds, reducing the risk of rear-end collisions (p. 77).
- b. The plan emphasizes **real-time parking information systems** to alleviate truck parking shortages in the region. This practice includes efforts to integrate **smart parking technology** to manage truck parking better, reducing congestion and enhancing operational safety, especially during peak freight hours (p. 77).

2. Infrastructure and Operations Enhancement

- a. *Connected Vehicle (CV) Technologies*: Atlanta is advancing **Vehicle-to-Infrastructure (V2I)** communication systems along major freight corridors. These systems allow trucks to interact with traffic signals and road infrastructure, helping to reduce delays and improve efficiency (p. 77).
- b. *Intelligent Transportation Systems (ITS)*: The use of **ITS technology** includes **dynamic traffic management** solutions that adjust traffic signals and provide route recommendations in real-time based on freight conditions. Key corridors like **Fulton Industrial Blvd** are being upgraded with ITS infrastructure to better handle freight movement (p. 77).

3. Multimodal Connectivity

- a. **Strategic Freight Cluster Plans (FCPs)**: The development of Freight Cluster Plans (FCPs) within key industrial and commercial districts, such as Fulton Industrial Blvd and Aerotropolis Atlanta, aims to improve multimodal connectivity. These plans focus on improving access between truck, rail, and other modes of transport (p. 77).

4. Adaptation

- a. The plan emphasizes sustainability by promoting the use of **infrastructure** such as **rain gardens and permeable pavements** along freight routes (p. 79).
- b. Additionally, investments are being made to **increase flood resiliency** in key freight corridors by improving stormwater management and flood protection systems (p. 79).

5. Workforce Development

- a. The plan discusses partnerships with local universities and training centers to ensure a skilled workforce for the growing freight sector. Specifically, Atlanta collaborates with universities such as **Georgia Tech** and **Georgia State University** to align educational programs with industry needs, particularly in **logistics, supply chain management, and transportation technology** (p. 16). These institutions help facilitate **workforce development** programs, training the next generation of workers to support advanced freight technologies and efficient operations.

6. Human Safety

- a. *Crash Hot Spot Identification*: The plan includes **comprehensive data collection** to identify **high-risk crash areas** along freight corridors. Mitigation strategies include **improving signage, installing more traffic lights**, and providing **clearer lane markings** at key intersections (p. 164).

- b. *Railroad Crossing Safety*: Specific attention is given to **at-grade railroad crossings**, where safety improvements, such as **automatic barrier systems**, are being implemented to reduce crashes involving freight vehicles (p. 164).

Boston Region MPO

1. Data-Driven Freight Planning

- a. The MPO has invested in **travel demand models** that incorporate **heavy vehicle data**, especially from toll systems, and **big data analysis** techniques to enhance accuracy in forecasting truck traffic. These data-driven insights are used for **regional planning** and **traffic management**, and they enable better decision-making for freight planning and infrastructure investments (p. 7-8).
- b. *Gate Surveys and Regional Intermodal Distribution*: Specific studies such as the **Conley Container Terminal gate survey** provide valuable data on truck and container movements in the region, offering insights into **intermodal distribution patterns**. This data informs decision-making regarding **intermodal terminal operations**, particularly those affecting **air freight** and **rail intermodal terminals** like those in **Worcester** (p. 13).

2. Partnerships

- a. The Boston MPO actively engages with **industry stakeholders** through frequent outreach, including presentations to the **Regional Transportation Advisory Council** and participation in **MassDOT's Freight Advisory Council**. The MPO staff's involvement in these groups ensures continuous collaboration with **private freight operators**, **local governments**, and **public agencies** to address freight-related issues (p. 13).
- b. MPO staff also collaborated with the **Federal Aviation Administration (FAA)** on a study examining **truck trip generation at airport air cargo facilities**. This collaboration helped develop alternative methodologies for estimating freight movement to accommodate growing **air cargo** demands in the region (p. 13).

3. Infrastructure Resilience and Improvement

- a. **Critical Urban Freight Corridors (CUFCs)**: As part of the **Fixing America's Surface Transportation (FAST) Act**, the Boston MPO designated several urban corridors as **Critical Urban Freight Corridors (CUFCs)**, including **Sullivan Square** and the **Southeast Expressway**. The designation of these corridors, particularly those identified in **Everett-Chelsea** and **South Boston Waterfront** studies, ensures that these routes are prioritized for **future investments** and incorporated into the **National Highway Freight Network** (p. 9-11).
 - i. These corridors are key to the region's **freight mobility**, and ongoing studies aim to address traffic issues, congestion, and truck flow (p. 11).
- b. Specific studies like the **Everett-Chelsea Truck Travel** study recommend modifications to the road network to **improve truck access** to industrial areas while **reducing impacts on residential zones**. This practice is a direct response to **infrastructure bottlenecks** that hinder freight flow (p. 3-4).
- c. The MPO conducted a study to identify the impact of weight and height restrictions on truck travel in the region. It maps out restricted bridges and provides qualitative estimates of how these restrictions affect truck movement, particularly for large vehicles and heavy goods. **This information is integrated into the MPO's travel demand model to help prioritize future projects** (p. 5).

Houston-Galveston

1. Intelligent Transportation Systems (ITS) for Freight Applications

- a. Designating a **Freight Technology Representative** within the H-GAC TSMO Subcommittee to drive the integration of emerging technologies (p. 82).
- b. Providing real-time information for the freight industry through the **Houston Regional Traffic Signal Map** (p. 82).
- c. **Early-stage deployment** of smart freight connectors, which will be prioritized on the H-GAC Critical Regional Freight Corridors (p. 82).
- d. There is also a focus on **collaborating with private sector autonomous trucking companies** to better integrate **autonomous trucks** into the region's freight corridors (p. 82).
- e. *Statewide Traffic Operations Center (STOC)*: A **centralized coordination system** at the **Houston TranStar** will integrate local Traffic Management Centers (TMCs) to share real-time data during freight disruptions, improving overall freight flow and reducing delays during adverse conditions (p. 14).

2. Innovative Technologies

- a. *Texas Connected Freight Corridor (TCFC)*: The **TCFC Project** has been highlighted as a key effort to integrate **vehicle-to-infrastructure (V2I)** communication along the **Texas Triangle** (I-10, I-45). The project is set to deploy roadside equipment for **safety messages, work zone information, and roadway conditions**, providing **real-time updates** to trucks, improving safety and operational efficiency (p. 14).

3. Data-Driven Freight Planning

- a. The plan emphasizes the **importance of data collection** to inform freight planning decisions. Data sources such as **truck counts, land-use analysis, and truck delay data** were incorporated to map and update the **H-GAC Freight Network**. This data-driven approach helped identify **517 miles** of freight-important highways not previously captured in the **National Highway Freight Network (NHFN)** (p. 8-9).

4. Parking and Logistics Solutions

- a. The **H-GAC Truck Parking Study** highlights the shortage of **public truck parking facilities** in the region and includes recommendations for expanding truck parking spaces, particularly in areas like **Katy-Brookshire** (p. 16). TxDOT is collaborating with **private companies** to establish new **truck parking facilities** near logistics centers, addressing long-standing capacity issues in the region.
- b. **Katy-Brookshire Logistics Hub**: A **freight village** concept is being piloted in the **Katy-Brookshire area**, aiming to provide **logistics centers** with direct access to **highway systems**. This project will streamline goods movement while reducing congestion in other parts of the region (p. 16).

5. Safety

- a. Given that Houston accounts for 17.6% of the state's truck-related crashes, there are several **safety initiatives**:
 - i. Establishment of a **Regional Truck Safety Task Force** (p. 84).
 - ii. Integration of **truck safety initiatives** into **Vision Zero** and other regional safety plans (p. 84).
 - iii. Recommendations to increase **truck parking spaces** to ensure drivers have adequate rest areas (p. 84).
- b. A *Regional Truck Safety Task Force* is being created to improve the safety of freight travel across the region. This will focus on enhancing the **design and**

management of truck routes to reduce accidents, particularly in **congested urban areas** (p. 17).

6. Bottleneck Reduction

- a. There is an emphasis on **off-peak truck activity** to reduce congestion, including creating a **Port Transportation Optimization Task Force** to improve the efficiency of port-related container movements (p. 84).
- b. The plan includes **congestion mitigation strategies** such as improving **signalization** at key intersections and expanding **truck-only lanes** to avoid conflicts with passenger vehicles, specifically on highways like **I-45** and **I-10** (p. 19).
- c. The **Truck 95th Percentile Planning Time Index (PTI)** is used to measure **travel time reliability** for trucks, with a focus on improving the reliability of travel times in congested areas (p. 21-22).

7. Infrastructure Resilience and Improvement

- a. The plan identified **517 miles of highways** to be added to the **H-GAC Freight Network**, focusing on **first and last-mile connectors** that are vital for improving access and congestion in freight corridors (p. 13).
- b. **346 projects** were evaluated, with **116 identified as high needs**. These projects are focused on upgrading critical freight corridors, especially around **I-45**, **I-10**, and **State Highway 99** (p. 63-72).
- c. The plan highlights the need to prioritize **railroad crossings** with high truck counts that impact **truck journey times**, with specific recommendations for upgrades within the **Houston Area Rail Transformation (HART) program** (p. 23-24).
- d. The collaboration between **Port Houston**, **Port of Freeport**, and the **Houston Airport System (HAS)** is highlighted, focusing on **infrastructure expansion** and streamlining **intermodal connectivity** for smoother freight movement. **HAS**, for example, is actively exploring new **cargo warehouse** expansions and infrastructure upgrades to increase freight capacity (p. 12-13).

8. Residential Considerations

- a. The plan includes measures to **mitigate residential impacts** of freight activity, focusing on neighborhoods in **LaPorte**, **Baytown**, and **Pasadena** that are heavily impacted by truck traffic (p. 84).
- b. A **regional truck route map** is being developed to better manage freight movement and reduce the impact on residential areas (p. 84).

9. Funding

- a. The plan highlights potential funding strategies for both **large-scale infrastructure projects** and **technology deployment** for freight management (p. 95).

Los Angeles County

1. Community Considerations

- a. Establishment of an ongoing goods movement-focused task force with community-focused stakeholders to guide the Metro's planning efforts on freight-related issues.
- b. This task force facilitates ongoing dialogue between community-based organizations (CBOs) and industry stakeholders to ensure freight planning aligns with community-driven goals (p. 80).

2. Public-Private Partnerships

- a. *Southern California Rail Investment Partnership*: This partnership aims to improve shared-use freight rail corridors, increase investment in freight rail capacity, and support regional mobility goals. The partnership will also work on creating a legislative platform to secure necessary investments and improve sustainability (p. 88).

3. Urban Freight Delivery

- a. LA Metro is addressing urban freight challenges by mainstreaming curbside demand and delivery issues into its planning efforts. This includes research on urban delivery and pilot projects to test findings and solutions. Additionally, Metro is working on the creation of a countywide curbside mobility policy platform to manage the increasing demand for curb space, especially as e-commerce deliveries rise (p. 92).
- b. *Curbside Demand Management*: Metro is continuing the **Curbside Mobility Forum as a recurring event** and is working with local jurisdictions, Metro departments, and curb space users to develop **solutions to curbside conflicts**. This initiative includes gathering data to understand urban delivery issues and develop potential solutions to alleviate first/last mile challenges. A countywide data portal will be established to manage curbside assets and regulations (p. 94).

4. Workforce Development

- a. Metro is partnering with educational institutions such as community colleges and trade schools to address workforce skill gaps and ensure that workers are prepared for the evolving logistics sector. Programs like **WIN-LA** focus on providing access to job training for underrepresented communities, including veterans and the homeless, thereby promoting diversity in the logistics workforce (p. 96).

Miami-Dade County

1. Truck Parking Solutions

- a. *Expansion*: Miami-Dade has acknowledged the severe shortage of truck parking and has identified five parcels for potential truck parking development. A preliminary assessment was conducted considering legal, environmental, and demand factors. Two parcels were deemed suitable, located in the **Homestead census-designated area** (p. 9-4).

2. Public-Private Partnerships (P3s)

- a. The Plan emphasizes the importance of leveraging P3s for advancing freight system investments. Notably, the **PortMiami Tunnel**, a successful public-private initiative, exemplifies how collaboration between public agencies and private firms can deliver critical infrastructure projects. Miami-Dade aims to identify more P3 opportunities to help accelerate remaining freight infrastructure needs (p. 9-2).
- b. *Development of Inland Port: Opa-locka West*. This initiative will improve the region's ability to handle growing cargo volumes and better connect to national and international markets. Collaborations with private developers and transportation agencies will be critical in securing the necessary investments and leveraging public funding to expand capacity (p. 4-14, p. 8-5).

3. Workforce Development

- a. With trade and logistics industries aging, Miami-Dade is focusing on addressing workforce skill gaps. This includes collaborating with entities like **Employ Florida**, **FDOT**, and the **Florida Chamber** to enhance the availability of a trained workforce for the logistics sector. Miami-Dade has committed to an active

- role in workforce development, engaging with industry, government, and academic institutions to address this challenge (p. 9-4).
- b. **WIN-Miami initiative:** a workforce development program designed to support **communities** in securing employment in the freight and logistics industries. This program targets underutilized populations, such as **homeless individuals** and **veterans**, offering training and placement in the expanding sector. The program aims to build a more resilient workforce (p. 6-4).
4. **Urban Freight Delivery**
- a. **Last-Mile Freight Solutions:** The plan discusses addressing **urban freight challenges** by incorporating **last-mile delivery** strategies, especially with the rise of e-commerce. Miami-Dade is working on solutions to manage increased demand for curbside deliveries, and plans include pilot projects to test new approaches. The county aims to reduce congestion and improve traffic flow by developing a **countywide curbside mobility policy platform** (p. 6-4).
 - b. Miami-Dade is continuing to foster collaboration through the **Curbside Mobility Forum**, which brings together local jurisdictions, freight operators, and stakeholders to develop solutions for managing curbside demand. This initiative includes using data to identify key urban freight issues and create policies that mitigate delivery-related traffic congestion (p. 6-4).
5. **Innovation**
- a. Miami-Dade has developed several innovative pilot programs aimed at resolving critical bottlenecks in international trade. These include initiatives such as the **Perishables Coalition**, the **Transshipment Committee**, and **CBP's Reimbursable Services Authority**, which provide alternatives to federal trade regulations and enhance operational efficiencies. Expanding these pilots to improve freight system competitiveness is a key goal of the Plan (p. 9-4).
 - b. The plan identifies **dynamic wireless charging** technology as a future innovation to improve the resilience of freight transport, particularly electric trucks. This would help reduce dependence on traditional fuel sources and support the transition to cleaner, more resilient transportation options. It's part of a broader effort to modernize freight corridors and reduce the environmental footprint of the logistics sector (p. 6-9).
6. **Funding**
- a. Miami-Dade County has successfully used programs like the **Infrastructure For Rebuilding America (INFRA)**, **State Infrastructure Banks (SIB)**, and **FDOT's Strategic Intermodal System (SIS)** to secure funding for critical freight projects. The Plan highlights the importance of continuing to pursue these funding opportunities, identifying projects in advance for grant readiness, and maximizing the use of available funds to support freight infrastructure development (p. 9-2).
7. **System Performance and Monitoring**
- a. The Miami-Dade Freight Plan stresses the need for ongoing monitoring of the freight system's performance, including **real-time truck flow and travel time reliability**. This data helps identify bottlenecks and inefficiencies, especially in key freight corridors, enabling timely responses to operational challenges (p. 7-2).
8. **Community Considerations**
- a. The Miami-Dade Freight Plan emphasizes the importance of engaging **community-based organizations (CBOs)** to ensure that freight planning addresses the needs of all communities. This ongoing engagement is aimed at ensuring that freight policies and projects contribute to broadly beneficial outcomes, particularly in areas affected economically by freight activity (p. 8-1).

- b. The plan outlines efforts to prioritize the deployment of advanced truck technologies in areas experiencing significant freight-related air quality impacts. By focusing on these areas, Miami-Dade aims to reduce public health risks associated with poor air quality while improving environmental conditions and community quality of life (p. 6-12).
- 9. Air Pollution Reduction**
- a. PortMiami is advancing resilience through its NetZero initiative, which aims to reduce operational impacts while enhancing continuity during extreme weather events. The project includes upgrading infrastructure to withstand weather-related challenges, implementing energy-efficient technologies, and supporting the long-term reliability of the region's critical maritime infrastructure (p. 6-13).

New York City

- 1. Public-Private Partnerships (P3s)**
- a. The **South Brooklyn Marine Terminal** is being transformed into a hub supporting offshore energy infrastructure, with upgrades designed to improve heavy cargo handling capacity and long-term port operations. These improvements are intended to strengthen freight system performance, support job creation, and modernize maritime infrastructure. The city's partnership with private companies to upgrade the terminal will also support expanded waterborne freight services (p. 11).
 - b. The **Red Hook Container Terminal** is slated for renovation through the installation of electric container cranes and upgrades to yard equipment. This project will enhance waterborne freight services, reduce truck congestion, and improve operational efficiency for urban freight logistics and e-commerce distribution (p. 12).
- 2. Urban Freight Delivery**
- a. New York City is implementing the **Off-Hour Deliveries (OHD)** program, which shifts deliveries to evening and overnight hours. This initiative has already enrolled **1,150 locations**, with a target of reaching **5,000 locations by 2040**. The program is supported by federal funding for incentives, such as low-noise equipment for trucks and retrofitting building facilities for unattended deliveries (p. 4).
 - b. **Neighborhood Loading Zone (NLZ) program:** supports residential deliveries, especially for e-commerce. The expansion of this program will include **1,500 NLZ locations by 2040**, which will reduce double parking and improve safety and efficiency for last-mile deliveries (p. 5).
- 3. Bottleneck Reduction and Freight Mobility**
- a. To reduce traffic congestion in urban neighborhoods, New York City is focusing on the development of **urban consolidation centers** and **micro-distribution hubs**. These centers will act as off-site locations where goods can be consolidated for delivery, reducing the number of trucks required to make individual deliveries.
 - b. New York City is also expanding its **cross-harbor rail freight** network. The **Bay Ridge cut** and other rail lines will be optimized to increase railcar volume, while the construction of **new transload facilities** will facilitate smoother transitions from rail to last-mile delivery trucks. This will significantly reduce truck traffic and its associated emissions (p. 14).
 - c. The city is exploring options to improve rail access in the **Sunset Park Industrial Business Zone**, including the construction of **transload facilities** and the conversion of roadways to create safer corridors for rail and freight traffic. These

efforts will improve safety, efficiency, and reduce congestion in this key freight corridor (p. 14).

4. Innovation and Technology

- a. To protect infrastructure and reduce truck damage, New York City plans to **expand the WIM network** to up to **50 locations by 2040**. This will allow the city to monitor overweight trucks and enforce truck route rules more effectively, helping to preserve road quality and ensure compliance with freight regulations (p. 9).
- b. The city is investing in **automated data collection systems** and **camera enforcement** technologies to monitor truck compliance with traffic and parking rules. These technologies will help improve the management of curb space, reduce violations, and ensure the safe and efficient movement of freight (p. 9).

5. Multimodal Connectivity

- a. New York City is developing a **marine highway system** that would integrate ferries and barges to transport freight across boroughs and reduce the reliance on trucks. **Cargo ferries** and **barge services** would be particularly useful for moving goods from regional distribution points to local destinations in the city. This would not only reduce road congestion but also cut down on emissions. The City intends to collaborate with the private sector to utilize underutilized piers and waterfront assets to facilitate these services (p. 12).

Portland

1. Multimodal Freight System Development

- a. Portland is advancing a multimodal freight network by integrating various modes of transportation, including rail, maritime, and road-based freight systems. The city is expanding its **marine terminals** (e.g., Port of Portland) and improving **rail connections** to reduce reliance on trucks for long-distance transportation. Portland is also leveraging **maritime shipping** through the **Columbia-Snake River System**, which moves bulk materials like grain and forest products, thus reducing truck congestion (p. 5).
- b. *Portland's Transportation System Plan (TSP)*: includes Portland's multimodal freight needs, with specific **rail-to-truck transloading** infrastructure improvements and **maritime infrastructure upgrades** (p. 11).

2. Community Considerations

- a. *Freight Corridor Air Quality Improvements*: The city is focusing on reducing freight-related air quality impacts along heavily traveled freight corridors by identifying areas with elevated pollution exposure and proposing targeted operational and infrastructure improvements. Community engagement efforts are also being conducted in neighborhoods affected by freight operations to gather local input and inform planning decisions (p. 6).
- b. **PBOT Matrix**: assesses the impact of freight projects on affected communities. Specific actions involve expanding **buffer zones** around industrial districts and retrofitting freight facilities (p. 15).
- c. **Transit Deficiency Areas Analysis** will identify locations needing improved transit access and develop transportation solutions like **shuttle routes** and **bike lanes** to ensure workers have access to industrial jobs (p. 150).

3. Resilience and Adaptation

- a. Given Portland's vulnerability to seismic events, particularly due to the **Cascadia Subduction Zone**, the city is focusing on strengthening critical freight infrastructure including bridges and access points. The **North Peninsula and**

Swan Island areas are highlighted as particularly vulnerable in the CIRE. The plan includes **seismic upgrades** for key freight routes and terminals to ensure the continuity of goods movement during and after a disaster (p. 29).

- b. The **Critical Infrastructure Resiliency Evaluation (CIRE)** identifies key infrastructure that needs reinforcement to withstand seismic events. Specific projects include the **seismic retrofitting** of bridges like the **Sellwood Bridge** and **St. Johns Bridge**, which are crucial for freight mobility (p. 34).

4. Workforce Development

- a. Portland is focusing on training and upskilling workers in the logistics and transportation sectors. The city is working with **community colleges, vocational schools, and industry partners** to offer specialized training in logistics, driving, and freight technology (p. 13).
- b. The **Portland Freight Education and Training Program** connects individuals with jobs in the growing freight sector. This program is designed to address workforce shortages while promoting **better employment practices** in the freight and logistics industries (p. 14).

5. Public-Private Partnerships (P3s)

- a. Portland is working closely with private sector partners to fund and develop freight infrastructure projects. The **South Waterfront** and **Red Hook Container Terminal** projects are prime examples where private businesses, like **shipping companies**, are collaborating with the **Port of Portland** to modernize freight operations (p. 36).
- b. The **Public-Private Freight Infrastructure Partnership Program** supports joint investments in freight infrastructure projects. This program also encourages innovation, such as the development of **automated transload facilities** and **smart port technologies** (p. 12).

6. Smart Freight Technology Integration

- a. **Portland Freight Tech Hub:** serves as a center for innovation, bringing together tech startups, logistics companies, and city planners to explore new solutions for urban freight. Portland is promoting the use of **smart freight technologies** to improve the efficiency and sustainability of freight movement. These technologies include **real-time tracking systems, automated vehicles, and AI-powered logistics platforms** (p. 49).
- b. **Smart Freight Integration Program:** provides incentives for companies to adopt **connected vehicle technologies, automated freight delivery systems, and AI-driven logistics management tools**. The program aims to reduce **traffic congestion** and **emissions** while improving freight flow in the city (p. 49).

7. Human Safety

- a. Portland's **Vision Zero Freight Safety Program** aims to eliminate all **freight-related fatalities and injuries**. Safety measures include the installation of **bike lanes, pedestrian crossings, and truck-specific safety zones** on high-crash corridors (p. 19).
- b. Portland is improving **freight safety** through better **road design, more signage, and safer intersection layouts**. A focus is placed on vulnerable users, such as **pedestrians and cyclists**, to ensure that **truck-involved crashes** are minimized. For instance, projects like **truck turn signal improvements** and **better visibility at intersections** are key components of this initiative (p. 19).
- c. The **Freight Safety and Crash Reduction Strategy** seeks to improve safety through data collection, technology (such as **AI monitoring for truck**

compliance), and public outreach efforts to enhance the community's awareness about freight safety (pp. 19, 62).

8. Urban Freight Delivery

- a. To address urban freight challenges, Portland is optimizing last-mile delivery/logistics through smaller vehicles, including **cargo bikes** and **vans** (p. 74).
- b. **Commercial Cargo Bike Pilot**: this program is being considered, aiming to accommodate cargo bikes for last-mile logistics, thus reducing the reliance on trucks.
- c. The **Portland Curbside Management Program** is designed to optimize the use of curb space by prioritizing freight loading during non-peak hours and ensuring that **delivery zones** are sufficient for growing demand. The program also helps reduce conflicts between freight vehicles and other road users because of these **dedicated freight loading zones** and managed curb space. (p. 74).

9. Infrastructure Resilience and Improvement

- a. The **Freight Infrastructure Enhancement Fund** is a funding program that prioritizes projects enhancing freight mobility, including **rail upgrades**, **bridge retrofitting**, and **improvements to intermodal terminals** (p. 73).

San Francisco Bay Area

1. Economic Development

- a. *Local Job Creation & Environmental Justice*: The plan focuses on creating middle-wage jobs through sustainable investments at key global gateways, particularly the Port of Oakland. It emphasizes job training and workforce development to ensure local residents benefit. Investments such as improved rail connections aim to remove trucks from congested highways, reducing environmental impacts and supporting the community's economic development (p. 46-47).
- b. *East Bay Transportation and Logistics Partnership*: This partnership is a collaborative workforce development effort involving community colleges, workforce development specialists, and private sector companies. The initiative is designed to train workers for goods movement-related jobs like logistics and transloading. Although it currently lacks long-term funding, it plays a critical role in addressing the region's demand for skilled workers in the evolving freight industry.
- c. The region is collaborating with educational institutions, such as the **Bay Area Community College Districts**, to develop these workforce training programs (p. 46).

2. Data and Intelligent Transportation Systems (ITS)

- a. The region is integrating ITS solutions, such as Adaptive Ramp Metering (ARM) and Active Traffic Management (ATM), to reduce congestion and enhance safety. These technologies will optimize existing road capacity, allowing for smarter freight movement, especially in urbanized areas (p. 55-56).
- b. The plan introduces **Smart Corridor** initiatives, which use **ITS** for truck corridors to manage traffic, reduce congestion, and improve freight flow. One notable project is the **Port of Oakland ITS**, which integrates communication infrastructure for appointment-based arrivals and reduces congestion at critical freight gateways.

3. Intermodal and Multimodal Connectivity

- a. The plan highlights a significant push to improve **rail services** to and from the **Port of Oakland**. This involves expanding the **Oakland Global Trade and Logistics Center** and improving **intermodal connections**, facilitating smoother transitions between truck and rail services. This is designed to reduce truck traffic on congested highways and improve the efficiency of freight transportation.

4. Infrastructure Resilience

- a. As part of the **Modernized Infrastructure** initiative, the plan supports the development of new **truck routes** and the **modernization of rail and road networks** in industrial corridors. These projects aim to provide safer and more reliable access to emerging industries like **biotechnology** and **advanced manufacturing** (p. 56).

5. Reducing Bottlenecks

- a. Building on research from **New York City**, the plan includes a policy guidance program to incentivize **off-peak deliveries**. These programs aim to reduce congestion during peak traffic hours by shifting delivery schedules to off-peak times.

6. Community Considerations

- a. The plan introduces a **Freight Corridors Community and Impact Reduction Initiative** that focuses on neighborhoods adjacent to freight facilities. This initiative will help mitigate the impacts of freight activities on adjacent communities.
- b. The plan incorporates **health impact assessments** (HIA) to evaluate the potential health effects of freight projects, ensuring that public health is considered when planning and implementing freight-related infrastructure projects.

Seattle

1. Community Considerations

2. Human Safety

- a. Seattle's **Vision Zero** initiative applies a **Safe System approach** to freight, focusing on reducing **serious injuries** and **fatalities** related to freight activities. This includes designing **truck-friendly intersections**, creating safer truck routes, and ensuring that **pedestrians** and **cyclists** are protected from large freight vehicles (p. F-10).
- b. The city is integrating **freight safety improvements** into its infrastructure design, including **leading pedestrian intervals** at traffic signals, traffic calming measures, and **dedicated spaces** for pedestrians and cyclists to ensure their safety around freight traffic (p. F-11).

3. Infrastructure Resilience and Improvement

- a. **Freight Asset Management Plan**: includes regular evaluations of freight infrastructure, like **heavy-haul routes** and **truck parking facilities**. The city has committed to maintaining and upgrading infrastructure to prevent **traffic bottlenecks** and support the **smooth movement of goods** (p. F-50).
- b. To support the efficient movement of goods, Seattle is exploring the possibility of creating **dedicated freight lanes** and **freight-and-bus lanes (FAB)**, particularly on streets with high truck volumes and significant freight activity. These lanes would reduce congestion and improve freight flow by separating freight from other vehicle traffic (p. F-14).

- c. **Dedicated Freight Lane Pilot:** seeks to evaluate the effectiveness of truck-only lanes on critical routes. This initiative could help reduce delays for freight vehicles while ensuring the safety of other road users (p. F-35).
4. **Urban Freight Delivery**
- a. **Last-Mile Delivery Hub Program:** supports the establishment of central pick-up/drop-off points for deliveries. The city is also piloting the use of cargo bikes to reduce traffic congestion and pollution in densely populated areas (p. F-40).
 - i. With the rise of e-commerce, Seattle is adapting its infrastructure to support **smaller vehicles** for last-mile deliveries. This includes the creation of **delivery hubs** in urban neighborhoods, where goods can be offloaded from large trucks and transferred to cargo bikes or vans for short-distance deliveries (p. F-35).
5. **Intermodal Connectivity**
- a. Seattle is enhancing its **intermodal freight connections** to improve the flow of goods between different transportation modes (e.g., rail, sea, air) (p. F-25).
 - b. **Intermodal Freight Strategy:** involves the development of dedicated **intermodal facilities** and **improved rail connections** to ensure efficient transfer of goods from the Port to the city's distribution hubs. This includes optimizing **rail crossings** and ensuring seamless transitions between the **port, rail, and truck networks** (p. F-33).
6. **Data Integration and ITS**
- a. Seattle is integrating **digital technology** into its freight network to optimize traffic flow, reduce congestion, and improve curb access. This includes **smart curb management, real-time tracking, and data-driven decision-making** to improve the reliability and efficiency of freight movement in urban areas (p. F-14).
 - b. **Smart Freight Management Program:** use technologies like **digital curb management, data collection tools, and intelligent traffic systems (ITS)** to optimize freight vehicle access and parking. This will help reduce inefficiencies like trucks searching for loading zones (p. F-36).
7. **Urban Freight Lab (UFL)**
- a. Since 2016, the Seattle Department of Transportation (SDOT) has partnered with the Urban Freight Lab at the University of Washington, to address urban freight challenges, particularly in downtown neighborhoods. This collaboration has led to significant research projects including: The Final 50 Study, Curb Management Project, and Last-Mile Freight Curb Access Program (p. F-44).
 - i. **The Final 50 Feet Study:** Investigated the processes involved in delivering materials from the curb to their final destination, aiming to reduce truck dwell time and improve delivery efficiency.
 - ii. **Curb Management Research:** Analyzed Seattle's commercial vehicle loading zone permitting process to enhance compliance and optimize curb usage.
 - iii. **Last-Mile Freight Curb Access Program:** A \$2 million initiative funded by the U.S. Department of Transportation's SMART grant, focusing on digitizing curb access to expedite deliveries and reduce emissions.
8. **Freight and Bus (FAB) Lanes**
- a. Seattle is piloting shared freight and transit lanes in congested areas to ensure that freight lanes maintain access to key distribution hubs. The City is testing FAB lanes in high-traffic corridors and evaluating performance. They plan to use lessons from the pilot to refine Seattle's freight lane policies (p. F-47).