MOBILITYPLAN 2050

Appendix J

Resiliency Planning

Contents

RESILIENCY AND SUSTAINABILITY

1.1 Overview

Resiliency and sustainability are critical principles for transportation that address the long-term viability and robustness of a transportation network. These principles are essential for creating transportation infrastructure that is not only efficient and reliable but also environmentally responsible and adaptable to climate change. The importance of integrating resiliency and sustainability into transportation planning ensures the continuity of essential services, supports economic stability, and contributes to the overall health and well-being of communities.

This section explores the definitions, significance, and practical applications of resiliency and sustainability, reviews existing plans and policies related to resiliency and sustainability, and identifies potential strategies to build resiliency and sustainability, all in the context of transportation.

While resilience and sustainability are related, they have different definitions and accomplish different goals. Sustainability in transportation planning is addressed through emissions regulations, carbon reduction actions, utilizing innovative materials, as well as through routine operation and maintenance programs. In 1987, the United Nations defined **sustainability** as "meeting the needs of the present without compromising the ability of future generations to meet their own needs."[1] **Resiliency** is the ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions.[2] Resiliency in transportation planning is focused on creating, or improving redundancy and reliability, and facilitating rapid response and recovery to emergency events. A key component of sustainability is minimizing the severity of climate change through mitigating actions, compared to resiliency that focuses on lessening the impacts of natural hazards and climate change . Transportation actions to improve resiliency and sustainability are often intertwined and can both improve responses to natural hazards while reducing carbon emissions. Examples of resilient and sustainable actions and the relationship between the two principles are shown in **Figure 1.**

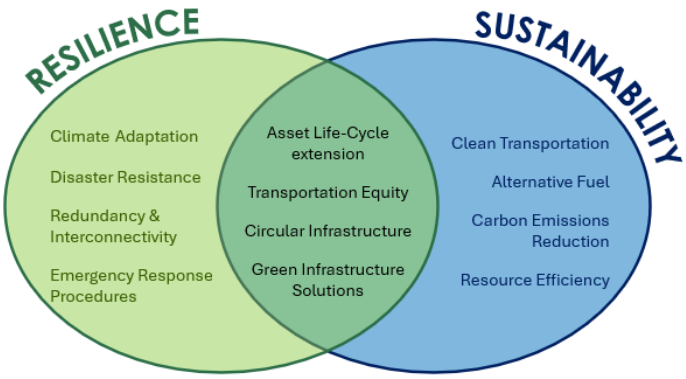

Figure 1 – Resilience and Sustainability Examples

[1] United Nations (UN). (1987). Report of the World Commission on Environment and Development: Our common future. Retrieved from 5987our-common-future.pdf (un.org).
[2] Federal Highway Administration (FHWA). (2014). "FHWA Order 5520." Retrieved from https://www.fhwa.dot.gov/legsregs/directives/orders/5520.cfm#par6.

The role of transportation in sustainable development was first recognized at the 1992 United Nation's Earth Summit and are currently crucial components in several Sustainable Development Goals (SDGs).[3] Nationally, there is a growing recognition of the opportunity to advance sustainability goals, climate mitigation, and resilience efforts through the transportation sector. The USDOT's recent efforts include supporting smart community design, improving efficiency through transit, rail, and high-efficiency vehicles, and transitioning to clean options with zero-emission vehicles and fuels. The Bipartisan Infrastructure Law (BIL) and the Inflation Reduction Act have made historic investments in resilient infrastructure for transit, rail, active transportation, and electric vehicles (EV)[4] in response to the challenges faced by transportation systems. Climate change and extreme weather events increasingly threaten the safety, reliability, and sustainability of transportation infrastructure.

Knox County, Tennessee faced 15 presidential disaster declarations between 1969 and April 2023, or approximately one presidential disaster declaration every three to four years.[5] Disasters routinely impact transportation infrastructure in the region, and climate change is expected to increase the frequency and severity of these events. In February 2019, nine days of rain in Knoxville resulted in a state of emergency, causing road washouts and closures, landslides, vehicle submersions, and a sinkhole around Knoxville. Similarly, flooding in July 2022 damaged several local roads, downed trees and blocked roadways, and flooded vehicles and an area near the railroad.[6] In January 2024, a winter snowstorm created dangerous driving conditions, resulting in crashes and closures of sections of I-40.[7]

Many new funding programs support transportation resiliency and sustainability as shown in **Table 1**. Several funding programs through the BIL provide states with formula funds to use at their discretion. For multiple programs, states can use formula funds to support local projects and initiatives.

Table 1 – Resiliency and Sustainability Funding Programs

Funding Program	Icon	Description
Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation Program (PROTECT)		Funding under the BIL to support resilience improvements of the surface transportation system to extreme weather events, and climate impacts. The program includes state formula funds[8] and discretionary grants[9].
Carbon Reduction Program (CRP)		Funding under the BIL for projects designed to reduce transportation emissions from on-road highway sources. The funds are administered as state formula funds.[10]

[3] United Nations. (UN). (n.d.) Sustainable Transport. Retrieved from Sustainable transport | Department of Economic and Social Affairs (un.org)
[4] USDOT. (n.d.) Fact Sheet: Climate Action at the United States Department of Transportation, Retrieved from COP Fact Sheet_new 11_17_22FINAL.pdf (transportation.gov)
[5] TEMA. (2023). Tennessee State Hazard Mitigation Plan 2023. Retrieved from Tennessee State Hazard Mitigation Plan 2023 | Plans (arcgis.com).
[6] City of Knoxville. (2022). City Departments Respond to Flooding, Retrieved from Blog: City Blog (knoxvilletn.gov)
[7] 10 News. (2024). Icy crashes cause closures on I-40 in Knoxville overnight, Retrieved from Crash reported on I-40 in Knoxville near I-640 | wbir.com
[8] USDOT. (2022). Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Formula Program. Retrieved from Bipartisan Infrastructure Law - Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Formula Program Fact Sheet | Federal Highway Administration (dot.gov).
[9] USDOT. (2023). Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation Program (PROTECT). Retrieved from Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation Program (PROTECT) | US Department of Transportation
[10] USDOT. (2024). Carbon Reduction Program. Retrieved from Carbon Reduction Program | US Department of Transportation.

Funding Program	Icon	Description
Building Resilient Infrastructure and Communities (BRIC)		Pre-disaster mitigation initiative by FEMA that funds communities to carry out large scale infrastructure mitigation and adaptation activities through grants.[11]
Hazard Mitigation Grant Program (HMGP)		Funding to support hazard mitigation planning at state, local, tribal, and territorial government level.[12]
National Electric Vehicle Infrastructure (NEVI) program		Funding under the BIL to support a nationwide network of electric vehicle (EV) charging stations to promote EV adoption and transportation decarbonization. The funds are administered as state formula funds.[13]
Charging and Fueling Infrastructure Grant Program		Funding under the BIL to strategically deploy publicly accessible electric vehicle charging infrastructure and other alternative fueling infrastructure. The funds are administered through discretionary grants.[14]
Low-Carbon Transportation Materials		Grants under the IRA to incentivize the use of construction materials that have lower levels of embodied greenhouse gas emissions. The funds are provided through reimbursement or incentives for using eligible materials.[15]

[11] FEMA. (2024). Building Resilience Infrastructure and Communities. Retrieved from Building Resilient Infrastructure and Communities | FEMA.gov.
[12] FEMA. (2023). Hazard Mitigation Grant Program (HMGP). Retrieved from Hazard Mitigation Grant Program (HMGP) | FEMA.gov.
[13] UDSOT. (2022). National Electric Vehicle Infrastructure Formula Program. Retrieved from Bipartisan Infrastructure Law - National Electric Vehicle Infrastructure (NEVI) Formula Program Fact Sheet | Federal Highway Administration (dot.gov)
[14] USDOT. (2023). Charging and Fueling Infrastructure Grant Program. Retrieved from Charging and Fueling Infrastructure Grant Program | US Department of Transportation
[15] USDOT. (2023). Low-Carbon Transportation Materials Grants.

1.2 Existing Conditions Assessment

The Existing Conditions Assessment identifies existing resiliency and sustainability strengths and opportunities for the region after reviewing current plans, policies, and programs.

1.2.1 Existing Plans, Policies & Programs

There are several plans related to resilience and sustainability within the region. Many of the state and regional plans ensure eligibility for grants that can support sustainable and resilient transportation projects. Additionally, some of the plans identify transportation resilience and sustainability related actions for the region. The plans reviewed are summarized below with more detail, including funding implications, found in Error! Reference source not found..

Five statewide plans were identified that relate to transportation sustainability and resiliency. Many of the plans are associated with new funding streams through the BIL. Some of the programs require plans to program funds (e.g., CRP and NEVI). Other BIL programs incentivize plan development with an improved cost-match (e.g, PROTECT). TDOT has adopted or is in the process of adopting a plan from each of these programs, maximizing the state's federal funding. Additionally, the state maintains an approved state hazard mitigation plan, enabling the state to leverage and distribute a variety of FEMA programs.

In addition, there are a few local plans related to resiliency and sustainability. The City of Knoxville has a *Knoxville Energy & Sustainability Work Plan*, guiding city initiatives related to sustainability. The planning area also participates in the *Knox County, City of Knoxville, and Town of Farragut Multi-Jurisdictional Local Hazard Mitigation Plan*, currently being updated. Having expired in 2023, immediate FEMA grant funding could be impacted during the lapse in coverage. The reviewed plans include:

State Plans

- TDOT Transportation Asset Management Plan (TAMP) – 2022
- Tennessee Electric Vehicle Infrastructure (TEVI) Deployment Plan Update – 2023
- Tennessee State Hazard Mitigation Plan (HMP) – 2023
- TDOT Carbon Reduction Strategy (CRS) – 2023
- TDOT Resilience Improvement Plan (RIP) - 2024

Local Plan

- Knox County, City of Knoxville, and Town of Farragut Multi-Jurisdictional Local Hazard Mitigation Plan (HPM) – 2018
- Knoxville Energy & Sustainability Work Plan - 2021

In addition to plans, several policies or programs relate to sustainability and resilience within the region. The Knoxville area was designated as an air quality non-attainment area by the EPA due to air pollution levels exceeding the national air quality standards in 2008.[16] The region has gone through a variety of planning and programmatic efforts to reduce emissions and is now considered a maintenance area, complying with the national ambient air quality standards. However, the region must continue implementing air quality improvement measures to avoid non-attainment. The City of Knoxville through Resolution R-265-2019 confirmed target reductions of 50% by 2030 for City operations and an 80% reduction by 2050 for community emissions.[17] In addition, Knox County maintains a Floodplain Program to regulate the floodplain and reduce impacts from flooding. Within Knox County, no buildings are permitted within the floodway. The County exceeds the minimum FEMA requirements and requires new development in the 100-year floodplain to be built one foot above the 500-year flood

[16] TPO Knoxville Regional. (n.d). The Clean Air Act. Retrieved from Air Quality – Knoxville Regional TPO (knoxtpo.org)
[17] City of Knoxville. (2021) Energy & Sustainability Work Plan. Retrieved from Sustainability Work Plan Brochure-single Pages (2022.04.01).pdf (civiclive.com).

elevation.[18] Additionally, the City of Knoxville defines the regulatory floodway as the 500-year floodplain which is stricter than the national FEMA requirement of the 100-year floodplain.[19]

1.2.2 Identified Strengths

The region has made significant progress to be more sustainable and resilient. Both the City of Knoxville and Knox County have floodplain requirements that exceed FEMA's floodplain management requirements. The Region has improved air quality to move from a non-attainment status to a maintenance area. Additionally, the City of Knoxville has established a Sustainability Program with an *Energy & Sustainability Work Plan* to guide priorities including priorities for the transportation sector. The City of Knoxville has also committed to set emission reductions by 2030 and 2050 through an established program since 2005.

The City has also taken steps to improve resiliency. Over the last decade, the City of Knoxville has invested $9 million to fix flood prone areas.[20] Additionally, Knoxville participates in FEMA's Community Rating System (CRS) which is a voluntary incentive program where communities receive insurance rate reductions for implementing actions and programs to reduce flood risk. Knoxville received a Class 6 rating which reduces insurance rates by 20% for the community and is the highest rating in Tennessee.[21]

In addition, TDOT has undertaken several plans and programs related to sustainability and resilience. The TDOT *CRS*, *TEVI*, and *RIP* allow for the State to leverage federal funds for sustainability and resilience. For the CRS, the Knoxville region is within the areas that receive funding based on population. Knoxville's estimated apportionment is approximately $7.9 million.

1.2.3 Identified Opportunities

While the region has made significant progress to improve sustainability and resiliency, there is still work to be done. The region struggles with high emissions and air quality specifically from transportation due to the topography of the region and heavy freight presence. Transportation emissions accounted for 33% of all GHG emissions in the United States in 2019.[22] Transportation emissions accounted for 59% of all GHG emissions in Knoxville in 2019.[23] While the region has moved from non-attainment status to a maintenance area, the region must continue to work to improve air quality.

Hazard Mitigation Planning is an important process to identify risks within a community and to be eligible for certain FEMA funds. While the Regional HMP is currently being updated, the previous plan expired before the update was approved, leaving the region ineligible for FEMA mitigation funds.

The climates and hazards historically faced by the community are changing. By 2050, Knoxville is expected to experience 18 more days above 95° F and a 10% increase in days with heavy precipitation.[24] Current transportation design standards and practices may need to be updated to prepare for future climate conditions within the lifecycle of an asset. For example, existing design storms may not reflect current climate trends. Additionally, extreme temperatures will be worsened by the Urban Heat Island effect as Knoxville continues to develop.

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[18] Knox County. (n.d). Knox County Floodplain Program. Retrieved from Knox County Floodplain Program - Stormwater - Engineering & Public Works - Knox County Tennessee Government.
[19] City of Knoxville. (n.d). Floodplains. Retrieved from Floodplains - City of Knoxville (knoxvilletn.gov).
[20] City of Knoxville. (2023). Officials Want Your Input for Hazard Mitigation Plan. Retrieved from Floodplains - City of Knoxville (knoxvilletn.gov) on April 15, 2024.
[21] FEMA. (2024). Community Rating System. Retrieved from Community Rating System | FEMA.gov on May 6. 2024.
[22] TDOT. (2023), TDOT Carbon Reduction Strategy. Retrieved from TDOT Carbon Reduction Strategy Final_02.20.24.pdf (tn.gov).
[23] City of Knoxville Office of Sustainability. (n.d). Transportation. Retrieved from Transportation - City of Knoxville (knoxvilletn.gov).
[24] Headwaters Economics. (n.d). Neighborhoods at Risk. Retrieved from Neighborhoods at Risk (headwaterseconomics.org) on April 15, 2024.

1.3 Strategies and Actions to Create a Resilient and Sustainable Transportation Network

The following strategies and actions are recommended to increase sustainability and of the transportation network within the region. TDOT has made progress on many of these strategies and actions through the *CRS*, *RIP*, and *TEVI* Plan. The City of Knoxville has also made progress towards some of these strategies and actions through the *Energy & Sustainability Work Plan* and initiatives. Projects can often incorporate both resilience and sustainability strategies to complement each other and additional transportation priorities. Examples of transportation infrastructure incorporating resilience and sustainability strategies are presented in **Figure 2** and **Figure 3**.

A menu of strategies and actions for increasing transportation sustainability and resilience are presented in section 1.5 (Tables 4 and 5).

A few priority strategies and actions are highlighted below for the region.

Sustainability

The Region should focus on reducing vehicle emissions. This directly relates to two of the sustainability strategies of Drive Less and Drive Wise. The region should prioritize transportation actions that reduce the number of vehicle miles traveled (VMT) and single occupant vehicles (SOVs). When the trips must be made, the focus should be on driving wise or reducing the impact of the trip.

Resilience

The region should focus on minimizing risk and building capacity. While the goal is to eliminate risk, it is often expensive to relocate transportation infrastructure. The region has noted issues with flooding and stormwater management with increased development. The region should focus on developing policies and best practices to incorporate resilience into projects and development such as utilizing nature-based solutions (NBS) for stormwater management. The region should also focus on including resilience in large infrastructure projects moving forward to protect large regional investments.

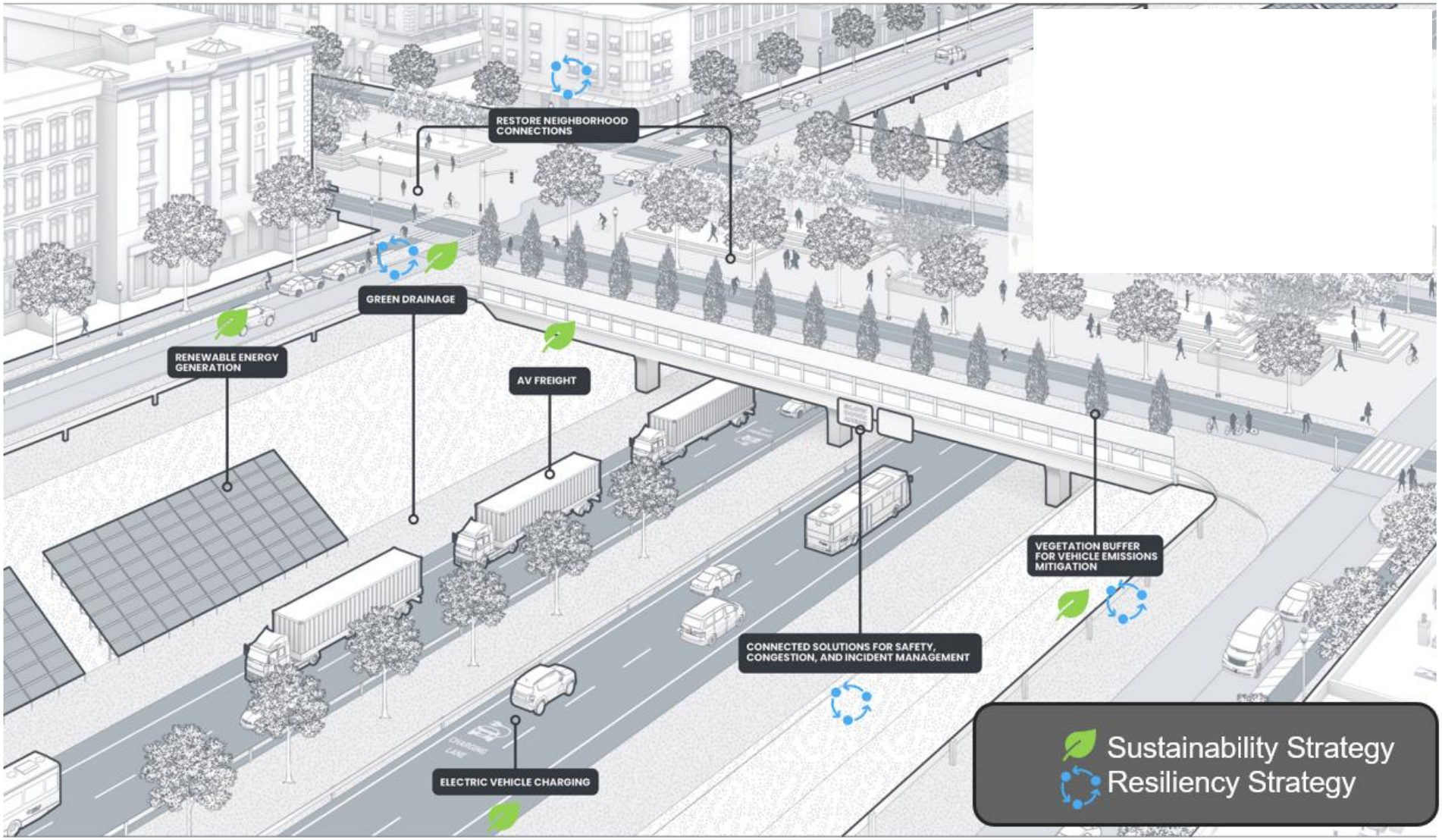

Figure 2 – Freight Corridor incorporating Sustainability and Resiliency Strategies

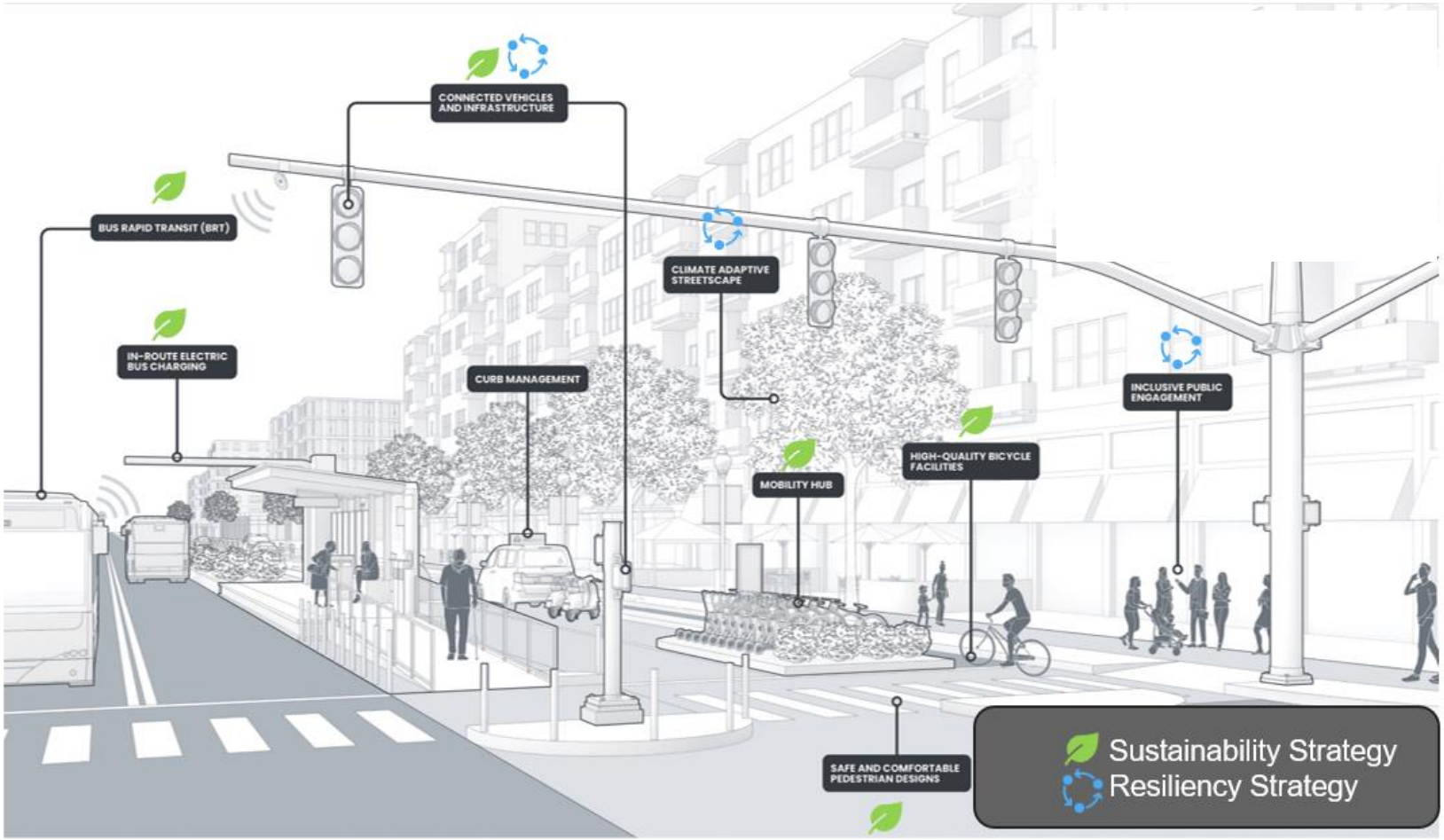

Figure 3 – Urban Corridor incorporating sustainability and resiliency strategies

1.4 Literature Review

The following section details the resiliency and sustainability related plans reviewed. State plans are shown in **Table 2** and local plans are shown in **Table 3**.

Table 2 – State Plans

Plan Name	Icon	Year	Description	Funding
TDOT Transportation Asset Management Plan (TAMP)		2022	The TAMP establishes a framework to consider the full life cycle when investing in transportation assets and infrastructure. The plan helps ensure the agency considers the full life cycle of assets which includes resilience. The TAMP includes *23 CFR Part 667 Periodic Evaluation of Facilities Repeatedly Requiring Repair and Reconstruction Due to Emergency Events.* In this analysis, TDOT evaluates emergency response data to identify pavement or bridges that have required repeated repair. None were within the planning area.	The TAMP is required by several federal programs including Moving Ahead for Progress in the 21st Century (MAP-21) Act, Fixing America's Surface Transportation (FAST) Act, and the Infrastructure Investment and Jobs Act (IIJA).
Tennessee Electric Vehicle Infrastructure (TEVI) Deployment Plan Update		2023	The TEVI plan outlines Tennessee's approach to planning, procuring, deploying, and administering NEVI (National Electric Vehicle Infrastructure) formula program funding. Through NEVI Formula Program funding, TDOT expects to receive approximately $88.3 million over five years (FY2022-2026) and must update the TEVI plan annually to meet program obligations. The vision for the TEVI Program is to "develop a safe, convenient, accessible, reliable, and equitable EV charging network that promotes the state's economic vitality and environmental stewardship while improving EV "range of confidence" and supporting EV adoptions throughout Tennessee".	TDOT has developed the TEVI NOFO to solicit applications for grant funding. Awardees will purchase, install, own, operate, maintain, and report on program-funded EV charging infrastructure. The first issuance of awards is expected in Spring 2024. Tennessee will primarily work with third parties to deploy the infrastructure.
Tennessee State Hazard Mitigation Plan (HMP)		2023	The State HMP shows Tennessee's commitment to pursue risk-reduction initiative for assets exposed to natural and technological hazards. The plan includes a statewide	The Plan makes the State eligible for a variety of FEMA funds which it can administer to local entities.

Plan Name	Icon	Year	Description	Funding
			evaluation of hazards and risks, capability assessment, and mitigation strategy. The mitigation strategy identifies key mitigation actions to reduce risk. The goal of the Tennessee Mitigation Program is to support and make effective long-term investments to lessen the impacts of disasters.	The State is eligible FEMA funds including Public Assistance (PA), Fire Mitigation Assistance Grants (FMAG), Hazard Mitigation Grant Program Post Fire, Hazard Mitigation Grant Program (HMGP) planning grant, HMGP project grant, Building Resilient Infrastructure and Communities (BRIC) planning grant, BRIC project grant, Safeguarding Tomorrow Revolving Loan Fund Program, Flood Mitigation Assistance (FMA) planning grant, FMA project grant and Rehabilitation of High Hazard Potential Dam (HHPD) Grant Program.[25]
TDOT Carbon Reduction Strategy (CRS)		2023	TDOT's CRS establishes baselines and expectations for TDOT's Carbon Reduction Program (CRP). Tennessee is expected to receive $139 million over five years (FY2022-2026) for carbon reduction through the Infrastructure Investment and Jobs Act (IIJA). Tennessee is required to have a CRS to utilize the funding. TDOT in consultation with the MPO's identified eight focus areas to identify eligible projects, programs, policies, and processes to utilize CRP funds. The eight focus areas are active transportation, alternative fuels, fleets and facilities, freight, green construction, transit, transportation demand management, and transportation system management and operations.	From the program requirements, 65 percent of funds must be distributed to relative to population shares. Knoxville meets these requirements, and its estimated apportionment is approximately $7.9 million.
TDOT Resilience Improvement Plan (RIP)		2024*	TDOT's RIP is currently in development. The plan will include a review of current transportation resilience practices, identification of transportation vulnerabilities, and project identification and prioritization for PROTECT funding.	The plan reduces TDOT's federal cost share requirements for utilizing formula PROTECT funding. Additionally, the plan can be used to support discretionary grant applications.

*The plan is currently under development but is expected to be completed in 2024.

[25] FEMA. (2023). Mitigation and Planning Grants. Retrieved from Mitigation Planning and Grants | FEMA.gov on April 15, 2024.

Table 3 – Local Plans

Plan Name	Icon	Year	Description	Funding
Knox County, City of Knoxville, and Town of Farragut Multi-Jurisdictional Local Hazard Mitigation Plan (HMP)		2018	The HMP was developed to reduce future losses to the County and its communities resulting from natural disasters. The plan includes a statewide evaluation of hazards and risks, capability assessment, and mitigation strategy. The mitigation strategy identifies key mitigation actions. The plan has three goals which include minimizing, preventing, or reducing vulnerabilities, increasing citizen awareness and preparedness, and strengthening protection of critical facilities and infrastructure. Several of the identified actions relate to transportation such as stormwater mitigation, drainage maintenance, replacing undersized stormwater infrastructures, and securing funding for roadway improvement projects that protect roadways from repetitive flooding,	The Plan expired on July 23, 2023. As of November 2023, the Plan was in the process of being updated.[26] Local Hazard Mitigation plans must be updated every five years to be eligible for FEMA funds such as Hazard Mitigation Grant Program Post Fire, Hazard Mitigation Grant Program (HMGP) planning grant, HMGP project grant, Building Resilient Infrastructure and Communities (BRIC) project grant, Safeguarding Tomorrow Revolving Loan Fund Program, Flood Mitigation Assistance (FMA) project grant, and Rehabilitation of High Hazard Potential Dam (HHPD) Grant Program.[27]
Knoxville Energy & Sustainability Work Plan		2021	Knoxville has been working to reduce emissions since 2005. In 2020, the City launched the Mayor's Climate Council to reevaluate the City's priorities and guide the updated Energy & Sustainability Work Plan. The Work Plan refocuses on community priorities to reduce greenhouse gas emissions and identifies new metrics to evaluate long-term success. The Work Plan notes that 59% of emissions in Knoxville are from transportation. The Plan identifies four transportation priorities including expanding and improving bicycle and pedestrian facilities, making public transit investments, significantly accelerating community adoption of electric vehicles, and partnering with commercial fleet operators to transition to electric vehicles.	-

[26] City of Knoxville. (2023). Officials Want Your Input for Hazard Mitigation Plan. Retrieved from Floodplains - City of Knoxville (knoxvilletn.gov) on April 15, 2024.
[27] FEMA. (2023). Mitigation and Planning Grants. Retrieved from Mitigation Planning and Grants | FEMA.gov on April 15, 2024.

1.5 Strategies and Actions

Sustainability strategies and actions are presented in **Table 4** and resilience strategies and actions are presented in **Table 5**.

Table 4 – Sustainability Strategies and Actions

Implementation Strategies for Sustainability	Description	Example Actions	Related Plans
Drive Less	To improve sustainability, reduce the number of vehicle miles traveled especially by single occupant vehicles (SOVs).	**Projects** • Promote mode shift to multimodal transportation options by improving bicycle and pedestrian facilities. • Invest in transit infrastructure such as electrifying the transit fleet, increasing transit efficiency (bus rapid transit), and establishing mobility hubs. **Policies and Processes** • Enhance laws protecting multimodal roadway users. • Develop standards and development requirements to prioritize multimodal infrastructure and transportation. **Programs** • Partner with businesses to promote remote work or alternative work schedules. • Incentivize carpooling, ridesharing, and multimodal transportation. • Encourage public transit ridership.	*TDOT Carbon Reduction Strategy (CRS)* *Knoxville Energy & Sustainability Work Plan*
Drive Wise	When trips cannot be reduced, reduce the impact of the trip.	**Projects** • Transition fleet vehicles and transit vehicles from fossil fuel powered vehicles to electric vehicles. • Invest in Transportation System Management and Operations (TSMO) solutions to increase efficiency and reduce idling. Examples include traffic signal optimization, traveler information, ramp metering, and high-occupancy vehicle (HOVs) lanes. • Invest in electric vehicle infrastructure such as EV charging stations. **Policies and Processes**	*TDOT Carbon Reduction Strategy (CRS)* *Knoxville Energy & Sustainability Work Plan*

Implementation Strategies for Sustainability	Description	Example Actions	Related Plans
		• Develop guidelines and initiatives to foster the integration of connected and autonomous vehicles (CAVs) to improve travel efficiency and safety. • Collect and analyze transportation data to understand trip behavior and congestion. **Programs** • Invest in traffic incident management solutions to reduce delay caused by incidents. • Incentivize the transition to electric vehicles for personal vehicle trips when necessary.	*Tennessee Electric Vehicle Infrastructure (TEVI) Deployment Plan Update*
Build Wise	When maintaining and constructing new transportation infrastructure, integrate sustainable options while understanding the impact of the project.	**Projects** • Transition traditional street lighting to energy-efficient alternatives. • Electrify fleet vehicles and construction vehicles. **Policies and Processes** • Develop standards and development requirements to encourage or require the consideration of sustainable options. • For large construction projects, inventory the emissions created by the project. • Incorporate ENIVISION certification/standards. • For large construction projects, increase public communication, traffic incident management strategies, and alternatives to reduce idling from construction. **Programs** • Review design standards and specifications to understand carbon emissions and impact of requirements. • Identify sustainable alternatives for commonly used materials and processes.	*TDOT Carbon Reduction Strategy (CRS)*

Table 5 – Resiliency Actions and Strategies

Implementation Strategies for Resiliency	Description	Example Actions	Related Plans
Eliminate Risk	To improve resiliency and mitigate impacts from natural hazards, eliminate or reduce risk by moving people, property, and infrastructure outside of hazard areas.	**Projects** • Move critical transportation facilities outside of hazard areas. For example, relocating facilities outside of floodplains. **Policies and Processes** • Strengthen floodplain management policies to ensure new investments are not increasing exposure to natural hazards. **Programs** • Invest in resilience planning to identify at-risk infrastructure. • Develop programs to support the relocation of critical infrastructure outside of hazard areas.	*Tennessee State Hazard Mitigation Plan (HMP)* *Knox County, City of Knoxville, and Town of Farragut Multi-Jurisdictional Local Hazard Mitigation Plan (HMP)* *TDOT Resilience Improvement Plan (RIP)*
Minimize Risk	When risk cannot be eliminated, increase the resilience of infrastructure and users of the transportation system.	**Projects** • Elevate infrastructure to minimize flood risk. • Utilize nature-based solutions (NBS) to minimize stormwater flooding and sequester carbon. • Install transit shelters to minimize extreme heat risk. • Use trees and vegetation to reduce heat islands. **Policies and Processes** • Strengthen stormwater requirements for new development. • Develop design standards that consider existing and future natural hazards. **Programs** • Develop solutions guides to encourage NBS. • Educate infrastructure operators and owners on changing risks.	*Tennessee State Hazard Mitigation Plan (HMP)* *Knox County, City of Knoxville, and Town of Farragut Multi-Jurisdictional Local Hazard Mitigation Plan (HMP)* *TDOT Resilience Improvement Plan (RIP)*

Implementation Strategies for Resiliency	Description	Example Actions	Related Plans
Build Capacity	While resiliency actions can minimize risk, communities also need to be prepared to respond to natural hazards to reduce losses to people, property, and infrastructure. During emergency events, transportation systems can be strained by evacuations.	**Projects** • Invest in infrastructure and technology to improve communication with the public during emergencies. • Identify and strengthen critical infrastructure necessary for evacuations. **Policies and Processes** • Clearly document internal responsibilities and roles during emergencies. • Maintain up to date emergency contact lists and communication protocols. **Programs** • Hold collaborative emergency exercises with multiple agencies to understand each agencies' role during emergency response and evacuations. • Identify areas with limited capacity to respond to natural hazards. • Identify detour routes in advance for key corridors.	*Tennessee State Hazard Mitigation Plan (HMP)* *Knox County, City of Knoxville, and Town of Farragut Multi-Jurisdictional Local Hazard Mitigation Plan (HMP)* *TDOT Resilience Improvement Plan (RIP)*