

# MIAMI-DADE TRANSPORTATION PLANNING ORGANIZATION CLIMATE RESILIENCY STUDY

June 2023



Prepared By:  
TranSystems

# Study Contents

## **Executive Summary**

**Technical Memo #1** – Existing Resiliency Efforts

**Technical Memo #2** – Vulnerable Transportation Infrastructure and Risk Assessment

**Technical Memo #3** – Electric and Alternative Fuels Market Research

**Technical Memo #4** – Connected Autonomous Vehicles and Alternative Fuels Strategic Plan

**Technical Memo #5** – Incorporating Resilience in the Long Range Transportation Plan

**Appendix A** – 2045 LRTP Projects with Projected Sea Level Rise Vulnerability Scores (*Memo #2*)

**Appendix B** – CAV + AFV Strategic Plan Matrix (*Memo #4*)

**Appendix C** – Stakeholder Meeting Presentations + Comments

## Executive Summary

The Miami-Dade Transportation Planning Organization (MDTPO) strives to create a resilient transportation network within Miami-Dade County. As climate change continues to alter weather patterns and increase the number of natural disasters, it is vital for MDTPO to plan for transportation solutions in advance to save money in the long run. Climate resilience refers to the ability of the transportation system to anticipate, prepare for, and adapt to any disruptions related to the climate or extreme weather. The objective of this study is to evaluate potential risks within the transportation system to understand future needs within the Long Range Transportation Planning (LRTP) process. This study will also review ways to accelerate the usage of alternative fuel vehicles (AFVs), and their associated charging infrastructure, and connected autonomous vehicles (CAVs) into the MDTPO jurisdiction. Other types of transportation forms, such as micromobility and transit systems, should have adequate sustainable infrastructure systems that can adapt to climate change impacts and provide all users with continued access. The study intends to find countywide transportation solutions and address other key issues such as land use, air quality, energy, economic development, commerce, and quality of life. Resiliency will be a key factor in the MDTPO 2050 LRTP, and information from this study will be utilized in the planning process.

The Climate Resiliency Study is structured as the following:

- Technical Memo #1 - a literature review involving existing and planned resiliency studies, initiatives, and strategies
- Technical Memo #2 – an analysis of existing Miami-Dade County (MDC) vulnerabilities, including sea level rise (SLR), heat, and social, to determine a scoring system for previous 2045 cost feasible LRTP projects and future 2050 cost feasible LRTP project selection
- Technical Memo #3 – a research document regarding existing and future MDC AFV market penetration
- Technical Memo #4 - a report and matrix of recommendations to better integrate policies for AFVs and CAVs
- Technical Memo #5 - the findings regarding incorporating resilience in the 2050 (cost feasible) LRTP planning process

The documents reviewed in the literature review included regional, national, and international resources. Due to the impacts anticipated to affect MDC, the MDTPO should expect to create strategies to both adapt and change to the climate. The MDC Sea Level Rise Strategy plan should be a key document to utilize and build upon to mitigate the impacts of SLR by understanding future projections. Additionally, MDPTO can slow the impacts of climate change by proactively transitioning the county fleet to AFVs and upgrading the transit system to reduce vehicular trips. MDPTO may consider establishing design guidelines for applicable resilient design strategies. Understanding what other regions/Transportation Planning Organizations (TPOs) are doing to prepare for climate will help advance the MDPTO transportation system.

Sea Level Rise is one of the most pressing environmental stressors within MDC. The University of Florida (UF) and the Florida Department of Transportation (FDOT) created the Sea Level Scenario Sketch Planning Tool (SLS Sketch Planning Tool), which was utilized in the study. The NOAA low, intermediate, and high projections were used for the year 2050. Additionally, the Federal Emergency Management Agency (FEMA) and Miami-Dade County Average Heat Vulnerability tools were used to understand vulnerabilities in the transportation system. The scoring criteria was created to prioritize the most vulnerable projects within the system. A vulnerability solution toolkit is outlined to understand potential solutions to each type of infrastructure. The following scoring criteria were identified for project points (intersections) and project lines (linear roadway projects):

**Miami-Dade County Potential Stressors Scoring – Project Points**

Sea Level Rise (2050 Projections)			Heat Vulnerability (2019)		Social Vulnerability (2021)	
SLR Projection	Probability of Occurring	Points	Type	Points	Type	Points
Low – Minimal Inundation	High	9	5 - High	2	Very High	2
Intermediate	Intermediate	6	4	1.5	Relatively High	1.5
High – Major Inundation	Low	3	3	1	Relatively Moderate	1
None		0	2	0.5	Relatively Low	0.5
			1 – Low	0	Very Low	0
Up to 9 points			Up to 2 points		Up to 2 points	



### Miami-Dade County Potential Stressors Scoring – Project Lines

Sea Level Rise (2050 Projections)		Heat Vulnerability (2019)		Social Vulnerability (2021)	
Type	Points	Type	Points	Type	Points
Within 100 feet of:		5 - High	2	Very High	2
High SLR	1				
Intermediate SLR	2				
Low SLR	3				
Low SLR (25%)	0.5				
Low SLR (50%)	1				
Low SLR (75%)	1.5				
Low SLR (100%)	2				
Intermediate SLR (25%)	0.5	4	1.5	Relatively High	1.5
Intermediate SLR (50%)	1				
Intermediate SLR (75%)	1.5				
Intermediate SLR (100%)	2				
High SLR (25%)	0.5	3	1	Relatively Moderate	1
High SLR (50%)	1				
High SLR (75%)	1.5				
High SLR (100%)	2				
None	0	2	0.5	Relatively Low	0.5
		1 – Low	0	Very Low	0
Up to 9 points		Up to 2 points		Up to 2 points	

MDC has a goal to reach carbon neutrality by 2050. One key investment to reach this goal includes AFV access. Florida’s electric vehicle (EV) registration grew 49 percent between 2020 and 2021. EVs accounted for approximately 3 percent of new vehicles purchased in MDC in 2020. MDC has a unique opportunity to be a leader in AFVs, especially by investing into adequate (charging) infrastructure. MDPTO should continue to coordinate with MDC to meet the goal of 40 percent registered passenger vehicles by 2035 and the switch to AFVs for county fleet.

AFVs and CAVs help the county reduce transportation emissions but require advanced policies and planning processes to implement. MDPTO must continue coordination with existing partners, especially with Florida Power and Light, to ensure there is adequate energy sources to transition to clean vehicles. Both public and private stakeholders play an important role in AFV and CAV support/implementation. Strategies are outlined for long range transportation planning, communication, immediate capital investment strategies, research and development, and regulations. An example of long range transportation planning strategies for AFVs and CAVs is outlined below:

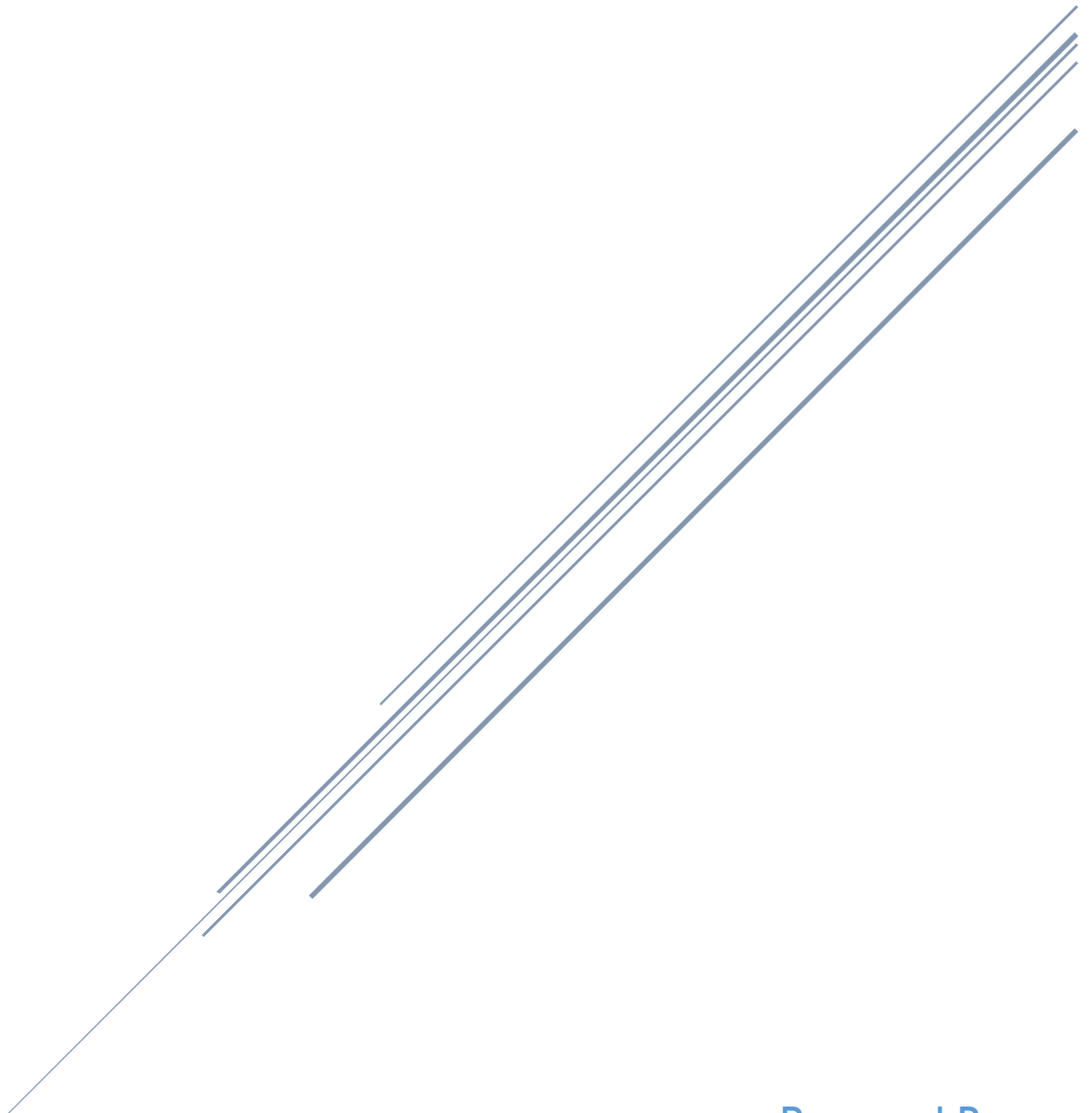
**AFV/CAV Strategy Matrix – Long Range Transportation Planning**

<b>MDTPO CAV/AFV Strategies</b>	<b>Implementation Action</b>	<b>Partners</b>	<b>Timeframe*</b>	<b>Priority**</b>
LRTP 1 - Assess existing infrastructure to meet CAV needs	1.1 Review pavement markings to ensure visibly distinct markings for safe driving	DTPW, FDOT	1-5 Years	Medium
	1.2 Confirm bridges and pavement are load bearing for future (freight) vehicle platooning	DTPW, FDOT	1-5 Years	Medium
	1.3 Review traffic signal equipment and traffic signal phasing/timing	DTPW, FDOT	5+	Low
	1.4 Develop a network plan of roadways that can safely accommodate truck platooning	DTPW, FDOT	1-5 Years	Medium
	1.5 Complete a feasibility study to prioritize locations with the greatest need and most cost-effective solutions	DTPW, FDOT	1-5 Years	Medium

To meet MDTPO goals, performance measures were identified related to meeting net zero emissions, mitigating sea level rise impacts, and maintaining connectivity and mobility. The MDTPO network was evaluated against sea level rise, hurricane risk, and the 100-year floodplain to identify concern areas in the region (including those without cost feasible projects). These, along with existing alternative fuel charging stations, vulnerabilities were identified and mapped. A resiliency process was built into the 2050 LRTP process, including a resiliency data analysis, resiliency plan + prioritization process, resiliency project implementation, and resiliency project maintenance and operation. Resiliency efforts must be included within the LRTP process to capitalize on funding opportunities and to maintain a reliable and robust multimodal transportation system.

# EXISTING RESILIENCY EFFORTS

Technical Memo #1  
June 2023



Prepared By:  
TranSystems

## Table of Contents

1.	Introduction .....	3
2.	Peer Review .....	6
2.1.	Plans for Peer Review .....	7
2.1.1.	Miami-Dade County Climate Action Strategy, 2021 .....	7
2.1.2.	MDC Septic Systems Vulnerable to Sea Level Rise (SLR), 2018.....	9
2.1.3.	Resilient305 Strategy, 2019 .....	12
2.1.4.	MDC Electricity Master Plan, 2012.....	15
2.1.5.	Unified Sea Level Rise Projections and Guidance Document, 2019 .....	17
2.1.6.	Miami-Dade County Sea Level Rise Strategy, 2021 .....	19
2.1.7.	Miami-Dade County Sustainable Buildings Program, 2020 .....	21
2.1.8.	Addressing Climate Driven Displacement, 2022 .....	22
2.1.9.	TPO SMART Plan, 2016.....	24
3.	Transportation Agencies Best Practices & Policies .....	26
3.1.	Transportation Agencies .....	26
3.1.1.	Miami Dade County.....	26
3.1.2.	FDOT .....	33
3.1.3.	Federal.....	35
4.	Regional, National, & International Projects.....	39
4.1.	Regional Projects.....	39
4.1.1.	Hillsborough County MPO: Vulnerability Assessment and Adaptation Pilot Project, 2014 39	
4.1.2.	Broward Climate Change Action Plan, 2020.....	40
4.1.3.	Southeast Florida Regional Climate Change Compact .....	41
4.2.	National Projects .....	42
4.2.1.	Resilience and Durability to Extreme Weather Pilot Project: Corpus Christi Metropolitan Planning Organization.....	42
4.2.2.	Plan Bay Area 2050.....	45
4.2.3.	Resilience & Durability to Extreme Weather in the H-GAC Region Pilot Program Report	47
4.2.4.	Climate Ready DC – Resilient Design Guidelines .....	50
4.2.5.	Charting The Course to Zero Port of Seattle’s Maritime Climate & Air Action Plan.....	53
4.3.	International Projects.....	58
4.3.1.	Reimagina Puerto Rico Report.....	58

4.3.2. New Amsterdam Climate – Roadmap Amsterdam Climate Neutral 2050.....60

5. Conclusion .....62

## 1. Introduction

The world's climate is inevitably, and rapidly, changing, and human activities are a factor affecting climate change. Society is feeling the impacts through temperature increases, intensified storms, rising oceans, prolonged droughts, and loss of animal species. The ability to prepare, withstand, quickly recover, and adapt when challenged with the adverse impacts of climate change is referred to as climate resilience or, without a climate connotation, resiliency. Nations across the globe are steadfast in their efforts to become more resilient towards climate change. The Miami-Dade region is working to become a partner in these efforts.

The Miami-Dade Transportation Planning Organization's (TPO) vision is "to achieve world-class mobility that promotes equity, accessibility, and economic competitiveness with an emphasis on resiliency and innovation, for the advancement of Miami-Dade County's transportation network and quality of life, for current and future generations."<sup>1</sup> To achieve this vision, the TPO has a responsibility to adopt and maintain a Long-Range Transportation Plan (LRTP) which plans, prioritizes, and programs funding for transportation projects for the region over a 25 year period. This effort will aid the resiliency and reliability of the transportation network by evaluating vulnerabilities and critical infrastructure for climate change events such as sea level rise.<sup>2</sup> In accordance with federal law, the LRTP must be updated every five years and is required to have at least a 20-year horizon period in order for the process to be "continuous cooperative, and comprehensive, and provide for consideration and implementation of projects, strategies, and services."<sup>3</sup> The projects that are prioritized are then eligible to receive funding in the Transportation Improvement Program (TIP). The TIP is a financial document that shows where the region will spend its federal dollars on regionally significant transportation projects. The TIP feeds into the Statewide TIP (STIP) so that all federally designated funds are planned together with all agencies in a coordinated and consistent manner. Determining how to incorporate resiliency within the LRTP planning effort is a major objective of this study.

President Biden signed the Bipartisan Infrastructure Law (BIL) into law in November of 2021. The BIL is the largest, long-term investment into the country's infrastructure and economy delivering \$550 billion through fiscal years 2022 to 2026. A significant part of the BIL is to mitigate the effects of climate change and increase the resilience of the country's infrastructure through several new programs. To conform to the BIL, the Federal Highway Administration (FHWA) divisions and Federal Transit Administration (FTA) regional offices will work with state departments of transportation, transportation planning organizations (TPO), and metropolitan planning organizations (MPO) to target specific Planning Emphasis Areas (PEA):

- Tackling the Climate Crisis – Transition to a Clean Energy, Resilient Future;
- Equity and Justice<sup>40</sup> in Transportation Planning;
- Complete Streets;
- Public Involvement;
- Strategic Highway Network / United States Department of Defense Coordination;
- Federal Land Management Agency Coordination;

---

<sup>1</sup> <http://miamidadetpo.org/about-tpo.asp>

<sup>2</sup> [http://floridatransportationplan.com/pdf/2020-01-29\\_FDOT%20Resilience%20Quick%20Start%20Guide\\_FINAL.pdf](http://floridatransportationplan.com/pdf/2020-01-29_FDOT%20Resilience%20Quick%20Start%20Guide_FINAL.pdf)

<sup>3</sup> <https://www.govinfo.gov/app/collection/cfr/2021/title23>

- Planning and Environment Linkages (PEL); and
- Data in Transportation Planning.<sup>4</sup>

The BIL provides the fiscal foundation for FHWA programs and activities. It is vital to understand and follow the guidelines and requirements for each program or activity so funding may be allocated accordingly. The 2050 LRTP update will discuss, develop, and address solutions to improve Miami-Dade County's infrastructure and economic resiliency. Not only will this study aid transportation projects and processes in the LRTP, but it will also help to accelerate strategies for electric and alternatively fueled vehicles. Transportation plans and infrastructure investments should assist in achieving a national greenhouse gas (GHG) reduction goal of about 50-55 percent below that of 2005 levels by 2030 and net-zero emissions by 2050.<sup>5</sup> Accelerating the transition towards electric and alternative fueled vehicles will aid in reaching the aforementioned goals. The BIL has various electric vehicle (EV) and alternative fuel programs and provides \$7.5 billion for EV infrastructure funding.<sup>6</sup> The National Electric Vehicle Infrastructure (NEVI) Program provides the Florida Department of Transportation (FDOT) with an estimated \$198 million over five years. The funds will address EV charging needs for passenger vehicles and light-duty trucks.

The Congestion Relief Program (CRP) is a newer grant program available to municipalities and MPOs located in urbanized areas as well as States.<sup>7</sup> The municipalities and MPOs must have a population of over 1 million. States can either be brought into the grant as partners or can apply independently. The grant provides funding for design, implementation, and construction costs for projects aiming to reduce congestion and related economic and environmental costs. Projects in areas experiencing high degrees of recurrent congestion take priority. All applicants must consider and include mitigation efforts to assist low-income drivers who may feel the effects of projects. A total of \$250 million will be allocated over a four-year term. Each grant will be no less than \$10 million and a minimum 20% non-federal matching share.

Florida Statutes (Section 339.157) requires FDOT to develop a Resilience Action Plan (RAP) that conforms to the requirements within the BIL. The RAP will assess flooding, storm, and sea level rise impacts on the state highway system and assess strategies to improve the resiliency of existing infrastructure.<sup>8</sup> Various features of the RAP may be applied to this assessment:<sup>5</sup>

- Vulnerability assessment to identify transportation facilities vulnerable to flooding due to storms and sea level rise;
- Consideration of current and future conditions of tides, rainfall, sea level rise, storm surge, or a combination;
- Utilization of updated data and information on rainfall and sea level rise from the National Oceanic and Atmospheric Administration;

---

<sup>4</sup> <https://www.transit.dot.gov/sites/fta.dot.gov/files/2022-01/Planning-Emphasis-Areas-12-30-2021.pdf>

<sup>5</sup> Ibid.

<sup>6</sup> <https://www.fdot.gov/planning/policy/ev/electric-vehicle-infrastructure-funding>

<sup>7</sup> <https://www.nlc.org/article/2022/08/03/innovative-ways-to-deal-with-traffic-congestion-road-funding/#:~:text=Congestion%20Relief%20Program,The%20Congestion%20Relief&text=This%20competitive%20grant%20provides%20funds,and%20operation%20of%20mobility%20services>

<sup>8</sup> <https://www.fdot.gov/planning/policy/resilience/resilience-action-plan>

- A review of all FDOT policies, procedures, manuals, tools, and guidance documents;
- Revisions that produce cost effective solutions for resiliency improvements; and
- The development of technical assistance for partners on local and regional resilience solutions.

The strategies, changes, and enhancements from the RAP can then be referenced directly within the LRTP and applied to local county projects.



## 2. Peer Review

The following peer review consists of literature collected from a variety of local, national, and international resources. All literature documents have relevance to resiliency in the face of climate change and the methodology behind how geographic locations are working to combat and adjust to the predicted challenges. The first section of the peer review encompasses local plans from Miami-Dade County (MDC) such as the Resilient305 Strategy and the MDC Climate Action Strategy. The second section focuses on transportation agencies and policies. This included FDOT, MDC's Department of Transportation and Public Works Department (DTPW), the City of Miami, and Federal policies. The third, and final, section is dedicated to reviewing regional, national, and international projects related to climate resiliency.

To ensure a consistent literature review, the following terminology was searched for - Flood, Drought, Heat, Wildfire, Wind, Sea Level Rise (SLR), Storm Surge, Resilience, Resiliency, Climate Change, Vulnerability, Natural Disasters/Hazards, Weather, Risk, Stormwater, Adaptation, Green House Gas, GHG, Alternative Fuel, Connected Autonomous Vehicles (CAV), and Electric Vehicle (EV). By searching for these specific terms, the most valuable information was extracted and can be used as inspiration for the 2050 LRTP. Additionally, the subsequent questions were analyzed during the document reviews:

- How is the term resilience used or defined? Is it a goal or an objective?
- Are there performance measures related to resilience?
- Was a vulnerability assessment conducted? If so, was it done for individual assets or system-wide?
- Does the plan include any of the following hazard risk types:
  - Existing hazards
  - Increases in the frequency of extreme events
  - Changes in gradual threat (e.g., increasing temperatures)
- Are there references or examples of identified resilience strategies or projects for transportation infrastructure?
- Are there ongoing monitoring and reporting efforts documenting vulnerabilities, resilience, and/or damages?
- Is there a stated reason for integrating resilience, such as federal or state regulations?
- Are greenhouse gas reduction goals for 2030 included? Beyond?
- Is there a Net-Zero Goal by 2050?

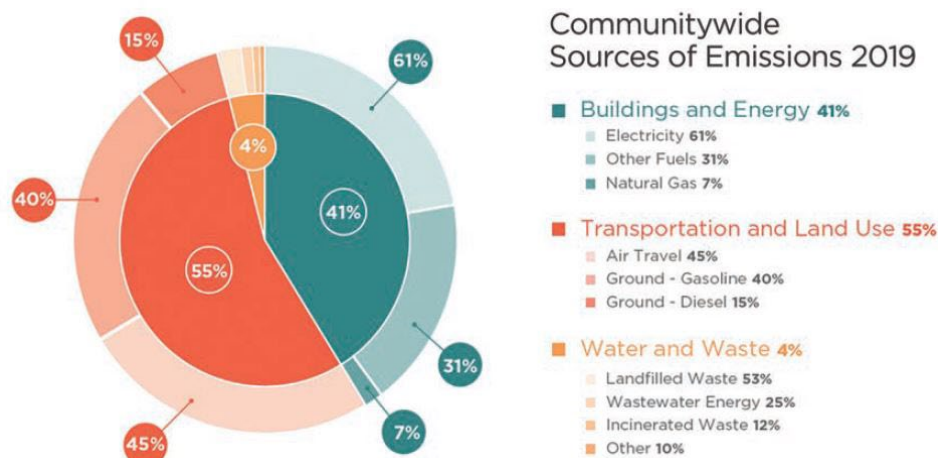
Asking these questions places a focus on the necessary information and excludes any additional elements within the documents irrelevant to the end goal.

## 2.1. Plans for Peer Review

### 2.1.1. Miami-Dade County Climate Action Strategy, 2021

MDC developed a Climate Action Strategy (CAS) to combat climate change and reduce factors that contribute negatively to the environment through the production of GHGs.<sup>9</sup> The CAS delineates three areas where GHGs are emitted countywide:

- Buildings and Energy – Contributes to 41 percent of emissions in MDC;
- Transportation and Land Use – Contributes to 55 percent of emissions in MDC; and
- Water and Waste – Contributes to 4 percent of emissions in MDC.



Source: Miami-Dade Climate Action Strategy

Figure 1: Communitywide Sources of Emissions 2019

The CAS delineates the necessary steps toward a more resilient environment by developing seven principal strategies aimed to reduce emissions by 50 percent by 2030. While buildings, including energy and water consumption, are major contributing factors to GHGs, this review will focus primarily on transportation and land use policies that can help guide the MDTPO 2050 LRTP.

Transportation related emissions stem from the burning of fossil fuels for automobiles, airplanes, vessels, lawnmowers, tractors, semi-trucks, and other mechanized vehicles. The two following major approaches were developed in the CAS and are projected to reduce 28 percent of GHGs in MDC:

- Reduce Transportation Related Fuel Consumption
- Expand and Protect Green and Blue Spaces

#### Reduce Transportation Related Fuel Consumption

##### 2030 Targets

- Shift 10 percent of transportation trips away from single occupant vehicles;
- Electrify MDC fleet vehicles: 80 percent of light vehicles and 50 percent of buses;

<sup>9</sup> <https://www.miamidade.gov/global/economy/resilience/climate-strategy/home.page>

- Transition 30 percent of communitywide vehicles to electric power; and
- Reduce GHGs from Miami International Airport and PortMiami operations by 50 percent.

#### **Actionable Items**

- Make walkability and safety a communitywide first priority;
- Complete 50 miles of protected bike lanes in downtown Miami;
- Work to ensure geographically dispersed and equitable public access to EV chargers that are EnergyStar certified and, whenever possible, use renewable energy;
- Establish County policies to prioritize and double the installation of roundabouts instead of traditional street intersections;
- Build out SMART Plan corridors;
- Implement the community-driven Better Bus Network;
- Complete a light fleet electrification analysis to replace County vehicles with battery-electric vehicles (BEVS);
- Examine facilities and install EV charging infrastructure; and,
- Develop plans with cruise lines and airlines to reduce emissions using the EPA National Port Strategy Assessment and Airports Council International's (ACI) Airport Carbon Accreditation program.

#### Expand and Protect Green and Blue Spaces

##### **2030 Targets**

- Expand community-wide tree canopy to 30 percent coverage;
- Ensure that all County facilities within the Urban Development Boundary (UDB) receive an average of at least 30 percent canopy coverage and all County facilities outside the UDB have an average of at least 50 percent canopy coverage;
- Reduce pollutant loads to surface waters to enable recovery of seagrasses to historic levels; and,
- Double non-wetland acreage in preservation.

#### **Actionable Items**

- Develop methodologies that will assess, track, and report changes to acreage amounts and functional quality per ecosystem type to determine the success of habitat protection strategies and accurately calculate carbon sequestration and storage;
- Develop a mitigation policy that ensures new developments increase the County's green infrastructure by the development's completion date; and,
- Prioritize or require Florida Friendly Landscaping as a universal landscaping technique to save water and reduce fertilizer and nutrient runoff.

### 2.1.2. MDC Septic Systems Vulnerable to Sea Level Rise (SLR), 2018

The MDC Septic Systems Vulnerable to SLR was developed in 2018 to provide an overview of how septic systems can be impacted by current and future water levels.<sup>10</sup> The document covers identified various at-risk areas including:

- Areas where groundwater levels are close to the existing septic systems surface and more likely to become compromised and may not provide adequate treatment;
- Severely at-risk areas and systems vulnerable to complete failure during an average rainy season; and,
- Areas expected to be impacted by SLR by 2030 and 2040.

The overarching goal of this document is to detail the objectives put in place to create a more resilient septic system. The document reports that MDC shall coordinate with municipalities in Florida to monitor existing septic tanks that are at risk of flooding and shall develop and implement programs to abandon at-risk systems and/or connect users to the public sewer system.

#### 2030 and 2040 Compromised Areas Results

By 2030, it is projected sea levels could be between six to ten inches higher than they were in 1992. Since 1994, Miami has observed a four-inch rise in water levels, which have increasingly put stress on many properties. More than 92% of vulnerable properties lie within the Urban Development Boundary (UDB). Table 1 shows the number of land parcels in MDC that are vulnerable due to SLR both inside and outside of the UDB:<sup>11</sup>

Table 1 - Vulnerable MDC SLR Parcels

	2030	2040
<i>Within UDB</i>	62,521	62,677
<i>Outside UDB</i>	4,556	4,557
<b><i>Total</i></b>	<b>67,007</b>	<b>67,234</b>

Source: MDC Septic Systems Vulnerable to SLR

<sup>10</sup> <https://www.miamidade.gov/green/library/vulnerability-septic-systems-sea-level-rise.pdf>

<sup>11</sup> [Ibid.](#)

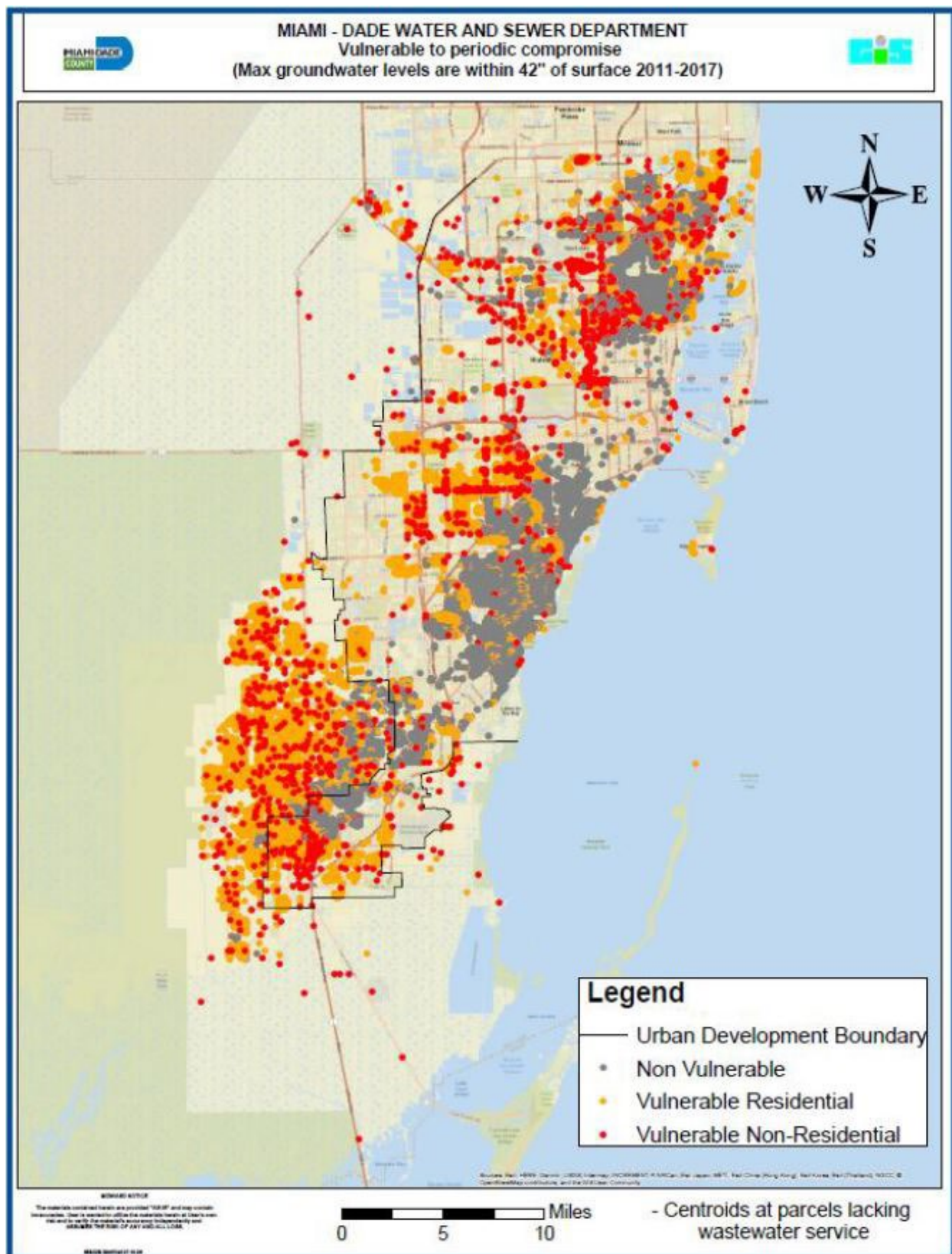


Figure 2: Compromised Areas Results

The report recommends that given the number of potentially impacted parcels under the existing conditions, it is prudent to plan for resiliency, particularly in densely populated urban areas. The following resolution and policies help form actionable strategies for the community.

### Resolution No. R-597-13

The Board of County Commissioners approved Resolution No. R-597-13 on July 2, 2013. The Resolution directs the Water and Sewer Department (WASD) to develop a plan extending sewer service to commercial and industrial areas. A commissioned study identified areas near transportation corridors lacking sewers. The Resolution intended to maximize economic development, promote job creation, and protect MDC's water supply.

### Other Relevant Policies

- **WS-3A:** Public facility improvements are to be evaluated for funding by certain criteria.
- **WS-4D:** The County shall create a Special Taxing District anywhere using existing private wells, interim wastewater treatment plants, or septic tanks that pose a threat to public health or environmental integrity. The Special Taxing District will finance connections to the public water supply or public sewer system.
- **WS-4G:** The County will not require connections to the wastewater collection system to be made in areas where gravity systems do not surcharge at any time of the day, for more than 30 days a year. Connections are not required if the system tends to overflow, discharge, or exfiltrate sewage at any time of the year under any storm events of five years or less.
- **WS-4H:** MDC will coordinate with the State and municipalities to monitor septic tanks at risk of malfunctioning due to high groundwater levels or flooding to develop and implement programs to eliminate at-risk systems and/or connect users to the public sewer system.

### Actionable Items

There are steps that can be taken to either reduce the number of new septic system installations in vulnerable areas and steps to reduce the risks posed by systems already installed in vulnerable areas.

#### *Reducing the environmental and public health risks of existing systems in vulnerable areas*

- **Sewer Extensions:** Connect existing structures within the UDB to the sanitary sewer system. Phase-in improvements over time.
- **Technical Solutions:** Upgrade existing systems by elevating and creating "mounded" systems. This solution is not the best option for areas vulnerable to flooding risks such as storm surges or in densely populated areas. Available replacements are alternative sewer systems or advanced decentralized treatment systems.
- **Reducing Vulnerability Through Drainage Improvements:** Local drainage practices and regional water management influence groundwater levels. Additional analysis needs to be conducted to see how those practices can be modified to reduce the impacts of rising groundwater on vulnerable infrastructure.



*Reducing the number of new septic systems installed in vulnerable areas*

- Masterplan for Service Expansions: WASD should review whether it would be beneficial to develop a masterplan for sewer service expansion and whether changes to the current funding mechanisms for service expansions would be beneficial.
- Regional and Sub-Regional Pump Stations: WASD should consider if it would be best to allow “sub-regional”, “phased regional”, or more equitable cost-sharing regional pump stations where only force mains are available.
- Feasible Distance: Revise Chapters 24-43.1 and 24-42.2 of the County Code to include criteria and requirements so variables related to unsaturated depth, flooding, and SLR are included.
- Variances: Review current rules and regulations. Current regulation allows variances to be granted to permit the use of a septic system. However, with the instances where additional systems are installed, there is potential for future impacts to freshwater resources and the environment related to SLR that are not considered.
- Setbacks: Review current rules and regulations. Currently, septic systems are required to be set back from surface waters. Review the requirement to determine whether the existing requirements benefit public health, freshwater resources, environmental health, and tourism.
- Requirements to Connect: Review rules and regulations for the size of a subdivision required to connect to the sanitary sewer. There is a possibility that developers of larger subdivisions evade requirements to connect to the sanitary sewer system.
- Review Design Standards: New septic systems must be a certain distance above groundwater level. Revised groundwater level maps from 2016 should be the required reference. Older, outdated maps should not be referenced.
- Regular Review of Policy Implementation: MDC should regularly review all policies to ensure the County makes consistent progress toward the goal of reducing public health risks and environmental risks created by compromised septic systems.

### 2.1.3. Resilient305 Strategy, 2019

The Greater Miami and the Beaches (GM&B) partnership based in MDC developed the Resilient305 Strategy.<sup>12</sup> It was created to address the county’s resilience strategies and introduce the discussion on how to combat resilience challenges through intergovernmental and community collaboration. Resilient305 encourages partnerships to safeguard the people and built infrastructure in its entirety from increasing events like hurricanes and infrastructure failures as well as stresses like SLR, flooding, traffic, and economic inequalities. The Resilient305 Strategy is organized into three overarching action areas: Places, People, and Pathways. Each action area has specific objectives that expand to various sub-actions. Spotlight sections within the action areas call out previous project examples to accompany the actions.

---

<sup>12</sup> [https://www.mbrisingabove.com/wp-content/uploads/Resilient305\\_final.pdf](https://www.mbrisingabove.com/wp-content/uploads/Resilient305_final.pdf)



Source: Resilient305 Strategy

Figure 3: Area and Population Statistics

This document defines resilience as “providing the opportunity for every person and every community to bounce back after large-scale flooding events, hurricanes, or economic hardships, and to not only survive, but thrive in the face of SLR, expensive housing, challenging traffic, and uncertain labor markets.”

### Action Items

#### Places

Beautiful environments, climate, and location cause South Florida to be extremely populated. However, there are several natural hazard threats to the area. The Places action aims to:

- Address location-based challenges and improve climate resiliency through research, design, and planning;
- Create, connect, and improve mobility and housing options; and,
- Enhance and safeguard our ecosystems.

This action has a total of 19 sub-actions, five spotlights, and 11 case studies. Five objectives will allow GM&B to complete the desired actions:

- Enhance natural systems
- Safeguard urban systems
- Create mobility options



- Increase energy efficiencies
- Enhance housing options

## People

The area's inhabitants create the resiliency of a city. When people do not have access to basic needs, resiliency diminishes. The People action aims to improve the everyday lives of citizens by:

- Supporting job and wealth creation;
- Addressing health needs for the most vulnerable; and,
- Prepare and empower neighborhoods and networks to anticipate and respond to all disruptions regardless of size.

This action has a total of 22 sub-actions, 13 spotlights, and eight case studies. Five objectives will allow GM&B to complete the desired actions:

- Cultivate financial stability
- Advance public health priorities
- Strengthen community response
- Communicate the concept of resilience

## Pathways

This action has sub-actions, six spotlights, and nine case studies. This action is the strategic course taken to accomplish the goals through expanding networks and sharing resources & tools. The Pathways action aims to:

- Build connections, collaborations, and committed leadership to change the status quo, therefore, enabling GM&B to become a leader in resilience.

Five objectives will allow GM&B to complete the desired actions:

- Pre-plan for post-recovery
- Cultivate resilience expertise
- Leverage our experience
- Develop shared resources
- Leverage our dollars

## Implementation

Throughout the three years, it took to create the Resilient305 Strategy, MDC, the City of Miami, and the City of Miami Beach were developing and implementing comprehensive strategies and action plans to improve resiliency within their jurisdictions. This includes:

- Integrating resilience into city and county-wide strategies, budgets, comprehensive plans, and emergency management plans;
- Appointing resilience liaisons from key departments;
- Developing and passing bonds to finance resilient infrastructure;

- Passing policies and securing funds to accelerate the creation and preservation of affordable housing;
- Improving and expanding mobility options;
- Expanding economic opportunities; and,
- Mitigating flood risks.

The Resilient305 Strategy is now an overarching link in planning efforts and a foundation for other municipalities, businesses, institutions, and organizations.

#### PIVOT Team

The Progress, Innovation, and Vision for Our Tomorrow Team, or PIVOT Team, investigates resources, timeframes, and priorities to develop work plans and oversee implementation and strategy progress for Resilient305 Strategy actions. The PIVOT Team is comprised of a senior administrator and a Chief Resiliency Officer (CRO) from each of the GM&B partners as well as a representative from The Miami Foundation. Appointed representatives provide legislative and budget guidance for strategy implementation. The PIVOT team also ensures the region's diversity reflects in all actions undertaken by the GM&B.

#### 2.1.4. MDC Electricity Master Plan, 2012

The MDC Electricity Master Plan (The Plan) provides a systemic approach to efficient energy usage within MDC government operations.<sup>13</sup> The Plan is designed to be the first step towards achieving a comprehensive energy management program for MDC. The overarching theme is that energy management must be addressed at both the organization (macro) and department (micro) levels. The Plan describes what should be done at the macro and micro levels, discusses organization-wide strategies and current implementation projects, identifies future strategies, and profiles the six largest electricity-consuming departments. The Plan focuses solely on electricity consumption and does not encompass all energy sources. The objective is to lay a framework for coordinated interdepartmental energy management within MDC through cross-departmental initiatives to streamline energy management and implement a five-step cycle that creates distinct and customizable plans for each capital department.

#### Five Step Cycle

The intention of the Five Step Cycle is to be understood and followed as a continuous cycle. The outputs of the process are designed to inform and feed back into the next cycle allowing for continuous improvements over time. The steps are as follows:

---

<sup>13</sup> <https://www.miamidade.gov/green/library/electricity-master-plan.pdf>

### **Step 1: Baseline Inventory**

- Establish a baseline by inventorying facilities falling under the department’s jurisdiction and summate facility electricity consumption in the baseline year of 2007. Repeat the process for every subsequent year.

### **Step 2: Benchmarking**

- Benchmarking measures changes over time and reveals areas for improvement. There are two types of benchmarks used to evaluate energy performance: historical and peer. Benefits include compliance with Resolution R-228-09, setting targets to improve performance, earning an ENERGY STAR rating, and various more, which are listed on document page 17.

### **Step 3: Set Goals and Identify Opportunities**

- Goals can range from organizational changes needed to improve energy management to an actual reduction or elimination of particular electrical loads. Strategizing and identifying opportunities begin after setting goals.

### **Step 4: Make it Happen**

- Prioritize the projects identified, assess funding options, and execute the projects.

### **Step 5: Measure Performance**

- Monitor and measure the implemented processes and projects against the original goals set and report on the results. Noted mistakes should lead to corrections and improvements in project management.

### **Miami-Dade County Office of Sustainability**

The MDC Office of Sustainability (OOS) was created in 2007. Its purpose was to coordinate and assist in organization-wide and department-level changes towards a sustainable government culture, operations, and service delivery to protect and enhance MDC’s unique environment.

### **The Big Six**

Six departments represent approximately 87 percent of MDC’s electricity use. They are known as “big users.” Each department has different energy-related approaches and projects that are in progress or completed.

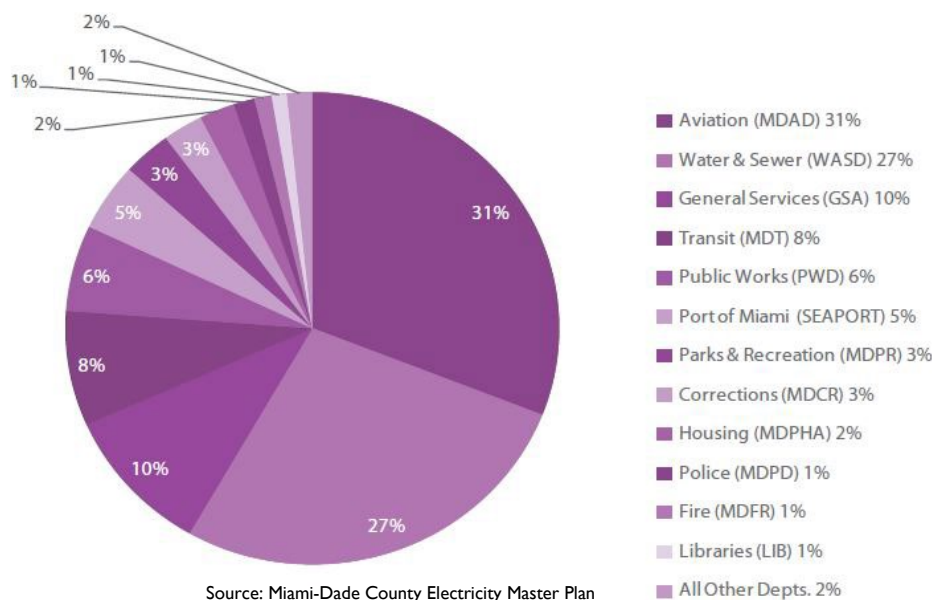


Figure 4: Miami-Dade County Government Electricity Consumption 2010

### 2.1.5. Unified Sea Level Rise Projections and Guidance Document, 2019

The Southeast Florida Regional Climate Change Compact (The Compact) created the Unified SLR Projection for Southeast Florida Report (The Projection).<sup>14</sup> The Compact consists of Miami-Dade, Monroe, and Palm Beach Counties. The Projection provides an update on the amount of anticipated sea level rise in Southeast Florida through 2120. This document supports local governments, regional entities, and other partners in understanding the various vulnerabilities SLR brings and informs the development of science-based policies, strategies, and infrastructure design. All estimates of SLR are provided from the baseline year of 2000 and a planning horizon of 2120. The Projection is updated every four years with the latest update completed in 2019. The 2019 Projection is based on SLR projections developed by the Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report and projections from the National Oceanic and Atmospheric Administration (NOAA). The projections account for regional effects including ice melt effects, changes in ocean dynamics, vertical land movement, and thermal expansion due to warming sea levels. The Projection includes discussions on how the ever-increasing presence of greenhouse gasses exacerbates SLR.

#### Greenhouse Gas (GHG) Emissions

Human activities have caused a significant increase in GHG emissions within the atmosphere. These gases are comprised of carbon dioxide, methane, and nitrous oxides in addition to the natural emissions of these gases. Fossil fuel burning is a major source of carbon dioxide production. GHG emissions will trap heat from the sun through the greenhouse effect process. As these gases accumulate in the atmosphere, the Earth's average temperature rises resulting in global warming. SLR is a result of both the expansion of seawater as the ocean temperatures increase and the melting of glaciers and ice

<sup>14</sup> [https://southeastfloridacompact.org/wp-content/uploads/2020/04/Sea-Level-Rise-Projection-Guidance-Report\\_FINAL\\_02212020.pdf](https://southeastfloridacompact.org/wp-content/uploads/2020/04/Sea-Level-Rise-Projection-Guidance-Report_FINAL_02212020.pdf)

sheets. As global warming accelerates, the rate of SLR accelerates. The rising waters pose a threat to the built infrastructure of the Southeast Florida region. The rate of SLR projections is dependent upon the amount of GHG emissions generated in the next decade and sustained in the coming decades. Therefore, it is up to the local inhabitants to adapt to these threats by improving their infrastructure's resiliency.

### Unified Sea Level Rise Projection for Southeast Florida

The document projects the anticipated range of SLR for the region from 2000 to 2120. As the terms expand in time, there is more variation in the projected SLR range due to the uncertainty of future GHG emission reduction efforts and the resulting geophysical effects. The three planning horizons are:

- Short Term: by 2040, sea level is projected to rise 10 to 17 inches above 2000 mean sea level (MSL)
- Medium Term: by 2070, sea level is projected to rise 21 to 54 inches above 2000 MSL
- Long Term: by 2120, sea level is projected to rise 40 to 136 inches above 2000 MSL

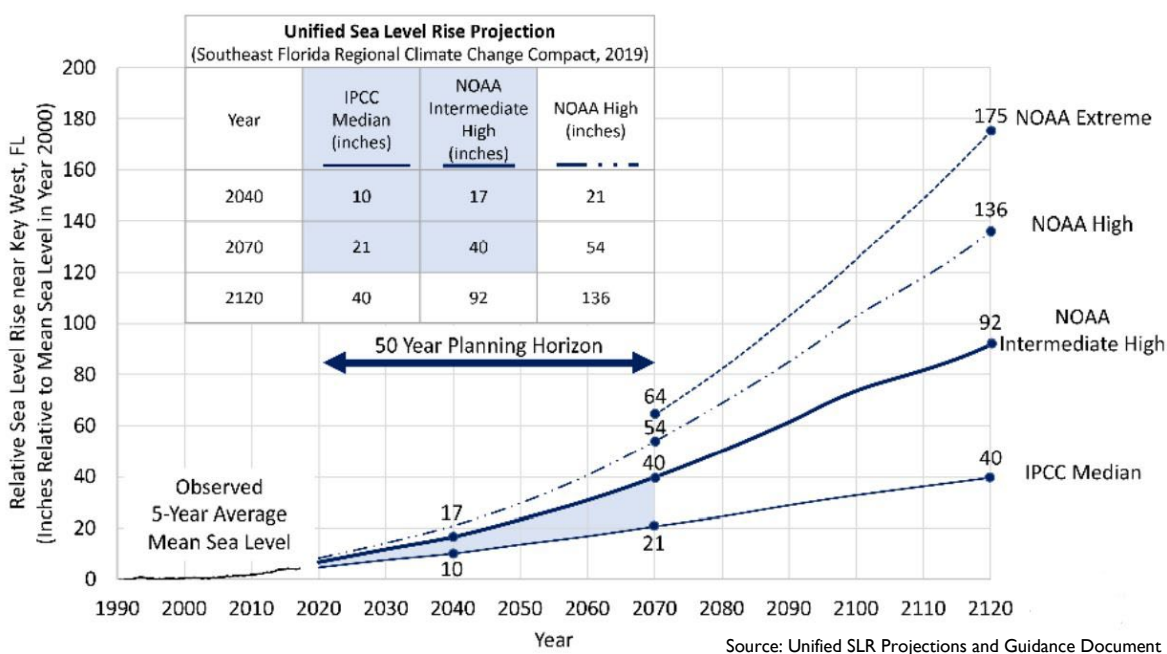


Figure 5 - Unified Sea Level Rise Projection

The blue shaded zone in the table and chart is what was recommended to be applied to most projects with a short-term planning horizon (up to 2070). The IPCC Median curve represents the most likely average sea level before 2070. It however does not represent the realistic interannual and interdecadal variations that occur with SLR values within the depicted blue zone. The NOAA Intermediate High curve should be applied for non-critical infrastructure services during or after 2070. The NOAA High curve should be utilized for planning critical, high-risk projects in service after 2070. It can also be used for projects that are more permanent or interdependent with other infrastructure or services. The NOAA

Extreme curve is presented for informational purposes and is not recommended for use. Lastly, the projections are measured in Feet North American Vertical Datum (NAVD). NAVD is a measurement that measures elevation above (altitude) and depression below (depth) mean sea level.<sup>15</sup>

### Application to Resilience Strategies

When these projections are used in unison with vulnerability studies, the user is informed of the potential magnitude and extent of SLR impact in a future timeframe. Elected officials should use the projections to inform the decision-making processes regarding adaptation policies, budget impacts associated with design features that address SLR, capital improvement projects associated with drainage and shoreline protection, and land use decisions. When applying the projection curves to infrastructure, the user must consider the nature, value, interconnectedness, and lifespan of the existing or proposed infrastructure. Understanding the risks critical infrastructure will be exposed to, such as SLR inundation, storm surge, and nuisance flooding, and creating a resiliency plan to combat these risks must be established in the early parts of the conceptual phase. The document provides direct guidance on how to apply the IPCC Median Curve, the NOAA Intermediate High Curve, and the NOAA High Curve.

#### 2.1.6. Miami-Dade County Sea Level Rise Strategy, 2021

The MDC SLR Strategy focuses on the County's path to resiliency with SLR. The document begins by summarizing the relationship MDC has had with the aquatic environment and how rising sea levels will cause this relationship to be reimagined in the coming decades. The Strategy presents five unique approaches to adapting to SLR. The successful adaptation is going to come from a large mosaic of approaches. Implementation of these approaches will occur best through a series of key actions and projects outlined in the final section of the document.

### Adaptation Approaches

Due to MDC's unique geology, unique approaches to addressing climate change are necessary to ensure future generations will thrive. The southeast Florida region calls for a variety of complementary approaches tailored to the landscape and community preferences. The approaches are used both individually and in unison to adapt to SLR. The approaches include:

- Build like the Florida Keys
- Elevate structures, buildings, and critical equipment
- Build artificial reefs and breakwaters
- Restore mangroves, marshes, and coral reefs
- Enhance barrier islands
- Promote new developments in the least flood-prone areas along transit corridors
- Expand greenways, blueways, and waterfront parks
- Make room for canals in flood-prone neighborhoods
- Increase waterfront setbacks
- Increase living shorelines

---

<sup>15</sup> [Vertical Datum Upgrade Frequently Asked Questions | WaterMatters.org \(state.fl.us\)](https://www.watermatters.org/state/fl.us)



- Create a network of small spaces for water in yards, streets, and parks
- Increase permeable surfaces
- Improve the regional drainage systems
- Deploy temporary flood panels
- Preserve wetlands
- Re-nourish beaches
- Raise the land on artificial fill
- Improve seawalls
- Raise roads
- Protect and restore seagrass beds



Figure 6: Adaptation Approaches

### Top Ten Actions

MDC has recommended and implemented policies and projects to create resilient communities in the face of flooding risks. By building upon previous work, the next steps towards building resilient infrastructure, assisting neighborhoods, and enhancing natural areas can begin. The document presents a non-exhaustive list of steps necessary to adapt to SLR:

1. Accelerate Adaptation Action Areas across the County
2. Require County projects to be designed for SLR
3. Establish safer building and seawall elevation standards
4. Ensure development avoids flooding neighboring properties
5. Enhance flood protection by expanding greenways and blueways
6. Flood-proof the County's most vulnerable critical facilities
7. Integrate green infrastructure into County projects
8. Prepare for disaster recovery to accelerate inclusive adaptation
9. Address vulnerable septic systems
10. Increase affordable, resilient housing on high ground within SMART Plan transit corridors

These actions have proven to be the most impactful regulatory and policy changes, investments, and planning efforts applied to reduce future risk. Implementing these actions requires continued collaboration and coordination. Each action within the document has many insightful details including adaptation approaches, implementation teams, case studies and resources, and proposed changes.

#### 2.1.7. Miami-Dade County Sustainable Buildings Program, 2020

The Miami-Dade County Sustainable Buildings Program (SBP) was established to provide direction to County departments and agencies to facilitate the integration of sustainable materials and methods to promote environmental quality, economic vitality, and social benefits by applying best practices in the design, construction, and maintenance of the county's built environment.<sup>16</sup> The SBP was codified in Sections 9-71 through 9-75 of the Code of Miami-Dade County together with Implementing Order 8-8. The Miami-Dade County Office of Resilience (OOR) within the Department of Regulatory and Economic Resources (RER) oversees and administrates the program. The OOR's mission is to lead MDC to a resilient and environmentally sustainable future by identifying vulnerabilities, coordinating stakeholders, and facilitating innovative solutions.

---

<sup>16</sup> <https://www.miamidade.gov/global/economy/resilience/sustainable-buildings-program.page>





Figure 7: LEED-certified Aventura Branch Library

## The SBP and Resiliency

The SBP aims to instill resilience into the built environment by applying the methodologies to all new construction projects and infrastructure renovations. Any new building or addition requires it to have a “Silver” or higher designation under the LEED for New Construction (LEED-NC) Rating System. The OOR conducts regular outreach to all county departments to review and verify the status of all ongoing projects on a semi-annual basis. Between 2008 and 2020, there have been savings of \$3.3 million in energy costs, 59,700 metric tons of carbon dioxide emissions have been avoided, and there have been 25 completed projects with 60 in-progress projects<sup>17</sup>. Over the next 20 years, OOR projects there will be \$30 million in energy savings from ongoing projects.

### 2.1.8. Addressing Climate Driven Displacement, 2022

The Addressing Climate Driven Displacement Study (ACDDS) focuses on three Florida counties – Miami-Dade, Pinellas, and Duval – due to their locations along the coastline.<sup>18</sup> All three counties face significant flooding risks due to SLR. Residents who live along the coast of these counties tend to have higher education levels and affluence whilst residents residing inland are likely to show varying levels of socioeconomic positions and racially or ethnically diverse communities. ACDDS discusses how coastal communities face challenges in developing adaptation and relocation strategies to develop resiliency against climate gentrification-driven displacement risks. The methodology was comprised of three parts:

- Mapping – Areas at risk of primary (coastal) displacement and neighborhoods at risk of secondary (inland) displacement through various gentrification drivers were identified. The maps identify census block groups at levels of low, moderate, and high displacement risks.

<sup>17</sup> [2021-05-27-sustainable-buildings-program-infographic.pdf \(miamidade.gov\)](https://www.miamidade.gov/2021-05-27-sustainable-buildings-program-infographic.pdf)

<sup>18</sup> <https://coss.fsu.edu/collins/wp-content/uploads/sites/28/2022/02/Butler-Jackson-Holmes-et-al.-2021-Final-LCI-Report-Climate-Gentrification-Updated-min.pdf>

- Policy Analysis – The analysis determines how efficiently coastal municipalities are planning for SLR and the protection of coastal neighborhoods as well as how effectively inland municipalities are planning to protect affordable housing options and stabilize neighborhoods.
- Interview – Stakeholder interviews were conducted to seek out an understanding of how these resiliency issues are understood and explained at a local level along with whether there are plans, activities, or strategies underway that have yet been incorporated into existing plans or policies.

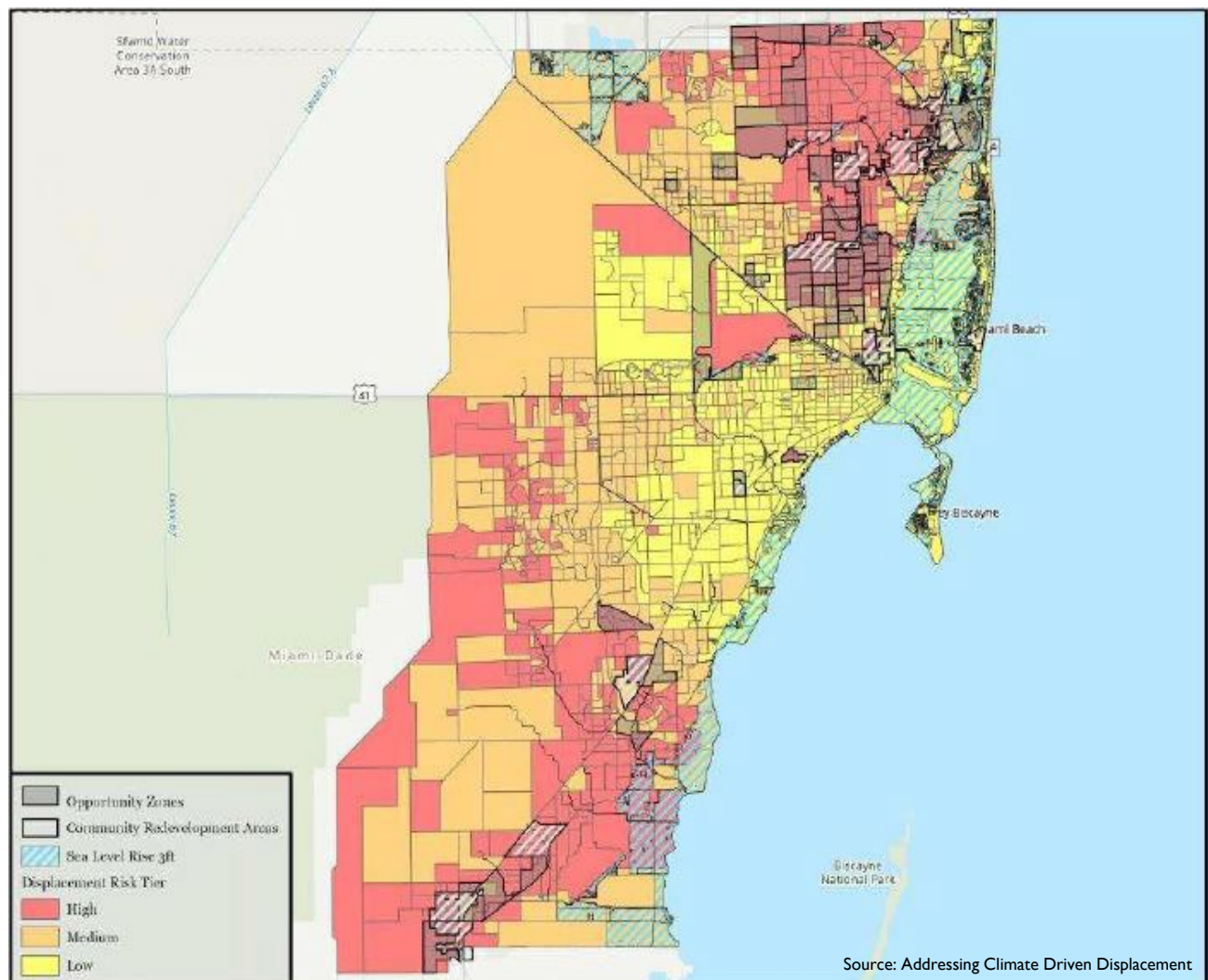


Figure 8: Displacement Risk Index Results

## Recommendations

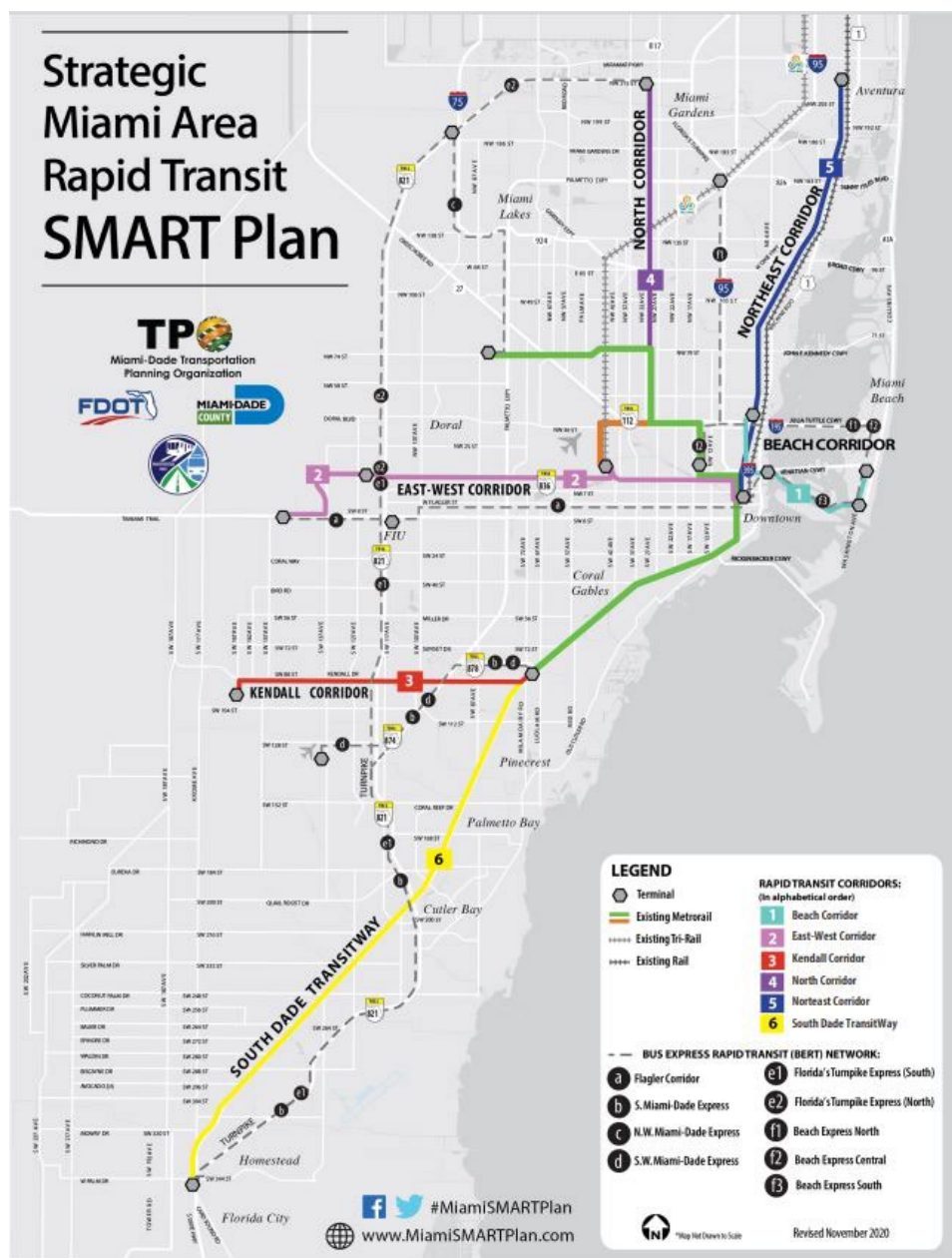
- There is time before SLR becomes problematic enough that it results in mass population displacement from the coast. However, SLR will affect many structures under construction today. Protections need to be put into place sooner rather than later.
- Focus on affordable housing protection and provision by addressing affordable housing needs to help mitigate the worst gentrification and displacement impacts.
- Expand education and access tools for residents and advocacy groups by providing mapping tools and toolkits so residents remain better informed on program efforts.
- Develop an integrative and collaborative approach for climate justice and equity to mend the gap between resilience and affordable housing.

### 2.1.9. TPO SMART Plan, 2016

The Miami-Dade County Strategic Miami Area Rapid Transit (SMART) Plan is a comprehensive program developed by the County's Transportation Planning Organization (TPO).<sup>19</sup> The SMART Plan advances six rapid transit corridors along a network system of Bus Express Rapid Transit (BERT) service to the Project Development and Environment (PD&E) study phase to determine project costs and potential funding sources. The SMART Plan is also referred to as the SMART region because it connects South Florida to Monroe and Palm Beach Counties. The SMART Plan's goal is to create a resilient system that facilitates movement throughout Miami-Dade and neighboring counties.

---

<sup>19</sup> <https://www.miamidadetpo.org/smartplan.asp>



Source: Miami-Dade County

Figure 9: Strategic Miami Area Rapid Transit SMART Plan

### Land Use Planning & Visioning

The Land Use Planning & Visioning process supports land use as a key role in a resilient transit system.<sup>20</sup> The process promotes transit use and increases mobility choices for users throughout the corridors. The ultimate purpose of the process is to develop a land-use scenario for each of the six SMART Plan corridors. The scenarios will develop a technical basis for the creation of transit-supportive land uses for all six corridors.

<sup>20</sup> <http://www.miamidadetpo.org/smartplan-land-use-planning-visioning.asp>



### Project Environmental Studies

Project Development and Environmental (PD&E) Studies evaluate proposed transportation improvements for the corridors. Specifically, they evaluate the implementation of a cost-effective, premium transit system and infrastructure within the six SMART Plan corridors.<sup>21</sup> Multimodal street improvements accommodating premium transit services are a primary focus. A comprehensive public involvement program is extremely valuable to these studies. The program conducts both formal and informal meetings with a variety of stakeholders ranging from the public to elected officials to local transportation providers. The TPO should fully understand the importance of the PD&E process, the benefits of implementing this streamlined process, and apply it to future relevant projects.

## 3. Transportation Agencies Best Practices & Policies

Best practices and policies from local transportation agencies will be evaluated to understand how the agencies will be tackling the issues of resiliency, adaptation, and alternative fuels.

### 3.1. Transportation Agencies

#### 3.1.1. Miami Dade County

##### Department of Transportation and Public Works

The Department of Transportation and Public Works (DTPW) includes two divisions: Transportation and Public Works.<sup>22</sup> The Transportation Division works to connect people to places through a high quality, reliable, safe, and clean mass transit system that meets the travel needs of a growing population. MDC offers these four transit systems: Metrobus, Metrorail, Metromover, and the Special Transportation Service. The Public Works (PW) division manages permits, the maintenance and development of roads, and traffic management.

##### DTPW Resiliency Projects

##### **Metrorail Expansion Efforts - AirportLink**

- In 2012, a 2.4-mile long extension from an existing station was built to connect Metrorail riders to Miami International Airport (MIA).<sup>23</sup>
- This addition provides passengers with a central transfer point to other transportation options including Metrobus, Tri-Rail, Greyhound, and many others, possibly including Amtrak in the future. Riders can connect to MIA by transferring to the Automated People Mover.
- This development improved the interconnectivity of MDC's transportation system.

##### **Electric Buses**

- September 1, 2022 - The Florida Department of Environmental Protection (DEP) awarded over \$68 million to purchase 227 electric buses in 13 counties across the state.<sup>24</sup>

<sup>21</sup> <http://www.miamidadetpo.org/smartplan-project-environmental-studies.asp>

<sup>22</sup> <https://www.miamidade.gov/global/transportation/home.page>

<sup>23</sup> [https://www.miamidade.gov/transit/library/pdfs/misc/airportlink\\_fact\\_sheet\\_english.pdf](https://www.miamidade.gov/transit/library/pdfs/misc/airportlink_fact_sheet_english.pdf)

<sup>24</sup> <https://www.miamidade.gov/releases/2022-09-01-electric-buses-state-funds.asp>

- Florida announced a \$19.8 million investment in MDC for the purchase of 63 electric buses. MDC was the largest award recipient from all the counties.
- DTPW will run one of the largest fleets of 40-foot electric buses in the US upon full fleet delivery.
- This transition is an effective way to reduce harmful emissions. Battery-electric buses emit no tailpipe pollution, so this will save approximately 230,000 pounds of GHG annually.

### CNG Buses

- April 8<sup>th</sup>, 2021 – DTPW purchased 140 new compressed natural gas (CNG) busses, which increased the total fleet to 560 CNG busses.
- 560 CNG busses represent three quarters of the entire fleet.
- CNG busses reduce MDC carbon footprint, increase reliability, and lower overall maintenance costs for the County.<sup>25</sup>

### Metrobus

The Metrobus serves all major shopping, entertainment, and cultural centers, major hospitals, and schools. Services are available across the county from Miami Beach and Key Biscayne all the way to Florida City and the Middle Keys.<sup>26</sup> There are a variety of payment options, which include the GO Miami-Dade Transit application, contactless payment, and cash.



Figure 10: Metrobus

### Metrorail

The Metrorail system is a 25-mile dual track providing services from Kendall through South Miami, Coral Gables, Downtown Miami, and all the way to northwest MDC.<sup>27</sup> The Metrorail connects riders to the Miami International Airport and has connections to Broward and Palm Beach County at three locations.

<sup>25</sup> <https://www.miamidade.gov/releases/2021-04-08-dtpw-140-cng-arrived.asp>

<sup>26</sup> <https://www.miamidade.gov/global/transportation/metrobus.page>

<sup>27</sup> <https://www.miamidade.gov/global/transportation/metrorail.page>

There are various payment methods including the GO Miami-Dade Transit application, EASY Card, or Ticket. The Metrorail operates from 5 a.m. until midnight seven days a week.



Figure 11: Metrorail and Station

### Metromover

The Metromover is a free elevated people mover system and DTPW is actively working on upgrading the system.<sup>28</sup> The Metromover operates seven days a week from 5 a.m. until midnight in the downtown Miami, Omni, and Brickell areas. Riders travel to major destinations such as the Miami-Dade Arena, Bayside Marketplace, Miami-Dade College, and the Miami-Dade County School Board.

<sup>28</sup> <https://www.miamidade.gov/global/transportation/metromover.page>



Figure 12: Metromover

### Special Transportation Service

The Special Transportation Service (STS) is a shared-ride public transportation service in compliance with the complementary paratransit service provisions of the Americans with Disabilities Act (ADA) of 1990.<sup>29</sup> STS provides door-to-door transportation service from a pick-up location to a drop-off location at \$3.50 per trip. The service operates 24-hours a day, seven days a week, and throughout most of MDC. To be eligible to use this service, you must have a physical or mental disability preventing you from using accessible public transportation independently, have a temporary disability, or people from out-of-town with disabilities presumed eligible under ADA jurisdiction.

### MDC Public Works

The PW division provides permits for work within rights-of-way and handles code enforcement for unpermitted work. The division provides and maintains traffic signals, traffic control signs, street signage and pavement markings, and all County and State-owned streetlights throughout MDC. The PW division also builds, operates, and maintains movable and fixed bridges, swales, roadway surface repairs, and guardrails. The Rickenbacker and Venetian Causeways are two notable transportation infrastructure systems maintained by the department. Additionally, the division manages the County Stormwater Utility for flood and water quality protection as well as maintains the secondary flood system. The PW division supports the County's goal of resilience by maintaining vital infrastructure. These pieces of the overall puzzle of MDC's transportation system must operate smoothly and work in unison.

### DTPW Fleet Management

The Fleet Management division is an internal service that maintains MDC's light and heavy mobile equipment fleet, provides fuel and maintenance to departments, municipalities, and other

<sup>29</sup> [https://www.miamidade.gov/global/service.page?Mduid\\_service=ser1471890065439510](https://www.miamidade.gov/global/service.page?Mduid_service=ser1471890065439510)



governmental entities, and administers the Vehicle Replacement and Fuel Conservation Program.<sup>30</sup> Fleet Management works on maintaining resilient infrastructure that supports the fluidity of people's daily actions. On their page within the MDC website, visitors can find elevator permits and inspection forms, public parking, and fueling locations.

### PortMiami 2035 Master Plan, 2011

The PortMiami 2035 Master Plan was developed as a planning tool to analyze if the Port is reaching its set goals, policies, and objectives.<sup>31</sup> There is extensive growth projected over the next decade for both cruise passengers and cargo traffic. This Master Plan divulges future projects that will help the Port withstand the projected growth. Additionally, the Master Plan is a sub-element of the Miami-Dade County Comprehensive Development Master Plan (CDMP).

Section 7 of the Master Plan is the Preferred Plan. It was created through cruise and cargo 2035 projections, feedback from Port users and staff, and reviewing issues and sustainable opportunities. In relevance to this review, the focus was set on the document section titled Global Climate Change and Natural Disaster Planning.

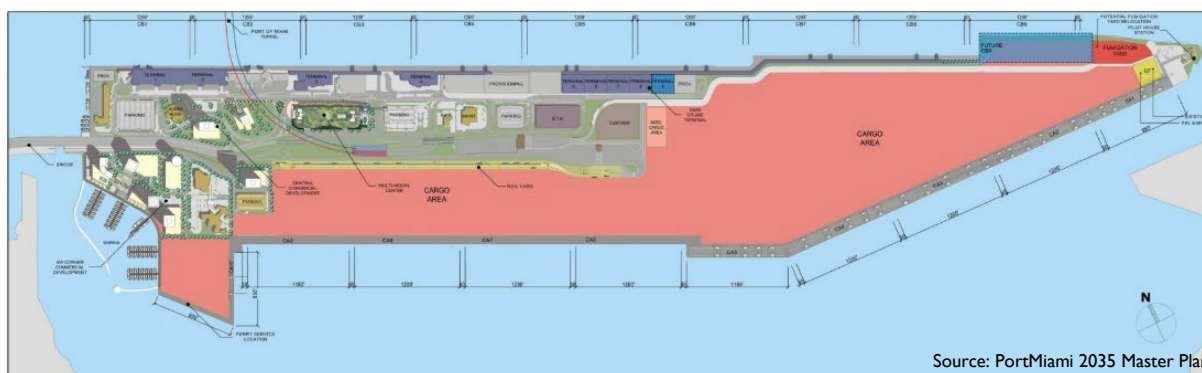


Figure 13: Preferred Long-Term Master Plan for PortMiami

PortMiami was built on a manmade land structure called Dodge Island that was built within the Biscayne Bay Aquatic Preserve. Protecting both the environment and future generations through sustainable development is vital to PortMiami and its future growth. Future projects will consider the surrounding areas, projected growth, and projects within the surrounding areas that will improve conditions and preserve the environment. Some future projects included are:

- Shore Power – vessels at a berth will plug into the electrical grid and turn off their engines to reduce emission levels in immediate surroundings
- Crane Electrification – cranes will be operated on the electrical grid rather than using diesel fuel which will reduce both fuel and noise emissions

<sup>30</sup> <https://www.miamidade.gov/global/business/facilitiesandfueling/home.page>

<sup>31</sup> <https://www.miamidade.gov/portmiami/master-plan.asp#:~:text=The%20PortMiami%202035%20Master%20Plan,to%20compete%20well%20into%202035.>

- LEED Buildings – all new Port buildings must need Miami-Dade County’s minimum requirements and receive LEED certification
- Green Energy Initiatives – includes sustainable projects (Port of Miami Tunnel, rail yard, wind farm implementation, and others) which assist in the reduction of congestion and emissions

Dodge Island is in a low-lying area, so it is prone to flooding, storm surge, and the effects of SLR. The Master Plan recommends that Dodge Island should raise its elevation to a minimum of 10 feet National Geodetic Vertical Datum (NGVD), which is the FEMA base flood elevation. The Master Plan also recommends that future project modifications must reduce or eliminate SLR impacts and evaluate the structural integrity of structures subject to hazards induced by SLR such as buildings, roadways, bridges, and seawalls.

Through the application of the Master Plan, PortMiami was able to obtain a \$16 million Rebuilding American Infrastructure with Sustainability and Equity (RAISE) grant in 2022.<sup>32</sup> The grant was for the NetZero: Cargo Mobility Optimization and Resiliency Project. The grant will allow PortMiami to:

- Add two rail tracks and three new electric rubber-tired gantry cranes;
- Install LED lights;
- Reconstruct the stormwater drainage system to address SLR;
- Support cargo gate improvements including roadway, realignments, gate canopies, and technology upgrades; and,
- Improve access and staging for trucks to move goods faster and reduce dwell time.

### City of Miami

#### **Department of Resilience and Public Works**

The Department of Resilience and Public Works (DRPW) is responsible for the infrastructure, maintenance, and construction in the City of Miami’s public right-of-way.<sup>33</sup> DRPW services include assistance in applying for a variety of permits, reporting potholes and damaged sidewalks, applying for plat approvals, inquiring about right-of-way dedications, and getting a public works covenant or agreement. The Maintenance Division cares for all street, tree, mowing, and storm maintenance. The Survey Division handles the platting process, right-of-way deeds, and survey work.

#### **Resiliency and Sustainability Division**

The Division of Resilience and Sustainability began as a division of the DRPW in November 2016. The Division collaborates with other departments to apply a resilience mentality to City operations, strategic planning, and budgeting processes to address systemic stresses, challenges, and enhance the ability to prepare and recover from acute shocks. The Department integrated the Division of Resilience and Sustainability in October 2020.

<sup>32</sup> <https://www.miamidade.gov/releases/2022-08-11-mayor-port-raise.asp>

<sup>33</sup> <https://www.miamigov.com/My-Government/Departments/Resilience-and-Public-Works>

## City of Miami Resiliency Initiatives

### **Climate Adaptation**

- Climate adaptation recognizes and studies the impacts of climate change<sup>34</sup>
- Miami Forever Climate Strategy – this strategy will reduce the increasing risks of flood, heat, and storm impacts over the next 40 years. Two of the strategy’s goals are to invest in resilient and smart infrastructure and promote adaptive neighborhoods and buildings.<sup>35</sup>

### **City of Miami Stormwater Master Plan (SWMP), 2021**

- Resilient stormwater management planning is necessary to protect public safety and infrastructure from local and regional flooding whilst meeting regulatory requirements protecting the environment.
- The SWMP helps stakeholders understand the essence of the natural conditions, constraints, and opportunities needed to manage stormwater in a safe, compliant, and sustainable matter.<sup>36</sup>

### **Miami Forever Bond**

- The intent is to build a strong, resilient future for Miami.
- The Bond will fund projects that will transform the City by investing \$400 million in five key categories:
  - Sea-Level Rise and Flood Prevention
  - Roadways
  - Parks and Cultural Facilities
  - Public Safety
  - Affordable Housing
- Bond projects will benefit current and future people, create jobs, and lower costs related to sea level rise and increased storm events.<sup>37</sup>

## City of Miami Greenhouse Gas (GHG) Initiatives

### **City of Miami 2018 Greenhouse Gas Inventory**

- This inventory provides the City of Miami with its first update in over a decade. Its results will inform a new climate action plan that will propel the City of Miami toward the goal of carbon neutrality by 2050.<sup>38</sup>

---

<sup>34</sup> <https://www.miamigov.com/My-Government/ClimateChange/Climate-Change-Action#panel-I-I>

<sup>35</sup> <https://www.miamigov.com/My-Government/ClimateChange/Climate-Change-Action/MiamiForeverClimateReady>

<sup>36</sup> <https://www.miamigov.com/My-Government/Departments/Office-of-Capital-Improvements/Stormwater-Master-Plan>

<sup>37</sup> <https://www.miamigov.com/My-Government/Departments/Office-of-Capital-Improvements/Miami-Forever-Bond>

<sup>38</sup> <https://www.miamigov.com/files/sharedassets/public/ghg-inventory-2018-full-report.pdf>

## Greenhouse Reduction Plan

- The City of Miami has a goal of reaching net zero Citywide GHG emissions by 2050. The Plan's objective is to develop a robust action plan to reduce GHG emissions and achieve carbon neutrality.<sup>39</sup>
- The GHG Inventory supports this initiative and the City has begun work on a GHG reduction strategy to determine how to reach carbon neutrality.
- City of Miami is aiming to cut Citywide GHG emissions by 60% from 2018 levels by 2035 as an interim goal.

### 3.1.2. FDOT

#### Florida Transportation Plan

The Florida Transportation Plan (FTP) is a plan used to guide Florida's transportation future and is updated every five years through a collaborative effort by state, regional, and local transportation partners within public and private sectors.<sup>40</sup> Four elements divide the FTP: Vision, Policy, Performance, and Implementation. For this review, the emphasis will be on the Implementation, Policy, and Performance elements.

#### **FTP Vision and Policy Element**

The Vision Element defines Florida's long-range transportation vision and goals for the next 25 years and beyond. There are seven integrated long-range goals:

1. Safety and Security
2. Infrastructure
3. Mobility
4. Choices
5. Economy
6. Community
7. Environment

Following the Vision Element is the Policy Element. The Policy Element was last updated in December 2020. It is the core element of the FTP and describes the objectives and strategies to guide transportation partners statewide in accomplishing the vision and goals. This element guides FDOT and its partners on how to develop and implement policies, plans, and programs that will assist in moving forward toward the vision of a safe, resilient, and quality transportation system. The Policy Element also defines 15 objectives that support the seven long-range goals. The intent is to provide measurable outcomes that help define and track progress toward the goals.



For this review, emphasis was placed on objectives that support infrastructure and mobility goals. These goals prioritize asset management and the quality and resilience of the state's transportation infrastructure. Having a resilient and connected system supports the state's mobility goal. Connectivity and resiliency indicate people and freight have efficient and reliable options for moving between origins

---

<sup>39</sup> <https://www.miamigov.com/My-Government/ClimateChange/Climate-Change-Action/GHGReduction>

<sup>40</sup> <http://floridatransportationplan.com/>

and destinations. It can equivalently mean that roads, transit, sidewalks, trails, and other infrastructure systems are complete with no gaps.

 <b>OBJECTIVES</b>	 <b>PROGRESS INDICATORS</b>
Maintain Florida's transportation assets in a state of good repair for all modes	<ul style="list-style-type: none"> <li>• Pavement condition</li> <li>• Bridge condition</li> </ul>
Increase the resilience of infrastructure	<ul style="list-style-type: none"> <li>• Vulnerability to flooding or storm surge</li> </ul>
Meet customer expectations for infrastructure quality and service	<ul style="list-style-type: none"> <li>• Hours or days of transportation facility closure due to smoke, fire, flooding, wind, or extreme temperature</li> </ul>
Improve transportation system connectivity	<ul style="list-style-type: none"> <li>• Frequency of repairs due to damage from extreme weather or other events</li> </ul>
	<ul style="list-style-type: none"> <li>• Customer satisfaction</li> </ul>
	<ul style="list-style-type: none"> <li>• Connections between modes/ systems and extent of system gaps</li> </ul>

Source: FTP Policy Element

Figure 14: Objectives and Progress Indicators

The next step would be to provide the foundational strategies to support the FTP goals. These apply universally to all objectives. The element emphasized the following:

- Strategically align investments with goals
- Provide sustainable and reliable transportation funding sources
- Develop and retain a skilled transportation workforce

Key strategies are needed to support objectives and achieve the goals. The highest priority of the FTP is to expand and strengthen the statewide commitment to Vision Zero. The objective of Vision Zero is to eliminate transportation fatalities and injuries on Florida's roads. The second priority is identifying and mitigating risks. Florida will incorporate these risks into planning and management decisions for all modes. The next element is the FTP Performance Element, which includes the performance measure reports.

### FTP Performance Element

The Performance Element is the third element within the FTP. The last update was in December 2020. The Performance Element's purpose is to report on how the system performs on key measures of safety, asset condition, and mobility. Performance management ensures an efficient investment of transportation funds by increasing accountability, transparency, and linking investment decisions to key outcomes. Performance measures integrate into FDOT and business practices on three levels:

- Strategic Level
- Decision-Making Level
- Project Delivery Level

This Performance Element report focuses on the specific list of measures and targets required by federal rule. They are grouped into five performance areas.



Source: FTP Performance Element

Figure 15: Performance Areas

These five areas connect back to the seven performance goals with added emphasis on goals related to safety, infrastructure, and mobility. The performance areas are holistic and can be associated with any goal. The Performance Element goes on to break down the performance results for each of the performance areas and discusses the targets, progress, performance-influencing factors, and how the FTP addresses the targets. The next element is the Implementation Element. It defines short-term actions to help accomplish the goals and objectives of the FTP.

### FTP Implementation Element

The Implementation Element is the fourth element within the FTP and was last updated in July 2022. The purpose of this element is to detail how work towards implementation during the next five years will occur. It specifies short-term actions and describes roles and processes for implementing the FTP and tracking progress toward accomplishing the vision and goals. A 34-person implementation committee guided the development of the Implementation Element. There were four meetings in 2021, focusing on defining actions for three of the 12 FTP strategies at each meeting. The Implementation Element defines actions for each of the five key areas:

- Collaboration
- Customers
- Performance & data
- Policy, planning, & decision-making
- Regional & local flexibility

The core of the Implementation Strategy is based on the 12 FTP strategies. Each strategy is covered within this element on a two-page spread. The left side highlights why the strategy is important, describes current practices, and identifies major opportunities and challenges. The right side defines actions within the five key areas.

Vision Zero is a vital strategy within the Implementation Element. A resilient infrastructure system should yield zero roadway fatalities. Many Florida Metropolitan Planning Organizations (MPOs) and local jurisdictions have embraced Vision Zero, and have formally adopted a Vision Zero plan or strategy.

### Resilience Action Plan (RAP)

FDOT is required under Section 339.157 of the Florida Statutes to develop a RAP.<sup>41</sup> It will assess the potential impacts of flooding, storms, and sea level rise on the State Highway System (SHS) and identify strategies that improve the resiliency of transportation facilities. Current and future events mold the RAP. By making the document compatible with the requirements called for in the Infrastructure Investment and Jobs Act (IIJA), FDOT is eligible for formula and discretionary funding from the federal government through the PROTECT program.

The goals of the RAP are:

- Recommend strategies to enhance the operational and infrastructure resilience of the SHS;
- Recommend design changes to retrofit existing state highway facilities and construct new ones; and,
- Enhance partnerships to address multijurisdictional resilience needs.

The RAP has various features, but there is an overarching theme of resiliency within the plan. An assessment will identify transportation facilities vulnerable to storm flooding and SLR. This assessment will also consider the current and future conditions of tides, SLR, rainfall, storm surge, and a combination by applying the most up-to-date data from NOAA. All FDOT policies, procedures, manuals, tools, and guidance will be reviewed, and revisions will produce cost-effective solutions for improving resiliency. FDOT will submit the plan to the Governor and Legislature no later than June 30, 2023, and it will be updated every three years.<sup>42</sup>

### Florida's Electric Vehicle Infrastructure Deployment Plan, 2022

The Electric Vehicle Infrastructure Deployment Plan (Plan) is Florida's framework for implementing the National Electric Vehicle Infrastructure (NEVI) Program.<sup>43</sup> The framework described within this five-year Plan supports the goals and objectives of the long-range transportation plan (LRTP), the Florida Transportation Plan (FTP), and the Electric Vehicle Infrastructure Master Plan (EVMP). The implementation of the NEVI program will build on Florida's existing electric vehicle (EV) charging network. This Plan states that Florida has more than 1,300 publicly available direct current fast chargers (DCFC) and 900 publicly available Level 2 chargers funded by VW Settlement funds. These DCFCs are some of the most resilient chargers in the market, charging vehicles within minutes as opposed to hours. The Plan calls out that although it consumes about eight billion gallons of gasoline annually, Florida takes second place in the highest number of EV sales in the nation. This indicates a large need for additional EVs. More than 4,000 miles of road have been added to an EV alternative fuel corridor (AFC) designated network to assist with this need. This allows the State to utilize funds from the NEVI program on EV charging gaps identified over the next five years.

---

<sup>41</sup> <https://www.fdot.gov/planning/policy/resilience/resilience-action-plan>

<sup>42</sup> [https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/planning/policy/resilience/rap-faqs\\_september-2022f.pdf?sfvrsn=b06c8503\\_2](https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/planning/policy/resilience/rap-faqs_september-2022f.pdf?sfvrsn=b06c8503_2)

<sup>43</sup> [https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/planning/policy/electric-vehicle/florida's-evidp\\_2022-07-29\\_final\\_v2.pdf?sfvrsn=21099b3e\\_2](https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/planning/policy/electric-vehicle/florida's-evidp_2022-07-29_final_v2.pdf?sfvrsn=21099b3e_2)



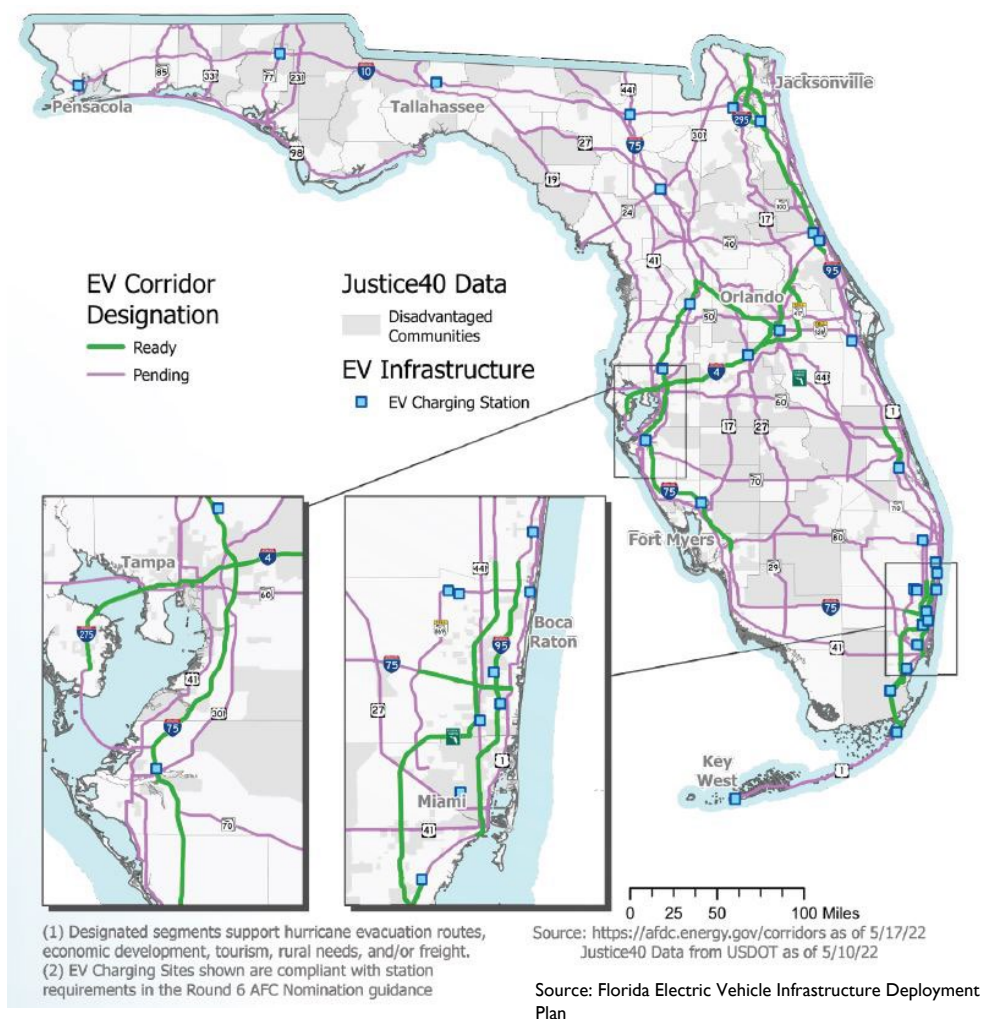


Figure 16: 2022 Alternative Fuel Corridor Designations

There are five functional Alternative Fuel Corridors. It is important to note that not all sections of the corridors are designated; some sections are awaiting designation.

- I-4
- I-75
- I-95
- I-275
- Turnpike

There are 31 pending Alternative Fuel Corridors:

- |         |                      |                    |
|---------|----------------------|--------------------|
| • I-4   | • SR 77              | • US 19            |
| • I-10  | • SR 80              | • US 27            |
| • I-75  | • SR 85              | • US 41            |
| • I-95  | • SR 100             | • US 98            |
| • I-295 | • SR 417 (Toll Road) | • US 231           |
| • SR 24 | • SR 528 (Toll Road) | • US 301           |
| • SR 29 | • SR 441             | • US 331           |
| • SR 40 | • SR 710             | • US 441           |
| • SR 50 | • SR 869 (Toll Road) | • Florida Turnpike |
| • SR 60 | • US 1               |                    |
| • SR 70 | • US 17              |                    |

To reach the vision of a complete, resilient EV network, the Plan is structured around a checklist of items needed to follow to implement the Electric Vehicle Infrastructure Deployment Plan.

- |   |                            |
|---|----------------------------|
| ✓ Plan Vision and Goals                 | ✓ Contracting              |
| ✓ Implementation Strategies             | ✓ Labor and Workforce      |
| ✓ Conditions Analysis                   | ✓ Cyber Security           |
| ✓ EV Charging Infrastructure Deployment | ✓ Civil Rights             |
| ✓ Implementation                        | ✓ Program Evaluations      |
| ✓ Equity Considerations                 | ✓ Discretionary Exceptions |
| ✓ Stakeholder Engagement                |                            |

For the review, only Plan Vision and Goals & Implementation Strategies will be discussed.

### Plan Vision and Goals

The Plan includes goals that will guide Florida as it moves forward in building out its resilient EV network:

- Expand energy sources for transportation fuels
- Position Florida as a national leader in EV infrastructure implementation
- Expand EV charging access to all Florida users
- Anticipate changes in travel choices and transportation technologies toward EV adoption
- Enhance Florida's transportation system overall, including roadways in rural and urban disadvantaged communities
- Support emergency evacuation

Florida will meet its target of 100 percent completion of a built-out EV network by achieving these goals. The goals support a convenient, reliable, equitable, and accessible EV infrastructure network.

## Implementation Strategies

Implementation is key to the successful attainment of the specified goals. This Plan's focus is to maximize U.S.-made EV equipment and follow Buy America requirements. A gap analysis for DCFCs identified initial investment areas and was updated with NEVI criteria to inform plan development and meet NEVI program goals.

- DCFC sites require at least four charging ports with 150 kW per port concurrently;
- DCFC sites must be within one mile of an interchange; and,
- DCFC sites cannot be more than 50 miles apart.

The Plan will fill the gaps through an efficient deployment of DCFCs as outlined in the following Implementation Strategies, Actions, and Activities. Three implementation strategies support the Plan:

- Implementation Strategy 1: Plan an equitable, reliable, future-proof network
- Implementation Strategy 2: Install and operate infrastructure to build out the network
- Implementation Strategy 3: Emergency preparedness and resiliency

Four actions further support the Plan:

- Collect, maintain, and leverage information and data to inform decision-making.
- Collaborate with partners to support the development and operations of the EV charging infrastructure network.
- Plan for procurement of EV charging infrastructure.
- Monitor potential risks that can delay efficient and effective deployment.

### 3.1.3. Federal

#### FHWA – National Electric Vehicle Infrastructure (NEVI) Formula Program

The Bipartisan Infrastructure Law (BIL) established the National Electric Vehicle Infrastructure Formula Program (NEVI Formula) under the U.S. Department of Transportation's (DOT) Federal Highway Administration (FHWA).<sup>44</sup> The program's purpose is to provide funding to States (including the District of Columbia and Puerto Rico) to deploy electric vehicle (EV) charging infrastructure and establish an interconnected network known as Alternative Fuel Corridors (AFC) that will facilitate data collection, access, reliability, and resiliency. One billion dollars per fiscal year, a total of five billion dollars, will be distributed between 2022 and 2026. Each state can receive a share of program funding equal to the State's share of distributed funds in federal-aid highway apportionments and Puerto Rico Highway Program funding.

The FHWA will establish regulations that set minimum standards and requirements for projects funded under the NEVI Formula Program. The regulations would apply to:

- Installation, operation, and/or maintenance of EV charging infrastructure;
- Interoperability of EV charging infrastructure;
- Traffic control devices or on-premises signage for EV charging infrastructure;

<sup>44</sup> <https://www.federalregister.gov/documents/2022/06/22/2022-12704/national-electric-vehicle-infrastructure-formula-program>

- Data, including format and schedule for data submission; and,
- Information on available EV charging infrastructure locations including pricing, real-time availability, and accessibility through map applications.

Each state is required to develop and submit an EV Infrastructure Deployment Plan to the Joint Office of Energy and Transportation to access funds. The Plans should discuss how the State would use the NEVI Formula Program funds consistent with the FHWA guidance. By States cooperating with the NEVI Formula Program and investing in the AFCs, the goal of reaching a reliable, interconnected, and resilient EV infrastructure network is possible.



Source: FHWA

Figure 17: Designated US EV AFCs

### FTA - Bus Exportable Power Systems

The Federal Transit Administration's Bus Exportable Power Systems (BEPS) program allows public transportation agencies, communities, and states access to resilient power options through hybrid-electric bus fleet vehicles during major power disruptions.<sup>45</sup> The goal is to develop a national BEPS standard through collaboration with the FTA, industry stakeholders, and technical partners so that different manufacturers' systems use the same technology base and applications for BEPS solutions.

<sup>45</sup> <https://www.transit.dot.gov/funding/grants/BEPS>



Source: FTA

Figure 18: Electric Bus at the pick-up station

## Objectives

The primary objectives for the BEPS include:

- Completion of an industry literature review on BEPS assessing system parameters, specifications, past results, and recommendations;
- Technology scans, surveys, or case studies with experienced transit agencies;
- Standards development;
- Plug-and-play BEPS system demonstration including minimum specifications and parameters for interoperability; and,
- A guide to implementing a BEPS system using these standards.

## Eligible Activities

Eligible activities include all activities related to the development of interoperable BEPS standards. Examples of project activities and efforts include, but are not limited to:

- Demonstration of portable units, industry surveys, and data collection on existing BEPS systems;
- Development of system specifications and standards;
- Innovations for providing an efficient BEPS system through public-private partnerships; and,
- Industry standards and guidebook development for BEPS solutions to share with the transit industry.



## Eligible Recipients

Eligible recipients include:

- Public transportation providers;
- Private for-profit and not-for-profit organizations, or consultants;
- State, city, or local government entities;
- Other organizations such as research consortia and institutions of higher education;
- Standard Development Organizations (SDOs)

## Additional Information

The Standard Development for BEPS Competitive Funding Opportunity implements the House Appropriations Committee direction accompanying the Consolidated Appropriations Act, 2021 (Pub. L. 116-260), which directed FTA to fund no less than \$1,000,000. Funds will be utilized to develop interoperable national standards for BEPS that allow the use of hybrid electric, and fuel cell buses as mobile power generators. The generators are used to power facilities, such as hospitals, following natural disasters and are authorized under Technical Assistance and Workforce Development Program (49 U.S.C. § 5314). The FTA's Technical Assistance and Workforce Development Program will fund qualifying projects.

### 2021 Florida Statutes – Chapter 380, the Resilient Florida Grant Program

Chapter 380, Section 380.093 is the Resilient Florida Grant Program (RFGP).<sup>46</sup> State Legislature recognizes that Florida is vulnerable to impacts from flooding and sea level rise. Allocated funding should prioritize the most significant risks to address the challenges effectively. The State Legislature also recognizes that to improve resiliency, it is necessary to complete comprehensive, statewide assessments of risks imposed by flooding and SLR and to develop a statewide approach to address the risks.

The Department of State established the EFGP to provide grants to municipalities or counties. Grants may be allotted for the following:

- Costs acquired from community resilience planning and data collection
- Vulnerability assessments to identify or address inland or coastal flooding and SLR risks
- Policy, project, and plan developments for community resiliency preparation from SLR and flooding
- Pre-construction activities for projects that will be submitted for inclusion in the Statewide Flooding and Sea Level Rise Resilience Plan located in a municipality of 10,000 or less population or a county of 50,000 or less population

---

<sup>46</sup> [http://www.leg.state.fl.us/statutes/index.cfm?App\\_mode=Display\\_Statute&Search\\_String=&URL=0300-0399/0380/Sections/0380.093.html](http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&Search_String=&URL=0300-0399/0380/Sections/0380.093.html)

## 4. Regional, National, & International Projects

Projects from regional, national, and international transportation agencies will be evaluated to understand how other regions around the globe are tackling resiliency and adaptation challenges.

### 4.1. Regional Projects

#### 4.1.1. Hillsborough County MPO: Vulnerability Assessment and Adaptation Pilot Project, 2014<sup>47</sup>

The Vulnerability Assessment and Adaptation Pilot Project (VAAPP) is one of 19 Pilot Projects across the U.S. conducted under the FHWA's second round of climate change vulnerability assessments. The VAAPP was partially funded through an FHWA grant. The VAAPP's objective was to identify cost-effective strategies that would mitigate and manage risks due to coastal and inland inundation. The results were incorporated into the Hillsborough County MPO's 2040 LRTP, the Post Disaster Redevelopment Plan (PDRP), and into transportation planning and decision-making strategies. The VAAPP referenced previous resilience and emergency preparedness works created by agencies in Tampa Bay and leveraged the expertise of the Hillsborough County Local Mitigation Strategy Working Group and other entities.

The VAAPP is comprised of three technical phases:

- Phase 1: Assemble a countywide multimodal transportation asset inventory and critical asset determination for a focused analysis. Develop potential future coastal and inland flooding scenarios & an assessment identifying existing or planned transportation assets with potential risks to SLR, storm surge, and inland flooding. Assessed were five segments which can be found listed on document page two.
- Phase 2: Apply the MPO's travel demand model to estimate losses in regional mobility due to facility disruptions.
- Phase 3: Use the Regional & Economic Models, Inc. (REMI) tool to divulge estimations of general economic losses associated with disrupted critical links and develop strategies for managing potential climate risks, also known as adaptation investments.

The assessments resulted in two variables that describe the cost effectiveness of the proposed adaptation strategy package. The first variable is an estimate of net benefits and avoided losses resulting from disruption duration reductions (in dollars). The second variable is the "tipping point", or the total number of days disruption needs to be avoided to achieve cost neutrality. Three of the five assessments returned a net loss and had corresponding tipping points of 11 to almost 21 days. A regional approach to considering potential losses associated with inundation was of high importance together with strong collaborations. The final purpose of this study was to act as a foundation for future segment assessments.

---

<sup>47</sup> [https://www.fhwa.dot.gov/environment/sustainability/resilience/pilots/2013-2015\\_pilots/florida/final\\_report/](https://www.fhwa.dot.gov/environment/sustainability/resilience/pilots/2013-2015_pilots/florida/final_report/)



#### 4.1.2. Broward Climate Change Action Plan, 2020

The Broward Climate Change Action Plan (CCAP) consists of goals, objectives, and actions that address the economic, environmental, and social impacts of climate change in Broward County.<sup>48</sup> The CCAP was adopted in 2021 and is to be implemented by local government, community partners, and residents. The plan centers around two overarching goals:

1. Mitigate climate change effect through the reduction of greenhouse gas (GHG) emissions by 2% per year.
2. Increase community resilience to climate change effects.

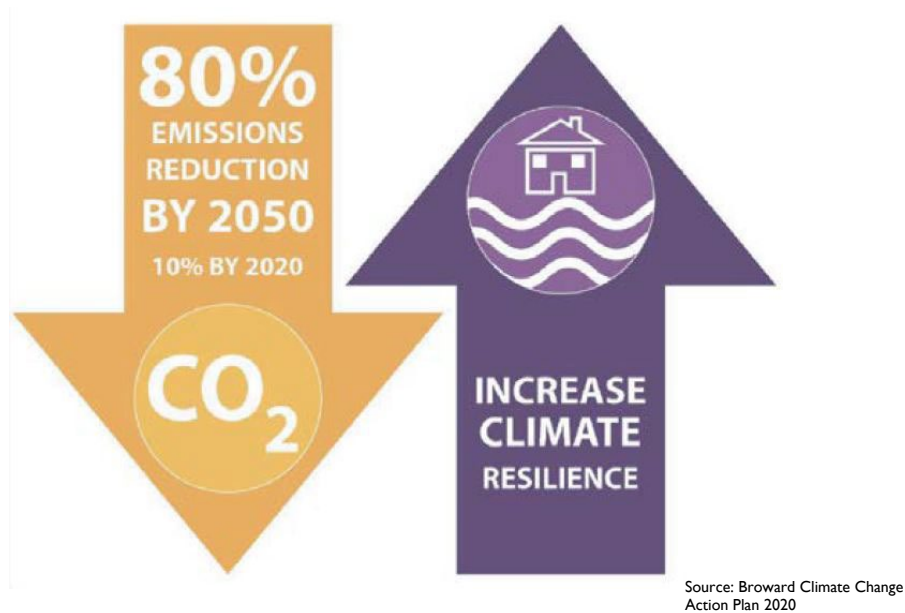


Figure 19: CCAP Goals

There are seven supporting elements:

- Policy
- Healthy Community
- Transportation
- Built Environment
- Energy Resources
- Natural Systems
- Water Resources

Each of the seven elements features an objective and a series of actions that support the two overarching goals. There are 125 actions on the reduction of greenhouse gas emissions, the increase of community resiliency, and the planning of adaptation measures for local impacts.

For this review, the focus will be on the Policy and Transportation elements.

<sup>48</sup> <https://www.transit.dot.gov/sites/fta.dot.gov/files/2022-03/Broward-County-Climate-Action-Plan-2020.pdf>

## Policy Element

Policies and regulations have a substantial influence on the resilience of communities in the face of climate change. The actions within this section create collaborative intergovernmental practices by creating joint legislative policies to raise awareness of Southeast Florida's vulnerability at both state and federal levels. An increase in advocacy for state and federal funding for mitigation and adaptation projects would also begin. The element has 18 actions that will lead to the enactment of policies and legislation for emission reduction from transportation and buildings, and an increase in community resilience through adaptations. An example of an action is to contribute to local, regional, and state climate planning efforts by supporting regional tools and planning document development that integrates regional climate change mitigation and adaptation goals into planning processes.

An example of an action within the Policy Element is to contribute to local, regional, and state climate planning efforts by supporting regional tools and planning document development that integrates regional climate change mitigation and adaptation goals into planning processes.

## Transportation Element

Transportation operations emit more than half of the County's GHG emissions. The actions within this element will seek to reduce emissions by increasing multi-modal system use and supporting electric vehicle use and infrastructure. Resilience will increase through the optimization of connectivity across sectors and transportation modes as well as through projects that assess and address system vulnerabilities. This element has 20 actions that aim to increase the overall resilience of the transportation system and infrastructure, reduce emissions, increase the County's EV fleet by 2030, and annually reduce transportation emissions by 2 percent.

An example of an action within the Transportation Element is to implement complete streets that will serve an array of users. This strategy should be used as the default approach in transportation planning and projects. There will eventually be complete networks of streets that cater to all users.

### 4.1.3. Southeast Florida Regional Climate Change Compact <sup>49</sup>

The Southeast Florida Regional Climate Change Compact (the Compact) is a 12-year old partnership between Palm Beach, Broward, Miami-Dade, and Monroe Counties. The Counties work together to reduce regional GHG emissions, implement new adaptation strategies, and improve climate resilience. The Counties came together because they recognized a shared challenge and the opportunity to begin climate change adaptations early and thrive off attained resiliency. The Compact's efforts have three objectives:

- Objective 1: Share regional tools and knowledge
- Objective 2: Increase public support and political will
- Objective 3: Coordinate action to accelerate efforts to increase regional climate resiliency

The Compact's website has various resources available for further information needs. Resources include Unified SLR Projections, a Policy Platform, the Regional GHG Inventory, Climate Assessment

---

<sup>49</sup> <https://southeastfloridacclimatecompact.org/>

Tool, Regional Climate Assessment Snapshot, Climate Indicators, and the RCAP Implementation Resources.

### **Regional Climate Action Plan (RCAP)**

The RCAP guides the Compact towards a coordinated climate action effort through a set of recommendations, implementation guidelines, and best practices to align with regional agendas. The first RCAP was published in 2012 after a two-year process with the intent for updates every five years. The second RCAP reflects upon the lessons learned across the first five years of implementation. The RCAP's purpose is to serve as a tool for municipal and county entities. It identifies vulnerabilities, actions, and policy initiatives to create a path toward regional resiliency. The online tool allows stakeholders to build their own customizable implementation plans based on their identities and priorities. The third edition of the RCAP was published in November of 2022.

## **4.2.National Projects**

### **4.2.1. Resilience and Durability to Extreme Weather Pilot Project: Corpus Christi Metropolitan Planning Organization<sup>50</sup>**

The Federal Highway Administration (FHWA) partnered with 11 pilot project teams to apply resilience solutions. The Resilience and Durability to Extreme Weather Pilot Project (the Pilot) is part of a series summarizing pilot projects and highlighting transportation resilience efforts across the country. For this Pilot, the FHWA partnered with Texas A&M University-Corpus Christi, the Corpus Christi MPO, and the MPO's consultant team (the Partners). The Pilot's primary objective is to identify, design, and monitor the performance of a nature-based shoreline protection feature that will enhance the resilience of Laguna Shores Road in Laguna Madre in Corpus Christi, Texas. The roadway has experienced flooding resulting in negative impacts on its lifecycle, an increase in maintenance costs, and public safety impacts.

---

<sup>50</sup> [https://www.fhwa.dot.gov/environment/sustainability/resilience/pilots/2018-2020\\_pilots/corpus\\_christi\\_case\\_study/](https://www.fhwa.dot.gov/environment/sustainability/resilience/pilots/2018-2020_pilots/corpus_christi_case_study/)



Figure 20: Laguna Shores Road project location

Laguna Shores Road is naturally prone to erosion and other impacts due to SLR and storm activity. This Pilot focused on exploring nature-based protection options for the southernmost portion of the road, as seen in Figure 19. This area has no buffer between the road and water, therefore making it more vulnerable than other portions. It is an ideal location to pilot this nature-based approach in this area because if it is successful, it can be implemented elsewhere as well.

The project entailed four key components:

- Conditions assessment
- Identify different shoreline protection strategies
- Construct a pilot shoreline protection project
- Monitor project effectiveness to potentially apply the technique to other vulnerable segments

### Stakeholder Engagement

The MPO's consultants, Texas A&M University-Corpus Christi students, and the MPO all worked on conducting the stakeholder engagements and initial research.

#### *MPO Consultant Team*

- Identified innovative shoreline protection strategies

- Generated engineering plans and specifications
- Baseline conditions assessment
- Study area erosion rate estimates
- Collect and review existing reports and data to understand site conditions

*Texas A&M University-Corpus Christi Students*

- Identified seagrass growth elevation
- Develop solution ideas

*Corpus Christi MPO*

- Held stakeholder meetings with government public works and planning staff who develop coastal infrastructure project and maintenance plans
- Citizens impacts by storms and rising waters
- Environmental activists for coastal ecosystem enhancements
- Academic researchers

**Assessments and Strategies**

The project team gathered and studied various data about existing and historical conditions such as inundation frequency, historical aerial photographs, surveys, and geophysical data. The MPO worked with local habitat specialists to develop a standard monitoring protocol for baseline habitat conditions including the dominant vegetative community. The project team also identified limits of seagrass growth and coverage percentage, bathymetric and topographic surveys, soil types, and wave conditions.

The proceeding step was to consider the alternatives. High-tide water levels were disturbing in-place erosion control features. The goal was to implement a shoreline protection feature that would avoid impacts to seagrass beds, provide room for marsh fill, and be made with land-based equipment. The two options were either a riprap breakwater option or a reef ball breakwater option. The riprap breakwater option should reduce wave heights, work in high or low energy environments, and provide habitats for small sea life. The reef ball breakwater option would use hollow, hemispherical artificial reefs made from concrete. These structures would provide new habitats for sea life, but results vary in reducing wave size and transmission.

**Results and Next Steps**

The overarching goal of the Pilot was to create and implement a natural resiliency method to improve road conditions during times of inundation and the future consequences of climate change and SLR. If the chosen method proved successful, it would be implemented on other sections of the road and other roads in general. For this project, the MPO decided to implement the riprap breakwater with imported marsh grass fill along the landward side of the breakwater. This decision was made because riprap breakwaters tend to provide greater wave attenuation than other options and can be built on sloped or uneven surfaces. Additionally, the probable construction cost for the riprap breakwater was within the project's budget.

#### 4.2.2. Plan Bay Area 2050

Plan Bay Area 2050 (PBA 2050) is a long-range plan developed by the Metropolitan Transportation Commission (MTC) and the Association of Bay Area Governments (ABAG) to build a more equitable and resilient future for the residents of the nine county Bay Area.<sup>51</sup> PBA 2050 developed 35 strategies to improve four elements in the Bay Area: housing, transportation, economy, and the environment. The plan also established five guiding principles for the plan: affordable, connected, diverse, healthy, and vibrant. PBA 2050 was preceded by Horizon, a scenario-planning effort that did not focus solely on linear forecasting (funding and growth), but on three scenarios that accounted for various potential political, technological, economic, and environmental challenges.<sup>52</sup>

##### Horizon

Two years before the PBA plan was developed, the Horizon initiative established the guiding principles that were used in the PBA 2050 plan and was developed two years in advance. Horizon was divided into four elements:

##### **Futures Planning**

Futures Planning is a nonlinear scenario planning effort that includes potential political, technological, economic, and environmental challenges. Nonlinear elements increase variability in planning for each developed scenario, which should theoretically make it closer to the unpredictability of the future.

---

<sup>51</sup> <https://www.planbayarea.org/finalplan2050>

<sup>52</sup> <https://mtc.ca.gov/planning/long-range-planning/plan-bay-area-2050/horizon>





**Rising Tides, Falling Fortunes** is defined by relaxed federal regulations and the elimination of federal programs from social services to infrastructure. In this Future, the federal government implements costly tariff policies as well as tight immigration restrictions. As a result, an era of slow growth begins across the United States, with particularly significant impacts in areas like the Bay Area. Labor constraints mean that innovation rates slow, and driverless electric vehicles fail to live up to the hype. Finally, a lack of international leadership means that worst-case sea level rise predictions come true – resulting in 3 feet of sea level rise by 2050.



**Clean and Green** is defined by an aggressive federal carbon tax to curb carbon dioxide emissions. This Future assumes that the policy is implemented in the early 2020s and results in similar commitments worldwide. Consequently, clean technologies thrive. Driverless electric vehicles become nearly universal, with consumers preferring to share rides more frequently. Virtual reality enables more telecommuting and distributed workplace locations, particularly for higher income individuals. Federal infrastructure investment allows for the completion of high-speed rail lines across the country, including California High-Speed Rail. Yet with high taxes and new regulations, jobs are assumed to be increasingly automated, which boosts productivity but results in fewer openings for workers without college degrees.



**Back to the Future** is defined by a thriving national economy supported by increased public investment in infrastructure, as well as immigration reform that increases the national population and workforce growth rate significantly. In the Bay Area, the technology sector thrives, leading to broad adoption of low-cost driverless vehicles. As a result, coastal metropolitan areas see a new wave of growth as technologies enable residents to commute longer distances to thriving urban job centers. Silicon Valley technologies remain dominant worldwide in everything from cars to e-commerce. Yet booming growth poses challenges for communities and their aging infrastructure that are absorbing that growth.

Figure 21: Nonlinear Scenarios

## Perspective Papers

The Perspective Papers are a series of white papers that explore strategies outside the scope of previous long-range planning processes. Each white paper proposes priority strategies for further study in the Futures Planning process. The priority strategies were chosen through a public evaluation and assessed through a second round of Futures Planning.

### 4.2.3. Resilience & Durability to Extreme Weather in the H-GAC Region Pilot Program Report

The Houston-Galveston Metropolitan Planning Organization, the Texas Department of Transportation, and the FHWA developed the Resilience and Durability to Extreme Weather in the Houston-Galveston Area Council (H-GAC) Region Pilot Program Report (the Report).<sup>53</sup> The goal of the report was to:

- Determine the criticality and vulnerability of regional transportation assets to extreme weather events;
- Create a suite of resiliency recommendations for local governments for the transportation network; and,
- Use the pilot program to inform future project selection criteria.

#### Keys Takeaways from the H-GAC Pilot Program

The H-GAC Pilot Program will aid in decision-making processes to incorporate resiliency into project selection for the TIP. FHWA's Vulnerability Assessment Framework was used to assess the vulnerability and risks associated with the transportation network with current and future extreme weather events.<sup>54</sup> H-GAC only evaluated freeways, principal arterials, minor arterials, and collectors from the region and were obtained from TxDOT. Similarly, the only structures that were evaluated were bridges over waterways. Eleven scenarios based on historic data of extreme weather events and feedback from stakeholders were developed to model flooding, storm surge, and SLR.

#### Criticality Assessment

The Criticality Assessment (CA) identified transportation assets that were critical to the region's travel and economic activities. The CA was derived by determining the following:

- Socioeconomic importance [20 percent of the overall criticality assessment] – Assessed by considering how each transportation asset contributes to the regional economy and provides access to key employment, trade, and travel hotspots. The specific indicators included in this category are services to the activity population, links to airports, and water ports.
- Usage and operational importance [40 percent of the overall criticality assessment] – Assessed by considering the volumes and types of traffic that each transportation asset holds. The specific indicators included in this category are Average Annual Daily Traffic (AADT), Average Annual Daily Truck Traffic (AADTT), and transit ridership.
- Health and safety importance [30 percent of the overall criticality assessment] – Assessed by considering how each transportation asset provides access to healthcare and safety facilities

---

<sup>53</sup> <https://www.h-gac.com/resiliency-planning>

<sup>54</sup> <https://toolkit.climate.gov/steps-to-resilience/understand-exposure>

and connects underserved areas and populations. The specific indicators included in this category are links to hospitals and fire stations and services to vulnerable populations.

- Emergency preparedness importance [10 percent of the overall criticality assessment] – Assessed by considering what roles each transportation asset plays in a state of emergency. The specific indicators included in this category are evacuation routes, links to shelters and emergency operation centers (EOC), and access to military facilities.

### Vulnerability Assessment

The Vulnerability Assessment (VA) evaluates the capacity of the transportation assets to endure and recover from an extreme weather event. The VA consists of three components: Exposure, Sensitivity, and Adaptive Capability.

#### **Exposure Assessment**

Exposure represents how well an asset will do based on a given flooding scenario. Exposure was measured by:

- Ground elevation – used LIDAR to determine ground and surface elevation
- Surface elevation – used a combination of LIDAR and an altitude model to determine the height of the transportation asset
- Water depth – raster datasets were used to develop a Water Surface Elevation (WSEL) Grid. The first raster dataset is the baseline in which water events (100-year flooding, 500-year flooding, Hurricane Harvey, storm surge, Hurricane Ike, and SLR) could be shown as scenarios for planning increases in WSEL
- Exposure depth – five by five raster grid which represents the difference between the roadway or bridge height and the flood WSEL

#### **Sensitivity Assessment**

The Sensitivity Assessment (SA) measures when asset (road or bridge) damage or disruptions will occur due to a stressor. The factors used to evaluate the SA are bridge age, structural evaluation, channel conditions, scour ratings, pavement conditions, and past closures related to flooding.

#### **Adaptive Capacity Assessment**

The Adaptive Capacity Assessment (ACA) measures how well an asset can cope with damage or disruption to a transportation asset. Network redundancy is measured by assigning a detour ratio with travel times (ESRI Network Analyst) where:

- A detour that takes longer and is scored lower
- A detour that takes less time for travel or has more alternative segments to choose from is scored higher

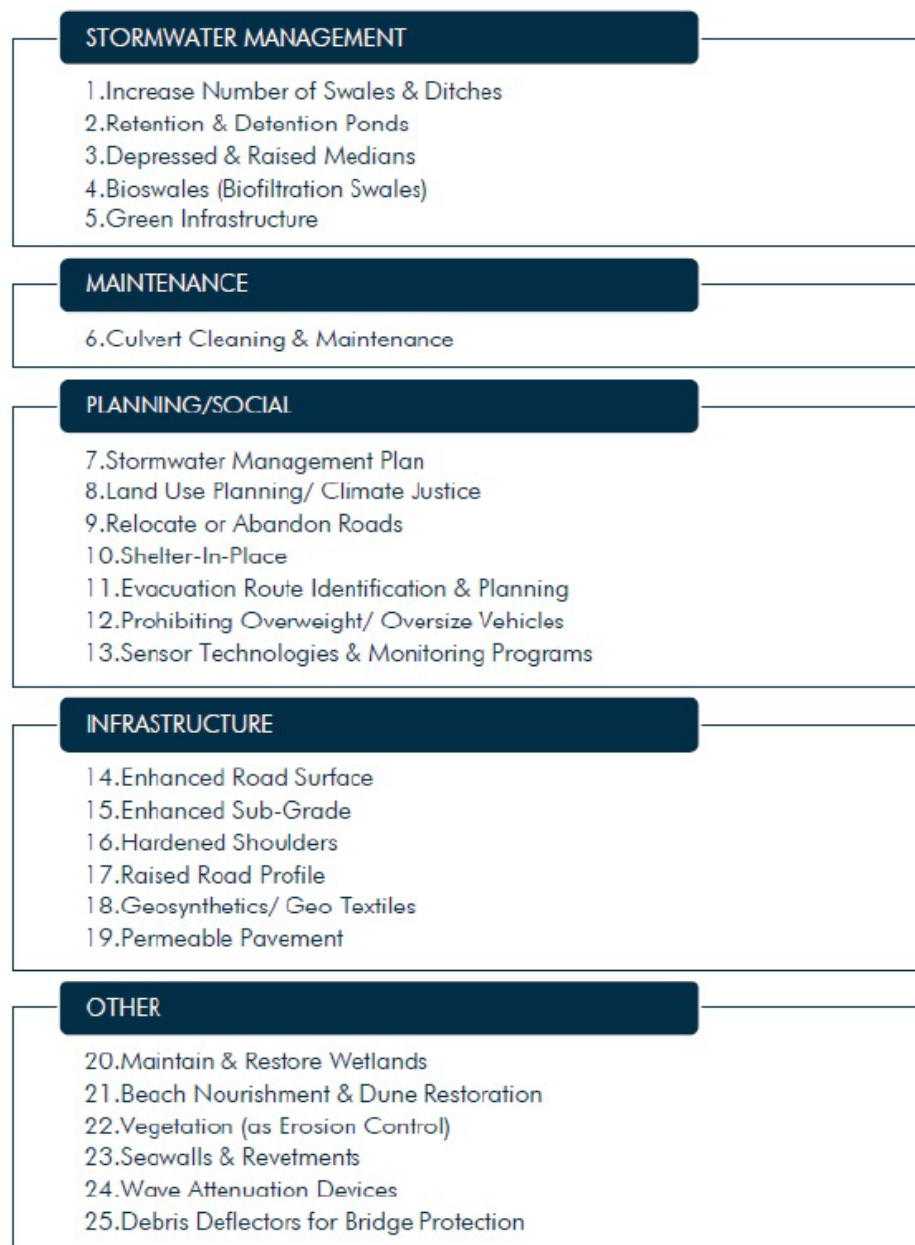
### Economic Impact Analysis

The REMI Transight was used to estimate potential economic loss from network disruptions due to climate stressors. Transportation model outputs (VMT, VHT, and total vehicle trips) were run for each

scenario developed and the outputs were entered into REMI to generate a loss in Gross Domestic Product.

### Adaptation Strategies

Twenty-five (25) adaptation strategies are presented as tools that can be used to protect vulnerable and critical assets as shown in Figure 22.



Source: H-GAC Pilot

Figure 22: 25 Adaptation Strategies

#### 4.2.4. Climate Ready DC – Resilient Design Guidelines

Climate Ready DC – Resilient Design Guidelines (RDG) establish a methodology that engineers, planners, and contractors can use to conduct a climate resilience needs assessment before planning, designing, and constructing new construction or renovations in the Washington D.C. region (District).<sup>55</sup> The plan is broken into four sections for easy reference; however, the first three are the most important for the LRTP as they establish a methodology to follow for the resiliency needs assessment.

##### Section 1 – Introduction and Context

The RDG was developed specifically for the built environment such as buildings, site landscaping, and internal sidewalks, and internal roadways. It was not intended for roadways, bridges, or other large infrastructure projects that connect to facilities. It also does not address the social aspects of resilience such as emergency planning. The primary vulnerabilities that the RDG focuses on are flooding and extreme heat. Section 1 details the resiliency design process for facilities:

- Assess Project Criticality and Lifespan
- Define Climate Risk by Location
- Select Climate-Informed Design Parameters
- Identify Applicable Resilient Design Strategies

Inserting resiliency early in the design process can save money and reduce risks. Figure 23 shows opportunities where resiliency can be inserted in each phase of the project lifecycle.

---

<sup>55</sup>[https://doee.dc.gov/sites/default/files/dc/sites/ddoe/service\\_content/attachments/CRDC%20resilient%20design%20guidelines\\_FINALApproved.pdf](https://doee.dc.gov/sites/default/files/dc/sites/ddoe/service_content/attachments/CRDC%20resilient%20design%20guidelines_FINALApproved.pdf)



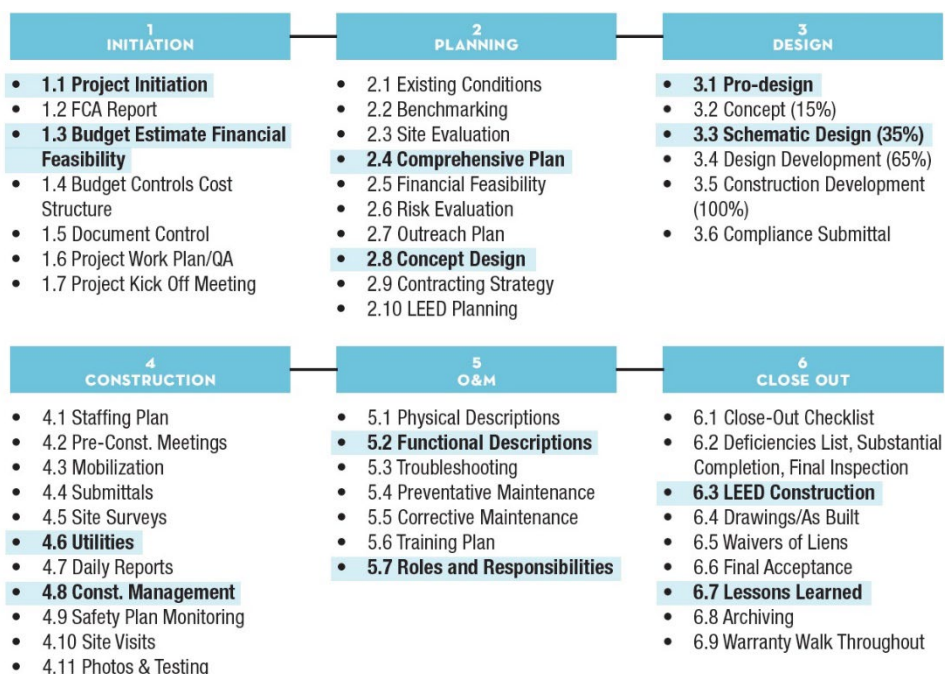


Figure 23: Strengthening Resiliency in Project Lifestyle

## Section II – Understanding Vulnerabilities in the District

The highlights from this section focus on sea level rise/extreme precipitation and elevated temperatures due to climate change. Two climate projections assumed are:

- High Emissions Scenario: GHGs continue to increase over time; and
- Low Emissions Scenario: Concentrations of GHGs stabilize before 2100.

The Potomac and the Anacostia Rivers will experience flooding by more frequent storm events, inadequate drainage, and coastal flooding caused by SLR or storm surges. This increase in flooding can result in danger to the citizens, property damage, and closures. SLR design values were established for the total number of days a year with greater than one inch of precipitation, a 15-year, 24-hour design storm accumulation (inches), and a 100-year, 24-hour design storm accumulation (inches). The design values are estimated across 2020, 2050, and 2080 timeframes with the two scenarios.

Similarly, the extreme heat hazard index was measured by days per year with a maximum temperature greater than 95 degrees Fahrenheit and days per year with a maximum heat index greater than 95 degrees Fahrenheit. These design values were given the same timeframe and compared against the same scenarios.

## Section III – Applying Resilience in the District

There are resilience profiles for each project. Each resilience profile contains three factors:

- Criticality – Function and population project serves
- Life Expectancy – How long a project will stand



- Location – Project location

Critical facilities range from hospitals to water and wastewater treatment facilities. High emission scenarios should be used when designing projects, especially if they exist in an area that is designated as a heat island. Life expectancy guides state that if a building has a life span of 30 years, the project should consider climate concerns within that horizon. Climate risks by location are applied to those facilities within heat islands or near water.

#### Section IV – Resilient Design Strategies

This section focuses on developing resilient design strategies, as shown in Figure 23.

#	BUILDING STRATEGIES	#	SITE/LANDSCAPE STRATEGIES
DESIGN FOR FLOODING		DESIGN FOR FLOODING	
1	Avoid Development in Flood Hazard Areas	25	Implement Project Setbacks
2	Keep Occupied Spaces Above the Sea Level Rise Adjusted Flood Elevation	26	Minimize Channelization of Stormwater
3	Integrate Exterior Dry Floodproofing Techniques	27	Design for Stormwater Infiltration
4	Improve Drainage Control and Prevent Intrusion into Buildings	28	Incorporate Green Infrastructure
5	Use Wettable Systems/ Finishes At and Below the Lowest Occupiable Floor	29	Install Permeable Pavement
6	Provide Rainscreen Detail for Siding/Cladding	30	Protect Critical Assets with Barriers
7	Reinforce Building Corners and Exteriors	31	Plan for Controlled Flooding
8	Specify a Resilient Elevator	SPECIAL CONSIDERATIONS FOR WATERFRONT AREAS	
9	Protect Mechanical and Electrical Equipment from Flooding	32	Increase Setbacks From Waterfront
10	Install Sewer Backflow Preventers	33	Design Waterfront Areas for Inundation
11	Consider a Vegetative (Green) Roof	34	Incorporate Living Shorelines
DESIGN FOR EXTREME HEAT		35	Protect Floating Docks and Marina Assets
12	Building Form and Envelope	36	Design Waterfront Boating Access to Accommodate Change
13	Continuous Air Barrier	DESIGN FOR EXTREME HEAT	
14	Design for Increased Termites	37	Provide Vegetative Shading
15	Disease Carrying Insects	38	Install Drought-Tolerant Landscaping
16	Mechanical Systems of The Future	39	Use Reflective Materials in Paved Patios, Parking Lots, and Sidewalks
17	Vegetated Facade	40	Provide Shaded Outdoor Gathering Spaces
18	Cool or Reflective Roofs		
DESIGN FOR POWER OUTAGES			
19	Achieve Passive Survivability		
20	Design for Natural Daylighting		
21	Provide Backup Power with Islanding Capability		
22	Wire Building so that Critical Loads Are on Separate Circuits		
23	Target 100% Building Electrification		
24	Install Solar Electric System		

Source: RDG

Figure 24: Resilient Design Strategies Matrix

#### 4.2.5. Charting The Course to Zero Port of Seattle's Maritime Climate & Air Action Plan

Charting The Course to Zero: Port of Seattle's Maritime Climate and Air Action Plan (the Plan) addresses climate change and air pollution from maritime sources at the Port of Seattle (the Port).<sup>56</sup> The Plan establishes strategies and actions for the Port to reduce GHG emissions by 2030 and reduce to net zero by 2050 with the following themes:

- Transition from fossil-based energy to zero-emission energy in Port maritime administration and facilitate the transition for maritime industries;
- Continually reduce energy use and emissions in the interim to proactively address the impacts of climate change and air quality on community health;
- Involve communities in decision-making and take an equity approach to climate and air emissions reductions;
- Advance policy, funding, and technology development for climate and clean air action through partnerships; and,
- Leverage habitat restoration projects to sequester carbon.

Figure 23 shows the targets established by the Port. Scope 1 emissions are Port owned or controlled sources. Scope 2 emissions are indirect emissions from purchased electricity used to operate the Port. Scope 3 emissions are caused by assets not owned by the Port but directly contribute to activities at the Port.

---

<sup>56</sup> <https://www.portseattle.org/page/charting-course-zero-port-seattles-maritime-climate-and-air-action-plan>

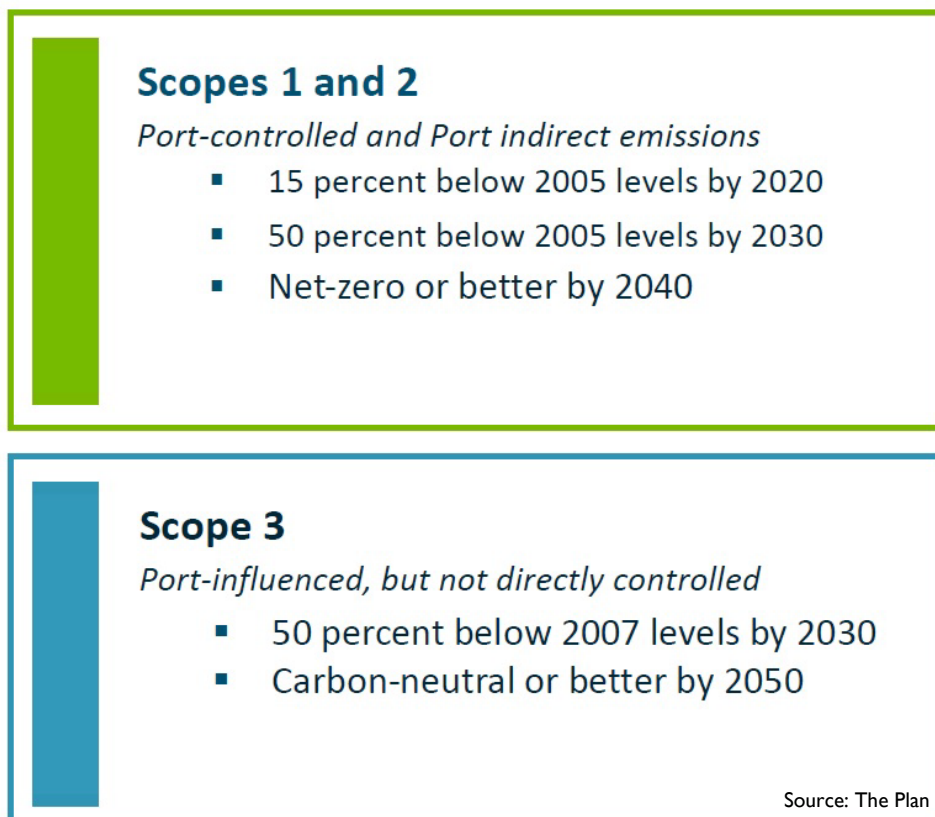


Figure 25: Port of Seattle GHG Reduction Targets

The Port further breaks down emissions into two separate categories:

- **Port Maritime Administration** sectors covered by this Plan include Port-owned buildings and campuses, fleet vehicles and equipment, solid waste generated by the Port and its tenants, and Port employee commuting – 6 percent of Port emissions; and
- **Maritime Activity** sectors covered by this Plan include cruise and grain ships, harbor vessels (tugboats, commercial fishing vessels, and recreational vessels), locomotives, trucks (including cruise buses), and cargo-handling equipment – 94 percent of Port emissions.

#### Port Maritime Administration

The Port Maritime Administration divides the sector into five categories with strategies to reduce emissions in each of the following: Building and Campus Energy, Fleet Vehicles and Equipment, Employee Commuting, Solid Waste, and Habitat Restoration, and Carbon Sequestration. While each category is important, this plan will focus on transportation related strategies.

#### **Fleet Vehicles and Equipment Strategies**

The following strategies aim to reduce GHGs for fleet vehicles and equipment at the Port:

- Port fleet can use “drop-in” renewable fuels such as renewable diesel or renewable gasoline;
- Develop an EV readiness plan to expand EV charging stations across Port waterfront properties;

- Establish an EV infrastructure charging program;
- Complete installation of EV charging sites at key locations across Port maritime properties;
- Begin fleet asset conversions to EVs, prioritizing sedans and sport utility vehicles;
- Pilot use of non-sedan EVs and equipment, including electric light-duty trucks and vans, and electric outboard engines for small workboats;
- Track technology developments in heavy-duty EVs and equipment and identify opportunities to electrify Port-owned diesel equipment (e.g., heavy forklifts);
- Install anti-idling technology on targeted assets with high idle uses;
- Incorporate telematics data into fleet management approaches to optimize utilization and maintenance; and
- Incorporate eco-driver training into Port employee training modules, including how to charge and drive electric fleet vehicles.

The following performance metrics were used to monitor progress for the Ports GHG reduction efforts:

- Percent of light-duty passenger fleet vehicles that are zero-emissions or use renewable fuels
- Percent of liquid and gaseous fuel purchased that is renewable
- Percent of the entire fleet (including all vehicles, equipment, and vessels) that are zero-emission

### **Employee Commuting Strategies**

The following strategies are aimed to curb GHGs emitted by Port employees traveling to and from work:

- Identify options to encourage the use of telework and compressed work weeks, provide financial support for home-work equipment, track and set targets for flexible work arrangements;
- Incorporate the Port's GHG reduction goals into the Employee Commuter Benefits Strategic Plan;
- Develop and implement an employee education and promotion program commuting options and how employees can utilize them;
- Review and identify opportunities to enhance employee onboarding and new employee orientation information and materials to include the Employee Commuter Benefits Program and how it aligns with Port values and goals; and,
- Continue advocating for safer and more accessible multi-modal transportation access to Pier 69 and other work sites with local transit and transportation agencies.

### *Performance Metrics*

The following performance metrics were used to monitor progress for the Ports GHG reduction efforts as they related to employee commuting:

- Drive alone rate at CTR-affected worksite (Pier 69); and,
- Percent of employees utilizing telework or flexible Continuous improvement work arrangements at CTR-affected worksites (Pier 69).

### Maritime Activity

The Maritime Industry has three sectors consisting of the Cross-Sector Maritime Activity, Waterside Maritime Activity, and Landside Maritime Activity.

#### **Cross-Sector Maritime Activity**

Maritime activity that constitutes different businesses and industries is considered a cross-sector. These activities are broad and consist of efforts such as:

- The Seattle Waterfront Clean Energy Strategy (SWCES) will develop and deliver a harbor-wide maritime energy distribution system and infrastructure to provide zero-emission energy for port, maritime, industrial, and other waterfront uses; and
- Engage Port tenants on barriers to zero-emission equipment and infrastructure;

#### **Leverage Green Lease Terms**

The Port is a landlord port and leases land to private companies, as such, the Port should develop green lease terms that ensure environmental requirements within a lease agreement that encourage or require port tenants to adopt practices that, among other environmental actions, reduce emissions or energy use.

#### **Advocate for Policies and Funding that Support Climate Change**

- Continue advocating for state and federal legislation and funding;
- Advocate for local utilities to achieve a 100 percent clean electricity supply; and
- Identify new business models and financial strategies to support implementation.

#### **Waterside Maritime Activity**

Waterside maritime activity consists of areas where the Port can reduce GHG emissions for services that service vessels that call the port. Here are some of the strategies:

- Install shore power at Pier 66 Cruise Terminal by 2023 and pursue funding to offset infrastructure costs;
- Require shore power use by shore power-equipped homeport cruise ships at Terminal 91, Pier 66, and any future cruise berths upon installation and commissioning of new shore power system(s);
- Evaluate shore power delivery options and rate structure at Port facilities, working with cruise lines and utility providers;
- Develop a national and international engagement strategy to advocate for strengthened standards, sustainable fuels, and the transition to zero-emission ocean-going vessels;
- Evaluate and align with international de-carbonization initiatives;
- Implement the International Association of Ports and Harbors' Cruise Emissions Reporting Project at the Port and collaborate with cruise lines to maximize participation;
- Evaluate an optional carbon offset or "Good Traveler" type program for Seattle's homeport cruise passengers, in coordination with cruise lines;

- Evaluate new shore power capability, charging, and fueling needs for harbor vessels at Pier 17, Pier 28, and Pier 46 North, and berths 6 and 8 at Terminal 91;
- Demonstrate zero-emission outboard engines in Port-owned vessel fleets and communicate results;
- Engage commercial fishing fleets and industry to identify barriers and opportunities to transition to zero-emission fishing vessels;
- Engage harbor vessel fuel providers to discuss opportunities and barriers to supplying low carbon fuels; and
- Evaluate incentive programs to accelerate the use of low carbon fuels and the transition to zero-emission harbor vessels.

### *Performance Metrics*

The following performance metrics were used to monitor progress for the Port's GHG reduction efforts related to waterside maritime activity:

- Percent of vessel calls with Tier 3 marine engines, cleaner fuel, or other emission-reduction technologies while underway;
- Percent of major cruise and container berths with shore power installed;
- Percent of shore-power-capable ships that plug in and percent of total ships that plug into shore power;
- Percent of tugs by tier level Information only;
- Percent of commercial vessels with hybrid engines or using renewable fuels;
- Percent of zero-emissions commercial vessels; and
- Total cost of ownership of zero-emissions tug relative to diesel tug.

### **Landside Maritime Activity**

Landside activity includes improving infrastructure to enable zero-emission cargo-handling equipment (CHE), trucks, and rail by 2030:

- Support adoption of zero-emission CHE, trucks, and rail by 2050;
- Provide infrastructure to enable zero-emission trucks by 2030; and
- Support continual advancements in vehicle efficiency and emission reduction from trucks and buses.

### *Performance Metrics*

These performance metrics were used to monitor progress for GHG reductions for landside maritime activities:

- Percent of zero-emission CHE adopted;
- Total cost of ownership of zero-emission CHE relative to diesel CHE;
- Percent of zero-emission trucks adopted;
- Total cost of ownership of zero-emission trucks relative to diesel trucks;
- Percent of unregulated engines known to be upgraded;
- Percent of switcher engines that use renewable fuels; and



- Percent of zero-emissions switcher engines adopted.

### 4.3. International Projects

#### 4.3.1. Reimagina Puerto Rico Report

In 2017, Hurricane Maria caused over a billion dollars worth of damage to both the natural environment and manmade infrastructure with an estimate of 4,645 human deaths in Puerto Rico. In some areas, electricity was out for up to eight months which affected both residents and businesses. After the natural disaster, the Rockefeller, Ford, and Open Society foundations came together to develop the Reimagina Puerto Rico (RPR) report with the help of 100 Resilient Cities (100RC) and many stakeholders.<sup>57</sup> The RPR report aimed to rebuild a more equitable and resilient Puerto Rico through four governing principles:

- Maximizing social well-being with all investments
- Equity and inclusiveness as a priority
- Transparency at all levels of policymaking
- Emphasizing and fostering coordination

The RPR report evaluated and analyzed several sectors for resiliency including Housing, Energy, Physical Infrastructure, Health/Education/Social Services, Economic Development, and Natural Infrastructure. This review will focus on transportation policies that will guide the MDTPO 2050 LRTP.

---

<sup>57</sup> [https://resilientcitiesnetwork.org/downloadable\\_resources/Network/San-Juan-Resilience-Strategy-English.pdf](https://resilientcitiesnetwork.org/downloadable_resources/Network/San-Juan-Resilience-Strategy-English.pdf)



Source: Relmagina Puerto Rico

Figure 26 - Relmagina Sectors

### Introduce Alternative Energy Sources to Power Transportation-Related Infrastructure

#### **Improve Reliability and Redundancy**

- Increase roundabouts rather than intersections that need electricity;
- Develop and implement a pilot program using distributed energy sources such as solar, battery, and kinetic energy for generation at transportation-related assets and facilities;
- Develop a critical infrastructure assessment and priority recovery plan outlining operations for ongoing key transportation assets;
- Develop an Integrated Critical Infrastructure Management Strategy to guide long-term reconstruction;

- Improve the Puerto Rico Four-year Investment Program (PICA) with a risk-based asset management framework and integrated enforcement to ensure resilience in the Island's infrastructure; and
- Develop and implement a Port Emergency Plan.

#### 4.3.2. New Amsterdam Climate – Roadmap Amsterdam Climate Neutral 2050

Amsterdam seeks to reduce carbon emissions by 55 percent in 2030 and 95 percent in 2050 to achieve the Paris Climate Agreement goals. To achieve this, Amsterdam developed the New Amsterdam Climate – Roadmap Amsterdam Climate Neutral 2050 (Roadmap) plan.<sup>58</sup> Amsterdam aims to eliminate all carbon emissions from vehicles and to have the City be climate-neutral by 2030. By 2040, Amsterdam will phase out natural gas usage. Finally, by 2050, Amsterdam aims to use a circular economy and become climate adaptive. The Roadmap uses four “transition paths” to achieve a climate-neutral city by developing a climate budget to understand where most GHGs originate (Figure 27).

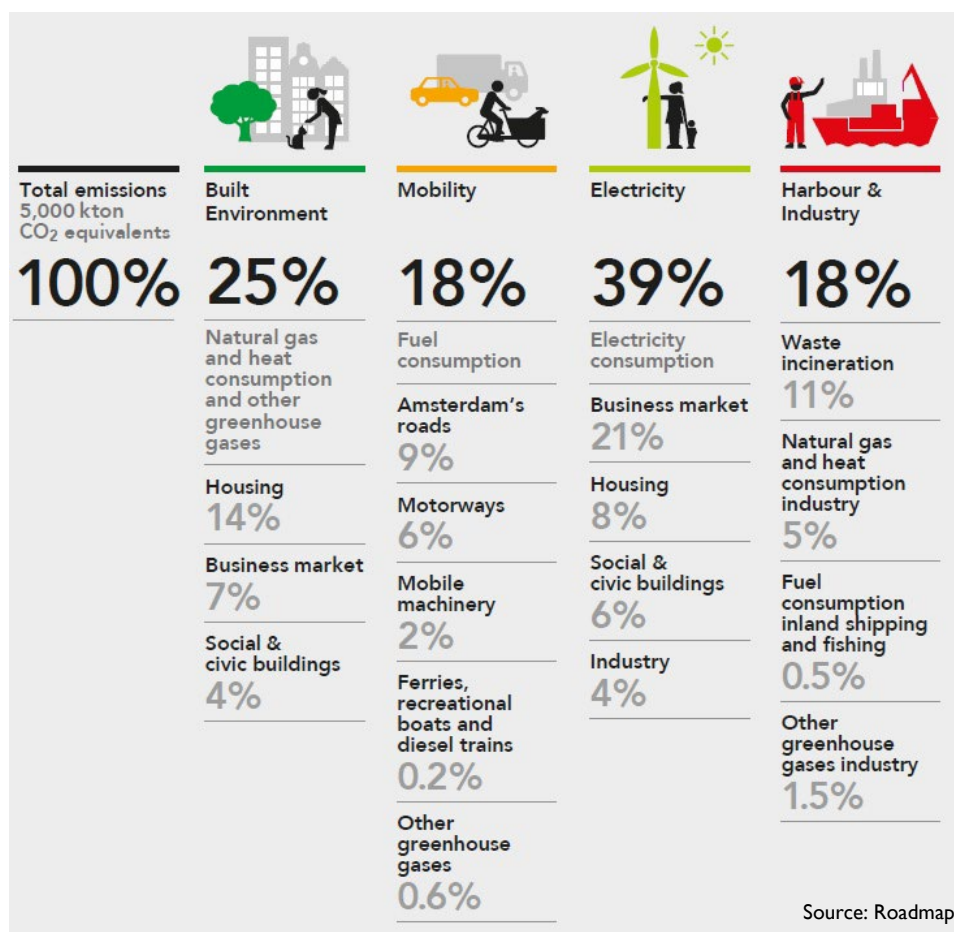


Figure 27 - Amsterdam Transition Paths

<sup>58</sup> <http://carbonneutralcities.org/wp-content/uploads/2020/03/Amsterdam-Climate-Neutral-2050-Roadmap.pdf>

There are 20 pillars split between the four transition paths, and this review will focus on only those that relate to transportation.

### Mobility

#### **Pillar 8 – Limiting Polluting Traffic**

- Minimize polluting kilometers per mile
- Encourage sustainable transport (walk, cycle, public transit)
- Facilitate sufficient sustainable alternatives
- Abolish parking places
- Close streets to motorized vehicles
- Improve cycling routes
- Add more convenient bicycle parking
- Achieve better and more attractive ride-share vehicles
- Create logistical hubs to switch to sustainable transportation

#### **Pillar 9 – Greening All Polluting Vehicles and Vessels**

- Introduce an environmental zone for passenger cars in 2020 and tighten up other environmental zones
- Introduce subsidies for emissions-free vehicles
- Facilitate and tender more charging points and rapid-charging locations for electric vehicles, vessels, taxis, buses, and passenger and pleasure boats

### Harbor and Industry

#### **Pillar 13 – Transforming the Harbor into a Sustainable Battery**

- Explore financing instruments that include whether income from fossil-fuel activities could be used for the energy transition
- Establish a lobbying strategy based on how the harbor as a sustainable battery can contribute to national and EU climate targets, and vice versa
- Develop an ambitious target for the generation and storage of sustainable energy in the harbor by working with stakeholders and organizing four expert sessions to clarify the design and operation of the sustainable battery concept
- Chart the consequences and potential of the climate ambitions for employment in the harbor area

## 5. Conclusion

The effects of climate change will be felt throughout MDC. This comprehensive review of plans, projects, and documents should provide the TPO with a multitude of information on strategies and solutions to countywide transportation problems and other vital issues relating to climate resiliency. Due to the inevitability of climate change consequences affecting MDC, the two overarching strategies the TPO can expect to apply are to adapt and to change.

This review assessed various local documents that provide great guidance on how MDC can adapt and become climate resilient. Specifically, the MDC Sea Level Rise Strategy plan promotes five approaches to how the County can adapt to SLR. The TPO should review this document, so an understanding of successful adaptations is developed, and inspiration drawn from the strategies presented. Each strategy has project examples that have been implemented successfully in other locations and has produced positive results in adapting to the effects of SLR. Additionally, the United SLR Projections and Guidance Document develop a 100-year SLR projection for MDC. The projections should be referenced when developing new project ideas or justifying adaptations.

The other strategic way to become climate resilient is to help slow or weaken the impending effects of climate change. Transitioning personal vehicles and County fleets to alternative fuels, hybrid, or fully electric will decrease emissions. For instance, Metrobus now operates 560 CNG and 63 electric buses, which represent over 75 percent of the entire fleet. By upgrading and promoting public transit vehicles, ridership can potentially increase. As a result, there can be fewer people and therefore fewer cars on the roadways. The TPO should encourage MDC to continue their pursuit of creating a more sustainable fleet. Likewise, the TPO should encourage the alteration of existing roadway infrastructure and future construction projects to provide accommodations for micromobility options such as bicycles and scooters, and pedestrian travel. Attention should also be paid to the New Amsterdam Climate Roadmap. The Roadmap has four transition plans to achieve a carbon-neutral city through the development of a climate budget that allows the city to understand where GHGs originate. Within the four plans, there are 20 pillars. The TPO should place focus on Pillar 8; it focuses on limiting polluting traffic and lists ways infrastructure could be altered to limit polluting traffic.

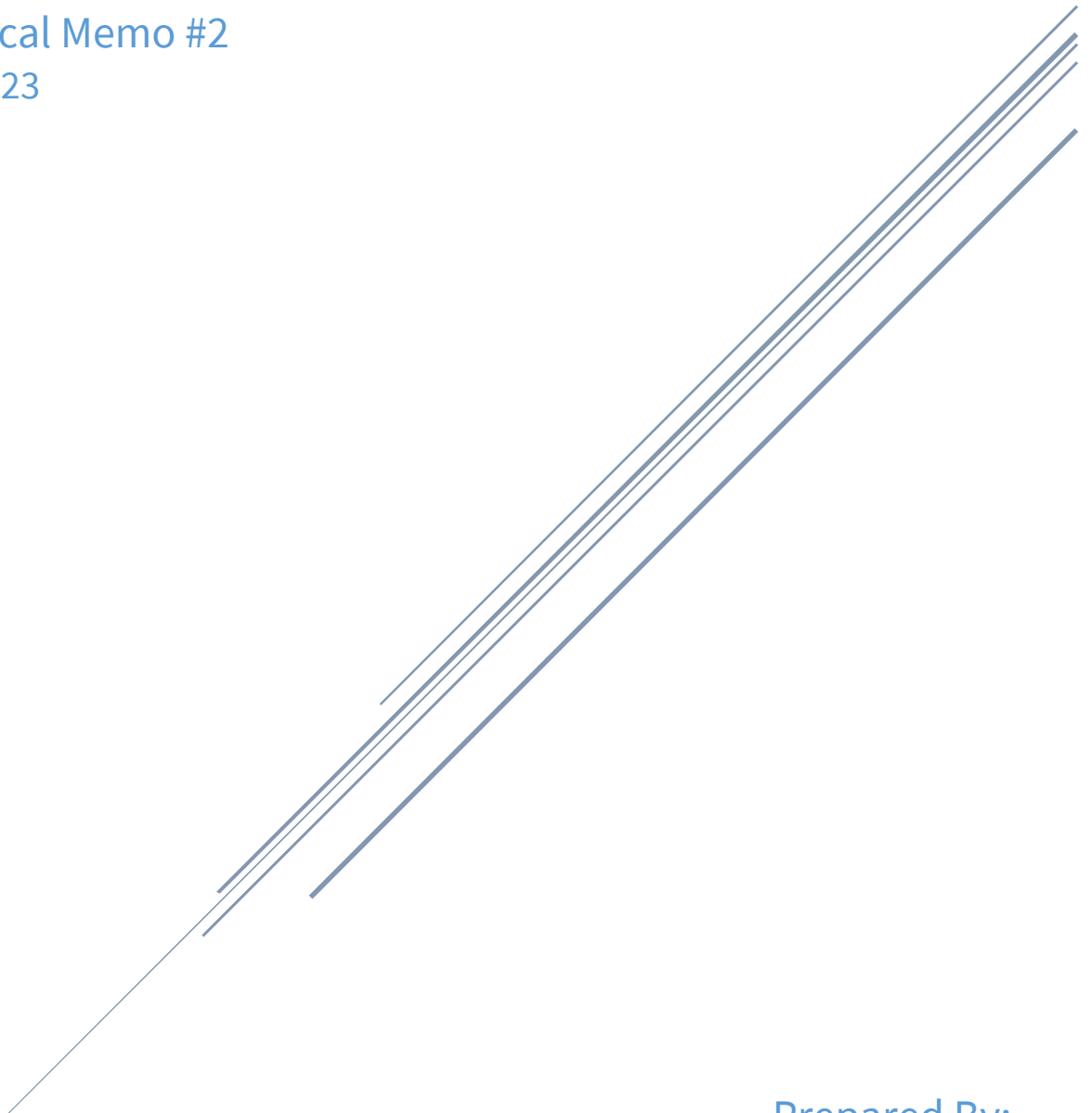
Likewise, the TPO could establish design guidelines similar to the DC Resilience Design Guidelines does for buildings and site landscaping, addressing flooding and extreme heat vulnerabilities. This process includes assessing project criticality and lifespan, defining climate risk, selecting climate-informed design parameters, and identifying applicable resilient design strategies. The H-GAC Region Pilot Program could then be used to determine and inform future project selection criteria by evaluating freeways, principal arterials, minor arterials, and collectors from the region and bridges over waterways. The report presented twenty-five adaptation strategies as tools that can be used to protect vulnerable and critical assets as well.

The documents reviewed in the memorandum come from regional, national, and international resources, and all of them have a common theme: improve local climate resiliency. As mentioned, MDC will inevitably feel the consequences of climate change. It is up to officials to accept this and continue making advances towards a climate resilient County.

# VULNERABLE TRANSPORTATION INFRASTRUCTURE AND RISK ASSESSMENT: PROJECT PRIORITIZATION

Technical Memo #2

June 2023



Prepared By:  
TranSystems



## Table of Contents

<b>1. Introduction .....</b>	<b>4</b>
<b>2. Sea Level Rise (SLR) Vulnerability .....</b>	<b>5</b>
2.1. Sea Level Rise Scenario Sketch Planning Tool .....	6
2.2. Miami-Dade County Flooding Vulnerability Viewer.....	7
2.3. Miami-Dade County Average Heat Vulnerability.....	7
2.4. FEMA National Risk Index (NRI).....	8
2.5. LRTP Sea Level Rise Vulnerability Analysis.....	9
<b>3. Infrastructure Vulnerabilities Based on Common Stressors.....</b>	<b>17</b>
3.1. Sea Level Rise .....	17
3.2. Increased Temperature and Extreme Heat Damage.....	18
3.3. Social Vulnerability .....	19
<b>4. Vulnerability Solution Toolkit.....</b>	<b>20</b>
<b>5. Resiliency Evaluation Criteria.....</b>	<b>21</b>
<b>6. Conclusion.....</b>	<b>23</b>

## Acronyms

<b>AFV</b>	Alternative Fuel Vehicle
<b>Bike/Ped</b>	Bicycle and pedestrian
<b>CMP</b>	Congestion Management Process
<b>DTPW</b>	Miami-Dade Department of Transportation and Public Works
<b>FDOT</b>	Florida Department of Transportation
<b>FEMA</b>	Federal Emergency Management Agency
<b>FTE</b>	Florida Turnpike Enterprise
<b>GIS</b>	Geographic information systems
<b>LiDAR</b>	Light Detection and Ranging
<b>L RTP</b>	Long Range Transportation Plan
<b>MHHW</b>	Mean-Higher-High Water
<b>mm/yr</b>	Millimeters per year
<b>MDX</b>	Miami-Dade Expressway Authority
<b>NOAA</b>	National Oceanic and Atmospheric Administration
<b>NRI</b>	National Risk Index
<b>RSLR</b>	Relative sea level rise
<b>SIS</b>	Strategic Intermodal System
<b>SLR</b>	Sea level rise
<b>SLS Sketch Planning Tool</b>	Sea Level Scenario Sketch Planning Tool
<b>SMART</b>	Strategic Miami Area Rapid Transit Program
<b>SoVI</b>	Social vulnerability index
<b>Tech Memo #2</b>	Technical Memorandum #2
<b>UF</b>	University of Florida
<b>USACE</b>	US Army Corps of Engineers

## Glossary

**Bathtub model** – sea level rise model that identifies all areas under a target elevation as potentially flooded, regardless of connectivity to waterways

**Brownouts** – partial outage in the electrical power supply system

**Combined R** – combined heat risk, including heat hospitalization and heat emergency department visit vulnerabilities

**King tide** – is a non-scientific term people often use to describe exceptionally high tides.

**National Risk Index (NRI)** – potential for negative impacts based on the result of natural hazard;  
*equation:* expected annual loss \* social vulnerability / community resiliency

**Resilient** – ability to withstand and/or recover quickly from natural hazards

**Sea level rise (SLR) projections [low, intermediate, high]** – types of SLR projections. The low projection indicates a “best case” scenario with a limited amount of sea level rise. The high projection indicates a “worst case” scenario with a higher amount of sea level rise.

**Shapefiles** – a simple, non-topological format for storing and displaying the geometric location and attribute information of geographic features and datasets. Geographic features in a shapefile can be represented by points, lines, or polygons (areas).

**Social vulnerability** – amount of potential negative effects on human health based on natural hazards

**Stressors** – types of natural hazards that cause strain on infrastructure and human health

**Vulnerability** – amount of exposure to natural hazard impacts

## 1. Introduction

Climate change effects are starting to be seen worldwide. Sea levels are rising, oceans are warming, and extreme weather events are occurring more frequently, with greater severity, and for longer durations than in the past. Several common environmental stressors often impact the Miami-Dade area, including extreme heat and flooding. Much of the existing and future/planned infrastructure is at risk of being affected by climate change. Infrastructure lifecycles can be shorted, or even become impassable if sea levels rise above the roadway elevations.

As a result of the likely impacts of climate change, the Miami-Dade TPO is undertaking a proactive effort to assess the likelihood of environmental stressors and their direct impact on the regional infrastructure. This understanding will provide for a strategic plan to address potential impacts and to plan future infrastructure projects in a manner that will reduce or eliminate the impacts of climate change on the regional infrastructure network.

This Technical Memorandum #2 (Tech Memo #2) evaluates the 2045 Long Range Transportation Plan (LRTP) Cost Possible projects and their susceptibility to impacts from climate change. This Tech Memo #2 also addresses common types of climate stressors and possible solutions to mitigate their effects. A toolkit for building resilient infrastructure and ways to prioritize impacted locations will also be evaluated. Additionally, a resiliency evaluation criterion was created to determine the planned projects with the greatest benefits for the Miami-Dade County 2050 LRTP.

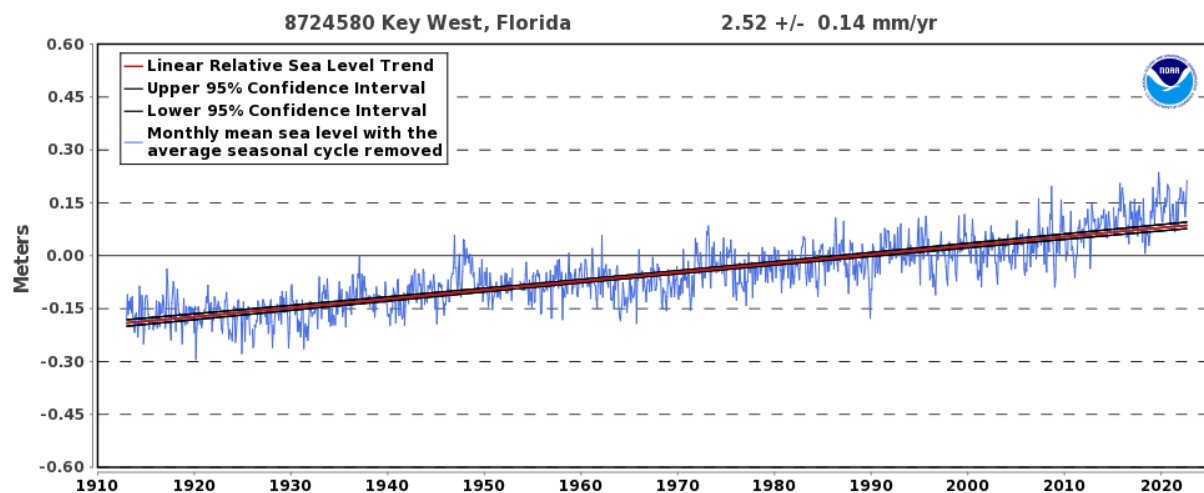


**Figure 1: Inundated Roadway within Miami-Dade County<sup>1</sup>**

<sup>1</sup> No Attribution Required - [https://www.miamidade.gov/global/news-item.page?Mduid\\_news=news1615248511545462](https://www.miamidade.gov/global/news-item.page?Mduid_news=news1615248511545462)

## 2. Sea Level Rise (SLR) Vulnerability

Sea level rise (SLR) is one of the most common effects of climate change as sea ice and glaciers melt. In Key West, Florida, the National Oceanic and Atmospheric Administration (NOAA) indicates that sea levels are rising at approximately 2.52 millimeters per year (mm/yr) with a 95 percent confidence interval of  $\pm 0.14$  mm/year based on monthly mean sea level rise data, as shown in **Figure 2**. SLR plays a crucial role in transportation planning, as it directly impacts the operations of infrastructure within the impacted area.



**Figure 2: Recorded Sea Level Rise in Key West, Florida<sup>2</sup>**

Earth.org, a global environmental think tank, has identified several impacts of sea level rise in Miami-Dade County:<sup>3</sup>

**EARTH · ORG**  
PAST · PRESENT · FUTURE

- *Prolonged flooding after storms.* The drainage system needs to be renovated, which would cost USD \$206 million.
- *Eroding beaches and domestic sand resources dwindling.* The Army Corps of Engineers estimated that the equivalent of 10,781 football fields covered in 30 cm of sand would be necessary to sustain Miami-Dade County's beaches for the next 50 years.
- *Hurricane-driven storm surges.* These surges will become 3 times as likely at 30 cm sea level rise, and 15 times more at 60 cm.
- *Aquifers unable to stop salt water from entering.* Porous limestone ground makes seawalls incapable of stopping salt water from infiltrating aquifers, negatively impacting agriculture and drinking water reserves.
- *Water rise.* Water level increases of only 10 to 35 centimeters would be sufficient to reduce 70 percent of Miami-Dade County's coastal flood control drainage capacity.

<sup>2</sup> [https://tidesandcurrents.noaa.gov/sltrends/sltrends\\_station.shtml?id=8724580](https://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?id=8724580)

<sup>3</sup> [https://earth.org/data\\_visualization/sea-level-rise-by-2100-miami/](https://earth.org/data_visualization/sea-level-rise-by-2100-miami/)

All projects within the Miami-Dade TPO 2045 LRTP were examined to determine those that are the most vulnerable to sea level rise. Two tools were evaluated to estimate sea level rise within the county: the Sea Level Scenario Sketch Planning Tool and the Miami-Dade County Flooding Vulnerability Viewer. Each of the tool's capabilities are discussed below. All tools utilized are for planning purposes only and should not be used for engineering design purposes.

## 2.1. Sea Level Rise Scenario Sketch Planning Tool

The Sea Level Scenario Sketch Planning Tool (SLS Sketch Planning Tool) is a planning tool created by the Florida Department of Transportation (FDOT) and the University of Florida (UF).<sup>4</sup> The tool launched in 2012 as Phase 1 and is currently in Phase 4. The most up-to-date phase includes NOAA 2017 SLR projections. The current data also includes the 2012 US Army Corps of Engineers (USACE) sea level change projections. All scenarios are mapped at the county level using local tide gauge data and sea level rise trends. The models contain data for the years: 2040, 2050, 2060, 2070, 2080, 2090, and 2100. The tool provides SLR models for inundation surfaces and affected transportation layers. For the sake of this exercise, the inundation surfaces data was used.

The available SLR data is shown within **Table 1**. The project scope identifies the need for three tiers of 2050 sea level rise estimation: low, intermediate, and high. The N1, N3, and N5 tools were used as they contained the most recent data available for the three tiers of estimation.

**Table 1: Seal Level Sketch Tool: Inundation Datasets**

Key – Sketch Tool Dataset	SLR Projection	Amount of Inundation
C1	USACE 2013 Low	Minimal
C2	USACE 2013 Intermediate	Moderate
C4	USACE 2013 High	Major
<b>N1</b>	<b>NOAA 2017 Low</b>	<b>Minimal</b>
N2	NOAA 2017 Intermediate-Low	Moderate
<b>N3</b>	<b>NOAA 2017 Intermediate</b>	<b>Moderate</b>
N4	NOAA 2017 Intermediate-High	Moderate
<b>N5</b>	<b>NOAA 2017 High</b>	<b>Major</b>
N6	NOAA 2017 Extreme	Excessive

The inundation tool provides a simple bathtub model output. The bathtub model works similarly to water filling up in a bathtub – the lower parts fill up first, then the higher parts continue to rise to the same level everywhere in the tub. The bathtub model identifies all areas under a target elevation as potentially flooded, regardless of connectivity to waterways. Light Detection and Ranging (LiDAR) data is a key element of this analysis. This model is ideal to use for locations within 50 miles of the ocean. There are other inundation models available; however, due to Miami's close location to water, the bathtub model was used for this analysis since it is the most conservative model.

<sup>4</sup> <https://sls.geoplan.ufl.edu/>



The files used in this analysis are:

- Miami\_2050\_NI\_MHHW\_BATH\_P [low projection]
- Miami\_2050\_N3\_MHHW\_BATH\_P [intermediate projection]
- Miami\_2050\_N5\_MHHW\_BATH\_P [high projection]

The low 2050 projection uses a relative sea level rise (RSLR) of 0.8 feet. The intermediate scenario projects 1.5 feet and the high scenario uses a 2.5 relative sea level rise. The RSLR is combined with NOAA sea level elevation to project areas where the water level would exceed the land elevation. Land elevations are based on lidar data. Low projections are the most important to analyze because the projections are most likely to occur.

The data used from SLR is derived from 2017 NOAA 2017 SLR projections. New 2022 NOAA SLR projections have been created; however, they are not yet available within the SLS Sketch Planning Tool. The 2022 data is very similar to the 2017 data for projections within the next 100 years. Discussions are currently underway between the University of Florida (software developers) and statewide stakeholders (including FDOT). The 2017 data is currently the preferred choice of data within the state and the industry. As newer data becomes available within the SLS Sketch Planning Tool, the newer data should be assessed to determine which dataset is the best course of action to use.

## 2.2. Miami-Dade County Flooding Vulnerability Viewer

The Miami-Dade County Flooding Vulnerability Viewer is a geographic information system (GIS) tool to look at current and future flood risk areas.<sup>5</sup> There are several GIS data layers available, which are primarily drawn directly from the NOAA database. The layers include building footprints, storm surge planning zones, ground elevation, groundwater, storm surge, sea level rise, and current/preliminary FEMA Flood zones. The sea level rise data also includes vulnerability to king tides.

The sea level rise is based on foot increments (1 to 10 feet). Additionally, there are NOAA Intermediate-Low 2040; NOAA Intermediate-High 2040; NOAA Intermediate-Low 2070; and NOAA Intermediate-High 2070 scenarios. This information is helpful to determine what areas are susceptible to sea level rise when a specific date range is not needed. Sea level rise cannot be accurately determined based on year; therefore, this data is ideal to use when more general information on sea level rise is needed to forecast risk. For the sake of this exercise, no information was used from the Miami-Dade County Flooding Vulnerability Tool because the NOAA years did not align with the 2045 LRTP, and the remaining data was based on foot increments rather than projected risk level based on the year being evaluated.

## 2.3. Miami-Dade County Average Heat Vulnerability

The Miami-Dade County Average Heat Vulnerability tool is a GIS tool to display average heat vulnerabilities within the area.<sup>6</sup> The average is based on heat hospitalization and heat emergency department visit vulnerabilities. The heat layers are based on the various zip codes within Miami-Dade County. Many elements were used to create the tool, and the “combined R” value provides generalized heat vulnerabilities for each zip code. This tool is used to include heat related solutions to

---

<sup>5</sup> <https://gisweb.miamidade.gov/vulnerabilityviewer/>

<sup>6</sup> <https://mdc.maps.arcgis.com/home/webmap/viewer.html?useExisting=1&layers=ad66ae5fb9b040b4a2dcc62145a92c6c>

projects within heat susceptible areas. The last update of the tool was in May 2022, with data from 2015-2019, in conjunction with the Miami-Dade County Heat Vulnerability Assessment project.<sup>7</sup>

The Office of Resilience at Miami-Dade County recently approved the Extreme Heat Action Plan. Extreme heat is increasing in frequency, as Miami, on average, has 51 or more days over 90 degrees Fahrenheit each year. The plan includes specific goals to reduce the health and economic impacts of heat within the county. The Extreme Heat Action Plan should be used in conjunction with the LRTP project list to ensure interagency communication and beneficial project impacts. Some related goals include increasing the number of shade trees planted, increasing the number of shaded bus stops, and constructing cool pavement corridors.



## 2.4.FEMA National Risk Index (NRI)

The National Risk Index (NRI) tool was created by the Federal Emergency Management Agency (FEMA). The NRI provides an online dataset for the county based on county view and census tract. The information includes risk factors for 18 natural hazards, social vulnerabilities, community resilience, and expected annual loss.<sup>8</sup> The calculation for the national hazard risk index is shown in **Figure 3**. The most recent dataset available is from November 2021.

This study specifically uses social vulnerabilities to help determine what communities/census tracts are in the greatest need. Social vulnerability risk shows the susceptibility of communities to the impacts of natural disasters, such as disproportionate amounts of deaths, injuries, losses, or interference with livelihood. Social vulnerability is measured using the social vulnerability index (SoVI) created by the University of South Carolina.<sup>9</sup> A community is at a greater risk, or has a higher social vulnerability, based on the types of disadvantages the residents face. These include, but are not limited to, higher amounts of residents living in poverty, residents having a minority status, people without vehicles, people with disabilities, older adults, people with limited/no health insurance, people with service industry employment, and people with limited English proficiency.<sup>10 11</sup>

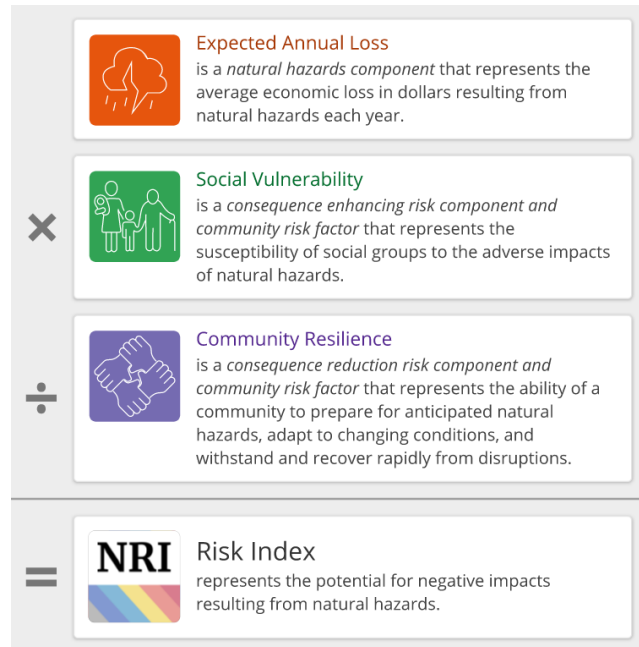
<sup>7</sup> <https://storymaps.arcgis.com/stories/6f1e91cf8a8e4d5d9bd67525575c042e>

<sup>8</sup> <https://hazards.fema.gov/nri/understanding-scores-ratings>

<sup>9</sup> [https://www.sc.edu/study/colleges\\_schools/artsandsciences/centers\\_and\\_institutes/hvri/index.php/sovi%2%ae-0](https://www.sc.edu/study/colleges_schools/artsandsciences/centers_and_institutes/hvri/index.php/sovi%2%ae-0)

<sup>10</sup> <https://www.wellsreserve.org/writable/files/What-is-Social-Vulnerability-Nov21.pdf>

<sup>11</sup> [https://www.sc.edu/study/colleges\\_schools/artsandsciences/centers\\_and\\_institutes/hvri/documents/sovi/us\\_county\\_sovi\\_10\\_14\\_readme.pdf](https://www.sc.edu/study/colleges_schools/artsandsciences/centers_and_institutes/hvri/documents/sovi/us_county_sovi_10_14_readme.pdf)



**Figure 3: NRI Formula**

## 2.5. LRTP Sea Level Rise Vulnerability Analysis

All 2045 LRTP Cost Feasible Projects were provided within GIS data and shapefiles for analysis. The following file naming conventions were provided:

### Project Point Name (LRTP Section)

- Freight\_Points (Freight)
- TurnpikeFTE\_Points\_CFP (Turnpike)
- Transit\_Points\_CFP (Transit)
- MDX\_Points\_CFP (MXD)
- FDOTSIS\_Points\_CFP (FDOT SIS)
- FDOTOR\_Points\_CFP (FDOT OR)
- DTPWRoadways\_Points\_CFP (Transit)
- LRTPpointTr\_1
- LRTPpointFree\_1
- LRTPpointFR\_1
- LRTPpointART\_1

### Project Line Name (LRTP Section)

- SR-836\_SW\_Extn\_Adopted\_Alignment
- Freight\_Lines (Freight)
- TurnpikeFTE\_Liness\_CFP (Turnpike)
- Transit\_Lines\_CFP (Transit)
- MDX\_Lines\_CFP (MXD)
- FDOTSIS\_Lines\_CFP (FDOT SIS)
- FDOTOR\_Lines\_CFP (FDOT OR)

- DTPWRoadways\_ Lines \_CFP (Transit)
- CMP\_ProjectLocations (CMP)
- BikePed\_CFP (Bike/Pedestrian)
- LRTPLineTr
- LRTPLinePort
- LRTPLineFree
- LRTPLineFr
- LRTPLineCMP
- LRTPLineBP
- LRTPLineArt

The following are the steps and notes to complete the GIS analysis.

1. Download all necessary shapefiles/layers from online databases then add to the GIS file:
  - a. Sea Level Rise [SLR Models (Inundation Surfaces), 2050, Miami-Dade County]
    - i. <https://sls.geoplan.ufl.edu/download-data/>
  - b. Social Vulnerability Index – FEMA
    - i. <https://hazards.fema.gov/nri/data-resources#shpDownload>
  - c. Average Heat Vulnerability - Miami-Dade County
    - i. <https://mdc.maps.arcgis.com/home/item.html?id=ad66ae5fb9b040b4a2dcc62145a92c6c>
2. Add each LRTP project (point and line) to GIS file.
  - a. *Note – it is important to add a unique value to each project that varies from the map ID/other existing database identifiers. This should be done before adding to GIS for ease of use. For this analysis, all unique names were identified as AXXX for points and BXXX for lines. This way data can more easily be combined after analysis. If there are data repeats (multiple lines for each LRTP project), it is easier to remove before analysis.*
  - b. *Note – During the process of adding projects to GIS, add a column of what section within the LRTP each project is. This can help better identify types of projects when analyzing. Confirm project map ID matches.*
  - c. *Note – Add a unique project ID, that follows the project throughout*
3. Merge all points and lines (separately). Use the Merge –Data Management Tools.
4. Complete the analysis for heat vulnerability by using spatial join within GIS:
  - a. Use target as LRTP Project Points and join as heat vulnerability;
  - b. Confirm join operation is one to many;
  - c. Select “keep all target features”;
  - d. Match option is intersect;
  - e. Run tool.
  - f. Add data to Excel sheet. Sort by “Combined R” value to determine heat risk. The following is each range/point for Heat Vulnerability:
    - i.  $\leq 3.842073 = 1$  (Least Vulnerable)
    - ii.  $\leq 6.971829 = 2$
    - iii.  $\leq 10.101586 = 3$
    - iv.  $\leq 13.231343 = 4$
    - v.  $\leq 16.361099 = 5$  (Most Vulnerable)

- g. *Note: Since project lines may cross multiple types of heat zones, use Excel to sort and grab the highest “Combined R” value for each project to produce the most conservative analysis.*
5. Complete the analysis for social vulnerability by using spatial join within GIS:
  - a. Use target as LRTP Project Points and join as NRI Census Tracts;
  - b. Confirm join operation is one to many;
  - c. Select “keep all target features”;
  - d. Match option is within;
  - e. Run tool.
  - f. Add data to Excel sheet. Use “SOVI\_Rating” data.
  - g. *Note: Since project lines may cross multiple census blocks, use Excel to sort and delete the repeats. Keep the highest social vulnerability rated census block for each project.*
6. Complete the analysis for sea level rise by using spatial join within GIS:
  - a. *Note: there are three different files to run:*
    - i. MIAMI\_2050\_N1\_MHHW\_BATH\_P [low]
    - ii. MIAMI\_2050\_N3\_MHHW\_BATH\_P [intermediate]
    - iii. MIAMI\_2050\_N5\_MHHW\_BATH\_P [high]
  - b. Use target as LRTP Project Points and join as each SLR file;
  - c. Confirm join operation is one to one;
  - d. Do not select “keep all target features”;
  - e. Match option is intersect
    - i. Add 500 feet radius for points to account for general intersection size
    - ii. Add 100 feet for points to account for right-of-way distance
  - f. Run tool.
  - g. Add data to Excel sheet. Use Excel to determine whether each project is susceptible to either low, intermediate, or high sea level rise projections.
    - i. *Note: Use standard deviation/quartile analysis within Excel to split project lines up based on project based data. The “QUARTILE.EXC” tool can find three breaks within the data points (25%, 50%, and 75%) and projects can be scored based on each of the four score ranges.*
7. To add an extra level to project line ranking (as project points are seen as “all-or-nothing”), projects can be calculated to determine what percentage of each line is within a specific polygon.
  - a. Open LRTP Project Line attribute table
    - i. Add column/field for length
    - ii. Use Calculate Geometry tool to calculate length (in feet)
  - b. Use the Definition Query tool (within the polygon properties) to parse out each specific type of heat vulnerability, social vulnerability, and SLR risk
  - c. Use the Clip Geoprocessing tool:
    - i. Use input as LRTP Project Lines and clip as heat vulnerability/social vulnerability/SLR;
    - ii. Run tool.
  - d. Open each new shapefile attribute table.
    - i. Add three new fields [Clipped length, “Polygon” Vulnerability Score/Rating, and Percent of “Polygon” Vulnerability Score/Rating]
      1. Clipped length (data type = double)

- a. Use Calculate Geometry tool to calculate the length (in feet)
2. Polygon” Vulnerability Score/Rating (data type = double/text)
  - a. Manually add a score in
    - i. Example, Combined R-value [1-5], Social Vulnerability Rating [High to Low]
3. Percent of “Polygon” Vulnerability Score/Rating (date type = float)
  - a. Use Calculate Field to calculate the percentage of clipped length to the overall project length
    - i. Equation:  $(\text{Clipped Length} / \text{Project Length}) * 100$
    - ii. *Note: You can buffer each line and/or polygon to get a larger sample of sea level rise projections on the project locations.*
  - e. Use Symbology to show each project line segment based on the associated polygon type. Create map.
8. Go through each point and line project to determine if any are repeats. Delete duplicates.
9. Use scoring, as discussed in the **\* - P** = Planning, D = Design, O&M = Operation and Maintenance
10. **Resiliency Evaluation Criteria** section, to determine which LRTP projects should be prioritized.

All three SLS sea level rise files were downloaded as polygon shapefiles. This way, ArcGIS Pro, the GIS software used for analysis, can utilize the data using the spatial join tool. There were no project points that directly intersected any of the three SLR model polygons. Therefore, to provide some guidance on potential SLR, a 500-foot buffer was used. This value was used because a 500-foot radius accounts for most elements and infrastructure of an average roadway intersection (including some right-of-way, turn lanes, and intersection equipment). The project lines were also reviewed for each SLR scenario.

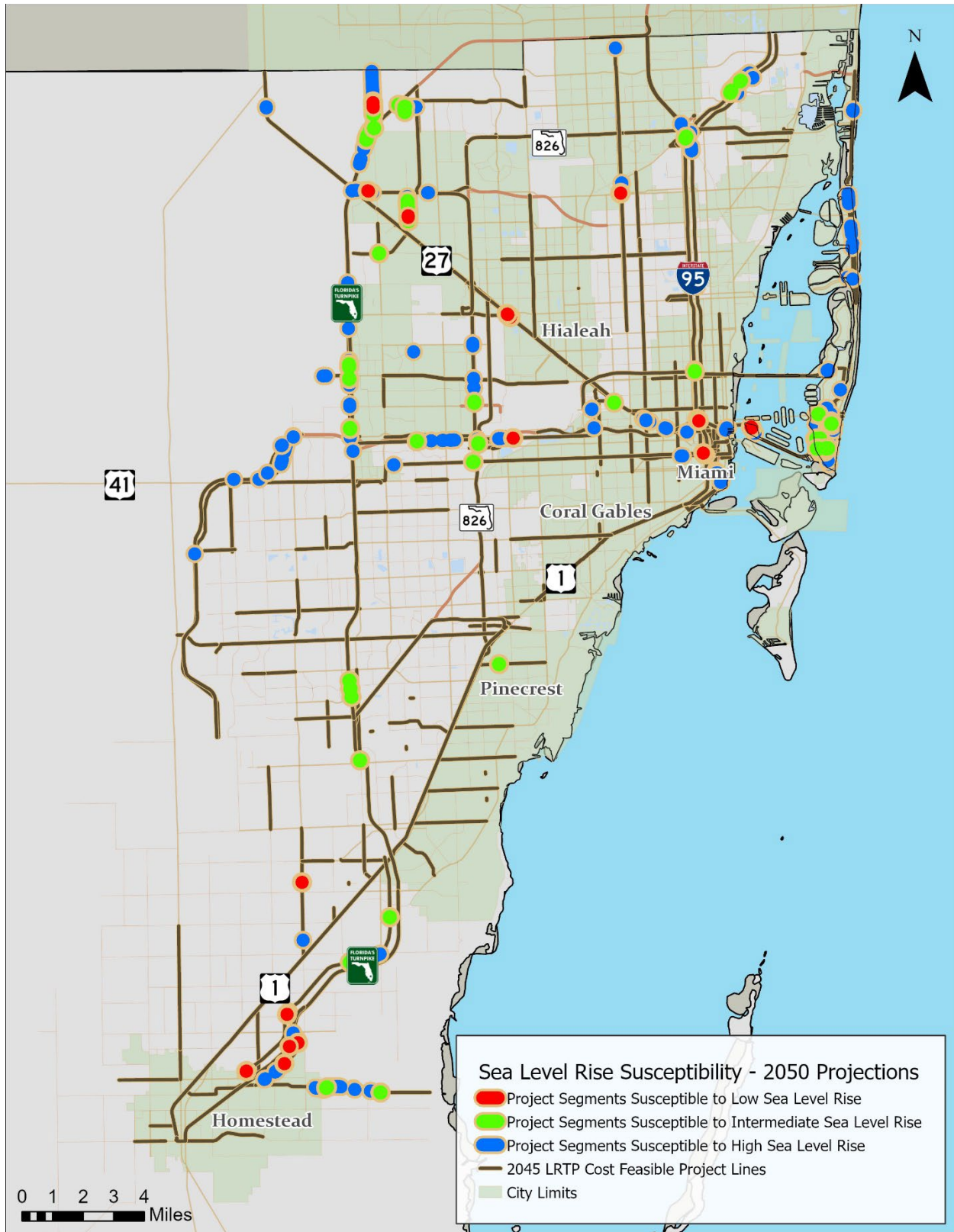
All 2045 LRTP projects and their projected sea level rise vulnerability are listed within each Excel sheet, as shown in **Appendix A**. A few of the most impacted projects (based on the three data sources) are identified in **Table 2** on the following page.



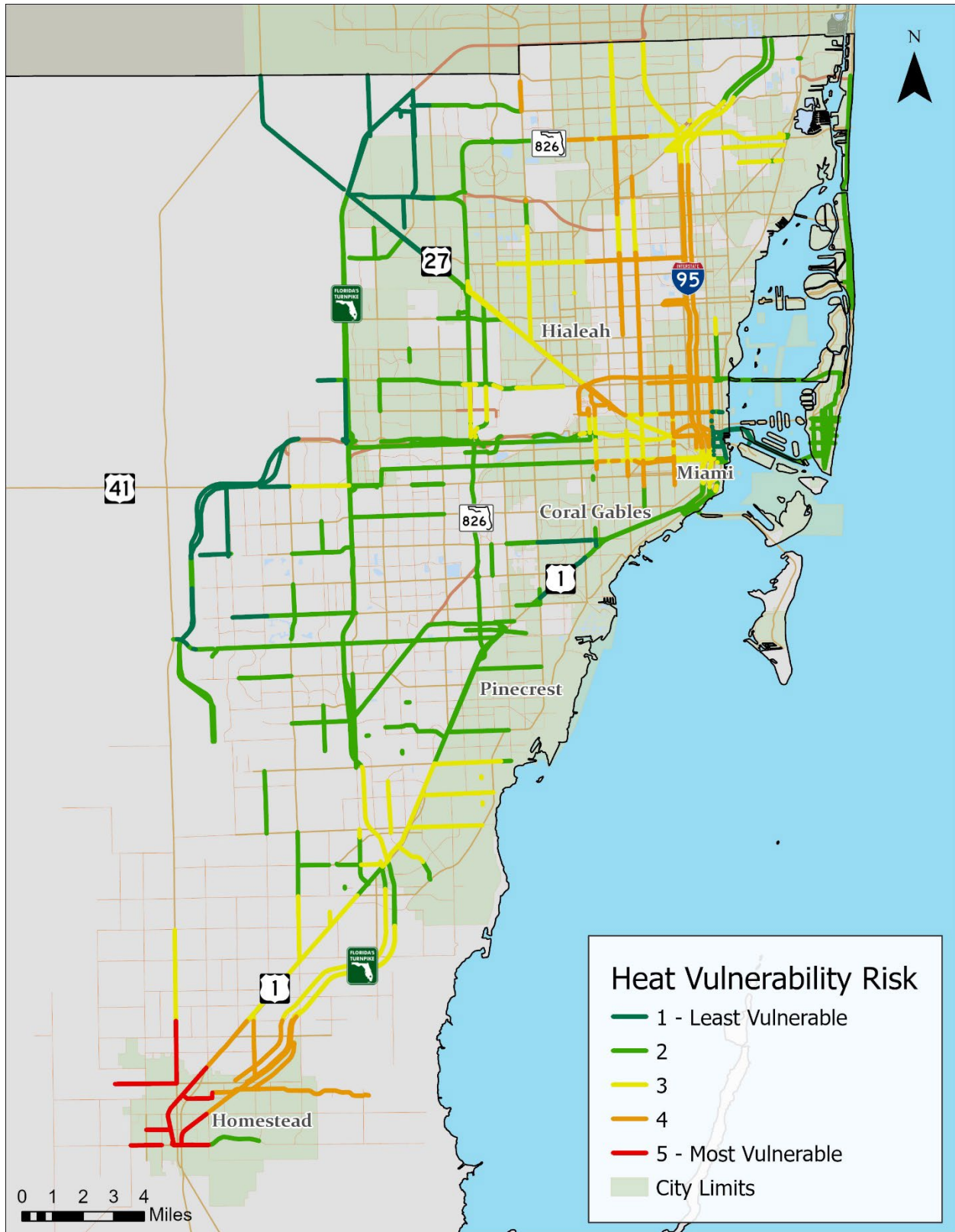
**Table 2: 2045 LRTP Project Sea Level Rise Vulnerability**

Project Location/ Facility	Project Description	Project Owner/Type	2045 LRTP Map ID	2050 SLR Risk
SR 836/Dolphin Expressway	Interchange improvements	MDX	4	Low
SR 9A / I-95 SB ramp to WB SR 836	Interchange improvements	FDOT SIS	5	Low
South Dade Transitway Park-and-Ride/terminal at SW 344 Street (344 Street Station)	Expand existing terminal/park-and-ride	DTPW	32	Low
NW 97th Street	Widen to four lanes	DTPW	33	Low
10th Street	On-road facility improvement	Bike/Ped	--	Low
Southern Turnpike Mainline/SR 91	Widen spur from six to eight lanes and reconstruct	Florida's Turnpike (FTE)	4	Low
SR 836 / I-395	Bridge replacement/add lanes	FDOT SIS	19	Low

The segments of LRTP projects directly touching/impacted by each sea level rise projection are shown within **Figure 4**. This figure shows segments of roadway that overlap with either low, intermediate, or high 2050 SLR projections. Heat and social vulnerability are visually shown on **Figure 5** and **Figure 6**, respectively.

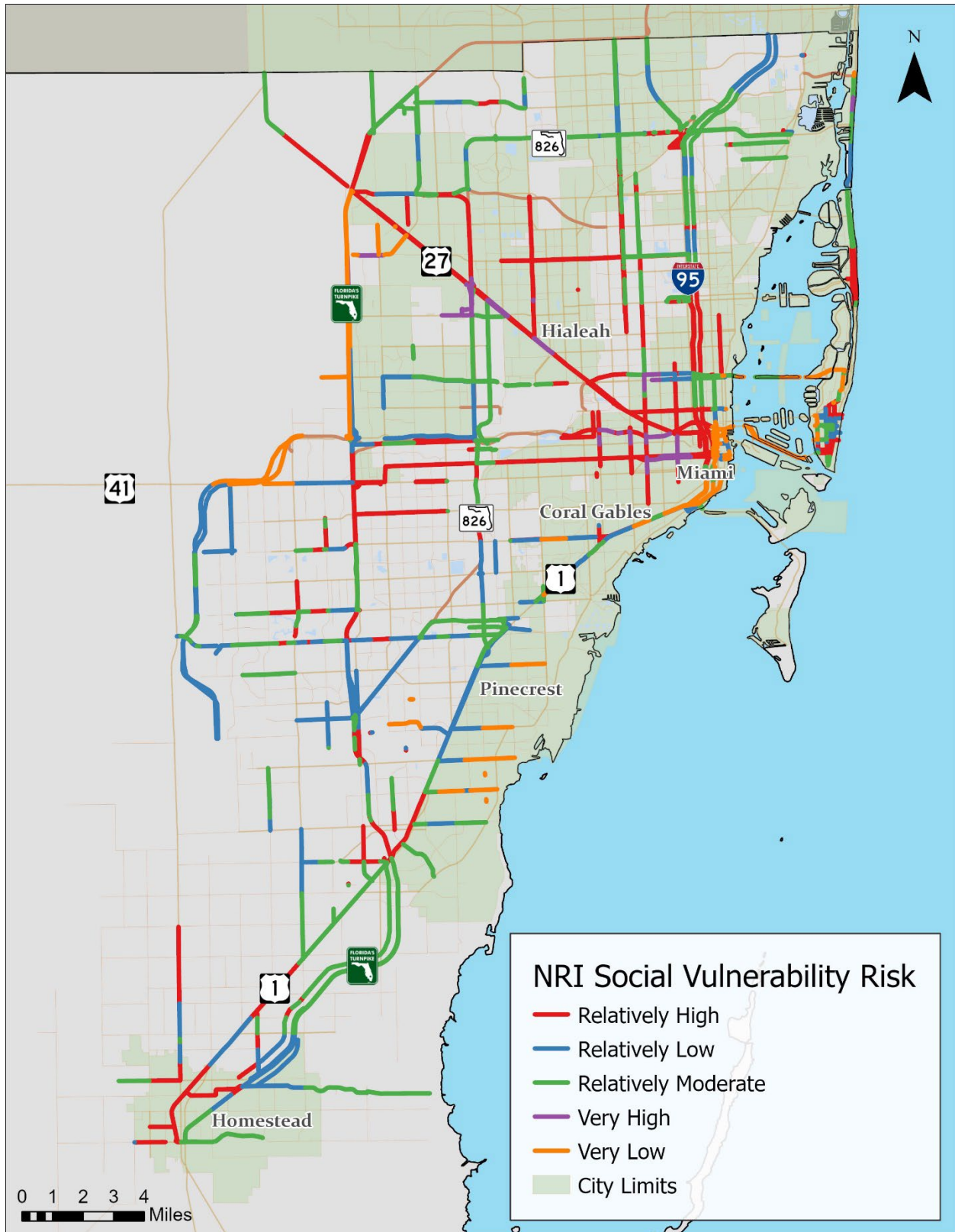


**Figure 4: 2045 L RTP Cost Feasibility Projects Compared to Sea Level Rise Projections**  
Source: SLS Sketch Planning Tool, Miami-Dade County 2045 Cost Feasible Project List



**Figure 5: 2045 LRTP Cost Feasibility Projects Compared to Heat Vulnerability (2019)**  
Source: Miami-Dade County Heat Vulnerability Tool, Miami-Dade County 2045 Cost Feasible Project List





**Figure 6: 2045 LRTP Cost Feasibility Projects Compared to NRI Social Vulnerability (2021)**

Source: FEMA NRI Social Vulnerability, Miami-Dade County 2045 Cost Feasible Project List

### 3. Infrastructure Vulnerabilities Based on Common Stressors

With the increasing number of extreme weather events, it is important to identify relevant stressors to Miami-Dade County and their associated impacts. A stressor is defined as a type of extreme weather event that has the potential to cause significant damage to transportation infrastructure. The following stressors were evaluated for Miami-Dade County:

- Sea Level Rise
- Increased Temperature and Extreme Heat

Stressors not only affect infrastructure, but they have lasting effects on the population, especially those populations that are traditionally marginalized. Therefore, the NRI Social Vulnerability scoring is important to analyze. Social vulnerability represents the susceptibility of social groups to the adverse impacts of sea level rise and increased temperature/extreme heat, the study's focused stressors. The Social Vulnerability dataset will be borrowed in an effort to understand the areas (and nearby residents who are most commonly using the infrastructure) in the greatest need and risk.

The following types of transportation infrastructure were analyzed to identify potential impacts from weather related events:

- Roadways
- Bridges
- Transit stops
- Bike lanes/sidewalks (bike/ped facilities)
- Alternative Fuel Vehicle (AFV) charging stations
- Stormwater management

#### 3.1. Sea Level Rise

Sea level rise is affecting coastal areas by inundating low-lying wetlands/drylands and eroding shores. Much of the Miami-Dade County area is susceptible to SLR. Infrastructure within areas of sea level rise may be damaged or destroyed and will require more frequent repair and maintenance. Increased sea level rise also increases the potential for tidal and storm surge flooding as shorelines change. Sea level rise has the potential to inflict the following impacts to infrastructure:

##### Roadway

- Excess water may produce inundated surfaces
- Pavement may become overwashed or erode
- Water may reduce vehicle traction and maneuverability when driving
- Vehicles may be detoured if a roadway is impassable

##### Bridge

- Excess water may produce inundated surfaces
- Uplift forces may lift the bridge
- Vehicles may be detoured if a bridge is impassable

##### Transit/Public Transportation

- Excess water may produce inundated surfaces
- Pavement may become overwashed or erode

##### Bike Lane/Sidewalk

- Excess water may produce inundated surfaces

- Pavement may become overwashed or erode
- User may be detoured if the roadway is impassable

#### **Alternative Fuel Vehicle Charging Stations**

- Water damage may affect electric charging capabilities
- Water level may increase the difficulty for evacuation plans for those with alternative fuel vehicles

#### **Storm Water Management**

- Excess water may produce increased stormwater runoff
- Water-borne debris may cause blockages in the system

### **3.2. Increased Temperature and Extreme Heat Damage**

Extreme heat is a period of at least two to three days (or more) of high temperatures (including humidity) over 90 degrees Fahrenheit.<sup>12</sup> Prolonged periods of extreme heat can negatively affect human health and the built environment, including transportation infrastructure. Extreme heat has the potential to inflict the following impacts to infrastructure:

#### **Roadway**

- Pavement may buckle or lose integrity as the temperature rises
- Extreme heat can reduce the lifespan of pavement
- Pavement will require more frequent surface treatments
- Utility brownouts can affect lighting and reduce visibility

#### **Bridge**

- Extreme heat may cause thermal expansion of piers
- Utility brownouts can affect lighting and reduce visibility

#### **Transit/Public Transportation**

- Pavement may buckle or lose integrity as the temperature rises
- Extreme heat may cause the deformation of rail tracks
- Limited to no shade covering for transit stops may cause health problems
- Utility brownouts can affect lighting and reduce visibility

#### **Bike Lane/Sidewalk**

- Pavement may buckle or lose integrity as the temperature rises
- Utility brownouts can affect lighting and reduce visibility
- Limited to no shade covering along sidewalks may cause health problems

#### **AFV Charging Stations**

- Rolling blackouts may shut off power to charging stations

#### **Storm Water Management**

- Increased water temperature can damage the ecosystem and create larger volumes of runoff

---

<sup>12</sup> <https://www.ready.gov/heat>



### 3.3.Social Vulnerability

Social vulnerability helps to determine areas where people are more adversely affected by stressors. Regarding natural hazards, those with higher social vulnerability risks have a more difficult time recovering and are more likely impacted. These areas are commonly communities with lower income residents, often including minorities, that have been historically disadvantaged. High social vulnerabilities have the potential to inflict the following impacts on users of impacted infrastructure:

#### Impacts

- Higher need and reliance upon transit and bike/pedestrian options due to lack of vehicle access
- Higher health risk for emergency heat
- Increased need for natural disaster planning and evacuation planning
- Increased need for emergency shelters and emergency supplies

## 4. Vulnerability Solution Toolkit

Widespread research has been completed to determine the potential mitigation strategies for climate change vulnerabilities. **Table 3** identifies solutions that may be implemented within the county to alleviate and potentially eliminate stressor induced infrastructure problems. These solutions may be selected, based on specific projects, to mitigate critical points of failure and help infrastructure to continue functioning during natural disasters. Low-cost solutions should be implemented in all projects. Medium and high-cost solutions should be implemented within L RTP projects that are high priorities, based on the project type and needs. Many projects include roadways (whether they are roadway, bridge, transit, or bike/pedestrian related). Therefore, solutions such as roadway realignment and increased roadway elevations are high price solutions that yield the greatest impact.

**Table 3: Vulnerability Solution Toolkit**

Solution	Type of Infrastructure Impacted						General Cost Estimate	Project Phase*
	Roadwa	Bridge	Transit	Bike/Ped	EV Chargin	Storm Water		
Create a hazard mitigation plan to use during emergencies	√	√	√	√	√	√	Low	P
Increase monitoring of infrastructure during extreme weather conditions	√	√	√	√	√	√	Low	O&M
Incorporate sea level rise into infrastructure planning	√	√	√	√	√	√	Medium	P
Install green infrastructure	√	√	√	√	√	√	Low	P, D
Relocate facilities to higher elevations	√	√	√	√	√		High	P, D
Build flood barriers to protect infrastructure	√	√	√	√	√		Medium	P, D
Install erosion control measures and improve soil strength	√	√	√	√			Medium	O&M
Realign roads and structures out of floodplains	√	√	√	√			High	P, D
Improve detour/alternative routes	√	√					Low	P
Provide a source of standby power and move electric equipment to a higher elevation					√		Medium	P, O&M
Construct additional AFV charging stations					√		Medium	P, O&M
Strengthening support structures and embankments		√					Medium	O&M
Develop coastal restoration plans to protect water utility infrastructure						√	Low	P
Improve drainage by reducing impervious surfaces and installing other streetscaping						√	Low	P, D

\* - P = Planning, D = Design, O&M = Operation and Maintenance

## 5. Resiliency Evaluation Criteria

Resiliency continues to be at the forefront of decisions within Miami-Dade County. As the 2050 LRTP Cost Feasible Projects and future plans are identified, resiliency evaluation criteria should be included. A test resiliency scoring was completed using the 2045 LRTP projects, as identified below. The test scoring was built to heavily weigh the sea level rise projections, as it is a key priority for the county. The heat and social vulnerability were scored similarly to build variation in project scoring, especially when deciding between multiple low SLR susceptible projects. Several other less concrete elements need to be included, however the stressor data extracted was used to identify higher risk locations. The scoring may be tweaked to add, remove, and change the point scoring to better reflect the vision of the county.

An ArcGIS analysis was performed to extract data from the current 2045 LRTP projects. This data was used to identify a general point scheme for the criteria. The data identifies high, medium, and low priority projects based on susceptibility to the above stressors. Low sea level rise projections are the most conservative analysis, affecting less transportation at lower inundation levels. Low projection sea level rise estimates have the highest probability of occurring. The higher the SLR projections, the higher the inundation levels and number of projects affected. After generalized scoring, projects can be parsed down based on the percent of the project length within each scoring. Scoring for project points and lines are shown in **Table 4** and **Table 5**, respectively.

**Table 4: Miami-Dade County Potential Stressors Scoring – Project Points**

Sea Level Rise (2050 Projections)			Heat Vulnerability (2019)		Social Vulnerability (2021)	
SLR Projection	Probability of Occurring	Points	Type	Points	Type	Points
Low – Minimal Inundation	High	9	5 - High	2	Very High	2
Intermediate	Intermediate	6	4	1.5	Relatively High	1.5
High – Major Inundation	Low	3	3	1	Relatively Moderate	1
None		0	2	0.5	Relatively Low	0.5
			1 – Low	0	Very Low	0
Up to 9 points			Up to 2 points		Up to 2 points	

The most up-to-date and available data was used for each of the scoring. There are some differences within the data compared for scoring. The heat and social vulnerabilities are closer to “existing” conditions, where the sea level rise is projected into the future. The heat and social vulnerabilities are more difficult to project, and readily available projected data was not found for them. As the projects are from the 2045 LRTP, sea level rise is compared to the appropriate future year. Sea level rise, especially within the South Florida region of the country, is studied heavily. Even though the years (existing versus future) are different, they both help determine risk for the infrastructure and nearby residents and can therefore be combined to evaluate the projects with higher needs. Sea level rise

projections have a higher weight during the scoring because they are projected towards the goal year and have the greatest potential impact on the functionality of the infrastructure projects.

**Table 5: Miami-Dade County Potential Stressors Scoring – Project Lines**

Sea Level Rise (2050 Projections)		Heat Vulnerability (2019)		Social Vulnerability (2021)	
Type	Points	Type	Points	Type	Points
Within 100 feet of:		5 - High	2	Very High	2
High SLR	1				
Intermediate SLR	2				
Low SLR	3				
Low SLR (25%)	0.5				
Low SLR (50%)	1				
Low SLR (75%)	1.5				
Low SLR (100%)	2				
Intermediate SLR (25%)	0.5	4	1.5	Relatively High	1.5
Intermediate SLR (50%)	1				
Intermediate SLR (75%)	1.5				
Intermediate SLR (100%)	2				
High SLR (25%)	0.5	3	1	Relatively Moderate	1
High SLR (50%)	1				
High SLR (75%)	1.5				
High SLR (100%)	2				
None	0	2	0.5	Relatively Low	0.5
		1 – Low	0	Very Low	0
Up to 9 points		Up to 2 points		Up to 2 points	

The cost of infrastructure varies project-by-project. Cost estimates for projects within the LRTP and the SMART Program are calculated at the general planning level, rather than a design or construction level. Planning level costs are also available based on cost per mile models.<sup>13</sup> Exact cost information is difficult to account for without more finalized cost estimates. One item that should be considered for cost is adding resiliency factors. These include the solutions described within the solutions toolkit. The appropriate solution, or solutions, should be identified upfront and included within the projected cost and design process.

With the continuously increasing occurrence and severity of natural hazard risks, it is vital to prioritize system resiliency within project selection and implementation. Building resiliency into project planning and design can avoid/reduce damage to assets, transportation service disruption, and lower levels of injury or losses. Designing for resilience helps reduce repairs and the disruption of facilities. The cost of resilience versus benefit cost is not yet thoroughly available.<sup>14</sup> Information is often more generalized, noting that costs incurred today will make assets stronger for future events.

<sup>13</sup> <https://www.fdot.gov/programmanagement/estimates/documents/costpermilemodelsreports>

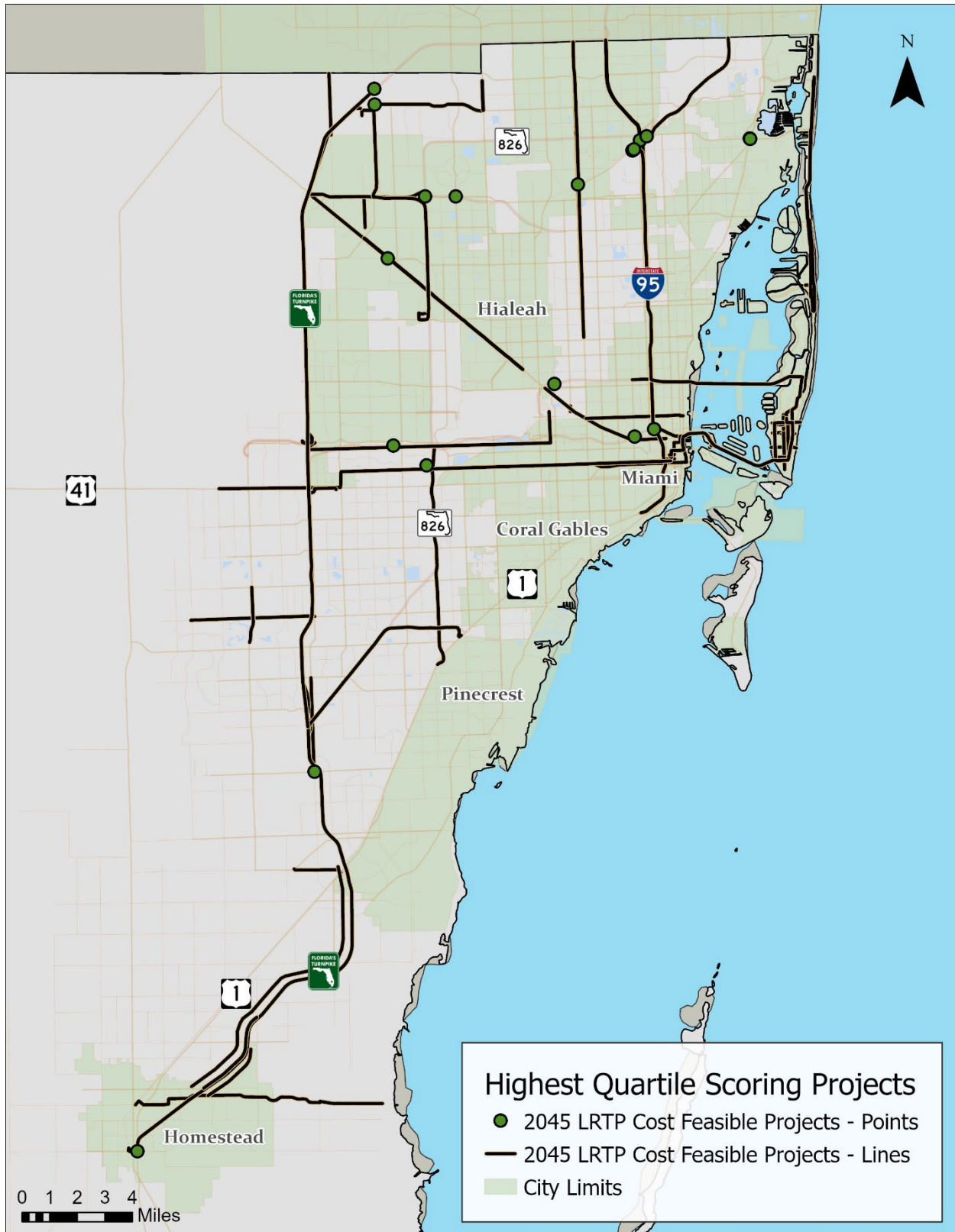
<sup>14</sup> <https://blogs.worldbank.org/transport/cost-benefit-building-resilience-transport-systems-what-do-we-know>

This scoring criterion can be a starting point for project ranking and prioritization. If any additional data is used for analysis, it is important to ensure the data is within the shapefile attribute tables before analysis. Some items, which can be added to project weighted scoring may include:

- Roadway functional classification
  - Roadways that carry more traffic volume should be prioritized
- Roadway access type/number of access points
  - Roadways with limited alternative routes should be prioritized

## 6. Conclusion

The effects of climate change are becoming increasingly apparent and Miami-Dade County is no exception. Miami-Dade TPO is taking a proactive approach to assess the impact of environmental stressors on regional infrastructure and is planning for future infrastructure projects that may be affected by and will reduce the impacts of climate change. Technical Memorandum #2 is a valuable resource that evaluates the 2045 LRTP projects and evaluates their susceptibility to climate change. The memorandum also provides a toolkit for building resilient infrastructure, ways to prioritize impacted locations, and a resiliency evaluation criterion to determine the most beneficial projects for the Miami-Dade County 2050 LRTP. The top 25 percent of highest scored projects, using the scoring, are shown in **Figure 7**. Overall, this initiative highlights the importance of addressing the impacts of climate change on important public infrastructure and the need for proactive measures to build a resilient future for Miami-Dade County.



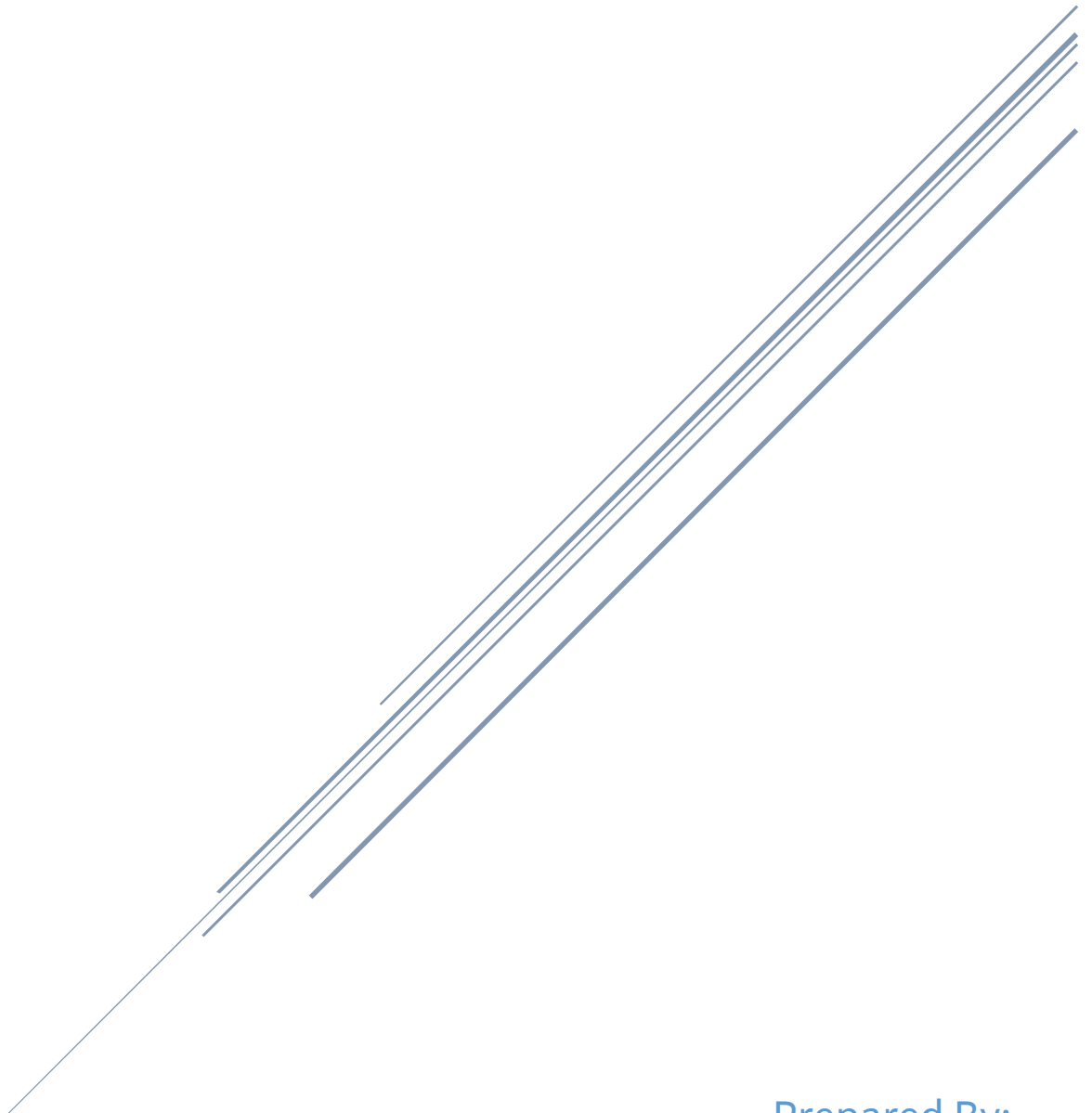
**Figure 7: 2045 Top Quartile Scoring L RTP Cost Feasibility Projects**

Source: TranSystems analysis of the Miami-Dade County 2045 Cost Feasible Project List



# ELECTRIC AND ALTERNATIVE FUELS MARKET RESEARCH

Technical Memo #3  
June 2023



Prepared By:  
TranSystems

## Contents

1. Introduction .....	2
2. Alternative Fuel Vehicle Benefits and Challenges.....	3
2.1. Electric Vehicles .....	3
2.2. Alternative Fuel Vehicles .....	4
2.3. Transportation Systems Management and Operations (TSMO).....	4
3. Market Penetration .....	5
3.1. Current (2020) Usage .....	5
3.2. Future (2050) Outlook .....	6
4. Electrifying Transportation.....	8
4.1. Automobiles and Freight Vehicles .....	8
4.1.1. Personal Vehicles.....	8
4.1.2. Freight Vehicles.....	9
4.1.3. Electric Charging Infrastructure .....	10
4.2. Public Transit.....	12
4.2.1. Transit System Vehicles.....	12
4.2.2. Re-Fueling Infrastructure .....	14
4.3. Micromobility.....	14
4.3.1. Micromobility Growth and Options.....	14
4.3.2. Electric Charging Infrastructure .....	16
5. Concluding Results.....	18

## 1. Introduction

Miami-Dade County (MDC) is making strides to promote the use of electric and alternative fuel vehicles (AFV) as well as expand countywide infrastructure. The average personal motor vehicle expels an average of six to nine tons of carbon dioxide (CO<sub>2</sub>) into the atmosphere per year.<sup>1</sup> Electric vehicles (EVs) are low-carbon alternatives that play crucial roles in the de-carbonization of vehicles and reaching zero-carbon emission goals both in MDC and around the world. AFVs utilize one or more alternative fuels. Alternative fuels include gaseous fuels (hydrogen, natural gas, or propane), alcohol-based fuels (ethanol, methanol, or butanol), vegetable and waste-derived oils, and electricity.<sup>2</sup> For this study, electric and alternative fuel vehicles will be referred to as AFVs.

Studies have shown that there is demand for AFVs, but the appropriate infrastructure is needed to support its growth. To enhance the transportation infrastructure to accommodate growth, Florida must apply successful transformational initiatives both physically and strategically. MDC recognizes that transportation is the largest contributor of greenhouse gasses (GHG) within the County.<sup>3</sup> The County's Comprehensive Development Master Plan (CDMP) contains:

- Countywide unleaded and diesel fuel reduction targets
- 2050 community-wide emission reductions by 50 percent
- Goals to expand the availability of AFV charging infrastructure throughout MDC

Additionally, MDC's Climate Action Strategy outlines goals for reducing climate pollution to net zero by 2050. There was some difficulty acquiring 2050 projections for freight, but an assumption is made that there will be technological advancements and implementations to help MDC reach its goals.

---

<sup>1</sup> <https://www.c2es.org/content/reducing-your-transportation-footprint/>

<sup>2</sup> <https://www.epa.gov/renewable-fuel-standard-program/alternative-fuels>

<sup>3</sup> <https://www.miamidade.gov/govaction/legistarfiles/Matters/Y2022/221292.pdf>

## 2. Alternative Fuel Vehicle Benefits and Challenges

Negative externalities that exist from climate change continue to affect communities around the world. New types of technological advancements are researched, designed, and are being implemented to reduce climate change impacts. AFVs are a major technology innovation being developed to help affect the issues associated with climate change. As of 2020, transportation accounted for 27 percent of the United States GHG emissions.<sup>4</sup> AFVs produce a significantly lower number of emissions than traditional vehicles. Major strides need to be made in investments to implement electric vehicles/fleets to reduce the environmental footprint transportation has on emissions. Benefits and challenges of these vehicles, along with SMART technology, are discussed.

### 2.1. Electric Vehicles

An electric vehicle is a motor vehicle that runs on batteries rather than petroleum fuels. Full electric vehicles do not have traditional gasoline tanks or internal combustion engines. EVs do not produce any emissions themselves, and a full battery can provide drivers with over 200 miles of range. Drivers can charge their vehicles overnight at home or at public charging stations. There are three levels of charging stations.<sup>5</sup> Level 1 and Level 2 charging stations will charge all EVs and can be installed at home. Level 3 chargers are known as fast charging stations and are more powerful than the other two levels. All-electric vehicles produce zero emissions and are ideal for carbon goals. Other types of electric vehicles include plug-in hybrid (PHEV) and hybrid electric (HEV) vehicles which still use fossil fuels when driving. These vehicles not only have lower emissions, but also typically have higher miles per gallon of gasoline equivalent (MPGe) than conventional vehicles.

#### Benefits

- Fewer emissions produced than traditional vehicles
- Reduced dependence on imported oil
- Lower maintenance costs

#### Challenges

- Needs efficient electric charging (amount and location)
- Increased need for modernized and expanded EV charging infrastructure
- Limited vehicle range based on battery life (range anxiety)
- Increased grid usage

---

<sup>4</sup> <https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions#:~:text=Greenhouse%20gas%20emissions%20from%20transportation,includes%20primarily%20gasoline%20and%20diesel.>

<sup>5</sup> <https://chargehub.com/en/electric-car-charging-guide.html>

## 2.2. Alternative Fuel Vehicles

AFVs are becoming more prevalent in the United States by government and private sector fleets, but interest is growing from individual consumers. The vehicles can run on one or more types of alternative fuels. There are over a dozen different fuel types that are either available or under development for use. These alternative fuels include biodiesel, hydrogen, ethanol, natural gas, solar, and electric. These vehicles are typically all lumped into one category (AFV), as they consist of a small market share of vehicles.

### Benefits

- Lower pollution emitted than traditional vehicles
- Reduced dependence on imported oil
- Fuels are renewable or created from recycled products

### Challenges

- Difficult refueling due to limited fueling locations
- Supply limitations

## 2.3. Transportation Systems Management and Operations (TSMO)

TSMO is a broad term used to address technology driven systems. These can include infrastructure related technologies, such as Intelligent Transport Systems (ITS) and autonomous vehicles. ITS aims to improve the overall efficiency of transportation, including the movement of people and goods. Types of innovations include, but are not limited to, autonomous vehicle (AV) communications/fleet management, adaptive signal control/radar detection, electric vehicle charging, and intelligent traffic management.<sup>6</sup> These systems coordinate to reduce travel times, improve safety, and reduce air pollution.

### Benefits

- Reduce environmental impacts by improving transportation efficiency
- Technology can react to traffic volumes, special events, and construction
- Improve safety

### Challenges

- Limited existing supply in the field
- Can be time-consuming to deploy

---

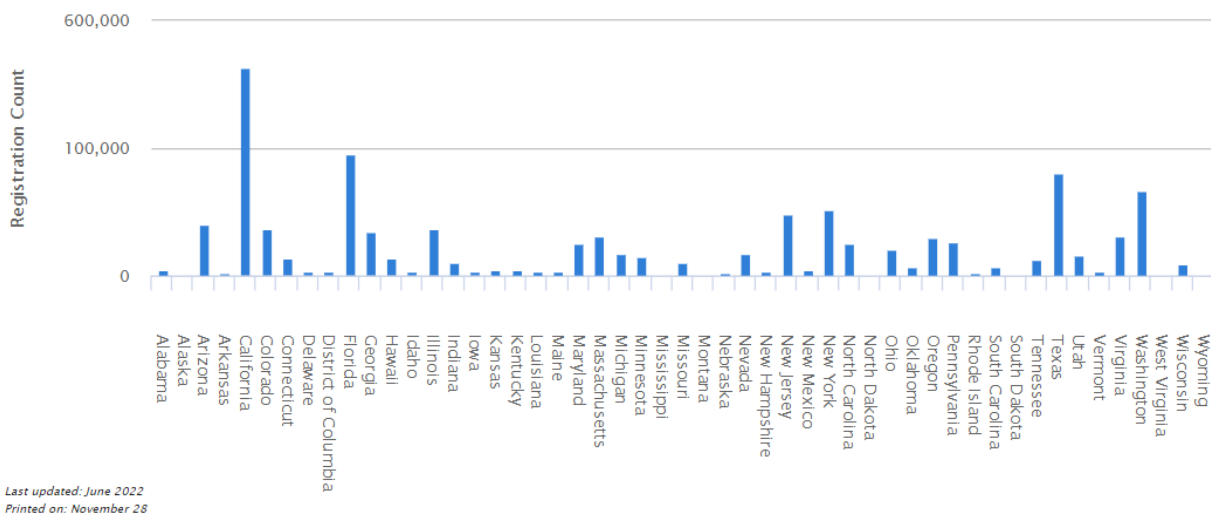
<sup>6</sup> <https://www.itstrs.its.dot.gov/benefits>

### 3. Market Penetration

Market penetration determines how much of a product is being utilized compared to its potential market. Data can provide outlets and opportunities to increase the market share of a product. In this case, the market share evaluation includes AFVs and other environmentally conscious transportation infrastructure. Existing usage is evaluated to understand what is being used and how often, establishing a baseline. While future market penetration is difficult to project, country-wide data and other well-researched goals for 2050 were examined.

#### 3.1. Current (2020) Usage

Florida is a national leader in EV deployment coming in second in electric vehicle registration after California. Florida has 95,640 EV registrations, as shown in **Figure 1**.



Source: Vehicle registration counts derived by the National Renewable Energy Laboratory with data from Experian Information Solutions

Figure 1: Electric Vehicle Registration by State

Source: [https://afdc.energy.gov/transatlas/#/?state=FL&view=vehicle\\_count](https://afdc.energy.gov/transatlas/#/?state=FL&view=vehicle_count)

**Figure 2** shows specific registration growth in Florida. There was a nearly 49 percent increase from 2020 (58,200 vehicles) to 2021. The amount of EVs purchased is currently growing exponentially, however registrations are anticipated to become linear until they flatten out. The projections in **Figure 2** are based on global applied research. The projected global compound annual growth rate (CAGR) is 18.2 percent between 2021 and 2030.<sup>7</sup> Although not specific to Miami-Dade County, this projection does generally follow the existing growth rate within Florida. The projections show the number of registered EVs within Florida will be approximately 430,500 vehicles in 2030.

<sup>7</sup> <https://www.alliedmarketresearch.com/electric-vehicle-market>



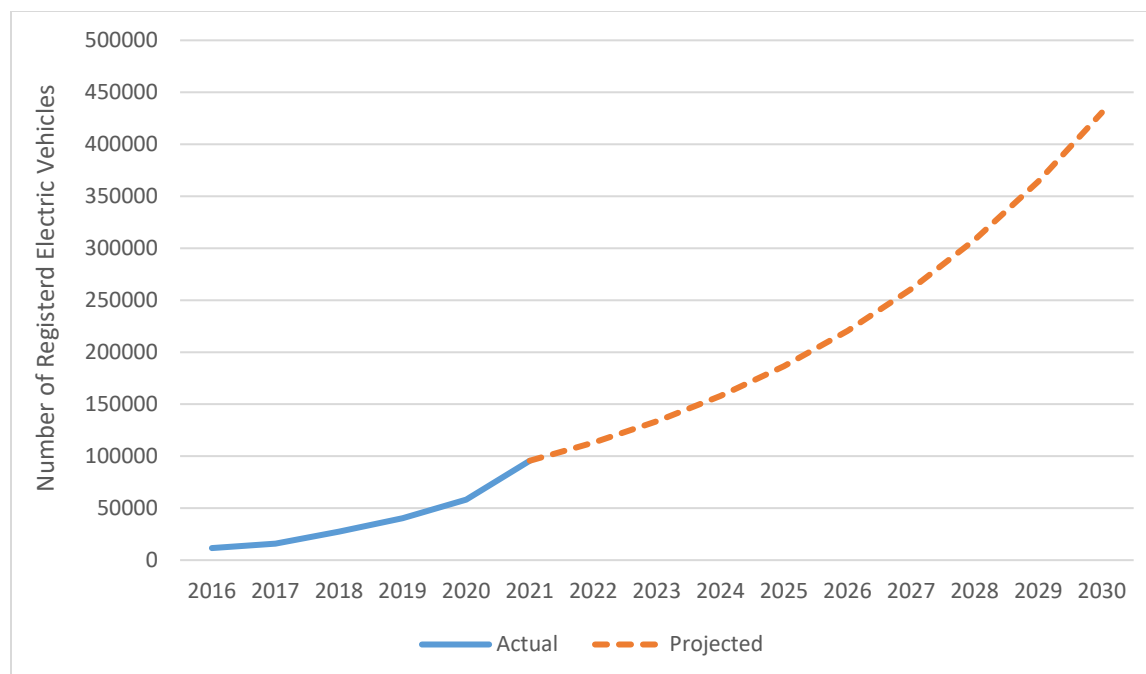


Figure 2: Florida Electric Vehicle Registration

Although the number of electric vehicles continues to increase, electric vehicles account for only 0.5 percent of the market share of vehicles within the state.<sup>8</sup> Most private vehicle trips within the county are from gas and diesel vehicles. In 2020, EVs accounted for roughly three percent of new vehicles purchased (three percent market share) within Miami.<sup>9</sup> This is a slightly higher rate than the overall state, indicating a large percentage of the state's EVs are purchased/used within Miami-Dade County. Based on statewide trends, Miami-Dade County likely saw a high percentage increase in EV registrations.

### 3.2. Future (2050) Outlook

MDC has a unique opportunity to become a leader within Florida for AFVs and their associated infrastructure. MDC boasts the highest population, for counties, within the state and has a head start on EV ownership. The County is developing the framework for a transition to EVs by developing Master Plans that will facilitate the goals MDC has also set in place. Therefore, a large increase in EV users is anticipated by 2050.

Research shows that AFV numbers increase as its associated charging infrastructure increases.<sup>10</sup> Even though most vehicle charging is done at home, the availability of external charging greatly affects the number of people purchasing AFVs. Additionally, state/local regulations that require a greater AFV model available is necessary to grow its market. Cities around the country that have initiated incentives

<sup>8</sup> [https://afdc.energy.gov/transatlas/#/?state=FL&view=vehicle\\_count](https://afdc.energy.gov/transatlas/#/?state=FL&view=vehicle_count)

<sup>9</sup> [https://theicct.org/wp-content/uploads/2021/12/ev-us-market-growth-cities-sept21\\_0.pdf](https://theicct.org/wp-content/uploads/2021/12/ev-us-market-growth-cities-sept21_0.pdf)

<sup>10</sup> [https://theicct.org/wp-content/uploads/2021/12/ev-us-market-growth-cities-sept21\\_0.pdf](https://theicct.org/wp-content/uploads/2021/12/ev-us-market-growth-cities-sept21_0.pdf)

and promotion actions (primarily within California) are seeing the greatest market share of electric vehicles.

The MDC Climate Action Strategy identifies several reduction goals:<sup>11</sup>

- Reduce the consumption of gasoline in County operations by 30% and the consumption of diesel fuel in County operations by 70% from the baseline year of 2016 by 2028 and further move toward conversion of the County's fleet to electric vehicles.
- Shift 10% of transportation modes away from single occupant vehicles by 2030
- Electrify the County fleet: 80% of light vehicles and 50% of buses by 2030

The City of Miami approved the *Miami Forever Carbon Neutral Plan* in November 2021. The plan details a general roadmap for the city/county to become carbon neutral by 2050. One primary objective is for 40 percent of registered passenger vehicles to be electric by 2035. Another prioritized action is to develop an EV Master Plan to support EV ownership growth. This would be a key opportunity for collaboration between MDC and the City of Miami.

Research within *Nature Climate Change* states 90 percent of light-duty vehicles on US roadways need to be electric by 2050 to keep transportation emissions aligned with climate mitigation targets.<sup>1213</sup> The increase of light-duty vehicles within Florida, and MDC, is anticipated to grow. The County should set specific goals based on climate mitigation targets. This should include not only personal vehicles, but freight and other types, especially county-owned vehicles.

The increase in electric vehicles poses a threat to local gas taxes – a primary funding source for transportation projects. A study conducted in 2020 by the Environmental and Energy Policy academic journal noted electric vehicle implementation has reduced gasoline tax revenue (nationwide) by \$250 million annually.<sup>14</sup> States have been introducing electric vehicle fees upfront at purchase to counteract the lack of gas taxes paid. Other states, such as Oregon and California, have piloted programs that track mileage through the odometer to charge a fixed rate based on mileage driven. This tactic could also take into account vehicle weight to correlate with the impact the vehicle has on the road. MDC should explore opportunities to continue bringing in vital tax revenue from vehicles with the reduction of funds from the gas tax.

<sup>11</sup> <https://www.miamidade.gov/green/library/climate-action-strategy-final-draft.pdf>

<sup>12</sup> <https://www.scientificamerican.com/article/ninety-percent-of-u-s-cars-must-be-electric-by-2050-to-meet-climate-goals/>

<sup>13</sup> [https://www.nature.com/articles/s41558-020-00921-7.epdf?sharing\\_token=nYahkz01T4CW9varVKpF-dRgN0jAijWel9jnR3ZoTv0MwZgD9OhVz9I1pdqn5uP1k1CpCf4fg7znFhbBxuv-brmLH-54S-3N6953HWpjdvSr5Tr5IFZh3Y9FHim7Ud-eZICB8GXhZZWAbqblYH32ee-ZIGFoDNJzZESxIAPMc\\_CTV15SeO35OFB\\_JYWn1RucGpDYcEkfgcC1DK3NmkVT5pHoSOuwDTIsj50gaDUWqM8WlrTVbyB3geSeQcp8\\_5iiqbA3KHfX3sOzYD-jUrNSJXE-HRnZK\\_0FoQ8GLVSH2eUcQ6mBV\\_MnnqoRqN0Y4oo\\_9wLJWG\\_CpfSWYCq3jT0hROw%3D%3D&tracking\\_referrer=www.scientificamerican.com](https://www.nature.com/articles/s41558-020-00921-7.epdf?sharing_token=nYahkz01T4CW9varVKpF-dRgN0jAijWel9jnR3ZoTv0MwZgD9OhVz9I1pdqn5uP1k1CpCf4fg7znFhbBxuv-brmLH-54S-3N6953HWpjdvSr5Tr5IFZh3Y9FHim7Ud-eZICB8GXhZZWAbqblYH32ee-ZIGFoDNJzZESxIAPMc_CTV15SeO35OFB_JYWn1RucGpDYcEkfgcC1DK3NmkVT5pHoSOuwDTIsj50gaDUWqM8WlrTVbyB3geSeQcp8_5iiqbA3KHfX3sOzYD-jUrNSJXE-HRnZK_0FoQ8GLVSH2eUcQ6mBV_MnnqoRqN0Y4oo_9wLJWG_CpfSWYCq3jT0hROw%3D%3D&tracking_referrer=www.scientificamerican.com)

<sup>14</sup> <https://cars.usnews.com/cars-trucks/features/states-losing-gas-tax-revenue-with-ev-adoption#:~:text=This%20is%20despite%20the%20fact, on%20motorists%20who%20buy%20electric.&text=A%202020%20study%20in%20the.revenues%20by%20%24250%20million%20annually.>

## 4. Electrifying Transportation

With personal vehicles, freight trucks, and public transportation vehicles becoming readily available with electric technology, the implementation of micromobility transportation options, such as electric scooters and bicycles, and their infrastructure are also expanding in cities across the country. These adaptations are necessary to aid in reducing harmful emissions and improving the health of our environments both in the short and long term.

### 4.1. Automobiles and Freight Vehicles

Florida is seeing a steady uptick in AFV usage. EV battery costs have been decreasing, therefore lowering the cost to purchase EVs. EVs will cost the same or less than traditional cars in the future.<sup>15</sup> The challenge with meeting the accelerated deployment rate of EVs is the dispersal of charging infrastructure. Florida does not lack sufficient electric vehicle supply equipment (EVSE), but unevenly distributed infrastructure causes some counties to require additional EVSE. MDC has made strides to improve infrastructure and accessibility both today and in the future. Success will depend on policy implementation and infrastructure investments.

#### 4.1.1. Personal Vehicles

In MDC, the success of transportation electrification and emission reduction depends on policy implementation and infrastructure investments. The Regional Climate Action Plan developed a recommendation titled Energy and Fuel 12, or EF-12, to promote community use of EVs.<sup>16</sup> The recommendation enacts the following:

- To maximize emission-reduction benefits, designate solar charging with battery storage and other renewable options as a priority. This will improve the community's emergency preparedness and resilience.
- Develop solar carports and consider cogeneration as an additional energy source.
- Identify and expand AFV charging infrastructure.
- Require new properties to have AFV infrastructure and a minimum amount of parking spaces dedicated to AFV vehicles.

MDC implemented the recommendation by passing an ordinance requiring new multifamily residential buildings and office and business properties (with exceptions) to have EV-ready, level 2 charging spaces. The ordinance is found within the Code of Miami-Dade County in Section 33-122.5.<sup>17</sup> EVs are a rapidly growing market. Currently, the average rate of EV adoption within Florida is about 1,600 units per month.<sup>15</sup>

---

<sup>15</sup> [https://www.fdacs.gov/ezs3download/download/95682/2638040/Media/Files/Energy-Files/EV-Roadmap-Report/EV\\_ROADMAP\\_REPORT\\_2020.pdf](https://www.fdacs.gov/ezs3download/download/95682/2638040/Media/Files/Energy-Files/EV-Roadmap-Report/EV_ROADMAP_REPORT_2020.pdf)

<sup>16</sup> <https://southeastfloridaclimatecompact.org/recommendations/promote-electric-vehicles/>

<sup>17</sup> <https://www.miamidade.gov/govaction/matter.asp?matter=190029&file=true&fileAnalysis=false&yearFolder=Y2019>

#### 4.1.2. Freight Vehicles

In 2020, the global electric truck market was valued at \$392.3 million. By 2030, projections predict the market will be valued at close to \$3,861.8 million. It is evident that companies will begin integrating Electric Freight Vehicles (EFVs) into their fleets. Miami-Dade County has committed to fleet electrification by 2023.<sup>18</sup> Additionally, they have established a fleet fuel efficiency purchase policy to make strides towards their net zero by 2050 goals.

EFVs have fewer internal moving parts in comparison to diesel trucks. This, in turn, reduces the maintenance costs of vehicles, improves their reliability, and reduces noise and environmental pollution. These factors alone should inspire government initiatives that will promote the integration of EFVs. What is likely to hinder the initial success of EFVs is the lack of charging infrastructure and high vehicle costs.

The EFV market is segmented into four categories: propulsion, vehicle type, range, and region. Propulsion types include battery electric, hybrid electric, plug-in hybrid electric, and fuel-cell electric. There are three vehicle types – light, medium, and heavy-duty vehicles. Ranges can be between 150, 151-300, and 300+ miles. Regions include North America, Europe, Asia-Pacific, Latin America, the Middle East, and Africa.

An example of a company working on getting EFVs out in the field is the Volvo Group.<sup>19</sup> Volvo offers transport and infrastructure solutions by offering trucks, buses, construction equipment, power solutions in marine and industrial applications, and financing. They have a commitment to changing and adapting to the future landscape through sustainable transport and infrastructure solutions making them top leaders in the world of e-mobility. Under their name, Volvo will offer six different trucks for a variety of jobs.

Mack Trucks, North America's largest heavy-duty truck producer, is part of the Volvo Group.<sup>20</sup> In 2022, the MDC Department of Solid Waste Management (DSWM) introduced the first ever all-electric waste collection vehicle at the waste-to-energy facility, the Resources Recovery Facility (RRF).<sup>21</sup> The vehicle will collect waste from the surrounding areas. Overnight the vehicle will charge, and the electricity used to charge it will be produced on-site via waste incineration. The total vehicle cost is \$668,619, including \$39,465 for charging infrastructure and \$33,000 for the service agreement. DSWM should see a return on investments within five to six years depending on fuel prices. The vehicle has a useful life of seven to eight years. Environmental benefits include zero emissions and noise reductions.

---

<sup>18</sup> <https://southeastfloridaclimatecompact.org/news/miami-dade-county-commits-to-fleet-electrification-by-2030-and-establishes-a-fleet-fuel-efficiency-purchase-policy/>

<sup>19</sup> <https://www.volvogroup.com/en/news-and-media/news/2022/oct/miami-dade-county-executives-introduce-the-mack--lr-electric-mod.html>

<sup>20</sup> <https://www.volvotrucks.com/en-en/trucks/alternative-fuels/electric-trucks.html>

<sup>21</sup> [https://www.miamidade.gov/global/news-item.page?Mduid\\_news=news1660655844469764](https://www.miamidade.gov/global/news-item.page?Mduid_news=news1660655844469764)

#### 4.1.3. Electric Charging Infrastructure

To continue the growth of EVs in Florida, the required infrastructure must be present and maintained. In 2020, Governor Ron DeSantis signed Senate Bill 7018 to enact Florida Statute 339.287.<sup>22</sup> The statute is titled “*Electric vehicle charging stations; infrastructure plan development*” and requires FDOT to coordinate, develop, and recommend a Master Plan for EV charging infrastructure along the State Highway System (SHS). As a response, FDOT coordinated with the Florida Department of Environmental Protection (DEP), the Florida Public Service Commission, and other agencies to develop the Electric Vehicle Infrastructure Master Plan (EVMP).

The EVMP supports the Florida Transportation Plan (FTP) by supporting EV infrastructure developments across the state and fosters economic development in return. The primary objectives of the EVMP are:

- **Support** short-range, long-range, and emergency evacuation travel in Florida
- **Adapt** current highway infrastructure to adapt to market demands
- **Ensure** the availability of necessary infrastructure such as reliable charging stations

Florida also developed the 2020 Florida Electric Vehicle Roadmap.<sup>23</sup> This document is the first comprehensive study of the status and needs of EV charging infrastructure throughout Florida for the next three to four years. The goals of the Roadmap are to:

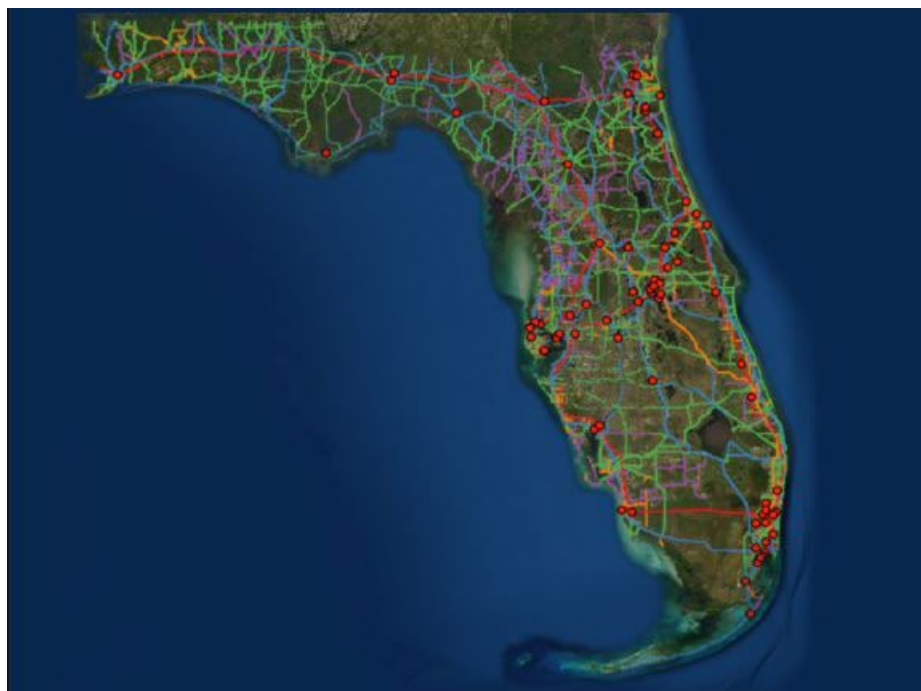
- Identify any impacts EV charging infrastructure may have on the electric grid
- Identify solutions to respond to negative impacts
- Locate gaps in EV charging infrastructure
- Identify best practices for placing charging stations
- Identify any regulatory or technical barriers blocking the expansion of EV charging infrastructure

According to the Florida EV Roadmap, there is a common misconception that Florida lacks sufficient EV charging infrastructure. Findings from this document show that there are enough DC Fast Chargers (DCFC) to meet charging demands until 2025 and enough level 2 chargers to meet needs for the next 10 years. The problem is that there are noticeable gaps in distribution and some counties require additional infrastructure to meet the needs of EV drivers. The Florida EV Roadmap also stresses the importance of adding additional EV charging infrastructure to evacuation routes for Floridians seeking refuge during natural and manmade disasters.

---

<sup>22</sup> [https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/planning/fto/evmp-status.pdf?sfvrsn=ac348cf4\\_8](https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/planning/fto/evmp-status.pdf?sfvrsn=ac348cf4_8)

<sup>23</sup> [https://www.fdacs.gov/ezs3download/download/95682/2638040/Media/Files/Energy-Files/EV-Roadmap-Report/EV\\_ROADMAP\\_REPORT\\_2020.pdf](https://www.fdacs.gov/ezs3download/download/95682/2638040/Media/Files/Energy-Files/EV-Roadmap-Report/EV_ROADMAP_REPORT_2020.pdf)



Source: EV Roadmap Report, 2020

Figure 3: June 2020, Fast charge network

As the number of personal EVs increases, so does the need for electric charging infrastructure. A reliable network is necessary to meet the needs of drivers. A reliable network may encourage prospective buyers to purchase their own personal EV vehicles. However, too many EV charging stations may lead to underutilization. To achieve balance, demands must be estimated through EV sales forecasts. The Roadmap uses the tool EVI-Pro Lite to tabulate the forecasts for workplace level 2, public level 2, and public DCFC charger plugs. The resulting projections are for the years 2021 through 2030. The results for MDC are as follows:

Table 1: EV Charging Forecasts

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
<b>Public Level 2</b>										
	26	29	34	44	57	61	63	66	70	75
<b>Workplace Level 2</b>										
	27	31	38	52	72	77	81	85	90	96
<b>DCFC</b>										
	58	62	70	86	108	113	118	123	130	139

Source: EV Roadmap Report, 2020

MDC has the highest electric vehicle charging projections over all the other counties in Florida.

Large-scale EFV charging stations are less available throughout the country. The National Renewable Energy Laboratory (NREL) through the US Department of Energy is currently coordinating and



conducting research on medium and heavy-duty electric vehicle charging.<sup>24</sup> The goal is to create effective charging stations to charge large vehicles in less than 30 minutes at a reasonable cost.

## 4.2. Public Transit

Even with an increased supply of personal AFVs, not all residents in MDC are able to afford them. Almost half of the county's 900,000 households have zero or limited access to a car.<sup>25</sup> Public transit is an important mode of transportation for the community. Additionally, a higher public transit ridership can reduce GHG emission rates due to fewer single occupancy vehicles on the road.

MDC's Department of Transportation and Public Works (DTPW) manages the mass transit system, which includes the Metrobus, Metrorail, Metromover, and Special Transportation Service. The Transit Development Plan for the fiscal year 2022 – 2031 identified that DTPW had an active fleet of 767 buses.<sup>26</sup> Of those, 137 were Diesel Hybrid Electric, 420 were Compressed Natural Gas (CNG), and 210 were diesel. Within the previous few years, DTPW has replaced nearly three quarters of its fleet with alternative fuel vehicles. Metrorail and Metromover both operate on an electric rail. Electrification is focused on MDC's heavy-duty and light-duty vehicle fleets.

### 4.2.1. Transit System Vehicles

MDC operates both heavy-duty and light-duty vehicle fleets. The Metrobus bus fleet and the garbage collection fleet are examples of heavy-duty fleet vehicles that include both Compressed Natural Gas (CNG) and battery electric technologies. Completed in 2020, the Office of the Commission Auditor (OCA) produced a report titled Analysis of Energy Alternatives Powering Heavy Fleet. It demonstrated a technical understanding of CNG, its source, and environmental advantages and disadvantages.<sup>27</sup> During the research, the OCA reviewed other alternative energy technologies that could power both public entity and corporate heavy fleets as well as various US jurisdictions' electrification goals.

There were three approaches to the study:

1. Identify the most cost-effective bus type through a Net Present Value (NVP) analysis
2. Quantify the total cost by main expenses for each considered bus type
3. Project MDC's total cost under two scenarios throughout a 12-year timeframe (2020 through 2032).

The study concluded that there are energy alternatives to CNG available. CNG promotes lower GHG emissions and has lower energy costs when compared to a diesel gallon equivalent, but clean diesel and fully electric offer both transitional fuel and long-term alternatives. A well-designed implementation strategy is required to avoid overinvesting in infrastructure and fleets. Overinvesting could produce a financial strain on the long-term goals of achieving a fully electric-powered fleet.

---

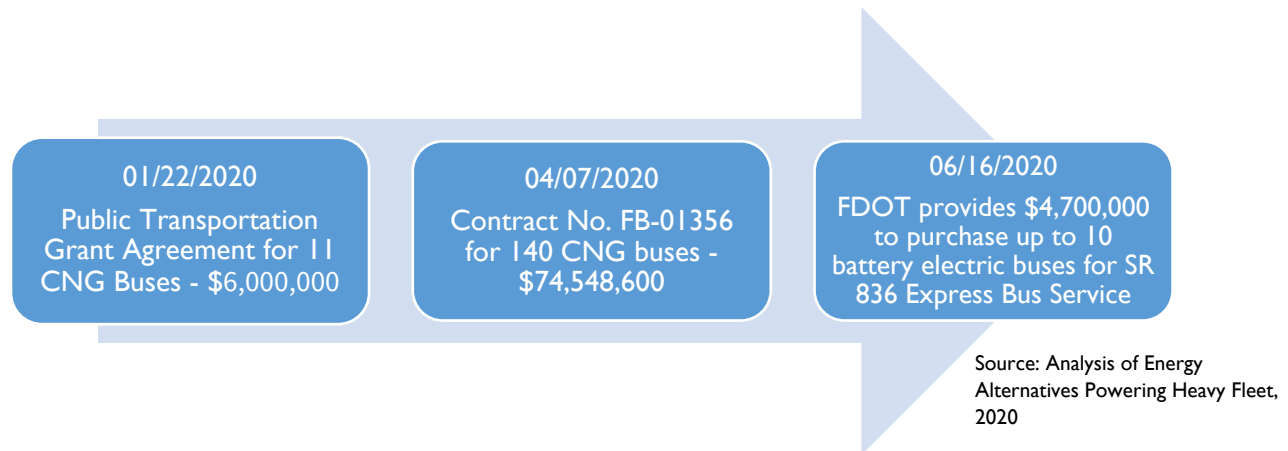
<sup>24</sup> <https://www.nrel.gov/transportation/medium-heavy-duty-vehicle-charging.html>

<sup>25</sup> <https://www.miamidade.gov/green/library/climate-action-strategy-final-draft.pdf>

<sup>26</sup> <https://www.miamidade.gov/transit/library/transit-development-plan-annual-report.pdf>

<sup>27</sup> <https://www.miamidade.gov/auditor/library/2020-analysis-of-energy-report.pdf>

MDC implemented CNG and battery electric technology into their fleets. The 2020 timeline flows as follows:



The County also adopted new technologies and policies for its vehicles. Idle reduction was implemented to save on fuel costs, diminish pollution and GHG emissions, and reduce engine wear. Adding global positioning systems, or GPS, to vehicles ensures drivers take the most efficient routes and lessen fuel usage. Installing vehicle telematics helps with onboard communication services and applications and their communications with GPS receivers or other devices. Telematics can promote efficient driving, reduce idling, lower carbon dioxide emissions, and give optimal route guidance. By adopting changes, a 44 percent reduction has been seen in emissions from the heavy-duty fleet.

In April 2020, MDC Mayor Levine Cava directed the county to take additional steps in reducing GHG on the County's path to net zero by adopting a fuel efficiency purchase policy and electrifying their light-duty fleet.<sup>28</sup> Light-duty vehicles include cars, vans, and up to ¾ ton pickups. This directive requires that light-duty vehicles purchased during FY 2021-22 must achieve the Environmental Protection Agency's (EPA) miles per gallon (MPG) standard of 40 mpg. In addition, the director establishes a 2030 goal of a full, battery electric fleet. During 2021-22, 10 percent of each Department's light fleet purchases must be battery electric. This percentage will increase by 10 percent or more each year until the final goal is met. If 10 percent increases are required every year, the Department's light fleet may be completely battery electric by 2032.

<sup>28</sup> <https://southeastfloridacclimatecompact.org/news/miami-dade-county-commits-to-fleet-electrification-by-2030-and-establishes-a-fleet-fuel-efficiency-purchase-policy/>

## 4.2.2. Re-Fueling Infrastructure

Florida has a total of 8,195 alternative fuel stations.<sup>29</sup> Table 2 summarizes the different available stations across the state.<sup>30</sup>

Table 2 - Florida Alternative Fuel Stations

Fuel	Public	Private
<b>Biodiesel (B20 and above)</b>	0	5
<b>Compressed Natural Gas (CNG)</b>	25	31
<b>Electric (EVSE Ports)</b>	6,970	892
<b>Ethanol (E85)</b>	139	5
<b>Hydrogen</b>	0	0
<b>Liquefied Natural Gas (LNG)</b>	2	1
<b>Propane (LPG)</b>	117	8
<b>Renewable Diesel (R20 and above)</b>	0	0

Source: Alternative Fuels Data Center

MDC has the presence of various types of alternative fuel refueling infrastructure, but it should expand into other specific fuel types such as biodiesel, hydrogen, compressed natural gas, liquefied natural gas, propane, and renewable diesel. There are either a couple or none of these types within the County. For example, Miami has one compressed natural gas refueling center at the Love's Trillium - Miami-Dade County Metrobus station.<sup>31</sup> MDC has various electric charging stations, but they tend to cluster around the most populated areas in the County such as Downtown Miami, Brickell, Miami Beach, Doral, and Coral Gables.

## 4.3. Micromobility

### 4.3.1. Micromobility Growth and Options

Micromobility has become a popular and reliable transportation option for last mile connectivity in various cities in the US. The Federal Highway Administration (FHWA) defines Micromobility as the usage of any small, low-speed human- or electric-powered vehicle.<sup>32</sup> These vehicles include electric scooters (e-scooters), electric-assist bicycles, bicycles, scooters, and other small, lightweight conveyances. People rent bicycles and e-scooters, via self-service rental programs to transport themselves quickly within a city or town. Popular micromobility rental providers include Lime, Bird, Bolt Mobility, Helbiz, and Freebee.

As of August 2020, there were over 260 shared micromobility systems. These include docked and dockless bike share and e-scooter systems. According to an FHWA and the National Association of City Transportation Officials (NACTO) report, over 136 million trips were taken in 2019 on micromobility systems.<sup>33</sup> As the industry was just in its infancy, ridership began to decline. There was a sharp, 48

<sup>29</sup> <https://afdc.energy.gov/stations/#/find/nearest?fuel=ELEC>

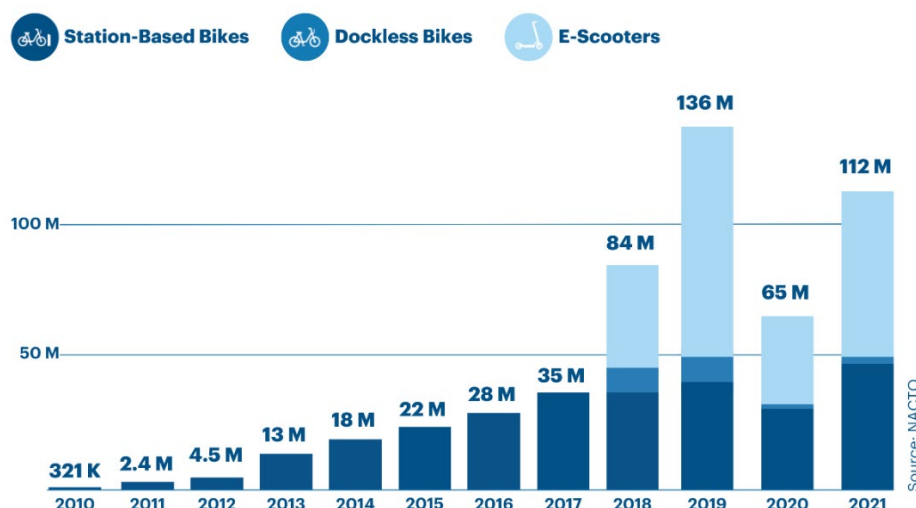
<sup>30</sup> <https://afdc.energy.gov/states/fl>

<sup>31</sup> <https://www.energy.gov/alternative-fuel-vehicles#/find/nearest?country=US&fuel=CNG>

<sup>32</sup> <https://highways.dot.gov/public-roads/spring-2021/02>

<sup>33</sup> <https://nacto.org/shared-micromobility-2020-2021/>

percent decline in 2020 due to the COVID-19 pandemic seeing only 65 million trips. The following year, trips rebounded back up to 112 million trips.



Since the introduction of the country's first bike share system in 2010, people in the U.S. have taken half a billion trips total on shared micromobility

Source: NACTO

Figure 4 - Shared Micromobility Ridership in the U.S. from 2010-2021

Micromobility devices can also be independently owned, but most rides are due to private companies deploying their fleets in targeted service areas. The intention of use is for short trips that act as first and last-mile connections to complete trips that begin via other transportation modes. Fleets are usually stationed in the public right-of-way either on a dock (such as e-bicycles) or as dockless devices (such as e-scooters). Users unlock the vehicle through a mobile phone application on their personal smartphones or by using a key fob. Payment is usually made through the mobile phone application once the ride is complete. MDC provides a free micromobility service called Freebee.<sup>34</sup> Freebee acts as an on-demand shuttle service, within select parts of the county, that can be ordered via an app or when you see one driving by. The vehicles are 100% electric and emission-free. The service was recently implemented, and hopes to improve public transportation and micromobility ridership.

MDC has worked on expanding the availability and improving the safety of micromobility transit options. In 2020, the City of Miami approved a pilot program that allowed nine private operators to offer e-scooter rentals within the city and surrounding neighborhoods.<sup>35</sup> Residents and visitors gained access to the e-scooters for the first time. The pilot program allowed city officials to study the effectiveness of the e-scooters as part of an overall transportation and mobility program. In 2020 the COVID-19 virus caused MDC Mayor Carlos Jimenez to ban citizens from operating any micromobility vehicles.<sup>36</sup> The rationale was that the shared fleets were not routinely cleaned and may have aided in spreading the virus.

<sup>34</sup> <https://ridefreebee.com/>

<sup>35</sup> <https://www.miamigov.com/Transportation-Roadways/Miami-Scooter-Pilot-Program>

<sup>36</sup> <https://www.miamidade.gov/releases/2020-03-18-COVID-scooters-prohibited.asp>

### 4.3.2. Electric Charging Infrastructure

MDC has been developing a micromobility network for short distance travelers. Dedicated micromobility networks provide various shared mobility options, improve community connectivity, and prioritize pedestrian and bicyclist safety.<sup>37</sup> By transforming existing corridors with traditional street designs into more Complete Streets, micromobility networks are created. MDC has been working on the first section of its micromobility network in the heart of Downtown Miami. The DTPW partnered with the City of Miami and the Downtown Development Authority to construct separated bicycle and scooter lanes in Downtown Miami.<sup>38</sup> The purpose is to advance towards safer streets and prioritize the Vision Zero and Complete Streets Programs. As part of the project, DTPW will improve high-visibility pedestrian crosswalks and signage, new ADA ramps, reparations of concrete sidewalks and manholes, build separate green bicycle lanes, and install separation elements (planters, armadillos, concrete stoppers, delineators, and more). Below is a map of the existing bicycle lanes and the Micromobility Network.



Figure 5 - Existing Bicycle Lanes and Proposed Micromobility Network

<sup>37</sup> <https://www.miamidade.gov/global/transportation/micromobility-networks.page>

<sup>38</sup> <https://www.miamidade.gov/transit/library/downtown-micromobility-fact-sheet.pdf>

Once this portion of the project is completed, the Downtown Miami Micromobility Network would have added a total of five miles of dedicated bicycle lanes. The goal of this plan is to keep building and expanding the network across the whole County.

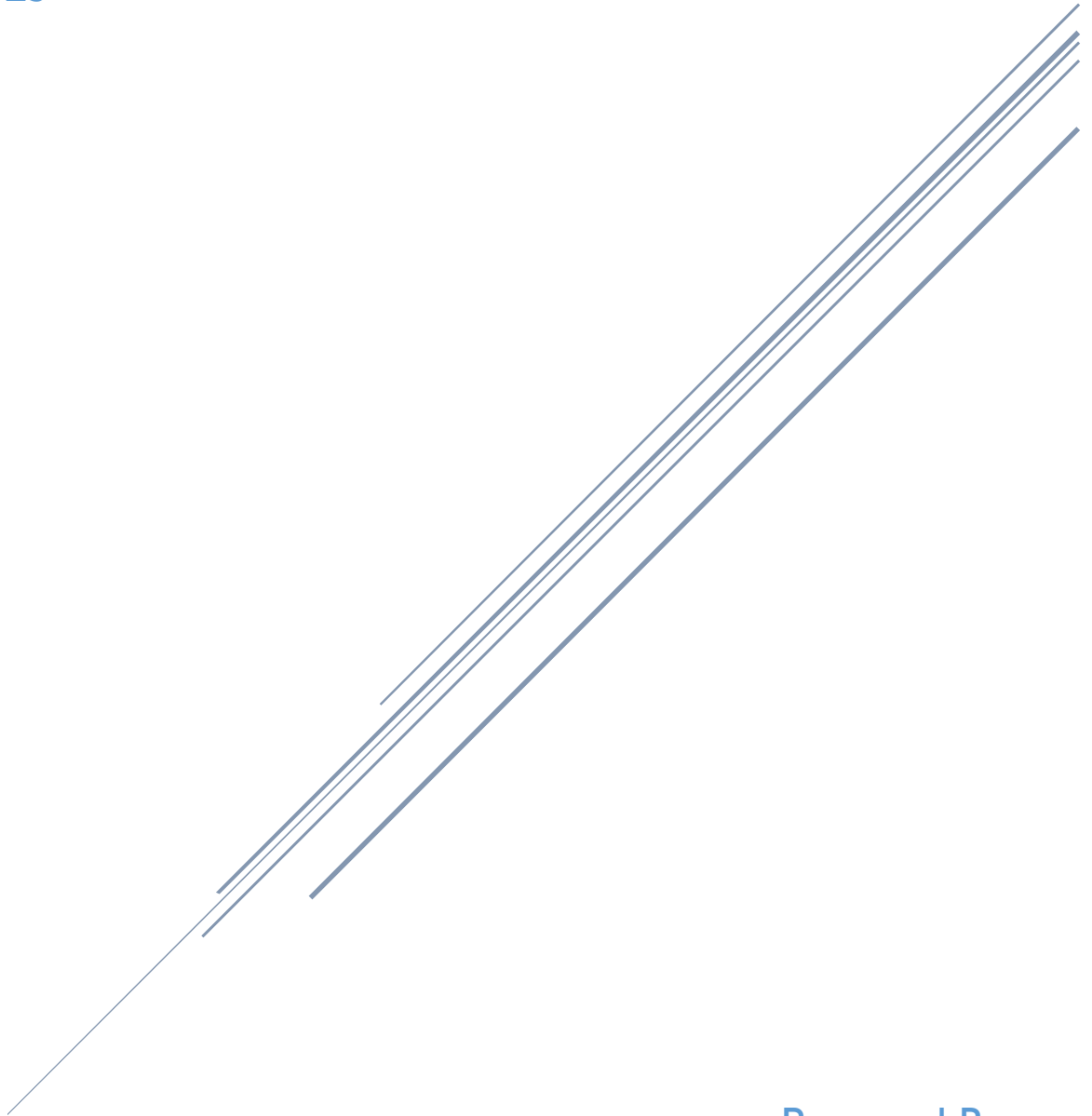


## 5. Concluding Results

Improving electric (and other alternative energy) vehicle access is a vital step in reducing GHG emissions. MDC and other Counties and States need to draft, approve, and implement policies to reach reduction goals. Outside of politics, transportation companies need to advance their technology and develop more personal AFVs, electric or hybrid freight trucks, and alternative fuel transit. It is also important to continue promoting public transportation and micromobility options to reduce the number of vehicles on the road. Trends have shown an increase in interest and purchases of electric vehicles. MDC should invest resources into creating more AFV infrastructure to support growth comfortably. Without proper infrastructure, AFV vehicle growth cannot be sustained and future emission goals will not be met. By investing in clean energy, MDC will be on track to reaching their carbon neutral goal by 2050.

# CONNECTED AUTONOMOUS VEHICLES AND ALTERNATIVE FUELS STRATEGIC PLAN

Technical Memo #4  
June 2023



Prepared By:  
TranSystems

## Table of Contents

1.	Introduction .....	1
2.	Cohesive Countywide Approach.....	2
3.	Long-Range Transportation Planning.....	3
3.1.	Alternative Fuel and Connected-Autonomous Vehicles .....	3
3.2.	CAV and AFV Market Demands .....	6
3.3.	Other Infrastructure Needs.....	8
3.3.1.	Rail (Passenger and Freight) Investments .....	8
3.3.2.	Green Infrastructure .....	9
3.3.3.	Multimodal Transportation Investments.....	10
3.3.4.	Renewable Energy.....	10
4.	Capital Investment Strategies.....	11
5.	Research and Development.....	13
6.	Regulation.....	14
7.	Communications.....	16
8.	Conclusion .....	18

## 1. Introduction

Alternative fuel and autonomous vehicles provide a crucial transportation opportunity within Miami-Dade County (MDC). As county, state, and federal mandates push for reduced transportation emissions, increasing alternative energy vehicle usage is the vision of the future. Connected autonomous vehicles (CAV) and alternative fuel vehicles (AFV) are all advancements in transportation that reduce or eliminate the distribution of greenhouse gases into the atmosphere. CAVs are vehicles embedded with technology that either partially replace or fully replace a human driver. These vehicles have the potential to control acceleration, braking, and steering. Fully automated vehicles are not expected to be available to the public before 2030.<sup>1</sup> AFVs are vehicles that run on various fuels such as biodiesel, electricity, ethanol, hydrogen, natural gas, propane, and renewable diesel. There are also emerging fuels under development including biobutanol, dimethyl ether, methanol, and renewable hydrocarbon biofuels.<sup>2</sup>

Technical Memo #4 provides the Miami-Dade Transportation Planning Organization (MDTPO) with relevant recommendations, strategies, timelines, and collaborators that will aid in the further implementation of CAV and alternative fuel vehicle technologies into MDC policies. These findings address the following categories:

- Working with public and private stakeholders to build a cohesive MDC approach for CAVs and AFVs
- Guidance for the 2050 Long Range Transportation Plan (LRTP) to include CAV and AFVs
- Capital investment strategies for CAVs and AFVs
- Research and development opportunities that address CAV and AFV challenges
- Potential regulations that could advance CAVs and AFVs in MDTPO
- Communication strategies to engage public and private stakeholders

---

<sup>1</sup> <https://www.ferrovial.com/en-us/innovation/technologies/connected-autonomous-vehicles/>

<sup>2</sup> <https://afdc.energy.gov/fuels/emerging.html>

## 2. Cohesive Countywide Approach

A unified, countywide approach will be successful for CAV and AFV implementation when broad stakeholders are engaged throughout the County. MDTPO should foster and/or maintain relationships with the following public and private entities.

Private entities to further relationships with include:

- Aptiv (CAV, EV technology)
- Florida Power and Light Co.
- Freight/Trucking Industry
- Lucid Motors (CAVs, EVs)
- Miami Climate Alliance
- Multi-Family Apartments
- NIO (EVs)
- Nissan (EVs)
- OBE Power
- Railroad Operators
- Rivian (CAVs, EVs)
- Shopping malls/large retailers
- Tesla (charging infrastructure, EVs)
- Volvo (EVs)
- Zoox (CAVs)

A relationship with MDC electric companies, such as Florida Power and Light, is extremely important to ensure there are adequate energy sources for the transition to clean fuel vehicles. MDTPO should also collaborate with the following public entities:

### Government Entities

- City of Coral Gables
- City of Doral
- City of Miami
- City of North Bay Village
- Clean City Coalition
- Florida Chamber of Commerce
- Florida DOT
- South Florida Regional Planning Council (SFRPC)
- Town of Cutler Bay
- Town of Medley
- Treasure Coast Regional Planning Council (TCRPC)

- Village of Miami Shores
- Village of Palmetto Bay
- Village of Pinecrest

### Public sites

- Hospitals
- Libraries
- Parks (national, regional, local)

### Schools

- Florida International University
- Public and private high schools
- University of Florida
- University of Miami

Cultivating public relationships and input is important because residents are the primary users of the proposed CAV and AFV infrastructure. MDTPO should hold strategic visioning workshops with both public and private stakeholders to establish goals and a vision that the community supports. It is important to maintain continuous communication with public and private stakeholders to ensure coordinated efforts and aligned investments. MDTPO should continue to participate in the Southeast Florida Regional Compact to collaborate with other municipalities/subject matter experts and build additional climate resiliency.

### 3. Long-Range Transportation Planning

The MDTPO LRTP is a 25-year vision document that reflects the future of transportation within the County. The LRTP identifies the current and future needs of the transportation system. The most recently produced LRTP is the Miami-Dade 2045 Long Range Transportation Plan, published in September 2019. The 2050 LRTP is currently ongoing during the time of this writing.

#### 3.1. Alternative Fuel and Connected-Autonomous Vehicles

The 2045 MDTPO LRTP addresses emerging technologies, including electric vehicles/buses, CAVs/self-driving taxis, and smart roads. Smart roads provide innovative transportation systems management and operations (TSM&O), which can reduce congestion, improve safety, and provide infrastructure for CAVs and AFVs. The Strategic Miami Area Rapid Transit (SMART) Program's goal is to connect communities by enhancing the local rapid transit network to ensure that it is accessible, integrated, sustainable, efficient, reflects all community needs, and supports future generations.<sup>3</sup> Each of these initiatives can play into the success of CAV and AFV implementation. Continued coordination with stakeholders regarding ideas, concerns, and implementation processes is important to consider within the LRTP strategies.

The 2050 LRTP should continue to address CAVs and AFVs implementations with the following strategies:

- LRTP Strategy 1 - Assess existing infrastructure to meet CAV needs
- LRTP Strategy 2 - Improve transportation systems management and operations
- LRTP Strategy 3 - Determine CAV and AFV policies
- LRTP Strategy 4 - Invest in additional infrastructure to meet net zero emissions goals
- LRTP Strategy 5 - Explore alternative funding opportunities to account for the reduction in the gas tax and revenues

The Minnesota Department of Transportation (MnDOT) developed a CAV Strategic Plan to prepare agencies for emerging changes in transportation.<sup>4</sup> Early investments in CAV-compatible infrastructure set the County up for success when this technology becomes more readily available in the market. Initial investments allow for more cost-effective and efficient decision-making. The following actions may be completed with stakeholder coordination to ensure MDC is prepared for CAV technology implementation:

- LRTP Strategy 1 - Assess existing infrastructure to meet CAV needs
  - Review pavement markings to ensure visibly distinct markings for safe driving<sup>5</sup>
  - Confirm bridges and pavement are load bearing for future (freight) vehicle platooning
  - Review traffic signal equipment and traffic signal phasing/timing
  - Develop a network plan of roadways that can safely accommodate truck platooning

<sup>3</sup> <https://www.miamidade.gov/global/transportation/corridor-plans.page>

<sup>4</sup> <http://www.dot.state.mn.us/automated/strategicplan.html>

<sup>5</sup> <https://www.reflective-systems.com/future-proofing-road-markings/#:-:text=What%20are%20visibly%20distinct'%20markings,the%20minimum%20standards%20are%20enforced.>



- Complete a feasibility study to prioritize locations for the most cost-effective solutions

The 2021 Bipartisan Infrastructure Law (BIL) includes information on increasing EV charging. One of the main goals is to provide investments toward a connected network of over 500,000 EV charging stations across the nation. MDC aims to capitalize on this funding resource to improve the existing charging infrastructure. Capital investments will support roads, bridges, and public facility enhancements (such as rest stops) to grow CAV and AFV technologies. Investments should also include installing additional TSM&O to assist CAV and AFV users. The following actions may be used to improve TSM&O within MDC:

- L RTP Strategy 2 - Improve transportation systems management and operations
  - Program smart road projects, potentially along SMART Corridors
  - Continue research on emerging technology
  - Install innovative TSM&O equipment along key corridors

One vision for the MDTPO is to support alternative energy vehicle usage by improving policies that increase AFV infrastructure. The following policies may be implemented to prepare for CAV and AFV success:

- L RTP Strategy 3 – Determine CAV and AFV policies
  - Update County design standards to accommodate CAV technology
  - Reduce parking requirements, as increased CAV usage will likely decrease parking needs
  - Review the potential for electronic tolling and congestion pricing

MDC has multiple types of AFV refueling infrastructure, however, most existing charging infrastructure relates to the most used AFV type, electric. MDC has hundreds of compressed natural gas (CNG) buses, however, there is only one refueling center within the county. Filling this gap is a priority because MDC has a long-term objective to increase the percentage of fleets that use alternative fuels. According to the 2020 Miami Transit Development Plan, 74 percent of their fleet uses alternative fuels currently with the goal to eventually run 100 percent.<sup>6</sup> Additional infrastructure investments, such as the following, may be implemented to provide MDC the opportunity to meet net zero emissions goals:

- L RTP Strategy 4 – Invest in additional infrastructure to meet net zero emissions goals
  - Coordinate with and support increased passenger and freight rail service
  - Include green infrastructure within LRTP project design processes
  - Include multimodal (transit, micromobility, walkability, bike-ability, etc.) within the LRTP process selection process
  - Include renewable energy within the LRTP project design process

It is necessary to maintain existing roadways and construct new projects, even as gas tax revenues decrease. Gas taxes largely fund the construction and maintenance of MDC transportation infrastructure. In Florida, the gas tax is about \$0.35 per gallon.<sup>7</sup> The funding received from the gas tax will be impacted by AFV growth because of the decrease in gas consumption. According to Fehr and

<sup>6</sup> <https://www.miamidade.gov/transit/library/transit-development-plan-annual-report.pdf>

<sup>7</sup> <https://igentax.com/gas-tax-state-2/>

Peers, a transportation planning and engineering firm based in California, if EV numbers increase nationally, national gas tax proceeds may decline between 21 percent and 30 percent by 2035.<sup>8</sup> In 2022, gas tax funding decreased to about 38 percent of the nation's transportation revenue from 41 percent in 2018.<sup>9</sup> States must use innovative ideas to maintain revenue for infrastructure projects.

As of April 28, 2023, the Florida Senate has passed a legislation to initiate an electric vehicle tax.<sup>10</sup> This bill will impose additional license taxes on EVs and plug-in hybrid vehicles. The new fees become effective on July 1, 2023. In addition to the newly passed EV tax, other states have implemented the following to continue generating revenue as the gas tax revenue decreases:

- Implementing a tax at public charging stations. It costs money to charge your vehicle at some public charging stations. A minimal tax could be added based on a per-kilowatt-hour fee structure. Iowa, Kentucky, Pennsylvania, and Oklahoma have already incorporated these fees.<sup>13</sup>
- Raising the gas tax to encourage the transition to EV or other sustainable modes whilst still funding transportation infrastructure. Research completed by Sarah West and Robertson Williams in 2004 for the National Bureau of Economic Research found that by raising the gas tax, fuel consumption was lowered, pollution decreased, and folks had a reason to work more hours. Their research found that an increase in gas tax caused working hours to increase by 0.07 percent, or two hours per household per year, likely to be able to afford the increase in gas costs.<sup>11</sup> A negative outcome of raising the gas tax is that gas prices will inevitably rise.
- Increasing the price of tolls or introducing new tolls specifically for infrastructure funding. In December 2023, Michigan's Department of Transportation (MDOT) released a study about increasing toll rates to improve revenues. According to the study, by tolling 14 of the busiest limited-access highways between \$1.5 and \$2.8 billion in revenue will be gained.<sup>12</sup> Toll prices can rise with increased congestion, which can increase funds and decrease vehicles during peak hours.
- Implementing a pay-as-you-drive fee. In Oregon, residents with fuel-powered vehicles pay 38 cents per gallon in fuel tax at gas pumps.<sup>13</sup> Participants of OReGO are eligible to pay-per-mile (1.9 cents per mile) as opposed to paying the gas tax. The OReGO funds collected are used similarly to fuel tax revenue, which funds the construction, maintenance, and preservation of transportation infrastructure. Therefore, highway infrastructure funding is not reliant only on fuel consumption.

<sup>8</sup> <https://www.fehrandpeers.com/how-vehicle-electrification-affects-the-gas-tax/>

<sup>9</sup> <https://www.washingtonexaminer.com/restoring-america/courage-strength-optimism/states-eye-new-fees-and-tolls-to-replace-lost-gas-taxes-from-electric-vehicles>

<sup>10</sup> <https://www.flsenate.gov/Session/Bill/2023/1070>

<sup>11</sup> <https://www.nber.org/digest/jul04/effect-gasoline-taxes-work-effort>

<sup>12</sup> <https://www.americanprogress.org/article/tolls-on-state-highways-would-ease-gas-tax-shortfall/>

<sup>13</sup> <https://www.myorego.org/how-it-works/>

The following actions may be taken to continue receiving funding for transportation projects.

- **L RTP Strategy 5** - Explore alternative funding opportunities to account for the reduction in the gas tax and revenues
  - Evaluate adding a tax at public charging stations
  - Consider raising the gas tax to encourage the transition to AFVs
  - Test out congestion pricing along toll roads
  - Consider implementing a pay-as-you-drive fee

### 3.2.CAV and AFV Market Demands

Trends indicate there is a steady rise in the purchases of alternative fuel vehicles. As demand shifts from gasoline powered to alternative fuel vehicles, needs for roadway, technology, and charging infrastructure are changing. The success of CAVs and AFVs depends on the access to necessary infrastructure for future transportation advancements.

Several factors influence the AFV buyer's market. One factor is the lack of available charging locations outside of their homes. The BIL recognizes that not all EV owners or potential owners can reliably charge their vehicles at their homes, and this is a factor stopping potential owners from transitioning towards EVs. The National Electric Vehicle Infrastructure Program (NEVI) is estimated to provide FDOT with \$198 million over five years to improve EV charging throughout the state.<sup>14</sup> A corridor must be located along an Alternative Fuel Corridor (AFC) to be eligible for funding. Businesses within one mile of an AFC may also be eligible for NEVI funding.<sup>15</sup> AFCs were initially designated in 2015 through the Fixing America's Surface Transportation Act which required the U.S. Department of Transportation to designate national alternative fueling corridors.<sup>16</sup> The BIL updated the requirements, and new roads were nominated in the Fall of 2022. The national AFCs include EV, hydrogen, propane, CNG, and liquid natural gas (LNG) fueling areas. EV charging stations must be located roughly every 50 miles to provide an adequate range for gas tanks along AFCs. As of July 6, 2022, the FHWA has designated seven corridors within MDC as AFCs.<sup>17</sup> The existing MDC AFCs are shown in **Figure 1**. Future LRTPs will include AFCs within MDC to provide guidance for potential federal funding and identify alternative fuel charging priorities.

<sup>14</sup> <https://www.fdot.gov/planning/policy/ev/electric-vehicle-infrastructure-funding>

<sup>15</sup> <https://www.chargepoint.com/incentives/commercial?type=13&state=23>

<sup>16</sup> [https://www.fhwa.dot.gov/environment/alternative\\_fuel\\_corridors/nominations/afc\\_6\\_designation\\_memo.pdf](https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/nominations/afc_6_designation_memo.pdf)

<sup>17</sup> <https://www.miamidade.gov/govaction/legistarfiles/Matters/Y2022/222481.pdf>

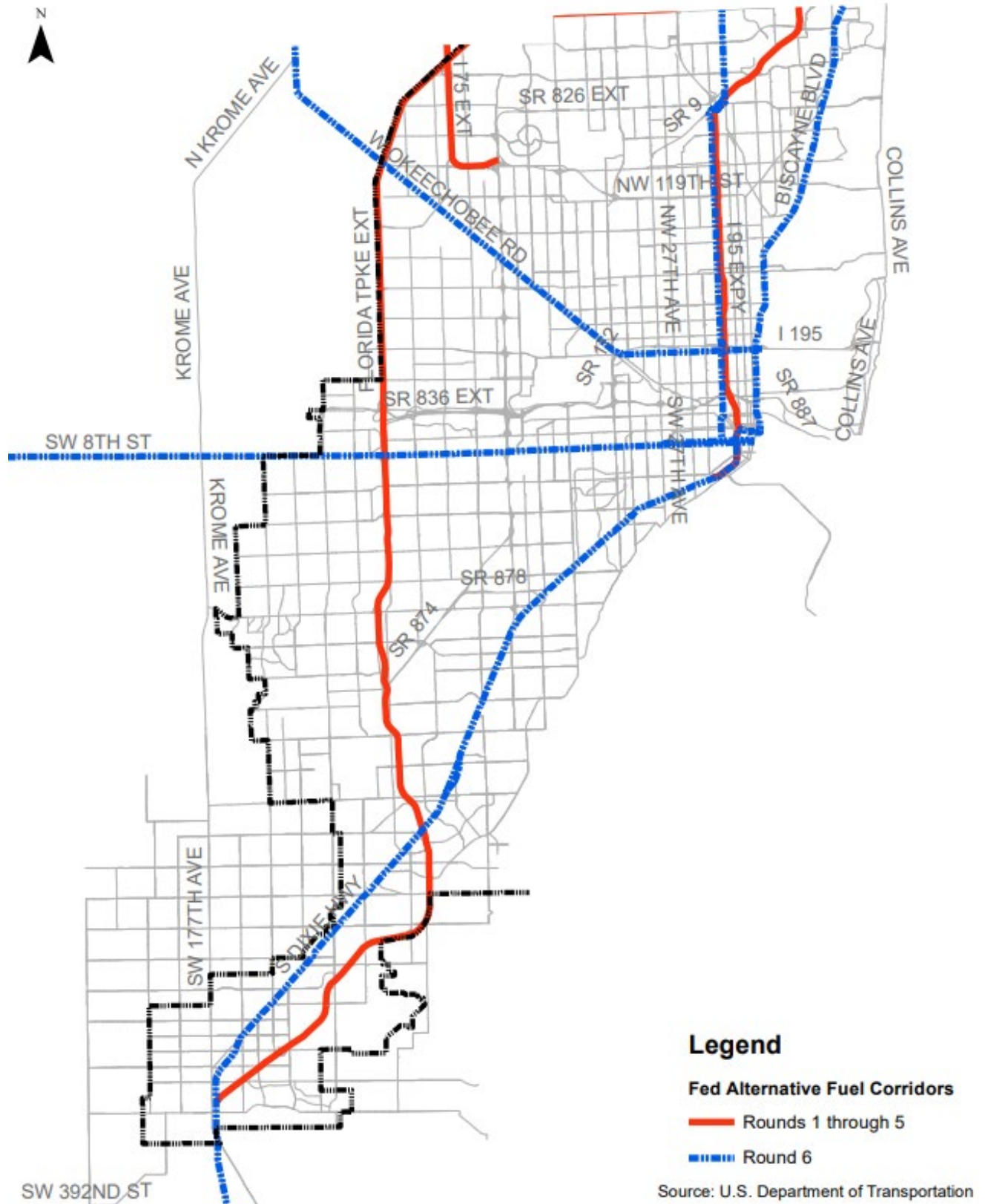


Figure 1: MDC Federally Approved AFCs, July 2022<sup>17</sup>

As more EV charging infrastructure is installed along AFCs, the travel demands will likely shift to those roadways. This can potentially increase volumes of traffic on roadways that may not have been as occupied before. Travel Demand Models (TDM) forecast long-range vehicular traffic on a transportation system based on travel patterns, demographics, and land use. TDMs include trip generation, trip distribution, mode choice, and trip assignment. MDTPO can additionally apply the Transportation Energy and Mobility Pathway Options Model (TEMPO) to its existing travel demand forecasting. TEMPO is a nationwide transportation demand model used to explore various transportation scenarios. TEMPO can distinguish opportunities for future and existing fuels while considering passenger and freight demands, new technology adoptions and vehicle ownership decisions, and refueling infrastructure. This model would allow MDTPO to model emerging trends and new possibilities such as CAV and AFV technology along AFCs. TEMPO models assist in better understanding radical transformations in transportation demands and their energy and emission impacts and facilitate the path to a net zero goal.

### 3.3. Other Infrastructure Needs

In addition to CAV and AFV implementation, long range planning efforts should also address additional infrastructure adjustments that will help to achieve net zero emissions. The following investments should be supplemented with the addition of CAVs and AFVs to decrease emissions. Additionally, they can provide short- and long-distance connections for CAV and AFV users. These include:

- Rail (Passenger and Freight) investments
- Green infrastructure
- Multimodal transportation investments
- Renewable energy

#### 3.3.1. Rail (Passenger and Freight) Investments

Passenger rail is an ideal form of transportation due to its efficiency and reduced environmental footprint. Rail trips have many benefits, including a reduction in the number of vehicular trips (less congestion and emissions), increased connectivity within the transit system, increased opportunity for economic development, and potential reduction in traffic incidents. It also provides better access for zero-car and low-income households. Passenger rail can include commuter and intercity passenger systems. Amtrak currently operates one long-distance/intercity route within the county: Silver Star. This service travels between Miami and New York. MDC also has one commuter train that runs along CSX tracks: Tri-Rail. This connects Miami, Broward, and Palm Beach Counties.

There are both public and private entities involved in passenger rail. The MDTPO SMART Program is advancing several rapid transit corridors, including Beach Corridor, East-West Corridor, North Corridor, Northeast Corridor, and South Dade TransitWay. The Locally Preferred Alternative (LPA) for the North Corridor is elevated rail and the Metromover is the LPA for the Beach Corridor. The Northeast corridor is another passenger rail corridor that will run between Miami and Aventura.<sup>18</sup> Full implementation of the SMART Program is necessary to meet the County's zero emission goal. Brightline is a privately

---

<sup>18</sup> <https://www.miamidade.gov/global/transportation/smart-plan-northeast-corridor.page>

owned passenger rail line that will run between Miami and Orlando. Initial services have started through the implementation of Brightline.

Railroads across the nation have evolved to provide efficient transportation solutions for both people and goods. Freight trains are one of the most fuel-efficient ways of moving freight, particularly along long distances. According to the Association of American Railroads, US freight railroads average moving one ton of freight nearly 500 miles per gallon of fuel.<sup>19</sup> Railroads also account for only 0.5 percent of total Greenhouse Gas (GHG) emissions in the U.S. and only 1.9 percent of transportation related GHG emissions.<sup>4</sup> Railroads also reduce highway congestion and its associated economic costs. A single freight train eliminates several hundred trucks. MDC is a hotspot for freight truck traffic due to its booming port, PortMiami, and a busy international airport, Miami International Airport. Both locations have access to railroads and could begin to rely on rail to move freight long distances rather than freight trucks. Long-haul freight trips that start/end within the county should be considered for rail to reduce emissions. MDC is near the end of a broader freight network, however, opportunities to transition freight from truck to rail should be considered as they arise.

### 3.3.2. Green Infrastructure

Green infrastructure implementation is a process to manage stormwater, reduce urban heat island effects, and improve air quality. Stormwater may contain trash, bacteria, and heavy metals; these pollutants are carried into storm sewers which empty into local waterways such as canals, lakes, and bays. Green infrastructure filters stormwater and absorbs larger volumes of water than traditional pavement, which reduces stormwater runoff. Green infrastructure also absorbs air pollutants and cools air temperature. Some examples of green infrastructure include:

- Rain gardens
- Bioswales
- Planter boxes
- Urban treescapes
- Permeable pavement
- Land conversation of natural areas (wetlands, forests, marshes, etc.)

Green infrastructure strategies are a cost-effective approach to improving MDC's resiliency to natural hazards by providing flood mitigation for critical infrastructure.<sup>20</sup> A downfall of green infrastructure is its increased maintenance costs, which contributes to its current lack of inclusion within projects. MDC may reduce upfront costs of green infrastructure by integrating it into planned projects, implementing projects at larger scales, and using incentive programs for businesses and residents.<sup>21</sup> MDTPO should select green infrastructure systems that capture the most runoff with the lowest long-term maintenance cost.

<sup>19</sup> <https://www.aar.org/wp-content/uploads/2020/06/AAR-Sustainability-Fact-Sheet.pdf>

<sup>20</sup> <https://www.epa.gov/green-infrastructure/green-infrastructure-cost-benefit-resources>

<sup>21</sup> <https://stormwater.wef.org/2015/12/real-cost-green-infrastructure/>



### 3.3.3. Multimodal Transportation Investments

Funding should be allocated towards long-term, environmentally friendly investments that improve access to and the availability of alternative forms of transportation and public safety. The results of investments can be tracked by economic studies to demonstrate project impacts. Some investments include:

- Continuous funding for electric and CNG busses to replace all existing diesel-ran busses
- Acquiring additional right-of-way (ROW) for future sidewalks, bike lanes, and other mobility infrastructure
- Initiating projects that improve neighborhood walkability, including changes through land use. Walkable neighborhoods may include quality footpaths, safety barriers, and complete streets that provide pedestrians with safe transportation options. Walkable communities are correlated with lower overall carbon emissions per capita than non-walkable communities<sup>22</sup>
- Improving multimodal safety, through additional bike lanes and other safety buffers, to encourage increased usage of alternative forms of transportation.
- Continued support for alternative fuel micromobility services such as electric scooters, electric bikes, and Freebee

Investments in walkable and bicycle-friendly paths, especially when connected to accessible public transportation, will reduce overall vehicular trips and transportation emissions. These improvements play a part in the transition to CAV and AFV, as a reduction in carbon emissions must also include a reduction in overall vehicle trips taken.

### 3.3.4. Renewable Energy

MDC uses large amounts of energy to power its infrastructure. Electricity production and transportation together account for about 90 percent of GHG emissions within the county.<sup>23</sup> Renewable energy can drastically decrease emissions. In October 2018, MDC conducted a solar feasibility study that evaluated the feasibility of solar energy generation and uses at county facilities. The results concluded that 238 facilities had sustainable roof areas for the solar panel systems. The County recognizes a switch to renewable energy needs to occur and has developed a long-term plan to make buildings as efficient as possible.<sup>24</sup> The first approach in the plan is to tackle existing buildings and retrofit them accordingly. The second approach is to expand renewable energy generation through utility investments. The third approach is to build ultra-low energy buildings by implementing energy-efficient tactics in the design phase to ensure progress from the get-go.

MDTPO should continue to encourage investments in the transition of renewable energy throughout the county. The MDC Transit Development Plan has outlined goals to provide transit services that reduce environmental impacts. One objective is to incorporate solar panels on DTPW facilities. A study will assess the potential of installing solar panels on DTPW-owned facilities, and MDC will investigate partnering with utility companies and solar advocacy groups to install solar panels. In addition to solar,

<sup>22</sup> <https://www.frontiersin.org/articles/10.3389/fbuil.2021.721218/full>

<sup>23</sup> <https://www.miamidade.gov/global/economy/resilience/energy.page>

<sup>24</sup> <https://www.miamidade.gov/global/economy/resilience/climate-strategy/energy-buildings.page>

the county should invest in research into other innovative types of renewable energy, such as biomass and wind energy. Biomass energy, which is derived from plant and algae-based materials, is a versatile renewable energy source that can be converted into fuels for cars, trucks, airplanes, and ships.<sup>25</sup> The two most used biofuels are ethanol and biodiesel. The Netherlands is using wind energy derived from turbines to power their railway network which serves close to 1.2 million riders each day.<sup>26</sup> Electricity generated from wind turbines accounted for half the traction power used to run the railway network. As of 2017, the Netherlands' national train company, Dutch Railways, became the world's first railway company to fully operate on wind-produced energy.<sup>27</sup>

## 4. Capital Investment Strategies

Capital investments ensure that MDC has a functional and sustainable transportation system that benefits everyone. Having a well-connected network reduces distances traveled, increases route options to diminish congestion, and facilitates walking and micromobility options. MDTPO should complete the following to ensure the adequate ability for CAV and AFV transportation availability within the county:

- CIS Strategy 1 – Coordinate with owners and operators of capital to establish a Capital Investment Strategy (CIS) within MDC
- CIS Strategy 2 – Maintain a good state of repair on transportation facilities
- CIS Strategy 3 – Scope land for potential renewable energy sources near AFC and EV charging stations

MDTPO should coordinate with owners and operators of capital to establish a Capital Investment Strategy (CIS) to implement alternative energy sources. When working with other municipalities on Capital Investment Strategies, such as FDOT, MDC, or private partners, MDTPO should prioritize infrastructure for CAVs and AFVs. The following actions may be completed with the assistance of MDC capital owners.

- CIS Strategy 1 – Coordinate with owners and operators of capital to establish a CIS within MDC
  - Conduct a gap analysis of AFV charging/fueling stations
  - Conduct a gap analysis for CAV TSM&O equipment
  - Continue monitoring EV registrations annually within MDC

The gap analyses may include some of these research areas:

- Gaps in the number/location of public and private charging stations
- Existing and future AFV user demand
- Distances between charging stations
- Rest area locations with charging stations
- Amount of AFV charging along key corridors, such as evacuation routes
- Energy source availability

<sup>25</sup> <https://www.energy.gov/eere/bioenergy/bioenergy-basics>

<sup>26</sup> <https://intrans.iastate.edu/news/this-will-blow-you-away-wind-energy/>

<sup>27</sup> <https://www.senseandsustainability.net/2018/02/22/dutch-trains-powered-by-100-wind-energy/>

- Comparison of the number of existing charging stations versus the number of necessary charging stations according to projections
- Identification of locations that can host new charging stations
- Negotiation procedures for public and private partnerships and lease/utility agreements
- Designs and construction plans for new infrastructure
- Locations of existing CAV TSM&O
- Existing and future CAV user demand
- Corridors that could accommodate CAVs
- Necessary TSM&O equipment to handle CAV demand projections

CAVs and AFVs operate best along routes with adequate charging facilities and good repair infrastructure (no potholes, legible pavement markings, etc.). The existing infrastructure assessment will provide the groundwork to maintain transportation infrastructure. The following types of infrastructure should be prioritized for CAVs and AFVs:

- CIS Strategy 2 – Maintain a good state of repair on transportation facilities
  - Maintain visible pavement markings
  - Maintain pavement conditions along roadways and bridges
  - Maintain AFV charging/fueling facilities

MDTPO will likely not own or operate AFC or EV charging. However, investments in land could advance renewable energy sources. The following actions should be considered to ensure adequate energy along key corridors:

- CIS Strategy 3 - Scope land for potential renewable energy sources near AF and EV charging stations
  - Acquire additional right-of-way (ROW)
  - Consider utilizing land banks for solar farms
  - Partner with utility companies

Additional investments, that work together with AFVs, CAVs, and charging infrastructure, that prioritize sustainability and safety include:

- Transit-oriented development (TODs) along SMART Program corridors. TODs create dense, connected communities that support alternative forms of sustainable travel.
- Green Urbanism techniques. Green Urbanism promotes safety, sustainability, green spaces, and green infrastructure within neighborhoods.
- Development along AFCs. This would provide new economic and market opportunities to the county in areas with plentiful charging infrastructure to improve public accessibility.

## 5. Research and Development

CAV and AFV technology is constantly changing. MDTPO should plan ahead to understand new technological advancements and the challenges it brings. The following strategies should be implemented to ensure MDTPO is consistently ahead of the curve on CAV and AFV research and development (R&D):

- R&D Strategy 1 - Explore grant opportunities for research development
- R&D Strategy 2 - Maintain relationships with Florida educational institutions and think tanks to monitor technological advancements
- R&D Strategy 3 - Utilize CAV testing institutions that are or will be established

MDTPO can partner with research experts to stay on top of new technology. CAV and AFV technology can be effectively implemented more quickly within the county after testing has been completed. One way to stay on top of cutting-edge technology advancements is to utilize State and Federal funding opportunities. The following actions can be implemented to catalyze grant opportunities:

- R&D Strategy 1 - Explore grant opportunities for research development
  - Regularly check federal grant opportunities for research funding
  - Determine strategic partners for grant applications
  - Identify additional research topics to explore that are high priorities

Florida is a national leader in climate action, technology advances, and research. MDTPO should capitalize on expert knowledge within the state to understand upcoming CAV and AFV innovations and challenges. Informational sessions for MDTPO staff will allow them to stay on top of ever-changing regulations and work to mitigate common challenges. The following actions should continue to be pursued to provide educational outlets and networking opportunities.

- R&D Strategy 2 - Maintain relationships with Florida educational institutions and think tanks to monitor technological advancements
  - Schedule bi-yearly meetings with education institutions to be updated on technological advancements
  - Schedule bi-yearly meetings with think tanks to be updated on technological advancements
  - Attend conferences and seminars to learn about CAV and AFV technology.

In addition to education, MDTPO should advance relationships with existing institutions working on CAV testing. SunTrax, within FDOT District 1, is a testing facility for emerging transportation technologies. The track includes a mix of high-speed and residential roadways to provide a mixture of roadway characteristics. MDTPO should use the following actions to learn more about CAV testing:

- R&D Strategy 3 - Utilize CAV testing institutions that are or will be established
  - Develop or maintain a relationship with SunTrax in FDOT District 1
  - Determine corridor/route for autonomous vehicle testing
  - Conduct a feasibility study on developing a CAV testing institution

## 6. Regulation

Various regulations exist across Florida to test and implement electric and alternative energy. Florida Statutes 163.3177 and 403.973 encourage alternative fuel for economic development. Landowners can apply to amend local government comprehensive plans to expand the existing use of rural agricultural industrial centers to include biomass material preparation facilities to be used to produce fuel, bioenergy, renewable energy, or alternative fuels for economic development.<sup>28</sup> MDTPO should follow the regulations under Florida Statute 286.29, which states:<sup>9</sup>

- When acquiring new vehicles under a state purchasing plan, all fleets must select vehicles with the greatest fuel efficiency available for a given class (with exceptions for emergency response vehicles).
- All state agencies must use ethanol or biodiesel-blended fuels, when available.
- Ethanol and biodiesel fuels must be purchased by state agencies administering central fueling to use in their fleet as much as possible.

Florida Statute 206.874, Excise Tax Exemption for Biodiesel Produced by Schools, details a state incentive related to biodiesel laws and regulations. It states that public or private secondary schools that create their own biodiesel are exempt from the diesel fuel excise tax and associated registration requirements. Schools must produce less than 1,000 gallons of fuel and fuel can only be used by the school, employees, or students.

Florida has 15 laws, 12 utility or private incentives, and four state incentives regarding alternative fuels and vehicles.<sup>29</sup> Florida Statutes 163.08, EV Charging Station Financing Authorization, allows local governments to offer funding to property owners to assist with financing EV charging station installations on their property. Some Florida cities offer private incentives. The Orlando Utilities Commission offers an EV rebate, an EV leasing program, and an EV incentive for local dealerships. Brickell Energy, based in Miami, has charging station incentives. As of 2019, Ordinance No. 19-17 requires electric vehicle supply equipment (EVSE-Ready infrastructure) to be included as part of the parking requirements for new construction within MDC.<sup>30</sup> The minimum number of spaces is determined based on the amount of off-street parking spaces at each location.

Florida also has enacted several legislations regarding CAV technology.<sup>31</sup> Florida has been at the forefront of autonomous legislation. Some notable existing legislations include:

- HB 311 (2019) authorizes the Florida Turnpike Enterprise (FTE) to fund, construct, and operate facilities for the advancement of autonomous and connected technology to improve safety and decrease congestion.
- SB 2500 (2019) appropriated \$2.5 million to the Tampa Bay Regional Transit Authority, with \$1 million set aside to study and develop innovative transit options, including smart city innovations and autonomous vehicle services.

<sup>28</sup> <https://afdc.energy.gov/fuels/laws/BIOD?state=fl>

<sup>29</sup> <https://afdc.energy.gov/laws/all?state=FL>

<sup>30</sup> <https://www.miamidade.gov/govaction/legistarfiles/Matters/Y2022/221292.pdf>

<sup>31</sup> <https://www.ncsl.org/transportation/autonomous-vehicles>

- SB 7068 (2019) created a multi-use corridor of regional economic significance program within the Department of Transportation (DOT) to advance the construction of multimodal transportation. This includes autonomous, connected, shared, and electric vehicle technology.

In addition to these existing Florida regulations, MDTPO should use the following strategies to build upon CAV and AFV regulations:

- Regulation 1 - Establish a corridor-specific area where CAVs can be tested during low volume traffic periods.
- Regulation 2 - Develop liability regulations that assign responsibility of fault to users of CAVs
- Regulation 3 - Consider establishing a countywide emissions testing

Research on CAVs is still needed; however, appropriate regulations need to be in place to allow for CAV testing. MDTPO should work to determine county locations where CAVs may be tested within a safe environment. This includes:

- Regulation 1 - Establish a corridor-specific area where CAVs can be tested during low volume traffic periods.
  - Create a list of potential corridors.
  - Confirm the list with CAV stakeholders

MDTPO does not propose or spearhead any legislation within the state or county. However, they can research potential regulations that would enhance the transportation network and show support for any applicable bills. This may be completed with the following actions:

- Regulation 2 - Develop liability regulations that assign responsibility of fault to users of CAVs
  - Research existing regulations throughout the country
  - Work with legal counsel/lobbyists

Many states and cities around the country require a type of vehicle emission testing. Testing ranges from older vehicles to all new vehicle registrations. Testing can be helpful to understand overall vehicle emissions and reduce highly polluting vehicles from the roadway network. If testing is conducted within MDC, the energy production to charge AFVs should also be accounted for. MDPTO may also consider analyzing existing GHG emissions in the county and using the projection of GHG emissions to prioritize cost feasible long range transportation projects, as shown in the actions below.

- Regulation 3 - Consider establishing a countywide emissions testing
  - Determine the feasibility of vehicle emissions testing by evaluating potential pros and cons
  - Produce a countywide greenhouse gas inventory and forecast
  - Report GHG impacts of TIP projects and/or plan alternatives



## 7. Communications

The success of AFVs and CAV technology will rise as MDC continues to provide communication and education to residents and businesses. Public and private stakeholders need to be involved in the process to become familiar with the new technology and to provide feedback, support, and potential growth opportunities. The movement will require support from public users, government officials, transportation agencies, and private stakeholders (such as software developers, energy companies, and vehicle manufacturers). MDC is currently teaching others about the benefits of AFVs by participating in National Drive Electric Week.<sup>32</sup> In September of 2022, the Miami-Dade County Office of Resilience and the SFRPC hosted an event at a local park that allowed the public to drive and learn about EVs. Electric cars from Tesla and Rivian, scooters from Lime, and bicycles from Hellbiz were all available to test drive. There was also an MDC electric bus for people to board and experience. It is vital to educate people about AFVs to encourage more people to drive emission-free vehicles.

MDTPO may use the following communication strategies to ensure an effective, supported transition to CAVs and AFVs:

- Communication Strategy 1 - Meet with the institutional resiliency community members periodically
- Communication Strategy 2 - Meet with private industry to discuss where the public sector can invest to increase market demand
- Communication Strategy 3 - Develop a marketing campaign that will promote CAV/AFV within the region

The primary users of AFVs are residents, so the county should prioritize their feedback to ensure all perspectives are included in the transition. Meetings with private stakeholders should be held to create partnerships with MDC. For example, MDC and OBE Power, a local Miami startup, entered a partnership in 2021 that offered smart EV charging stations at parking facilities throughout the county. Public meetings can be held in neighborhoods across the county. The strategic plan can be presented so the public understands the environmental and economic benefits of transitioning to AFVs. Stakeholders involved in final decision-making processes should be in attendance to listen to public feedback. Efforts should be made to continue holding informational meetings that expose residents and government officials to CAV and AFV advancements. The following actions should be completed to engage both public and private stakeholders.

- Communication Strategy 1 - Meet with the institutional resiliency community members periodically
  - Occasionally meet with residents of MDC to discuss CAV and AFV countywide implementation processes
  - Schedule a quarterly meeting with resiliency experts within MDC
  - Assemble a team of MDTPO employees to conduct resiliency meet-ups (CAV and AFV Taskforces)

<sup>32</sup> [https://www.miamidade.gov/global/news-item.page?Mduid\\_news=news1663608710764488](https://www.miamidade.gov/global/news-item.page?Mduid_news=news1663608710764488)

- Communication Strategy 2 - Meet with private industry to discuss where the public sector can invest to increase market demand
  - Occasionally meet with private stakeholders of MDC to discuss CAV and AFV countywide implementation processes

To supplement meetings, MDTPO may choose to create advertisements to educate residents and business owners. The Florida Chamber of Commerce has put together an advocacy page for autonomous vehicles.<sup>33</sup> MDTPO could put together informational campaigns to inform people about CAV and AFV advancements within the county. This may be completed by the following actions:

- Communication Strategy 3 - Develop a marketing campaign that will promote CAV/AFV within the region
  - Use marketing strategies to create CAV and AFV advertisements geared toward public
  - Utilize social media to advertise CAV and AFV advancements within MDC
  - Distribute monthly newsletter on CAVs and AFVs

---

<sup>33</sup> <https://autonomous-florida.com/>

## 8. Conclusion

A global path towards the vision of net zero is necessary to mitigate the impacts brought forth by climate change. There are many obstacles to overcome, and it will take years to reach the full working implementation of CAV and AFV technology. MDTPO must initially tackle implementation with a countywide approach and then focus on partnering with cities and towns throughout the County. Investments into the countywide gap and market analyses is necessary to visualize where gaps in infrastructure are located and determine necessary adjustments. For example, if there are evenly distributed public charging stations, like gas stations, people may become more encouraged to turn to environmentally friendly vehicular options and begin propelling MDC to a more sustainable future. Long term planning, infrastructure adjustments, and construction should also be made to rail, green infrastructure, public accessibility (walkability and bicycle facilities), and renewable energy.

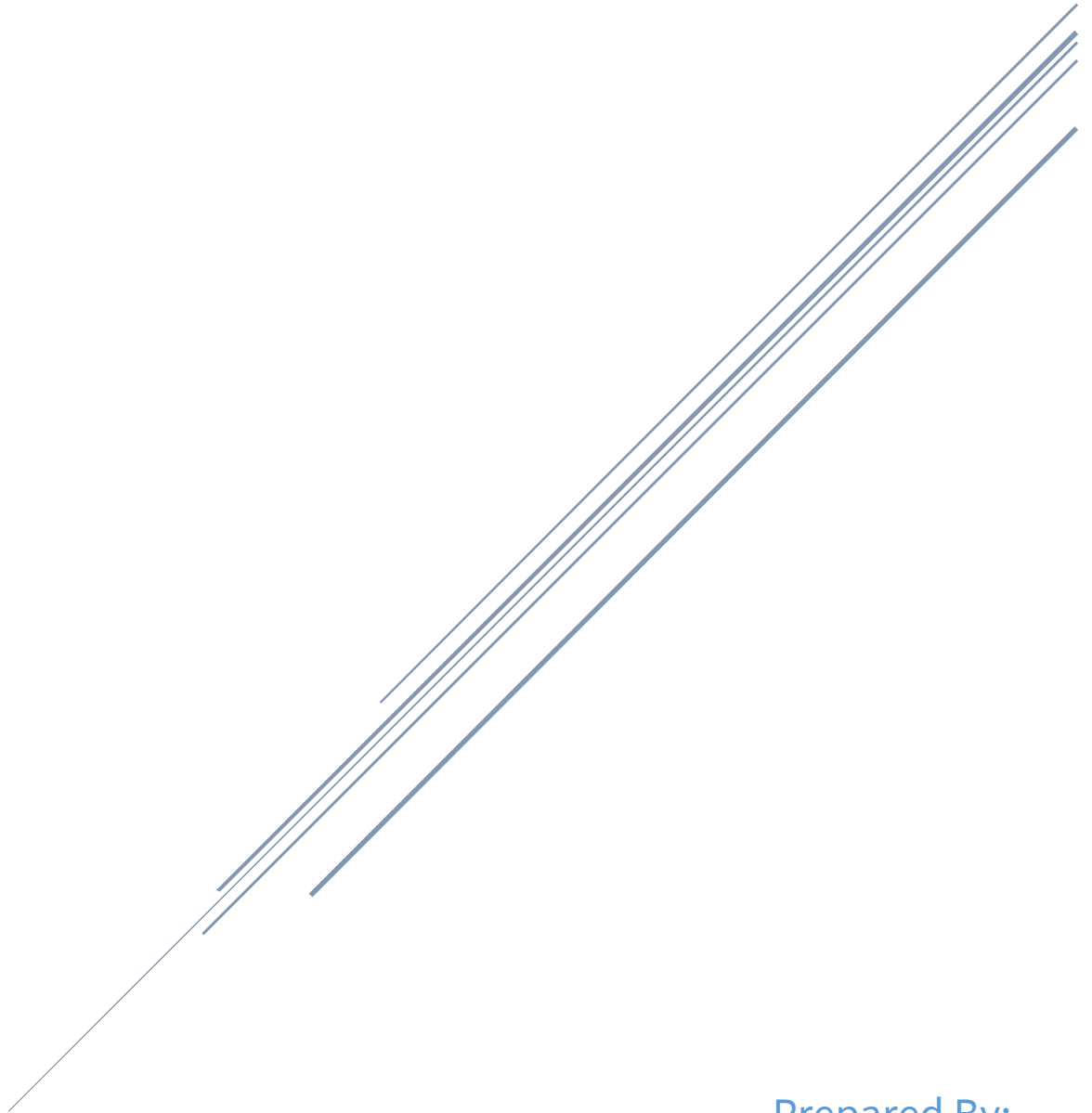
The Miami Climate Alliance is one of several entities currently holding workshops and conducting public outreach to identify and implement just solutions for climate resiliency. Continuing to host public and private workshops with residents, stakeholders and representatives of CAV and AFV companies will inform locals about the importance of instilling these new technologies into society and help create new partnerships. Additional education opportunities where the public can learn about CAV and AFV technologies from experts will increase comfort in advancements and lead to less hesitation in adopting new routines. Developing partnerships with private entities, such as MDC with OBE Power, can promote the continued installation of necessary EV chargers both in private dwellings and public locations. Partnerships with public entities, such as local city governments, may introduce new regulations or incentives to encourage the use of AFV, and CAV vehicles, fuels, and technology.

This process will take time and long-range planning will be necessary. Without the support for AFV, and CAV advancements, it is unlikely that MDC will achieve its net zero goal in a timely manner. If the infrastructure, investments, regulations, incentives, and support are not present, there will be no urgency to transition. It is a positive transition, and the MDTPO is making it possible for MDC to be a frontrunner on the road toward sustainability.

# INCORPORATING RESILIENCE IN THE LONG RANGE TRANSPORTATION PLAN

Technical Memo #5

June 2023



Prepared By:  
TranSystems

## Table of Contents

<b>1. Introduction .....</b>	<b>2</b>
<b>2. Performance Measures .....</b>	<b>3</b>
2.1. Goal - Net Zero Emissions .....	3
2.1.1. Transportation Performance Measures (TPM) .....	4
2.2. Goal - Mitigate Sea Level Rise Impacts .....	5
2.2.1. Sea Level Rise Performance Measures (SPM) .....	5
2.3. Goal - Maintain Connectivity and Mobility.....	6
2.3.1. Connectivity and Mobility Performance Measure (CPM) .....	6
<b>3. Resiliency Risk Assessment .....</b>	<b>7</b>
<b>4. Miami-Dade TPO Needs Plan.....</b>	<b>14</b>
<b>5. Cost Feasibility Plan .....</b>	<b>18</b>
<b>6. Transportation Resilience Funding Opportunities .....</b>	<b>20</b>
<b>7. Conclusion.....</b>	<b>22</b>

## 1. Introduction

One of the main goals of completing a long-range transportation plan (LRTP) is to prioritize investments for the area's residents, businesses, and visitors. The Miami-Dade Transportation Planning Organization (MDTPO) is currently establishing the 2050 LRTP to represent the 25-year transportation planning horizon for Miami-Dade County (MDC). The document is a strategic and comprehensive plan to identify transit, highway, freight, and non-motorized transportation improvements to address mobility, safety, security, resiliency, and emerging technologies. The cost feasibility plan will consider the county's existing and future transportation infrastructure needs.

There are five phases and objectives of the 2050 LRTP process. These include People, Performance, Projects, Priorities, and Policy. The cost feasible selection process includes a thorough analysis of existing conditions and plan development. Technical Memo #5 outlines how to build resiliency into this selection process. Resilience is the ability to withstand and/or recover quickly from difficulties. In this case, difficulties pertain to the climate and its negative impacts. As climate change continues, potential threats to the transportation system are increasing. Transportation infrastructure is susceptible to many risks, including water damage, erosion, and heat. The MDTPO is including resilience within their 2050 LRTP to ensure their transportation network meets the needs of those within the region.

The Florida Department of Transportation (FDOT) produced a *Resilience Quick Guide: Incorporating Resilience in the MPO Long Range Transportation Plan* in January 2020.<sup>1</sup> This document lays out guidance for Florida Metropolitan Planning Organizations (MPOs) or Transportation Planning Organizations (TPOs) to plan for resilience. Technical Memo #5 uses this document as a framework to provide a resilient and reliable multimodal transportation system, by outlining how resilience can be integrated into various phases of the LRTP, including during the performance measures (PMs) development, the Needs Plan, Scenario Planning, and the Cost Feasibility plan.



**Figure 1: 2050 MDTPO LRTP Logo**

<sup>1</sup> [http://floridatransportationplan.com/pdf/2020-01-29\\_FDOT%20Resilience%20Quick%20Start%20Guide\\_FINAL.pdf](http://floridatransportationplan.com/pdf/2020-01-29_FDOT%20Resilience%20Quick%20Start%20Guide_FINAL.pdf)

## 2. Performance Measures

One of the first steps of FDOT's *Resilience Quick Guide* is to identify performance measures that advance the national performance areas. The Federal Highway Administration (FHWA) has identified seven national transportation goals established by Congress.<sup>2</sup> These include:

1. Safety
2. Infrastructure Condition
3. Congestion Reduction
4. System Reliability
5. Freight Movement and Economic Vitality
6. Environmental Sustainability
7. Reduced Project Delivery Delays

All FHWA transportation goals relate to resiliency and sustainability. Projects should include these goals during the planning and design process. Accordingly, the MDTPO aims to improve environmental sustainability, preserve agricultural land, minimize air and water pollution, and mitigate the impacts of climate change on the transportation system. If infrastructure is built to withstand potential hazards, it will remain in service. This helps reduce congestion, provide a reliable system, ensure continuous freight movement, reduce delays within the supply chain, and keep the public safe.

One of the first phases in the MDTPO's 2050 LRTP process includes establishing goals and objectives, which then are connected to performance measures for progress tracking. The 2050 LRTP performance measures must address each of the seven national transportation goals. Through the Miami-Dade Climate Action Strategy, MDC has identified three main goal areas: net zero emissions by 2050, mitigate the impact of sea level rise (SLR), and maintain connectivity and mobility along the transportation network. Several performance measures are identified to track progress toward each goal.

### 2.1.Goal - Net Zero Emissions

The Miami-Dade Climate Action Strategy (CAS) identifies the goal of net-zero emissions by 2050.<sup>3</sup> This goal will be achieved through community-wide emission reduction, reduction of gasoline operations, reduced electricity usage, green building construction, and implementation of solar/clean energy sources. As of 2019, 55 percent of fossil fuels used within MDC came from transportation related emissions. To meet the goals for net zero emissions, measurements must be put in place that track how well policies and technologies are reducing transportation-related fuel consumption and improving emissions within MDC. A switch to electric vehicles (EV) and alternative fuel vehicles (AFVs) is central to attaining net zero emissions. Additionally, providing residents and visitors with alternative transportation types, such as public transit, biking, and walking, will reduce overall vehicle needs. Tracking the following PMs will help MDTPO monitor reductions in transportation related emissions.

---

<sup>2</sup> <https://www.fhwa.dot.gov/tpm/about/goals.cfm>

<sup>3</sup> <https://www.miamidade.gov/green/library/climate-action-strategy-final-draft.pdf>



### 2.1.1. Transportation Performance Measures (TPM)

#### TPM 1 – Track the Number of State Registered EV and Alternative Fuel Vehicles

MDC has identified a goal to increase the number of non-gasoline-powered vehicles. In 2020, EVs accounted for roughly three percent of new vehicles within MDC.<sup>4</sup> MDTPO needs to monitor registrations annually to ensure adequate infrastructure for AFVs. MDTPO can partner with the Office of Resiliency and Southeast Florida Clean Cities Coalition to track AFV registrations within the county.

#### TPM 2 – Track the Number of Alternative Fuel Charging Stations

Increasing the number of alternative fuel vehicles requires additional charging options, including an emphasis on electric charging. Existing (and vacant) gas stations may be renovated to provide additional alternative charging facilities. MDTPO can partner with the Office of Resiliency and Southeast Florida Clean Cities Coalition to track AFV fuel charging stations within the county and identify areas where additional infrastructure is needed.

#### TPM 3 – Track Amount of pedestrian facilities [miles]

Walking, a zero-emission form of transportation, becomes a more favorable type of transportation when adequate pedestrian facilities are in place. This includes sidewalks, trails, and crosswalks. This evaluation may include the needs of pedestrians, including safe streets, visibility, and comfort.<sup>5</sup> Walking helps reduce transportation related emissions within the county. MDTPO may utilize GIS to inventory all pedestrian facilities within MDC.

#### TPM 4 – Track Amount of bicycle facilities [miles]

Biking is another zero-emission transportation form and a great option for trips over a half-mile. People are more inclined to bike when safe, designated bike lanes or trails exist. The higher the number of connected bike facilities, the higher the probability people will choose biking as a transportation option. It is also important to provide public biking options, like Citi Bike, to allow people to use bike rentals for travel. MDTPO may utilize GIS to inventory all bicycle facilities within MDC.

#### TPM 5 – Track Percent of Population with Transit Accessibility

Transit service is another low-emission transportation option. Transit is important for longer-distance travel and should be connected to bike/pedestrian facilities to provide first/last mile access. High concentrations of socially vulnerable populations should be prioritized when reviewing access to transit. MDTPO can coordinate with the MDC Department of Transportation and Public Works (DTPW) about existing/future transit lines and utilize social vulnerability tools (such as the Federal Emergency Management Agency National Risk Index) to track this performance measure.

#### TPM 6 – Track Percent of Transit Track with Performance Restrictions

Well-functioning transit systems reduce single-occupancy vehicle trips. Performance restrictions are segments of rail track where the maximum permissible speed of transit vehicles is set to a value below

<sup>4</sup> [https://theicct.org/wp-content/uploads/2021/12/ev-us-market-growth-cities-sept21\\_0.pdf](https://theicct.org/wp-content/uploads/2021/12/ev-us-market-growth-cities-sept21_0.pdf)

<sup>5</sup> <https://safety.fhwa.dot.gov/saferjourney1/library/pdf/pedfacguide.pdf>

its full-service speed.<sup>6</sup> Restrictions are related to track equipment and regular maintenance. The amount, and locations with restrictions, should be measured to prioritize upgrades to these transit segments. MDTPO may discuss track restrictions with DTPW to understand potential priority projects.

## 2.2.Goal - Mitigate Sea Level Rise Impacts

MDC is becoming increasingly susceptible to SLR impacts. These effects should continuously be monitored and reviewed to proactively plan for climate change impacts. Technical Memo (Tech Memo #2) within the Climate Resiliency Study discussed sea level rise projections in depth. This task included the visualization of 2050 projected SLR levels and a review of the SLR risk of the 2045 LRTP Cost Feasible Projects. Additionally, a network-wide analysis of impacted roadways is shown within Section 3: **Resiliency Risk Assessment**. Identified performance measure baselines are derived from the existing MDC roadway network and the most conservative projected hazard impacts. The following PMs relate to mitigation factors due to SLR.

### 2.2.1. Sea Level Rise Performance Measures (SPM)

#### SPM 1 - Track the Percentage of roadways affected by sea level rise (including a breakdown of evacuation routes)

A roadway becomes impassable once it has been impacted by SLR. The county needs to keep records within a database to show which roadways are impacted by SLR and those that are projected to be impacted in the future. It is important to understand which roadway segments are most likely impacted by SLR to potentially implement projects to reduce the odds of them being impacted. The Sea Level Scenario Sketch Planning Tool (SLS Sketch Planning Tool) may be used to understand low, intermediate, and high SLR projections and impacted roadways for 2050, similar to Tech Memo #2 analysis. All roadways that have been identified as evacuation routes should either be removed from evacuation route documentation or be prioritized for resiliency related projects (such as those identified within Tech Memo #2). There are 20 centerline miles of roadway within MDC that are estimated to be affected by 2050 low sea level rise projections.

#### SPM 2 – Track Percentage of bridge structures affected by sea level rise and storm surge

Bridges provide access over bodies of water and are important infrastructure for MDC. Bridge elevations are likely to be higher than sea level rise projections. However, bridges may be impacted based on the impacts of SLR and storm surges, such as structural damage. This PM is needed to assure a mode of transportation/accessibility between islands within the County. The Sea Level Scenario Sketch Planning Tool (SLS Sketch Planning Tool) may be used to understand low, intermediate, and high SLR projections and impacted bridges for 2050, similar to Tech Memo #2 analysis. Bridges may require additional analysis, as they are typically designed for higher flooding risks than roadways and no specifically identified within the analysis.

---

<sup>6</sup> <https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/regulations-and-guidance/asset-management/60356/tam-infrastructure-performance-measure-reporting-guidebook.pdf>

## 2.3.Goal - Maintain Connectivity and Mobility

Natural hazards can restrict connectivity and mobility throughout the area. Standing water, collapsed bridges, and debris are just some of the potential impacts. Impassable roadways and bridges not only cause inconvenience but also increase emissions and can impact the supply chain. Identified performance measure baselines are derived from the existing MDC roadway network and the most conservative projected hazard impacts, including the 100-year floodplain and Category 1 hurricanes. The following PMs can be used to maintain adequate connectivity and mobility within the county.

### 2.3.1. Connectivity and Mobility Performance Measure (CPM)

#### [CPM 1 – Track the Number of centerline miles within the 100-year floodplain](#)

The number of lanes within the 100-floodplain is important to know to understand potential flooding risks. This performance measure can provide a better understanding of the need to apply funding toward resiliency. The SLS Sketch Planning Tool may be used to visualize and calculate the number of roadway miles within the projected floodplain. There are 4,335 centerline miles of roadway within MDC that are estimated to be affected by the 100-year floodplain projections.

#### [CPM 2 – Track the Number of centerline miles within the Category 1 Hurricane impact area](#)

Category 1, and even more intense, hurricanes frequently occur within MDC. Although their impacts are a shorter-term impact, it is still vital to understand the impacts they may cause on the transportation system. The SLS Sketch Planning Tool may also be used to visualize and calculate the number of roadway miles within the projected Category 1 hurricane impact areas. There are 467 centerline miles of roadway within MDC that are estimated to be affected by Category 1 Hurricane projections.

#### [CPM 3 – Track Delay times and Truck Travel Time Reliability \(TTTR\) for freight vehicles](#)

Freight efficiency can reduce emissions emitted. Determining bottleneck locations with a higher than typical delay can help improve mobility for freight and reduce emissions. MDTPO may coordinate with FDOT to research and analyze truck delays and TTTRs for the MDC roadway network.

### 3. Resiliency Risk Assessment

A risk is the possibility something will be exposed to a specific impact and its potential severity. The highest risks include places with the highest probability of occurrence and magnitude of consequence. In terms of transportation, a risk could be an environmental, economic, or operational impact on vulnerable infrastructure. To reduce the risk of adverse impacts on the transportation system, a risk assessment should be in place to establish a network-wide perspective for resilience. MDTPO has a robust inventory of assets and should continue to update and build on existing infrastructure to understand the potential risks. Identifying potential risks is vital to decreasing the transportation system's risk exposure.

#### Potential Miami-Dade County Risks

According to the Federal Emergency Management Agency (FEMA) National Risk Index (NRI), MDC has a 'very high' risk.<sup>7</sup> The score accounts for expected annual loss, social vulnerabilities, and community resiliency. MDC has a higher risk score than 99.9 percent of other counties within the nation, which is primarily due to its geographical location. The following risks include both natural and human-induced hazards that may impact MDC.

##### Natural Hazards

- Coastal Flooding/Storm Surge
- Drought
- Earthquake
- Hail
- Hurricane
- Landslide
- Lightning
- Riverine Flooding
- Sea Level Rise\*
- Wind

- Temperature Fluctuation\*
- Tornado
- Wildfire

##### Human-Induced Hazards

- Advanced Technology
- Congestion
- Cyberattack
- Hazardous Chemicals/Materials
- Pollution (Air, Light, Material, etc.)
- Population Growth
- Social Vulnerability\*
- Terrorism

\* - Items previously evaluated within Tech Memo #2

Each hazard presents varying threats and outcomes. Every condition listed has the potential to strain the transportation network. For example, impassable roadways from water have immediate impacts on the transportation network by restricting all movement along a roadway. Impassable roadways also impact local/regional economics because of the slowed supply chain efforts.

Tech Memo #2 outlines the steps to perform the sea level rise vulnerability analysis on a project-by-project basis. Only the 2045 Cost Feasible projects were evaluated with the SLS Sketch Planning Tool from Tech Memo #2, however, other data sets are available for a network-wide analysis.<sup>8</sup> Tech Memo #2 used the SLR models (inundation surfaces) to glean the low, intermediate, and high sea level rise projections for the year 2050. The SLS Sketch Planning Tool also provides data for every roadway within MDC in an ArcGIS format which identifies the following characteristics:

<sup>7</sup> <https://hazards.fema.gov/nri/map>

<sup>8</sup> <https://sls.geoplan.ufl.edu/download-data/>

- Roadway name
- Roadway classification
- Percent/feet affected by each sea level rise scenario

The data from the SLS Sketch Planning Tool was extrapolated for the MDTPO to quickly identify how cost-feasible projects are negatively impacted. While the following maps are a broad high-level scale for viewing within Tech Memo #5, the ArcGIS database is a tool that Miami-Dade TPO can quickly use to zoom in and see affected projects on the ground. **Figure 2** identifies all roadways within MDC that would be affected by low SLR in 2050. In addition to SLR, the SLS Sketch Planning Tool shapefile includes the 100- and 500-year floodplain and Category 1 through Category 5 hurricane data. Like SLR, the data is broken up into percentages and feet projected to be impacted. **Figure 3** shows roadways projected to be impacted by Category 1 hurricanes and **Figure 4** shows roadways projected to be impacted by the 100-year floodplain. Each of these maps displays the most conservative projection by showing the lowest projections for each hazard. The lowest projections are most likely to occur. If a roadway is anticipated to be affected by low sea level rise, the 100-year floodplain, and a Category 1 hurricane, each would still be impacted by more extreme weather events.

Within the SLS Sketch Tool, the roadway segments display the percent impacted. The total length of each segment was calculated using GIS and then multiplied by the percent projected to be anticipated. **Table 1** shows the number of centerline miles of roadway impacted by each of the three hazards based on functional classification, along with the total number of each within the county. These values are used as the baseline values for the performance measures. The roadways were based on the Census TIGER/line shapefile roadway classifications.<sup>9</sup>

**Table 1 - Impacted Roadways within MDC**

Roadway Classification*	Total MDC Roadway Centerline Mileage (mi)	Impacted by 2050 Low SLR Roadway Centerline Mileage (mi)	Impacted by Category 1 Hurricane Roadway Centerline Mileage (mi)	Impacted by 100-Year Floodplain Roadway Centerline Mileage (mi)
Primary Road	499	0	4	165
Secondary Road	549	0.2	25	246
Local	8,656	19.75	438	3,924
Bike/Ped/Trail	58	0.03	5	54
All	9,762	20	472	4,389

\* **Primary Road** includes primary Road, ramps, and service drive along the highway

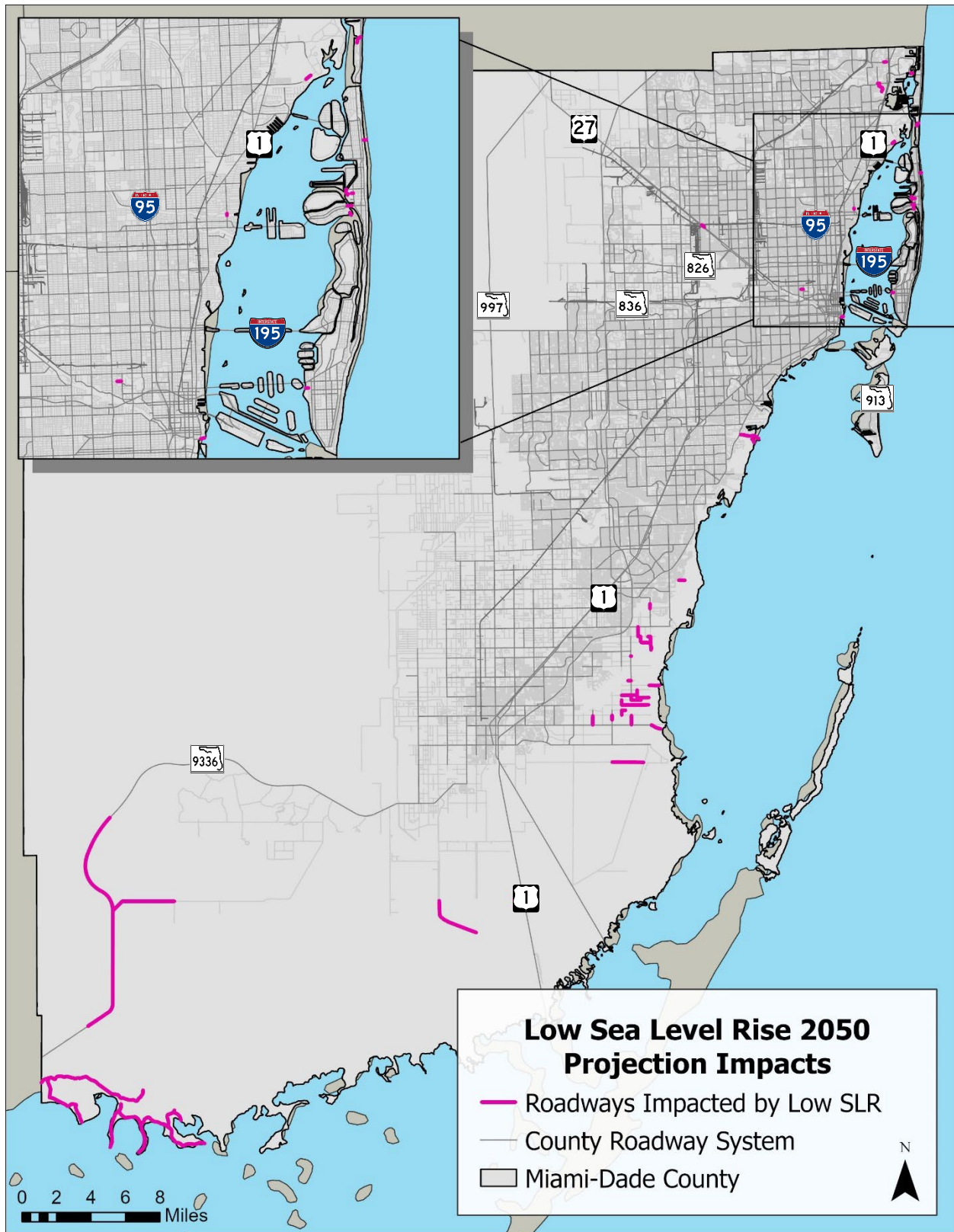
**Secondary Road** includes secondary Road

**Local Road** includes alley, local neighborhood road (rural, city), parking lot road, private driveway, private service vehicle road

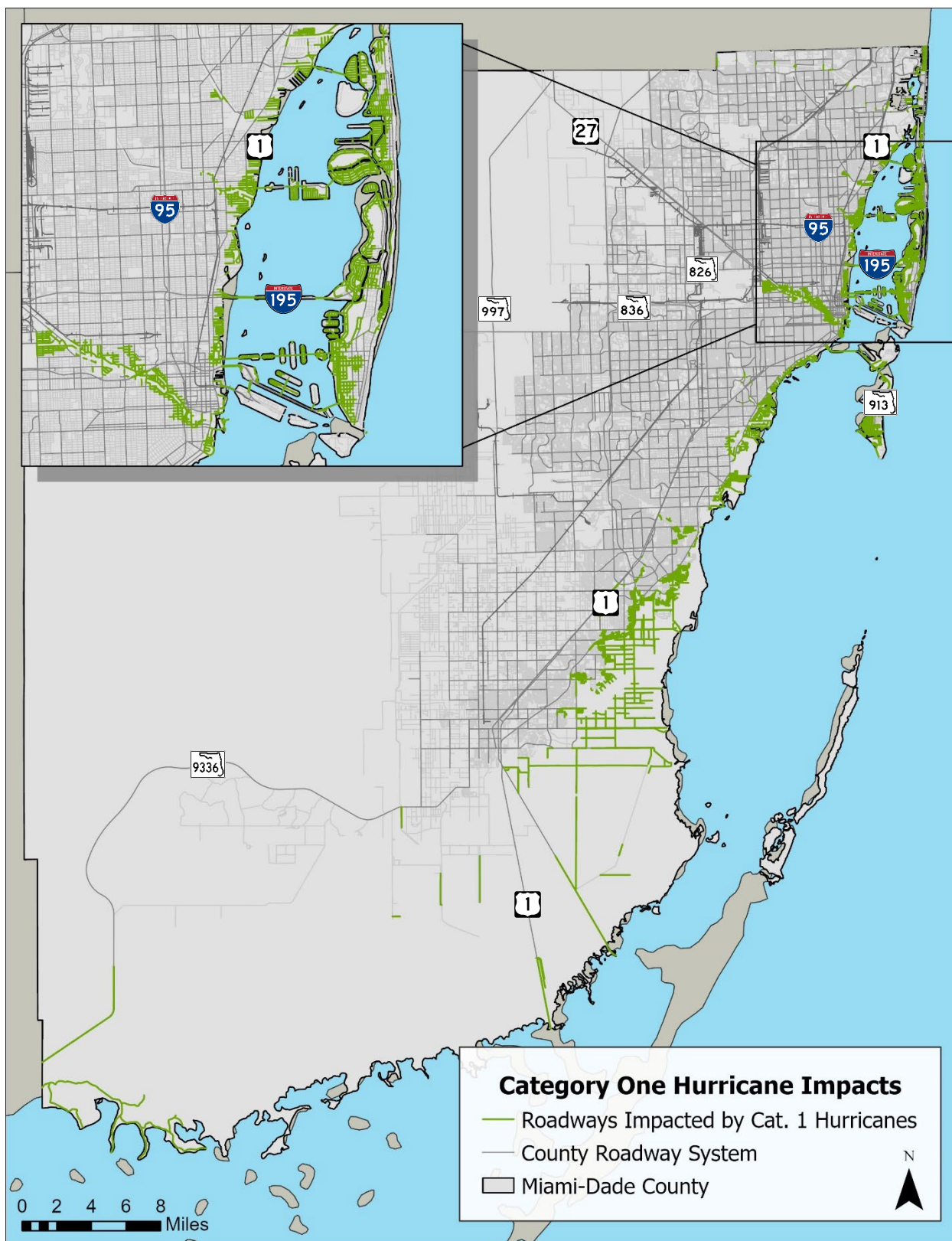
**Bike/Ped/Trail** includes bike path or trail, bridle path, vehicular trail, and walkway/pedestrian trail

<sup>9</sup> <https://www2.census.gov/geo/pdfs/reference/mtfccs2022.pdf>, page 15





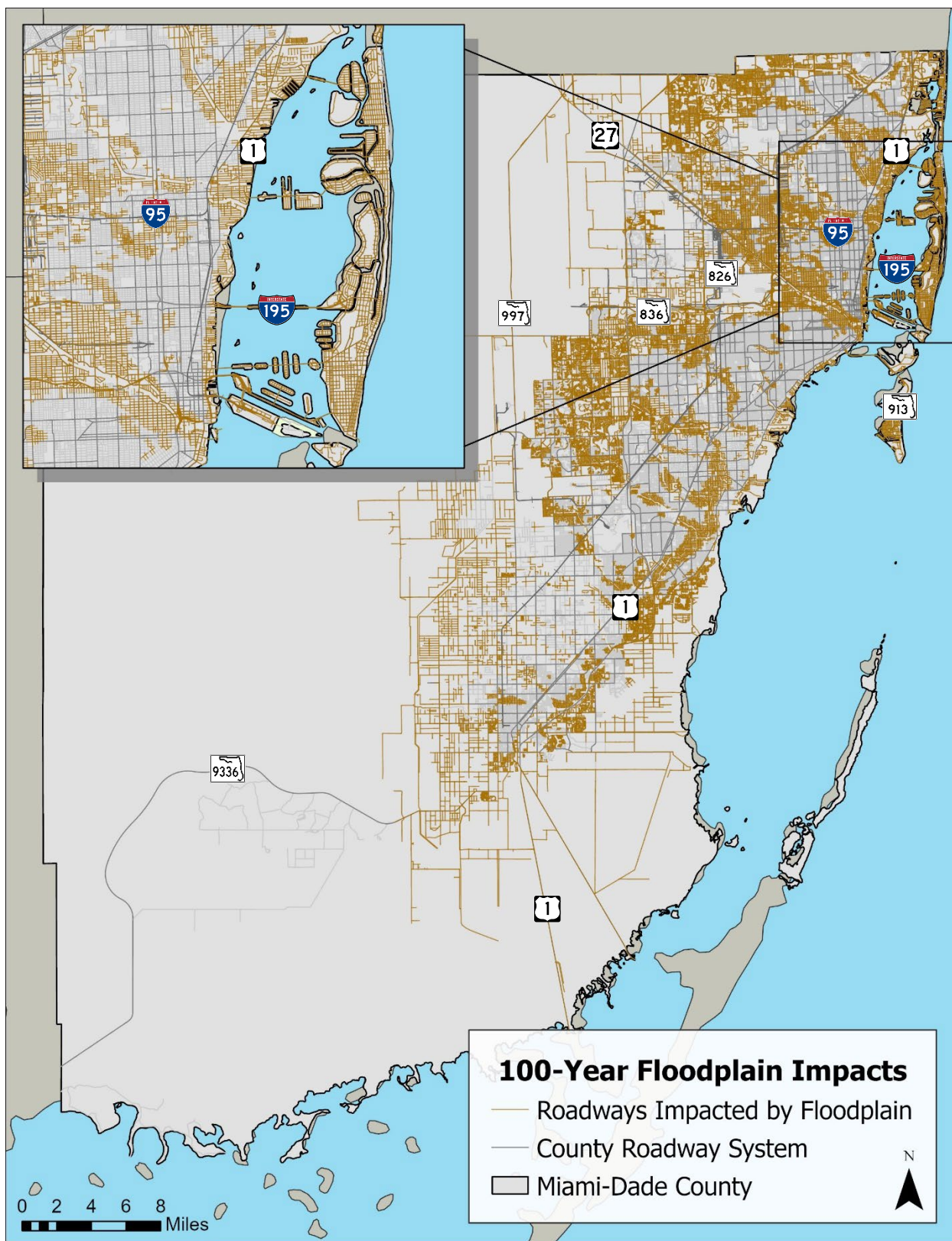
**Figure 2 - County Roadways Projected to be Impacted by Low Sea Level Rise Projections**  
Source: SLS Sketch Planning Tool



**Figure 3 - County Roadways Projected to be Impacted by Category One Hurricanes**

Source: SLS Sketch Planning Tool





**Figure 4 - County Roadways Projected to be Impacted by the 100-Year Floodplain**

Source: SLS Sketch Planning Tool

In addition to **Figure 2** through **4**, **Table 2** identifies a few examples of roadways impacted by all three natural hazards. A comprehensive list of all roadways within an Excel spreadsheet includes each roadway impacted by the three natural hazards, along with roadways impacted by all three combined.

**Table 2 - Sample of Impacted Roadways by All Three Natural Hazards**

Roadway Name	Roadway Limits		Roadway Classification
	From	To	
SW 359th St	SW 117th Ave	SW 110th Ave	Local Road
SW 312th St	SW 112th Ave	SW 107th Ave	Local Road
SW 97th Ave	SW 256th St	SW 261st St	Local Road
Biscayne Blvd	US 1	N/A	Secondary Road
71st St	Bay Drive	Bonita Drive	Secondary Road

Alternative fuel charging stations are another type of vital infrastructure within MDC that can be analyzed with GIS to see its potential hazard impacts. The county continues to increase the number of electric and alternative fuel vehicles, and fueling infrastructure is at risk of being affected by natural hazards. Public charging stations are more likely to be susceptible than private charging to flooding risks.<sup>10</sup> One impacted EV charging station would impact a high number of EV users, reducing their options for vehicle fueling. Miami-Dade County has 515 alternative fuel charging stations.<sup>11</sup> Of these, 27 are projected to be impacted by either low, intermediate, or high projected 2050 sea level rise. **Table 3** shows the alternative fuel charging stations impacted by SLR.

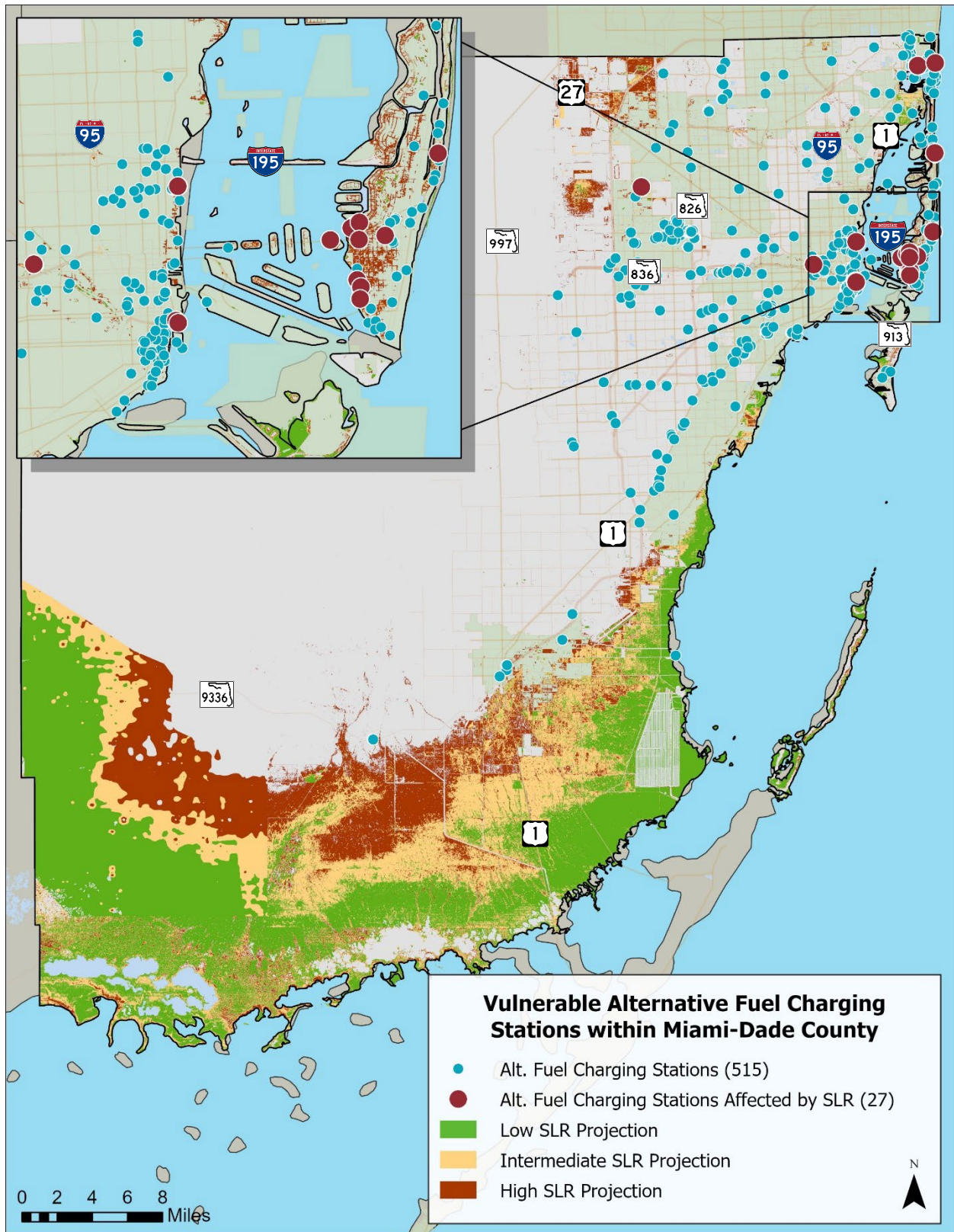
**Table 3 - Impacted Alternative Fuel Charging (AFC) Stations within MDC**

Type of AFC	Impacted AFC - Low SLR	Impacted AFC - Intermediate SLR	Impacted AFC - High SLR	Total AFC
Electric	4	10	27	<b>488</b>
Propane	0	0	0	<b>5</b>
Ethanol (E85)	0	0	0	<b>21</b>
Compressed Natural Gas	0	0	0	<b>1</b>
<b>All</b>	<b>4</b>	<b>10</b>	<b>27</b>	<b>515</b>

<sup>10</sup> <https://www.nature.com/articles/s41467-022-30848-w>

<sup>11</sup> <https://afdc.energy.gov/stations/#/find/nearest> [afdc.energy.gov]





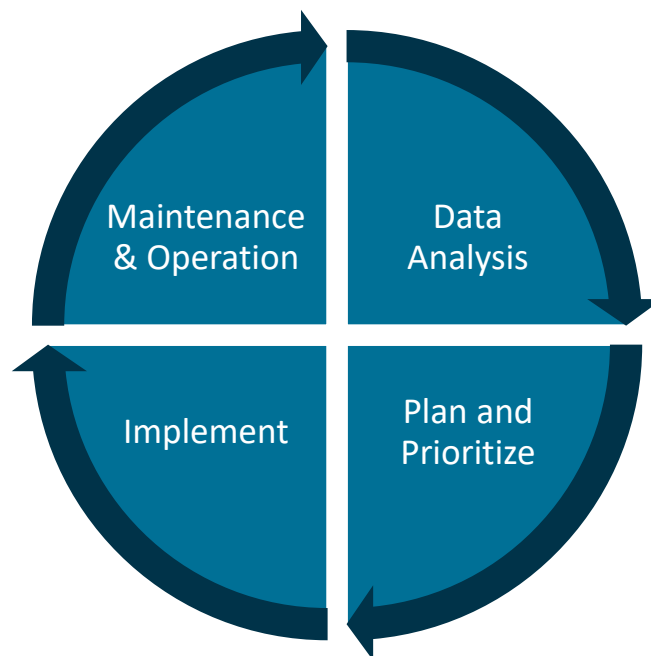
**Figure 5 - Alternative Fuel Charging Stations Projected to be Impacted by Sea Level Rise**  
Source: SLS Sketch Planning Tool, Department of Energy

## 4. Miami-Dade TPO Needs Plan

During the 2050 LRTP update, MDTPO will develop a Needs Plan which outlays transportation projects throughout the entire county. MDTPO will incorporate resiliency within their Needs Planning process by examining the system wide transportation network for locations with natural hazard risk potential. This will guide the TPO to identify areas and potential projects to be considered for their Cost Feasible Plan. The analysis strategy is outlined to maximize opportunities and describe how LRTP projects incorporate resiliency. The following transportation resiliency goals are based on MDTPOs 2045 LRTP objectives:

- Improve the resiliency/reliability of the transportation system
- Reduce the vulnerability and increase the resilience of critical infrastructure to the impacts and events
- Preserve infrastructure (sustainability and resilience)
- Site and design new transportation infrastructure to minimize exposure to sea level rise within the infrastructure lifespan
- Prepare and catalyze the growth of the EV market
- Reduce greenhouse gas emissions

**Figure 6** shows the resiliency project cycle, which will be integrated into the 2050 LRTP Cost Feasible process.



**Figure 6 - Resiliency Project Cycle**

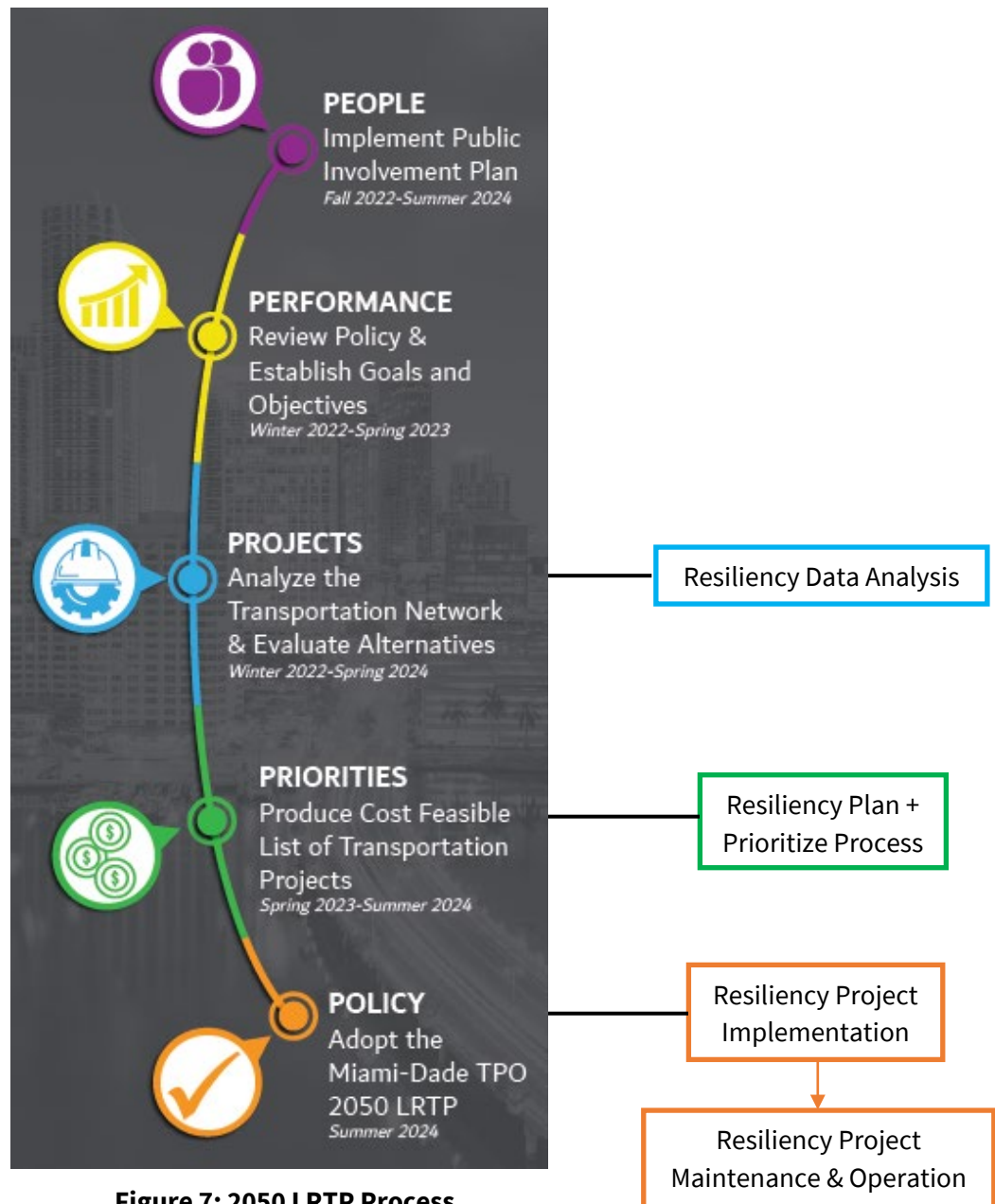
### MDTPO Resiliency Specific Process Outline

The following steps should be followed while developing the Needs Plan to incorporate resiliency for transportation projects:

1. Ensure existing network-wide transportation infrastructure, including potential projects for the 2050 LRTP, are geocoded in GIS:
  - a. Point shapefiles are intersection projects.
  - b. Linear shapefiles are roadway, transit, bike/pedestrian, or corridor-specific projects.
2. Perform data analysis (*run concurrently with Projects – shown in **Figure 7***):
  - Use network-wide infrastructure to evaluate existing conditions and potential exposures. Incorporate EV/alternative energy vehicle infrastructure within the analysis.
  - Evaluate the travel demand model to identify important corridors, including Strategic Miami Area Rapid Transit (SMART) Corridors and evacuation routes. This is considered the criticality of the asset.
    - Evaluate freight corridors based on truck volume and distribution amounts.
  - Assess risks and vulnerabilities for the county-wide network (using the tool outlined within Tech Memo #2):
    - Focus on sea level rise, flooding, heat, and social vulnerabilities
    - Additional risk may be added with new iterations of the tool as data is deemed necessary and available within GIS. This may include king tides, compound flooding, storm surge, etc.
    - Scenario testing may include combined risks, such as SLR and flooding events, to understand how projects may be impacted by multiple hazards occurring at once
3. Plan and Prioritize Resiliency Projects/Project Elements (*run concurrently with the Priorities – shown in **Figure 7***):
  - After potential infrastructure impacts are identified, determine appropriate strategies to mitigate them. The toolkit within Tech Memo #2 can be used as a resource for solutions
  - Coordinate with stakeholders to review data analysis and seek additional input
4. Implement resilient projects – *complete after adopting 2050 LRTP*
  - Utilize various funding sources to fund projects
  - Use innovative ideas to construct projects with a minimal environmental impact
5. Operate and Manage resilient projects – *complete after project implementation*
  - As vulnerable events are always likely, backup plans should be in place to dictate worst-case-scenario planning
  - Conduct asset management procedures to ensure infrastructure maintains useable and safe for public
  - Utilize innovative Transportation Systems Management and Operations (TSM&O) technology to provide efficient evacuation and alternate routes for natural hazards

**Figure 7** displays the decision process for determining cost-feasible projects for the 2050 LRTP process.

The data analysis step should be completed before the final cost feasibility determination. This is because if a project is incredibly susceptible to sea level rise or another hazard, the project should be weighed to decide if the project is worth completing due to its potential impacts. Additionally, if it scores highly, resiliency efforts need to be included in the planning cost estimate.



**Figure 7: 2050 LRTP Process**

All projects completed through the LRTP should include low-cost resiliency elements, such as green infrastructure. Higher cost projects, such as raising the elevation of a bridge or roadway, should only be completed along key parts of the county network. The following identification factors are starting points to prioritize which projects should receive resiliency elements within the design.

### Resiliency Selection Prioritization

- Projects that are scoring in the top quartile of Tech Memo #2 scoring for
  - Sea level rise
  - Heat vulnerability
  - Social vulnerability
- Evacuation routes
- Freight corridors
- High functional classification roadways that carry high traffic volumes
- Roadways and bridges that provide access to residential homes with limited access
  - MDTPPO may consider doing a countywide study of vital roadways to assure continued connectivity during high-risk events
  - Include detour routes
- Eligible funding period
- Transit corridors that connect socially vulnerable communities
- Projects with longer design cycles
- Capital projects with extreme needs

It is important to evaluate existing LRTP projects in this process. Additionally, roadways that have not previously been identified within the LRTP should also be evaluated for resiliency criteria, as they may want to be included in the cost feasibility plan. Collaboration between other public agencies, jurisdictions, and private industries is vital to the success of implementation.



## 5. Cost Feasibility Plan

Miami-Dade County will include resiliency within the 2050 LRTP Cost Feasible plan process. Resiliency should be included within the process to improve the ability to mitigate the impacts of future hazards. Some of the most vulnerable/top quartile scoring 2045 LRTP cost feasible projects from Tech Memo #2 are shown in **Table 4**. Intersection projects, roadway projects, and alternative vehicle charging locations are identified below with high level planning project recommendations. Detailed engineering recommendations should be vetted during the design process with survey data and engineering analysis. **Table 4** also illustrates how data may be compiled once appropriate projects have been selected after some of the resiliency cycle is completed.

**Table 4 - 2045 Cost Feasible Projects with Potential Resiliency Implementation Considerations**

Project Owner	Project Type	Project Location/Facility	2050 SLR Projection	Heat Vulnerability Risk Score	Social Vulnerability Risk Score	Potential Resiliency Project
DTPW	Roadway	NW 97 Avenue	Low	1	Relatively High	Construct at a higher elevation
DTPW	Bike/Ped	10th Street	Low	2	Relatively High	Install flood barriers
DTPW	Transit	Beach Corridor	Low	4	Relatively High	Plan a detour route
DTPW	Bike/Ped	10th Street	Low	2	Relatively High	Green Infrastructure
MDX	Roadway	SR 924 / Gratigny Parkway West Extension	Low	2	Relatively High	Realign roadway out of the floodplain
MDX	Roadway	SR 836/Dolphin Expressway	Low	4	Relatively High	Construct at a higher elevation
DTPW	Transit	South Dade Transitway Park & Ride at SW 344 Street	Low	5	Relatively Moderate	Install flood barriers
FDOT SIS	Freight	Golden Glades Multimodal Transportation Facility	Low	3	Relatively High	Harden infrastructure
N/A	EV Charging	Echo Aventura	Low	N/A	N/A	Raise power source

Each infrastructure type is identified below with several potential solutions. This data mimics the toolkit with Tech Memo #2.

Roadway and Bridge Projects – Widening, Interchange/Intersection Improvement, Bridge Reconstruction, etc.

Consider:

- Relocating to a higher elevation
- Installing flood barriers
- Realigning road and structure out of the floodplain
- Hardening infrastructure/strengthening support structures
- Installing erosion control to improve soil stability
- Installing cooling pavement and other green infrastructure
- Plan for detour routes
- Incorporate sea level rise into infrastructure planning

Transit Projects – Facility Improvement, Transit Scheduling, etc.

Consider:

- Installing flood barriers
- Hardening infrastructure/strengthening support structures
- Installing green infrastructure
- Plan for detour routes
- Incorporate sea level rise into infrastructure planning

Bike/Pedestrian Projects – Sidewalk/trail/bike lane/crosswalk construction, etc.

Consider:

- Installing flood barriers
- Hardening infrastructure/strengthening support structures
- Installing green infrastructure
- Planning for detour routes
- Incorporating sea level rise into infrastructure planning

## 6. Transportation Resilience Funding Opportunities

Currently, two major federal funding opportunities deal with resiliency for transportation systems. Both funding opportunities are derived from the existing federal transportation authorization, the Bipartisan Infrastructure Law (BIL). These opportunities should be monitored annually and MDTPO or other eligible government agencies should prepare applications in advance of their publication. For local jurisdictions that wish to write and obtain their own federal funding, this should serve as:

- Inclusion of their project (or a plan to have this project included) in the relevant State, metropolitan, and local planning documents

### National Electric Vehicle Infrastructure (NEVI) Formula Program

NEVI's purpose is to provide funding to States (including the District of Columbia and Puerto Rico) to deploy EV charging infrastructure and establish an interconnected network, known as Alternative Fuel Corridors (AFC), that will facilitate data collection, access, reliability, and resiliency.<sup>12</sup> One billion dollars per fiscal year will be distributed between 2022 and 2026. As of July 6, 2022, the FHWA has designated seven corridors within MDC as AFCs.<sup>13</sup> Each State receives a share of program funding equal to the State's share of distributed funds in federal-aid highway apportionments and Puerto Rico Highway Program funding.

FHWA regulations set minimum standards and requirements for projects funded under the NEVI:

- Installation, operation, and/or maintenance of EV charging infrastructure;
- Interoperability of EV charging infrastructure;
- Traffic control devices or on-premises signage for EV charging infrastructure;
- Data, including format and schedule for data submission; and,
- Information on available EV charging infrastructure locations including pricing, real-time availability, and accessibility through map applications.

Each State is required to develop and submit an EV Infrastructure Deployment Plan to the Joint Office of Energy and Transportation to access funds. The State Plans should discuss how the State would use the NEVI Formula Program funds consistent with the FHWA guidance.

### Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Grant Program

PROTECT funds can be used to plan for and improve resiliency in transportation infrastructure.<sup>14</sup> The funds are divided into four categories as shown in Table 5:

---

<sup>12</sup> <https://www.federalregister.gov/documents/2022/06/22/2022-12704/national-electric-vehicle-infrastructure-formula-program>

<sup>13</sup> <https://www.miamidade.gov/govaction/legistarfiles/Matters/Y2022/222481.pdf>

<sup>14</sup> <https://www.fhwa.dot.gov/environment/protect/formula/>

**Table 5- Highlights of PROTECT Grant Program**

<b>Category</b>	<b>Purpose</b>	<b>Funding Level</b>
<b>Planning Grants</b>	<ul style="list-style-type: none"> <li>Resilience planning, preliminary design, design, or the development of data tools to simulate transportation disruption scenarios;</li> <li>Technical assessments for the vulnerabilities of its surface transportation assets</li> <li>Evacuation preparation and planning</li> </ul>	Up to \$45 million
<b>Resilience Improvement Grants</b>	<ul style="list-style-type: none"> <li>Improving the ability of an existing surface transportation asset to withstand one or more elements of a weather event or natural disaster</li> <li>Increasing the resilience of surface transportation infrastructure from the impacts of changing conditions, flooding, wildfires, weather events, and other natural disasters</li> </ul>	Up to \$638 million
<b>Community Resilience &amp; Evacuation Routes Grants</b>	<ul style="list-style-type: none"> <li>Strengthening and protecting evacuation routes essential for providing and supporting evacuations caused by emergency events</li> <li>For routes that inadequately facilitate evacuations, including the transportation of emergency responders and recovery resources, activities include: <ul style="list-style-type: none"> <li>Expanding capacity through the installation of communication and intelligent transportation system equipment and infrastructure, counterflow measures, or shoulders</li> <li>Constructing new or redundant evacuation routes</li> <li>Acquiring evacuation route or traffic incident management equipment or signage</li> <li>Ensuring access or service to critical facilities</li> </ul> </li> </ul>	Up to \$45 million
<b>At-Risk Coastal Infrastructure Grants</b>	<ul style="list-style-type: none"> <li>Strengthening, stabilizing, hardening, elevating, relocating, or otherwise enhancing the resilience of non-rail infrastructure subject to increased long-term future risks of weather events, natural disasters, or changing conditions to improve transportation/public safety and reduce future rebuilding costs by avoiding larger future maintenance or rebuilding costs</li> </ul>	Up to \$120 million

## 7. Conclusion

The MDTPO is using climate resiliency standards to create and maintain a reliable and robust multimodal transportation system. Applying resiliency in the project selection process can be at a higher initial cost, but resiliency additions bring much more added value by providing a system that can withstand natural hazard events. Funding needs to be appropriately distributed in the most efficient way possible to meet performance measure targets and ensure resiliency within future TPO projects. Overall plans, such as an updated evaluation/detour plan and hazard mitigation plan, should be created and regularly updated separately from the LRTP Cost Feasible Process. The county should utilize the tool created within Tech Memo #2 and outline within this plan to assess, prioritize, and determine mitigation solutions for LRTP projects. The LRTP should also include information about alternative fuel vehicle charging, as this will become an essential piece of infrastructure as the county grows into their 2050 goal of zero emissions.

# APPENDIX A



# Project Points

Project Owner/Type	Map ID	Plan Period	Scenario	Facility	Description	Project Cost (\$Million)	Social Vulnerability	Social Vulnerability Score	Heat Rating (1-5)	Heat Score	SLR (Low)	SLR (Intermediate)	SLR (High)	Sea Level Rise Rating	Sea Level Rise Score	Sum Score
DTPW	1	PP1	Scenario 1	Medley Bridge / Canal Improvement Program	Improvements at; NW 121 Way, NW 116 Way, NW 105 Way, NW 79 Ave	\$0.26	Relatively High	1.5	1	0	No	Yes	Yes	Intermediate	4	5.5
DTPW	44	PP3	Scenario 1	US 27/Okeechobee Road	Improvements at; NW 121 Way, NW 116 Way, NW 105 Way, NW 79 Ave	\$0.26	Relatively High	1.5	3	1	No	No	Yes	High	2	4.5
DTPW	1	PP1	Scenario 1	Medley Bridge / Canal Improvement Program	Way, NW 79 Ave	\$0.26	Very High	2	2	0.5	No	No	No	None	0	2.5
DTPW	35	PP3	Scenario 3	SW 72 St	Intersection improvements	\$0.56	Relatively High	1.5	2	0.5	No	No	No	None	0	2
DTPW	1	PP1	Scenario 1	Medley Bridge / Canal Improvement Program	Improvements at; NW 121 Way, NW 116 Way, NW 105 Way, NW 79 Ave	\$0.26	Relatively High	1.5	1	0	No	No	No	None	0	1.5
DTPW	32	PP3	Scenario 1	NW 72 Ave (Milam Dairy)	Operational improvements	\$4.09	Relatively Moderate	1	2	0.5	No	No	No	None	0	1.5
DTPW	15	PP2	Scenario 3	SW 16 St	Construct new 2 lane roadway	\$1.47	Relatively Moderate	1	2	0.5	No	No	No	None	0	1.5
DTPW	1	PP1	Scenario 1	Medley Bridge / Canal Improvement Program	Improvements at; NW 121 Way, NW 116 Way, NW 105 Way, NW 79 Ave	\$0.26	Very Low	0	2	0.5	No	No	No	None	0	0.5
FDOT OR	12			SR 5 / US 1 / Grade Separations	Relatively Moderate	1	2	0.5	No	Yes	Yes	Yes	Intermediate	4	5.5	
FDOT OR	13			SR 953 / Leleune / Iron Triangle	Relatively High	1.5	3	1	No	No	No	Yes	High	2	4.5	
FDOT OR	6			I-95 Interchange	Relatively Moderate	1	3	1	No	No	No	No	None	0	2	
FDOT OR	19			I-195 at Miami Avenue Interchange Improvement	Relatively High	1.5	2	0.5	No	No	No	No	None	0	2	
FDOT OR	13			SR 5 / US 1 / Grade Separations	Relatively Low	0.5	2	0.5	No	No	No	No	None	0	1	
FDOT SIS	5	PP1	Scenario 1	SR 9A / I-95 SB ramp to WB SR 836	Intermodal Hub Capacity	\$76.47	Relatively High	1.5	3	1	Yes	Yes	Yes	Low	6	9
FDOT SIS	2	PP1	Scenario 1	Golden Glades Multimodal Terminal	Modify Interchange	\$134.97	Relatively Low	0.5	2	0.5	Yes	Yes	Yes	Low	6	8.5
FDOT SIS	31	PP4	Scenario 3	I-75 / SR 826 Interchange	Interchange ramp (new)		Relatively High	1.5	3	1	No	Yes	Yes	Intermediate	4	6.5
FDOT SIS	12	PP1	Scenario 3	SR 826 / Palmetto Expressway SR 826 EB ramp to SR 9A / I-95 NB	Modify Interchange		Relatively Moderate	1	1	0	No	Yes	Yes	Intermediate	4	5
FDOT SIS	34	PP4	Scenario 3	I-75/Miami Gardens Interchange	Modify Interchange	\$28.25	Relatively High	1.5	3	1	No	No	Yes	High	2	4.5
FDOT SIS	33	PP4	Scenario 3	I-75 / HEFT Interchange	Passenger Teminal	\$74.50	Very High	2	2	0.5	No	No	Yes	High	2	4.5
FDOT SIS	10	PP1	Scenario 3	SR 25 / Okeechobee Rd & SR 826 / Palmetto Expressway	Interchange Improvement		Relatively High	1.5	4	1.5	No	No	No	None	0	3
FDOT SIS	29	PP3	Scenario 3	Palmetto Metrorail Intermodal Terminal Ph 1 & 2	Modify Interchange	\$9.71	Relatively Moderate	1	1	0	No	No	Yes	High	2	3
FDOT SIS	20	PP1	Scenario 3	SR 836 / I-95 Interchange Ramps	Interchange ramp (new)		Relatively High	1.5	3	1	No	No	No	None	0	2.5
FDOT SIS	30	PP4	Scenario 3	I-75	Intermodal Hub Capacity	\$207.90	Data Unavailable	0	4	1.5	No	No	No	None	0	1.5
Freight	13	PP2	15	SR 9/NW 27 Avenue	Interchange Improvements		Relatively High	1.5	4	1.5	No	No	Yes	High	2	5
Freight	14	PP2	15	SR 934/SW 74 Street	Traffic Operation and Geometric Improvements		Very High	2	2	0.5	No	No	Yes	High	2	4.5
Freight	7	PP2	15	NW 25 Street	Traffic Operation and Geometric Improvements		Relatively Moderate	1	3	1	No	No	Yes	High	2	4
Freight	17	PP2	15	SR 948/NW 36 Street	Traffic Operation and Geometric Improvements		Relatively High	1.5	4	1.5	No	No	No	None	0	3
Freight	18	PP2	15	SR 948 / NW 36 St	Traffic Operation and Geometric Improvements		Relatively High	1.5	4	1.5	No	No	No	None	0	3
Freight	19	PP2	15	SR 948/NW 36 Street	Traffic Operation and Geometric Improvements		Data Unavailable	0	2	0.5	No	No	Yes	High	2	2.5
Freight	20	PP2	15	SR 948 / NW 36 St	Traffic Operation and Geometric Improvements		Data Unavailable	0	2	0.5	No	No	Yes	High	2	2.5
Freight	3	PP1	15	SR 969/NW 72 Ave	Traffic Operation Improvements		Relatively Moderate	1	2	0.5	No	No	No	None	0	1.5
Freight	16	PP2	15	SR 948/NW 36 Street	Traffic Operation and Geometric Improvements		Relatively Low	0.5	3	1	No	No	No	None	0	1.5
Freight	18	PP2	15	SR 948/NW 36 Street	Geometric Modifications		Relatively Low	0.5	3	1	No	No	No	None	0	1.5
Freight	3	PP2	15	SR 969 / NW 72 Ave / Milam Dairy Rd	Geometric Modifications		Relatively Moderate	1	2	0.5	No	No	No	None	0	1.5
Freight	5	PP2	15	NW 12 Street	Traffic Operation and Geometric Improvements		Relatively Low	0.5	2	0.5	No	No	No	None	0	1
Freight	6	PP2	15	NW 25 Street	Traffic Operation and Geometric Improvements		Data Unavailable	0	3	1	No	No	No	None	0	1
Freight	17	PP2	15	SR 948 / NW 36 St	Traffic Operation and Geometric Improvements		Relatively Low	0.5	2	0.5	No	No	No	None	0	1
Freight	19	PP2	15	SR 948 / NW 36 St	Traffic Operation and Geometric Improvements		Relatively Low	0.5	2	0.5	No	No	No	None	0	1
L RTP Art	18		15		Relatively Moderate	1	2	0.5	No	Yes	Yes	Yes	Intermediate	4	5.5	
L RTP Art	17		15		Relatively Low	0.5	2	0.5	No	No	No	No	None	0	1	
MXD	4	PP1	Scenario 1	SR 836/Dolphin Expressway	Interchange Improvements		Relatively High	1.5	4	1.5	Yes	Yes	Yes	Low	6	9
MXD	6	PP1	Scenario 1	SR 924/Gratigny Parkway	Interchange		Relatively Low	0.5	2	0.5	Yes	Yes	Yes	Low	6	7
MXD	1	PP1	Scenario 1	SR 836/Dolphin Expressway	Interchange Modification at NW 87 Avenue		Relatively High	1.5	2	0.5	No	Yes	Yes	Intermediate	4	6
MXD	8	PP2	Scenario 1	SR 112/Airport Expressway	Interchange		Relatively High	1.5	4	1.5	No	No	Yes	High	2	5
MXD	9	PP2	Scenario 1	SR 874/Don Shula Expressway	Interchange		Relatively Moderate	1	2	0.5	No	No	Yes	High	2	3.5
MXD	2	PP1	Scenario 1	SR 836/Dolphin Expressway	New SR 836 and Heft Ramp Connection		Relatively Low	0.5	2	0.5	No	No	No	None	0	1
MXD	5	PP1	Scenario 1	SR 874/Don Shula Expressway	Ramp Connection		Relatively Low	0.5	2	0.5	No	No	No	None	0	1

# Project Points

Project Owner/Type	Map ID	Plan Period	Scenario	Facility	Description	Project Cost (\$Million)	Social Vulnerability	Social Vulnerability Score	Heat Rating (1-5)	Heat Score	SLR (Low)	SLR (Intermediate)	SLR (High)	Sea Level Rise Rating	Sea Level Rise Score	Sum Score
Transit	32	PP2	Scenario 2	South Dade Transitway Park-and-Ride/terminal at SW 344 Street (344 Street Station)	Expand existing terminal/park-and-ride at SW 344th Street Construction/implementation technological components for the Golden Glades Multimodal Transportation Facility (GGMTF)	\$4.61	Relatively Moderate	1	5	2	Yes	Yes	Yes	Low	6	9
Transit	23	PP2	Scenario 2	Golden Glades Multimodal Transportation Facility - IT Components - SMART Terminal	Construct Park-and-Ride/Transit Terminal with 300 surface parking spaces and 4 busbays	\$10.00	Relatively High	1.5	3	1	Yes	Yes	Yes	Low	6	8.5
Transit	38	PP4	Scenario 2	Mall of the Americas Station - SMART Terminal	Construct Park-and-Ride/Transit Terminal with 100 surface parking spaces	\$6.37	Relatively High	1.5	2	0.5	No	Yes	Yes	Intermediate	4	6
Transit	25	PP2	Scenario 2	North Miami Beach Station	Expand existing park-and-ride, construct new parking garage with 500 parking spaces and four bus bays.	\$14.25	Relatively Moderate	1	2	0.5	No	Yes	Yes	Intermediate	4	5.5
Transit	27	PP2	Scenario 2	South Dade Park-and-Ride/terminal at SW 152 Street and HEFT	Palmetto Metrorail Intermodal Terminal Ph 1 & 2	\$14.25	Relatively Moderate	1	2	0.5	No	Yes	Yes	Intermediate	4	5.5
Transit	29	PP2	Scenario 2	South Dade Transitway Park-and-Ride at SW 288 St and HEFT	Purchase land for future Park-and-Ride	\$33.12	Relatively Moderate	1	4	1.5	No	No	Yes	High	2	4.5
Transit	26	PP2	Scenario 2	North Miami Station	Construct Park-and-Ride/Transit Terminal with 100 surface parking spaces	\$16.10	Relatively Moderate	1	2	0.5	No	No	Yes	High	2	3.5
Transit	21	PP2	Scenario 2	Aventura Terminal - SMART Terminal	Construct Park-and-Ride with 100 surface parking spaces	\$5.50	Relatively Low	0.5	2	0.5	No	No	Yes	High	2	3
Transit	7	PP1	Scenario 4	Mount Sinai Transit Terminal - SMART Terminal	Construct Transit Terminal with six bus bays	\$5.50	Very Low	0	2	0.5	No	No	Yes	High	2	2.5
Transit	11	PP1	Scenario 2	South Dade Transitway Park-and-Ride at Marlin Road - SMART Terminal	Construct Park-and-Ride with 100 surface parking spaces	\$2.90	Relatively High	1.5	3	1	No	No	No	None	0	2.5
Transit	15	PP1	Scenario 2	South Dade Transitway Park-and-Ride at SW 168 Street	Upgrade existing park-and-ride, Phase I - 90 additional surface parking spaces, Phase II - modernized 450 space parking garage	\$14.04	Relatively High	1.5	3	1	No	No	No	None	0	2.5
Transit	16	PP1	Scenario 2	South Dade Transitway Park-and-Ride at SW 264 Street (264 Street Station) - SMART Terminal	Construct Park-and-Ride with 100 surface parking spaces	\$3.50	Relatively Moderate	1	3	1	No	No	No	None	0	2
Transit	17	PP1	Scenario 2	South Dade Transitway Park-and-Ride at SW 296 Street (296 Street Station) - SMART Terminal	Improve Existing Park-and-Ride with a 400 space parking garage	\$23.70	Relatively Low	0.5	4	1.5	No	No	No	None	0	2
Transit	20	PP1	Scenario 2	Unity Station (TOD) - SMART Terminal (in TIP scheduled for completion in 2021)	Construct terminal for North Corridor Rapid Transit with 350 parking spaces and transit oriented development (TOD) opportunities.	\$5.00	Relatively Moderate	1	3	1	No	No	No	None	0	2
Transit	29	PP2	Scenario 2	South Dade Transitway Park-and-Ride at SW 152 Street	Upgrade park-and-ride, Phase 1- reconstruct /provide 196 leased spaces, Phase 2 - modernized 511 space parking garage	\$13.67	Relatively Moderate	1	3	1	No	No	No	None	0	2
Transit	30	PP2	Scenario 2	South Dade Transitway Park-and-Ride at SW 244th Street (244 Street Station)	Reconstruct existing facility increase the number of leased parking spaces from 101 spaces to 111 spaces.	\$2.50	Relatively Moderate	1	3	1	No	No	No	None	0	2
Transit	3	PP2	Scenario 2	Miami Intermodal Center (MIC) Central Station	Data Unavailable	\$2.50	Relatively Moderate	0	4	1.5	No	No	No	None	0	1.5
Transit	12	PP1	Scenario 2	South Dade Transitway Park-and-Ride at SW 104 Street (104 Street Station) - SMART Terminal	Lease parking with 100 parking spaces (\$500/spc./yr.)	\$0.05	Relatively Moderate	1	2	0.5	No	No	No	None	0	1.5
Transit	13	PP1	Scenario 2	South Dade Transitway Park-and-Ride at SW 112th Avenue (112 Avenue Station) - SMART Terminal	Reconstruct existing facility, improve operations, increase parking spaces from 467 spaces to 500 spaces.	\$4.40	Relatively Moderate	1	2	0.5	No	No	No	None	0	1.5
Transit	18	PP1	Scenario 2	Southland Mall Station - SMART Terminal	Lease 100 parking spaces and construct a four-bay transit terminal	\$3.27	Relatively Moderate	1	2	0.5	No	No	No	None	0	1.5
Transit	22	PP2	Scenario 2	Dadeland South Intermodal Station Ramps	Construct direct ramps to/from elevated Bus Rapid Transit platform		Relatively Moderate	1	2	0.5	No	No	No	None	0	1.5
Transit	24	PP2	Scenario 2	Midtown Station - SMART Terminal	Construct Park-and-Ride/Transit Terminal with 100 surface parking spaces		Relatively Moderate	1	2	0.5	No	No	No	None	0	1.5
Transit	33	PP2	Scenario 4	South DadeTransitwaypark-and-ride/terminalat Dadeland South	Expand Park-and-Ride and construct a new parking garage with ground-floor retail and office space.	\$76.75	Relatively Moderate	1	2	0.5	No	No	No	None	0	1.5
Transit	14	PP1	Scenario 2	South Dade Transitway Park-and-Ride at SW 136 Street (136 Street Station)	Lease parking with 100 parking spaces	\$0.00	Relatively Low	0.5	2	0.5	No	No	No	None	0	1
Transit	28	PP2	Scenario 4	South Dade Transitway Park-and-Ride at Dadeland North	Expand Park-and-Ride and construct a new parking garage with ground-floor retail and office space.	\$51.75	Relatively Low	0.5	2	0.5	No	No	No	None	0	1
Transit	35	PP4	Scenario 2	Intermodal Terminal at SW 88 St / HEFT - SMART Terminal	Lease 100 surface parking spaces for park-and-ride/transit center	\$0.00	Relatively Low	0.5	2	0.5	No	No	No	None	0	1
Transit	37	PP4	Scenario 2	Kendall/SR-874 Station - SMART Terminal	Construct Park-and-Ride with 100 surface parking spaces	\$15.00	Relatively Low	0.5	2	0.5	No	No	No	None	0	1
Transit	39	PP4	Scenario 2	Miami Executive Airport Park-and-Ride - SMART Terminal	Park-and-ride with 75 surface parking spaces and 4 bus bays	\$3.00	Relatively Low	0.5	2	0.5	No	No	No	None	0	1
Turnpike	2	PP1	Scenario 3	Golden Glades Truck Travel Center	Modal Systems Planning		Relatively High	1.5	3	1	No	Yes	Yes	Intermediate	4	6.5
Turnpike	3	PP1	Scenario 3	Southern Turnpike Mainline/SR 91	Interchange improvement		Relatively High	1.5	3	1	No	No	Yes	High	2	4.5
Turnpike	10	PP2	Scenario 3	Turnpike Extension / SR 821	Interchange improvement (ultimate)	\$2.44	Very Low	0	2	0.5	No	No	Yes	High	2	2.5
Turnpike	1	PP1	Scenario 3	SR 976/SW 40 Street	Intersection Improvements		Relatively Moderate	1	2	0.5	No	No	No	None	0	1.5
Turnpike	5	PP1	Scenario 3	Turnpike Extension / SR 821	Interchange improvement	\$28.63	Relatively Moderate	1	2	0.5	No	No	No	None	0	1.5
Turnpike	9	PP2	Scenario 3	Turnpike Extension / SR 821	Interchange improvement	\$11.37	Relatively Low	0.5	2	0.5	No	No	No	None	0	1

# Project Lines

Owner/Type	Map ID	Plan Period	Scenario	Facility	Limits (From)	Limits (To)	Description	Project Cost (\$Million)	Social Vulnerability	Social Vulnerability Score	Heat Rating (1-5)	Heat Score	SLR Low	SLR Low (100')	SLR Low (100') Score	SLR Intermediate	SLR Intermediate (100')	SLR High	SLR High (100')	SLR High (100') Score	Sea Level Rise Rating	Low Score	Intermediate SLR Score	High Score	Sum Score	
Bike/Ped	0			10th Street	Washington Avenue	Biscayne Bay Path			Relatively High	1.5	2	2.5	No	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	0	2	2	11
Bike/Ped	0			Pennsylvania Avenue	Washington Avenue	27th Street			Relatively High	1.5	2	2.5	No	No	0	Yes	Yes	1	Yes	Yes	1	Intermediate	0	2	2	10
Bike/Ped	0			6th Street	Washington Avenue	West Avenue			Relatively High	1.5	2	2.5	No	Yes	0	Yes	Yes	1	Yes	Yes	1	Intermediate	0	2	2	10
Bike/Ped	0			Pennsylvania Ave					Relatively High	1.5	2	2.5	No	No	0	Yes	Yes	1	Yes	Yes	1	Intermediate	0	2	2	10
Bike/Ped	0			M-Path Greenlink					Relatively High	1.5	2	2.5	No	No	0	Yes	Yes	1	Yes	Yes	1	Intermediate	0	2	2	10
Bike/Ped	0			Biscayne Everglades Trail (Seg 6)	SR 997/Krome Avenue	Biscayne National Park			Relatively High	1.5	5	2.5	No	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	0	1	1.5	9.5
Bike/Ped	0			Biscayne-Everglades Greenway (Seg 6)					Relatively High	1.5	5	2.5	No	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	0	1	1.5	9.5
Bike/Ped	0			17th Street	Washington Avenue	West Avenue			Relatively High	1.5	2	2.5	No	Yes	0	Yes	Yes	1	Yes	Yes	1	Intermediate	0	1.5	2	8.5
Bike/Ped	0			72nd Street	SR A1A/Collins Avenue	Dickens Avenue			Relatively High	1.5	2	2.5	No	Yes	1	No	Yes	1	Yes	Yes	1	Low	0	0	2	9
Bike/Ped	108			SW 1st Street	SW 5 Avenue	SW 2nd Avenue			Relatively High	1.5	3	2.5	No	Yes	1	No	Yes	1	Yes	Yes	1	Low	0	0	1.5	8.5
Bike/Ped	0			Miami River Greenway (complete missing segments)	NW 36th Street	NW 12th Avenue			Relatively High	1.5	4	2.5	No	Yes	1	No	Yes	1	Yes	Yes	1	Low	0	0	1.5	8.5
Bike/Ped	0			SW 1st St					Relatively High	1.5	3	2.5	No	Yes	1	No	Yes	1	Yes	Yes	1	Low	0	0	1.5	8.5
Bike/Ped	0			Miami River Greenway (Missing Segments)					Relatively High	1.5	4	2.5	No	Yes	1	No	Yes	1	Yes	Yes	1	Low	0	0	1.5	8.5
Bike/Ped	0			19th Street/Dade Boulevard	Meridian Avenue	23rd Street			Relatively High	1.5	4	2.5	No	Yes	1	No	Yes	1	Yes	Yes	1	Low	0	0	1	8
Bike/Ped	0			1st Street	Meridian Avenue	16th Street			Relatively High	1.5	2	2.5	No	No	0	No	Yes	1	Yes	Yes	1	Intermediate	0	0	1	8.5
Bike/Ped	0			Espanola Way	SR A1A/Collins Avenue	Jefferson Avenue			Relatively Moderate	1	2	0.5	No	No	0	Yes	Yes	1	Yes	Yes	1	Intermediate	0	2	2	7.5
Bike/Ped	0			NW 11th Street	NW 12th Avenue	SW 2nd Avenue			Relatively High	1.5	4	2.5	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	7
Bike/Ped	0			NW 20th Street	NW 27th Avenue	US 1/Biscayne Boulevard			Relatively High	1.5	4	2.5	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	7
Bike/Ped	0			NW 11 St					Relatively High	1.5	4	2.5	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	7
Bike/Ped	0			SMART Terminal Connector - NW 20th St					Relatively High	1.5	4	2.5	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	7
Bike/Ped	0			SMART Terminal Connector - SR 968 / SW 1st St					Very High	2	4	1	No	Yes	1	No	Yes	1	Yes	Yes	1	Low	0	0	1	7
Bike/Ped	0			Lenox Avenue	Lincoln Lane N.	17th Street			Relatively Low	0.5	2	2.5	No	No	0	No	Yes	1	Yes	Yes	1	Intermediate	0	0	2	7
Bike/Ped	0			Meridian Avenue	16th Street	19th Street			Relatively High	1.5	2	2.5	No	No	0	No	No	0	Yes	Yes	1	High	0	0	2	7
Bike/Ped	0			Lincoln Lane N.	Meridian Avenue	Lenox Avenue			Relatively High	1.5	2	2.5	No	No	0	No	No	0	Yes	Yes	1	High	0	0	2	7
Bike/Ped	0			Meridian Ave					Relatively High	1.5	2	2.5	No	No	0	No	No	0	Yes	Yes	1	High	0	0	2	7
Bike/Ped	0			Lincoln Lane N.					Relatively High	1.5	2	2.5	No	No	0	No	No	0	Yes	Yes	1	High	0	0	2	7
Bike/Ped	0			15th Street	Washington Avenue	West Avenue			Relatively Moderate	1	2	0.5	No	No	0	Yes	Yes	1	Yes	Yes	1	Intermediate	0	1.5	2	7
Bike/Ped	0			15th Street	Washington Avenue	West Avenue			Relatively Moderate	1	2	0.5	No	No	0	Yes	Yes	1	Yes	Yes	1	Intermediate	0	1.5	2	7
Bike/Ped	0			NW 22nd Avenue	SW 2nd Street	Airport Expwy/SR 112			Very High	2	4	1	No	Yes	1	No	Yes	1	Yes	Yes	1	Low	0	0	0.5	6.5
Bike/Ped	0			SR 968/SW 1st Street	SW 24th Avenue	US 1/Biscayne Boulevard			Very High	2	4	1	No	Yes	1	No	Yes	1	Yes	Yes	1	Low	0	0	0.5	6.5
Bike/Ped	0			NW 22nd Ave					Very High	2	4	1	No	Yes	1	No	Yes	1	Yes	Yes	1	Low	0	0	0.5	6.5
Bike/Ped	0			NW 11 St					Relatively High	1.5	4	2.5	No	No	0	No	Yes	1	Yes	Yes	1	Intermediate	0	0.5	6.5	6.5
Bike/Ped	0			W Okeechobee Road	NW 103rd Street	W 18th Avenue			Very High	2	4	1	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	6
Bike/Ped	0			SE 3rd Street	S Biscayne Boulevard	SE 1st Avenue			Relatively Low	0.5	3	2.5	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	6
Bike/Ped	0			SW 12th Avenue	SW 13th Street	NW 46th Street			Very High	2	4	1	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	6
Bike/Ped	0			SW 37th Avenue	Fonseca Avenue	NW South River Drive			Very High	2	4	1	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	6
Bike/Ped	0			W Okeechobee Road					Very High	2	4	1	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	6
Bike/Ped	0			SE 3rd St					Relatively Low	0.5	3	2.5	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	6
Bike/Ped	0			SMART Terminal Connector - SW 12th Ave					Very High	2	4	1	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	6
Bike/Ped	0			SMART Terminal Connector - SW 37th Ave					Very High	2	4	1	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	6
Bike/Ped	0			SW 344th Street	South Transitway	SW 152nd Avenue			Relatively High	1.5	4	2.5	No	No	0	No	Yes	1	No	Yes	1	Intermediate	0	0	0	6
Bike/Ped	0			SMART Terminal Connector - SW 344th St					Relatively High	1.5	4	2.5	No	No	0	No	Yes	1	No	Yes	1	Intermediate	0	0	0	6
Bike/Ped	0			SW 104th Street	SW 77 Avenue	SW 57 Avenue			Relatively Low	0.5	2	2.5	No	No	0	Yes	Yes	1	Yes	Yes	1	Intermediate	0	0.5	0.5	6
Bike/Ped	0			Washington Avenue	S. Pointe Drive	Dade Boulevard			Relatively High	1.5	2	2.5	No	No	0	No	No	0	Yes	Yes	1	High	0	0	0.5	5.5
Bike/Ped	0			SW 10th Street	Brickell Plaza	SW 1st Avenue			Very Low	0	3	2.5	No	No	0	No	No	0	Yes	Yes	1	High	0	0	2	5.5
Bike/Ped	0			US 1/5 Dixie Highway	SW 136th Street	Dadeland North Station			Relatively Low	0.5	2	2.5	No	No	0	No	Yes	1	No	Yes	1	Intermediate	0	0	0	5
Bike/Ped	0			SW 152nd Street	US 1/5 Dixie Highway	SW 67th Avenue			Relatively Low	0.5	3	2.5	No	No	0	No	Yes	1	No	Yes	1	Intermediate	0	0	0	5
Bike/Ped	0			SW 104 St					Relatively Low	0.5	2	2.5	No	No	0	No	No	0	No	Yes	1	Intermediate	0	0	0	5
Bike/Ped	0			US 1/5 Dixie Highway					Relatively Low	0.5	2	2.5	No	No	0	No	Yes	1	No	Yes	1	Intermediate	0	0	0	5
Bike/Ped	0			SW 152 St					Relatively Low	0.5	3	2.5	No	No	0	No	No	0	Yes	1	Intermediate	0	0	0	5	
Bike/Ped	0			Convention Center Drive	17th Street	Dade Boulevard			Relatively High	1.5	2	2.5	No	No	0	No	No	0	No	Yes	1	High	0	0	0	5
Bike/Ped	0			Lincoln Lane N.	Washington Avenue	Meridian Avenue			Relatively High	1.5	2	2.5	No	No	0	No	No	0	No	Yes	1	High	0	0	0	5
Bike/Ped	0			NE 21st Avenue/NE 364th Street	Snake Creek Greenway	NE 23rd Avenue			Relatively High	1.5	3	2.5	No	No	0	No	No	0	No	Yes	1	High	0	0	0	5
Bike/Ped	0			Convention Center Drive					Relatively High	1.5	2	2.5	No	No	0	No	No	0	No	Yes	1	High	0	0	0	5
Bike/Ped	0			Lincoln Lane N					Relatively High	1.5	2	2.5	No	No	0	No	No	0	No	Yes	1	High	0	0	0	5
Bike/Ped	0			SMART Trails - NE 21st Ave / NE 164 Street					Relatively High	1.5	3	2.5	No	No	0	No	No	0	No	Yes	1	High	0	0	0	5
Bike/Ped	0			M-Path Greenlink	SW 67th Avenue	Miami River Greenway			Very Low	0	3	2.5	No	No	0	No	No	0	Yes	Yes	1	High	0	0	1.5	5
Bike/Ped	0			M-Path Greenlink					Very Low	0	3	2.5	No	No	0	No	No	0	Yes	Yes	1	High	0	0	1.5	5
Bike/Ped	0			CSX Rail Corridor	NW 7th Street	Perimeter Greenway			Relatively Moderate	1	2	0.5	No	Yes	1	No	Yes	1	No	Yes	1	High	0	0	4.5	4.5
Bike/Ped	0			SMART Trails - CSX Rail Corridor					Relatively Moderate	1	2	0.5	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	4.5
Bike/Ped	0			Drexel Avenue	12th Street	14th Street			Relatively Moderate	1	2	0.5	No	No	0	No	No	0	Yes	Yes	1	High	0	0	2	4.5
Bike/Ped	0			Drexel Ave					Relatively Moderate	1	2	0.5	No	No	0	No	No	0	Yes	Yes	1	High	0	0	2	4.5
Bike/Ped	0			NW 27th Avenue	NW 183rd Street	NW 215th Street			Relatively Moderate	1	3	0.5	No	No	0	No	No	0	Yes	Yes						

# Project Lines

Owner/Type	Map ID	Plan Period	Scenario	Facility	Limits (From)	Limits (To)	Description	Project Cost (\$Million)	Social Vulnerability	Social Vulnerability	Heat Rating	Heat Score	SLR Low	SLR Low (100') Score	SLR Intermediate	SLR Intermediate (100') Score	SLR High	SLR High (100') Score	Sea Level Rise Rating	Low SLR Score	Intermediate SLR Score	High SLR Score	Sum Score
										Score	(1-5)												
Bike/Ped	0			SR 968/SW 1 St	SW 6 Ave	SW 2 Ave			Relatively High	1.5	3	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			Lincoln Road	Beachwalk	SR 124/Colinas Avenue			Relatively High	1.5	2	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			NE 2nd Avenue	NE 36th Street	NE 71st Street			Relatively High	1.5	3	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			W Davis Parkway	SW 187th Avenue	South Transway			Relatively High	1.5	4	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			N Miami Avenue	NE 14th Street	US 27/NW 36th Street			Relatively High	1.5	4	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			Marlin Road	Belview Dr	Old Cutler Road			Relatively High	1.5	3	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			SW 38th Avenue	Underline	Cadima Avenue			Relatively High	1.5	2	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			Improve Safety by Public Outreach	Various Locations	Various Locations			Relatively High	1.5	2	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			Initiatives					Relatively High	1.5	4	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			NW 3rd Court					Relatively High	1.5	4	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			SR 925 / NW 3 Ct					Relatively High	1.5	4	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			SR 925 / NW 3 Ave					Relatively High	1.5	4	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			SR 968 / SW 1 St					Relatively High	1.5	3	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			Lincoln Road					Relatively High	1.5	2	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			SMART Terminal Connector - NE 2nd Ave					Relatively High	1.5	3	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			SMART Terminal Connector - W Davis Parkway					Relatively High	1.5	4	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			SMART Terminal Connector - N Miami Ave					Relatively High	1.5	4	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			Marlin Road					Relatively High	1.5	3	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			SMART Trails - SW 38th Ave	Beachwalk	Meridian Avenue			Relatively High	1.5	2	2.5	No	No	0	No	No	0	None	0	0	0	4
Bike/Ped	0			13th Street		Old Cutler Road			Relatively Moderate	1	2	0.5	No	No	0	No	Yes	1	High	0	0	1.5	4
Bike/Ped	0			SW 184th Street	US 1/5 Dixie Highway				Relatively Moderate	1	3	0.5	No	No	0	Yes	1	Intermediate	0	0	0	0	3.5
Bike/Ped	0			SW 184 St					Relatively Moderate	1	3	0.5	No	No	0	Yes	1	Intermediate	0	0	0	0	3.5
Bike/Ped	0			NW 25th Street - Route B	NW 37th Avenue	NW South River Drive			Data Unavailable	0	4	2.5	No	No	0	No	Yes	1	High	0	0	0	3.5
Bike/Ped	0			SMART Trails - NW 25th Street - Route B					Data Unavailable	0	4	2.5	No	No	0	No	Yes	1	High	0	0	0	3.5
Bike/Ped	0			NW 22nd Avenue	NW 36th Street	NW 111th Street			Very High	2	4	1	No	No	0	No	No	0	None	0	0	0	3
Bike/Ped	0			North Miami Avenue/ NE 1st Avenue	NW 5th Street	NW 17th Street			Relatively Low	0.5	4	2.5	No	No	0	No	No	0	None	0	0	0	3
Bike/Ped	0			US 136 St	US-1	Old Cutler Road			Relatively Low	0.5	2	2.5	No	No	0	No	No	0	None	0	0	0	3
Bike/Ped	0			SR 986/SW 72nd Street	SW 57th Avenue	SW 64th Court			Relatively Low	0.5	2	2.5	No	No	0	No	No	0	None	0	0	0	3
Bike/Ped	0			Canal	SW 62nd Avenue	SW 69th Avenue			Relatively Low	0.5	2	2.5	No	No	0	No	No	0	None	0	0	0	3
Bike/Ped	0			US 27/NW 36th Street	NW 19th Avenue	US 1/Biscayne Boulevard			Very High	2	4	1	No	No	0	No	No	0	None	0	0	0	3
Bike/Ped	0			FPL easement	SW 107th Avenue	South Dade Transway			Relatively Low	0.5	2	2.5	No	No	0	No	No	0	None	0	0	0	3
Bike/Ped	0			NW 22nd Ave					Very High	2	4	1	No	No	0	No	No	0	None	0	0	0	3
Bike/Ped	0			North Miami Ave / NE 1st Ave					Relatively Low	0.5	4	2.5	No	No	0	No	No	0	None	0	0	0	3
Bike/Ped	0			US 136 St					Relatively Low	0.5	2	2.5	No	No	0	No	No	0	None	0	0	0	3
Bike/Ped	0			SR 986 / SW 72 St					Relatively Low	0.5	2	2.5	No	No	0	No	No	0	None	0	0	0	3
Bike/Ped	0			Coral Gables Canal					Relatively Low	0.5	2	2.5	No	No	0	No	No	0	None	0	0	0	3
Bike/Ped	0			SMART Terminal Connector - US 27 / NW 36th St					Very High	2	4	1	No	No	0	No	No	0	None	0	0	0	3
Bike/Ped	0			SMART Trails - FPL Easement					Relatively Low	0.5	2	2.5	No	No	0	No	No	0	None	0	0	0	3
Bike/Ped	0			Non-motorized Facility Improvements	Various Locations	Various Locations			N/A	0	1	2.5	No	No	0	No	No	0	None	0	0	0	2.5
Bike/Ped	0			County-Wide Complete Streets					N/A	0	1	2.5	No	No	0	No	No	0	None	0	0	0	2.5
Bike/Ped	0			Future Projects	Various Locations	Various Locations			N/A	0	1	2.5	No	No	0	No	No	0	None	0	0	0	2.5
Bike/Ped	0			SW/NW 1st Avenue	SW 2nd Street	SW 11th Street			Very Low	0	4	2.5	No	No	0	No	No	0	None	0	0	0	2.5
Bike/Ped	0			SW 11th Street	Brickell Plaza	SW 1st Avenue			Very Low	0	3	2.5	No	No	0	No	No	0	None	0	0	0	2.5
Bike/Ped	0			SW 11 St					Very Low	0	3	2.5	No	No	0	No	No	0	None	0	0	0	2.5
Bike/Ped	0			SW side of SW 117th Avenue	Roberta Hunter Park	Trail junction			Relatively Moderate	1	2	0.5	No	No	0	No	No	0	None	0	0	0	1.5
Bike/Ped	0			SW 1 Ct	SW 11 St	SW 7 St			Relatively Moderate	1	3	0.5	No	No	0	No	No	0	None	0	0	0	1.5
Bike/Ped	0			SW 57th Avenue	SR 986/72nd Street	SW 64th Street			Relatively Moderate	1	2	0.5	No	No	0	No	No	0	None	0	0	0	1.5
Bike/Ped	0			Snapper Creek Canal	SW 81st Avenue	US 1/5 Dixie Highway			Relatively Moderate	1	2	0.5	No	No	0	No	No	0	None	0	0	0	1.5
Bike/Ped	0			SW 168th Street	US 1/5 Dixie Highway	Old Cutler Road			Relatively Moderate	1	3	0.5	No	No	0	No	No	0	None	0	0	0	1.5
Bike/Ped	0			South of Snapper Creek Expressway	Underline				Relatively Moderate	1	2	0.5	No	No	0	No	No	0	None	0	0	0	1.5
Bike/Ped	0			SR 94/SW 88th Street	SR 997/Krome Avenue	SW 162nd Avenue			Relatively Moderate	1	2	0.5	No	No	0	No	No	0	None	0	0	0	1.5
Bike/Ped	0			SE 32nd Road/Brickell Avenue - Route A	Underline	SR 913/Rickenbacker Causeway			Relatively Moderate	1	2	0.5	No	No	0	No	No	0	None	0	0	0	1.5
Bike/Ped	0			SE/SW 26th Road - Route B	SR 913/Rickenbacker Causeway	Underline			Relatively Moderate	1	2	0.5	No	No	0	No	No	0	None	0	0	0	1.5
Bike/Ped	0			SMART Trails - SW side of SW 117 Ave					Relatively Moderate	1	2	0.5	No	No	0	No	No	0	None	0	0	0	1.5
Bike/Ped	0			SMART Terminal Connector - Snapper Creek Canal					Relatively Moderate	1	2	0.5	No	No	0	No	No	0	None	0	0	0	1.5
Bike/Ped	0			SMART Trails - South of Snapper Creek Expressway					Relatively Moderate	1	2	0.5	No	No	0	No	No	0	None	0	0	0	1.5
Bike/Ped	0			SMART Trails - SR 94 / SW 88th Street					Relatively Moderate	1	2	0.5	No	No	0	No	No	0	None	0	0	0	1.5
Bike/Ped	0			SMART Trails - SE 32nd Road / Brickell Ave - Route					Relatively Moderate	1	2	0.5	No	No	0	No	No	0	None	0	0	0	1.5
Bike/Ped	0			SMART Trails - SE / SW 26th Road - Route B					Relatively Moderate	1	2	0.5	No	No	0	No	No	0	None	0	0	0	1.5

# Project Lines

Owner/Type	Map ID	Plan Period	Scenario	Facility	Limits (From)	Limits (To)	Description	Project Cost (\$Million)	Social Vulnerability Score	Heat Rating (1-5)	Heat Score	SLR Low (100%)	SLR Low Intermediate	SLR Intermediate (100%)	SLR Intermediate (100%) Score	SLR High (100%)	SLR High (100%) Score	Sea Level Rise Rating	Low SLR Score	Intermediate SLR Score	High SLR Score	Sum Score		
CMP	0						Very High	2	3	1	Yes	Yes	1	Yes	Yes	1	Yes	1	Low	1.5	1.5	1	10	
CMP	0						Very High	2	2	1	No	Yes	1	No	Yes	1	Yes	1	Low	0	0	1.5	7.5	
CMP	0						Relatively High	1.5	4	2.5	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	7	
CMP	0						Very High	2	4	1	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	6	
CMP	0						Very High	2	4	1	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	6	
CMP	0						Relatively High	1.5	3	2.5	No	No	0	No	Yes	1	No	Yes	1	Intermediate	0	0	6	
CMP	0						Relatively High	1.5	3	2.5	No	No	0	No	No	0	Yes	Yes	1	High	0	0	1	
CMP	0						Relatively High	1.5	3	2.5	No	No	0	No	No	0	Yes	Yes	1	High	0	0	5	
CMP	0						Relatively High	1.5	4	2.5	No	No	0	No	No	0	No	No	0	High	0	0	5	
CMP	0						Relatively High	1.5	2	2.5	No	No	0	No	No	0	No	No	0	None	0	0	4	
CMP	0						Relatively High	1.5	2	2.5	No	No	0	No	No	0	No	No	0	None	0	0	4	
CMP	0						Relatively High	1.5	3	2.5	No	No	0	No	No	0	No	No	0	None	0	0	4	
CMP	0						Relatively High	1.5	3	2.5	No	No	0	No	No	0	No	No	0	None	0	0	4	
CMP	0						Relatively Low	0.5	2	2.5	No	No	0	No	No	0	No	No	0	None	0	0	3	
CMP	0						Relatively Moderate	1	3	0.5	No	No	0	No	No	0	No	No	0	None	0	0	1.5	
CMP	0						Relatively Moderate	1	4	0.5	No	No	0	No	No	0	No	No	0	None	0	0	1.5	
CMP	0						Relatively Moderate	1	2	0.5	No	No	0	No	No	0	No	No	0	None	0	0	1.5	
DTPW	33	PP3		NW 97 Avenue	NW 122 Street	NW 138 Street	Widen to 4 lanes		1.5	1	2.5	Yes	Yes	1	Yes	Yes	1	Low	2	2	2	13		
DTPW	45	PP4		NW 32 Avenue	NW 21 Street	N River Drive	New 4 lane Road and bridge		1.5	4	2.5	No	Yes	1	Yes	Yes	1	Low	0	1.5	1	9.5		
DTPW	12	PP2	Scenario 1	NW 107 Ave	NW 170 St	Broward County line	Extend NW 107 Ave to the County Line	\$34.80	Relatively Moderate	1	1	0.5	Yes	Yes	1	Yes	Yes	1	Low	1	2	2	9.5	
DTPW	42	PP3	Scenario 1	SW 200 St	US-1	Quail Roost Dr	Add 2 lanes and reconstruct	\$11.73	Relatively High	1.5	3	2.5	No	Yes	1	No	Yes	1	Low	0	0	0	7	
DTPW	39	PP2	Scenario 1	SW 72 St	SW 157 Ave	SW 117 Ave	Add 2 lanes and reconstruct	\$31.09	Relatively High	1.5	2	2.5	No	Yes	1	No	Yes	1	Low	0	0	0	7	
DTPW	47	PP4		SW 84 Street	SW 137 Avenue	SW 165 Street	Widen to 6 lanes		1.5	2	1.5	No	Yes	1	No	Yes	1	Low	0	0	0	7		
DTPW	39	PP3		SW 117 Avenue	SW 152 Street	SW 104 Street	Widen to 6 lanes		1.5	2	2.5	No	0	Yes	Yes	1	Intermediate	0	0.5	0.5	7			
DTPW	29	PP2	Scenario 1	SW 137 Ave	US-1	SW 184 St	Add 2 lanes and reconstruct	\$11.07	Relatively Moderate	1	3	0.5	Yes	Yes	1	Yes	Yes	1	Low	1	0.5	0.5	6.5	
DTPW	34	PP3		NW 107 Avenue	NW 106 Avenue	NW 122 Street	New 4L Roadway		2	2	1	No	Yes	Yes	1	Yes	Yes	1	Intermediate	0	1	0.5	6.5	
DTPW	38	PP2	Scenario 3	SW 42 St	HEFT	SW 137 Ave	Widen to 6 lanes	\$10.59	Relatively High	1.5	2	2.5	No	No	0	No	Yes	1	Intermediate	0	0	0	6	
DTPW	10	PP2		NW 22nd Avenue	NW 103 Street	NW 119 Street	Widen to 6 lanes		1.5	4	2.5	No	No	0	Yes	1	No	Yes	1	Intermediate	0	0	6	
DTPW	11	PP2		NW 97 Avenue	NW 58 Street	NW 52 Street	Add 2 Lanes and reconstruct		1	2	0.5	No	Yes	1	No	Yes	1	Low	0	0	1	5.5		
DTPW	17	PP2	Scenario 1	SW 117 Ave	SW 107 Ave	NW 73 Avenue	Add 2 lanes and reconstruct	\$8.54	Relatively High	1.5	2	2.5	No	No	0	No	Yes	1	High	0	0	0	5	
DTPW	46	PP4		NW 7th Street	NW 79 Avenue	NW 72 Avenue	Widen from 2 to 4 lanes and reconstruction		1.5	2	2.5	No	No	0	No	No	0	Yes	1	High	0	0	5	
DTPW	14	PP2	Scenario 1	NW South River Dr	NW 107 Ave	NW 74 Ave	Roadway and operational improvements	\$5.00	Relatively High	1.5	3	2.5	No	No	0	No	Yes	1	High	0	0	0	5	
DTPW	7	PP1		SW 344th Street	US 1	SW 172 Avenue	Widen from 4 to 6 lanes		1	4	0.5	No	Yes	1	No	Yes	1	Low	0	0	0	4.5		
DTPW	6	PP1	Scenario 1	SW 157 Ave	SW 8 St	SW 8 St	Widen from 2 to 4 lanes	\$17.39	Relatively Low	0.5	1	2.5	No	No	0	No	0	Yes	1	High	0	0	0	4
DTPW	13	PP2	Scenario 1	NW 107 Ave	NW 25 St	NW 41 St	Add 2 lanes and reconstruct	\$15.01	Relatively Low	0.5	2	2.5	No	No	0	No	0	Yes	1	High	0	0	0	4
DTPW	24	PP2	Scenario 1	SW 107 Ave	Quail Roost Dr	SW 160 St	Add 2 lanes and reconstruct	\$12.00	Relatively High	1.5	3	2.5	No	No	0	No	0	None	0	0	0	0	4	
DTPW	31	PP2	Scenario 1	SW 152 Ave	US-1	SW 312 St	Add 2 lanes and reconstruct	\$11.64	Relatively High	1.5	4	2.5	No	No	0	No	0	None	0	0	0	0	4	
DTPW	16	PP2	Scenario 1	SW 24 St	SW 87 Ave	SW 87 Ave	Add 2 lanes and reconstruct	\$16.31	Relatively High	1.5	2	2.5	No	No	0	No	0	None	0	0	0	0	4	
DTPW	43	PP3	Scenario 1	SW 312 St	SW 197 Ave	NW 14 Ave/SW 176 Ave	Add 2 lanes and reconstruct	\$29.61	Relatively High	1.5	5	2.5	No	No	0	No	0	None	0	0	0	0	4	
DTPW	21	PP2	Scenario 3	SW 102 Ave	SW 145 St	SW 146 St	Bridge over C-100 canal	\$4.55	Relatively High	1.5	2	2.5	No	No	0	No	0	None	0	0	0	0	4	
DTPW	40	PP3	Scenario 3	SW 122 Ave	SW 212 St	SW 210 St	Bridge over Black Creek canal	\$1.03	Relatively High	1.5	2	2.5	No	No	0	No	0	None	0	0	0	0	4	
DTPW	28	PP2	Scenario 3	SW 136 St	Harrison St	SW 112 Ave	Bridge over C-100 canal	\$2.23	Relatively High	1.5	2	2.5	No	No	0	No	0	None	0	0	0	0	4	
DTPW	5	PP1		SW 117 Avenue	US 1	SW 184 Street	Road Reconstruction/Traffic Operational Improvements		1.5	3	2.5	No	No	0	No	0	No	0	None	0	0	0	4	
DTPW	41	PP3		SW 127 Avenue	SW 42 Street	SW 26 Street	Widen to 4 lanes		1.5	2	2.5	No	No	0	No	0	No	0	None	0	0	0	4	
DTPW		PP4		SW 102 Avenue	SW 145 Street	SW 145 Street	New 2 Lane Roadway with Bridge Construction		1.5	2	2.5	No	No	0	No	0	No	0	None	0	0	0	4	
DTPW	8	PP2	Scenario 1	NE 151 St	NE 10 Ave	West Dixie Hwy	Add 2 lanes and reconstruct	\$13.15	Relatively High	1.5	3	2.5	No	No	0	No	0	None	0	0	0	0	4	
DTPW	9	PP2	Scenario 1	NE 159 St	NE 6 Ave	West Dixie Hwy	Add 2 lanes and reconstruct	\$14.33	Relatively High	1.5	3	2.5	No	No	0	No	0	None	0	0	0	0	4	
DTPW	4	PP1	Scenario 1	SW 42 St	SW 167 Ave	SW 157 Ave	Widen from 2 to 4 lanes	\$7.39	Relatively Low	0.5	2	2.5	No	No	0	No	0	None	0	0	0	0	3	
DTPW	36	PP3		SW 72 Avenue	SW 56 Street	SW 40 Street	Widen to 4 lanes		0.5	2	2.5	No	No	0	No	0	None	0	0	0	0	3		
DTPW	2	PP1	Scenario 1	Medley Freight Access Roadway Improvements	US-27 (Keechcree)	Medley	Bridge widening and canal improvements	\$0.26	Very High	2	2	1	No	No	0	No	0	None	0	0	0	0	3	
DTPW	3	PP1	Scenario 1	NW 12 St	NW 107 Ave	SR-826 (Palmetto)	Widening: 4 to 6 lanes	\$20.00	Relatively Low	0.5	2	2.5	No	No	0	No	0	None	0	0	0	0	3	
DTPW	25	PP2	Scenario 3	SW 120 St	SW 99 Court	SW 99 Ave	Bridge over C-100C canal	\$3.80	Very Low	0	2	2.5	No	No	0	No	0	None	0	0	0	0	2.5	
DTPW	20	PP2	Scenario 3	SW 77 Ave	SW 159 Terrace	SW 160 Terrace	Bridge over C-100A feeder canal	\$3.64	Very Low	0	3	2.5	No	No	0	No	0	None	0	0	0	0	2.5	
DTPW	37	PP3	Scenario 3	SW 77 Ave	SW 173 St	SW 174 St	Bridge over C-100A feeder canal	\$3.18	Very Low	0	3	2.5	No	No	0	No	0	None	0	0	0	0	2.5	
DTPW	27	PP2	Scenario 1	SW 127 Ave	SW 120 St	SW 144 St	Add 2 lanes and new 4 lane road construction	\$6.37	Relatively Moderate	1	2	0.5	No	No	0	No	0	None	0	0	0	0	1.5	
DTPW	30	PP2	Scenario 1	SW 147 Ave	SW 184 St	SW 152 St	Add 2 lanes and reconstruct	\$13.86	Relatively Moderate	1	2	0.5	No	No	0	No	0	None	0	0	0	0	1.5	
DTPW	38	PP3	Scenario 1	SW 80 St	US-1	SW 72 Ave	Add 2 lanes and center turn lane and reconstruct	\$7.02	Relatively Moderate	1	2	0.5	No	No	0	No	0	None	0	0	0	0	1.5	
DTPW	22	PP2	Scenario 1	SW 104 St	SW 147 Ave	SW 137 Ave	Add 2 lanes and reconstruct; widen 4 to 6 lanes	\$8.10	Relatively Moderate	1	2	0.5	No	No	0	No	0	None	0	0	0	0	1.5	
DTPW	23	PP2	Scenario 1	SW 104 St	Hammocks Blvd	SW 147 Ave	Add 2 lanes and reconstruct; widen 4 to 6 lanes	\$5.80	Relatively Moderate	1	2	0.5	No	No	0	No	0	None	0	0	0	0	1.5	
DTPW	26	PP2	Scenario 3	SW 127 Ave	South of SW 224 St	W Dixie Highway	Construct new 2 lane roadway	\$0.56	Relatively Moderate	1	3	0.5	No	No	0	No	0	None	0	0	0	0	1.5	

# Project Lines

Owner/Type	Map ID	Plan Period	Scenario	Facility	Limits (From)	Limits (To)	Description	Project Cost (\$Million)	Social Vulnerability	Social Vulnerability Score	Heat Rating (1-5)	Heat Score	SLR Low	SLR Low (100')	SLR Low (100') Score	SLR Intermediate	SLR Intermediate (100')	SLR Intermediate (100') Score	SLR High	SLR High (100')	SLR High (100') Score	Sea Level Rise Rating	Low SLR Score	Intermediate SLR Score	High SLR Score	Sum Score
FDOT OR	4	PP1	#N/A	I-195 Bus On Shoulders (Roadway Improvements)	I-195	Collins Ave	New Express Bus Service	\$7.81	Relatively High	1.5	4	2.5	No	Yes	1	No	Yes	1	Yes	Yes	1	Low	0	0	1	8
FDOT OR	20	PP4		I-195 Corridor	N of I-395	Miami Beach Convention Center S of NW 62 St	Planning Study Segment 2		Relatively High	1.5	4	2.5	No	No	0	Yes	1	Yes	Yes	1	Low	Intermediate	0	1	1	8
FDOT OR	15	PP2	Scenario 3	I-195 Corridor Improvements	NW 12th Ave	Alton Road	Operational and Capacity (PO&E and Design)		Relatively High	1.5	4	2.5	No	Yes	1	No	Yes	1	Yes	Yes	1	Low	0	0	0.5	7.5
FDOT OR	5	PP1	Scenario 3	Miami Gardens Dr / NW 186 St	I-75	57th Avenue	Widen 4 To 6 Lanes		Relatively High	1.5	4	2.5	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	7
FDOT OR	22	PP4		I-95 Corridor	S of GGI	S of Miami Gardens Dr	Planning Study Segment 4		Relatively High	1.5	3	2.5	No	No	0	No	Yes	1	No	Yes	1	Intermediate	0	0	0	6
FDOT OR	21	PP4		I-95 Corridor	S of NW 62 St	S of GGI	Planning Study Segment 3		Relatively High	1.5	4	2.5	No	No	0	No	0	No	No	Yes	1	High	0	0	0	5
FDOT OR	7	PP1	Scenario 3	SR 112 / I-195 Frontage Rd & Ramp	SR 934 / NE / NW 79 St	SR 934 / Oneway Pair	New Road		Relatively High	1.5	4	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4
FDOT OR	13	PP2		SR 934 / NE / NW 79 St	W of I-95 (13 Ct)		Traffic Flow Change and Complete Streets		Relatively High	1.5	4	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4
FDOT OR	3	PP1	Scenario 3	I-195 / SR 112 Texas U-Turn	NW 12 Ave	NW 10 Ave	Express lanes access for Miami Beach		Relatively High	1.5	4	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4
FDOT OR	16	PP2		SR 936 / SW 344 St	NW 182 Ave	SW 192 Ave	Widen 2 to 4 lanes		Relatively High	1.5	4	2.5	No	No	0	No	0	No	No	0	None	0	0	0	4	
FDOT OR	23	PP4		I-95 Corridor	SR 5 / US 1 / S Duie Hwy	S of I-135	Planning Study Segment 5		Relatively High	1.5	4	2.5	No	No	0	No	0	No	No	0	None	0	0	0	4	
FDOT OR	11	PP2		I-95 Corridor	S of Miami Gardens Drive	Broward/C/L	Planning Study Segment 5		Relatively Moderate	1	3	0.5	No	No	0	No	No	0	No	Yes	1	High	0	0	0	2.5
FDOT OR	9	PP1		SR 994 / Quail Roost Dr	SW 127 Ave	SW 127 Ave	Widen 2 to 4 lanes		Relatively Moderate	1	2	0.5	No	No	0	No	No	0	No	No	0	None	0	0	0	1.5
FDOT OR	14	PP2		SR 934 / NE / NW 81 / 82 St	W of I-95 (13 Ct)	SR 934 / Oneway Pair	Traffic Flow Change and Complete Streets		Relatively Moderate	1	4	0.5	No	No	0	No	No	0	No	No	0	None	0	0	0	1.5
FDOT SIS	38	PP4	Scenario 1	PortMiami Tunnel-Phase 82	Watson Island	MacArthur Causeway Bridge	Project Financing		Very Low	0	1	2.5	Yes	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	2	2	1.5	11
FDOT SIS	36	PP4	Scenario 1	PortMiami Tunnel	MacArthur Causeway	PortMiami	Port of Miami Tunnel Oversight Consultant		Very Low	0	1	2.5	Yes	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	2	2	1.5	11
FDOT SIS	39	PP4		PortMiami Tunnel-Phase A8	Watson Island	MacArthur Causeway Bridge	Project Financing		Very Low	0	1	2.5	Yes	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	2	2	1.5	11
FDOT SIS	27	PP2	Scenario 3	SR 826 / Palmetto Expy	US-1/S. DIXIE HWY	SR 836/DOLPHIN XWAY	Managed Lanes	\$462.00	Relatively High	1.5	2	2.5	No	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	0	0.5	0.5	8
FDOT SIS	41	PF	Scenario 3	SR 9A/I-95	US-1/SOUTH DIXIE HIGHWAY	SOUTH OF NW 62ND STREET	Project Development & Environmental	\$17.04	Relatively High	1.5	4	2.5	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	7
FDOT SIS	1	PP1		Golden Glades Interchange Various					Relatively High	1.5	3	2.5	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	7
FDOT SIS	19	PP1		Ramp Improvement	W of I-95	MacArthur Causeway Bridge	Interchange Ramp (New)	\$804.00	Relatively High	1.5	4	2.5	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	7
FDOT SIS	20	PP1		SR 836 / I-95			Bridge replacement and add lanes	\$207.37	Very High	2	4	1	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	6
FDOT SIS	12	PP1		SR 826 / I-95 Interchange Ramps	NW 17 Ave	I-95 (MDX)	Interchange Improvement	\$207.37	Very High	2	4	1	No	Yes	1	Yes	1	No	Yes	1	Low	0	0	0	6	
FDOT SIS	15	PP1		SR 826 IB ramp to SR			Interchange ramp (new)	\$187.76	Relatively High	1.5	3	2.5	No	No	0	No	Yes	1	No	Yes	1	Intermediate	0	0	0	6
FDOT SIS	5	PP1		SR 9A / I-95 SB ramp to WB SR 836			Interchange improvement	\$41.15	Relatively High	1.5	4	2.5	No	No	0	No	Yes	1	No	Yes	1	Intermediate	0	0	0	6
FDOT SIS	7	PP1		SR 25 / Okeechobee Rd	Broward County Line	W of HEFT	Add lanes and reconstruct	\$63.24	Relatively High	1.5	1	2.5	No	No	0	No	0	Yes	1	High	0	0	0	1	6	
FDOT SIS	37	PP4	Scenario 1	PortMiami Tunnel-Phase 52	Watson Island	MacArthur Causeway Bridge	Project Financing		Very Low	0	1	2.5	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	5.5
FDOT SIS	35	PP4	Scenario 3	I-95	US 1 to Broward County line	Managed Lanes / Capacity / Operations	Ultimate Plan Study	\$390.84	Relatively High	1.5	4	2.5	No	No	0	No	No	0	Yes	Yes	1	High	0	0	0.5	5.5
FDOT SIS	26	PP2	Scenario 1	SR 826 / Palmetto Expy / GGI	W. OF NW 17TH AVENUE	I-95 (EXPRESS LANES)	Managed Lanes	\$225.22	Relatively High	1.5	4	2.5	No	No	0	No	No	0	No	Yes	1	High	0	0	0	5
FDOT SIS	42	PF	Scenario 3	SR 9A/I-95	N. OF NW 151 STREET	BROWARD COUNTY LINE	Project Development & Environmental	\$9.42	Relatively High	1.5	4	2.5	No	No	0	No	No	0	No	Yes	1	High	0	0	0	5
FDOT SIS	32	PP4	Scenario 3	I-75 Corridor Improvements	NW 138th St	SR 826	Ultimate Plan	\$64.70	Relatively High	1.5	2	2.5	No	No	0	No	No	0	No	Yes	1	High	0	0	0	5
FDOT SIS	10	PP1	Scenario 1	SR 25 / Okeechobee Rd & SR 826 / Palmetto Expressway	Various Ramps		Modify Interchange	\$87.69	Very High	2	3	1	No	No	0	No	No	0	No	Yes	1	High	0	0	0	4
FDOT SIS	24	PP2	Scenario 1	SR 25 / Okeechobee Rd	E. OF NW 116 WAY	E. OF NW 87 AVE (CONCRETE)	Degrass Okeechobee Mainline Under NW 87 Ave And Provide Service Road For Local Movements To NW 87 Ave; Realign NW 103 Further to the North; Provide NW 87 Ave SB Left Turn Flyover Ramp; Relocate The NW 105 Way	\$355.95	Relatively High	1.5	2	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4
FDOT SIS	9	PP1	Scenario 1	SR 25 / Okeechobee Rd	EAST OF NW 87 AVE	NW 79 AVE (CONCRETE)	Provide Additional Through Lane Each Direction and Intersection Turning Radius to Facilitate Operations At Intersections at NW 95 St and at NW 79 Ave	\$78.25	Relatively High	1.5	2	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4
FDOT SIS	4	PP1	Scenario 3	NE 203 St Intersection Improvements	BETWN SR 5/US-1 & W. DIXIE HWY		Grade Crossing/Signal		Relatively High	1.5	2	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4
FDOT SIS	28	PP2	Scenario 3	Truck Parking At GGI East Lot		V			Relatively High	1.5	3	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4
FDOT SIS	23	PP1		SR 936 / Palm Dr	SR 997 / Krome Ave	SR 5 / US 1 (Truck Bypass)	Widen/Resurface Exist Lanes	\$1.30	Relatively High	1.5	4	2.5	No	No	0	No	0	No	No	0	None	0	0	0	4	
FDOT SIS	22	PP1		SR 997 / Krome Ave	SW 312 St / Campbell Dr	SW 296 St (Truck Bypass)	Add lanes and rehabilitate pavement	\$5.64	Relatively High	1.5	5	2.5	No	No	0	No	0	No	No	0	None	0	0	0	4	
FDOT SIS	21	PP1		SR 997 / Krome Ave	SW 296 St	S of SW 232 St	Add lanes and reconstruct	\$92.75	Relatively High	1.5	5	2.5	No	No	0	No	0	No	No	0	None	0	0	0	4	
FDOT SIS	18	PP1		SR 826 / Palmetto Expressway	I-75	Golden Glades Interchange	Add special use lane	\$97.95	Relatively High	1.5	4	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4
FDOT SIS	11	PP1		SR 826 Connector	at Golden Glades Interchange and various ramps		Add lanes and reconstruct	\$69.38	Relatively High	1.5	3	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4
FDOT SIS	8	PP1		SR 25 / Okeechobee Rd	E of NW 107 Ave	E of NW 116 Way (concrete)	Elevate Okeechobee Rd over NW 116 way; construct NW 116 way SB left turn flyover; construct SR 25 EB new off ramp for local access to NW 116 Way;	\$144.70	Relatively High	1.5	1	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4
FDOT SIS	40	PF	Scenario 3	SR 9A/I-95	N. OF NW 151 STREET	BROWARD COUNTY LINE	Project Development & Environmental	\$33.18	Relatively Moderate	1	3	0.5	No	No	0	No	Yes	1	No	Yes	1	Intermediate	0	0	0	3.5
FDOT SIS	43	PF	Scenario 3	SR 9A/I-95	N. OF NW 151 STREET	BROWARD COUNTY LINE	Project Development & Environmental		Relatively Moderate	1	4	0.5	No	No	0	No	Yes	1	No	Yes	1	Intermediate	0	0	0	3.5
FDOT SIS	6	PP1		SR 9A / I-95	N of Biscayne Canal	SR 860 / Miami Garden Dr	Widen/resurface exist lanes	\$65.19	Relatively Moderate	1	3	0.5	No	No	0	No	Yes	1	No	Yes	1	Intermediate	0	0	0	3.5
FDOT SIS	34	PP4	Scenario 3	I-75 / Miami Gardens Interchange	Turnpike (HEFT)	NW 170th St	Modify Interchange	\$71.67	Relatively Moderate	1	1	0.5	No	No	0	No	No	0	No	Yes	1	High	0	0	0	2.5
FDOT SIS	13	PP1		SR 826 / Palmetto Expressway	I-75	N of Canal C-8 Bridge (approx NW 162nd St)	Add lanes and reconstruct	\$221.75	Relatively Moderate	1	2	0.5	No	No	0	No	No	0	No	Yes	1	High	0	0	0	2.5
FDOT SIS	16	PP1	Scenario 1	SR 826 / Palmetto Expressway	E. OF NW 57 AVE	E. OF NW 42 AVE	Managed Lanes	\$96.88	Relatively Moderate	1	4	0.5	No	No	0	No	No	0	No	No	0	None	0	0	0	1.5
FDOT SIS	17	PP1	Scenario 1	SR 826 / Palmetto Expressway	E. OF NW 42 AVE	E. OF NW 32 AVE	Managed Lanes	\$93.56	Relatively Moderate	1	4	0.5	No	No	0	No	No	0	No	No	0	None	0	0	0	1.5
FDOT SIS	15	PP1	Scenario 1	SR 826 / Palmetto Expressway	E. OF NW 67 AVE	E. OF NW 57 AVE	Managed Lanes	\$109.82	Relatively Moderate	1	2	0.5	No	No	0	No	No	0	No	No	0	None	0	0	0	1.5
FDOT SIS	25	PP2	Scenario 1	SR 826 / Palmetto Expy	E. OF NW 32 AVE	W. OF NW 17 AVE	Managed Lanes	\$92.44	Relatively Moderate	1	4	0.5	No	No	0	No	No	0	No	No	0	None	0	0	0	1.5
FDOT SIS	14	PP1		SR 826 / Palmetto Expressway	N of Canal C-8 Bridge (NW 162 St)	E of NW 67 Ave	Add lanes and reconstruct	\$125.15	Relatively Moderate	1	2	0.5	No	No	0	No	No	0	No	No	0	None	0	0	0	1.5



# Project Lines

Owner/Type	Map ID	Plan Period	Scenario	Facility	Limits (From)	Limits (To)	Description	Project Cost (\$Million)	Social Vulnerability	Social Vulnerability Score	Heat Rating (1-5)	Heat Score	SLR Low	SLR Low (100%)	SLR Low (100%) Score	SLR Intermediate	SLR Intermediate (100%) Score	SLR High (100%)	SLR High (100%) Score	Sea Level Rise Rating	Low SLR Score	Intermediate SLR Score	High SLR Score	Sum Score			
Freight	12	PP2		SR 916/NW 27 Avenue	SR 916/NW 135 Street	SR 9	Widen from 6 to 8 lanes divided arterial		Relatively High	1.5	4	2.5	Yes	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	1.5	1.5	1	11	
Freight	23	PP4		SR 817/NW 27 Avenue	North Corridor		Incorporate truck considerations to the SMART Plan		Relatively High	1.5	4	2.5	Yes	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	0.5	0.5	0.5	8.5	
Freight	4	PP1		US 27/Okeechobee Road	SR 821/HEFT	NW 74 Street	Traffic Adaptive Signal System		Very High	2	3	1	Yes	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	1	1	0.5	8.5	
Freight	2	PP1		SR 826/Palmetto Exp	SR 836/Dolphin Exp	US 27/Okeechobee Road	AV/CV Technology		Very High	2	3	1	No	No	0	Yes	Yes	1	Yes	Yes	1	Intermediate	0	0.5	1	6.5	
Freight	1	PP1		SR 821/HEFT	SR 836/Dolphin Exp	NW 106 Street	AV/CV Technology		Relatively Moderate	1	2	0.5	No	No	0	Yes	Yes	1	Yes	Yes	1	Intermediate	0	1.5	1.5	6.5	
Freight	16	PP2		SR 934/SW 74 Street	SR 826/Palmetto Exp	US 27/Okeechobee Road	Widen from 2 to 8 lanes divided arterial		Very High	2	3	1	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	6	
Freight	8	PP2		NW 106 Street	NW 116 Way	NW South River Drive	Widen from 2 to 4 lanes divided arterial		Very High	2	2	1	No	No	0	No	Yes	1	No	Yes	1	Intermediate	0	0	0	5	
Freight	22	PP3		SR 969/NW 72 Avenue	SR 836/Dolphin Exp	US 27/Okeechobee Road	Widen from 6 to 8 lanes divided arterial and TSM&O		Relatively High	1.5	3	2.5	No	No	0	No	No	0	No	Yes	1	High	0	0	0	5	
Freight	10	PP2		NW 41 Street	1 mile west of NW 122 Avenue	SR 821/HEFT	Widen from 2 to 4 lanes divided arterial		Very Low	0	2	2.5	No	No	0	No	No	0	Yes	Yes	1	High	0	0	1.5	5	
Freight	14		Scenario 1	NW South River Dr					Relatively High	1.5	3	2.5	No	No	0	No	No	0	No	Yes	1	High	0	0	0	5	
Freight	15	PP2		SR 934/SW 74 Street	NW 87 Avenue	SR 826/Palmetto Exp	TSM&O		Very High	2	2	1	No	No	0	No	No	0	No	Yes	1	High	0	0	0	4	
Freight	9	PP2		NW 116 Way and Beacon Station Blvd	NW South River Drive	US 27/Okeechobee Road	Traffic Operation Improvements		Relatively High	1.5	2	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4	
Freight	11	PP2		NW North River Drive	SR 948/NW 36 Street	SR 9/NW 27 Avenue	RRR and Truck Parking		Relatively High	1.5	4	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4	
Freight	21	PP2		SR 969/NW 72 Avenue	SR 934/SW 74 Street	SR 836/Dolphin Exp	Traffic Operation Improvements and Access Management		Relatively Moderate	1	3	0.5	No	No	0	No	No	0	No	Yes	1	High	0	0	0	2.5	
LRT/Art	48			SW 137 Ave					Relatively High	1.5	2	2.5	No	No	0	No	No	Yes	1	No	Yes	1	Intermediate	0	0	0	6
LRT/Art	43		Scenario 1	SW 312 St					Relatively High	1.5	5	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4	
LRT/Art	4		Scenario 3						Relatively High	1.5	2	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4	
LRT/Art	4		Scenario 1	SW 42 St					Relatively Low	0.5	2	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	3	
LRT/Art	0			US 27 / Okeechobee Road					Very High	2	3	1	Yes	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	1.5	1.5	1	10	
LRT/Art	0			SR A1A					Very High	2	2	1	No	Yes	1	No	Yes	1	Low	0	0	1.5	7.5	0	0	7.5	
LRT/Art	0			SR 823 / Red Road					Relatively High	1.5	4	2.5	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	7	
LRT/Art	0			SR 9 / NW 27 Ave					Very High	2	4	1	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	6	
LRT/Art	0			SR 823 / Red Road / W 4th Ave / NW 57 Ave					Very High	2	4	1	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	6	
LRT/Art	0			SR 948 / NW 36 St / NW 41 St					Relatively High	1.5	3	2.5	No	No	0	No	Yes	1	No	Yes	1	Intermediate	0	0	0	6	
LRT/Art	0			US 1					Relatively High	1.5	3	2.5	No	No	0	No	No	0	Yes	Yes	1	High	0	0	1	6	
LRT/Art	0			SR 826 / NE 167 St / Miami Beach Blvd					Relatively High	1.5	3	2.5	No	No	0	No	No	0	No	Yes	1	High	0	0	0	5	
LRT/Art	0			SR 932 / 49 St					Relatively High	1.5	4	2.5	No	No	0	No	No	0	No	Yes	1	High	0	0	0	5	
LRT/Art	0			SR 976 / SW 40 St / Bird Road					Relatively High	1.5	2	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4	
LRT/Art	0			US 41 / SW 8 St					Relatively High	1.5	2	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4	
LRT/Art	0			E 33 St					Relatively High	1.5	3	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4	
LRT/Art	0			SW 56 St / Miller Drive					Relatively Low	0.5	2	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	3	
LRT/Art	0			NW 78 Ave Extension					Relatively Moderate	1	3	0.5	No	No	0	No	No	0	No	No	0	None	0	0	0	1.5	
LRT/Art	0			SR 847 / NW 47 Ave					Relatively Moderate	1	4	0.5	No	No	0	No	No	0	No	No	0	None	0	0	0	1.5	
LRT/Art	0			NW 67 Ave / Flamingo Rd					Relatively Moderate	1	2	0.5	No	No	0	No	No	0	No	No	0	None	0	0	0	1.5	
LRT/Free	35		Scenario 3						Relatively High	1.5	4	2.5	Yes	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	0.5	1.5	1.5	10.5	
LRT/Free	0								Relatively High	1.5	2	2.5	No	Yes	1	No	No	0	No	No	0	None	0	0	0	4	
MDX	10	PP4	Scenario 3	SR 924 / Gratiot Parkway West Extension	SR 826	HEFT	New Extension of SR 924 / Gratiot Parkway West to HEFT, including access ramps to west to SR 924, and I-75 north	\$327.88	Relatively High	1.5	2	2.5	Yes	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	1.5	1	1.5	11	
MDX	3	PP1		SR 836/Dolphin Expressway	NW 57 Avenue	NW 17 Avenue	Operational, Capacity, and Interchange Improvements		Very High	2	3	1	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	6	
MDX	7	PP2	Scenario 3	Kendall Parkway / SR 836 (Dolphin) SW Extension	SR 836 (Dolphin) terminus at NW 137th Ave / NW 12th street	SW 136 St	SR 836 SW Extension / Kendall Parkway, New Multimodal corridor	\$1,092.00	Relatively Moderate	1	2	0.5	No	No	0	No	No	0	Yes	Yes	1	High	0	0	0.5	3	
SR 836	0								Relatively Moderate	1	2	0.5	No	No	0	No	No	0	Yes	Yes	1	High	0	0	1	3.5	
Transit	40	PF	Scenario 2	Beach Corridor	Midtown Miami and Downtown	Miami Beach Convention Center	Rapid Transit connecting Midtown/Miami CBD to Miami Beach Convention Center area.	\$897.00	Relatively High	1.5	4	2.5	Yes	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	1.5	1	1.5	11	
Transit	3	PP1	Scenario 2	Beach Express South	Miami Beach Convention Ctr.	Downtown Intermodal Terminal	Implement Bus Express Rapid Transit service	\$9.60	Relatively High	1.5	3	2.5	No	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	0	1.5	1.5	10	
Transit	41	PF	Scenario 2	East-West Corridor	FIU-MMC	MIC at MIA	Rapid Transit connecting western Miami-Dade County to downtown Miami via the MIC	\$2,145.00	Relatively High	1.5	4	2.5	Yes	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	0.5	0.5	1	9	
Transit	8	PP1	Scenario 2	NW Miami-Dade Express (BERT)	Palmetto Metrorail Station	Ride Facility	Implement Bus Express Rapid Transit service	\$6.00	Very High	2	2	1	No	No	0	Yes	Yes	1	Yes	Yes	1	Intermediate	0	1.5	1.5	8	
Transit	1	PP1	Scenario 2	Beach Express North	Miami Beach Convention Ctr.	Golden Glades Multimodal Transportation Facility	Implement Bus Express Rapid Transit service	\$10.00	Relatively High	1.5	4	2.5	No	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	0	0	0.5	7.5	
Transit	34	PP3	Scenario 2	North Corridor	Tamiami Executive Airport	Dolphin Station at NW 12th St/HEFT	Elevated Fixed Guideway Rapid Transit connecting MLK Stations to Unity Station	\$1,895.00	Relatively High	1.5	4	2.5	No	Yes	1	No	Yes	1	Yes	Yes	1	Low	0	0	0.5	7.5	
Transit	42	PF	Scenario 2	Flagler Corridor (BRT)	Tamiami Station	Downtown Intermodal Terminal	Implement Bus Rapid Transit service	\$621.40	Very High	2	4	1	Yes	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	0.5	0.5	0.5	7.5	
Transit	5	PP1	Scenario 2	Florida's Turnpike Express (North)	FIU Panther Station	I-75/Miami Gardens Station	Implement Bus Express Rapid Transit service	\$4.72	Very High	2	2	1	No	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	0	0.5	1	7.5	
Transit	6	PP1	Scenario 2	Florida's Turnpike Express (South)	SW 344th Street Park-and-Ride Facility	Dolphin Station	Implement Bus Express Rapid Transit service	\$10.00	Relatively High	1.5	4	2.5	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	7	
Transit	9	PP1	Scenario 2	S Miami-Dade Express (BERT)	344 St Transitway Station	Dadeland North Metrorail Station	Implement Bus Express Rapid Transit service	\$9.00	Relatively High	1.5	4	2.5	No	Yes	1	No	Yes	1	No	Yes	1	Low	0	0	0	7	
Transit	2	PP1	Scenario 2	Beach Express Central	Miami Beach Convention Ctr.	Civic Center Metrorail Station	Implement Bus Express Rapid Transit service	\$8.00	Very High	2	4	1	No	Yes	1	No	Yes	1	Yes	Yes	1	Low	0	0	0.5	6.5	
Transit	36	PP4	Scenario 2	Kendall Corridor	West Kendall Transit Terminal at Kendall Drive and SW 162nd Avenue	Dadeland area Metrorail Stations	Rapid Transit connecting the West Kendall Transit Terminal to the Dadeland area Metrorail Stations	\$312.00	Relatively High	1.5	2	2.5	No	No	0	No	Yes	1	No	Yes	1	Intermediate	0	0	0	6	
Transit	4		Scenario 2						Relatively High	1.5	5	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4	
Transit	10	PP1	Scenario 2	South Dade Transitway	Dadeland South Metrorail Station	SW 344th St Park-and-Ride	Implement BRT along the Transitway	\$300.00	Relatively High	1.5	5	2.5	No	No	0	No	No	0	No	No	0	None	0	0	0	4	
Transit	19	PP1	Scenario 2	SW Miami-Dade Express (BERT)	Miami Executive Airport	Dadeland North Metrorail Station	Implement Bus Express Rapid Transit service	\$5.00	Relatively Moderate	1	2	0.5	No	No	0	No	No	0	No	Yes	1	High	0	0	0	2.5	
Turnpike	15	PP4		Turnpike Extension / SR 821	MP 0 - US 1	MP 2 - SW 312 St /Campbell Drive	Widen from 4 to 6 lanes with interchange improvements		Relatively High	1.5	4	2.5	Yes	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	1	1	1.5	10.5	
Turnpike	13	PP3	Scenario 1	Turnpike Extension / SR 821	MP 2 - SW 312th St / Campbell Dr	MP 5 - SW 288th St / Biscayne Dr	Widen from 4 to 6 lanes	\$37.46	Relatively Low	0.5	4	2.5	Yes	Yes	1	Yes	Yes	1	Yes	Yes	1	Low	1.5	1	1.5	10	
Turnpike	16	PP4	Scenario 3	Turnpike Extension / SR 821	MP 17 - Don Shula Expwy / SR 874	MP 39 -																					

## APPENDIX B

Communications	MDTPO CAV/AFV Strategies	Implementation Action	Partners	Timeframe*	Priority**
	Comm 1 - Meet with the institutional resiliency community members periodically	1.1 - Occasionally meet with residents of MDC to discuss AFV and CAV countywide implementation processes	MDC, FDOT	1-5 Years	Medium
		1.2 - Schedule quarterly meeting with resiliency experts within MDC	MDC, FDOT	1-5 Years	Medium
		1.3 - Assemble team of MDTPO employees to conduct resiliency meet ups (AFV and CAV Taskforces)	MDC	< 1	High
	Comm 2 - Meet with private industry to discuss where the public sector can invest to increase market demand	2.1 - Occasionally meet with private stakeholders of MDC to discuss AFV and CAV countywide implementation	MDC, Private Stakeholders (see list), FDOT	1-5 Years	Medium
	Comm 3 - Develop a marketing campaign that will promote CAV/AFV within the region	3.1 - Use marketing strategies to create CAV and AFV advertisements geared toward public	MDC	1-5 Years	Medium
		3.2 - Utilize social media to advertise CAV and AFV advancements within MDC	MDC	1-5 Years	Medium
		3.3 - Distribute monthly newsletter on CAVs and AFVs	MDC	1-5 Years	Medium

\* - To the best of our knowledge, the timeframe is based around the technology and resources available.

\*\* - The priority is based on the timeframe. If the project is short-term, it is a high priority. If a mid-term timeline, it is a medium priority. Longer-term action items, although still important, are lower priorities.

Long Range Transportation Planning	MDTPO CAV/AFV Strategies	Implementation Action	Partners	Timeframe*	Priority**
	LRTP 1 - Assess existing infrastructure to meet CAV needs	1.1 Review pavement markings to ensure visibly distinct markings for safe driving	DTPW, FDOT	1-5 Years	Medium
		1.2 Confirm bridges and pavement are load bearing for future (freight) vehicle	DTPW, FDOT	1-5 Years	Medium
		1.3 Review traffic signal equipment and traffic signal phasing/timing	DTPW, FDOT	5+	Low
		1.4 Develop a network plan of roadways that can safely accommodate truck platooning	DTPW, FDOT	1-5 Years	Medium
		1.5 Complete a feasibility study to prioritize locations with the greatest need and most cost-effective solutions	DTPW, FDOT	1-5 Years	Medium
	LRTP 2 - Improve transportation systems management and operations (TSM&O)	2.1 Program smart road projects, potentially along SMART corridors	DTPW, FDOT	< 1	High
		2.2 Continue research into emerging technology	FDOT, MDC	5+	Low
		2.3 Install innovative TSM&O equipment along key corridors	DTPW, FDOT	1-5 Years	Medium
	LRTP 3 - Determine AFV and CAV policies	3.1 Update County design standards to accommodate CAV and AFV technology	MDC	5+	Low
		3.2 Reduce parking minimum requirements	MDC	1-5 Years	Medium
		3.3 Review potential for electronic tolling and congestion pricing	MDC	1-5 Years	Medium
	LRTP 4 - Invest in additional infrastructure to meet net zero emissions goals	4.1 Coordinate with and support increased passenger and freight rail service	DTPW, Brightline, Railroad Operators	5+	Medium
		4.2 Include green infrastructure within LRTP project design process	MDC, DTPW	< 1	High
		4.3 Include multimodal projects into LRTP project selection process	MDC, DTPW	< 1	High
		4.4 Include renewable energy within LRTP project design process	MDC, DTPW	< 1	High
	LRTP 5 - Explore alternative funding options to account for the reduction in gas tax and revenues	4.1 - Evaluate adding a tax at public charging stations.	MDC	1-5 Years	Medium
		4.2 - Consider raising the gas tax to encourage the transition to AFVs.	MDC	1-5 Years	Medium
		4.3 - Test out congestion pricing along toll roads	MDC	1-5 Years	Medium
		4.4 - Consider implementing a pay-as-you-drive fee.	MDC	5+	Medium

\* - To the best of our knowledge, the timeframe is based around the technology and resources available.

\*\* - The priority is based on the timeframe. If the project is short-term, it is a high priority. If a mid-term timeline, it is a medium priority. Longer-term action items, although still important, are lower priorities.

Immediate Capital Investment Strategies	MDTPO CAV/AFV Strategies	Implementation Action	Partners	Timeframe*	Priority**
	CIS 1 - Coordinate with owners and operators of capital to establish a Capital Investment Strategy within MDC	1.1 - Conduct a gap analysis of AFV charging/fueling stations	MDC, Owners of Capital	1-5 Years	Medium
		1.2 - Conduct a gap analysis for CAV TSM&O equipment	MDC, Owners of Capital	1-5 Years	Medium
		1.3 - Continue monitoring EV registrations annually within MDC	MDC, FDOT	<1	High
	CIS 2 - Maintain a good state of repair on transportation facilities	2.1 - Maintain visible pavement markings.	DTPW, FDOT	1-5 Years	Medium
		2.2 - Maintain pavement conditions along roadways and bridges	DTPW, FDOT	1-5 Years	Medium
		2.3 - Maintain AFV charging/fueling facilities	DTPW, FDOT	1-5 Years	Medium
	CIS 3 - Scope land for potential renewable energy sources near AFC and EV charging stations	3.1 - Acquire additional ROW	MDC	1-5 Years	Medium
		3.2 - Consider utilizing land banks for solar farms	MDC	5+	Low
		3.3 - Partner with utility companies	MDC, Florida Power and Light Co	1-5 Years	Medium

\* - To the best of our knowledge, the timeframe is based around the technology and resources available.

\*\* - The priority is based on the timeframe. If the project is short-term, it is a high priority. If a mid-term timeline, it is a medium priority. Longer-term action items, although still important, are lower priorities.

Miami Dade County Research and Development Focus	MDTPO CAV/AFV Strategies	Implementation Action	Partners	Timeframe*	Priority**
	R&D 1 - Explore grant opportunities for research development.	1.1 - Regularly check federal grant opportunities for research funding	FDOT, MDC	1-5 Years	Medium
		1.2 - Determine strategic partners for grant applications	FDOT, MDC	<1	High
		1.3 - Identify additional research topics to explore that are high priorities	MDC	1-5 Years	Medium
	R&D 2 - Maintain relationships with Florida educational institutions and think tanks to monitor technological advancements	2.1 - Schedule bi-yearly meetings with education institutions to be updated on technological advancements	Educational Institutes	1-5 Years	Medium
		2.2 - Schedule bi-yearly meetings with think tanks to be updated on technological advancements	Miami Climate Alliance, SFRPC	1-5 Years	Medium
		2.3 - Attend conferences and seminars to learn about CAV and AFV technology.	FDOT, MDC	<1	High
	R&D 3 - Utilize CAV testing institutions that are or will be established	3.1 - Develop or maintain a relationship with SunTrax in FDOT District 1	FDOT	<1	High
		3.2 - Determine corridor/route for autonomous vehicle testing	MDC, FDOT	1-5 Years	Medium
		3.3 - Conduct a feasibility study on developing a CAV testing institution	MDC, FDOT	5+	Low

\* - To the best of our knowledge, the timeframe is based around the technology and resources available.

\*\* - The priority is based on the timeframe. If the project is short-term, it is a high priority. If a mid-term timeline, it is a medium priority. Longer-term action items, although still important, are lower priorities.

Regulations	MDTPO CAV/AFV Strategies	Implementation Action	Partners	Timeframe*	Priority**
	Regulation 1 - Establish a corridor-specific area where CAVs can be tested during low volume traffic periods.	1.1 - Create a list of potential corridors.	MDC	1-5 Years	Medium
		1.2 - Confirm the list with CAV stakeholders	CAV Owners, MDC	1-5 Years	Medium
	Regulation 2 - Support liability regulations that assign responsibility of fault to users of the CAVs	2.1 - Research existing regulations throughout country	MDC	1-5 Years	Medium
		2.2 - Work with legal counsel/lobbyists	MDC	5+	Low
	Regulation 3 - Consider establishing countywide emissions testing	3.1 - Determine the feasibility of vehicle emissions testing by evaluating potential pros and cons	MDC, FDOT	1-5 Years	Medium
		3.2 - Produce a countywide greenhouse gas (GHG) inventory and forecast.	MDC, FDOT	1-5 Years	Medium
		3.3 - Report GHG impacts of TIP projects and/or plan alternative.	MDC, FDOT	1-5 Years	Medium

\* - To the best of our knowledge, the timeframe is based around the technology and resources available.

\*\* - The priority is based on the timeframe. If the project is short-term, it is a high priority. If a mid-term timeline, it is a medium priority. Longer-term action items, although still important, are lower priorities.



## APPENDIX C

## Miami-Dade Resiliency Task 2 and 3 Stakeholder Meeting

### Questions and Comments

April 6, 2023

Questions:

**1. Q - Does the UF's tool aligns with the SE FL Regional Climate Change Compact SLR projections?**

- A - The SE FL Regional Climate Change Compact uses a mix of 2017 NOAA and Intergovernmental Panel on Climate Change (IPCC) projections. NOAA projections are more conservative. Therefore, the UF tool analysis does align with the SE FL study.

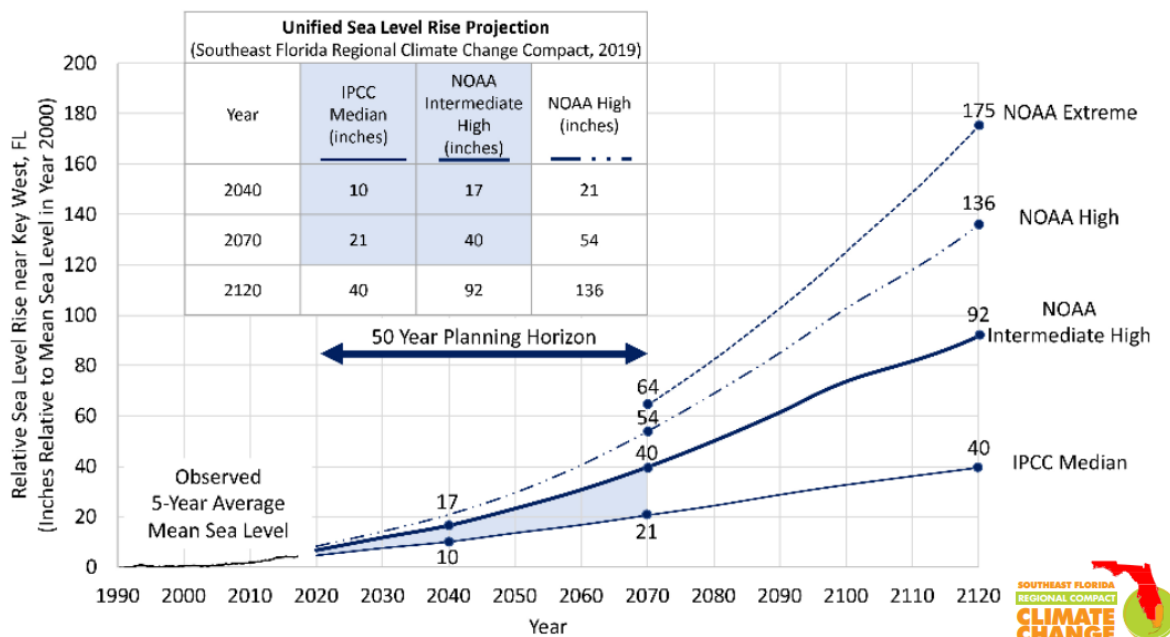


FIGURE 1: Unified Sea Level Rise Projection

**2. Q - South Florida Regional Transportation Authority (SFRTA) received a data request from West Palm Beach (WPB) to see if they can quantify the emissions that the trains release at the stations. SFRTA does not quantify this. Is there an emissions inventory or is it built into the tool?**

- A – This project is primarily focused on SLR rather than emissions. An emissions inventory was not part of the project scope, but may potentially be included in a future project. There is a roughly \$1 million grant that will be used for an emissions inventory that will be completed by March 2024. (Office of Resiliency related)

**3. Q - What is the end design life of cost-feasible projects? Are the 2045/2050 projects proposed to be constructed soon and have design lives of < 30 years?**

- A - Projects in the plan have various design lives. Projects in the 2045 LRTP are anticipated to move through planning and design by 2045.

**4. Q - What about storm surge?**

- A – We primarily looked at SLR, as data was readily available and the available data aligned with the planned/designed (ie: 2050 projections) project timelines. Storm surge should be included in future iterations of the tool.
- There is a report that looked at vulnerabilities of our roadways and there may be things that can be built upon within our study.

**5. Q - Can you describe how the total points distribution was determined, e.g., giving 2 points to social vulnerability and heat but 9 to SLR?**

- A - The points were given to weigh the impacts of sea level rise most heavily. Social vulnerability and heat vulnerability were used to better parse out the most vulnerable projects and areas.

**6. Q - Which assets are included in the study? MDC is required by the state to look at critical assets for the Resilient FL Program where the SLR assessment is required. They are still in the initial stages and would like to know more about complementing efforts.**

- A – This project focused only on 2045 L RTP Cost Feasible Projects. However, the methodology can be extended to a network-wide analysis. A discussion of this is shown within Task 5.

**7. Q - How will this assessment be used with planned projects?**

- A – There will be a resiliency process within the L RTP Cost Feasible process. Task 5 dives more into the details.

**8. Q – How does the tool take into consideration the impacts of SLR?**

- A – The highest amount of points is for low projection sea level rise. If a roadway is projected to be impacted by low SLR, it will also be impacted by higher amounts of SLR. Points were an “all or nothing” so points were only scored if there were SLR projections within 500 feet of the point (intersection). Lines (project segments) were scored based on the percentage of SLR along the line and which quartile the percentage fell in. This helped greater weigh projects where most of the segment would be impacted by SLR.

**Comments:**

1. Look at data available on compound flooding.
  - This may be added in a new iteration of the Resiliency tool. New data sources should be vetted and approved by MDTPO.
2. The Office of Resiliency often looks at vulnerability as an index made up of a combination of exposure and criticality of the asset (priority road or evacuation route, etc.).
  - The tool itself focused on exposure. Within Task 5, there is discussion of the criticality of assets, understanding that there are other elements to weigh within the resiliency process (such as evacuation routes, arterials roads, etc.).

3. CDMP Policy LU-13E. The design, location, and development of infrastructure and buildings operated by or on behalf of Miami-Dade County shall include an evaluation of sea level rise utilizing the Unified Sea Level Rise Projection.
4. This is an important report to consider. <https://www.energy.gov/sites/default/files/2023-01/the-us-national-blueprint-for-transportation-decarbonization.pdf>
5. It may be good to assign more points to the low and intermediate SLR projections since those scenarios are more likely and therefore are at higher risk/probability of being affected.
6. The Marine Corps is using storm surge within their studies. MDC staff may follow up with this data.
  - Christian will work with Jim to potentially follow up with a data sheet.
7. Socially vulnerable communities may have detrimental effects during project selection. Please consider the impacts a project may have on a community.

Sources:

- <https://southeastfloridaclimatecompact.org/unified-sea-level-rise-projections/> (NOAA and IPCC)
- <http://www.miamidade.gov/govaction/legistarfiles/Matters/Y2021/210608.pdf>
- <https://www.energy.gov/sites/default/files/2023-01/the-us-national-blueprint-for-transportation-decarbonization.pdf>

# MIAMI-DADE TPO

## CLIMATE RESILIENCY STUDY





# INTRODUCTIONS

## **Miami-Dade TPO**

**Franchesca Taylor**

Program Development Manager

## **TranSystems**

**Andy Nicol**

Project Manager

**Ryan McClure**

Senior Planner

**Dani Almanza**

Planner

## **Project Working Group**

**Florida Department of  
Transportation**

**Florida Power & Light**

**Florida Turnpike  
Enterprise**

**Miami-Dade  
Expressway Authority**

**Miami-Dade County  
Fleet Management**

**Miami-Dade County  
Transportation & Public  
Works**


**Miami-Dade County  
Regulatory and Economic  
Resources**

**Miami-Dade County Water &  
Sewer Department**

**South Florida Regional  
Transportation Authority**

# WHY STUDY RESILIENCY?

- **Planning Emphasis Areas** | FTA / FHWA was updated on 12/30/2021 – Transition to a Clean Energy, Resilient Future.
- **Natural Environment** | Changes in the natural environment such as sea level rise, storm severity, frequency, increased rainfall and flooding, heat, and the uncertain future can and should be planned for.
- **Manmade Environment** | Infrastructure investments should be made on roads, bridges, ports, bicycle/pedestrian, and transit facilities vulnerable to changes in the natural environment.



**Resiliency:** *The ability to anticipate, prepare for, and adapt to changing conditions to withstand, respond to, and recover from disruptions.*



# PROJECT WORKING GROUP

## Purpose

The PWG was selected to help steer the Climate Resiliency Study at key integral times.

Members will meet three to four times to provide essential guidance during the **nine-month project period**. All input and guidance is welcome and will be used in manner to aid resiliency as an important piece into Miami-Dade TPOs transportation planning efforts.



# SCOPE OF WORK



## **Task 1 – Literature Review & Data Gathering**

Technical Memo #1 - Existing Resiliency Efforts

## **Task 2 – Develop Priority List of Vulnerable Transportation Infrastructure & Risk Assessment**

Technical Memo #2 – Vulnerable Infrastructure

## **Task 3 – Electric & Alternative Fuels Market Research**

Technical Memo #3 – Current (2020) & Potential (2050) CAV & Alternative Fuel Vehicles/Infrastructure (Public Transit, micro-mobility, & personal/freight vehicles).

## **Task 4 – CAV & Alt Fuels Policy Recommendations**

Technical Memo #4 – CAV Strategic Plan and Recommendations

## **Task 5 – Project Coordination & Management**

Billing/Project Management & Meetings



# LITERATURE RESEARCH DATA GATHERING



# LOCAL RESEARCH

- MDC Climate Action Strategy
- 305Resilient
- MDC Electricity Master Plan
- Unified SLR Projections & Guidance Document
- MDC SLR Strategy
- MDC Sustainable Buildings Program
- Addressing Climate Driven Displacement
- TPO SMART Plan

**PWG SUGGESTIONS?**

# SEA LEVEL RISE

## Unified SLR Projections & Guidance Document

The document provides anticipated SLR in Southeast Florida through the year 2120. Three planning horizons:

- **Short Term:** by 2040, sea level is projected to rise 10 to 17 inches above 2000 mean sea level (MSL)
- **Medium Term:** by 2070, sea level is projected to rise 21 to 54 inches above 2000 MSL
- **Long Term:** by 2120, sea level is projected to rise 40 to 136 inches above 2000 MSL

## MDC SLR Potential Strategies

County's path to resiliency with SLR through five unique approaches:

- **Build on Fill:** Raise the land on artificial fill
- **Build Like the Keys:** Elevate structures on pilings and live with more water
- **Build on high ground around transit:** Promote new development in least flood prone areas near transit
- **Expand Greenways & Blueways:** Expand waterfront parks & make room for canals in flood prone areas
- **Create Green and Blue Neighborhoods:** Create a network of small spaces for water in yards, streets, & parks.

# REGIONAL, NATIONAL, & INTERNATIONAL RESEARCH

- Broward Climate Action Plan
- Southeast Florida Regional Compact Climate Change
- Hillsborough County MPO: Vulnerability Assessment & Adaptation Pilot Project Resilience and Durability to Extreme Weather Pilot Project: Corpus Christi MPO
- Plan Bay Area 2050
- Resilience & Durability to Extreme Weather in the H-GAC Region Pilot Program Report
- Climate Ready DC - Resilient Design Guidelines
- Charting The Course to Zero Port of Seattle's Maritime Climate & Air Action Plan
- Reimagina Puerto Rico Report
- New Amsterdam Climate – Roadmap Amsterdam Climate Neutral 2050

**PWG SUGGESTIONS?**



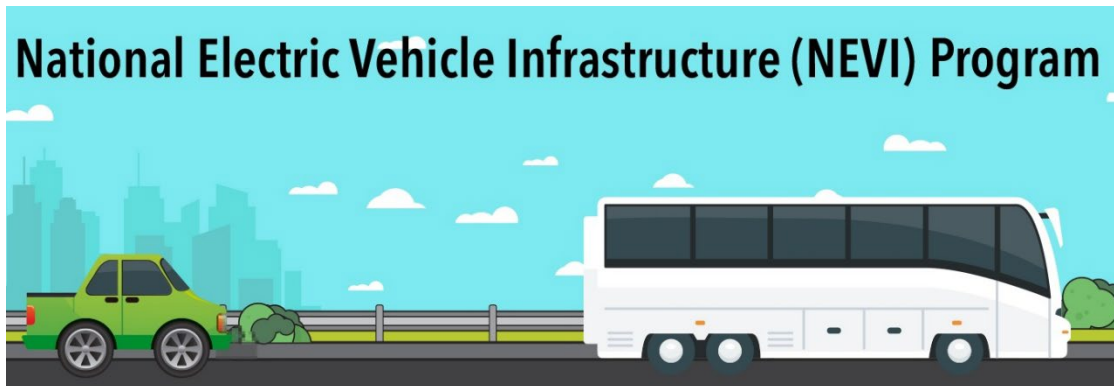
# FEDERAL & STATE GUIDANCE





# NATIONAL ELECTRIC VEHICLE INFRASTRUCTURE (NEVI) PROGRAM

- **NEVI** was established by the **BIL** and is primarily formula funding
- **Funds** → used on Designated Alternative Fuel Corridors **OR** on built-out roads
- Each State DOT must **submit a plan** to US DOT each Fiscal Year describing how NEVI funds will be used
- Requires DOT to **designate EV corridors for freight** along the NFHN and near ports, intermodal facilities, and warehouse locations
- **Eligible Projects** → EV Charging Infrastructure Open to Public



## NEVI 5-Year Funding

Bipartisan Infrastructure Law (BIL)				
2022	2023	2024	2025	2026
\$1.000 B	\$1.000 B	\$1.000 B	\$1.000 B	\$1.000 B

# FLORIDA'S ELECTRIC VEHICLE INFRASTRUCTURE DEPLOYMENT PLAN

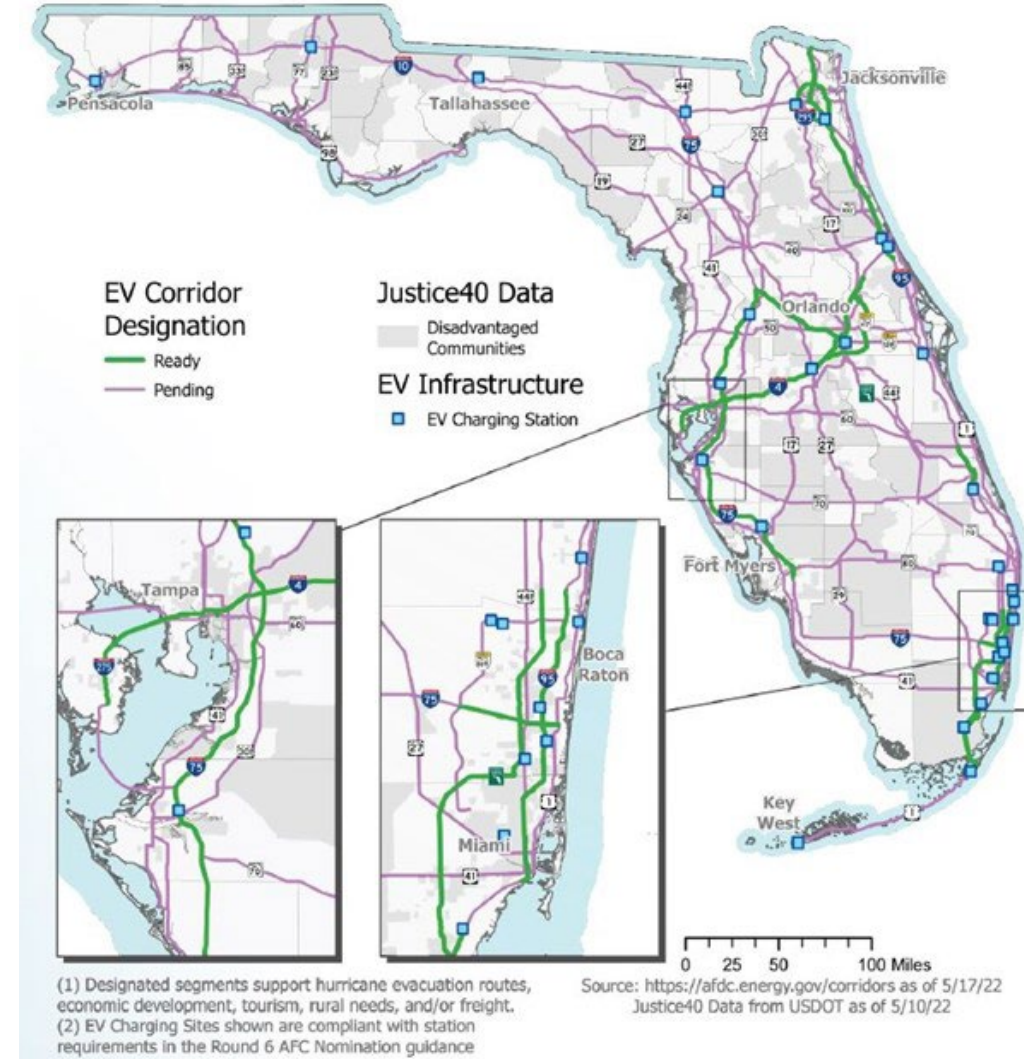
FDOT five-year Plan to accommodate the requirements of NEVI and improve EV infrastructure opportunities throughout the State

## Goals

- Expand energy sources for transportation fuels
- Position Florida as a national leader in EV infrastructure implementation
- Expand EV charging access
- Enhance Florida's overall transportation system
- Support emergency evacuation

## Actions

- Collect, maintain, and leverage information and data to inform decision-making
- Collaborate with partners to support the EV charging infrastructure network
- Plan for procurement of EV charging infrastructure
- Monitor potential risks that can delay deployment



# PROTECT FORMULA FUNDING PROGRAM

- The Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (**PROTECT**) Formula Program was developed under the Bipartisan Infrastructure Law.
- A total of **\$7.3 billion** in formula funding will be dispersed throughout five years to help states and communities improve their resiliency and respond and recover better following natural disasters.
- Florida will receive over **\$364 million** in funds.
- Eligible resiliency projects involve improvements to existing transportation infrastructure or constructing new infrastructure to improve community resiliency.



## PROTECT 5-Year Funding

Bipartisan Infrastructure Law (BIL)				
2022	2023	2024	2025	2026
\$1.40 B	\$1.43 B	\$1.46 B	\$1.49 B	\$1.52 B

Source: FHWA Bipartisan Infrastructure Law Fact Sheet



# RESILIENCY ACTION PLAN

The RAP is codified into Florida Law under **Statute Section 339.157** and will be developed in accordance with the BIL to enhance FDOT's opportunities with the Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) formula program. Discretionary funding is available through this program as well.

RAP will assess the impacts of flooding, storms, and SLR on Florida's State Highway System.

## GOALS

- Recommend strategies to **enhance infrastructure and operational resilience** of the State Highway System
- Recommend design changes to **retrofit existing and construct new** state highway facilities
- **Enhance partnerships** to address multijurisdictional resilience needs



# 2050 LONG RANGE TRANSPORTATION PLAN

## Potential Strategies

- Ensure **accurate data** for the Alternative Fuels Data Center (AFDC)
- **Explore opportunities** to include EV charging infrastructure along the NFHN
- Work to **market EV Charging Station Financing Authorization** (Florida Statute 163.08) to local jurisdictions
- **EV Infrastructure Support** – Florida utilities joined the National Highway Coalition (NEHC) to create a network of direct fast charging (DCFC) stations connection highway systems. Incorporate utilities in transportation project planning when in or near the AFC or the NHS.



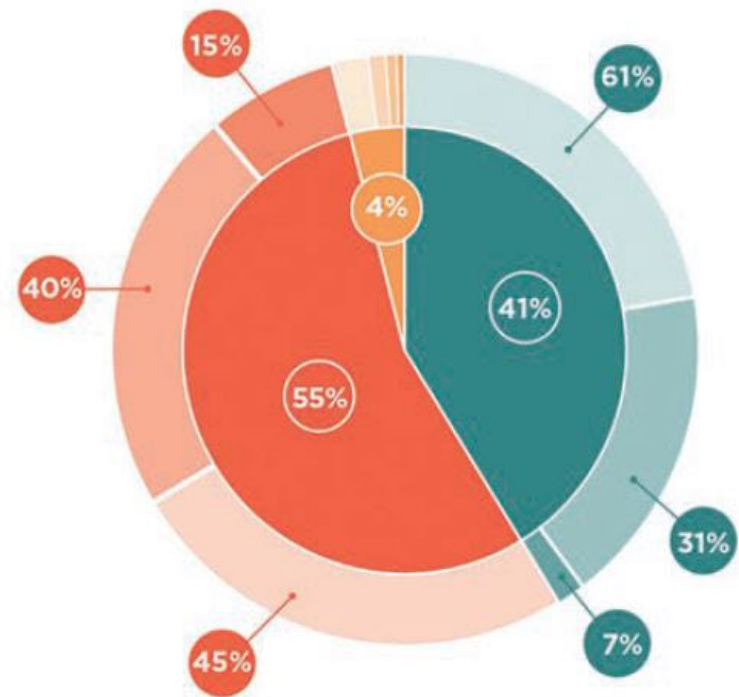
# LOCAL HIGHLIGHTS





# CLIMATE ACTION STRATEGY

This Plan documents countywide sources for emissions and strategizes on how to reduce them by 50% in 2030.



Communitywide Sources of Emissions 2019

- Buildings and Energy 41%
  - Electricity 61%
  - Other Fuels 31%
  - Natural Gas 7%
- Transportation and Land Use 55%
  - Air Travel 45%
  - Ground - Gasoline 40%
  - Ground - Diesel 15%
- Water and Waste 4%
  - Landfilled Waste 53%
  - Wastewater Energy 25%
  - Incinerated Waste 12%
  - Other 10%

Source: Miami-Dade County Climate Action Strategy

# CLIMATE ACTION STRATEGY

## 2030 TARGETS

- 10% of transportation trips are single occupant vehicles
- Electrify 80% of light vehicles and 50% of buses
- Transition 30% of vehicles to electric power
- Reduce GHGs from Miami International Airport and PortMiami operations by 50%

Source: Miami-Dade County Climate Action Strategy

## POTENTIAL STRATEGIES

- Make walkability & safety a priority
- Facilitate public access to EV chargers
- Establish policies that prioritize roundabout installation
- Develop plans with cruise lines and airlines to reduce emissions using the EPA National Port Strategy Assessment and Airports Council International's (ACI) Airport Carbon Accreditation program

# CLIMATE ACTION STRATEGY

## Potential Strategies for 2050 LRTP

- Projects that include multi-modal transportation options are scored higher
- Incorporate lessons learned from MDC on the transition of fleet vehicles to EV for other public agencies or private companies
- Infrastructure projects that include EV charging stations that include equity, EnergyStar certification, or use renewable energy sources are prioritized
- Develop incentives for PortMiami and MIA to use EPA National Port Strategy Assessment and the Airports Council International Airport Carbon Accreditation Program



# NATIONAL HIGHLIGHTS

Greenhouse Gas & Transportation Infrastructure



# PORT OF SEATTLE'S MARITIME CLIMATE & AIR ACTION PLAN

## GOAL

Reduce GHG emissions by 50% of 2005 levels in 2030 and net-zero by 2050.

### Plan Themes

- Fossil-based energy → zero-emission energy
- **Reduce energy use and emissions** to address the climate change impacts and air quality on community health
- **Involve** communities in decision-making and take an **equity approach** to climate and air emissions reductions
- **Advance** policy, funding, and technology development for climate and clean air action through **partnerships**
- **Leverage** habitat restoration projects to sequester carbon

### Scopes 1 and 2

*Port-controlled and Port indirect emissions*

- 15 percent below 2005 levels by 2020
- 50 percent below 2005 levels by 2030
- Net-zero or better by 2040

### Scope 3

*Port-influenced, but not directly controlled*

- 50 percent below 2007 levels by 2030
- Carbon-neutral or better by 2050

Source: Port of Seattle Maritime Climate & Air Action Plan

# PORT OF SEATTLE - SECTORS

## Port Maritime Administration

**6% of entire Port emissions portfolio**

- Port-owned buildings and campuses
- Fleet vehicles and equipment,
- Solid waste generated by the Port its tenants,
- Port employees (commuting)

## Maritime Activity

**94% of entire Port emissions portfolio**

- Cruise and grain ships
- Harbor vessels (tugboats, commercial fishing vessels, and recreational vessels)
- Locomotives
- Trucks (including cruise buses)
- Cargo-handling equipment



# 2050 LONG RANGE TRANSPORTATION PLAN

## Port Maritime Potential Strategies

- Port fleet can use “drop-in” **renewable fuels**
- **Develop** an EV readiness plan and charging program to expand EV charging stations across Port waterfront properties
- Begin **fleet asset conversions** to EVs, prioritizing sedans and sport utility vehicles
- **Pilot use** of non-sedan EVs and equipment, including electric light-duty trucks and vans, and electric outboard engines for small workboats
- **Track technology developments** in heavy-duty EVs and equipment and **identify opportunities** to electrify Port-owned diesel equipment (e.g., heavy forklifts)
- **Install anti-idling technology** on targeted assets with high idle uses
- **Incorporate telematics data** into fleet management approaches
- **Incorporate eco-driver training** into Port employee training modules, including how to charge and drive electric fleet vehicles

# 2050 LONG RANGE TRANSPORTATION PLAN

## Maritime Potential Strategies

- **Install shore power** at Pier 66 Cruise Terminal by 2023 and **pursue funding** to offset infrastructure costs
- **Require** shore power use by shore power-equipped homeport cruise ships at Terminal 91, Pier 66 and any future cruise berths
- **Collaborate** with cruise lines to obtain 100 percent shore power-equipped calls by 2030
- **Develop** a national and international engagement strategy to advocate for strengthened standards, sustainable fuels, and the transition to zero-emission ocean-going vessels
- **Implement** the International Association of Ports and Harbors' Cruise Emissions Reporting Project at the Port and **collaborate** with cruise lines to maximize participation
- **Evaluate** an optional carbon offset or "Good Traveler" type program for Seattle's homeport cruise passengers, in coordination with cruise lines
- **Demonstrate zero-emission** outboard engines in Port-owned vessel fleets and communicate results
- **Engage** commercial fishing fleets and industry to identify barriers and opportunities to transition to zero-emission fishing vessels

# RESILIENCE & DURABILITY TO EXTREME WEATHER IN THE H-GAC REGION PILOT PROGRAM REPORT

## Plan Goals

Determine criticality and vulnerability of regional transportation assets to extreme weather events

Create a suite of resiliency recommendations for local governments for the transportation network

Use the pilot program to inform future project selection criteria



# RESILIENCE & DURABILITY TO EXTREME WEATHER IN THE H-GAC REGION PILOT PROGRAM REPORT

## Key Takeaways

- Aid decision-making to **incorporate resiliency** into project selection for the **TIP**
- FWHA's Vulnerability Assessment Framework **assessed vulnerability and risks** associated with the transportation network due to weather events
- **Major roads** – Freeway, Principal Arterial, Minor Arterial, Collectors – were collected from TxDOT and were the only roads used
- **Bridges over waterways** were collected from TxDOT and were the only bridges used
- Eleven (11) scenarios based on historic data of extreme weather events and feedback from stakeholders were **developed to model** flooding, storm surge, and SLR

# HOUSTON-GALVESTON MPO

## Potential Strategies

- **Incorporate a Criticality Assessment** – 20% for Socioeconomic, 40% Usage & Operational, 30% Health & Safety, & 10% for Emergency Preparedness
- **Incorporate a Vulnerability Assessment** – Consists of Exposure, Sensitivity, and Adaptive Capability
  - Exposure – Ground elevation, Surface elevation, Water Depth, and Exposure Depth
  - Sensitivity – Determines how an asset will be damaged or disrupted by a stressor
  - Adaptive Capacity – Determines how well an asset can cope with damage or disruption by evaluating alternative routes in ArcGIS
- **Economic Impact Analysis** – Potential economic loss was estimated for network weighing model outputs (VMT, VHT, and total vehicle trips) for different scenarios and compared to Gross Domestic Product (GDP).





# NEXT STEPS

**Potential Meeting Dates**  
**Task 2 – Week of January 30<sup>th</sup>, 2023**  
**Task 3 & 4 – March**  
**Task 5 – April / May**





# THANK YOU QUESTIONS?

**Franchesca Taylor – Program  
Development Manager, Miami-Dade TPO**  
[Franchesca.Taylor@miamidade.gov](mailto:Franchesca.Taylor@miamidade.gov)

**Andy Nicol – Vice President**  
[awnicol@transystems.com](mailto:awnicol@transystems.com)

**Ryan McClure – Senior Planner**  
[rdmccclure@transystems.com](mailto:rdmccclure@transystems.com)



An aerial photograph of Miami, Florida, showing the city skyline, waterfront, and bridges. The sun is setting over the water, creating a warm orange glow. The sky is blue with scattered white clouds. The city skyline is visible in the background, with several tall buildings. In the foreground, there are bridges and a large body of water. The overall scene is a beautiful sunset view of Miami.

# MIAMI-DADE TPO

## CLIMATE RESILIENCY STUDY

TRANSYSTEMS

April 6, 2023

# AGENDA

## **Task 2 – Develop a Priority List of Vulnerable Transportation Infrastructure & Risk Assessment**

Technical Memo #2 – Vulnerable Infrastructure

## **Task 3 – Electric & Alternative Fuels Market Research**

Technical Memo #3 – Current (2020) & Potential (2050) CAV & Alternative Fuel Vehicles/Infrastructure (Public Transit, micro-mobility, & personal/freight vehicles).

## **Next Steps – Meeting on April 21<sup>st</sup>**

Technical Memo #4 and #5

## **Questions – Open Discussion**

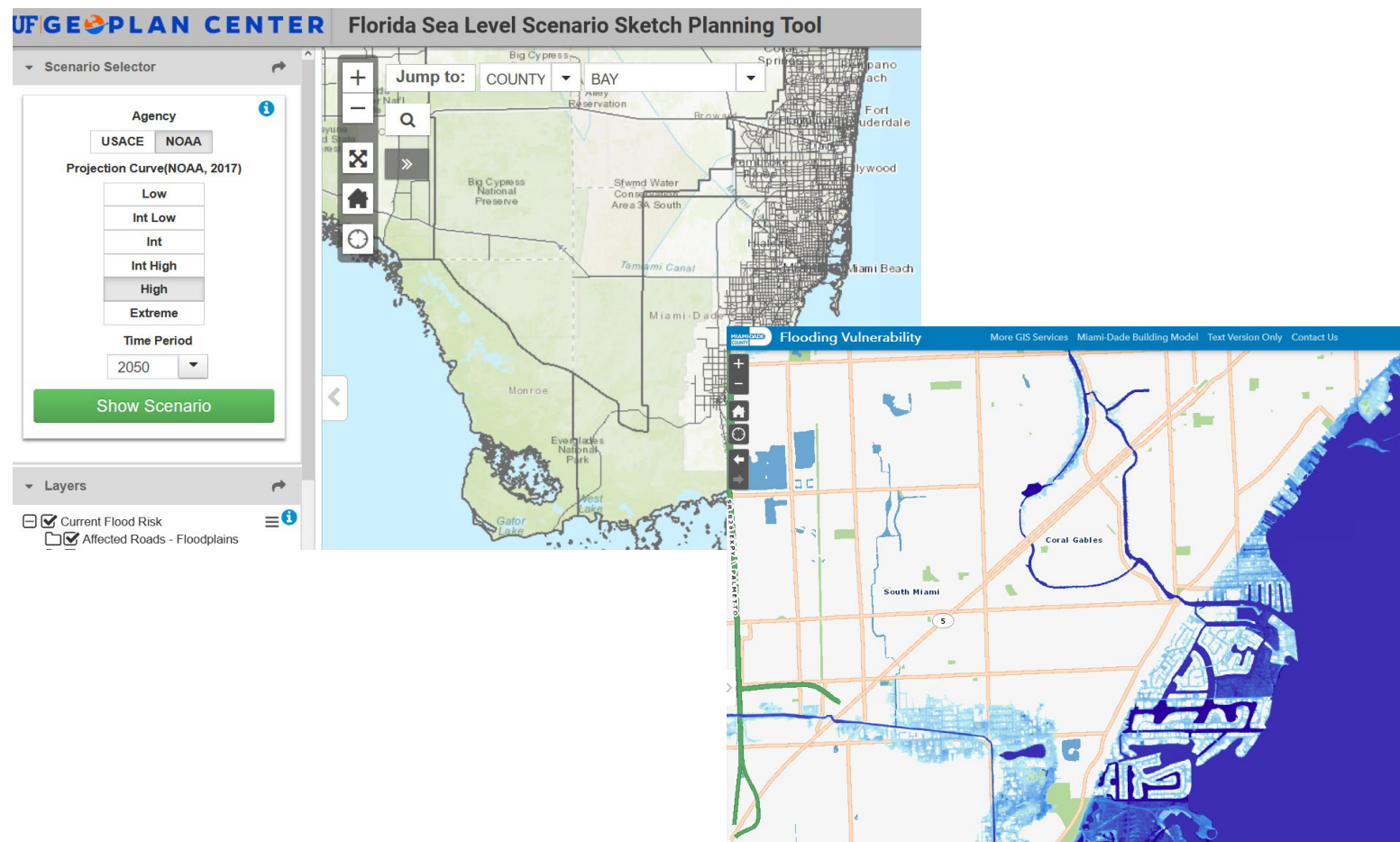
# Prioritized List of Vulnerable Infrastructure Task 2





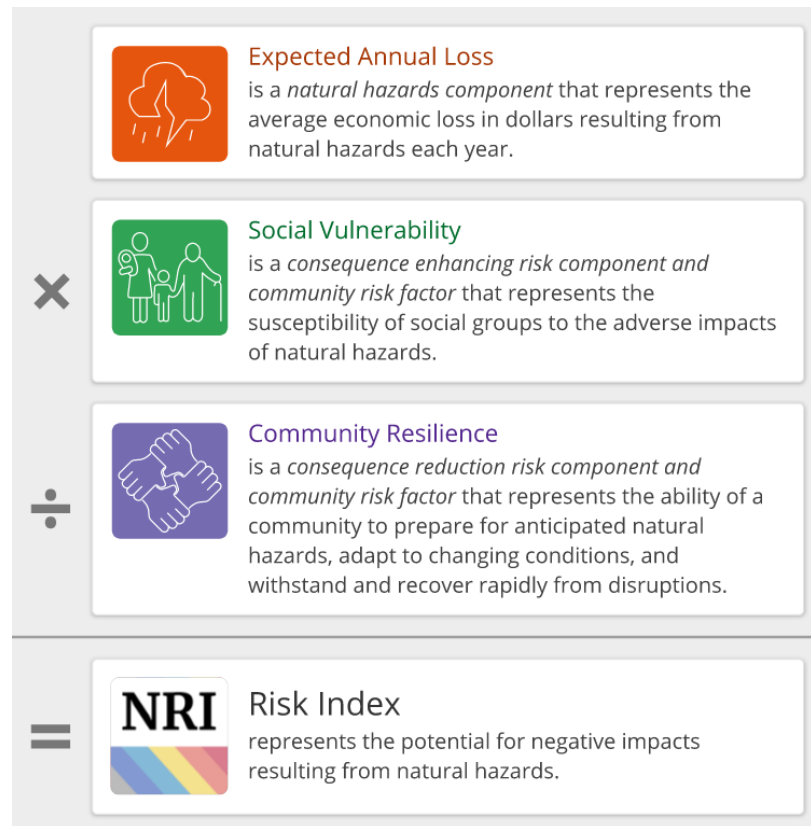
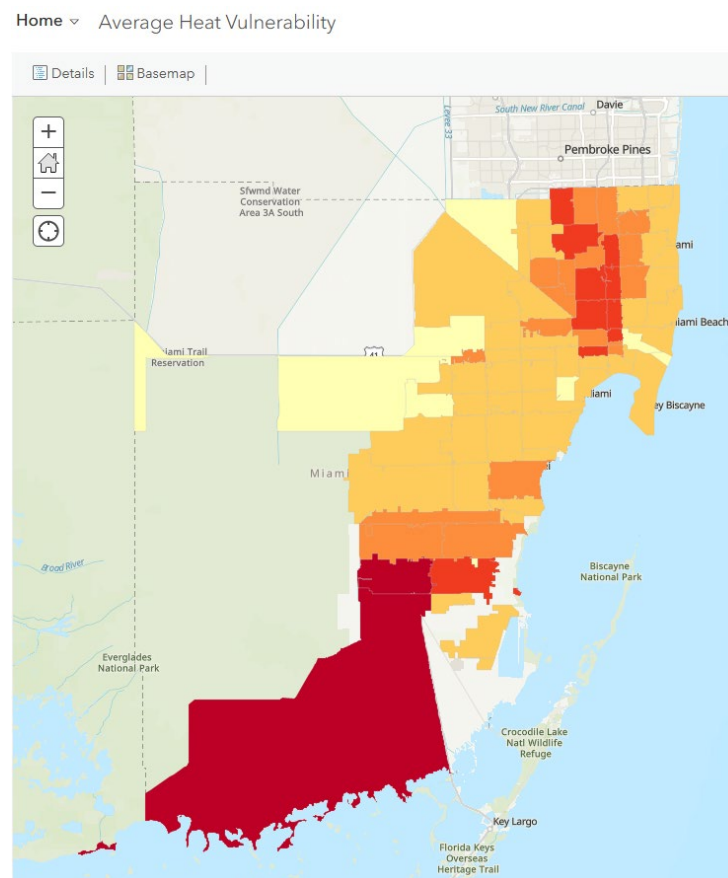
# Tool Evaluation

A thorough evaluation of both the University of Florida's **Sea Level Rise Sketch Planning Tool** and Miami-Dade County's **Flooding Vulnerability Viewer** was conducted



# Tool Evaluation

Miami-Dade County's **Average Heat Vulnerability Map** and FEMA's **National Risk Index** were also evaluated for utilization.

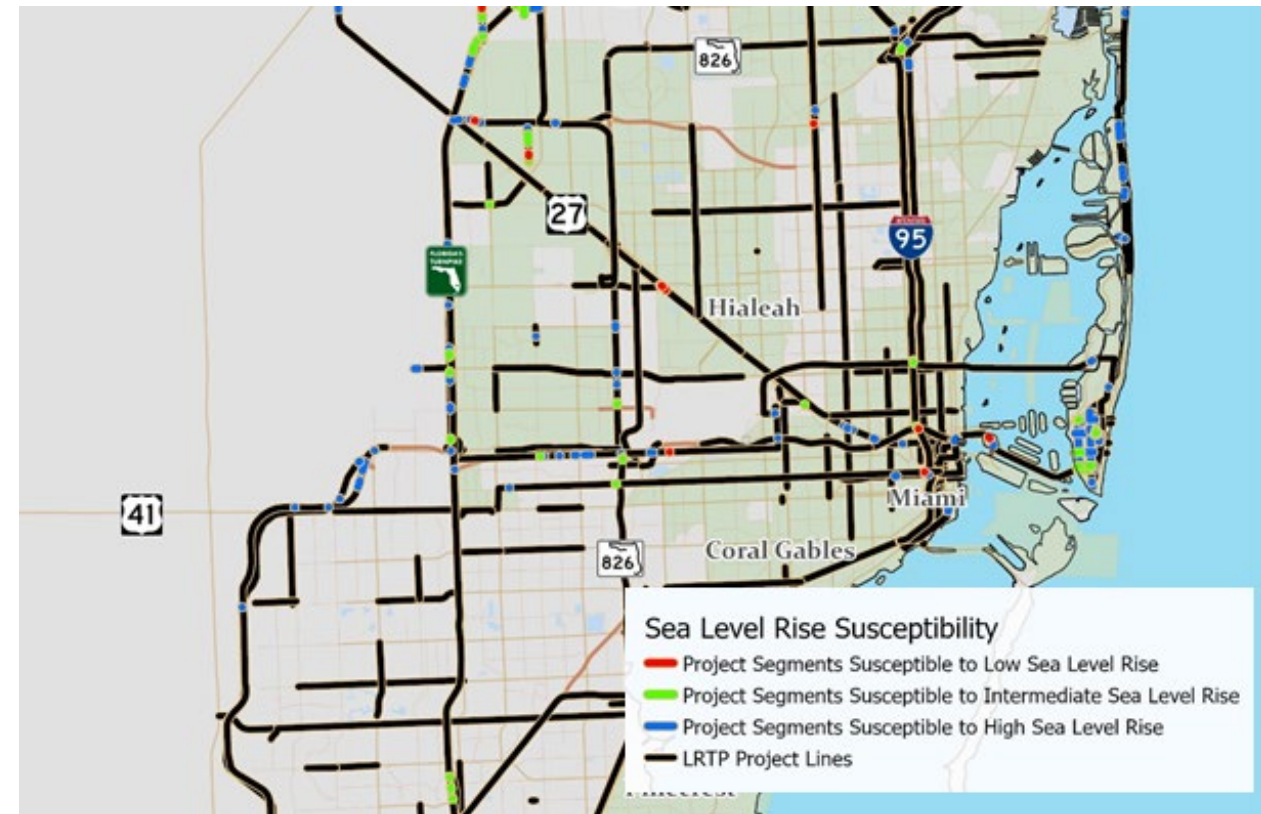




# 2045 Cost Feasible Projects Vulnerabilities

## Sea Level Rise

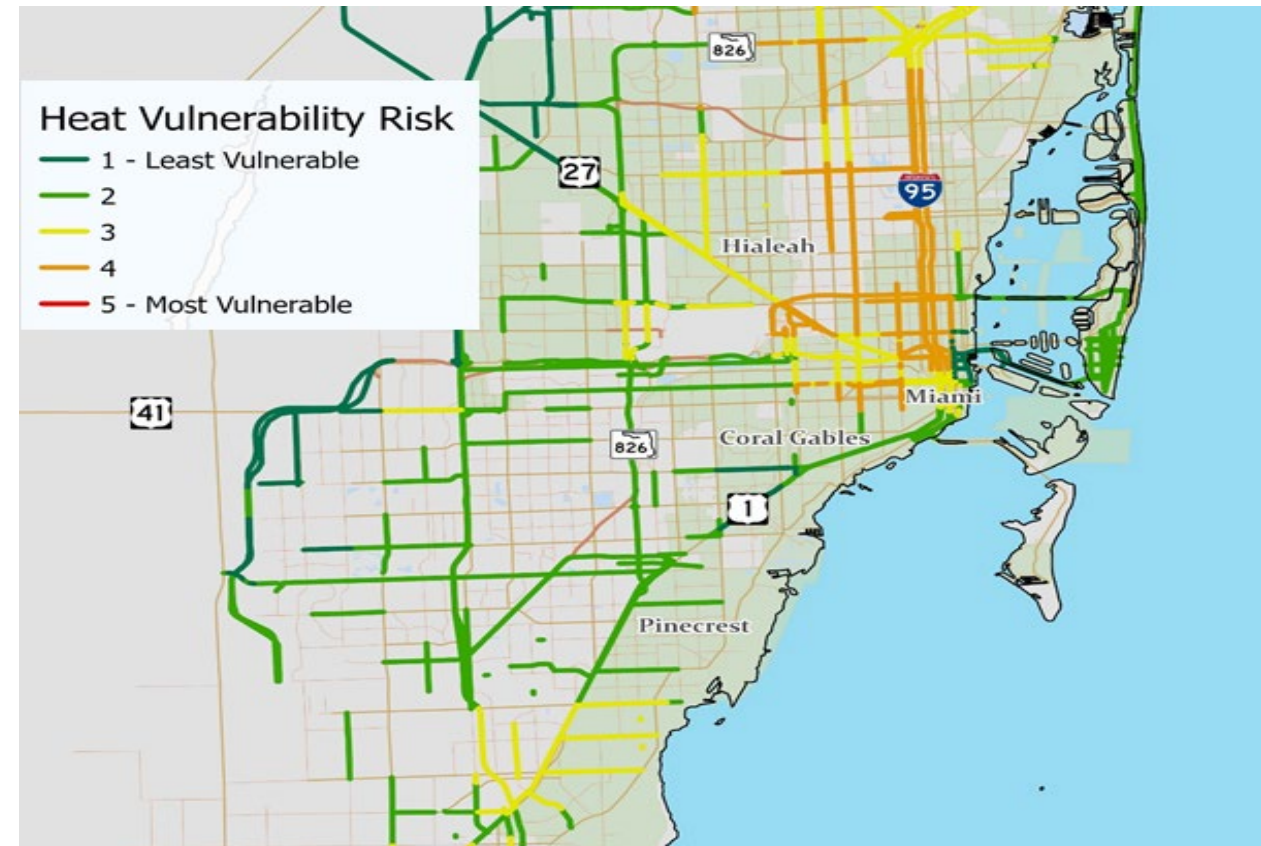
- All 2045 Cost Feasible Projects Mapped against 2050 (Low, Moderate, High) SLR predictions
- Potential 2050 Cost Feasible Projects will run through the same process
- GIS shows visuals, but the project scoring occurs within a spreadsheet



# 2045 Cost Feasible Projects Vulnerabilities

## Extreme Heat

- All 2045 Cost Feasible Projects mapped with extreme heat vulnerability predictions
- Potential 2050 Cost Feasible Projects will run through the same process
- GIS shows visuals, but the project scoring occurs within a spreadsheet



# 2045 Cost Feasible Projects Vulnerabilities

## Social Vulnerability

- All 2045 Cost Feasible Projects mapped with their social vulnerability risk
- Potential 2050 Cost Feasible Projects will run through the same process
- GIS shows visuals, but the project scoring occurs within a spreadsheet



# 2045 Cost Feasible Projects Rankings

## Scoring Matrix – Project Lines

Sea Level Rise (2050 Projections)		Heat Vulnerability (2019)		Social Vulnerability (2021)	
Type	Points	Type	Points	Type	Points
Within 100 feet of:		5 - High	2	Very High	2
High SLR	1				
Intermediate SLR	2				
Low SLR	3				
Low SLR (25%)	0.5				
Low SLR (50%)	1				
Low SLR (75%)	1.5				
Low SLR (100%)	2				
Intermediate SLR (25%)	0.5	4	1.5	Relatively High	1.5
Intermediate SLR (50%)	1				
Intermediate SLR (75%)	1.5				
Intermediate SLR (100%)	2				
High SLR (25%)	0.5	3	1	Relatively Moderate	1
High SLR (50%)	1				
High SLR (75%)	1.5				
High SLR (100%)	2				
None	0	2	0.5	Relatively Low	0.5
		1 – Low	0	Very Low	0
Up to 9 points		Up to 2 points		Up to 2 points	

## Scoring Matrix – Project Points

Sea Level Rise (2050 Projections)			Heat Vulnerability (2019)		Social Vulnerability (2021)	
SLR Projection	Probability of Occurring	Points	Type	Points	Type	Points
Low – Minimal Inundation	High	9	5 - High	2	Very High	2
Intermediate	Intermediate	6	4	1.5	Relatively High	1.5
High – Major Inundation	Low	3	3	1	Relatively Moderate	1
None		0	2	0.5	Relatively Low	0.5
			1 – Low	0	Very Low	0
Up to 9 points			Up to 2 points		Up to 2 points	



# Vulnerability Solution Toolkit

Solution	Type of Infrastructure Impacted						General Cost Estimate	Project Phase*
	Roadway	Bridge	Transit	Bike/Ped	EV Charging	Storm Water		
Create a hazard mitigation plan to use during emergencies	√	√	√	√	√	√	Low	P
Increase monitoring of infrastructure during extreme weather conditions	√	√	√	√	√	√	Low	O&M
Incorporate sea level rise into infrastructure planning	√	√	√	√	√	√	Medium	P
Install green infrastructure	√	√	√	√	√	√	Low	P, D
Relocate facilities to higher elevations	√	√	√	√	√		High	P, D
Build flood barriers to protect infrastructure	√	√	√	√	√		Medium	P, D
Install erosion control measures and improve soil strength	√	√	√	√			Medium	O&M
Realign roads and structures out of floodplains	√	√	√	√			High	P, D
Improve detour/alternative routes	√	√					Low	P
Provide a source of standby power and move electric equipment to a higher elevation					√		Medium	P, O&M
Construct additional electric vehicle charging stations					√		Medium	P, O&M
Strengthening support structures and embankments		√					Medium	O&M
Develop coastal restoration plans to protect water utility infrastructure						√	Low	P
Improve drainage by reducing impervious surfaces and installing other streetscaping						√	Low	P, D

P = Planning

D = Design

O&M = Operation and Maintenance

# Alternative Fuels Market Research Task 3



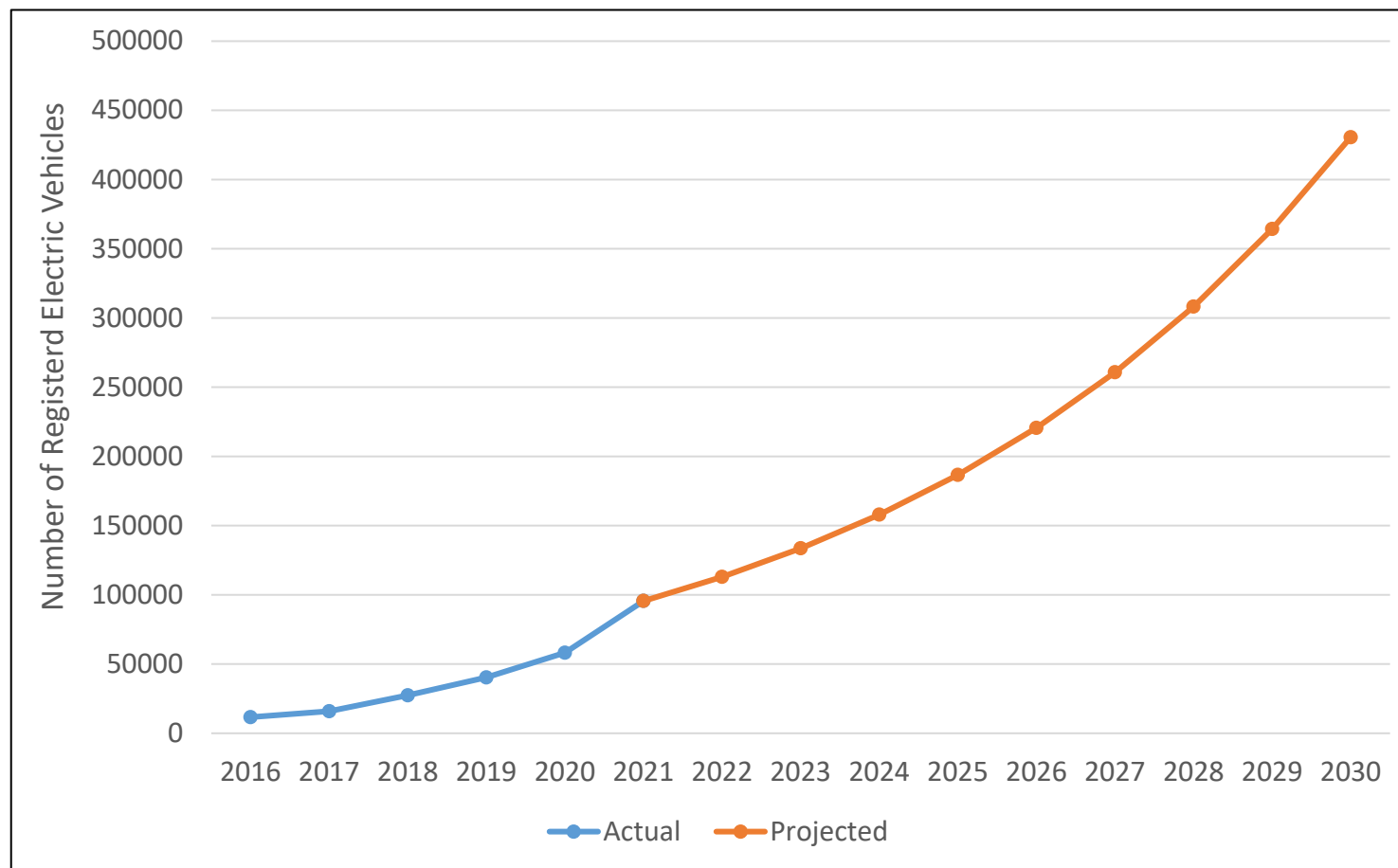


# Market Opportunities

- Personal Vehicles → Alternative Fuels
- Freight Vehicles → Hybrid, Autonomous
- County-Owned Fleet → Fuel Efficient, Zero Emissions
- Public Transit → CNG, Electric
- Micromobility → Electric Scooters & Bikes
- Charging Infrastructure → Electric, CNG, Solar
- Technology (TSM&O) → Electric, Solar

# Florida Electric Vehicle Registration

**49 percent**  
growth from  
2020 to 2021



EVs accounted for  
~**3%** of new vehicles  
purchased within  
MDC in 2020.



An aerial photograph of a city, likely Los Angeles, showing a mix of residential neighborhoods with red-tiled roofs and dense commercial skyscrapers. A major highway runs through the center. A large white arrow graphic points from the left towards the text.

# NEXT STEPS

**Meeting Dates**  
**Task 4 & 5 – April 19<sup>th</sup>**  
**2-3pm**

**Tran** Systems

Image Credit:  
Nearmap





# THANK YOU QUESTIONS?

**Franchesca Taylor – Program  
Development Manager, Miami-Dade TPO**  
[Franchesca.Taylor@miamidade.gov](mailto:Franchesca.Taylor@miamidade.gov)

**Andy Nicol – Vice President**  
[awnicol@transystems.com](mailto:awnicol@transystems.com)

**Ryan McClure – Senior Planner**  
[rdmccclure@transystems.com](mailto:rdmccclure@transystems.com)

**TRANSYSTEMS**

An aerial photograph of Miami, Florida, showing the city skyline, waterfront, and bridges over the water. The sun is setting on the left, casting a warm glow over the scene. The sky is blue with some clouds. The water is calm, reflecting the light from the sun. The city skyline is visible in the background, with several tall buildings. In the foreground, there are bridges and a large stadium-like structure on the right.

# MIAMI-DADE TPO

## CLIMATE RESILIENCY STUDY

TRANSYSTEMS

May 4, 2023

# AGENDA

- 1. Brief Review Task 2 & 3 Project**
- 2. PWG Questions from Task 2 & Task 3**
- 3. Task 4 – Strategic Policy Recommendations for CAVs & AFVs**
- 4. Task 5 – Incorporating Resilience in the LRTP**
- 5. Next Steps**
- 6. Questions**



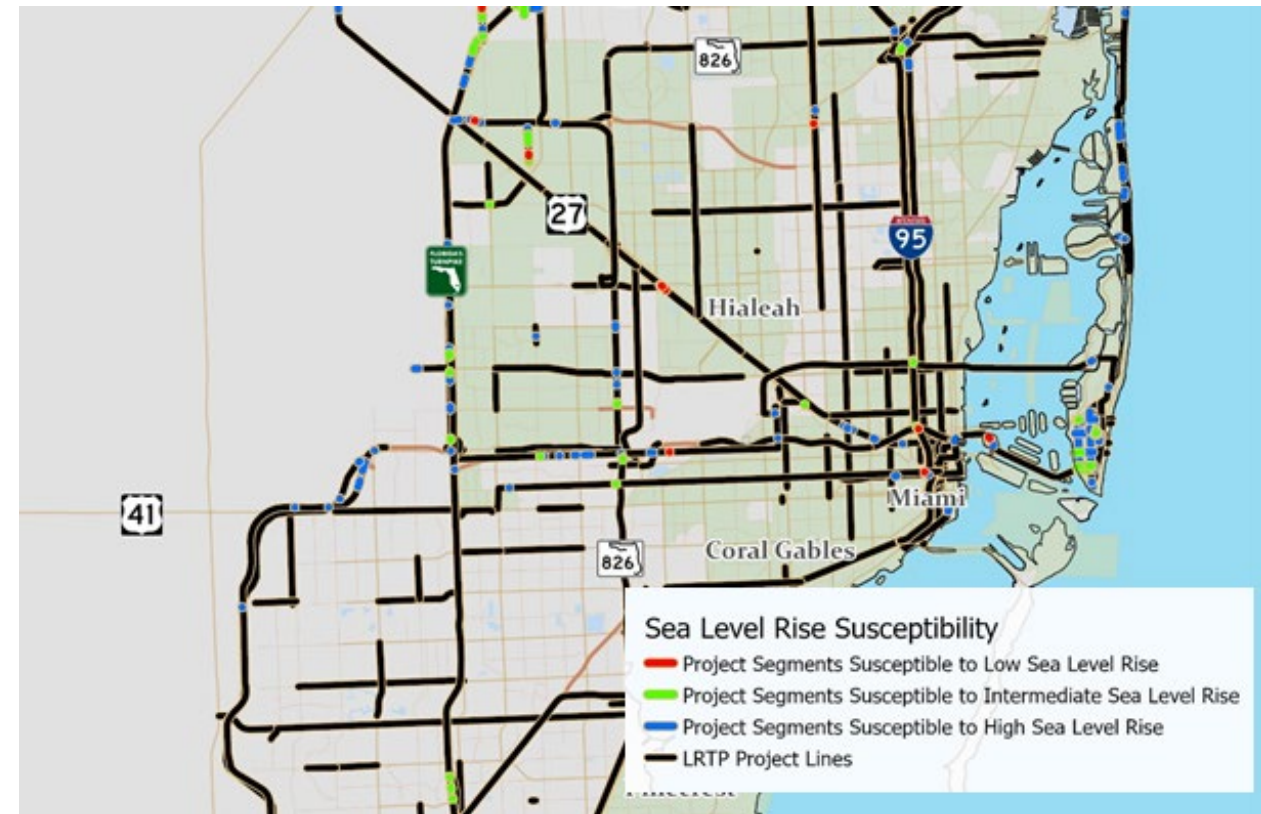
# Prioritized List of Vulnerable Infrastructure Task 2



# 2045 Cost Feasible Projects Vulnerabilities

## Sea Level Rise

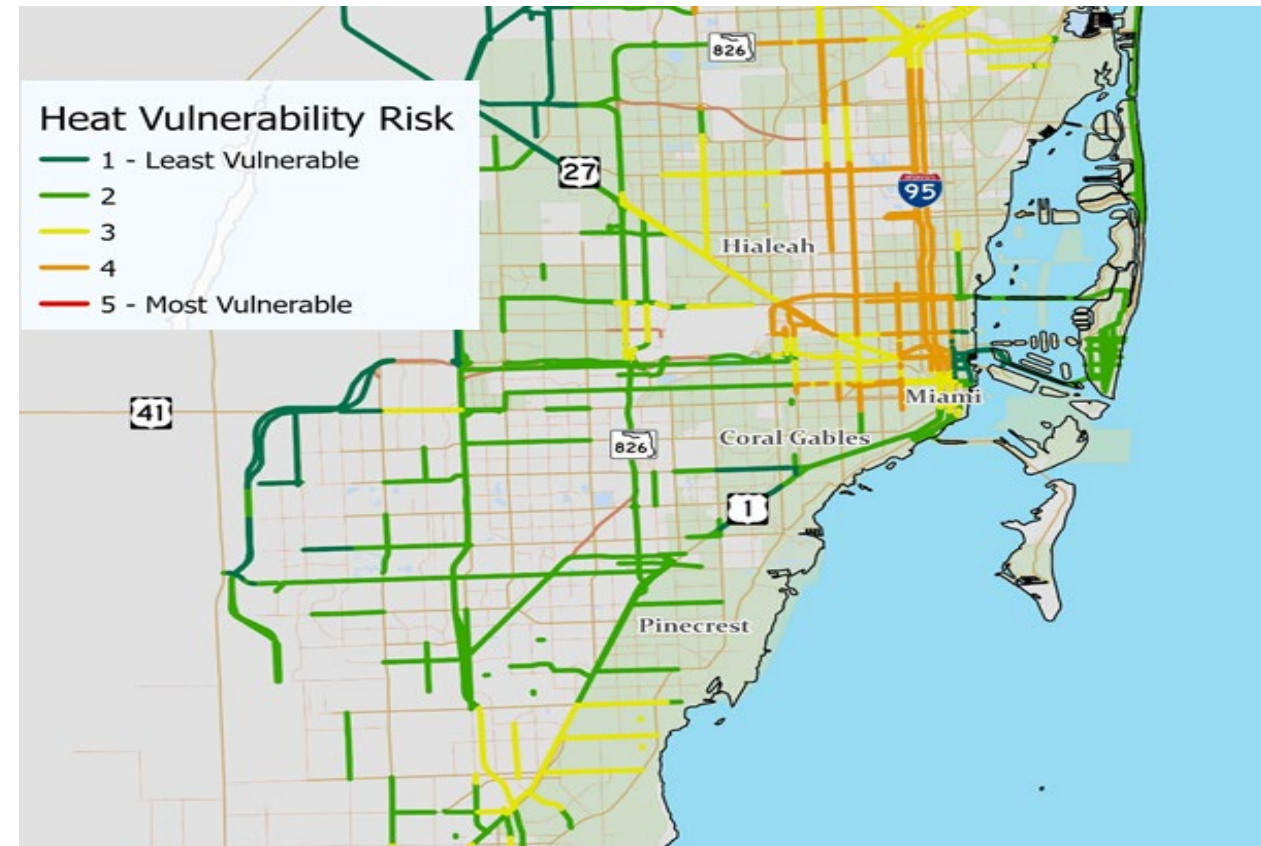
- All 2045 Cost Feasible Projects Mapped against 2050 (Low, Moderate, High) SLR predictions
- 2050 Cost Feasible Projects will run through the same process
- GIS shows visuals, but the project scoring occurs within a spreadsheet



# 2045 Cost Feasible Projects Vulnerabilities

## Extreme Heat

- All 2045 Cost Feasible Projects mapped with extreme heat vulnerability predictions
- 2050 Cost Feasible Projects will run through the same process
- GIS shows visuals, but the project scoring occurs within a spreadsheet





# 2045 Cost Feasible Projects Vulnerabilities

## Social Vulnerability

- All 2045 Cost Feasible Projects mapped with their social vulnerability risk
- 2050 Cost Feasible Projects will run through the same process
- GIS shows visuals, but the project scoring occurs within a spreadsheet



# 2045 Cost Feasible Projects Rankings

## Scoring Matrix – Project Lines

Sea Level Rise (2050 Projections)		Heat Vulnerability (2019)		Social Vulnerability (2021)	
Type	Points	Type	Points	Type	Points
Within 100 feet of:		5 - High	2	Very High	2
High SLR	1				
Intermediate SLR	2				
Low SLR	3				
Low SLR (25%)	0.5				
Low SLR (50%)	1				
Low SLR (75%)	1.5				
Low SLR (100%)	2				
Intermediate SLR (25%)	0.5	4	1.5	Relatively High	1.5
Intermediate SLR (50%)	1				
Intermediate SLR (75%)	1.5				
Intermediate SLR (100%)	2				
High SLR (25%)	0.5	3	1	Relatively Moderate	1
High SLR (50%)	1				
High SLR (75%)	1.5				
High SLR (100%)	2				
None	0	2	0.5	Relatively Low	0.5
		1 – Low	0	Very Low	0
Up to 9 points		Up to 2 points		Up to 2 points	

## Scoring Matrix – Project Points

Sea Level Rise (2050 Projections)			Heat Vulnerability (2019)		Social Vulnerability (2021)	
SLR Projection	Probability of Occurring	Points	Type	Points	Type	Points
Low – Minimal Inundation	High	9	5 - High	2	Very High	2
Intermediate	Intermediate	6	4	1.5	Relatively High	1.5
High – Major Inundation	Low	3	3	1	Relatively Moderate	1
None		0	2	0.5	Relatively Low	0.5
			1 – Low	0	Very Low	0
Up to 9 points			Up to 2 points		Up to 2 points	



# PWG Questions

Miami-Dade Resiliency Task 2 and 3 Stakeholder Meeting

Questions and Comments

April 6, 2023

Questions:

**1. Q - Does the UF's tool aligns with the SE FL Regional Climate Change Compact SLR projections?**

- A - The SE FL Regional Climate Change Compact uses a mix of 2017 NOAA and Intergovernmental Panel on Climate Change (IPCC) projections. NOAA projections are more conservative. Therefore, the UF tool analysis does align with the SE FL study.

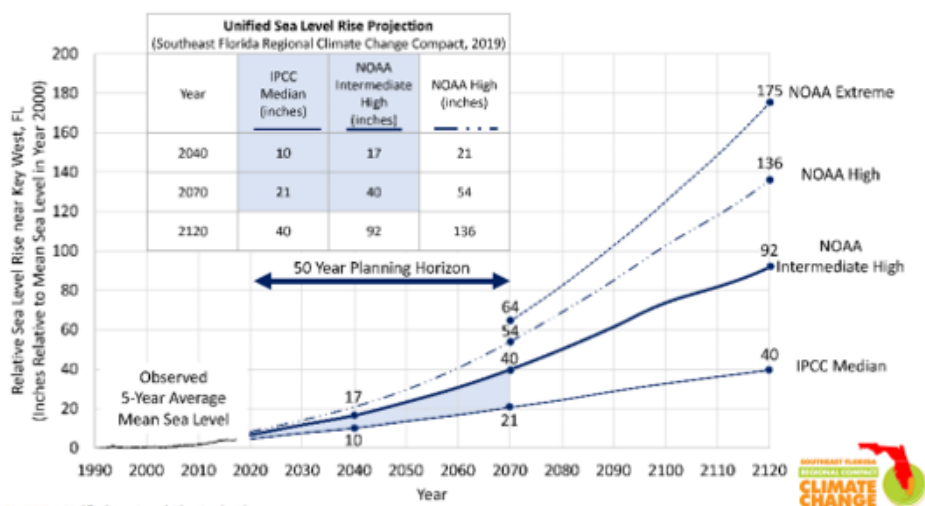


FIGURE 1: Unified Sea Level Rise Projection

**2. Q - South Florida Regional Transportation Authority (SFRTA) received a data request from**

**4. Q - What about storm surge?**

- A - We primarily looked at SLR, as data was readily available and the available data aligned with the planned/designed (ie: 2050 projections) project timelines. Storm surge should be included in future iterations of the tool.
- There is a report that looked at vulnerabilities of our roadways and there may be things that can be built upon within our study.

**5. Q - Can you describe how the total points distribution was determined, e.g., giving 2 points to social vulnerability and heat but 9 to SLR?**

- A - The points were given to weigh the impacts of sea level rise most heavily. Social vulnerability and heat vulnerability were used to better parse out the most vulnerable projects and areas.

**6. Q - Which assets are included in the study? MDC is required by the state to look at critical assets for the Resilient FL Program where the SLR assessment is required. They are still in the initial stages and would like to know more about complementing efforts.**

- A - This project focused only on 2045 LRTP Cost Feasible Projects. However, the methodology can be extended to a network-wide analysis. A discussion of this is shown within Task 5.

**7. Q - How will this assessment be used with planned projects?**

- A - There will be a resiliency process within the LRTP Cost Feasible process. Task 5 dives more into the details.

**8. Q - How does the tool take into consideration the impacts of SLR?**

- A - The highest amount of points is for low projection sea level rise. If a roadway is projected to be impacted by low SLR, it will also be impacted by higher amounts of SLR. Points were an "all or nothing" so points were only scored if there were SLR projections within 500 feet of the point (intersection). Lines (project segments) were scored based on the percentage of SLR along the line and which quartile the percentage fell in. This helped greater weigh projects where most of the segment would be impacted by SLR.

Comments:

# Alternative Fuels Market Research Task 3



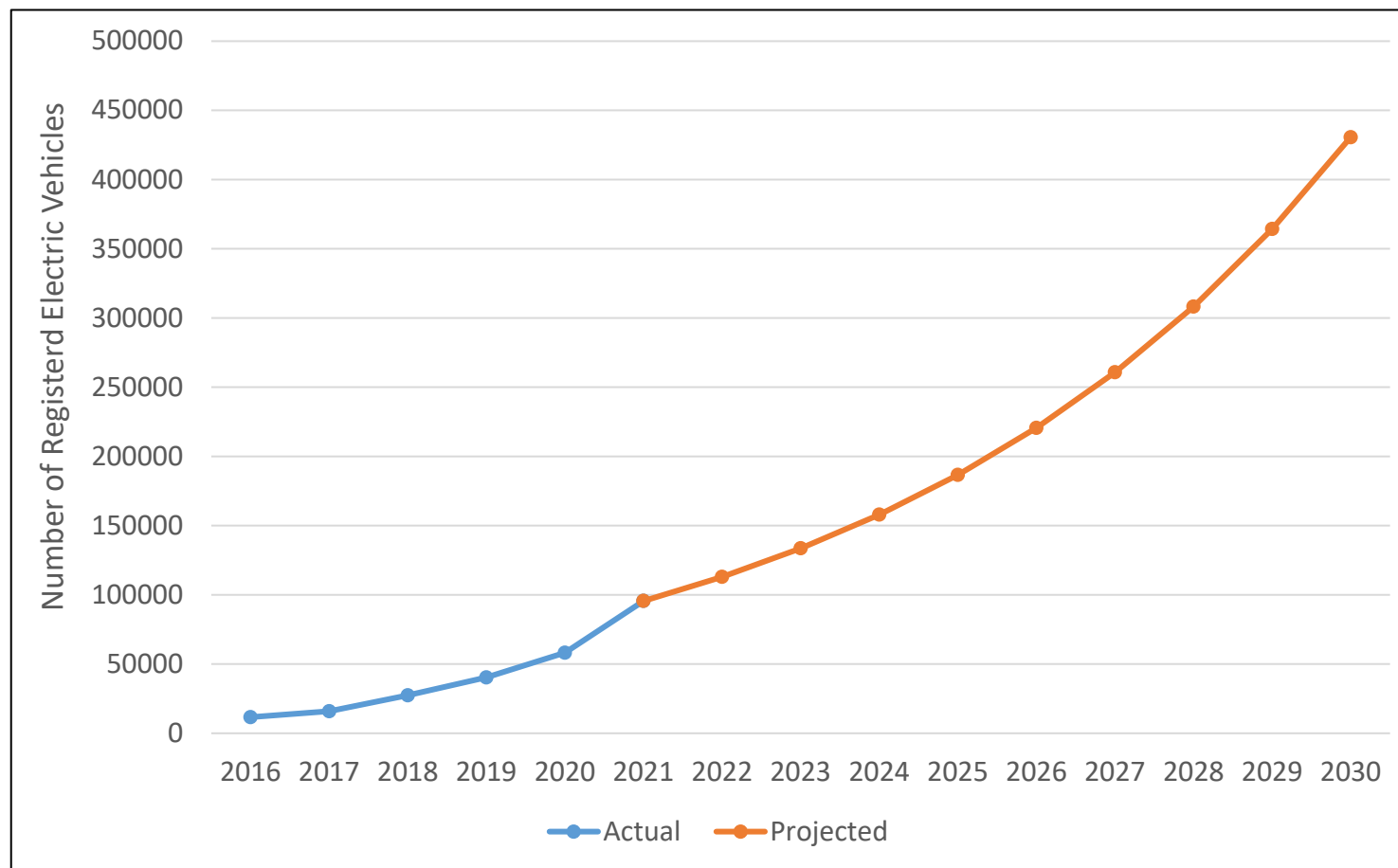


# Market Opportunities

- Personal Vehicles → Alternative Fuel
- Freight Vehicles → Hybrid, Autonomous
- County Owned Fleet → Fuel Efficient, Zero Emissions
- Public Transit → CNG, Electric
- Micromobility → Electric Scooters, Bikes
- Charging Infrastructure → Electric, CNG, Solar
- Technology (TSM&O) → TSM&O, Electric, Solar

# Florida Electric Vehicle Registration

**49 percent**  
growth from  
2020 to 2021



EVs accounted for  
~**3%** of new vehicles  
purchased within  
MDC in 2020.



# Strategic Policy Recommendations for CAVs & AFVs

## Task 4





# TPO Collaboration

## Private Entities

Freight / Trucking Industry  
Florida Power and Light Co.  
Multi-Family Apartments  
Shopping malls/large retailers  
Miami Climate Alliance  
Tesla  
Volvo  
Nissan  
Rivian  
Lucid Motors  
Zoox  
Aptiv  
NIO

## Governments

City of Coral Gables  
City of Doral  
City of Miami  
City of North Bay Village  
Clean City Coalition  
Florida DOT  
Town of Cutler Bay  
Town of Medley  
Village of Pinecrest  
Village of Palmetto Bay  
Village of Miami Shores  
South Florida Regional  
Planning Council (SFRPC)

## Public Sites

Libraries  
Hospitals  
Parks (national, regional, local)

## Education

Public and private high schools  
University of Miami  
Florida International University  
University of Florida

# Structure of Strategic Policy Recommendations

## Policy Areas

- Long Range Transportation Planning
- Capital Investment Strategies
- Research & Development
- Regulations
- Communications

## Recommendation Categories

- Strategies
- Implementation Action
- Partners
- Timeframe
- Priorities

# CAV/AFV Strategies

## LRTP

LRTP 1 - Assess existing infrastructure to meet CAV needs

LRTP 2 - Improve transportation systems management and operations

LRTP 3 – Determine AFV and CAV policies

LRTP 4 – Invest in additional infrastructure to meet net zero emissions goals

LRTP 5 – Explore alternative funding opportunities to account for the reduction in the gas tax and revenues

## Capital Investment

CIS 1 –Coordinate with owners and operators of capital to establish a Capital Investment Strategy (CIS) within MDC

CIS 2 – Maintain a good state of repair on transportation facilities

# CAV/AFV Strategies

## Research & Development

R&D 1 - Explore grant opportunities for research development

R&D 2 - Maintain relationships with Florida educational institutions and think tanks to monitor technological advancements

R&D 3 – Utilize CAV testing institutions that are or will be established, such as SunTrax in FDOT District 1

## Regulations

Regulations 1 – Establish a corridor specific area where CAVs can be tested during low volume traffic periods

Regulations 2 – Support liability regulations that assign responsibility of fault to users of the CAVs

Regulations 3 – Consider establishing countywide emissions testing

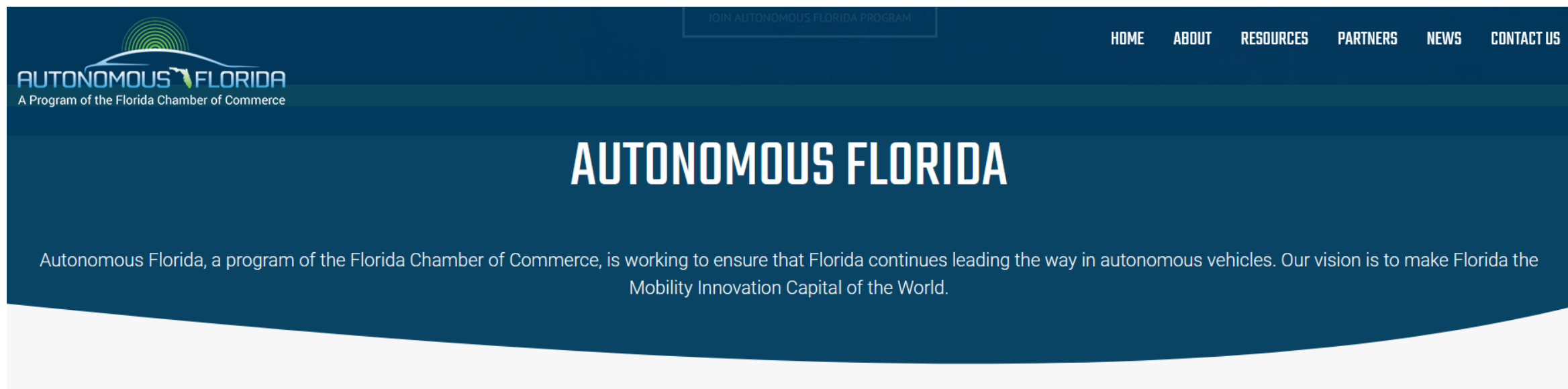
# CAV/AFV Strategies

## Communication

Communication 1 - Meet with the institutional resiliency community members periodically

Communication 2 – Meet with private industry to discuss where the public sector can invest to increase market demand

Communication 3 – Develop a marketing campaign that will promote CAV/AFV within the region





# LRTP Strategy Example

MDTPO CAV/AFV Strategies	Implementation Action	Partners	Timeframe	Priority
LRTP 1 - Assess existing infrastructure needs for CAVs	1.1 Review pavement markings to ensure visibly distinct markings for safe driving	DTPW, FDOT	1-5 Years	High
	1.2 Confirm bridges and pavement are load bearing for future (freight) vehicle platooning	DTPW, FDOT	1-5 Years	High
	1.3 Review traffic signal equipment and traffic signal phasing/timing	DTPW, FDOT	5+	High
	1.4 Develop a network plan of roadways that can safely accommodate truck platooning	DTPW, FDOT	1-5 Years	Medium
	1.5 Complete a feasibility study to prioritize locations with the greatest needs and most cost-effective solutions	DTPW, FDOT	1-5 Years	High

# Incorporating Resilience in the Long-Range Transportation Plan

## Task 5



# Performance Measures

## **Net Zero Emissions**

- Number of EV and Alternative Vehicles
- Amount of Pedestrian/Bicycle Facilities

## **Mitigate Sea Level Rise Impacts**

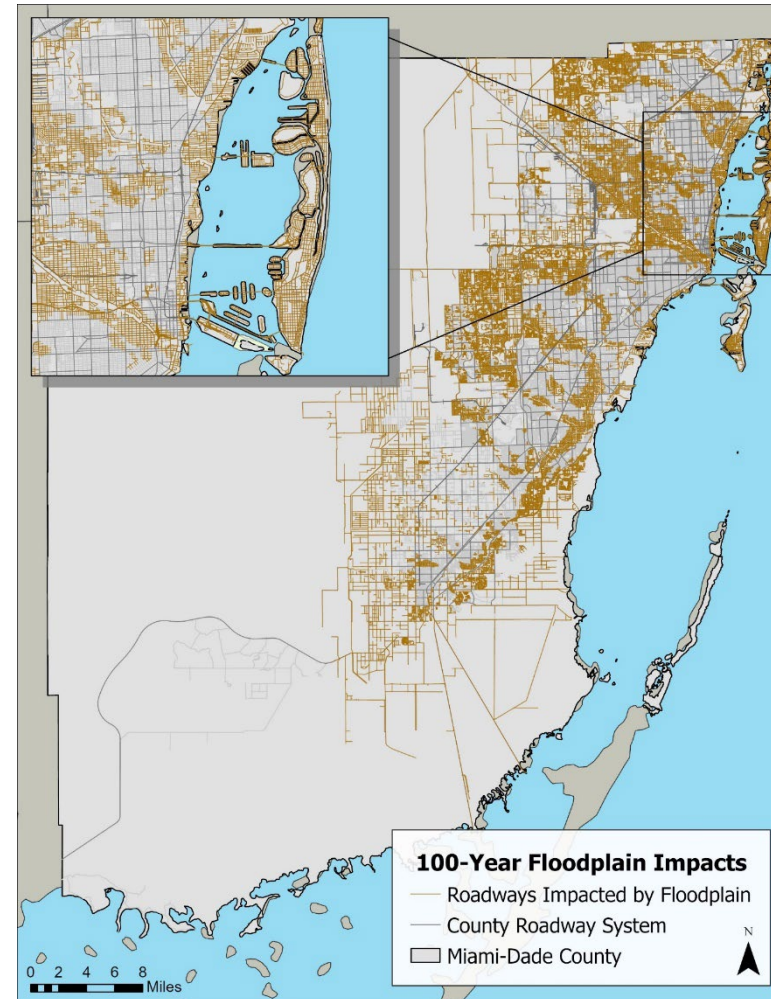
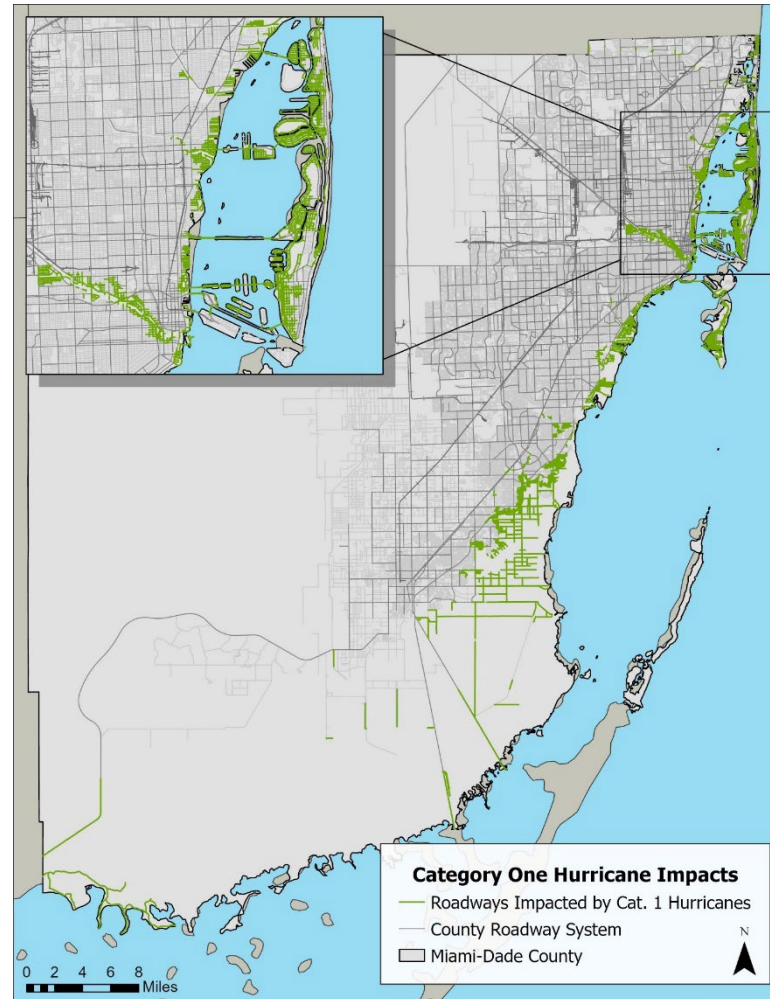
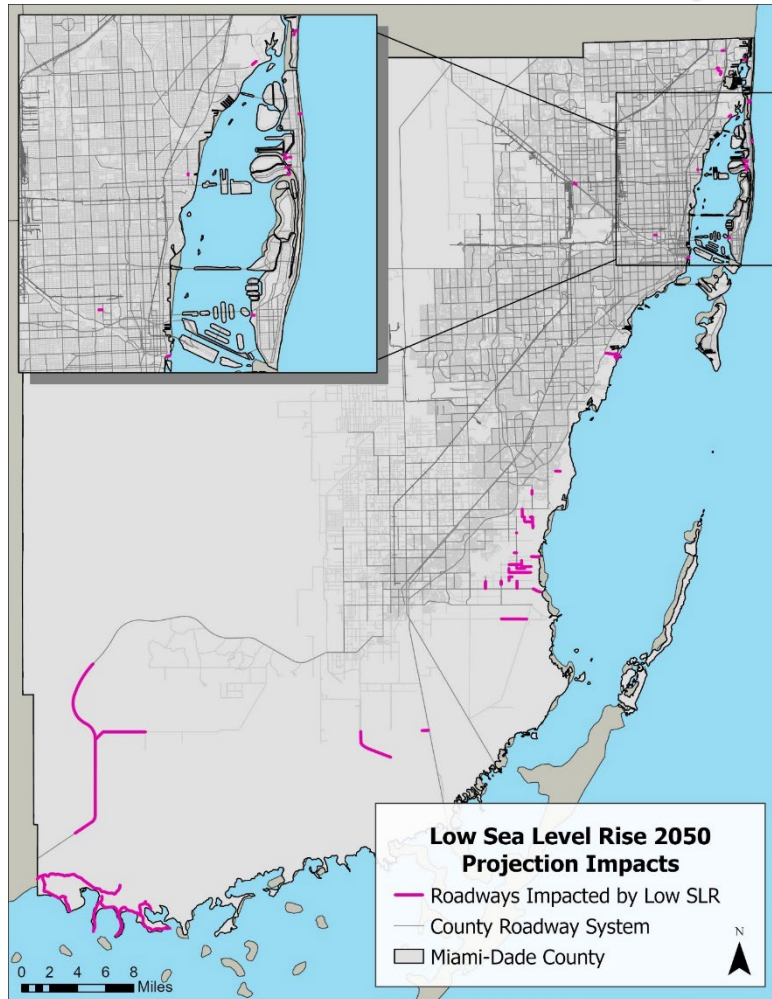
- Percentage of Bridge Structures Affected by SLR
- Percentage of Roadways Affected by SLR

## **Maintain Connectivity and Mobility**

- Number of Lanes within 100-Year Floodplain
- Delay Time and Truck Travel Time Reliability for Freight Trucks

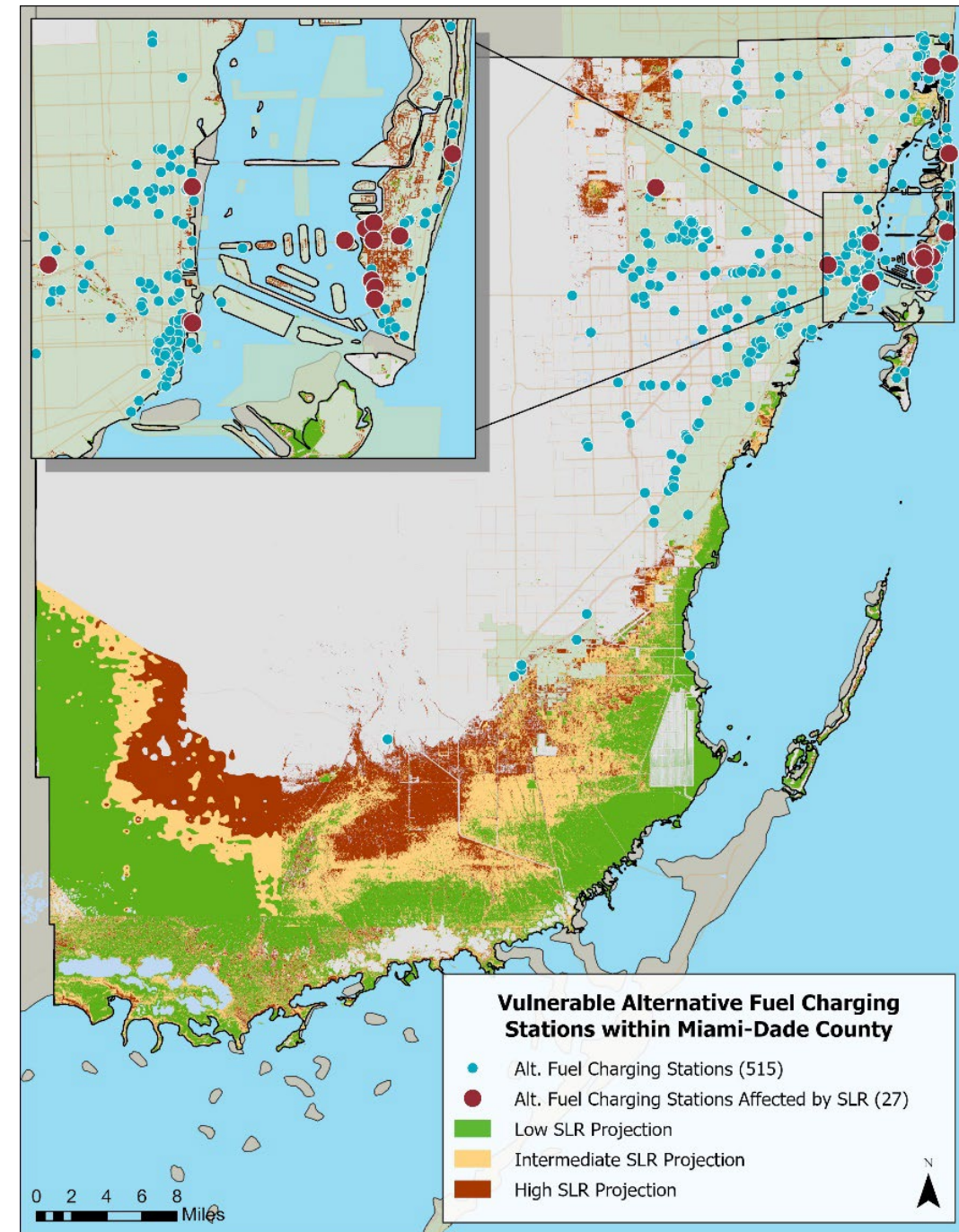
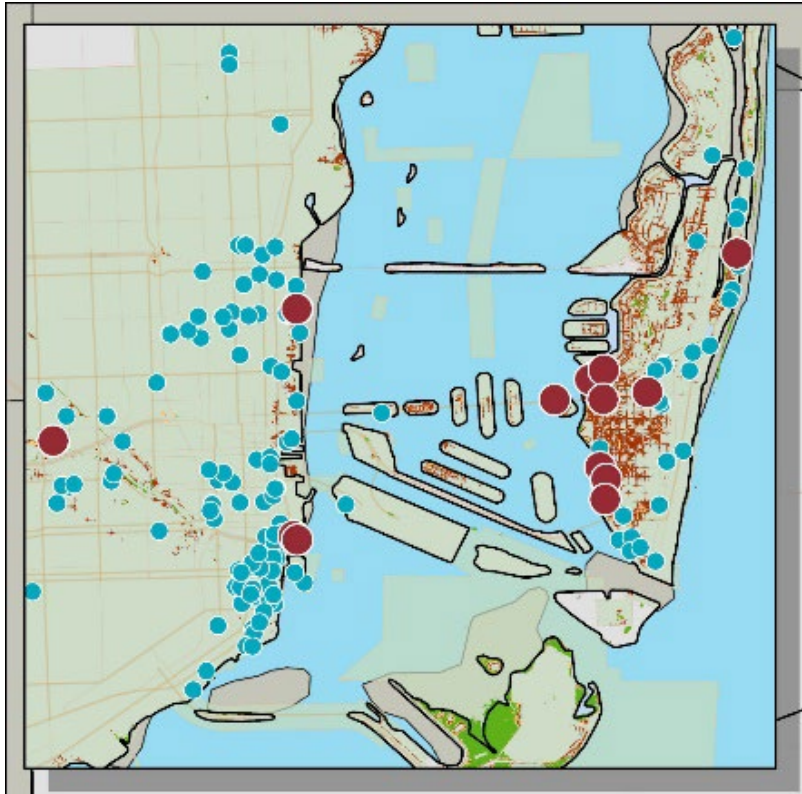


# Roadways Impacted by 2050 Projections Hazards





# Existing Alternative Fuel Charging Stations Impacted by 2050 SLR Projections





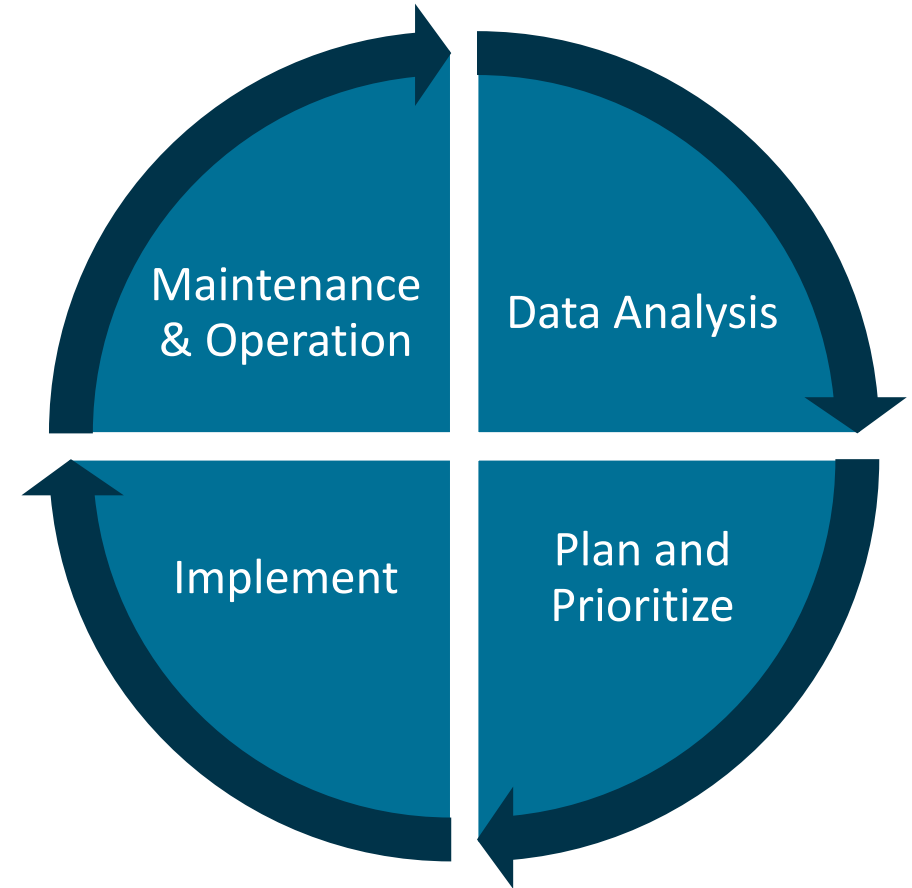
# Table of Existing AFC Stations Impacted by 2050 SLR Projections

Type of AFC	Impacted AFC - Low SLR	Impacted AFC - Intermediate SLR	Impacted AFC - High SLR	Total AFC
Electric	4	10	27	488
Propane	0	0	0	5
Ethanol (E85)	0	0	0	21
Compressed Natural Gas	0	0	0	1
All	4	10	27	515

# Needs and Cost Feasibility Plan

## Project Types:

- Highway & Freight
- Transit
- Bike and Pedestrian
- Charging Infrastructure



**Resiliency Project Cycle**



# THANK YOU QUESTIONS?

**Franchesca Taylor – Program  
Development Manager, Miami-Dade TPO**  
[Franchesca.Taylor@miamidade.gov](mailto:Franchesca.Taylor@miamidade.gov)

**Andy Nicol – Vice President**  
[awnicol@transystems.com](mailto:awnicol@transystems.com)

**Ryan McClure – Senior Planner**  
[rdmccclure@transystems.com](mailto:rdmccclure@transystems.com)

**TRANSYSTEMS**