Final Report - Executive Summary

MIAMI-DADE MPO WORK ORDER # GPC IV-12

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INTRODUCTION

The purpose of this study is to investigate sustainable transportation strategies and their effect on travel behavior. This study is not recommending any policies or implementation strategies but is rather a high level planning exercise conducted using a systems planning approach. It is important for the reader to note that given the scope of this study, the scenarios were developed as broad concepts to be applied countywide. The strategies included in each of the scenarios were selected to test their potential effectiveness at a macro scale. These strategies went above and beyond the current plans and policies. This study provides an opportunity to evaluate these different strategies outside of the process used to develop the Long Range Transportation Plan (LRTP), which is guided by federal regulations.

The general tasks of this study were the identification of strategies that may lead to a sustainable transportation system, the creation of scenarios through combinations of these strategies, and the evaluation of these scenarios using the regional travel demand model, the Southeast Regional Planning Model (SERPM) version 6.5, as well as off-model techniques. The Miami-Dade MPO established several guidelines at the beginning of the study, as follows:

1. *Intensive capital improvements beyond those identified in the Cost Feasible Plan of the 2035 LRTP would not be considered.*
2. *Each scenario should be comprised of a unique set of strategies.*
3. *Strategies included in a scenario must be focused on changing travel demand and under the realm of influence of Miami-Dade County.*

Each step of this study was completed in collaboration with a Study Advisory Committee, or SAC. The SAC consisted of members from other departments within Miami-Dade County, municipalities, and state and regional agencies.

LITERATURE REVIEW

The first task of this study was to complete a literature review to determine if and where similar studies have been conducted, to identify definitions of sustainability as it relates to the transportation system, and to identify strategies for inclusion in scenarios. Research was conducted to identify different places within the U.S. and around the world where sustainable transportation has been addressed as part of the long-range transportation planning process. Several case studies were included because they illustrated initiatives that have been in development for long periods of time, encompass transportation solutions, and showcase successes (Appendix C). The four cities highlighted in the literature review are Portland, Oregon; Bogota, Colombia; London, England; and San Francisco, California.

Through the literature review, the study team was unable to identify an effort comparable to that proposed by this study. However, this research did assist the study team in developing an approach for the Miami-Dade MPO study, particularly the use of a survey technique (Tel Aviv Case Study) to narrow down the strategies to be considered in the scenario development and conceptualizing scenario definitions (Chicago Case Study).

Another purpose for the literature review was to provide guidance in developing a definition for a sustainable transportation system. Appendix C contains detailed information on the evolution of the term “sustainability” as it relates to transportation, as well as definitions of sustainable transportation that have been adopted by organizations worldwide. At the first SAC meeting, these definitions were reviewed and the following was agreed upon as the most appropriate definition for this study.

> *Sustainable transportation means a transportation system that is able to meet today's needs and those of the future using the existing and committed infrastructure identified in the 2035 Long Range Transportation Plan.*

Perhaps the most valuable result of the literature review was the identification of a set of sustainable transportation strategies. The entire list of strategies is detailed in *Appendix C.*

At the outset of this study, the following aspirational goals were established.

- Reduction in Vehicle Miles Travelled (VMT): 5% by 2015 and an additional 5% for each 5 year period that follows, for an overall reduction of 25% by 2035
- Increase in total bicycle or pedestrian trips: 6% by 2015 and an additional 6% for each 5 year period that follows, for an overall increase of 30% by 2035
- Increase transit ridership: 10% by 2015 and an additional 10% for each 5 year period that follows, for an overall increase of 50% by 2035
- Reduce single-occupancy vehicle trips: 5% by 2015 and an additional 5% for each 5 year period that follows, for an overall reduction of 25% by 2035

It should be noted that these targets were aspirational in the sense that a scenario would not be considered a failure if it did not achieve them, rather, they would help evaluate the degree of success achieved by each scenario.

STRATEGY SCREENING

To focus project resources on the strategies that may provide the greatest insight and information, a screening of the universe of strategies for moving Miami-Dade County's transportation system towards sustainability was conducted. A two-tiered screening methodology was established to narrow in on strategies to be included in scenario development.

The first step of the screening process was to determine whether any of the universal strategies conflicted with the goals and objectives of local agencies or plans. No strategies were found to be in conflict with local plans; therefore no strategies were omitted based on the Tier One screening. The strategies were prioritized under Tier Two of the screening process. Priorities were determined based on an evaluation of the strategy's strengths, weaknesses, and limitations given the local context. Members of SAC were called upon to perform the screening of the universe of strategies. Online surveys and documents describing each strategy to be evaluated and the screening methodology were sent to the group of evaluators.

As a result of the surveys, 14 of the 53 strategies were removed from further consideration due to receiving a negative score. Another 18 strategies were dropped because they were inappropriate for this study in that they could not be meaningfully evaluated. The remaining 21 strategies were assigned to one of three scenarios for testing. A complete account of this screening is included in Section 3.

SCENARIO CONCEPTS

The sustainable transportation strategies that passed through the screening process were stratified into three groups, with each group representing a distinct scenario. Each distinct scenario consisted of a unique set of strategies. Having non-overlapping strategies between the scenarios helped evaluate the impact of a given set of strategies and explain the performance of each scenario.

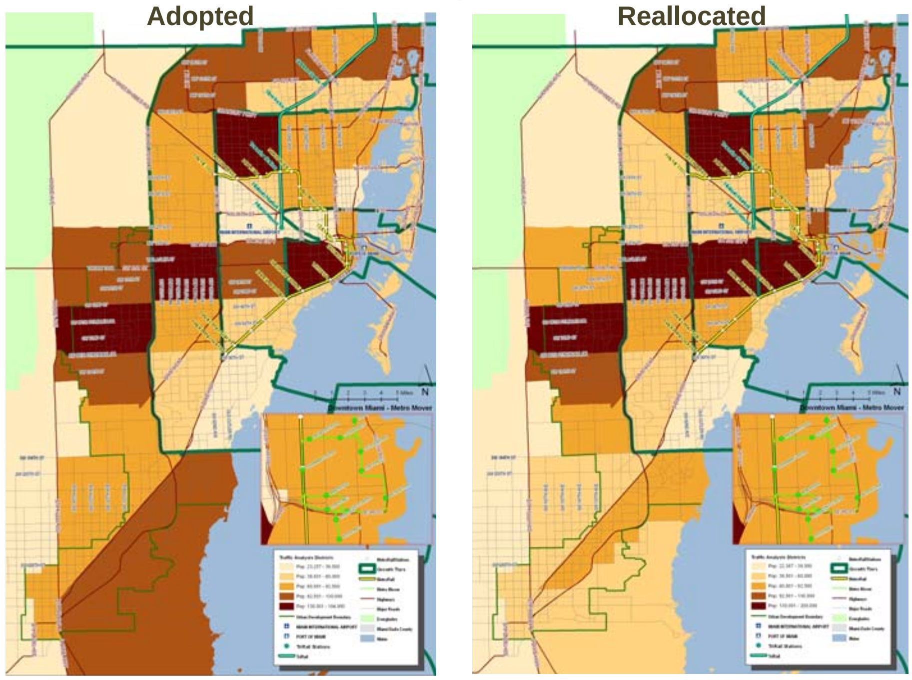
Scenario 1: Mobility Management

The concept is to improve mobility using direct monetary incentives or disincentives through a combination of highway, transit, and parking related improvements. This scenario considers the creation of a network of managed lanes on the County's expressway facilities, use of these lanes for an express bus service network that will offer reduced fares, increased parking prices, and operational improvements on the expressways. On facilities where tolls are already collected, managed lanes will be tolled at a higher rate compared to the existing toll lanes.

Scenario 2: Linkages

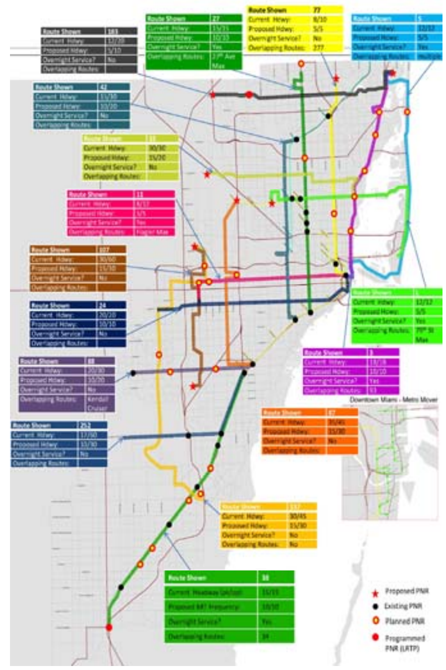
2035 Population

Adopted | Reallocated



In this scenario, emphasis is on the transportation-land use relationship. The concept is to minimize travel needs by reallocating population and job growth (2015-2035) based on smart growth and transit oriented development (TOD) principles. This scenario considers reallocating residential and employment densities to transit corridors, urban centers and activity corridors; adjusting the jobs-housing balance; and the implementation of Complete Streets.

Scenario 3: Multimodal



In this scenario, the emphasis is on arterial transportation network and facilities for transit use. The concept is to increase transit mode split and passenger throughput using transit improvements. This scenario considers improving the transit rider experience by providing real time information and more comfortable stations; increasing system-wide transit travel speeds; creating a network of arterial bus rapid transit (BRT) corridors; and adding park-and-ride locations. Transportation demand management (TDM) strategies such as carpooling/vanpooling, telecommuting, car-sharing, and parking cash-out programs that encourage non single occupant vehicle travel, deter car ownership, and increase person throughput are also included in this scenario.

SUSTAINABILITY SCENARIO EVALUATION

All three scenarios were evaluated using the regional travel demand forecast model (SERPM v6.5) and compared against the 2035 LRTP adopted by Miami-Dade County in October 2009. The entire scenario evaluation process and its results are documented in the technical memorandum entitled *Scenario Evaluation Results.* Performance measures for evaluating the scenarios using SERPM included: Vehicle Miles Traveled (VMT); Vehicle Hours Traveled (VHT); delay (vehicle hours) or congestion; mode split; transit ridership; and trip length.

In addition to using SERPM, certain strategies were evaluated using off-model techniques based on literature review and empirical data. Appropriate adjustments were made to performance measures to reflect local planning context. Off model calculations were used to determine the impact on performance measures, including greenhouse gas (GHG) emissions, energy consumption, productivity, and equity.

Table 1 provides a summary of the evaluation results for each scenario.

Table 1: Summary of Scenario Evaluation Results

Evaluation Criteria	2035 LRTP Baseline	Scenario 1: Mobility Management	Scenario 2: Linkages	Scenario 3: Multimodal
Vehicle Miles Travelled (VMT), Daily	65,355,000	62,925,000	61,293,000	64,283,000
Absolute Change from LRTP		(2,430,000)	(4,062,000)	(1,072,000)
Percent Change from LRTP		-4%	-6%	-2%
Vehicle Hours Travelled (VHT), Daily	2,778,000	2,622,000	2,428,000	2,723,000
Absolute Change from LRTP		(155,490)	(350,000)	(55,000)
Percent Change from LRTP		-6%	-13%	-2%
Average Annual Delay (hours)/Person	101	93	74	97
Absolute Change from LRTP		(8)	(27)	(4)
Percent Change from LRTP		-8%	-27%	-4%
Mode Split				
Single Occupant Vehicle (SOV)Person Trips	5,780,000	5,415,000	5,675,000	5,725,000
SOV Percentage	53%	50%	53%	52%
High Occupant Vehicle (HOV)Person Trips	4,959,000	5,281,000	4,913,000	4,911,000
HOV Percentage	45%	48%	45%	45%
Transit	202,500	239,550	193,500	300,100
Transit Percentage	2%	2%	2%	3%
Transit Mode Share				
All Trip Purposes	2%	2%	2%	3%
Home Based Work Trips	5%	5%	4%	6%
Transit Boardings Change Compared to Baseline				
Total Transit		18%	-4%	48%
Home Based Work		12%	-10%	32%
Trip Length (in miles)	8.3	8.3	7.9	8.3
Absolute Change from LRTP		0.0	-0.4	0.0
Percent Change from LRTP		0%	-5%	0%
Greenhouse Gas Emissions (CO2 lbs/day)	50,093,000	50,087,000	46,478,000	49,554,000
Absolute Change from LRTP		-6,000	(3,615,000)	(539,000)
Percent Change from LRTP		0%	-7.2%	-1.1%
Energy Cost, US dollars in kilowatt hours	1,785	1,785	1,655	1,766
Absolute Change from LRTP		0	(130)	(19)
Percent Change from LRTP		0%	-7%	-1%
Cost of Congestion/Lost Productivity, US $	$6.9 billion	$6.7 billion	$6.3 billion	$6.7 billion
Absolute Change from LRTP		-$0.2 billion	-$0.6 billion	-$0.2 billion
Percent Change from LRTP		-2%	-8%	-2%
Equity	No disproportionate impacts			

COST-REVENUE ANALYSIS

Order of magnitude costs and revenues were developed to understand the financial implications of the program of transportation projects indentified in different scenarios. It should be noted that these costs and revenues are systemwide preliminary planning level estimates. Wide ranges for costs and revenues were developed given the pre-conceptual definition of individual projects and lack of any level of engineering design.

Tables 2 and 3 summarize the results of the cost and revenue estimation for the Mobility Management and Multimodal scenarios. A cost-revenue analysis was not conducted for the Linkages scenario since there were no associated transportation improvements. More information about this analysis can be found in the technical memorandum *Scenario Evaluation Results*. All cost and revenue numbers are in present day cost (2011 dollars).

Table 2: Mobility Management Scenario Cost & Revenue Estimates

Total Capital Costs	**$1.5 - $2.8 billion that buys:**
	356 lane miles of Managed Lanes ($1.4B - $2.7B)
	Seven new Express Bus Routes ($101M - $120M) 279 route miles of new service 700 revenue hours daily 12,300 revenue miles daily 6,500 daily riders 126 articulated buses
	120 Parking Meters ($1.4M - $3.0M)
Annual O&M Costs	**$92 - $221 million**
	Managed Lanes ($39M - $114M)
	Express Bus Routes ($16M – $22M)
	Parking ($37M - $85M)
Annual Revenue	**$228 - $404 million**
	Managed Lanes ($80M - $233M) Express Bus Routes ($1M - $2M) Parking ($147M - $169M)

Table 3: Multimodal Scenario Cost & Revenue Estimates

Total Capital Costs	**$61 - $90 million that buys:**
	16 Arterial BRT Routes ($14M - $17M) 549 route miles of arterial BRT service 4,100 revenue hours daily 51,000 revenue miles daily 279,000 daily riders 18 additional articulated buses
	Transit Signal Priority ($29M - $38M) On-board equipment for the entire 1,200 buses 2,600 signalized intersections
	Real Time Passenger Information ($4M - $11M) 1,000 bus shelters equipped with electronic display signs
	Park-and-Ride Lots ($13M - $24M) 1,500 parking spaces
Annual O&M Costs	**$14 - $21 million**
	Arterial BRT ($11M - $15M incremental cost over 2035 LRTP Baseline)
	Transit Signal Priority ($1M – $1.5M)
	Real Time Passenger Information ($1M - $3M)
	Park-and-Ride Lots ($0.7M - $1M)
Annual Revenue	**$2.5 - $4 million**
	Fare box Revenue ($2.5M - $4M incremental revenue over 2035 LRTP Baseline)

SUMMARY

Through this study the following conclusions can be made:

- Affecting VMT, VHT and transit ridership on a countywide basis is difficult; and
- Given the above, the aspirational targets set at the beginning of the study were too aggressive.

The results of this effort should be used to inform upcoming studies such as the Southeast Florida 2060 Vision Plan being developed by the South Florida and Treasure Coast Regional Planning Councils; an analysis of the ability to implement tolled managed highways with rapid/enhanced bus routes and ridesharing programs being conducted by the Miami-Dade MPO; a study on parking being conducted by the Florida Department of Transportation, District 6; and future comprehensive planning activities conducted by the Miami-Dade Department of Permitting, Environment and Regulatory Affairs and the municipalities within Miami-Dade County.

Strategies for Integration of
Sustainability and the Transportation System

DECEMBER 2011

MIAMI-DADE MPO Metropolitan Planning Organization

MIAMI-DADE MPO WORK ORDER # GPC IV-12

JACOBS Engineering Group, Inc.

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1. INTRODUCTION

The concept of sustainability has been around for decades. Perhaps the most common definition of the term sustainable is the ability to provide for the needs of today while also providing for the needs of future generations. This concept is easier to grasp when it is used in the context of consumable resources like water, food, energy, or land. It is more difficult to understand when it is considered in the context of the transportation system, partly because there are so many different pieces of this system, but also because of the various inputs and outputs related to transportation. For the purposes of the Strategies for Integration of Sustainability and the Transportation System study conducted by the Miami-Dade Metropolitan Planning Organization (MPO). The performance of both the highway and transit networks was evaluated.

This report documents the four phases of the study: the literature review and research, the screening of strategies, scenario development, and scenario evaluation. Three stand alone technical memorandums were prepared to document the efforts of these phases. These technical memoranda are provided in the appendices of this document. The final section of this report summarizes the findings and discusses future uses for the results of this study.

1.1 PURPOSE

The Miami-Dade MPO initiated the Strategies for Integration of Sustainability and the Transportation System as a proactive measure to begin the investigation of various strategies for improving the sustainability of the transportation system on a county-wide level. The reasons for conducting this as a stand-alone study are two-fold. First, with the general movement towards sustainability at a federal level, the Miami-Dade MPO wanted to get out ahead of possible federal regulations that may require future Long Range Transportation Plan (LRTP) efforts to consider sustainable strategies. Second, it was important that this exercise occur outside the typical LRTP process to allow sufficient time to review all potential strategies and have a better understanding of what may be effective prior to the start of the next LRTP update, should federal regulations be passed to require the inclusion of sustainability in the LRTP process. The overarching goal of the study was to identify those strategies that have the greatest influence on travel behavior, by reducing overall travel demand or shifting the demand away from single occupant vehicles.

The general tasks of this study were the identification of strategies that may lead to a sustainable transportation system, the creation of scenarios through combinations of these strategies, and the evaluation of these scenarios using the regional travel demand model, the Southeast Regional Planning Model (SERPM) version 6.5, as well as off-model techniques. It is important for the reader to note that given the scope of this study the scenarios were developed as broad concepts to be applied countywide. The strategies included in each of the scenarios were selected to test their potential effectiveness at a macro scale. These strategies went above and beyond the current plans and policies. The Miami-Dade MPO established several guidelines at the beginning of the study as follows.

- Intensive capital improvements beyond those identified in the Cost Feasible Plan of the 2035 LRTP would not be considered. For example, the extension of the Metrorail system throughout the County could not be considered due to the high capital costs of such a strategy. The reason for this guideline was to ensure that the scenarios evaluated were sustainable from a financial perspective. The Miami-Dade MPO has a very thorough and thoughtful process for establishing priorities in its LRTP, which are carefully matched to the available funding.
- Each scenario should be comprised of a unique set of strategies. The point here was to avoid the duplication of strategies within the scenarios so that the impacts of particular strategies could be isolated. For example, evaluating a different pattern of land uses within each scenario while also including different pricing strategies or transit improvements would make it difficult, if not impossible, to evaluate the effect of any of those strategies on its own.
- Strategies included in a scenario must be focused on changing travel demand and under the realm of influence of Miami-Dade County. Many of the participants in this study were inclined to suggest the use of alternative fuels as a key strategy to consider in achieving sustainability of the transportation system. Unfortunately, this and similar strategies (such as incentives for driving low emission vehicles) could not be considered since the development and use of alternative fuels is an issue that extends beyond the influence of Miami-Dade County. Further, these types of strategies do not affect travel demand or behavior since they encourage driving.

1.2 PROCESS

This study is divided into four major tasks: literature review, screening of sustainable strategies, detailed definition of scenarios, and evaluation of scenarios. The literature review was conducted to determine: (1) if similar studies have been conducted in the US and abroad, (2) to identify sustainable strategies for a county-wide transportation system, and (3) to define what sustainability means in the context of the transportation system. Once a catalogue of strategies was identified, these needed to be narrowed down to a smaller set that are consistent with the guidelines addressed above and that could be reasonably evaluated with SERPM and off-model techniques. The strategies were then grouped into broader categories that ultimately became the different scenario concepts. These broad concepts were used to define specific improvements or adjustments to the transportation infrastructure (using the 2035 LRTP Cost Feasible Plan as the basis from which improvements were made) that became the detailed scenarios. Finally, the scenarios were evaluated using SERPM and off-model techniques to determine how each affected a series of indicators or measures.

Each step of this study was completed in collaboration with a Study Advisory Committee, or SAC. The SAC consisted of members from other departments within Miami-Dade County, municipalities, and state and regional agencies. Representatives from each of the agencies identified in Table 1.1 were invited to participate on the SAC. Participation was primarily through attendance at SAC meetings, four of which were held throughout the study at major milestones. Information was also exchanged electronically via e-mail and a file transfer site. Presentations and sign-in sheets from each SAC meeting are included in Appendix A.

TABLE 1.1: STUDY ADVISORY COMMITTEE MEMBER AGENCIES

<table>
<tr><th>MIAMI-DADE COUNTY AGENCIES</th><th>NOW KNOWN AS...</th></tr>
<tr><td>Aviation (Miami International Airport</td><td></td></tr>
<tr><td>Environmental Resources Management</td><td>Department of Permitting, Environment and Regulatory Affairs</td></tr>
<tr><td>Planning and Zoning</td><td rowspan="2">Department of Sustainability, Planning and Economic Enhancement</td></tr>
<tr><td>Office of Sustainability</td></tr>
<tr><td>Metropolitan Planning Organization (MPO)</td><td></td></tr>
<tr><td>Miami-Dade Expressway Authority (MDX)</td><td></td></tr>
<tr><td>Public Works Department</td><td>Public Works and Waste Management</td></tr>
<tr><td>Seaport (Port of Miami)</td><td></td></tr>
<tr><td>Transit (MDT)</td><td></td></tr>
<tr><th>MUNCIPALITIES</th><th>REGIONAL</th></tr>
<tr><td>City of Miami</td><td>Miami-Dade County School Board</td></tr>
<tr><td>Village of Pinecrest</td><td>South Florida Regional Transportation Authority</td></tr>
<tr><td>City of Hialeah</td><td>South Florida Regional Planning Council</td></tr>
<tr><td>City of North Miami</td><th>STATE</th></tr>
<tr><td>City of Miami Gardens</td><td>Florida Department of Transportation</td></tr>
<tr><td>City of Miami Beach</td><td>Florida Department of Environmental Protection</td></tr>
<tr><td></td><td>Florida’s Turnpike Enterprise</td></tr>
</table>

Two presentations were also made to the Transportation Planning Committee of the MPO. The first presentation was made in June 2011 to review the purpose of the study and the scenario concepts. The second presentation was made in December 2011 to review the scenario evaluation results. Copies of these presentations are included in Appendix B.

2. SUSTAINABILITY AND THE TRANSPORTATION SYSTEM

The first task of this study was to complete a literature review to determine if and where similar studies have been conducted, to identify definitions of sustainability as it relates to the transportation system, and to identify strategies for inclusion in scenarios. The full version of the literature review conducted for this study is included in Appendix C. The following are excerpts or summaries from this document that pertain to the three key points.

2.1 WHAT'S BEEN DONE IN OTHER PLACES

Research was conducted to identify different places within the U.S. and around the world where sustainable transportation has been addressed as part of the long-range transportation planning process. Several case studies were identified in Portland, Oregon, London, England, Bogota, Colombia and San Francisco, California. While there are many cities across the globe who have undertaken sustainable transportation strategies, including Singapore, Paris, New York, Amsterdam, and Vancouver, these four cities were chosen because they illustrate initiatives that have been in development for long periods of time, encompass transportation solutions, and showcase successes. Through the literature review, the study team was unable to identify an effort comparable to that proposed by this study. This research did assist the study team in developing an approach for the Miami-Dade MPO study, particularly the use of a survey technique (Tel Aviv Case Study) to narrow down the strategies to be considered in the scenario development and conceptualizing scenario definitions (Chicago Case Study). Appendix C provides a detailed discussion on Tel Aviv and Chicago case studies.

2.1.1 PORTLAND, OREGON

Portland was chosen as one of the case studies since it is one of the nation's "most livable cities" and a leader in sustainable development. The city is known for its innovative planning efforts that protect farm land and natural areas, revitalize commercial districts, preserve the character of residential neighborhoods, minimize its environmental footprint, and promote the use of alternative modes of transportation. By taking a regional planning approach that carefully considers the interrelation between land use and transportation, the Portland region is a national model for maintaining and creating vibrant communities. The specific strategies implemented in Portland include parking management in downtown, travel auditors, improvements in public transportation, and coordinated land use and transportation plans. Use of alternative fuels is an issue that extends beyond the influence of Miami-Dade County. Further, these types of strategies do not affect travel demand or behavior since they encourage driving.

2.1.1.1 PARKING MANAGEMENT

By combining a variety of innovative off-street parking policies and regulations, Portland has for decades served as a model for effective parking management. The city's investment in extensive, reliable public transit infrastructure has enabled it to wean residents and commuters off private automobiles. Since 1992, the state has mandated that all localities guide their development with transit accessibility goals.

Portland's proactive approach began in the early 1970's, when the city's downtown air quality violated federal carbon monoxide standards one out of every three days. This led to a freeze at 45,000 parking spaces in 1972. Thanks in part to this measure and to the improved technology of automobile exhaust systems, downtown Portland has not exceeded the carbon monoxide standard since 1984. In 1997, the city lifted the freeze replacing it with a more flexible system of parking maximums and minimums to manage, rather than prevent, parking space construction. Parking minimums are not applied to developments in the city's densest commercial neighborhoods, including downtown, and neighborhood commercial districts, and central residential districts. Similarly, minimums do not apply to any sites within 500 feet of a transit line that provides service at least every 20 minutes during peak hours. (ITDP, 2010)

All types of transit are free within Fareless Square downtown. TriMet agreed to provide Fareless Square in exchange for Portland placing price and quantity controls on downtown parking, thus allowing greater development density in the downtown core. The parking controls included:

- *A cap on the total amount of parking available in the downtown area, with no minimum parking requirements for individual developments (through 1995).*
- *Metering all on-street parking.*
- *All public and private parking garages open to the public are pay-to-park.*

A developer or owner also benefits from reduced minimums if willing to manage parking by arranging space sharing or bike parking in a facility. When the parking demands from two or more uses located near one another occur at different times, the city's zoning code allows a shared parking facility with fewer spaces than the combined, separate requirements for each use. Similarly, bicycle parking may substitute up to 25% of required car parking spaces. For every five bike parking spaces a developer builds, one fewer car parking space may be constructed.

"Limiting the number of spaces allowed promotes efficient use of land, enhances urban form, encourages use of alternative modes of transportation, provides for better pedestrian movement, and protects air and water quality," states the city's zoning code. Thus, parking maximums complement minimums in many neighborhoods. The city conducted a study to determine parking demand under different policy scenarios. Taking account of transit capacity, they calibrated parking requirements to meet their travel demand forecasts within the context of the entire transportation system and their land use objectives.

Consistent with the city and state's commitment to public transit, the maximums vary according to a site's distance from bus or light rail — closer to transit less parking is permitted. Several neighborhoods are therefore subject to low maximums. Downtown office and retail developments, for example, are limited to one space per 1,000 square feet of floor space, and hotels may provide only one space per hotel room. Given this low limit, developers almost always build up to the maximum; no waivers to build above the maximum have been granted since 1974.

The city treats parking as a transferable entitlement. However, a developer choosing to build below the maximum or the owner of a historic building that lacks parking, may transfer its parking development rights to another property. In this model a developer may transfer (but not sell) parking rights up to the maximum allowed to another developer as long as the transfer agreement has been completed prior to the laying of the new development's foundation. For pre-existing buildings or for new development where a transfer agreement had not been made prior to the foundation laying the existing building may transfer up to 70% of the original entitlement to another developer. In return, the transferring property has the right to use its parking entitlement in the facility where the rights have been transferred but they must pay the prevailing rate for the privilege. This policy maintains city control over a district's parking supply yet allows developers the flexibility necessary to finance, build and operate new and existing developments. It also helps to consolidate facilities, reducing the number of curb cuts and intrusions into the pedestrian realm.

The impact of this group of programs and policies has been significant. The city reports that transit use increased from 20 to 25% in the early 1970's and to 48% in the mid-1990's. (ITDP, 2010)

2.1.1.2 TRAVEL AUDITORS

Initiated as a pilot project known as TravelSmart, this effort covered 600 households and provided customized information about alternate travel modes to those individuals identified as willing to try other modes. This pilot project was so successful that in 2004, the city of Portland combined it with the launch of the interstate MAX light-rail line. The expanded effort covered over 14,000 individuals with a 92 percent response rate. After-survey data analysis shows that car trips decreased in the target area and shifts to walking, bicycling and public transit were noted. The total reduction in vehicle miles travelled (VMT) was 14 percent.

Based on this success, the City of Portland has turned this into a citywide initiative known as SmartTrips. Using a targeted, phased roll out the program sends a newsletter to residents in a specific area that provides information on nearby walks, bike clinics, bike rides, streetscape improvements, Safe Routes to Schools, and transit services. This newsletter includes an order form that allows residents to request additional information and incentives for using alternative transportation. The program has expanded to include business and new residents. These efforts have succeeded in reducing drive-alone car trips by eight to twelve percent per year, with simultaneous increases in walking, biking, riding public transit, and carpooling.

2.1.1.3 IMPROVEMENTS IN PUBLIC TRANSPORTATION

Portland has been an innovator in public transit since the late 1970's when residents rejected new highways and parking garages in favor of transit facilities and public opened space. In 1978 the Portland Transit Mall opened with one-way streets specifically for transit, making the Mall a focus for downtown redevelopment. In 1981 the city built Pioneer Courthouse Square instead of a 10th-floor parking garage. And in 1986, the MAX light rail line between downtown and Gresham opened as one of the first modern light rail systems in the country. Since then the city's public transportation services have grown to include 79 bus lines, four light rail lines serving 52 miles, Paratransit services and a 14.7 mile commuter rail line. While Portland is the 24th largest metro area in the US, it has the 7th highest transit ridership per capita.

2.1.1.4 LINKING TRANSPORTATION AND LAND USE PLANNING

Metro, the nation's only elected regional government, serves more than 1.5 million residents in Clackamas, Multnomah and Washington counties and the 25 cities in the Portland region. It was formed in 1979 to forge new strategies and innovative partnerships to build vibrant communities, promote economic growth and protect wildlife habitat. Metro provides regional services that include overseeing solid waste and recycling services, the management of public places like the Oregon Zoo, Portland Center for the Performing Arts, the Oregon Convention Center and the Portland Expo Center, and the stewardship of more than 12,000 acres of parks and natural areas.

Metro is also charged with developing growth management and land use policies, creating an overall transportation plan and allocating federal funds through the Transportation Priorities program. The agency is responsible for approving the expenditure of these federal transportation funds—which have been pivotal in implementing the region's land use and transportation vision. Various committees with broad representation in the region advise Metro; this process assures local elected officials are directly involved in regional policy and investment decisions.

2.1.2 LONDON

London is at the cutting edge of implementing innovative sustainable transportation solutions. Learning from London's experience is useful for any city that plans to incorporate sustainability into their transportation systems planning process. Strategies employed in London include congestion pricing, bicycle initiatives, and promoting education of alternatives to single occupancy vehicles.

2.1.2.1 CONGESTION PRICING

London's Congestion Charging scheme was agreed upon in February 2002. Charging commenced in February 2003. Cameras at entrances, exits and around the zone read each automobile's license plate. The plates are checked against a database to work out whether the user has pre-paid the charge, is exempt, or has a 100% discount. If a match is found, any images of that vehicle are deleted from the database. Otherwise, the images are validated and a Penalty Charge Notice is sent to the registered owner of the vehicle. People residing within the congestion zone are offered a 90% discount.

By law, all surpluses raised must be reinvested into London's transportation infrastructure. On introduction, the scheme was the largest ever undertaken by a capital city. In fiscal years 2007, 2008 and 2009, over $162 million (US Dollars) in net revenue was reported. In October 2010, a number of other changes to the Congestion Charging scheme which took effect in January 2011 were introduced, including:

- *Charge increase*
- *Congestion Charging Auto Pay*
- *Greener Vehicle Discount*
- *Extending the 100% discount for Electric Vehicles to include Plug in Hybrid Electric Vehicles (PHEVs)*
- *Implementing a $15 (US Dollars) registration and annual charge for 9+ seat 100%*

The daily Congestion Charge rose on January 4, 2011 to $15 (US Dollars) per day if paid in advance or on the day of travel, $18 (US Dollars) if paid by midnight the charging day after travel, or $14 (US Dollars) if registered for Congestion Charging Auto Pay.

Congestion Charging Auto Pay is an automated payment system. It automatically records the number of charging days a vehicle travels within the charging zone each month and takes the charge from a registered debit or credit card on a monthly basis. The Greener Vehicle 100% Discount (GVD) allows a 100% discount from the Congestion Charge for cars that emit 100 g/km or less of CO_2 and that meet the Euro 5 standard for air quality. Users must register for the discount and pay $15 (US Dollars) a year per vehicle. Over the course of the next 12 to 18 months, it is anticipated that new electric and hybrid electric plug-in vehicles will be brought to market with significantly lower emission levels. In 2012, TfL plans to review developments in the market, with the intention of reducing the discount levels to 80 g/km or lower when the time is right.

While congestion has risen back to pre-charging level, it would be much worse without the charge. Widespread water and gas main replacement projects are the primary reason for the rise in congestion; as road capacity has been greatly reduced as have traffic management measures to help pedestrians and other road users. (TfL)

2.1.2.2 BICYCLE INITIATIVE

Bicycling initiatives were also undertaken as part of London's strategy for achieving more sustainable transportation. Part of the Mayor's Transport Strategy is the aim to increase cycling in London by 400% by 2025 (compared to 2000 levels) thereby achieving the target of 5% of all journeys being made by bicycle. To support this aim, an extensive bicycle sharing and bicycle infrastructure program were implemented.

Barclays Cycle Superhighways are new cycle lanes into central London linking outer London. They provide cyclists with safer, faster and more direct journeys into the city. The first two have been launched, with 10 more being introduced by 2015. Barclays Cycle Superhighways will be up to 9 miles in length, and will connect the outer boroughs to inner London. The pilot routes are both around 8 miles in length.

The Superhighways were built to:

- *Improve cycling conditions for people who already commute by bike;*
- *Encourage those who do not already ride to do so;*
- *Help cut congestion;*
- *Relieve overcrowding on public transport; and*
- *Reduce emissions.*

The lanes will be at least five feet wide and will continue through intersections. Advanced Stop Lines (ASLs) will be provided at signals to help cyclists get ahead of the traffic, and a number of junction layouts have changed to provide more space. Barclays Cycle Superhighways will provide thousands of new cycle parking spaces, free or subsidized Commuter Cycle Training, as well as better facilities for cyclists at work.

The estimated cost of delivering the two pilot Cycle Superhighways routes is $35 million (US Dollars); and this includes the Smarter Travel measures to encourage increased levels of cycling such as cycle training, maintenance and parking. The pilot routes will allow TfL to test all of the measures for their effectiveness, helping to determine the scope, detailed design and cost of the remaining routes.

2.1.2.3 PROMOTING ALTERNATIVES TO SINGLE OCCUPANCY VEHICLES

Travel demand management strategies have been a part of a wider response by the Mayor and Transport for London (TfL) to the challenges posed by climate change and mounting pressure on London's transport system from the forecast rise in population and employment. In 2005/06, there was a significant increase in the amount of future funding to support Travel Demand Management (TDM) projects, which Transport for London (TfL) continues to develop and implement in partnership with the London boroughs, businesses, schools and community groups. Funding had been increased from $26 million (US Dollars) in 2005/06 and $27 million (US Dollars) in 2006/07 to $38 million (US Dollars) in 2007/08 and $45 million (US Dollars) in 2008/09.

These projects, some of which are detailed below, aim to encourage people to switch to more environmentally friendly modes of travel. As such, they are vital to the long-term sustainability of London's transport system. (TfL)

- ***Personalized Travel Planning*** *-Trials in Kingston, Sutton and Haringey in 2006/07 saw 56,000 households being given tailored travel advice, with at least 16% of respondents now using public transport more often and 24% walking and cycling more.*
- ***School Travel Plans*** *- Based on analysis of 300 plans completed in 2005/06 an average reduction of 5.5% in single occupancy car trips was achieved in just one year (equivalent to 1.9 million fewer car trips per year).*
- ***Car Clubs (Carsharing)*** *- TfL research among car club members in 2006 saw 20% of users having given up their own car and 30% having deferred purchasing a car as a direct result of their car club membership.*
- ***Workplace Travel Planning*** *- These plans support activities such as flexible working and teleconferencing. They typically achieve a 15-20% reduction in single occupancy car trips where employees are encouraged to change their travel to or during work. Employers that sustain plans over a prolonged period have seen even better results.*

2.1.3 BOGOTA, COLOMBIA

Bogotá is a world leader in planning, designing, and implementing non-motorized transportation solutions. Bicycling and walking are intrinsically part of sustainable transportation strategies. Therefore, Bogotá was deemed an appropriate case study. Bogotá is home to 7 million people. About 85% of the people in the city do not use cars for their daily transport, the city invested heavily in non-motorized transport and transit to provide mobility and accessibility to its residents. Bogota's promotion of non-motorized travel is evidenced through their Ciclovía and CicloRuta programs. Bogotá is so transit friendly that people voted in favor of outlawing cars in the city during rush hour by 2015. The specific strategies identified in Bogota include improvements in public transportation and non-motorized transportation.

2.1.3.1 IMPROVEMENTS IN PUBLIC TRANSPORTATION

The initial $350 million (US Dollars), 24 mile TransMilenio system was up and running in less than two years. The buses, running in separate lanes down the center of the city's main arteries, are able to carry 780,000 people a day at an average speed of 16 miles per hour, considerably outpacing cars and private buses. Estimates have found that the system saves people an average of 300 hours of commuting time annually. Unlike many subways or elevated trains, the TransMilenio operates at a profit. The city plans to add a number of new lines to the system by 2015, so that 85% of residents will live within 500 meters of a bus station.

2.1.3.2 NON-MOTORIZED TRANSPORTATION

Bogota has two programs in place that encourage the use of walking and bicycling in lieu of driving: Ciclovia and CicloRuta.

CICLOVÍA

Ciclovía is a weekly, city-wide, car free day in Bogotá that puts 70 miles of roads, including La Septima, the city's main commercial center, off-limits to cars and has been running since 1974. More than two million people come out every week to bike and walk. Ciclovía is hosted every Sunday and holiday from 7 a.m. to 2 p.m. on a network of connected, downtown Bogota streets. No infrastructure was required to make the streets car free. Permanent signs were installed on Ciclovía roads to inform the public. Temporary signs are positioned on Ciclovía days to alert drives to road closures. Lights and traffic rules are obeyed at the intersection of Ciclovía routes and roads that remain open to automobiles. Complementary services, such as on-street juice and food vendors, have been cited as an important piece of the Ciclovía experience.

The city built 70 miles of bicycle routes and closed several streets to cars and converting them into pedestrian malls. More drastically, the city began to restrict car use during rush hour, banning each car in the city from the downtown area two days a week, based on the license plate number. The results were dramatic: the average commute time dropped by 21 minutes, and pollution was reduced significantly. The city had been debating a multi-billion dollar subway system for decades. The leadership decided to invest in significantly cheaper rapid transit bus system that had turned Curitiba, Brazil into a model city for effective public transportation.

CICLORUTA

A 188 mile network of 9-12 feet wide bidirectional protected bicycle lanes and adjoining pedestrian boulevards, at the same time as constructing TransMilenio. The system is a best practice, not only because it has reduced car dependence and associated emissions, but it has also fundamentally changed behavior in the city. Along the transport corridors in the suburbs, higher density buildings of between three and seven stories encourage residents to travel by bicycle. These efforts appear to be working. Five percent of all trips in Bogotá are by bike, compared to 0.5% before CicloRuta.

The system is divided into three sections.

- ***The Main Network -*** Connects the key city centers, its main educational and work areas, with the most populated residential areas. It also connects with the secondary network. These lines are surroundings the more important road axes that they link the great city center with more the densely populated areas; axes cross-sectional and in the road axes that cross the city of North to the South; axes longitudinal.
- ***Secondary Network -*** Connects housing areas, parks and facilities and attractions with the main network. These paths are mostly designed to serve as feeders to TransMilenio. All main stations of TransMilenio have guarded bike parking facilities.
- ***Complementary Network -*** This links recreational networks, and external routes to the system. These paths are located along the river banks which in turn are part of the system of Linear Parks of the City; including surrounding wetlands

CicloRutas play an important role for the poor people of the City. More than 23% of the trips made by the lowest income group in the city are pedestrian and by bikes. As the income level rises, there are less people walking or biking.

Separating the bicyclist from traffic has improved safety for bikes significantly. In Bogotá there has been a 33% decrease in deaths relating to bikes (from 115 in year 2001 to 77 in year 2004). This has occurred despite the large increase in CicloRutas trips. In addition, injuries reduced 8.8% (2,754 in 2001 to 2,512 in 2004) despite a 38% increase in bike use.

Speed is often an interesting benefit: bikes mean speed is 11 miles per hour, while private vehicles run at 8 miles per hour.

Additionally, air quality improvement is helped with the use of CicloRutas when people leave the car at home. It was calculated for Bogota a reduction in GHG of 36.6 thousand tones of CO_2. CicloRutas also helped to recover public space, along riverbanks, and wetlands - the city's 13 wetlands were occupied for years by illegal constructors, after construction of the CicloRutas development stopped in this precious natural environment.

2.1.4 SAN FRANCISCO, CALIFORNIA

San Francisco, a city with over 800,000 residents, has evolved over the last half century from a municipality that once required one parking space for every new dwelling to one of the most innovative examples of parking management in the country. This has occurred through investment in transit, gradual replacement of off-street parking minimum requirements with maximums, parking unbundling, and proactive on-street parking management. High density development and a preponderance of buildings that pre-date off-street parking mandates has helped keep the number of autos per person relatively low. Gradual transformation in parking provides useful mechanisms that other cities can appropriately modify and implement in their jurisdictions.

2.1.4.1 OFFSET PARKING

Due to its low residential population and high number of commuters, the city introduced many of its parking reforms downtown. Following the opening of the Bay Area Rapid Transit Authority (BART) rail line in 1973, the city authorized a cap of all downtown commuter parking spaces. Minimums do not apply to any use downtown, and a maximum of one space is permitted for every four downtown residential units. Similarly, parking may occupy no more than seven percent of an office building's gross floor area, about one space for every 20 office workers.

San Francisco has proceeded to eliminate residential minimum parking requirements through the adoption of neighborhood plans for districts close to the downtown, and first through the Mission Bay Redevelopment Plan in 1997. More recently, the 2005 Rincon Hill Plan was the first to eliminate minimum parking requirements for all uses in a residential neighborhood.

Recent developments subject to residential parking maximums demonstrate that the maximums have a binding effect. Most developers build up to the maximum allowed number of spaces. The city's residential parking maximums range from 0.5 to one space per unit, depending on neighborhood factors such as access to transit and density; these were often converted from the existing minimum requirements.

"To some extent (parking maximums) have been achievable because they have been part of a larger package of policy and infrastructure and other changes for neighborhoods as prerequisite for development," reports Joshua Switzky of the San Francisco Planning Department. The drawback to comprehensive neighborhood planning, however, has been its slow pace. Several of the neighborhood plans recently implemented have taken nearly 10 years to complete, due to occasional funding gaps and the state's lengthy environmental review process.

The 2005 Rincon Hill Plan also mandated that developers unbundle parking spaces from residential units and dedicate parking spaces to car share and covered bicycle parking in larger residential developments. In April 2008 the city extended these reforms to the Hayes Valley, Duboce Triangle, and North Mission neighborhoods, and made unbundled residential parking a requirement throughout San Francisco.

Enforcement of parking unbundling is difficult and some developers have sought to circumvent the requirement. They legally unbundle the sale of a parking space from the residential unit but price the space well below market rate (such as for $100) to the buyer of a residential unit. The token sum leaves parking nearly free thus essentially bundled, but in compliance with the letter of the law. When parking spaces are unbundled, assessing the land they occupy has proven difficult. The city assessed unbundled parking spaces separate from the residential unit, but the spaces rather function more as easements. This is particularly the case when unbundled parking spaces are not independently accessible, that is, when parking spaces are "stacked" for greater efficiency.

2.1.4.2 CURB SIDE PARKING (SAN FRANCISCO'S SFPARK: CIRCLE LESS LIVE MORE)

San Francisco probably has the most politically favorable environment for large scale parking reform of any major U.S. city. Though car use is high, the political boundaries of the dense city encompass very few car dependent areas. Prior to 2009, the city council / Board of Supervisors had already approved the highest curbside parking rates in the U.S. Curbside meter rates on neighborhood commercial strips were two to three times higher than New York or Chicago.

Despite this, meter rates were still politically sensitive, and apparently set too low because San Francisco continues to suffer from chronic curbside parking shortages. The resulting cruising and double parking led to heightened air pollution and significant bus service delays as documented in the SFMTA's Transit Effectiveness Project.

San Francisco's SFpark is the largest, and by far the most sophisticated, curbside parking reform project underway in the United States. The San Francisco Municipal Transit Agency's (SFMTA) $24.75 million federally funded project encompasses 6,000 of San Francisco's 25,000 metered curbside parking spots in seven pilot neighborhoods. The heart of SFpark is a Data Management System which sorts a tremendous amount of data collected from the network array of remote sensors in all 6,000 parking spots. San Francisco installed new electronic, multi-space meters in 2009 and will activate parking spot sensors attached to the pavement sometime in 2010. These wireless sensors can detect whether a spot is occupied by a vehicle and report parking occupancy information in real time to a central computer. City officials and technology vendors say the parking sensors are so sensitive they can recognize the magnetic signature of individual vehicles. The project will produce valuable data about the effect of meter pricing on occupancy.

Paraphrasing the SFMTA, the city's transit provider and street manager:
[SFpark] "…will use pricing to help redistribute the demand for parking. The goal is to encourage drivers to park in garages and lots, and to almost always have one space available on every metered block. . . . With more availability, drivers will circle and double park less. Muni (buses) will be faster and more reliable, and greenhouse gas emissions reduced." The SFMTA's unstated hope is that SFpark will change public attitudes towards metering through positive examples, and by providing better information and better customer service. It is expected that SFpark will foster public support for a curbside parking system based on broader transportation goals rather than local politics. SFpark has three operational goals:

- *To provide real-time parking information.*
- *"Just right" meter prices that mitigate parking demand.*
- *To provide real-time parking information.*

Additional goals include better ways to measure parking usage and better enforcement of parking rules. SFMTA internal surveys have shown that enforcement is erratic and poorly targeted, and as many as one third of vehicles are illegally parked at any given time. Data collected will provide real time information on turnover, length of stay, failure to pay and other illegal parking allowing the city to precisely and more effectively deploy enforcement personnel.

2.1.4.3 CHANGES IN PARKING OPERATIONS

Rates are set based on occupancy targets. They may range from $0.25 to $6.00 per hour. Based on their effectiveness, rates will be reset in increments of up to $0.50 / hour every four.

- *Rates will be set differently at different times of day and during special events to achieve the desired occupancy / availability objectives.*
- *Some meters are in effect longer than they had been. Again to ensure that occupancy and availability goals are met.*
- *Extended parking time limits*
- *Real-time information is available via web for curbside parking; information on off-street parking is available by web, variable message signs and SMS.*
- *More convenient payment methods are available: credit cards, pre-paid SFMTA smartcards and cash.*

The SFMTA, overseen by the mayor, is the only major transit agency in the U.S. to control curbside parking and to receive all parking meter and fine revenue. Thus, the agency has a double financial incentive to properly manage curbside parking: it makes money from meters and fines, plus it saves money from bus operations when it reduces bus service delays caused by circling and double parked vehicles.

Before San Francisco shifted to digital meters over the last decade, it was losing $1.5 to $2.0 million a year to theft. As recently as 2007, the city was only collecting 22% of the maximum potential meter revenue it could, compared to 38% in San Diego and over 50% in Boston. (ITDP, 2010) Table 2.1 shows the change in San Francisco's parking rates as a result of these new parking management strategies.

TABLE 2.1: SAN FRANCISCO HOURLY PARKING RATES

Area	Pre-SF*park*	SF*park* (Minimum-Maximum)
Downtown/Commercial	$ 3.50	$ 0.25 to 6.00
Near Downtown	$ 3.00	$ 0.25 to 6.00
Neighborhood Retail	$ 2.00	$ 0.25 to 6.00

2.2 SUSTAINABLE TRANSPORTATION SYSTEM DEFINED FOR THIS STUDY

For this study defining a sustainable transportation system is essential to determining the characteristics of such a system and to investigate appropriate performance measures for evaluating sustainability. Furthermore, it helps refine the methodology for creating and evaluating different scenarios. Finally, the definition of sustainable transportation will help guide decision making throughout the process of this study.

The literature review contained in Appendix B contains detailed information on the evolution of the term sustainability as it relates to transportation, as well as definitions of sustainable transportation that have been adopted by organizations worldwide. At the first SAC meeting, these definitions were reviewed and the following was agreed upon as the most appropriate definition for this study.

Sustainable transportation means a transportation system that is able to meet today's needs and those of the future using the existing and committed infrastructure identified in the 2035 Long Range Transportation Plan.

To assist in evaluating the degree of success of each scenario, the following aspirational targets were developed.

- ***Reduction in Vehicle Miles Travelled (VMT):*** *5% by 2015 and an additional 5% for each 5 year period that follows, for an overall reduction of 25% by 2035*
- ***Increase in total bicycle or pedestrian trips:*** *6% by 2015 and an additional 6% for each 5 year period that follows, for an overall increase of 30% by 2035*
- ***Increase transit ridership:*** *10% by 2015 and an additional 10% for each 5 year period that follows, for an overall increase of 50% by 2035*
- ***Reduce single-occupancy vehicle trips:*** *5% by 2015 and an additional 5% for each 5 year period that follows, for an overall reduction of 25% by 2035*

2.3 STRATEGIES FOR MOVING TOWARDS A SUSTAINABLE TRANSPORTATION SYSTEM

While there are innumerable strategies for moving towards sustainability in transportation, this section summarizes a range of the options available, including those that have been shown to be the most effective. The strategies are categorized into three groups as shown in the table below and organized in the previous case studies.

TABLE 2.2: SUSTAINABLE TRANSPORTATION STRATEGY CATEGORIES

GROUP	CATEGORY
Pricing/Behavior	Manage traffic and congestion
	Promote education and involvemement of all stakeholders
Efficient Resource Utilization	Support improvements in public transportation
	Link transportation and land use in transportation plans
	Prioritize highway repair and safety performance versus new capacity
Transit, Pedestrian, and Bicycle	Support non-motorized transportation
	Encourage transit use

Many of the strategies for moving toward sustainability could be classified under more than one of these categories. For example, widening sidewalks would support non-motorized transportation and could lead to reduced congestion. Strategies were designated to the category which was deemed the most directly related to that strategy. Accordingly, a strategy to widen sidewalks would be classified under Support non-motorized transportation.

2.3.1 PRICING/BEHAVIOR

According to the 2010 Urban Mobility Report, Miami-Dade is the fifth most congested metropolitan area in the Nation in terms of travel time. In 2009 the financial cost of congestion experienced by County residents amounted to approximately $3.3 billion, and resulted in excess fuel consumption of 109 million gallons. As the population of Miami-Dade County continues to grow, so does the demand on the existing transportation system, which requires innovative investments and collaborative strategies to curtail the rising costs of congestion. (MPO)

- **Road Pricing and Tolling**

  Economists have long advocated road pricing as an efficient and equitable way to finance roads and other transportation programs, and encourage more efficient transportation. Road pricing has two general objectives - revenue generation and congestion management. (VTPI) The revenue generation component of road pricing leads to opportunities to create public-private partnerships that share the evaluation and risk responsibilities of maintaining existing roads and financing new infrastructure.

  - **Variable Pricing**

    Variable pricing on toll facilities is a strategy used to manage congestion during peak periods. Motorists are charged higher tolls during the peak period and charged lower tolls or no tolls in the off-peak hours. The purpose of variable pricing is to spread peak hour demand over a greater time period to reduce the peaking characteristics of rush hour traffic flow. (TTI, 2001)

  - **Cordon Tolling**

    Under Cordon Tolling, fees are paid by motorists to drive into a particular area, usually a city center. Some cordon tolls are only applied during peak periods, such as weekdays. It is not unusual for attempts to implement cordon tolling to fail due to lack of stakeholder buy-in.

    The introduction of a road pricing initiative as part of a larger package of congestion relief measures is advised because it demonstrates to the public an understanding that road pricing alone will not solve urban congestion problems

  - **Parking Management**

    Parking management and parking pricing are effective ways to reduce automobile travel, and tend to be particularly effective in urban areas. In particular, since most urban-peak highway trips are for commuting, employee parking pricing can have a similar effect as a road toll. Analysis by Roth (2004) indicates that more efficient pricing of on-street parking would make urban driving more expensive but more efficient, due to lower levels of traffic congestion and the relative ease in finding a parking space near destinations, as well as providing new revenues. (VTPI)

- **Commuter Programs**

  Peak hour congestion on urban freeways is largely due to the predominance of the standard 8 AM to 5 PM work schedule. The structure of many large cities can also compound congestion as widely distributed workers funnel through a few congested corridors to several large activity centers. The peak hour trips associated with the 8 a.m. to 5 p.m. schedule not only saturate freeway corridors, but also saturate downtown streets, parking facilities, elevators, and the relative ease in finding a parking space near destinations, as well as providing new revenues. (VTPI)

  - **Variable Work Hours**

    This flexibility allows employees to shift trips to and from work either before or after the peak hour. Some programs allow participants to shift their schedule on a day to day basis, while other programs require that participants work a selected schedule on a routine basis. (TTI, 2001)

- **Telecommuting**

  Telecommuting allows workers to either eliminate a commute trip all together by working from home or to reduce trip length by working from a satellite office.

- **Ridesharing**

  Ridesharing programs provide a service of matching up potential carpoolers and/or vanpoolers through a database of interested participants based on the locations of their origins/destinations.

- **Vanpools**

  Vanpools use passenger vans to provide organized transit service to a registered group of individuals. Vanpools reduce congestion by organizing groups of individuals to share trips. Vanpools are most effective serving long distance commuters and are an effective tool for reducing vehicle miles of travel (VMT). Park and ride lots and park and pool lots often serve as meeting places for vanpool participants.

● **Park-and-Ride Lots**

Park and ride lots are an important tool for encouraging carpool, vanpool, and transit usage by creating locations where people can leave their cars/bicycles and join up with higher occupancy vehicles.

● **Parking Cash-Out Programs**

Employers can become members of the Best Workplaces for Commuters program, which offers benefits to workers that encourage less reliance on driving, including cash in lieu of a parking. (ITDP, 2010)

● **Distanced Based Fees**

Converting vehicle insurance and registration fees into distance-based charges provides a significant financial incentive to reduce driving, comparable to nearly doubling fuel prices. Unlike Road Pricing, distance-based fees affects all travel, not just travel on certain highways, and so provides congestion reduction benefits on surface streets without shifting traffic to other routes. (VTPI)

● **Motorist Information Systems**

Motorist information can include changeable message signs, radio reports and internet information about traffic conditions. These can reduce motorist stress by letting them anticipate conditions.

● **Ramp Metering**

Ramp meters control the number of vehicles that can enter a highway ramp. This tends to maintain smoother traffic flow on highways.

● **Grade Separation and Intersection Improvements**

Ramp meters control the number of vehicles that can enter a highway ramp. This tends to maintain smoother traffic flow on highways.

● **Grade Separation Can Significantly Increase Roadway Capacity**

A typical arterial lane can carry less than 1,000 vehicles per hour, while a grade separated freeway can carry more than twice that amount. Grade separation of rail lines can increase traffic flow where railroad crossings are a major cause of traffic delay. (VTPI)

● **One-way Streets**

In some situations, converting from two-way to one-way streets can increase traffic flows and simplify intersections, although access to buildings may be less convenient.

- **Narrow Vehicles**

  Motorcycles and ultra narrow cars (less than 42 inches wide) can travel side-by-side, particularly under lower-speed conditions, and so allow more vehicles to travel per lane. (VTPI)

The creation of the community's well-being starts with the education and action of its citizens. (Williams, 2007) Precedents in other areas of American life, such as the reduction of smoking, the rise in recycling, and the reduction in drinking and driving, point to the fact that education can be effective.

Some promote "social marketing" or education as a key to the eventual sustainability of our transportation system. They argue that Americans are bombarded with advertising that, for economic reasons, encourages them to purchase larger and less fuel-efficient vehicles and to use them for more and more reasons (McGovern 2004). In contrast, in parts of Europe and Australia and most recently in experiments in American cities such as Portland, Oregon (TravelSmart), willing households have had their travel choices "audited" by trained outsiders. Household members were helped to reorganize their weekly travel to take greater advantage of public transit, form trip chains that reduce the number of automobile cold starts, combine the trips of household members that were previously made independently of one another, and forgo some trips entirely. Some see this type of educational activity as promising for at least two reasons. The first is the direct shift in travel behavior toward sustainable mobility that they hope it will help to bring about. The second is the fact that education will, perhaps more gradually, contribute to changes in public policy by making more aggressive approaches to regulation more acceptable in the political arena than they are now. Others, of course, think that well-meaning experiments in consumer education are likely to result in little or no change in travel at the scale of our entire society, or worse, to interfere with individual freedom in a democratic society. (Wachs, 2004)

It would be difficult, however, to find fault in programs that garner increased public input into the transportation planning process. Innovative multimedia marketing campaigns and virtual meeting spaces can allow for the participation of the greatest number and variety of stakeholders leading to more sustainable transportation plans. Greater levels of involvement can ensure that the County's priorities in moving towards sustainability is in line with those of residents and local businesses, and that transportation plans will be supported.

2.3.2 EFFICIENT RESOURCE UTILIZATION

Compact development is a relatively low-cost yet promising long-range strategy to mitigate climate change, reduce energy consumption, and reduce overall travel demand. Its promise, though, is dependent on how well it can leverage the momentum of changing market demand. Market studies show that the demand for compact development is growing. For example, the U.S. Environmental Protection Agency has documented continuing trends toward center city investment, finding that many cities have doubled or even tripled their capture of regional residential construction since 2000. In addition, market preference research for "generation Y" (people in their 20's) showed that 77% plan to live in the urban core, and one-third will pay more to live near shops, work, and entertainment. The strong urban preference of generation Y suggests very high demand for urban housing types. (ULI, 2010)

These trends are recognized in the County's CDMP which calls for a more compact and efficient urban form within the County's Urban Development Boundary and better integration of land use development and the transportation system. Smart Growth and Transit Oriented Development (TOD) offer two similar compact land-use models, with TOD focusing on access to public transit.

.2.3.2.1 SMART GROWTH

Based on the experience of communities around the nation that have used smart growth approaches to create and maintain great neighborhoods, the Smart Growth Network developed a set of 10 basic principles.

- *Mix land uses*
- *Take advantage of compact building design*
- *Create a range of housing opportunities and choices*
- *Create walkable neighborhoods*
- *Foster distinctive, attractive communities with a strong sense of place*
- *Preserve open space, farmland, natural beauty, and critical environmental areas*
- *Strengthen and direct development towards existing communities*
- *Provide a variety of transportation choices*
- *Make development decisions predictable, fair, and cost effective*
- *Encourage community and stakeholder collaboration in development decisions (EPA, 2010)*

.2.3.2.2 TRANSIT ORIENTED DEVELOPMENT (TOD)

According to FTA, TOD is compact, mixed-use development within walking distance of public transportation and is a key element of livable and sustainable communities. TOD increases transit ridership and reduces automobile congestion, providing value for both the public and private sectors. Planned and existing TOD areas have been delineated in the County's GreenPRINT plan and the City of Miami's zoning code, Miami 21.

.2.3.2.2 PRIORITIZE HIGHWAY REPAIR AND SAFETY PERFORMANCE OVER NEW CAPACITY

Highways may be unsustainable not only due to impacts on land-use and congestion, but also because of impacts to people's safety and local ecology. Sustainable transportation plans may include repairs to highway networks that are conducive to fewer accidents, enhance storm-water management and promote wildlife corridors. Fewer accidents reduce negative externalities, i.e. social and economic cost borne by the general public. Better drainage, preserving the environment, and avoiding fragmentation of wildlife habitat by building new roads enhances the environmental capital for current and future generations. Therefore, in mature urban areas most of the federal transportation dollars should be spent in maintaining the existing infrastructure and increasing its efficiency using technology as opposed to building new roads or adding more highway lane miles. The Green Highways Partnership (GHP), launched in 2005 as a diverse, public-private partnership, claims that green highways are not defined by a list of requirements. Green highways are defined by an effort to go "beyond compliance" and leave the project area "better than before" through community partnering, environmental stewardship, and transportation network improvements in safety and functionality.

.2.3.3 TRANSIT, PEDESTRIAN, AND BICYCLE

- **Encourage Transit Use**

  Public transportation can play an important role in confronting environmental challenges. According to the FTA, "Public transportation can improve air quality, reduce greenhouse gas emissions, facilitate compact development (conserving land and decreasing travel demand), and save energy among other benefits." Public transportation can also improve the accessibility of employment and education opportunities. Since transit is a viable alternative to more resource exhaustive forms of transportation, it can be an integral component for moving towards sustainability, allowing for social equity and economic development while minimizing negative impacts to the environment.

The County's GreenPRINT Plan calls the acceleration of transit improvements "critical not only to realizing sustainability benefits for residents, but also to achieving emissions reductions needed to mitigate climate change." Given that 68% of the County's residents have never used mass transit (Miami-Dade 2010) the County should be proactive in promoting transit services and attracting transit users. There are many ways to improve public transit service and encourage transit ridership besides increasing service, such as:

- **Fare Policy**

  An important element of transit service (both bus and rail) is fare structure and collection method. Differential fare structures often exist within a transit system to provide various services or to increase ridership in certain markets for a number of reasons. Discounted fares may be offered to support mobility options of various groups based on age, financial capacity, disabilities, or affiliation (students, employer, etc.). Discounts may be offered based on factors such as frequency of use, prepayment, and time commitment purchase (weekly pass, monthly pass, annual pass). Fare structures may also be differentiated based on trip characteristics such as trip location, length, and duration, time of trip (peak or off-peak, weekday or weekend), mode, and quality of service (express or local).

- **Transit Priority**

  Bus lanes, queue-jumper lanes, bus-priority traffic signals, and other measures, such as grade separation so transit is not delayed by cross-streets and traffic congestion, reduce delay to transit vehicles and can significantly improve travel times and reliability of service.

- **Comfort and Convenience Improvements**

  Reduced crowding, better seats and cleaner vehicles can improve the users experience and encourage increased patronage. Transit stop enhancements including shelter (enclosed waiting areas, with heating in winter and cooling in summer), seating, wayfinding and other navigation tools, washrooms, refreshments, internet services, and other convenience features help to promote transit use.

- **Improved Rider Information and Marketing Programs**

  Real-time information on transit vehicle arrival and multi-modal access guides which include maps, schedules, contact numbers and other information on how to reach a particular destination by public transit can improve the experience of transit users.

- **Support Non-Motorized Transportation**

  The American Heart Association has estimated that every hour of walking may increase life expectancy by two hours. Of course, when residents get out of their car to walk and bike, carbon emissions are avoided as well. Infrastructure improvements, improving safety and promotional and education efforts can all help to encourage non-motorized trips.

  The 2009 National Household Transportation Survey found that 50% of all trips are three miles or less and 28% of all trips are one mile or less – distances easily traversed by foot or bicycle. Yet 60% of trips under one mile are made by automobile. (National Complete Streets Coalition)

- **Complete Streets**

  Complete streets are designed and operated to enable safe access for all users. Pedestrians, bicyclists, motorists and transit riders of all ages and abilities must be able to safely move along and across a complete street. Since each complete street is unique, it is impossible to give a single description. But ingredients that may be found on a complete street include sidewalks, bike lanes (or wide paved shoulders), special bus lanes, comfortable and accessible transit stops, frequent crossing opportunities, median islands, accessible pedestrian signals, curb extensions, and more.

Tree Canopy

Another strategy to promote outdoor activity, including pedestrian and bicycle travel, is to increase and improve the tree canopy. While Miami-Dade has the advantage of year-round warm weather, the County also has periods of extreme heat. Shadier bike paths and sidewalks will cool communities and get residents moving outside. It should also be noted that a community's green infrastructure provides many environmental, social and economic benefits including reducing the need for air conditioning, slowing stormwater runoff, improving air and water quality, protecting soil from erosion, storing atmospheric carbon, improving wildlife habitat and reducing noise levels, among others. (Miami-Dade, 2010)

Traffic Calming

Traffic Calming is a system of design and management strategies that aim to balance traffic on streets with other uses. It is founded on the idea that streets should help create and preserve a sense of place and that their purpose is for people to walk, look, meet, play, shop and even work alongside cars. One benefit of traffic calming is that it can be applied inexpensively and flexibly. For example, traffic calming measures include painting lines, colors or patterns; using planters, bollards and other removable barriers; eliminating or adding parking; or installing sidewalk extensions with temporary materials.

Car Free Planning

Car free planning involves designing particular areas for minimal automobile use, including:

- *Developing urban districts (such as a downtown or residential neighborhood) where personal automobiles are unnecessary and automobile traffic is restricted. Such restrictions can be part or full-time and often include exceptions for delivery vehicles, taxis, and vehicles for people with disabilities.*
- *Housing developments where residents are discouraged from owning private cars.*
- *Pedestrian-oriented commercial streets where driving is discouraged or prohibited.*
- *Car free arterials for longer distance travel.*
- *Resorts and parks that encourage or require non-automotive access.*
- *Car free days and car free events.*
- *Temporary restrictions on driving, such as during an air pollution emergencies or a major sport event that would otherwise create excessive traffic problems.*

3. SCREENING OF STRATEGIES AND SCENARIO CONCEPTS

3.1 STRATEGY SCREENING

To focus project resources on the strategies that may provide the greatest insight and information, a screening of the universe of strategies for moving Miami-Dade County's transportation system towards sustainability was conducted. The universe of applicable strategies is, by definition, composed of items that are expected to improve the sustainability of the transportation network. At the same time, the relative impact of one strategy in the universe compared to another is unknown, underscoring the value of this study. A two tiered screening methodology was established to narrow in on strategies to be included in scenario development. The selected strategies were combined into three distinct scenarios of sustainable transportation.

3.1.1 TIER ONE - AGREEMENT WITH LOCAL PLANS

The first step of the screening process was to determine whether any of the universal strategies conflict with the goals and objectives of local agencies or plans. Local goals and objectives are documented in:

- *GreenPrint, Office of Sustainability*
- *2035 Long Range Transportation Plan, MPO*
- *Transit-Development Plan FY 2010-2020, MDT*
- *2035 Long Range Transportation Plan, SEFTC*
- *South Florida Regional Freight Plan, SEFTC*
- *2025 Florida Transportation Plan, FDOT*
- *2006 Florida Strategic Highway Safety Plan, FDOT*
- *Miami-Dade Expressway Authority (MDX)*
- *Comprehensive Development Master Plan, Miami-Dade County*

No strategies were found to be inherently in conflict with local plans so that no strategies were omitted based on the Tier One screening.

Review of the local goals and objectives revealed potential conflicts that would arise during the scenario building exercise, especially for strategies that deal with highway capacity improvements. Goals dealing with supporting existing neighborhoods, protecting quality of life and promoting energy conservation highlight the community's desire for balanced solutions that should not focus solely on improving private vehicle travel on highways.

Specific objectives in the local plans include:

- *Develop regulations and programs that promote connectivity, pedestrian movement and lower vehicular speeds (GreenPrint)*
- *Minimize and mitigate air and water quality impacts of transportation facilities, services, and operations (Miami-Dade LRTP)*
- *Reduce fossil fuels use (Miami-Dade LRTP)*
- *Promote projects that support urban infill and densification (Miami-Dade LRTP, SEFTC Freight Plan)*
- *Minimize adverse impacts to established neighborhoods (Miami-Dade LRTP)*
- *Promote the use of alternative vehicle technologies (Miami-Dade LRTP, SEFTC Freight Plan)*
- *Miami-Dade County shall require all new development and redevelopment in existing and planned transit corridors and urban centers to be planned and designed to promote transit-oriented development (TOD), and transit use, which mixes residential, retail, office, open space and public uses in a pedestrian-friendly environment that promotes the use of rapid transit services (Comprehensive Development Master Plan).*
- *Energy efficient development shall be accomplished through metropolitan land use patterns, site planning, landscaping, building design, and development of multimodal transportation systems (Comprehensive Development Master Plan).*

3.1.2 TIER TWO - PRIORITIZATION WITHIN LOCAL CONTEXT

The strategies were prioritized under Tier Two of the screening process. Priorities were determined based on an evaluation of the strategy's strengths, weaknesses, and limitations given the local context. Members of the study advisory committee (SAC) and other industry experts were called upon to perform the screening of the universe of strategies. Online surveys and documents describing each strategy to be evaluated and the screening methodology were sent to the group of evaluators. After becoming familiar with the strengths, weaknesses and limitations, the group of evaluators gave each strategy a ranking in the following three categories.

- ***Effectiveness*** *– How effective will the strategy be in moving the County's transportation system towards sustainability (i.e. reducing vehicle miles travelled (VMT) and congestion, promoting a mode shift toward preferred modes)? One major factor in determining priorities will be that the strategy must not center on increasing the supply of transportation since there is more to gain from strategies which improve travel demand patterns.*
- ***Ease of Implementation*** *– What factors affect the ability to implement the strategy locally: capital and operating costs, political feasibility, or the availability of technology to realize the strategy in the foreseeable future? A factor to consider will be whether the strategy is within the realm of local influence. Strategies which are not locally implementable will be assigned low priorities*
- ***Appropriateness*** *– Is the strategy appropriate for this study? Does the strategy meet the study objective and can it be evaluated in a manner that provides value? It will be necessary to determine whether any of the strategies are not appropriate for scenario inclusion based on the ability to model and evaluate the strategy. Even with creative evaluation measures, a useful evaluation of certain strategies may not be possible.*

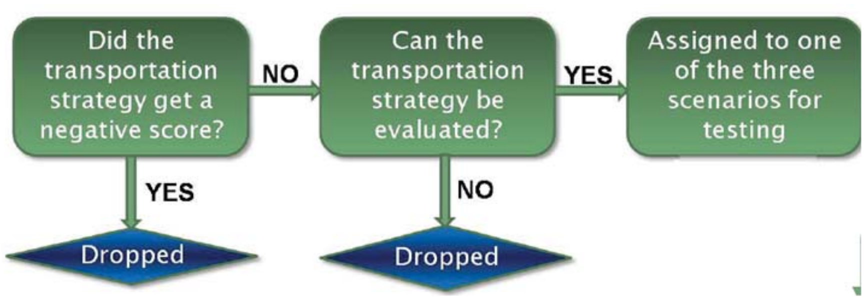
The performance of strategies was rated by the group using a qualitative ordinal scale of measurement as shown in Table 3.1 under the "performance" heading. After retrieving the survey results, the ordinal ratings were converted into numerical values, shown under the "score" heading from Table 3.1, to determine priority. The numerical score for each strategy was averaged within each category across evaluators. An overall average score was calculated for each strategy by averaging the scores from the three evaluation categories. Strategies with higher scores are considered of higher priority than those with low scores. Strategies with a negative score in any of the three evaluation categories were omitted from further consideration as shown in the flow diagram in Figure 3.1.

Because the universe of strategies was comprehensive, it included strategies that were not appropriate for this study due to an inability to quantitatively evaluate their impact in terms of the performance targets. If any of those strategies made it through the two screening tiers without being dropped they were ultimately removed from the subset of strategies used for scenario development.

Table 3.1

Score	Performance
3	Excellent
2	Very Good
1	Good
0	Fair
-1	Poor
-2	Very Poor
-3	Unacceptable

FIGURE 3.1 - SCENARIO DEVELOPMENT METHODOLOGY



3.1.3 SCREENING RESULTS

Twenty-four of the 31 SAC members and both industry experts responded to the confidential online survey. Fourteen of the 53 strategies were dropped for receiving a negative score. Another 18 strategies were dropped because they were inappropriate for this study in that they could not be meaningfully evaluated. The remaining 21 strategies were assigned to one of three scenarios for testing.

Table 3.2 shows the top-scoring strategies in each of the three evaluation categories.

TABLE 3.2 - TOP SCORING STRATEGIES BY CATEGORY

Rank	Effectiveness	Ease of Implementation	Appropriateness	Overall
1	Smart Growth	Improve Rider Information	Smart Growth	Improved Rider Information
2	Transit Headway Reduction	Fare Policy	Park-and-Ride Lots	Park-and-Ride Lots
3	Transit Oriented Development (TOD)	Tie between Transit Signal Priority & Park-and-Ride Lots	Transit Oriented Development	Smart Growth

Table 3.3 shows the universe of strategies sorted by the Overall Average scores, with the strategy with the best Overall Average score on top.) Improved Rider Information (real-time information on transit services) was deemed the best overall followed by Park-and-ride lots and then by Smart Growth and Transit Oriented Development. Strategies shown in red are those eliminated due to negative scores.

As indicated in the graphic below many of the individual strategies dropped due to an inability to evaluate them will still be included in a scenario as part of a more comprehensive strategy, where there is quantitative data available on the more comprehensive strategy. In other words, these strategies can be evaluated as part of a larger whole, but cannot be evaluated on their own.

NEGATIVE SCORES

- Designated bus-only lanes[1]
- Reversible lanes
- Car-free planning
- Grade separaton
- Pedestrian/transit mall
- Incentives for buying zero-emission vehicles
- Advanced vehicle technology
- Alternative fuels
- Ramp metering
- Distance based fees (vehicle registration, insurance)
- Cordon tolling
- One-way streets
- Professional Travel auditors
- Narrow vehicles

UNABLE TO EVALUATE WITH SERPM

- Transit headway reductions[1]
- Transit route extension and restructuring[1]
- Queue jumper[1]
- Off-board fare collection[1]
- Modern vehicles[1]
- Upgrade existing infrastructure[2] (rail track, rolling stock)
- Tree canopy[3]
- Traffic calming[3]
- Bike sharing[4]
- Ridesharing[5]
- Social marketing
- Variable work hours/flex-time
- Intersection improvements
- Context Sensitive Solutions
- Parking management
  - Unbundling the cost of parking
  - Coordinated land use
  - Transfer of rights
  - On & Off street pricing

TABLE 3.3 - SURVEY RESULTS: PRIORITIZATION OF STRATEGIES BASED ON OVERALL AVERAGE SCORE

Sustainable Transportation Strategy	Effectiveness	Ease of Implementation	Appropriateness	Overall Average
Improved rider information (Real time information)	1.61	1.57	1.52	1.57
Park-and-ride lots	1.65	1.22	1.70	1.52
Smart growth	2.00	0.59	1.77	1.45
Transit Oriented Development (TOD)	1.77	0.82	1.59	1.39
Transit signal priority	1.39	1.22	1.30	1.30
Transit headway reduction	1.91	0.41	1.50	1.27
Complete streets	1.67	0.85	1.24	1.25
Improved bus shelters	1.26	1.17	1.30	1.24
Arterial Bus Rapid Transit (BRT)	1.57	0.52	1.48	1.19
Ridesharing	1.26	1.09	1.17	1.17
Advanced arterial signal systems	1.27	1.09	1.00	1.12
Route extension and restructuring	1.55	0.57	1.17	1.10
Vanpool/Carpool	1.26	1.00	1.00	1.09
Fare policy	0.95	1.43	0.81	1.06
Telecommuting	1.57	0.65	0.87	1.03
Parking management (Variable Parking Pricing)	1.30	0.74	0.91	0.98
Parking management (coordinated land use and parking regulations)	1.32	0.55	1.00	0.96
Social marketing	0.74	1.09	0.91	0.91
Variable work hours or Flex-time	1.17	0.65	0.91	0.91
Variable pricing (Managed lanes/HOT lanes)	1.09	0.78	0.74	0.87
Biking initiatives/programs	0.73	0.91	0.77	0.80
Motorist information systems	0.82	0.95	0.64	0.80
Queue jumper	1.15	0.38	0.81	0.78
Off-board fare collection	1.00	0.41	0.91	0.77
Modern vehicles (Hybrid with Wi-Fi connections)	0.96	0.70	0.65	0.77
Upgrade existing infrastructure (rail track, rolling stock)	1.22	0.39	0.70	0.77
Traffic calming	0.71	0.90	0.67	0.76
Bike-sharing	0.86	0.73	0.68	0.76
Tree canopy	0.77	0.91	0.59	0.76
Shoulder-riding enhancements	0.73	0.91	0.59	0.74
Intersection Improvements	0.91	0.68	0.55	0.71
Parking management (On-street & Off-street parking pricing)	0.87	0.48	0.65	0.67
Parking management (transfer of parking rights)	0.90	0.43	0.62	0.65
Parking management (unbundling the cost of parking)	1.00	0.25	0.50	0.58
Designated bus-only lanes	1.17	-0.30	0.87	0.58
Car-sharing	0.82	0.32	0.50	0.55
Freight operations improvements (intersection design changes, lengthening turning storage lanes, designated additional truck routes, removing delivery restrictions, planning for loading zones and truck access within site design, and designating parking and staging areas)	0.73	0.18	0.50	0.47
Parking cash-out programs	0.80	0.00	0.55	0.45
HOV/truck-only lanes	0.77	0.14	0.36	0.42
Reversible lanes	0/86	-0.09	0.27	0.35
Context sensitive solutions	0.43	0.38	0.14	0.32
Car-free planning	0.81	-0.24	0.14	0.24
Grade separation	0.86	-0.32	0.00	0.18
Pedestrian/transit mall	0.41	-0.05	0.18	0.18
Incentives for buying zero emission vehicles	0.35	-0.09	0.17	0.14
Advanced vehicle technology	0.62	-0.10	-0.10	0.14
Alternative fuels	0.45	-0.50	0.32	0.09
Ramp metering	0.15	0.15	-0.10	0.07
Distance based fees (vehicle registration, insurance)	0.61	-0.61	-0.13	-0.04
Cordon tolling	0.55	-0.68	-0.14	-0.09
One-way streets	-0.05	-0.14	-0.27	-0.15
Professional travel auditors	-0.20	-0.80	-0.75	-0.58
Narrow vehicles	-1.14	-1.73	-1.41	-1.43

Notes: Sorted by Overall Average, from highest to lowest

Strategies with red shading received a negative score for at least one of the performance measures.

3.2 SCENARIO CONCEPTS

The sustainable transportation strategies that made it through the screening process were stratified into three groups with each group representing a distinct scenario. Each distinct scenario consists of a unique set of strategies. Having non-overlapping strategies between the scenarios helps evaluate the impact of a given set of strategies and explain the performance of each scenario. The conceptual scenario descriptions are presented in this section. The reader should note that the strategies considered in these scenarios were not endorsed by the partner agencies as potential policies or implementation steps. The strategies were employed solely to examine their effectiveness on reducing travel demand.

3.2.1 SCENARIO 1: MOBILITY MANAGEMENT

The mobility management scenario considers the creation of a network of managed lanes on the County's expressway facilities, use of these lanes for an express bus service network that will offer reduced fares, increased parking prices and operational improvements on the expressways. On facilities where tolls are already collected, managed lanes will be tolled at a higher rate compared to the existing toll lanes. The strategies included in the Mobility Management scenario are listed in Table 3.4.

TABLE 3.4 - MOBILITY MANAGEMENT DETAIL

Strategy	Evaluation Method	Description
Managed/HOT Lanes	SERPM	A regional network of managed lanes on I-75, SR 826, SR 836, SR 112 / I-195, Turnpike, SR 874, SR 878, HEFT (SR 821), SR 924, and I-95 (existing and extended). Two managed lanes in each direction are provided by taking one general purpose lane or tolled lane. Peak period toll rates will be the existing tolls plus $2.00. Off-peak rates will be existing tolls plus $0.75.
Transit Fare Policy	SERPM	Express bus routes operate on all managed lanes at 10 minute peak and 60 minute off-peak headway. Ticket fare on these express buses is minimal at $1.15, more than 50% less than existing (2010) fares.
Variable Parking Policy	SERPM	Long term parking cost are 3 times (3X) the existing (2005 base year) parking rates for areas charging $0.25 or more per hour. Long term parking cost are $0.75 on average in new areas with employment densities ≥ 25 employees per acre and in areas charging less than $0.25 per hour. Short term parking cost will be 2 times (2X) the existing (2005 base year) parking rates
Motorist Information Systems	Off-model	A 10% decrease in vehicle hours of delay will be assumed to account for the combined effect of these strategies. However, adjustments will be made to accomodate the percentage reduction in delays in Miami-Dade County's context considering model output from SERPM.
Freight Operational Improvements	Off-model	

Managed lanes combined with increased parking prices are expected to be a deterrent to traveling via single-occupant vehicle, especially during peak periods when costs would be highest. Extensive express bus service with attractive fares is meant to provide a viable alternative to driving alone. These components are expected to improve the efficiency of the regional transportation system. Operational improvements that further increase transportation system efficiency and throughput such as motorist information systems, and freight operational improvements are an integral part of the overall strategy.

3.2.2 SCENARIO 2: LINKAGES

The concept is to minimize travel needs by reallocating population and job growth (2015-2035) based on smart growth and transit oriented development (TOD) principles. In this scenario, emphasis is on the transportation-land use relationship.

This scenario considers reallocating residential and employment densities to transit corridors, urban centers and activity corridors; adjusting the jobs-housing balance and implementation of Complete Streets.

TABLE 3.5 - POPULATION REALLOCATION GUIDELINES

Area	2035 Population Growth in SERPM	2035 Population Growth as Proposed
Urban Core	18%	40%
Urban Fringe	27%	30%
Suburban	35%	20%
Exurban	21%	10%

Table 3.5 shows the general pattern of population growth as currently forecast and under the proposed reallocation. Where most of the population growth is forecast to occur in suburban areas, the proposed scenario has the largest growth in the urban core and the least growth in exurban areas. Only the growth forecast from 2015 to 2035 is reallocated. The incremental growth between 2015 and 2035 is approximately 612,600 people and 409,900 jobs. The employment allocation will be based on and balanced with population growth. Detailed description of the methodologies for relocating population and employment growth is presented in Table 3.6, which also includes the strategies used in this scenario.

TABLE 3.6 - LINKAGE DETAIL

Strategy	Evaluation Method	Description
Transit Oriented Development	SERPM	Redistribute as much population and employment to Regional, Metropolitan, and Community Urban Centers identified on Comprehensive Development Master Plan (CDMP) Meet Federal Transit Administration guidance for a High Land Use Rating with > 25 dwelling units per acre and Floor area ratio (FAR) > 2.5 within ½ mile of premium transit stations Do not exceed maximum FAR thresholds as designated in the CDMP
Smart Growth	SERPM	Redistribute any remaining employment or population to achieve overall county ratio of 1 job to each 1.5 households Focus redistribution on the Activity Corridors identified in the Evaluation and Appraisal Report (EAR)
Complete Streets	Off-Model	No reduction in VMT will be included to account for this strategy.

3.2.3 SCENARIO 3: MULTIMODAL

The concept is to increase transit mode split and passenger throughput using transit improvements. In this scenario, the emphasis is on arterial transportation network and facilities for transit use. The multi-modal scenario considers improving the transit rider experience by providing real time information and more comfortable stations, increasing system-wide transit travel speeds, creating a network of arterial bus rapid transit (BRT) and adding park-and-ride locations.

Transportation demand management (TDM) strategies such as carpooling/vanpooling, telecommuting, car-sharing, and parking cash-out programs that encourage non single occupant vehicle travel, deter car ownership, and increase person throughput are included in this scenario as shown in Table 3.7.

TABLE 3.7 - MULTIMODAL DETAIL		
Strategy	**Evaluation Method**	**Description**
Arterial Bus Rapid Transit	SERPM	New headways will be an improvement over existing for BRT corridors. Station spacing will be approximately 0.5 miles. The local bus service route that is being replaced by the BRT route will be eliminated on these corridors. Travel speeds on BRT will be assumed to be 25% faster than local bus service. Fare is reduced 50% from existing (2010) ticket fare during peak period.
Transit Signal Priority	SERPM	Implementation of a system-wide TSP with a 10% improvement in overall bus speeds.
Improved Rider Information & Bus Shelters	SERPM	Removal of the penalty and weighting on transit wait times.
Park-and-Ride Lots	SERPM	Implementation of locations from Miami-Dade Consolidated Park-and-Ride Facilities Plan (2010) Implementation of locations identified to coincide with proposed BRT corridors.
Vanpool/Carpool w/Parking Cash-out	Off-Model	Reduction in Home Based Work (HBW) trips and VMT based on literature new and finements from South Florida Community Services (SFCS) data.
Telecommuting	Off-Model	Reduction in HBW trips based on literature review appropriately adjusted for local planning context.
Car-sharing	Off-Model	Reduction on the order of 15 trips for every vehicle in the car-sharing fleet will be taken from non-home-based trips.
Biking Initiatives/ Programs	Off-Model	An overall reduction in VMT will be taken for this strategy. The amount of the reduction will be based on literature review results with appropriate adjustments for local planning context.

Sixteen Arterial BRT corridors were identified for this scenario by examining the top 10 performing existing bus routes (MDT), the top 10 performing bus routes in 2035 (SERPM) and BRT corridor selection conducted by the MPO (2004). The sixteen corridors are listed in Table 3.8.

TABLE 3.8 - PROPOSED ARTERIAL BRT CORRIDORS			
Biscayne Blvd/US 1	Kendall Dr	42nd Ave	Busway
Collins Ave	Miami Gardens Dr	87th Ave	49th/103rd/95th St
Coral Way	37th Ave	107th Ave	79th St
Flagler St	27th Ave	137'h Ave	152nd St

While BRT service will have improved headways, the additional service will be funded through the reinvestment of savings resulting from system-wide improvements in travel time. The peak vehicle requirements will stay the same for the system.

4. SCENARIO EVALUATION

4.1 METHODS OF EVALUATION

All three scenarios were evaluated using the regional travel demand forecast model (SERPM v6.5) and compared against the 2035 LRTP adopted by Miami-Dade County in October 2009. Performance measures for evaluating the scenarios using SERPM included:

- *Vehicle Miles Traveled (VMT)*
- *Vehicle Hours Traveled (VHT)*
- *Delay (Vehicle Hours) or Congestion*
- *Mode Split*
- *Transit Ridership*
- *Trip Length*

In addition to using SERPM, certain strategies were evaluated using off-model techniques based on literature review and empirical data. Appropriate adjustments were made to performance measures to reflect local planning context.

Off model calculations were used to determine the impact on the following performance measures:

- *Greenhouse gas (GHG) emission*
- *Energy consumption*
- *Productivity*
- *Equity*

The following is a brief description of the scenarios along with the discussion of modeling methodology for different transportation strategies considered under each scenario. The complete technical memorandum describing the evaluation results in contained within Appendix D.

4.1.1 SCENARIO 1: MOBILITY MANAGEMENT

The emphasis in the Mobility Management scenario was to understand the effect of pricing policies on travel behavior and their efficacy in affecting travel demand. The Mobility Management scenario created a series of managed lanes on the County's expressway facilities, establishing express bus service on these managed lanes at a discounted rate compared to current express bus fares, increasing both short and long-term parking prices in existing pay-to-park areas, as well as in some new areas based on the number of employees, and accounted for operational improvements to increase the travel speeds.

4.1.1.1 REGIONAL NETWORK OF MANAGED LANES

In this scenario, an extensive regional network of managed lanes (two managed lanes in each direction) comprising approximately 356 lane miles was created by taking one general purpose lane and the shoulder in each direction on the County's expressway and limited access facilities. These expressway or limited access facilities included I-75, SR 826, SR 836, SR 112/I-195, Turnpike, SR 874, SR 878, HEFT (SR 821), SR 924, and I-95 (existing and programmed). These facilities are shown in Figure 4.1 and the access points identified on the map represent the toll gantry locations. Average peak hour toll per trip ($2.00) and off peak hour toll per trip ($0.75) based on the I-95 Managed Lanes experience were used to determine the toll rate on managed lanes in this scenario. For facilities that are currently tolled by Miami-Dade Expressway (MDX) Authority and Florida's Turnpike Enterprise, the tolls in managed lanes were set using the following formula.

Peak hour toll rate on Managed Lanes = Existing (Year 2010) toll rate for the facility + $2.00
Off Peak hour toll rate on Managed Lanes = Existing (Year 2010) toll rate for the facility + $0.75

In other words, a premium was charged to use these managed lanes, which was an additional $2 on top of the existing toll during the peak period and an additional $0.75 during the off-peak period.

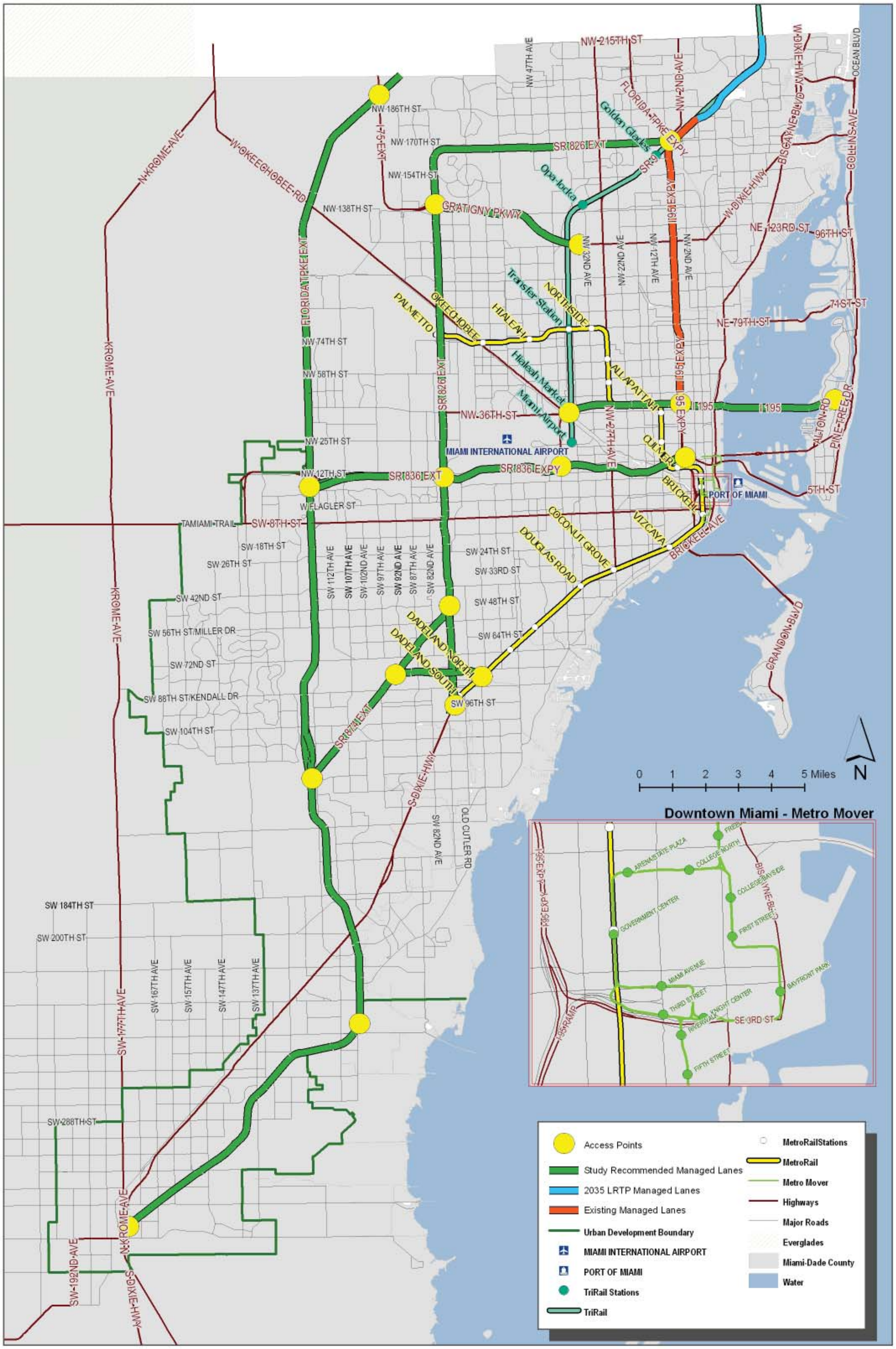


Figure 4.1 Managed Lanes Regional Network
STRATEGIES FOR INTEGRATION OF SUSTAINABILITY AND TRANSPORTATION SYSTEM

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

4.1.1.2 EXPRESS BUS SERVICE

To provide an alternative to driving and attract choice riders, a regional network of express bus service was established. The concept of such an express bus service is similar to I-95 Express Bus service currently operated by Miami-Dade Transit (MDT) and Broward County Transit (BCT). The express buses operate on the managed lanes network throughout the County. In addition to providing faster bus service between key destinations, transit fare was reduced by 50% ($1.15) compared to the existing (Year 2010) express bus service fare of $2.35. Buses operate at 10- and 60-minute headway during peak and off peak hours for a total service span of 14 hours per day providing approximately 12,300 daily revenue miles or 700 daily revenue hours of service.

4.1.1.3 VARIABLE PARKING PRICING

Both long-term and short-term parking rates were increased to deter driving. Figure 4.2 shows all of the areas affected by the variable parking pricing strategy.

- **Long-Term Parking**
  Parking costs in existing long-term parking areas were increased three-fold and a minimum fee of $0.75 was set in new areas where a minimum density of at least 50 employees per acre is projected for the year 2035. The base year cost for long-term parking ranged from $0 to $8. In the Mobility Management scenario, this cost range was increased to $0.75 to $24.

- **Short-Term Parking**
  For short-term parking costs, the price to park was doubled in all of the existing areas where paid parking was available. However, a short-term parking fee was not imposed in any new areas. The base year cost for short-term parking ranged from $0 to $7. In the Mobility Management scenario, this cost range was increased to $0.25 to $14.

4.1.1.4 OPERATIONAL IMPROVEMENTS

This scenario included motorist information system and freight operational improvements to increase the efficiency of the existing and planned transportation infrastructure. These strategies would increase passenger and goods throughput on the County's transportation network. Since the regional TDM has limited sensitivity to test operational improvements, off model techniques were used to evaluate the impact of these strategies.

4.1.1.5 MODEL METHODOLOGY

In this scenario, the following three main modifications were incorporated into the TDM:

- *Coding of managed lanes facilities*
- *Incorporating managed lane express bus routes into the TDM*
- *Increased parking rates (short term and long term)*

4.1.1.5.1 CODING OF MANAGED LANES

In order to easily identify the newly created managed lanes facilities, all new nodes created for this purpose were numbered 29,500+ (not to exceed 30,000 which would be interpreted as exclusive right-of-way within the SERPM). None of the new managed lanes were given exclusive access to managed lanes on other facilities, unless exclusive access is already anticipated to be in place under the LRTP Cost Feasible Plan. In other words, no new system-to-system access was modeled. To access an adjoining managed lanes facility, the path would need to consist of mainline facility links between managed lanes facilities. In SERPM, each managed lane link is identified as such by setting the HOT field equal to one. Please refer to Figure 4.1 for the managed lanes network.

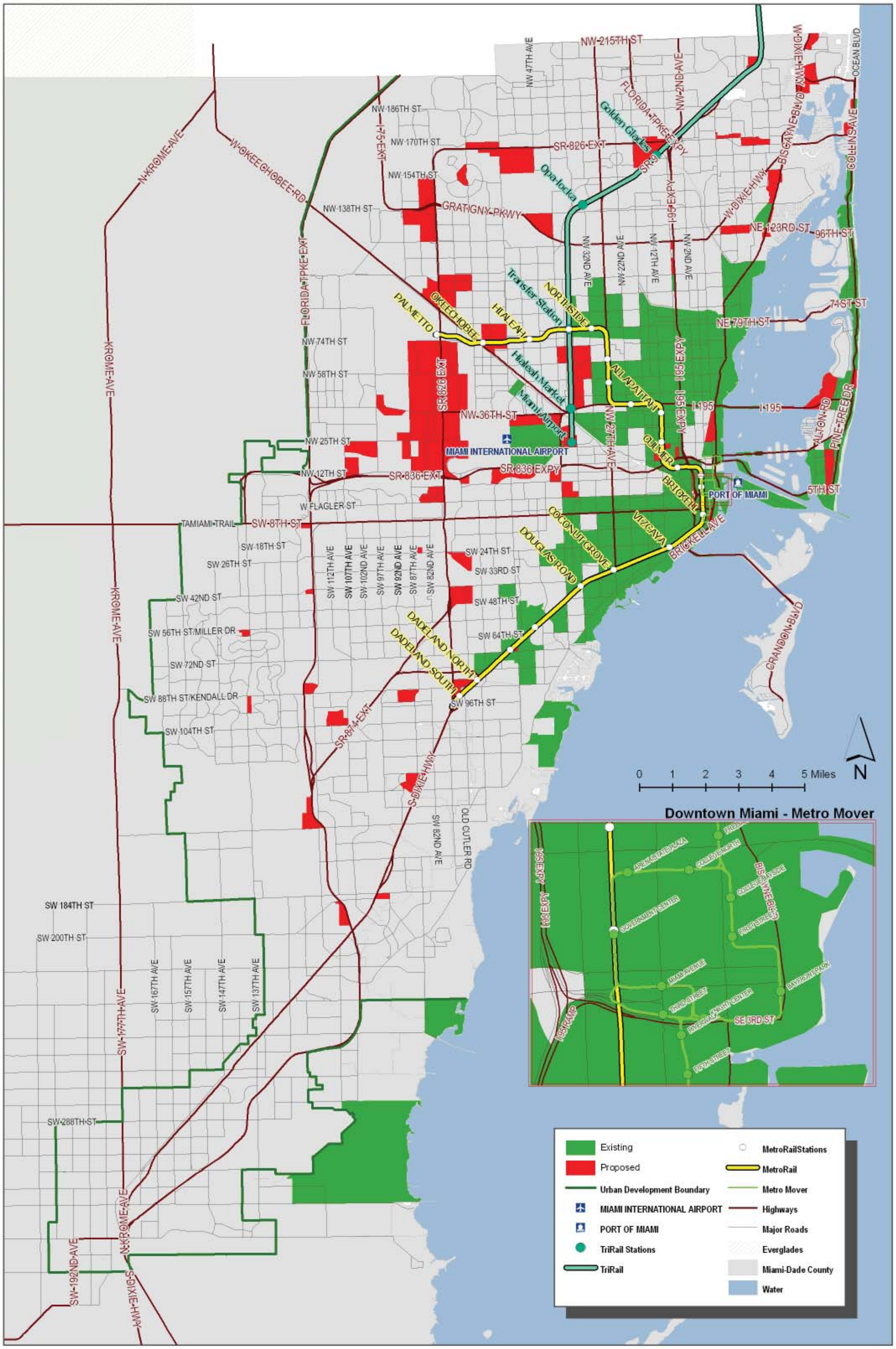


Figure 4.2 Pay-to-Park Areas
STRATEGIES FOR INTEGRATION OF SUSTAINABILITY AND TRANSPORTATION SYSTEM

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

4.1.1.5.2 INCORPORATING MANAGED LANES EXPRESS BUS ROUTES INTO THE TDM

In order to resemble all aspects of this scenario with respect to the new managed lanes express buses, several SERPM elements were modified, mostly within the Transit Path building application. Incorporating the managed lanes express bus routes into the TDM involved additions/modifications to the following elements:

- *Coding of managed lane express bus routes (Project Mode #11 was utilized)*
- *Revising and incorporating fare structure for Project Mode (#11)*
- *Applying the baseline speeds for Mode 6 (Express bus) to Project Mode (#11)*
- *Changing transit path-building mode where project mode paths are generated*
- *Modifying Max Legs by Mode catalog key*

TABLE 4.1: MANAGED LANES EXPRESS BUS ROUTES IN SCENARIO 1

MODEL ROUTE ID	FACILITY	FROM	TO	STOPS
M11L001MI M11L001MO	I-95	Collins/41st St Airport	Airport Collins/41st St	
M11L002MI	I-95	Golden Glades PNR	Collins/41st St	
M11L003MI M11L003MI	SR 836	FIU/Dolphin Mall Gov. Center	Gov. Center FIU/Dolphin Mall	FIU, Dolphin Mall, Airport, Gov Center Gov Center, Airport, Dolphin Mall, FIU
M11L004MI M11L004MO	SR 826	Golden Glades PNR FIU/Dolphin Mall	FIU/Dolphin Mall Golden Glades PNR	Golden Glades, Dolphin Mall, FIU FIU. Dolphin Mall, Golden Glades
M11L005MI M11L005MO M11L006MI M11L005MO	HEFT	I-75 FIU FIU SW 344th/Busway	FIU I-75 SW 344th/Busway FIU	 FIU, Dolphin Mall, Coral Reef Dr, Coconut Palm Dr, SW 344th SW 344th, Coconut Palm Dr, Coral Reef Dr, Dolphin Mall, FIU
M11L007MI M11L007MO	SR 874	Mall of Americas SW 344th/Busway	SW 344th/Busway Mall of America	Mall of Americas, Coral Reef Dr, Coconut Palm Dr, SW 344th SW 344th, Coconut Palm Dr, Coral Reef Dr, Mall of Americas
M11L008MI M11L008MO	SR 826 Ext	Dolphin Mall Dadeland Mall	Dadeland South Dolphin Mall	Dolphin Mall, Mall of Americas, Dadeland South Dadeland South, Mall of Americas, Dolphin Mall

Notes: PNR = Park-n-Ride; FIU = Florida International University

4.1.1.5.3 INCREASED PARKING RATES (SHORT-TERM AND LONG-TERM ROUTES)

In SERPM, parking rates are included in the Traffic Analysis Zone (TAZ) database input file (s65tazs_35.dbf). The TAZ database file includes fields "SPK_35" and "LPK_35", for short-term (3-hour) parking cost and long-term (9 hour) parking cost, respectively. Both fields represent the respective cost in cents per TAZ. TAZs internal to Miami-Dade County are numbered 2701-4166. Therefore, the short-term and long-term parking cost fields were adjusted for TAZs 2701-4166 accordingly.

4.1.1.5.4 OFF MODEL STRATEGIES

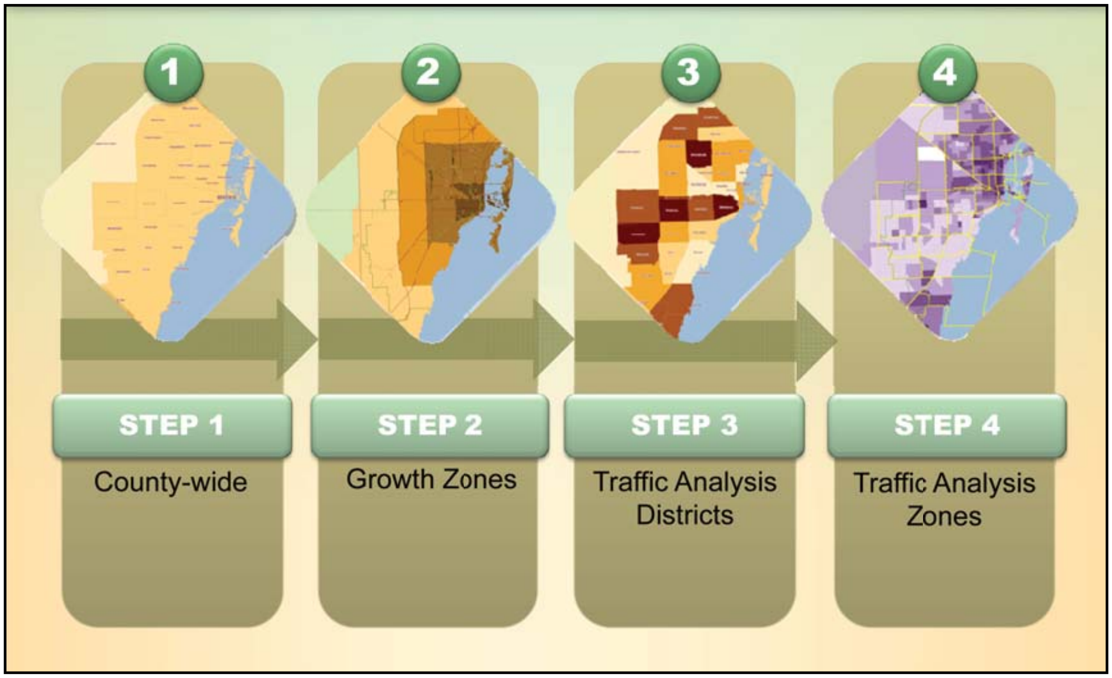
Transportation strategies that could not be tested using the regional TDM in this scenario included freight and arterial roadway operational improvements. Adjustments to the VHT and Delay were made to the TDM output based on information obtained during the literature review. For these strategies, an additional 1% reduction in VHT and Delay was taken.

4.2 SCENARIO 2: LINKAGES

The Linkages scenario attempts to better coordinate land use and transportation using smart growth and transit oriented development (TOD) principles to minimize people's travel needs. In this scenario, population and employment (jobs) growth forecast to occur between 2015 and 2035 was reallocated to urban centers and activity corridors identified in Miami-Dade County's Comprehensive Development Master Plan (CDMP) and to transit corridors. Population and employment were reallocated to achieve job-housing balance based Federal Transit Administration's (FTA) guideline of 0.8 to 1.5 jobs per household. Non-motorized improvements such as Complete Streets were considered to be an integral part of the Linkages scenario.

The growth allocation methodology was a four-step process as shown in Figure 4.3

FIGURE 4.3 POPULATION AND EMPLOYMENT REALLOCATION PROCESS



- **Step 1**

  Population and employment (job) growth increments between 2015 and adopted 2035 socioeconomic data were calculated to determine the control total at the county level. It was assumed that between 2010 and 2015, the land development pattern would be dictated by permits that were already approved and infrastructure improvements identified and programmed by various agencies through their planning process. Based on population and employment (job) forecast for the 2035 LRTP, it was determined that population growth increment of approximately 609,650 and employment growth increment of approximately 409,910 was available for reallocation between 2015 and 2035.

Step 2

In this step, the County was divided into four growth zones – Urban Core, Urban Fringe, Suburban, and Exurban (Figure 4.4). The creation of these growth zones was based on the man-made barriers created with major transportation corridors and Traffic Analysis District (TAD) boundaries . The Urban Core was identified as the area with the highest level of rail transit infrastructure and the Central Business District. The Urban Fringe is the area between the Urban Core and SR 826. This zone includes the remainder of the Metrorail and Tri-Rail systems. The Suburban zone is contained within the area between the Urban Fringe and Florida's Turnpike. The Exurban zone is the remainder of the area between the Suburban zone and the Urban Growth Boundary.

Population growth targets were established for each zone as shown in Table 4.2. The adopted 2035 land use data, which is based on recent growth patterns, shows that more than half of the population growth between 2015 and 2035 is projected to occur in the Suburban and Exurban growth zones, while the growth in the Urban Core of Miami-Dade County is the lowest of all four zones. To take advantage of the signification transportation infrastructure that exists in the Urban Core and Urban Fringe, higher population growth targets were set for those zones. In addition, large employment centers are also found in the Urban Core and Urban Fringe zones of the County. The Linkages scenario targets reverse the population growth pattern in Miami-Dade County.

TABLE 4.2: POPULATION GROWTH TARGETS FOR 2035 BY GROWTH ZONE

Growth Zone	Adopted 2035 Population Growth	Reallocated 2035 Population Growth Target
Urban Core	18%	40%
Urban Fringe	27%	30%
Suburban	35%	20%
Exurban	21%	10%

Step 3

After zone level population growth targets were set, population and employment were allocated to TADs iteratively to achieve jobs-housing balance thresholds (0.8 to 1.5 jobs per household range) while meeting population growth targets at the zone level. So the zone level population served as the control total in step three. Adopted and reallocated 2035 population and employment (jobs) including jobs-households ratio at TAD level are included in Appendix C.

Step 4

In the final step, the TAD allocation was then further divided into the traffic analysis zones (TAZ). This was done based on the presence of certain features: fixed guideway transit, community centers and activity corridors. TAZs that had one or more of these features were allocated 75% of the growth with the remaining 25% being distributed among the other TAZs within the TAD. Table 4.3 illustrates TAD to TAZ allocation using TAD #22 as an example.

TABLE 4.3: TRAFFIC ANALYSIS DISTRICT TO TRAFFIC ANALYSIS ZONE GROWTH ALLOCATION EXAMPLE

TAD #22 - Allapattah		Total Population Growth 17,411 75% 13,059	
TAZ #	Feature	75% Growth	25% Growth
441 & 442	Metrorail	1,041	
452 & 453	None		338
457-462	NW 27th Ave Activity Corridor	12,018	
463-466	None		4,014
	TOTALS	13,059	4,352

Figures 4.5 and 4.6 shows the 2035 adopted and reallocated population in Miami-Dade County. Under the adopted plan, the bulk of the growth is anticipated to occur in the Exurban zone. Higher population concentrations are also found in the suburban zone, with fewer areas in the urban fringe and urban core. Under the reallocated scenario, population growth was effectively moved from the Exurban and suburban areas into the urban fringe and urban core.

Figures 4.7 and 4.8 shows the 2035 adopted and reallocated employment (jobs) in Miami-Dade County. In the adopted plan, the highest employment is located in the urban core, urban fringe and suburban zones. In the reallocated scenario, employment growth was moved out of some of these higher employment areas. The intent was to get closer to the desired jobs-housing ratio, which meant moving some jobs out into areas with higher population.

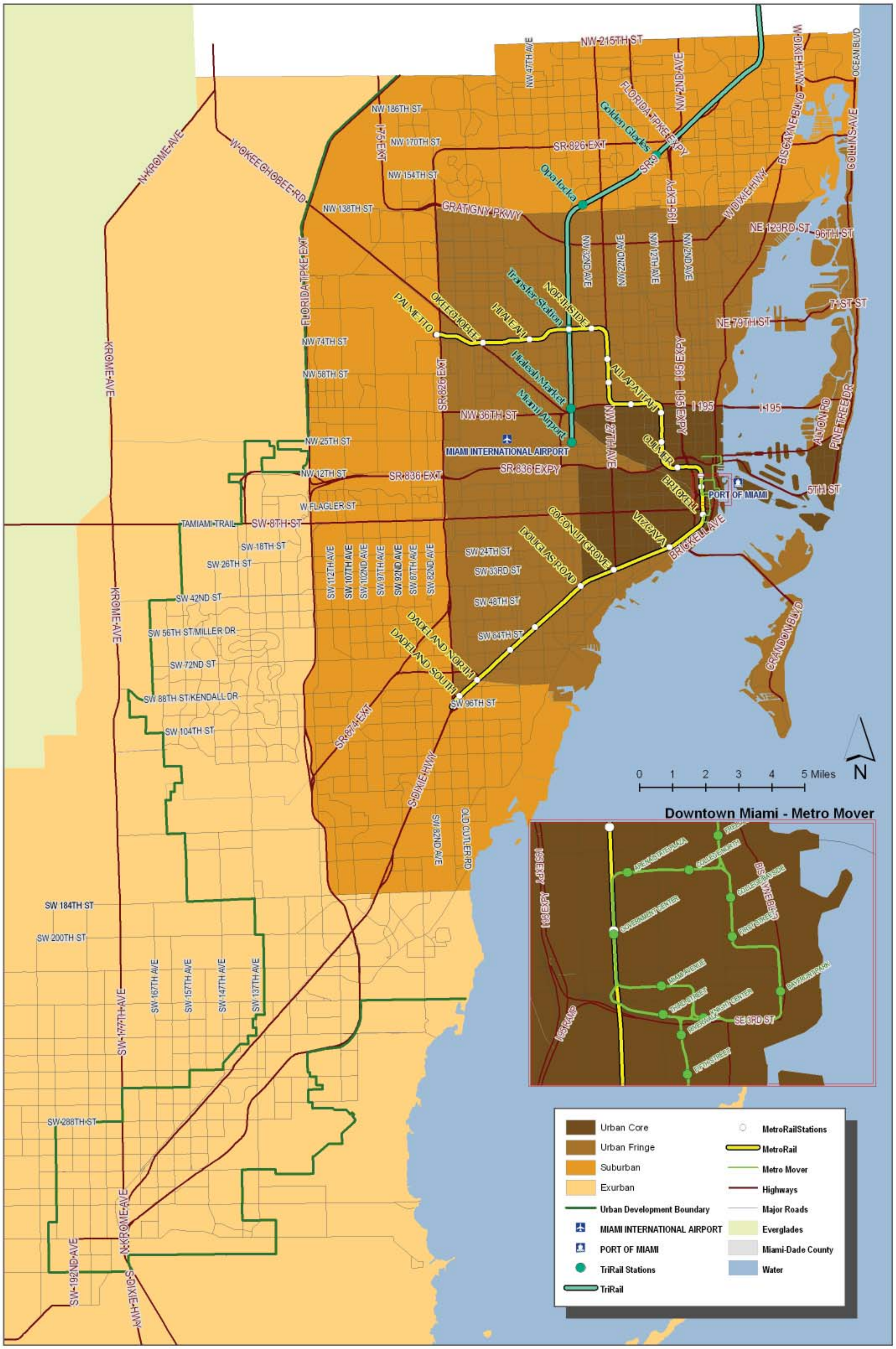


Figure 4.4 Growth Tiers, Miami-Dade County

STRATEGIES FOR INTEGRATION OF SUSTAINABILITY AND TRANSPORTATION SYSTEM

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

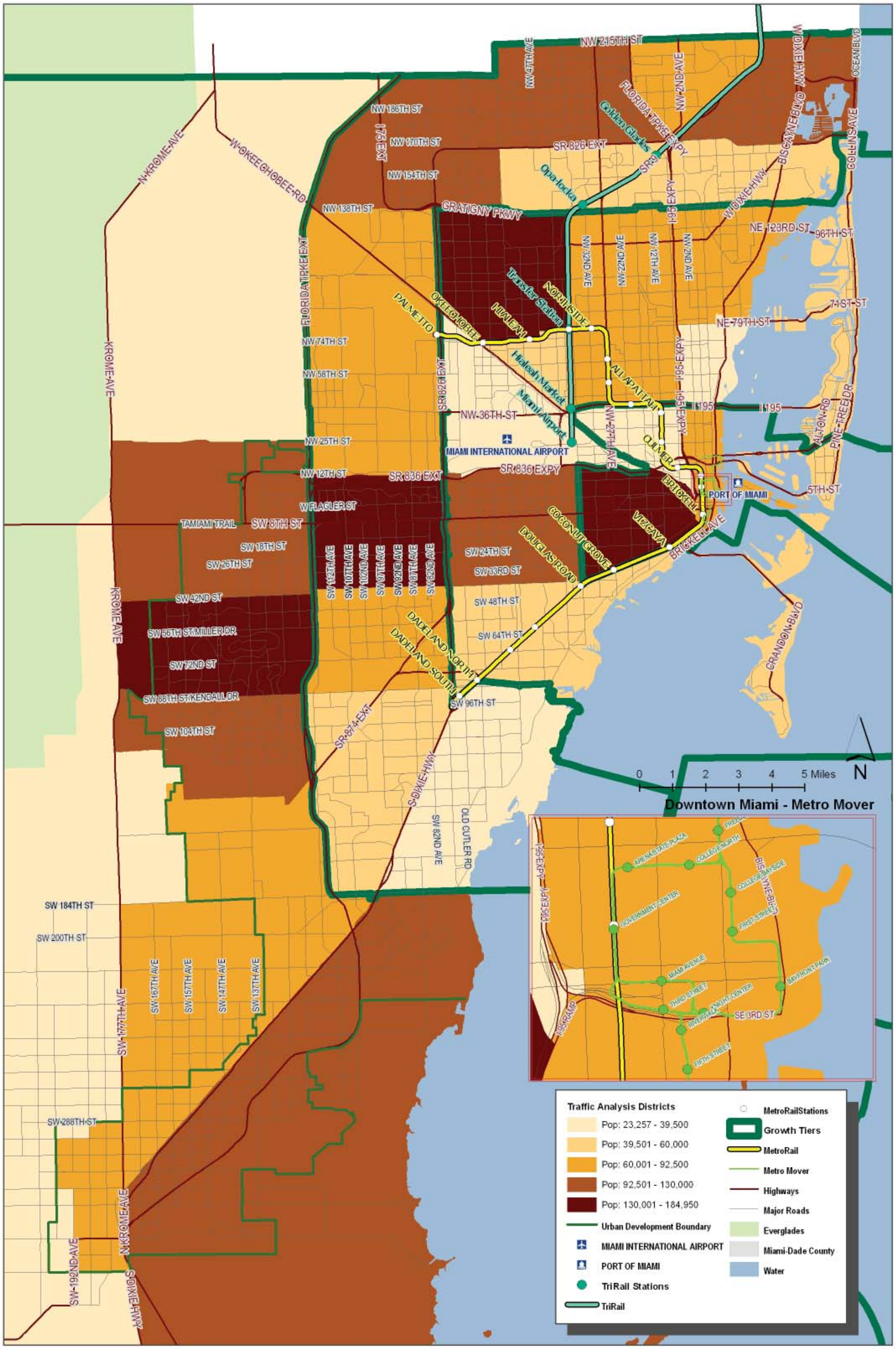


Figure 4.5 Linkages Scenario: 2035 Population (Adopted)

STRATEGIES FOR INTEGRATION OF SUSTAINABILITY AND TRANSPORTATION SYSTEM

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

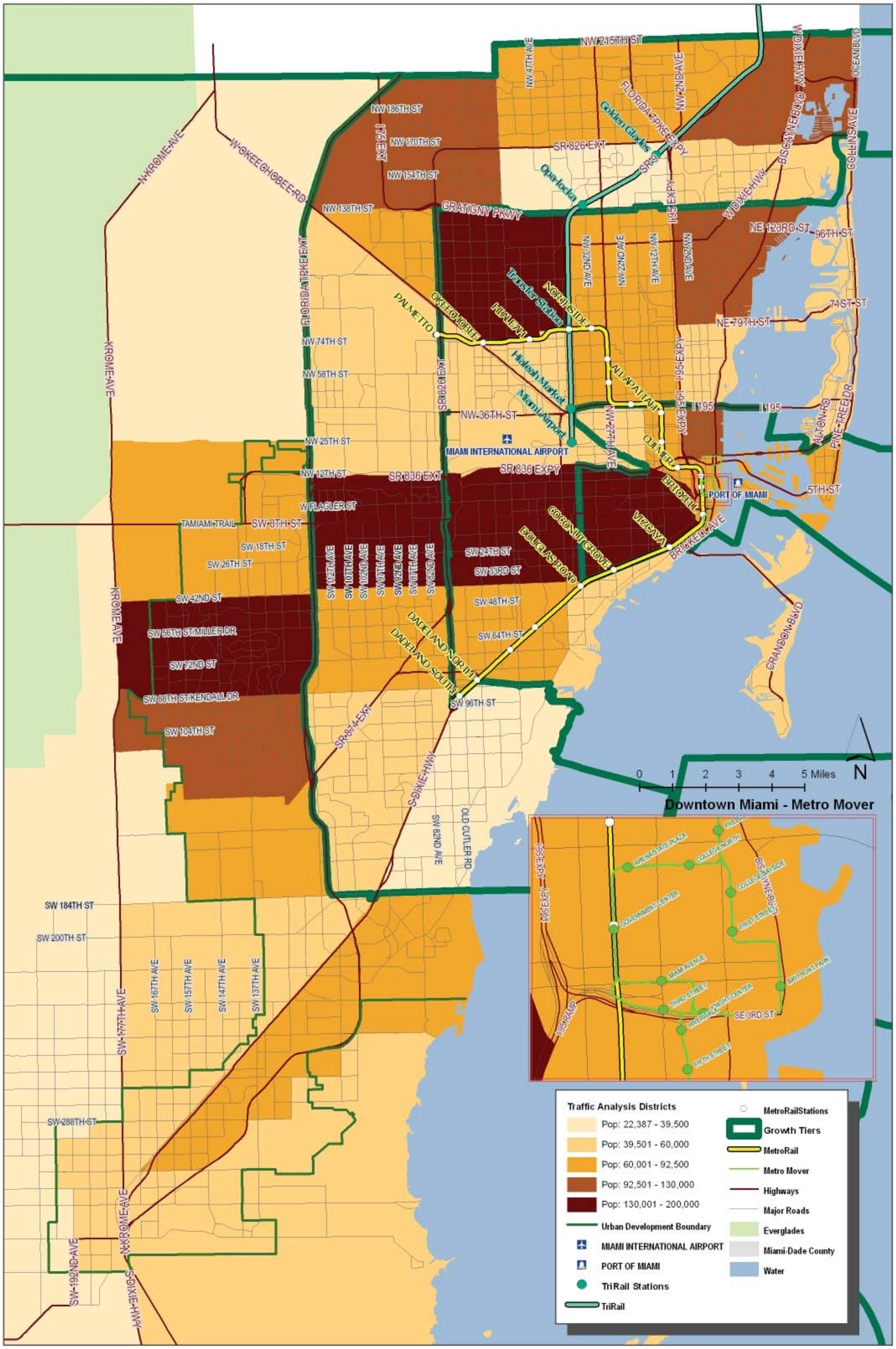


Figure 4.6 Linkages Scenario: 2035 Population (Reallocated)

STRATEGIES FOR INTEGRATION OF SUSTAINABILITY AND TRANSPORTATION SYSTEM

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

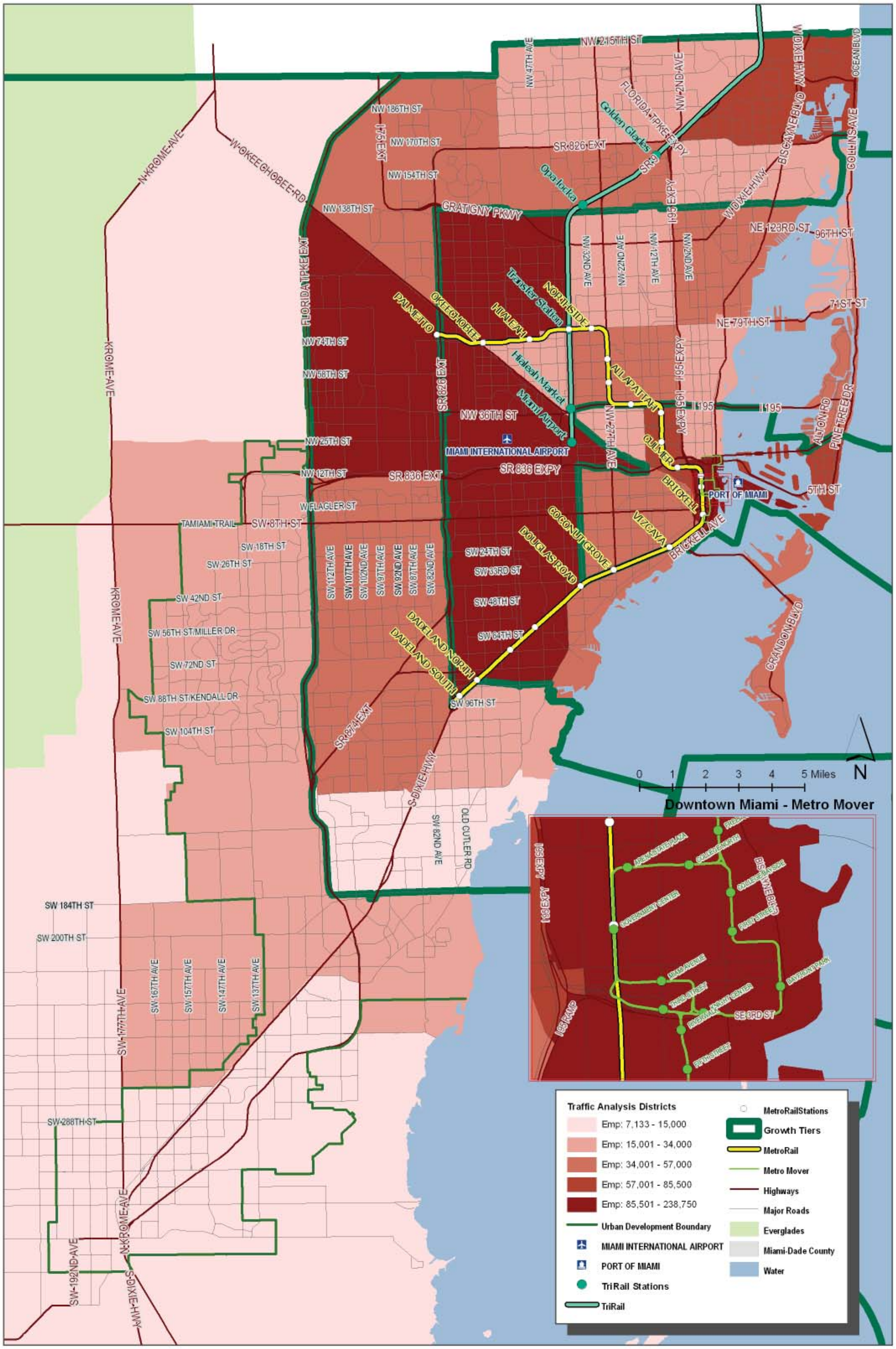


Figure 4.7 Linkages Scenario: 2035 Employment/Jobs (Adopted)

STRATEGIES FOR INTEGRATION OF SUSTAINABILITY AND TRANSPORTATION SYSTEM

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

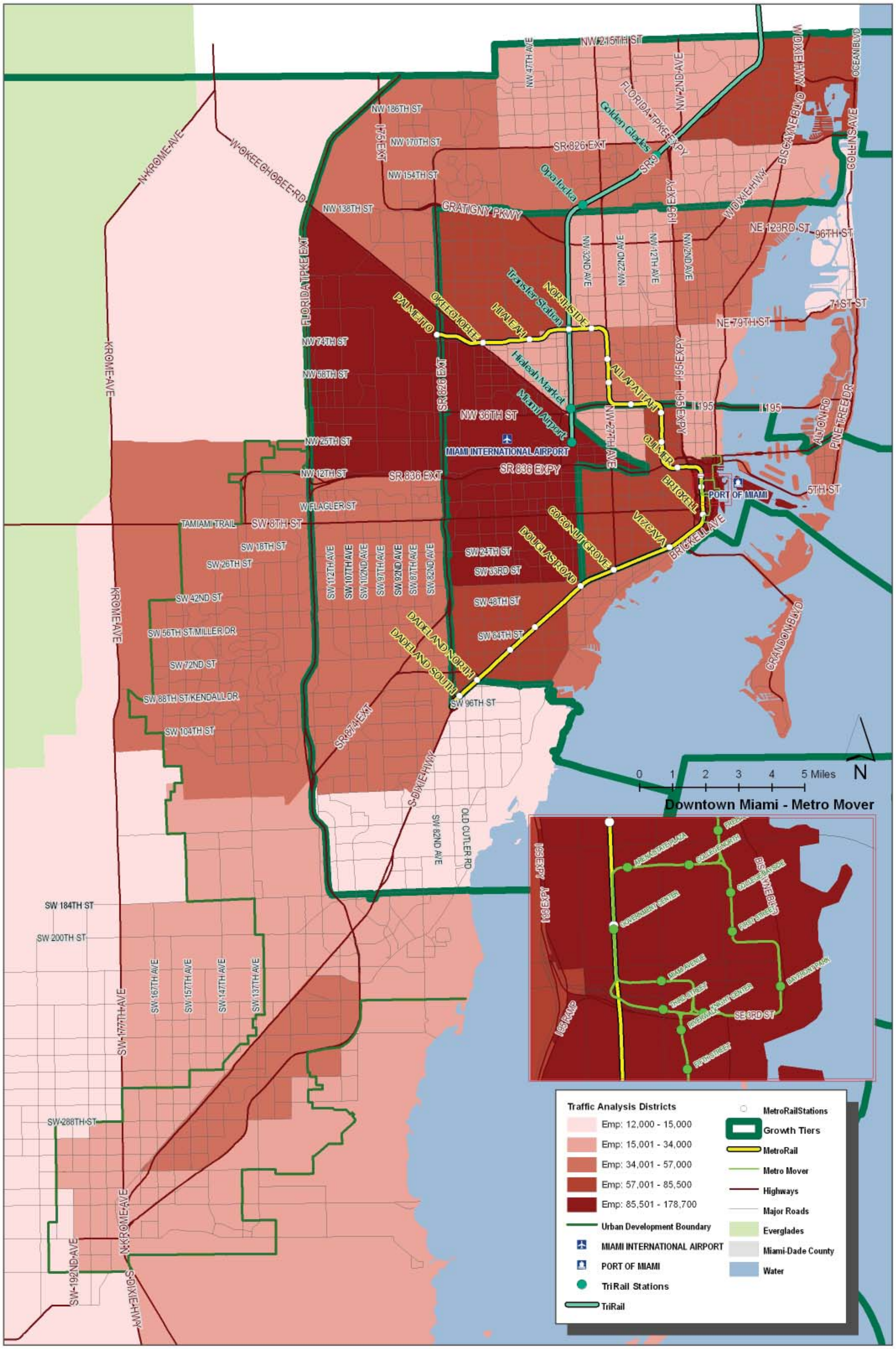


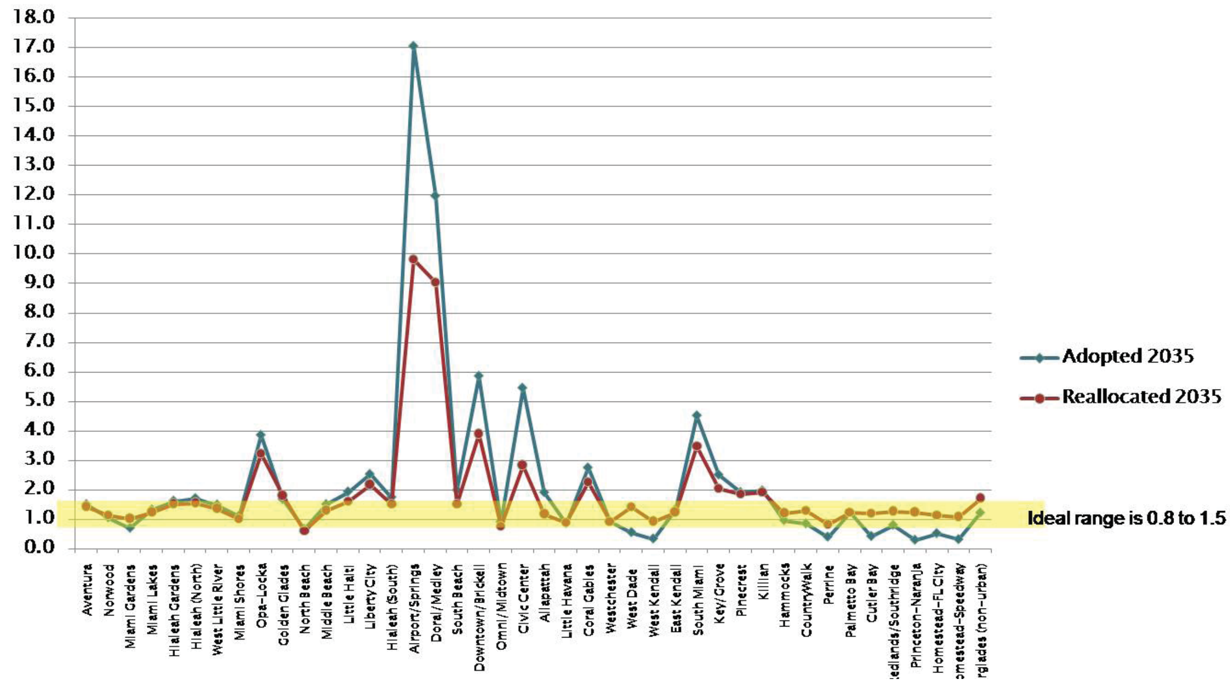
Figure 4.8 Linkages Scenario: 2035 Employment/Jobs (Reallocated)

STRATEGIES FOR INTEGRATION OF SUSTAINABILITY AND TRANSPORTATION SYSTEM

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

Figure 4.9 shows the adopted jobs to housing ratio for each of the TADs with the blue line. The red line shows the new ratio based on the proposed scenario. The number of areas included in the yellow highlighted band fall within the ideal range of jobs-household ratio (0.8-1.5) with the proposed scenario. Only 12 out of the 42 areas (less than 30%) have higher ratios. There are certain areas which are large employment centers such Airport, Doral, Downtown, Civic Center, Coral Gables, and South Miami were it is extremely difficult to meet the ideal jobs-household ratio. The reason is two-fold, these areas are regional employment centers and they already have a large existing employment base.

FIGURE 4.9: 2035 JOBS TO HOUSING RATIO (ADOPTED VS. REALLOCATED)



4.2.1 MODEL METHODOLOGY

In SERPM the only change in the TDM run was made to the zonal socioeconomic database input file (s65tazs_35.dbf). For all internal traffic analysis zones (TAZs) within Miami-Dade County (TAZs 2701 4166), population and employment data was modified. Table 4.4 contains the comprehensive list of fields (with descriptions) within SERPM containing the population and employment data. These variables were changed based on their percentage share of the adopted 2035 TAZ data. This same percentage share was applied to the reallocated 2035 TAZ level data to compute and design the new TAZ land use data set for this scenario. No other transportation improvements beyond those programmed in the 2035 LRTP cost feasible plan were included in the highway and transit network. This helped evaluate and isolate the impact of land use changes only on the County's transportation infrastructure.

TABLE 4.4: POPULATION AND EMPLOYMENT DATABASE FIELDS WITHIN SERPM

TAZ Database Field	Description
HHCO_35	Households without children (<18 years of age)
HHC1_35	Households with children
VC0_35	Vehicles in households without children category
VC1_35	Vehicles in households with children category
WC0_35	Workers in households without children category
WC1_35	Workers in households with children category
PC0_35	Persons in households without children category
PC1_35	Persons in households with children category
POP_35	***Total Population***
INDE_35	Industrial employment (SIC=1-39 & NAICS=11,21,23,31-33)
COME_35	Commercial employment (SIC=50-59 & NAICS=42,44-45,722)
SVCE_35	Service employment (SIC=40-49,60-99 & NAICS=22,48-49,51-56,61,62,71,721,81,99 & Government Employment)
TOTE_35	***Total Employment (SIC=1-99 & NAICS=11-99 & Government Employment)***

4.3 SCENARIO 3: MULTIMODAL

Emphasis in the Multimodal scenario is on improving transit rider's experience and thereby attracting new transit riders. The Multimodal scenario created an arterial bus rapid transit (BRT) network, providing real time passenger information at enhanced bus shelters, improving system-wide bus speeds using transit priority signal (TSP), adding new park-and-ride locations, reducing transit fare, and promoting telecommuting, ride sharing, biking, and car sharing.

4.3.1 ARTERIAL BUS RAPID TRANSIT

To provide this arterial BRT service, existing local bus service in the corridor was eliminated. This local bus route was replaced by faster bus service at improved headways. Depending on the corridor, the headways ranged from five minutes to 20 minutes during peak hour and five minutes to 30 minutes during off peak hours. Bus speeds were 25% faster when compared to the local bus speed. Faster speeds were achieved by more efficient bus stop spacing of one-half mile and providing TSP to buses. Furthermore, transit fare was reduced by 50% compared to the existing bus fare ($2.00). The Multimodal scenario added 549 route miles and approximately 4,100 daily revenue hours of premium bus service.

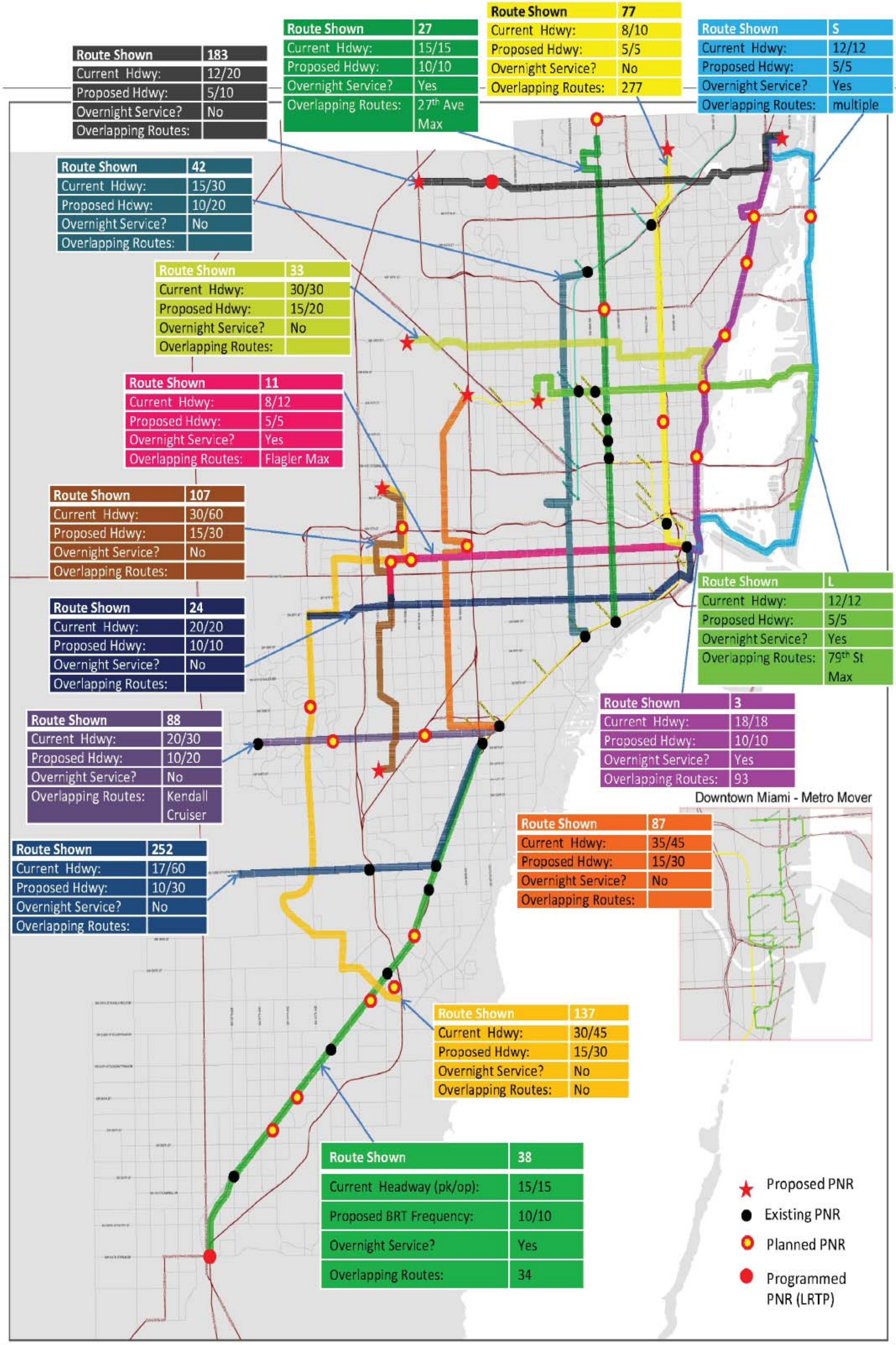


Figure 4.10 Arterial BRT Corridors

STRATEGIES FOR INTEGRATION OF SUSTAINABILITY AND TRANSPORTATION SYSTEM

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

4.3.2 REAL TIME PASSENGER INFORMATION

Enhanced bus shelters were assumed to be equipped with electronic display panels that report real time bus arrival information on the BRT corridors. Having the bus arrival information available at bus stops would make waiting time more bearable for transit users. To evaluate this strategy in the model, the weight on the passenger wait times and the transfer penalties were removed. The basis for this is the notion people are better able to plan their trips and more willing to wait if they see the real wait times as opposed to their perception of what the wait times might be without this real time information.

4.3.3 TRANSIT SIGNAL PRIORITY (TSP)

Buses were assumed to be equipped with transmitters and every signalized intersection had the necessary infrastructure to enable buses to use TSP throughout the transportation network in the County. Bus speeds were increased by 10% over the existing speeds on a system-wide basis to reflect this strategy in the model.

4.3.4 PARK-AND-RIDE LOTS

Buses were assumed to be equipped with transmitters and every signalized intersection had the necessary infrastructure to enable buses to use TSP throughout the transportation network in the County. Bus speeds were increased by 10% over the existing speeds on a system-wide basis to reflect this strategy in the model.

4.3.5 MODEL METHODOLOGY

The modeling application for this scenario involved modifications to the following two main transit-related components:

- *System-wide transit enhancements*
- *Conversion of bus / express / limited-stop routes into bus rapid transit (BRT) routes*

4.3.5.1 SYSTEM-WIDE TRANSIT ENHANCEMENTS

Two enhancements to the overall transit system within Miami-Dade County were made in this scenario:

- *Speed increase of ten percent (10%) for all transit modes*
- *Fare reduction of 50% for all transit modes*

- **Speed Increase**

  The speed of all Miami-Dade transit routes were increased by ten percent (10%), namely: PT Modes 5 (Miami-Dade bus), 6 (express bus), and 13 (limited-stop bus). The transit speeds are used during the Transit Paths building module. Auto-transit speed curves are used to generate transit speeds. The transit speed increases were therefore incorporated after the transit speed lookup was performed for each applicable transit mode. In this way, the speed is adjusted within each loop iteration, ensuring the increase is applied throughout the modeling process (Transit Paths\Network Preparation\Exec. Order 3 – PRNET00B.S).

- ## Fare Reduction

  In addition to the speed increase of the overall Miami-Dade transit system, a fare reduction of fifty percent (50%) was applied to each Miami-Dade transit mode. Table 4.5 shows the default values contained within the fare file (FUTRFARES_35R.DAT) and the respective reductions that were made to the boarding and transfer fares for this scenario run.

TABLE 4.5: DEFAULT AND REVISED FARES FOR THE MULTIMODAL SCENARIO

Field Name	Description	Default Fare[1]	Scenario Fare[1]
Boarding Fares			
PalmTran	PalmTran - Regular 1-ride Fare	$1.50	$1.50
PalmTranPass	PalmTran - Regular Daily Pass Fare	$3.50	$3.50
BCT	BCT - Regular 1-ride Fare (2009 fare)	$1.50	$1.50
BCTPass	BCT - Regular Daily Pass Fare (2009 fare)	$3.50	$3.50
Metrobus	MetroBus - Regular 1-ride Fare	$2.00	***$1.00***
Metroexp	MetroBus Express - Regular 1-ride Fare	$2.35	***$1.15***
Metrorail	MetroRail - Regular 1-ride Fare	$2.00	***$1.00***
Metromover	Metromover - Free Ride	$0.00	$0.00
ProjMode	Insert fares for Project Mode	$0.00	***$1.15***
Transfer Fares			
Metro2BCT	MetroBus / BCT regular transfer	$0.50	***$0.25***
Metroxfer	MetroBus regular transfer	$0.50	***$0.25***
Metro2exp	MetroBus and Express transfer - assuming diff (35 cents) of metrobus and express fare plus normal transfer (50 cents)	$0.85	***$0.40***
Notes: [1]All fares are regular; no discount has been applied. Tri-rail feeder bus "Free" fares in transfer between tri-rail and feeder buses are handled in CV script (AMMAT00F.s)			

Source: SERPM 6.5, Technical Reports 1&2 – Model Data, Calibration and Validation (FDOT, October 2008).

4.3.5.2 CONVERSION OF BUS / EXPRESS / LIMITED-STOP ROUTES INTO BUS RAPID TRANSIT (BRT) ROUTES

To model the BRT routes for the purpose of this scenario, the project mode 11 was utilized. Table 4.6 lists the 16 routes that were converted from their existing transit mode (Miami-Dade bus Mode 5, Express Bus Mode 6, or Limited-Stop Bus Mode 13) into the BRT Project Mode 11 for Scenario #3. The change was made in the transit route line file (TROUTE_35R.LIN). In addition to coding these lines as Mode #11, the following changes were also incorporated into the SERPM in order to complete the conversion from the existing transit modes to the BRT routes:

- *Headway increases for peak and off-peak periods*
- *Half-mile station spacing*
- *Additional park-and-ride lots*
- *Speed increase of 25%*

TABLE 4.6: ROUTE LINES CONVERTED INTO BRT PROJECT MODE 11 FOR SCENARIO #3

SERPM Route Line	Miami-Dade Transit Route
M13L177MD	183
M5L45MD	27
M5L76MI (SB) M5L76MO	77
M5L14MI (NB) M5L14MO (SB)	S
M5L57MI (SB) M5L57MO (NB)	42
M5L50MD	33
M5L33MI M5L33MO	11
M5L70MD	107
M5L43MI (EB) M5L43MO (WB)	24
M5L81MD	88
M5L19MD	252
M5L11MI (EB) M5L11MO (WB)	L
M5L23MI (SB) M5L23MO (NB)	3
M5L80MD	87
M5L93MD	137
M13L17MI M13L17MO	38

Source: SERPM 6.5, Technical Reports 1&2 – Model Data, Calibration and Validation (FDOT, October 2008).

TABLE 4.7: ORIGINAL AND PROPOSED HEADWAYS FOR BRT ROUTES

	SERPM 2035 Default Headways		Scenario #3 Proposed Headways	
Route	Peak	Off-Peak	Peak	Off-Peak
183	30	45	5	10
27	30	30	10	10
77	8 8	25 20	5 5	5 5
S	12 12	12 12	5 5	5 5
42	30 30	60 60	10 10	20 20
33	25	30	15	20
11	8 8	12 12	5 5	5 5
107	30	65	15	30
24	40 40	40 40	10 10	10 10
88	30	60	10	20
252	20	30	10	30

- **Headway Increases During Peak and Off-Peak Periods**
  As part of the route line conversions to BRT, increases in headways are also proposed during both the peak and off-peak periods. Therefore, the default headways included in the 2035 transit line file (TROUTE_35R.LIN) were modified accordingly. Table 4.7 shows the 2035 original SERPM headways and the proposed headways for the respective converted BRT routes.

- **Half-Mile Station Spacing**
  In accordance with the scenario specifications, all BRT Project Mode transit routes were ensured to provide, at a minimum, half-mile spacing between all stops along the route. Wherever necessary, additional stops were incorporated into the transit line file (TROUTE_35R.LIN) for these routes.

Additional Park-And-Ride Lots

As part of this scenario, park-and-ride (PNR) lots are proposed to be located at each end of the BRT routes. Therefore, additional PNR lots were incorporated into the highway network input file (S65_35.NET) as necessary. In order to provide unconstrained capacity for these new lots, the related attributes for these nodes were defined as shown in Table 4.8. It should be noted, that a maximum driving distance of 5 miles (SERVICEMILES=5) was assumed to be reasonable for this application.

TABLE 4.8: NODE ATTRIBUTES FOR NEW PARK-AND-RIDE LOCATIONS

Node Attributes	Description	Unconstrained Value
STATIONNUMBER	Station ID Number	> 5000
SERVICEMILES	Maximum driving distance (miles)	5
PARKINGSPACES	Parking spaces	9999
PARKINGCOSTAM	All day (peak) parking cost (cents)	0
PARKINGCOSTMD	Midday (off-peak) parking cost (cents)	0
TERMTIMEPNR	Added park-and-ride impedance (terminal time - minutes)	0
TERMTIMEKNR	Added drop-off impedance (terminal time - minutes)	0
ACTIVEFLAG	Station Usage (1=yes, 0=no)	1

Speed Increase

All newly defined BRT Project Mode routes are proposed to operate at an increased speed of 25%. Therefore, similarly to the speed increase application for the other Miami-Dade transit modes, the speeds for the Project Mode routes were increased by 25% after the transit speed lookup was performed from the auto-transit curves (Transit Paths\Network Preparation\ Exec. Order 3 – PRNET00B.S).

Similar to the Mobility Management scenario, the following changes were incorporated into the SERPM to complete the modeling application related to the Multimodal scenario:

- *Revising and incorporating fare structure for Project Mode (#11)*
- *Applying the baseline speeds for Mode 6 (Express bus) to Project Mode (#11)*
- *Changing transit path-building mode where project mode paths are generated*
- *Modifying Max Legs by Mode catalog key*

Please refer to the respective sections under the Mobility Management scenario for model application details.

- **Additional Park-And-Ride Lots**

  As part of this scenario, park-and-ride (PNR) lots are proposed to be located at each end of the BRT routes. Therefore, additional PNR lots were incorporated into the highway network input file (S65_35.NET) as necessary. In order to provide unconstrained capacity for these new lots, the related attributes for these nodes were defined as shown in Table 4.8. It should be noted, that a maximum driving distance of 5 miles (SERVICEMILES=5) was assumed to be reasonable for this application.

4.3.5.3 OFF MODEL STRATEGIES

Transportation strategies that could not be tested using the regional TDM in this scenario included vanpool/carpool with parking cash out programs, telecommuting, car sharing, and biking programs/initiatives. Adjustments were made to the TDM output for VMT on the basis of literature review and empirical data to account for these transportation strategies during the scenario evaluation phase. To account for the addition of parking cash out programs to the existing vanpool/carpool service offered by South Florida Commuter Services, an additional 1.5% reduction in single occupant Home Based Work trips was taken. For telecommuting, an additional one half percent reduction in Home Based Work trips was taken. A car sharing fleet size of 500 vehicles was assumed that allowed for a reduction of 7,500 personal autos, which equated to an additional reduction of 62,017 VMTs. To account for additional bicycle and pedestrian trips, an additional 19,649 VMTs were reduced based on an estimated average bicycle trip length of two miles and a mode share of 0.46%.

4.4 EVALUATION RESULTS

As described above, sustainable transportation scenarios were evaluated on a host of performance measures using the regional TDM and off model calculations. The following is a description and comparison of evaluation results for the Mobility Management, Linkages, and Multimodal scenarios against Miami-Dade County's adopted cost feasible 2035 LRTP.

TRAVEL DEMAND MODEL (SERPM)

Metrics for gauging county-wide travel demand and system-wide congestion included VMT, VHT, delay (Vehicle Hours of Delay), mode split, transit ridership, and trip length. The Southeast Regional Planning Model (SERPM) Version 6.5 was used for all Travel Demand Modeling (TDM) applications and model-related results for the Miami-Dade County Sustainability Study. The SERPM area is comprised of Miami-Dade County, Broward County, and Palm Beach County. Because all scenarios for this project include applications exclusive to Miami-Dade County, the sub-area capabilities of the SERPM were used to concentrate the application and results specifically to the Miami-Dade County area.

Each of the scenarios was compared to a baseline that was defined as the Cost Feasible Plan from the adopted 2035 LRTP. For the baseline scenario, the 2035 Cost Feasible Model was run using all default parameters and files, as provided by the Florida Department of Transportation. This scenario, like all scenarios run for the purpose of this study, was run for Year 2035 using Alternative "R". The evaluation results, including both model-related and off-model analyses, are provided in this section.

4.4.1 VEHICLE MILES TRAVELED (VMT)

Daily VMT represent the total travel demand on an average weekday in Miami-Dade County. Figure 4.11 indicates that travel demand reduces across all three scenarios compared to 2035 LRTP. The largest reduction of approximately 6% is forecast for the Linkages scenario, followed by Mobility Management and Multimodal scenario at 4% and 2% respectively.

Overall reduction in VMT in the Linkages scenario results from a reduction in the trip length of home based work (HBW) trips. In the Mobility Management scenario, shifting to carpool/vanpool is responsible for reducing the VMT. This shift to high occupancy vehicle (HOV) mode can be attributed to higher cost of driving (tolls) and higher parking cost. For the Multimodal scenario, the VMT reduction is caused by mode shift for HBW trips.

Accounting for off-model strategies in the Multimodal scenario, VMT is be further reduced by 0.5%, which represents a total reduction of approximately 372,000 or 1.6% when compared to 2035 LRTP baseline. Reduction for individual strategies is shown in Table 4.9 below. Appendix D provides detailed calculations and assumptions for VMT adjustments for each transportation strategy included in the Multimodal scenario.

FIGURE 4.11: DAILY VEHICLE MILES TRAVELLED, ALL TRIP PURPOSES (2035)

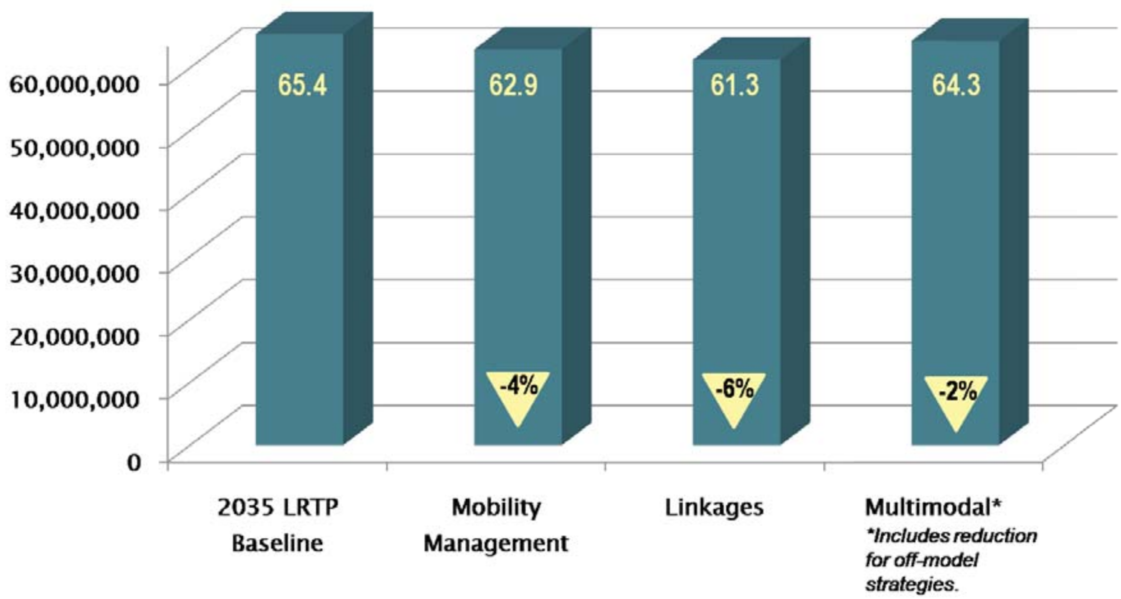


TABLE 4.9: MULTIMODAL SCENARIO OFF MODEL STRATEGIES

Transportation Strategy	VMT Reduction (Off Model Adjustment)
Carpool/vanpool with parking cash out programs	210,000
Telecommuting	80,000
Car sharing	62,000
Biking initiatives/programs	20,000
Total	372,000
SERPM VMT Output = 64,655,000	**With Off Model Adjustment VMT = 64,283,000**

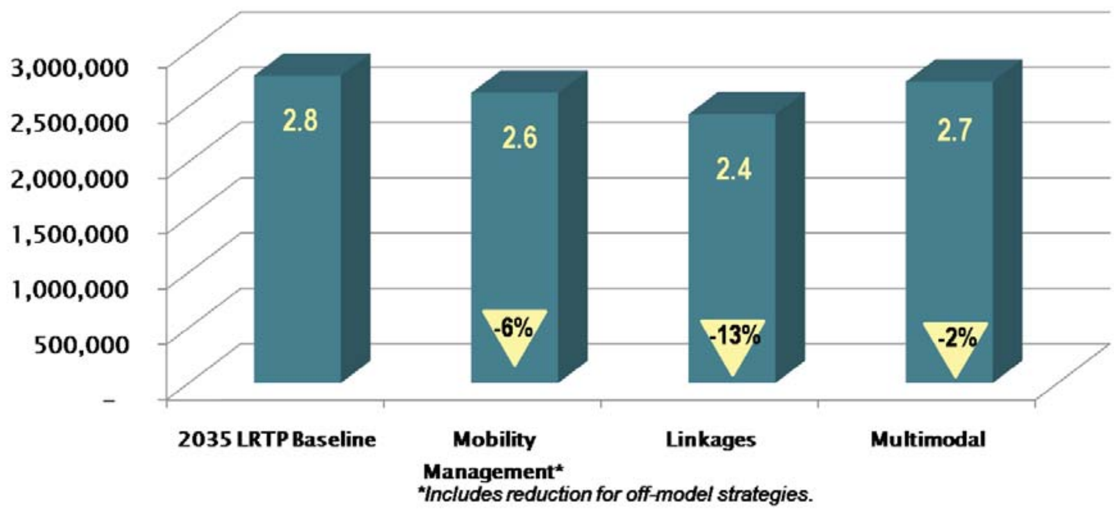
4.4.2 VEHICLE HOURS TRAVELED (VHT)

VHT is the total number of hours that all cars spend on the road during an average weekday. Figure 4.12 shows the system-wide measurement of VHT in the County. The results are similar to those for VMT, with the Linkages scenario showing the greatest reduction of approximately 13% compared to the 2035 LRTP baseline. It should be noted that the model-based reduction in VHT for the Mobility Management and Multimodal scenarios is marginally higher (at 5% and 1% respectively) compared to corresponding VMT reduction in these scenarios, indicating that these scenarios are reducing congestion and travel time even if they are not affecting the total number of miles traveled.

For the Linkages scenario, the VHT reduction is more than double the VMT reduction. This is due to the shorter trip lengths observed under this scenario and the shifting to non-motorized transport modes for certain travel needs.

Accounting for off-model strategies (Motorist Information Systems and Freight Operational Improvements) in the Mobility Management scenario, the delay can be further reduced by one percentage point (840,500 million x 1%) to 8,405 hours on a system-wide basis.

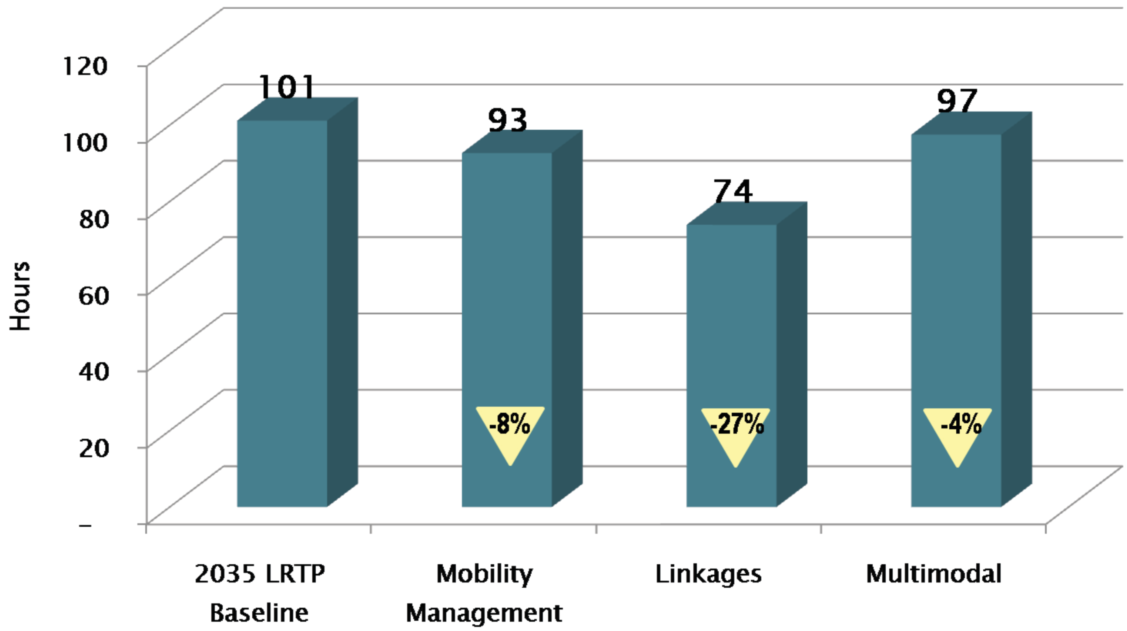
FIGURE 4.12: DAILY VEHICLE HOURS TRAVELLED, ALL TRIP PURPOSES (2035)



4.4.3 DELAY (VEHICLE HOURS OF DELAY)

Average annual delay per person measures the time Miami-Dade travelers spend sitting in traffic congestion over the entire year. Based on the Texas Transportation Institute's (TTI) 2010 Mobility Report, average delay per person in the County was approximately 40 hours. By 2035, annual delay is forecast to more than double under most scenarios (Figure 4.13). The Linkages scenario is more successful in relieving congestion compared to the other scenarios. The Mobility Management scenario receives one extra percentage point reduction due to the off-model strategies discussed under VHT above, resulting in an eight percent reduction overall.

FIGURE 4.13: AVERAGE DELAY PER PERSON, ALL TRIP PURPOSES, 2035

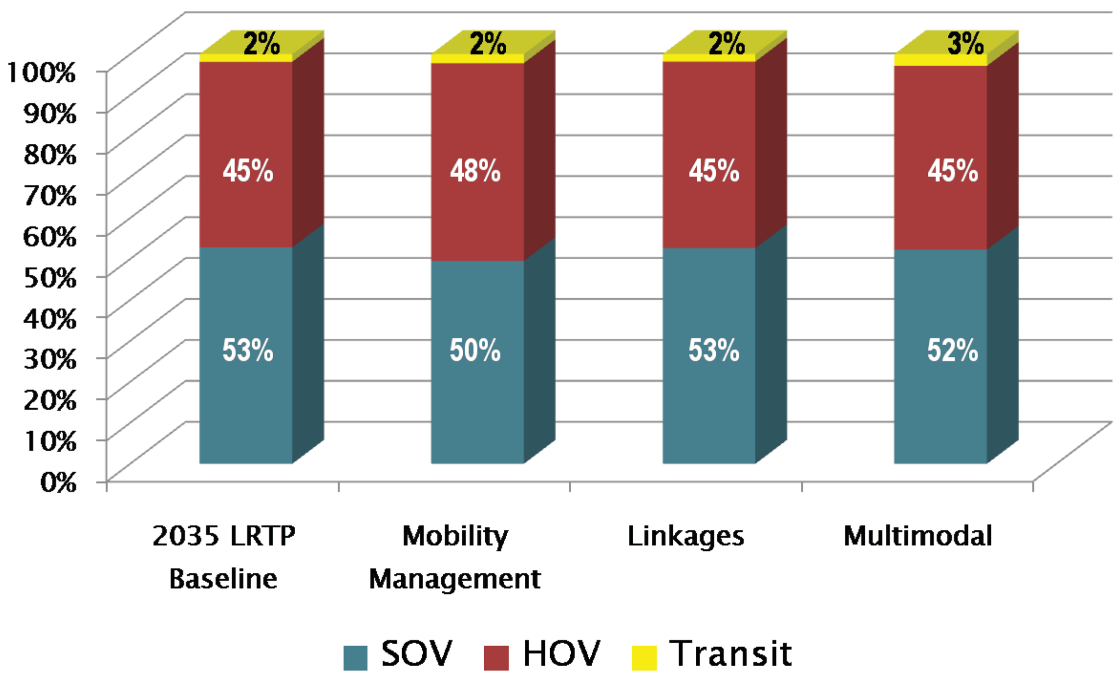


4.4.4 MODE SPLIT

Mode split measures the proportion of person trips that uses each of the different means of transportation: single occupant vehicle (SOV), high occupancy vehicle (HOV), transit, and bicycle/pedestrian. For the Mobility Management scenario, as shown in Figure 4.14, HOV use increased by three percentage points possibly resulting from increased costs for both driving and parking. In the Multimodal scenario, modal split increases by one percentage point, indicating approximately 50% increase in transit ridership. A corresponding one percentage point reduction in SOV travel is noted. The increased travel speed for transit, increased frequencies, and reliability helps make transit slightly more competitive with driving.

Mode split is one metric where the Linkages scenario does not outperform the other scenarios. In this scenario population and jobs were reallocated to achieve a better jobs-housing balance; however no other transportation improvements were programmed. In other words, this scenario did not deter driving by increasing the cost of driving via tolls or parking fee and/or improve transit service.

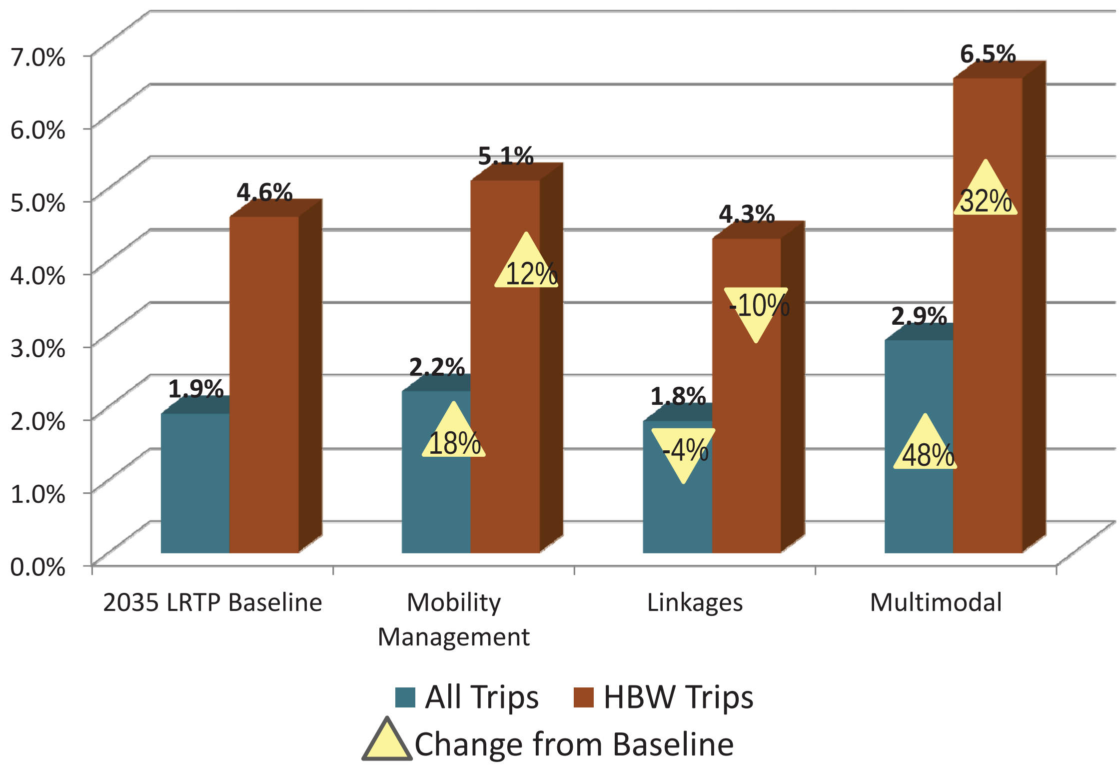
FIGURE 4.14: DAILY MODE SPLIT, ALL TRIP PURPOSES, 2035



4.4.5 TRANSIT RIDERSHIP

Transit ridership measures the number of daily boardings (unlinked transit trips) on all modes of transit in Miami-Dade County. While it may seem that transit mode split changed marginally between different scenarios compared to the 2035 LRTP baseline; in fact, there was a substantial increase in transit ridership for both the Mobility Management and Multimodal scenarios (Figure 4.15). The increase in transit ridership for home based work (HBW) trips was even higher for these scenarios in comparison to the 2035 LRTP baseline. In the case of the Linkages scenarios, the forecast indicated a reduction in transit ridership, which seemed counter intuitive. However, this anomaly was compensated by an increase in non-motorized HBW trips and as well as marginal reduction in total person trips in the Linkages scenario.

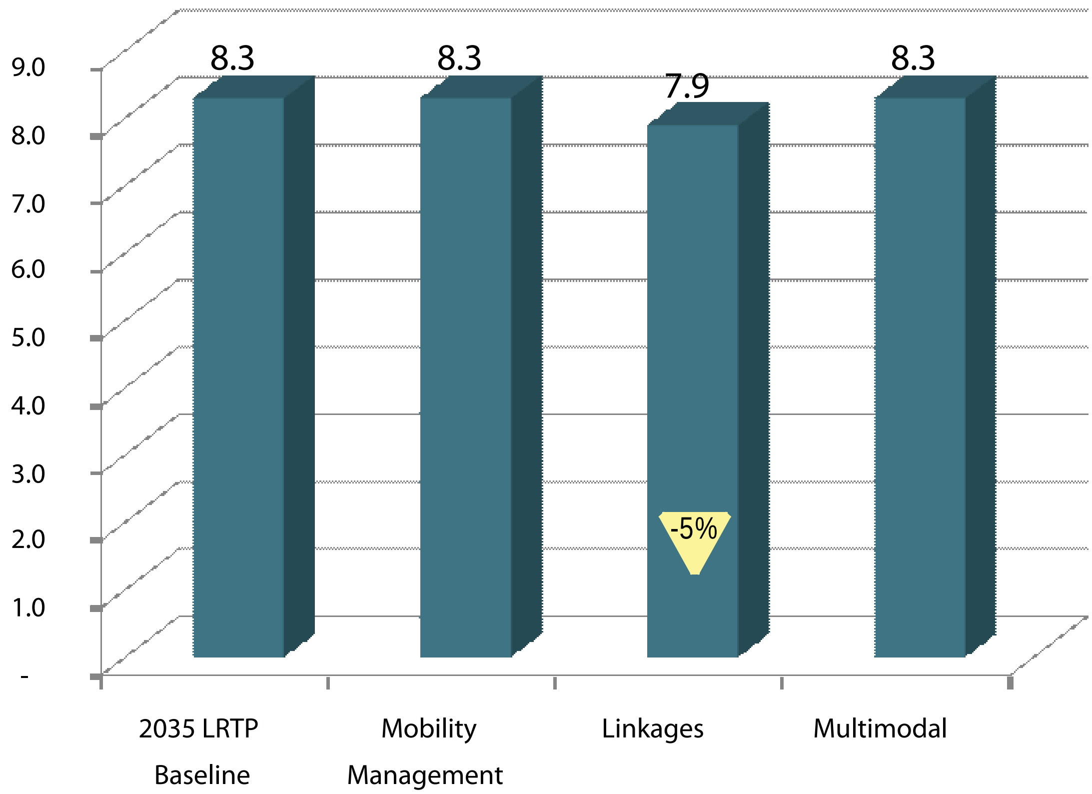
FIGURE 4.15: DAILY TRANSIT BOARDINGS IN 2035



4.4.6 TRIP LENGTH

Average auto trip length (the average distance traveled in miles) remained constant at 8.3 miles in the Mobility Management and Multimodal scenarios, as shown in Figure 4.16. In the Linkages scenario, the average auto trip length was reduced to 7.9 miles, which is approximately five percent. Considering that the auto trip length is all trip purposes, a five percent reduction for the Linkages scenario is significant.

FIGURE 4.16: AVERAGE AUTO TRIP LENGTH IN 2035



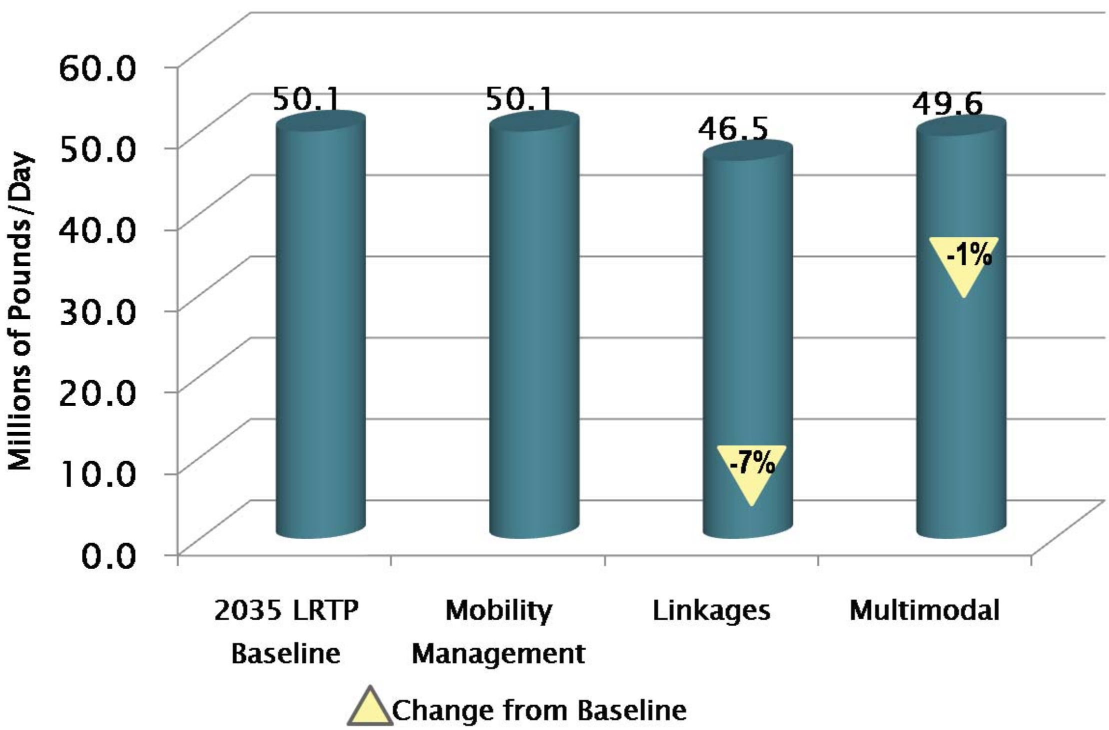
OFF MODEL TECHNIQUES

Off model techniques included analysis tools such as spreadsheets and Geographic Information System (GIS) software used to derive numbers for GHG emission, energy consumption, productivity, and equity

4.4.7 GREENHOUSE GAS (GHG) EMISSION

Carbon dioxide is the key player in climate change and sea level rise. The transportation sector accounts for approximately 30% of GHG emissions. Miami-Dade County is proactive and has set ambitious GHG reduction targets in various sustainability initiatives at the county level. As shown in Figure 4.17, the Linkages and Multimodal scenarios have positive impacts on GHG reduction, reflecting the shift from driving to other modes in both scenarios, as well as the shorter trip lengths observed in the Linkages scenario. The Mobility Management scenario has similar GHG emissions as the 2035 LRTP Baseline. GHG emissions were calculated for each scenario by multiplying passenger miles for that mode times emission rates from CATO Institute's Policy Analysis, "Does Rail Transit Save Energy or Reduce Greenhouse Gas Emissions?", published April 14, 2008.

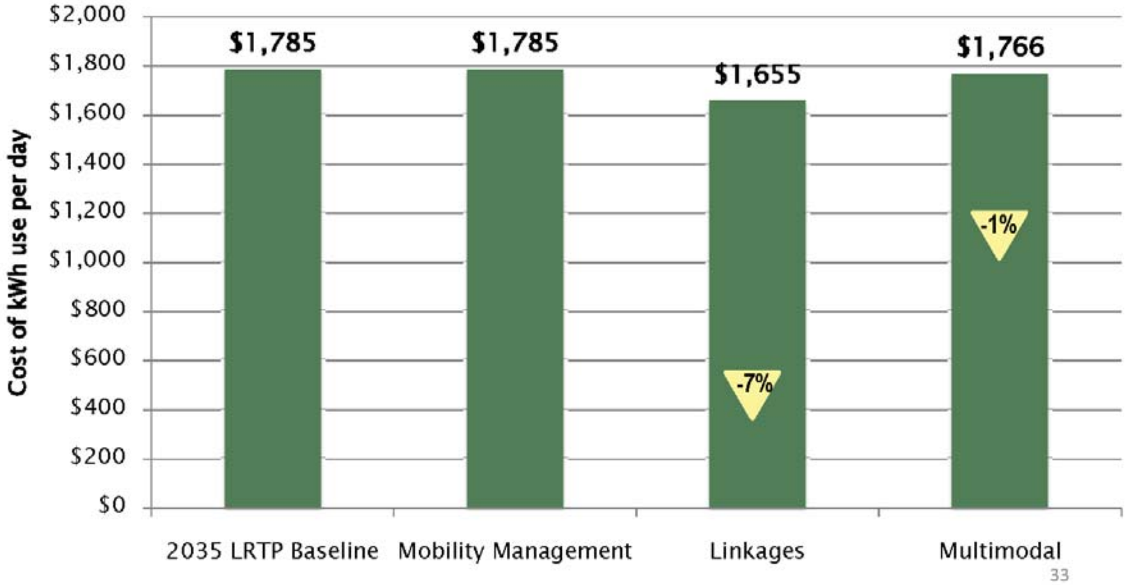
FIGURE 4.17: CO_2 EMISSIONS (LBS/DAY), 2035



4.4.8 ENERGY CONSUMPTION

To calculate the daily energy cost, the average kilowatt per hour rate from Florida Power & Light (FPL) was multiplied by the daily energy use under each scenario. Both the Linkages and Multimodal scenarios show (see Figure 4.18) a reduction in energy used, while the Mobility Management scenario stays the same as the 2035 LRTP Baseline.

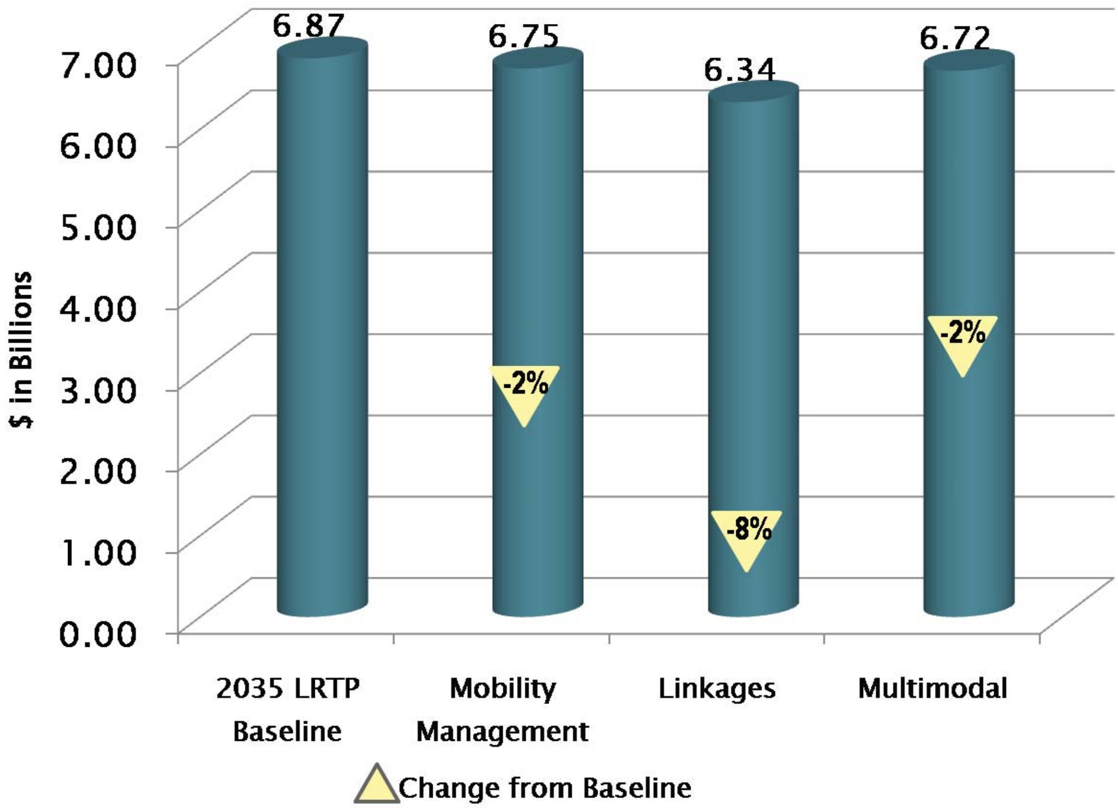
FIGURE 4.18: DAILY ENERGY COST BY SCENARIO IN 2035



4.4.9 LOST PRODUCTIVITY

Lost productivity represents the time lost by commuters due to traffic congestion and excess fuel consumed because of idling. Lost productivity was calculated using TTI's factors for average hourly wage, average fuel consumption multiplied by vehicle hours of delay from the regional TDM. Per TTI's 2010 Mobility Report, Miami-Dade County lost approximately $3.2 billion due to congestion in 2010. Figure 4.19 shows that these losses will more than double over the next 25 years in the 2035 LRTP Baseline, Mobility Management and Multimodal scenarios. Under the Linkages scenario, the loss still increases but does not quite double.

FIGURE 4.19: LOST PRODUCTIVITY BY COMMUTERS DUE TO TRAFFIC IN 2035



4.4.10 EQUITY

Adversely impacting or providing access to low income population in Miami-Dade County based on different types of transportation improvements in various scenarios was used for this metric. Equity analysis can become extremely complex, but for this planning exercise high level spatial analysis was conducted using Geographical Information System (GIS).

4.4.10.1 MOBILITY MANAGEMENT SCENARIO

For this scenario the approach was to check if access/egress points for managed lanes were provided such that geographic areas having large concentration of low income population in the County did not receive negative impacts of localized congestion; while at the same time they had an opportunity to use the express bus service as an alternative to paying higher tolls and parking costs for commute trips. GIS analysis included creating a two-mile buffer around managed lanes access/egress location and creating an overlay with the low income population thematic map (using 2000 US Census data). Darker areas have larger concentration of low income population (Figure 4.20). For this scenario, the low income population was not disproportionately impacted.

4.4.10.2 LINKAGES SCENARIO

In this scenario the idea was to ensure that jobs reallocation did not result in net job loss in geographic areas having high concentration of low income population. Overlaying traffic analysis districts (TAD) and low income population thematic map, it was estimated that 51,000 jobs were added in high concentration low income population areas. This represented approximately 12% of the total employment (jobs) reallocation (Figure 4.21).

4.4.10.3 MULTIMODAL SCENARIO

For the Multimodal scenario, the concept from an equity standpoint was to provide low income population access to premium transit service (arterial BRT) as well as ensure that elimination of local bus service in the arterial BRT corridors did not negatively impact low income population. GIS analysis included creating a half-mile buffer around arterial BRT stations and creating an overlay with the low income population thematic map. Darker areas have larger concentration of low income population (Figure 4.22). Low income population was not disproportionately impacted.

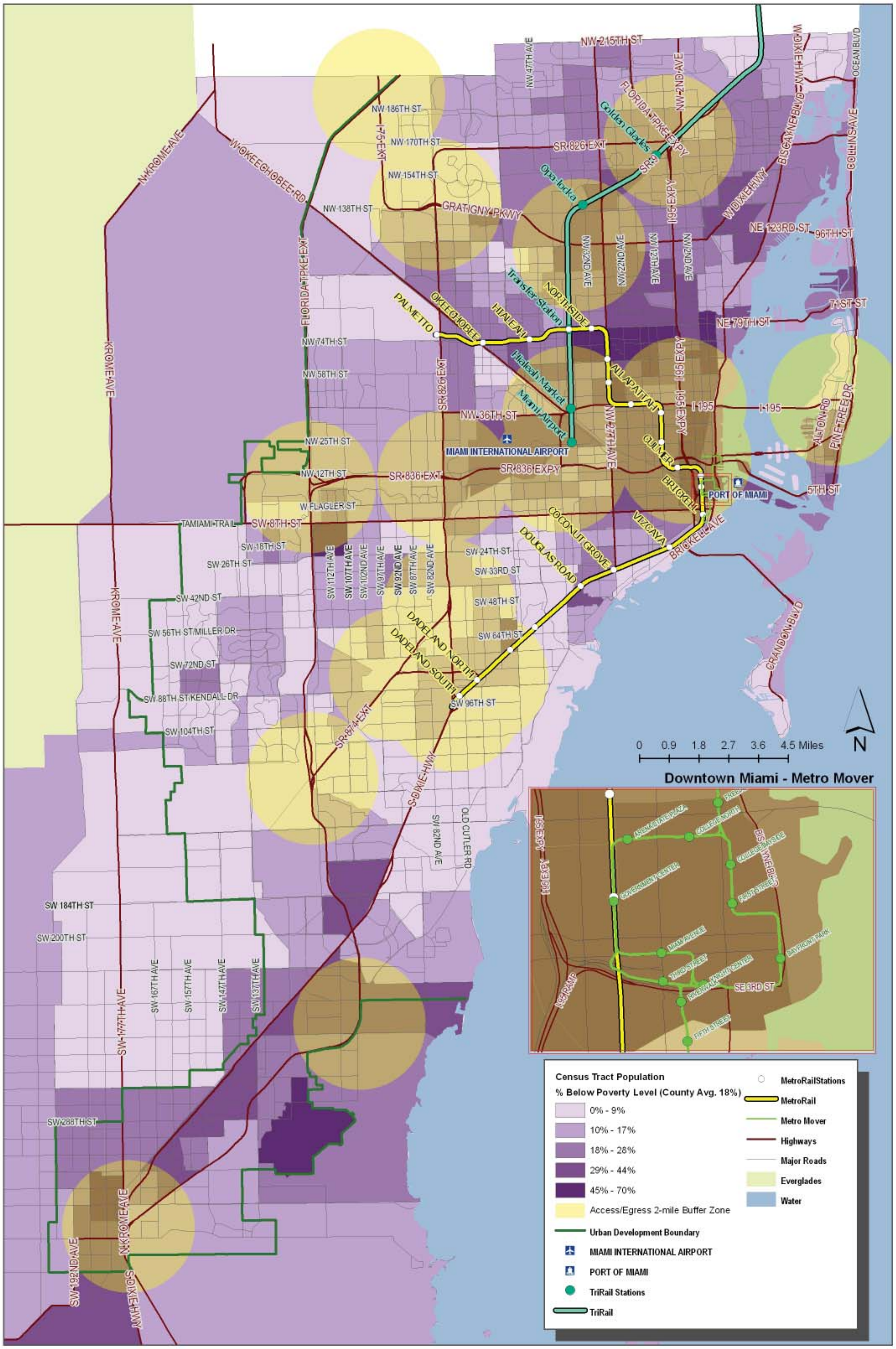


Figure 4.20 Mobility Management Scenario Transportation Equity Analysis

STRATEGIES FOR INTEGRATION OF SUSTAINABILITY AND TRANSPORTATION SYSTEM

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

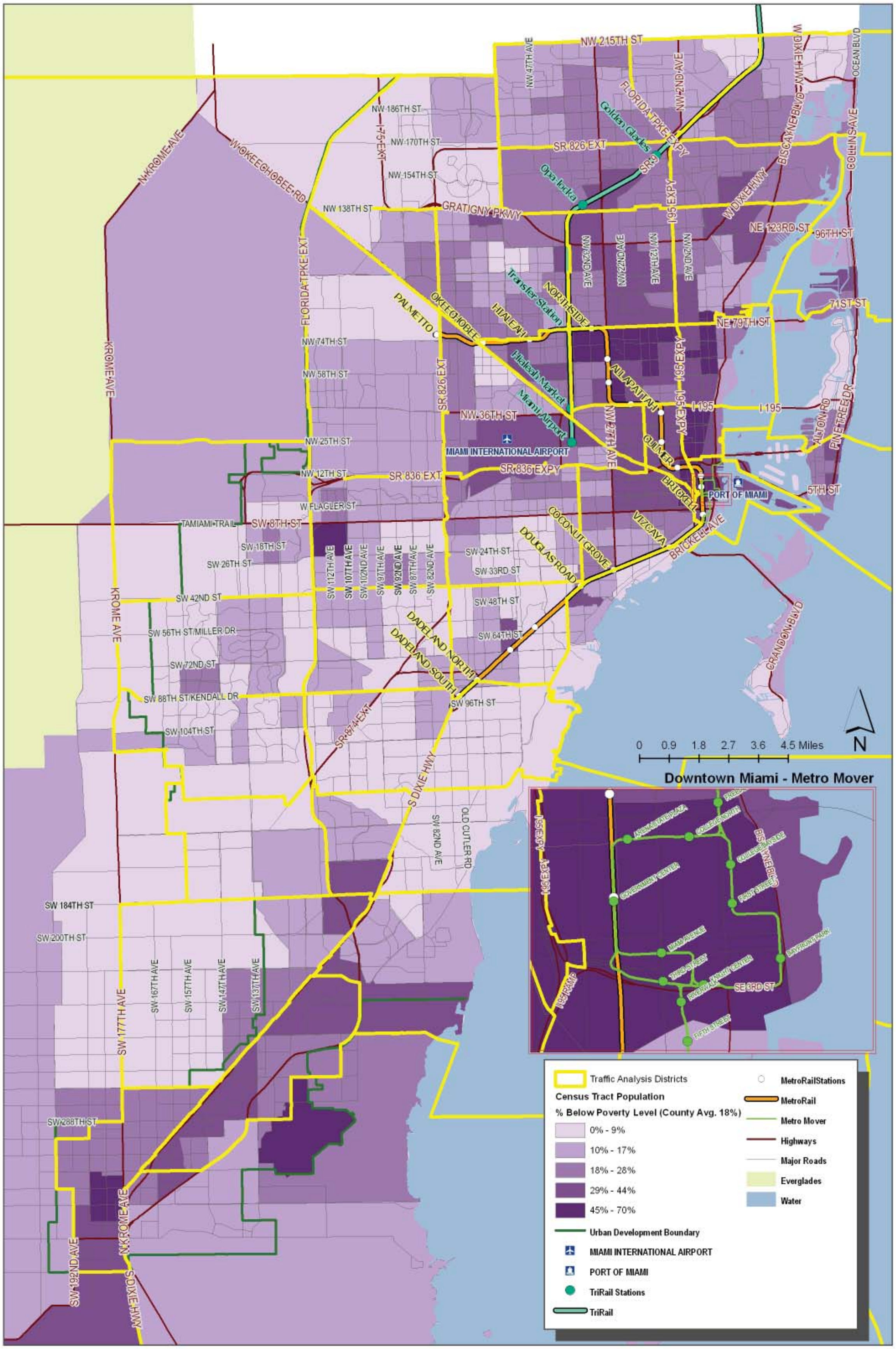


Figure 4.21 Linkages Scenario Equity Analysis

STRATEGIES FOR INTEGRATION OF SUSTAINABILITY AND TRANSPORTATION SYSTEM

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

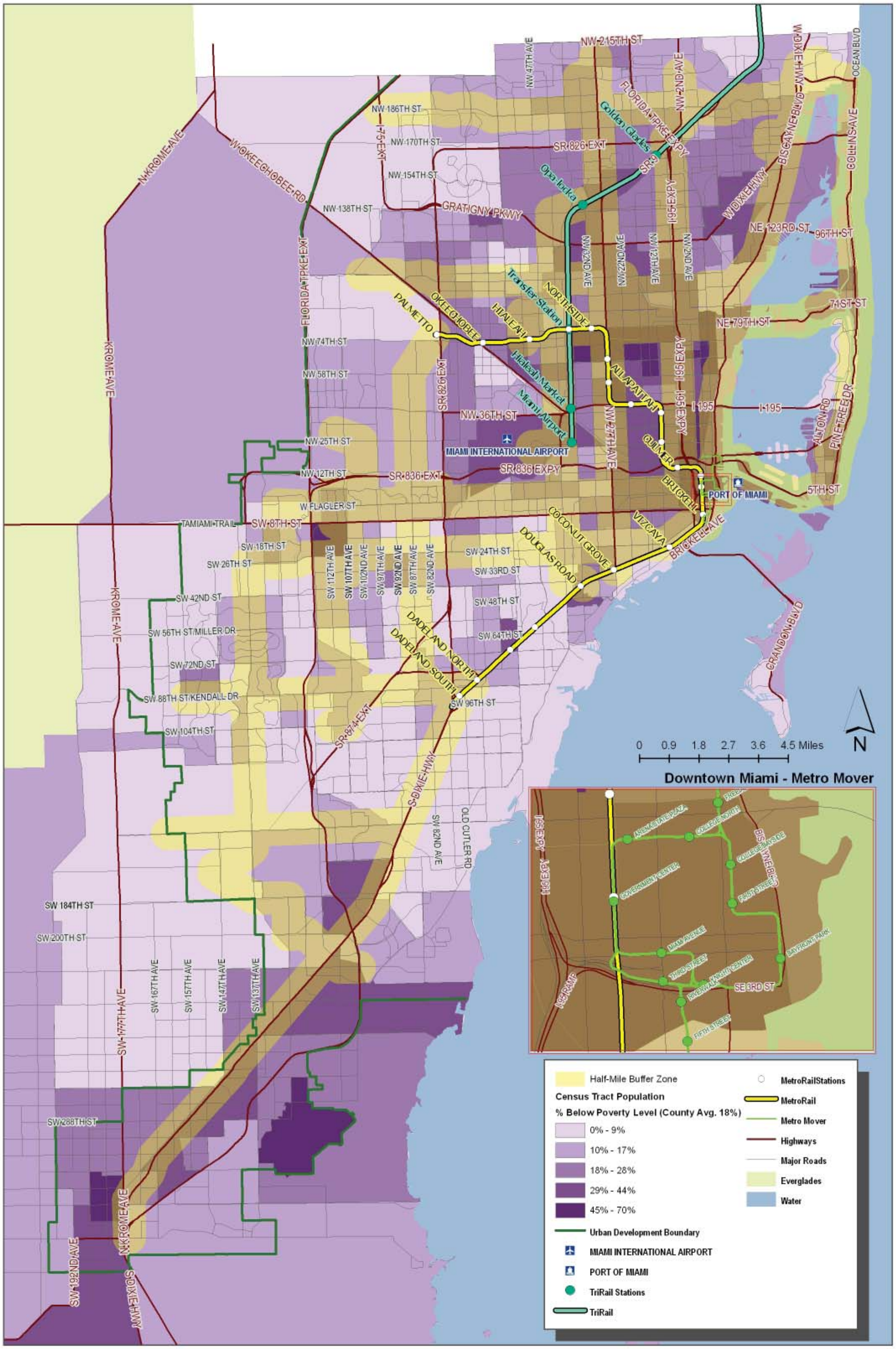


Figure 4.22 Multimodal Scenario Transportation Equity Analysis

STRATEGIES FOR INTEGRATION OF SUSTAINABILITY AND TRANSPORTATION SYSTEM

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

4.5 COST REVENUE ANALYSIS

Order of magnitude costs and revenues were developed to understand the financial implications of the program of transportation projects identified in different scenarios. It should be noted that these costs and revenues are system-wide preliminary planning level estimates. Wide ranges for costs and revenues were developed given the pre-conceptual definition of individual projects and lack of any level of engineering design. Below is a description of the cost and revenue estimation methodology for each scenario and resulting total capital cost and annual operating and maintenance cost as well as corresponding revenue streams. All cost and revenue numbers are in present day cost, which is 2011 dollars.

4.5.1 SCENARIO 1: MOBILITY MANAGEMENT

4.5.1.1 COST AND REVENUE ESTIMATION METHODOLOGY

For the Mobility Management scenario, cost and revenue estimates for managed lanes, express bus, and variable parking pricing strategies were developed.

- **Managed Lanes**

  As described in Section 2.1.1, a regional network of managed lanes was created in this scenario consisting of two lanes in each direction by taking one general purpose lane and shoulders on the County's limited access facilities. It is assumed that no additional right-of-way (ROW) would be required to accommodate managed lanes. Transitioning between managed lanes between different facilities does not include any special construction for ramps. Such transition would require drivers "weaving" for a short distance using the general purpose lanes.

  Capital cost for managed lanes includes, striping, resurfacing, Intelligent Transportation System (ITS) infrastructure for providing real-time toll collection technology, pylons, and maintenance of traffic (MOT). The low end of the cost range was based on I-95 Managed Lanes project, which cost $16 million per mile. The high end cost assumed contingency and soft costs in addition to the low end cost, which resulted in an estimated $30 million per mile.

  Operations and maintenance (O&M) cost were also based on I-95 Managed Lanes project experience as documented in the fiscal year (FY) 2010 Revenue Report. This report indicates that approximately 49% of the revenue is applied to O&M. This percentage was applied to the low and high end of the revenue forecast to create annual O&M range.

  Revenue was estimated using SERPM. Forecast 2035 traffic volume for managed lanes obtained from the traffic assignment step of the modeling process was multiplied by toll rates for corresponding managed lane segments. Traffic volume was stratified based on auto occupancy into single occupant vehicle (SOV), high occupancy vehicle with two passengers (HOV2), and high occupancy vehicle (HOV) with more than two passengers (HOV2+). Auto occupancy for HOV2+ is approximately 3.2 passengers per vehicle. For creating the low end of the range, it was assumed that all HOV2+ are registered in the South Florida Commuter Services (SFCS) database and do not pay tolls, while for the high end all HOV2+ were assumed to pay tolls.

- **Express Bus**

  Express bus service was provided using the regional managed lanes network in the Mobility Management scenario. Buses provided "closed door service" between origin-destination pairs at 10/60 minute headway during peak/off peak hours respectively. Daily span of service was 14 hours with six hours during peak period and eight hours during off peak period. Peak vehicle requirement (PVR) for express bus service was estimated to be 126 buses including 20% spare ratio.

  The range of capital costs for 60 feet articulated buses was obtained from Characteristics of BRT for Decision Making, FTA (2009) report for the low end ($800,000) and Miami-Dade Transit (MDT) for the high end ($950,000).

  The range for the O&M costs was based on Miami-Dade Transit's base costs and incremental costs per revenue hour. The low end estimate used was $90 per revenue hour and the high end estimate used was $123 per revenue hour.

  Fare box collection for express bus service was determined using annualized ridership from the TDM (SERPM) and fare policy for this scenario.

- **Variable Parking Pricing**

  Capital costs for this strategy include the purchase and installation of parking meters in existing surface parking lots and on-street parking spaces. Specific parking lots or streets where parking meters would be installed were not identified. Currently, the Miami Parking Authority owns 29,300 parking spaces. It was assumed that approximately 30,000 additional parking spaces would be metered in areas where this policy was implemented. The number of parking meters required was calculated based on the standard of one parking meter per 250 spaces. Unit capital cost was obtained from the South Florida Regional Transportation Authority, which estimated between $12,000 and $25,000 per unit.

  O&M costs were based on the Miami Parking Authority's FY 2010 Annual Report, which was estimated at approximately 25% of annual revenue. This cost includes maintenance and repair of parking facilities and staff.

  Annual parking revenue was developed based on vehicles trips by trip purpose at traffic analysis zone (TAZ) level obtained from the regional TDM (SERPM v6.5). Long-term parking revenue used 50% of the Home Based Work trips. Short-term parking revenue used 20% of the Home Based Work trips, 20% of Home Based Other trips, and 10% of Non Home Based trips.

4.5.1.2 COST AND REVENUE ESTIMATION RESULTS

Based on the data sources and methodology explained above, the total capital costs for the program of projects identified in the Mobility Management scenario was estimated to be between \$1.5 billion to \$2.8 billion (2011 dollars), while annual O&M cost ranged from \$92 million to \$221 million (2011 dollars). Annual revenue was forecast between \$228 million to \$404 million (2011 dollars). Cost and revenue associated with specific improvements are described in Table 4.10 along with the assets it creates..

TABLE 4.10: MOBILITY MANAGEMENT SCENARIO COST & REVENUE ESTIMATES

Total Capital Costs	**\$1.5 - \$2.8 billion that buys:**
	356 lane miles of Managed Lanes (\$1.4B - \$2.7B)
	Seven new Express Bus Routes (\$101M - \$120M) 279 route miles of new service 700 revenue hours daily 12,300 revenue miles daily 6,500 daily riders 126 articulated buses
	120 Parking Meters (\$1.4M - \$3.0M)
Annual O&M Costs	**\$92 - \$221 million**
	Managed Lanes (\$39M - \$114M)
	Express Bus Routes (\$16M – \$22M)
	Parking (\$37M - \$85M)
Annual Revenue	**\$228 - \$404 million**
	Managed Lanes (\$80M - \$233M) Express Bus Routes (\$1M - \$2M) Parking (\$147M - \$169M)

4.5.2 SCENARIO 2: LINKAGES

In this scenario, population and employment (jobs) were reallocated to achieve better land use-transportation coordination. Complete Streets policy was considered to be an integral part of Linkages scenario. However, in this scenario transportation improvement projects were not included. Consequently, cost and revenue estimates associated with Linkages were not calculated. However, it is recognized that land use changes will require political will and cost associated with public outreach and participation.

4.5.3 SCENARIO 3: MULTIMODAL

4.5.3.1 COST AND REVENUE ESTIMATION METHODOLOGY

For this scenario, cost and revenue estimates for arterial BRT, real time passenger information, transit signal priority, and park-and-ride lots were developed.

ARTERIAL BUS RAPID TRANSIT

The concept of creating an arterial BRT network and providing premium transit service on the 16 most productive corridors was based on the hypothesis that eliminating overlapping local bus route, reducing bus stop density while maintaining access for patrons, and increasing bus speeds would yield buses that could be reassigned to these arterial BRT corridors. Few additional buses would be required even with aggressive headways on arterial BRT corridors when such reallocation of buses would occur. Consequently, the capital and O&M costs for this strategy could be controlled significantly.

Similar to the Mobility Management scenario, the range of capital costs for 60 feet articulated buses was obtained from Characteristics of BRT for Decision Making, FTA (2009) report for the low end estimate of $800,000, and Miami-Dade Transit (MDT) for the high end estimate of $950,000.

As with the Mobility Management scenario, the range for O&M costs was based on Miami-Dade Transit's base costs and incremental costs per revenue hour. The low end estimate used was $90 per revenue hour and the high end estimate used was $123 per revenue hour.

Similarly, Miami-Dade Transit's fare box recovery ratio of 23% was used to determine the fare box collection for the arterial BRT system.

TRANSIT SIGNAL PRIORITY (TSP)

Unit capital and O&M costs for transit signal priority (TSP) were obtained from Characteristics of BRT for Decision Making, FTA (2009). The capital costs include $900 to $1,100 per emitter and $10,800 to $14,000 per receiver, phase selector, control box and controller. Approximately 2,600 signalized intersections in Miami-Dade County were equipped with TSP infrastructure in this scenario. The O&M costs were between $475 and $610 per year.

REAL TIME PASSENGER INFORMATION

Unit capital and O&M costs for real time passenger information technology was obtained from Characteristics of BRT for Decision Making, FTA (2009). The capital costs range from $4,000 to $10,000, including the electronic display sign at bus shelters. The O&M costs were between $1,160 and $2,900 per year. Approximately 1,000 bus stops in the arterial BRT corridors were equipped with electronic display panels for relaying bus arrival information.

PARK-AND-RIDE LOTS

Capital and O&M costs for park-and-ride lots were developed using industry standard unit costs. The capital costs for surface parking are estimated between $5,000 and $7,500 per space. For structured parking the capital costs are estimated to be between $18,000 and $20,000 per space. O&M costs for surface parking are estimated between $250 and $375 per space, while surface parking estimates are between $900 and $1,250 per space. Based on park-and-ride demand derived from the regional travel demand forecast (SERPM v6.5), the total number of parking spaces were determined. Unit cost was multiplied by the number of parking spaces to calculate the total capital and associated O&M cost.

4.5.3.2 COST AND REVENUE ESTIMATION RESULTS

Based on the data sources and methodology explained above, the total capital costs for the program of projects identified in the Multimodal scenario was estimated to be between \$61 million to \$90 million (2011 dollars), while incremental annual O&M cost from the 2035 LRTP baseline ranged from \$13 million to \$21 million (2011 dollars). And annual revenue was forecast between \$2.5 million to \$4 million (2011 dollars). Cost and revenue associated with specific improvements are described in Table 4.11 along with the assets created.

Eighteen (18) additional buses were required when all transit improvements were tested in the TDM. The 2035 LRTP baseline forecast indicated fleet size requirement of approximately 1,250 buses. Approximately one third of this fleet (419 buses) was reallocated to the arterial BRT corridors. These 419 buses were made available by eliminating local and duplicative service in the arterial BRT corridors. Since headways were more aggressive in the arterial BRT corridors compared to the local bus service that was eliminated, it spiked the peak vehicle requirement (PRV) for arterial BRT corridors to 488 buses, i.e. 69 additional buses (488-419=69). Furthermore, implementing TSP throughout the County increased bus speeds system-wide and that yielded 51 buses. Therefore, the net requirement of buses was reduced from 69 to 18 (69 – 51 = 18 buses).

TABLE 4.11: MULTIMODAL SCENARIO COST & REVENUE ESTIMATES

TOTAL CAPITAL COSTS	\$61 - \$90 MILLION THAT BUYS:
	16 Arterial BRT Routes (\$14M - \$17M) 549 route miles of arterial BRT service 4,100 revenue hours daily 51,000 revenue miles daily 279,000 daily riders 18 additional articulated buses
	Transit Signal Priority (\$29M - \$38M) On-board equipment for the entire 1,200 buses 2,600 signalized intersections
	Real Time Passenger Information (\$4M - \$11M) 1,000 bus shelters equipped with electronic display signs
	Park-and-Ride Lots (\$13M - \$34M) 1,500 parking spaces
ANNUAL O&M COSTS	**\$13 - \$21 MILLION**
	Arterial BRT (\$11M - \$15M incremental O&M Cost over 2035 LRTP Baseline)
	Transit Signal Priority (\$1M - \$1.5M)
	Real Time Passenger Information (\$1M - \$3M)
	Park-and-Ride Lots (\$0.7M - \$1M)
ANNUAL REVENUE	**\$2.5 - \$4 MILLION**
	Fare Box Revenue (\$2.5M - \$4M, incremental revenue over 2035 LRTP Baselines)

5. SUMMARY OF FINDINGS

Table 5.1 provides a summary of all the scenarios compared to the 2035 LRTP baseline across all performance measures

5.1 WHAT DO THE RESULTS MEAN?

The intent of this study was not to select a specific scenario for implementation or even further review; however, there are a few observations worth noting.

- *VMT, VHT and mode split are difficult to affect system-wide.*
- *Pricing policies are effective at increasing HOV use and the use of transit for Home Based Work trips.*
- *Better linking land use and transportation can help to reduce:*
  - *The overall number of trips;*
  - *Trip lengths;*
  - *Hours of delay; and*
  - *GHG emissions.*

TABLE 5.1: SUMMARY OF SCENARIO EVALUATION RESULTS

Evaluation Criteria	2035 LRTP Baseline	Scenario 1: Mobility Management	Scenario 2: Linkages	Scenario 3: Multimodal
Vehicle Miles Travelled (VMT), Daily	65,355,000	62,925,000	61,293,000	64,283,000
Absolute Change from LRTP		(2,430,000)	(4,062,000)	(1,072,000)
Percent Change from LRTP		-4%	-6%	-2%
Vehicle Hours Travelled (VHT), Daily	2,778,000	2,622,000	2,428,000	2,723,000
Absolute Change from LRTP		(155,490)	(350,000)	(55,000)
Percent Change from LRTP		-6%	-13%	-2%
Average Annual Delay (hours)/Person	101	93	74	97
Absolute Change from LRTP		(8)	(27)	(4)
Percent Change from LRTP		-8%	-27%	-4%
Mode Split				
Single Occupant Vehicle (SOV)Person Trips	5,780,000	5,415,000	5,675,000	5,725,000
SOV Percentage	53%	50%	53%	52%
High Occupant Vehicle (HOV)Person Trips	4,959,000	5,281,000	4,913,000	4,911,000
HOV Percentage	45%	48%	45%	45%
Transit	202,500	239,550	193,500	300,100
Transit Percentage	2%	2%	2%	3%
Transit Mode Share				
All Trip Purposes	2%	2%	2%	3%
Home Based Work Trips	5%	5%	4%	6%
Transit Boardings Change Compared to Baseline				
Total Transit		18%	-4%	48%
Home Based Work		12%	-10%	32%
Trip Length (in miles)	8.3	8.3	7.9	8.3
Absolute Change from LRTP		0.0	-0.4	0.0
Percent Change from LRTP		0%	-5%	0%
Greenhouse Gas Emissions (CO2 lbs/day)	50,093,000	50,087,000	46,478,000	49,554,000
Absolute Change from LRTP		-6,000	(3,615,000)	(539,000)
Percent Change from LRTP		0%	-7.2%	-1.1%
Energy Cost, US dollars in kilowatt hours	1,785	1,785	1,655	1,766
Absolute Change from LRTP		0	(130)	(19)
Percent Change from LRTP		0%	-7%	-1%
Cost of Congestion/Lost Productivity, US $	$6.9 billion	$6.7 billion	$6.3 billion	$6.7 billion
Absolute Change from LRTP		-$0.2 billion	-$0.6 billion	-$0.2 billion
Percent Change from LRTP		-2%	-8%	-2%
Equity	No disproportionate impacts			

Simply putting increased residential density and employment next to transit will not increase transit use without also making transit more competitive with other modes of transportation.

Transit ridership was most affected by:

- Increased bus frequency;
- Improved bus speeds; and
- Improved reliability.
- Aspirational targets set at the beginning of the study was too aggressive

TABLE 5.2: ASPIRATIONAL TARGETS

MEASURE	VEHICLE MILES TRAVELLED	BIKE & PEDESTRIAN TRIPS	TRANSIT RIDERSHIP	SINGLE OCCUPANY VEHICLES
*Targets**	*-25%*	*+30%*	*+50%*	*-25%*
Mobility Management	-4%	No Change	+18%	-6%
Linkages	-6%	No Change	-4%	-2%
Multimodal	-2%	No Change	+48%	-1%
**Compared to baseline of 2035 LRTP*				

As noted at the beginning of this document, this exercise was designed to conduct a high-level investigation of different sustainable transportation strategies. The results of this study could be affected by additional efforts in any of the following areas:

- *A more in-depth analysis of the market for managed lanes;*
- *A detailed analysis of existing pay-to-park area usage and fees, markets for additional pay-to-park areas, and the ability of people to accept new or adjusted parking fees;*
- *An enhanced analysis of express bus markets to better determine routes, stops, and destinations;*
- *A more thorough review of existing land use patterns and land suitability for absorbing additional residential densities and employment;*
- *Evaluation of and improvements to access to existing premium transit stations;*
- *More detailed analysis of potential arterial BRT corridors to determine where such routes would be most successful;*
- *A market analysis for new park-and-ride facilities; and*
- *The use of additional analysis tools such as the Surface Transportation Efficiency Analysis Module (STEAM 2.0), Social Cost of Alternative Land Development Scenarios (SCALDS), and Spreadsheet Model for Induced Travel Estimation – Managed Lanes (SMITE-ML).*

5.2 HOW WILL THE RESULTS BE USED?

The results of this effort should be used to inform upcoming studies such as the Southeast Florida 2060 Vision Plan being developed by the South Florida and Treasure Coast Regional Planning Councils; an analysis of the ability to implement tolled managed highways with rapid/enhanced bus routes and ridesharing programs being conducted by the Miami-Dade MPO; a study on parking being conducted by the Florida Department of Transportation, District 6; and future comprehensive planning activities conducted by the Miami-Dade Department of Permitting, Environment and Regulatory Affairs and the municipalities within Miami-Dade County.

One additional observation made during this study is the separation that exists between transportation agencies within Miami-Dade County. For example, under current conditions the Mobility Management scenario could not be implemented without an agreement between Miami-Dade Transit and the Miami-Dade Expressway Authority (MDX) that would allow for the use of toll funds for transit improvements and operations. Currently MDX will allow MDT to operate express buses on its facilities, but without some additional revenue sources MDT is limited in its ability to provide these services. Thus, another potential use for this study is to assist in starting interagency discussions about such issues that may allow some of the strategies tested here to move closer to reality.

APPENDICES.

Appendix A – Study Advisory Commitee (SAC) Materials
Appendix B – Transportation Planning Council (TPC) Presentation
Appendix C – Literature Review Tech Memo
Appendix D – Tech Memo 4 – Evaluation Results

APPENDICES.

Appendix A – Study Advisory Commitee (SAC) Materials

Strategies for Integration of Sustainability and the Transportation System

Study Advisory Committee (SAC) Member List

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Strategies for Integration of

Sustainability and Transportation System

Study Advisory Committee (SAC) Meeting

MIAMI-DADE COUNTY/ MPO

Study Purpose

To identify and evaluate strategies to improve the sustainability of Miami-Dade County's transportation system *with an emphasis on accommodating future travel needs using transportation demand management strategies*.

2

Outside of Study Parameters

- Prescribing a "preferred" scenario or land use
- Selecting specific strategies & policies for implementation
- Leveraging federal, state or local grants for building "green" infrastructure
- Evaluating sustainable design and construction practices

3

Study Approach

Identify a combination of transportation management strategies and evaluate them using a *scenario system planning* approach.

Challenges

- Little precedent
- Analyses tools and techniques

4

Study Linkages

Sustainability, Scenario Planning & 2040 LRTP

Scenario system planning exercise feeds into the next LRTP update cycle.

- **SAFETEA-LU**: Scenario planning is voluntary
- **GREEN-TEA***: Scenario planning is expected to become part of the federal metropolitan planning process
- Federal, state & local sustainability initiatives

Note: *Upcoming federal surface transportation legislation

Detailed Study Plan & Schedule

Activity	Year 2010 - 2011											
	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov
Preliminary Literature Review Results		SAC Meeting										
Final Literature Review Tech. Memo.			Deliverable									
Screening Analysis Tech. Memo.				Deliverable								
Selection of Scenarios						SAC Meeting						
Scenario Descriptions Tech. Memo.						Deliverable	TPC Meeting					
Scenario Evaluation: Modeling												
Scenario Evaluation: Identification of Secondary Impacts												
Scenario Evaluation: Order of Magnitude Costs										SAC Meeting		
Scenario Evaluation Results Tech. Memo.											Deliverable	
Draft Study Document/Executive Summary												Deliverable

Note: TPC Meeting in Dec. 2011 on study completion

Study Advisory Committee

(SAC) Role

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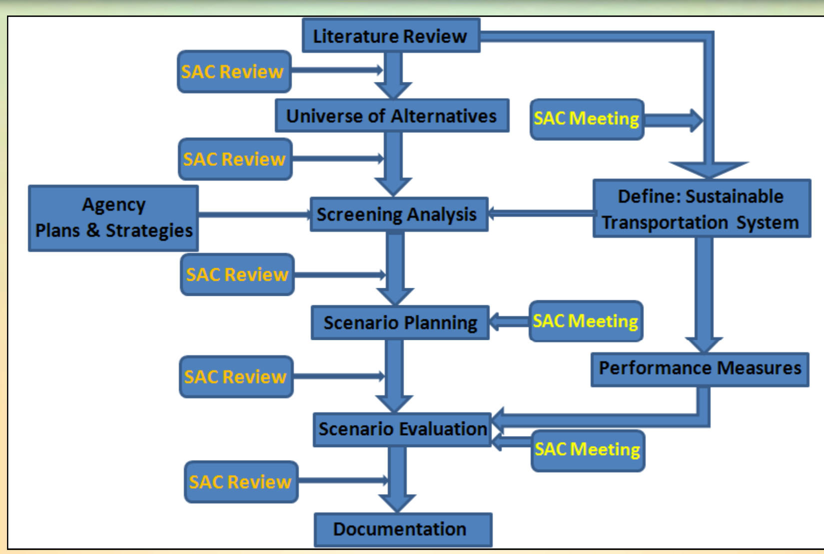
Study Advisory Committee's Role



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Sustainable Transport Definition

Study Context

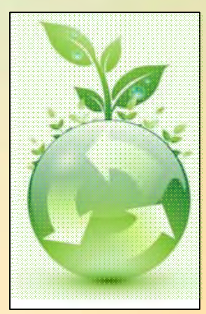
2035 LRTP Central Concept

"Applying the 4 T's strategy to accommodate future travel demand" *(transit, tolling, technology, & telecommuting)*

Urban Mobility Report (2010)

Miami-Dade County in 2009

- Delay:141 millions hours or
  56 hours per Miami-Dade resident
- Financial implication of delay: $3.3 billion
- Excess fuel consumption*: 109 million gallons
- Average annual cost of congestion:
  $1,300 per Miami-Dade resident



Note: *Fuel consumption due to delay/congestion rather than free-flow conditions

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Transportation Demand

2035 Socioeconomic Trends & Mobility Trends

Growth rates between 2005-2035

- More than 3 million residents (+ 39%)
- 615,000 additional jobs (+ 45%)
- Population density increases from 1,180 to 1,639 persons/sq. mile
- 60.68 million vehicle miles traveled
- Daily linked trips (+46%)
- Daily auto trips (+47%)

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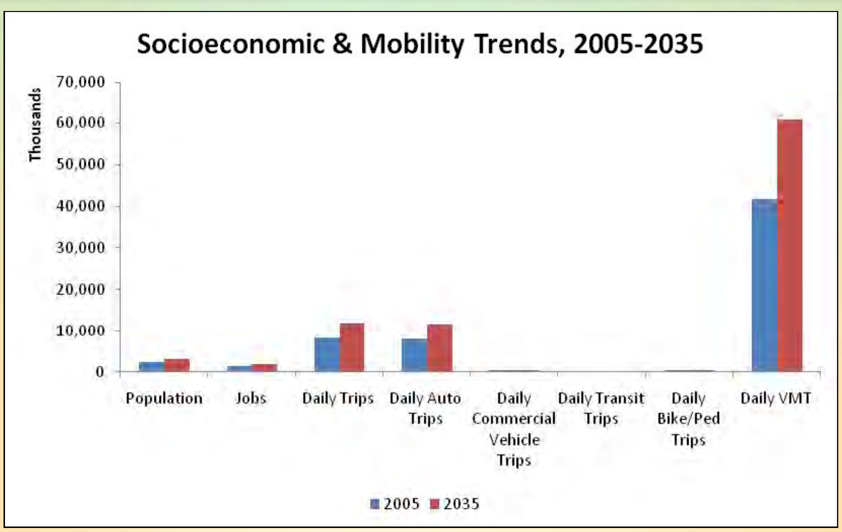
Transportation Demand



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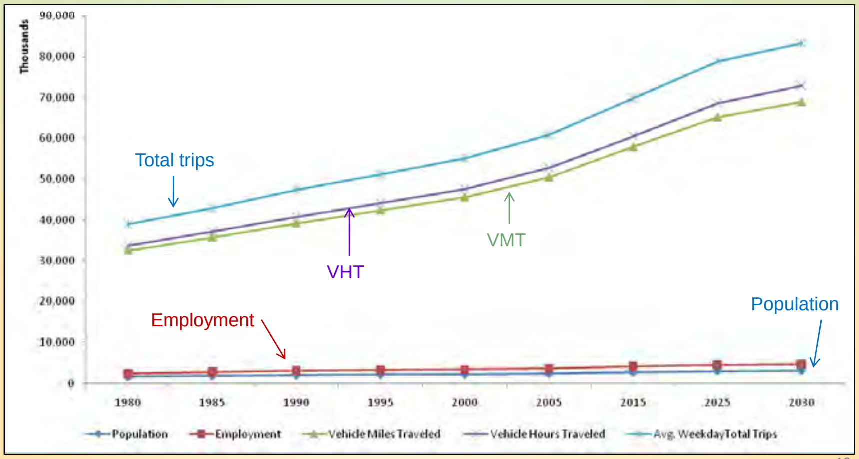
Transportation Demand

Population & Employment Growth v/s Vehicle Miles Traveled (VMT) & Vehicle Hours Traveled (VHT)



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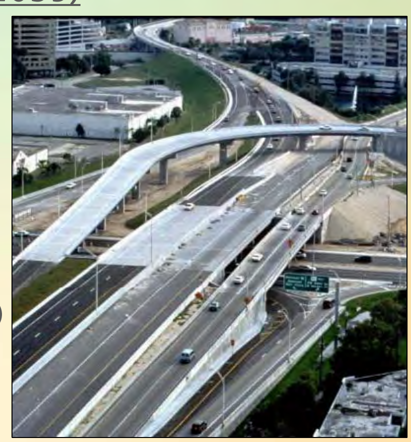
Transportation Supply

Highway and Transit Supply (2035)

- 5,615 highway lane miles
- 265 centerline miles of freeway
- 420 centerline mile of arterials
- 80 lanes miles of managed lanes (HOV/HOT)
- Reduction of transit service coverage area



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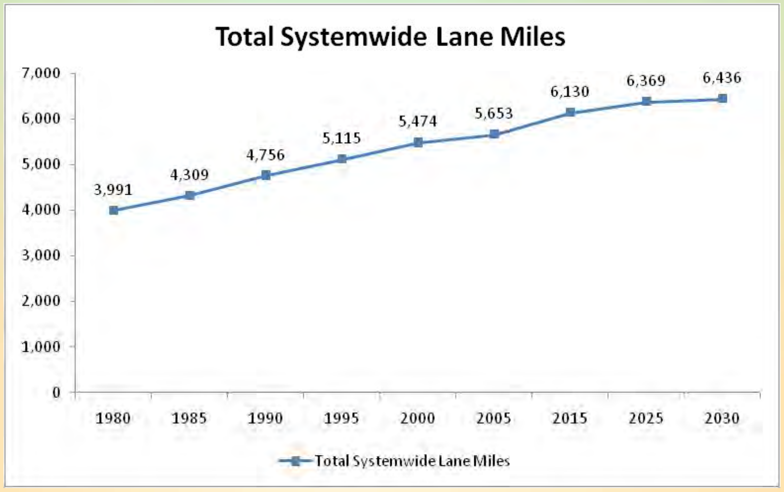
Transportation Supply



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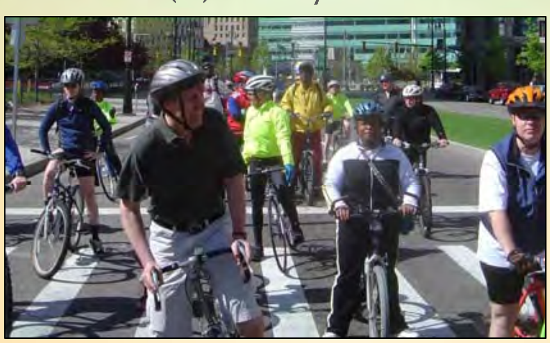
Transportation Supply

Non-Motorized Transportation Supply

- 58 miles (+) of sidewalks
- 136 miles (+) of bicycle facilities



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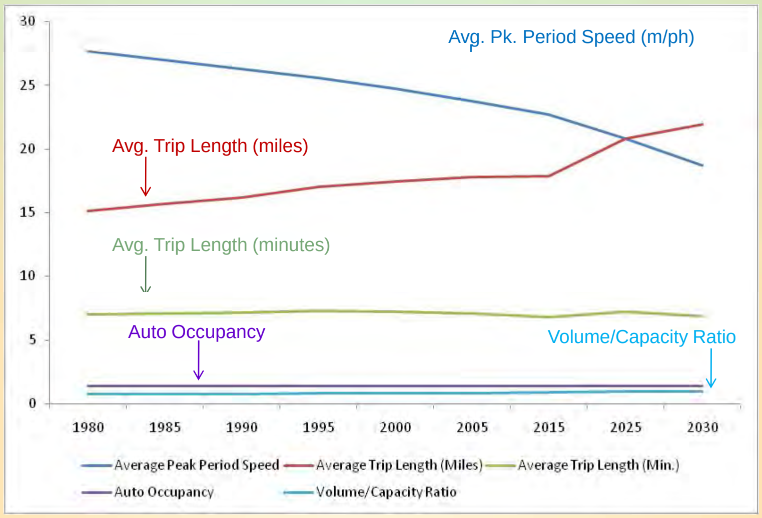
Demand v/s Supply

How can we make this sustainable?

Speed, Trip Length, Auto Occupancy, & v/c Ratio Trends



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Sustainable Transport Definition

- To develop guiding principle(s) that provide direction throughout the course of this study
- To identify evaluation criteria and performance measures

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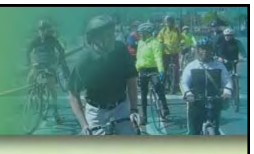
Sustainable Transport Definition



Primary function:

Move people and goods efficiently

Provide access

Support economy

Support land-use & demand

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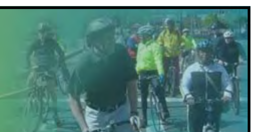
Sustainable Transport Definition



Secondary function:

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Sustainable Transport Definition

Essential characteristics:

Multi-modal, options

Able to fund, maintain and operate

Accessible

Affordable

Equitable

Coordination with land-use

Efficient (travel time, capacity utilization, fuel)

Reliable

Not harming to environment

Appropriate carbon footprint (infrastructure and operations)

Safe & Secure

Comfort (transit)

Renewable fuel sources

Flexible

Resilient to expected impacts of climate change

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Sustainable Transport Definition

Desired characteristics:

Efficiency (travel time, capacity utilization, fuel)

Seamless connections

Aesthetic

Comfort

Flexible

Promotes healthy living

Improves quality of life

Fits in community context

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Sustainable Transportation Strategies

Sustainable Transportation Strategies

Category	General Strategy
Pricing/Behavior	Manage traffic & congestion
	Promote education and involvement of all transportation stakeholders
Efficient Resource Utilization	Support improvements in public transportation
	Link transportation & land use in transportation plans
	Prioritize highway repair and safety performance v/s new capacity
Pedestrian/Bicycle Zones	Support non-motorized transportation

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Sustainable Transportation Strategies

Case Studies

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Sustainable Transportation Strategies

Case Study: Implementation Phase

Category\City	San Francisco, CA	Portland, OR	London, U.K.	Bogota, Colombia
Manage traffic & congestion	Primary	Secondary	Primary	
Promote education and involvement of all transportation stakeholders		Secondary	Secondary	
Support improvements in public transportation	Secondary	Primary	Secondary	Primary
Link transportation & land use in transportation plans		Primary		Secondary
Prioritize highway repair and safety performance v/s new capacity				
Support non-motorized transportation		Secondary	Secondary	Primary

Sustainable Transportation Strategies

Case Study: Planning Phase

Category\City	Nashville, TN	Central Virginia, VA	Denver, CO	Sacramento, CA	Gainesville, FL
Manage traffic & congestion	Primary				
Promote education and involvement of all transportation stakeholders					
Support improvements in public transportation	Primary		Primary	Primary	
Link transportation & land use in transportation plans	Primary	Primary	Primary	Primary	Primary
Prioritize highway repair and safety performance v/s new capacity					
Support non-motorized transportation	Secondary			Primary	

Sustainable Transportation Strategies

Case Study: Planning Phase

Category\City	Minnesota	Chicago, IL	Tel Aviv, Israel
Manage traffic & congestion		Primary	Primary
Promote education and involvement of all transportation stakeholders	Primary	Secondary	Primary
Support improvements in public transportation		Secondary	Primary
Link transportation & land use in transportation plans		Primary	Primary
Prioritize highway repair and safety performance v/s new capacity		Primary	
Support non-motorized transportation		Primary	Primary

Sustainable Transportation Strategies

Case Study Common Factors

- Land use scenario planning
- Geographic coverage – multi county
- Sustainable transportation strategies overlap between scenarios
- Variety of analytical tools used
  - Expert opinions
  - Spreadsheet models
  - Travel demand models
  - Combination of all of above
- Do not recommend "preferred scenario"

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Next Steps

- SAC Review (February 2011)
  - Literature review technical memo
  - Comprehensive list of list transportation strategies
  - Performance measures
- Screening analysis
  (Planning level)
  (March 2011)

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Thank You

Strategies for Integration of Sustainability and the Transportation System

Miami-Dade Metropolitan Planning Organization
SAC Meeting #1
Wednesday, January 26, 2011

Introductions

Wilson Fernandez began the meeting by introducing himself as the MPO project manager for the study and thanking everyone for attending. He asked the participants to go around the room and introduce themselves. A copy of the sign-in sheet is provided at the end of this summary.

Wilson also introduced the SAC Vice-Chair, Mr. Subrata Basu, Director of Miami-Dade Planning & Zoning, and stated that the collaboration with this department was important. He also mentioned that although Subrata was retiring and would not be participating in future SAC meetings, Mr. Basu's comments and vision at today's meeting are very important.

Wilson provided a brief overview of the purpose of the study. He highlighted the value of the study as it will show Miami-Dade as proactive in incorporating sustainability concepts in transportation planning in anticipation of such elements to be addressed by future federal policies. He encouraged members to be creative and active participants in the process while working with the consultant as only a guide.

Wilson introduced the project study consultants as Jacobs Engineering and the Study's Project Manager as Jill Quigley.

Study Purpose

Jill began by reviewing the Study's Purpose which is to identify and evaluate strategies to improve the sustainability of Miami-Dade County's transportation system with an emphasis on accommodating future travel needs using transportation demand management strategies.

She then reminded the group that all of the information that she will be covering in the PowerPoint was in the handout. She explained to the group that the study will develop different scenarios each consisting of a set of sustainable transportation strategies. As far as possible the strategies in the scenarios would be mutually exclusive. Different tools and techniques will be used to evaluate these scenarios. She also mentioned that such a study has not been done before. She pointed out certain aspects of the study that were beyond the scope of this effort.

Jill explained that the scenario system planning exercise feeds into the next LRTP update and emphasized the need to get ahead of anticipated Federal legislation (GREEN-TEA).

Jill provided the group with the schedule of the study. The SAC will convene in person three times this year with the final draft study document due by November 2011.

Questions and comments received during this time included:

Q: What is the scenario planning approach?
A: Scenario planning approach in context of this study is to create alternative scenarios by combing different travel demand management strategies and evaluating them using the regional travel demand model as well as off-model tools and techniques.

Q: Will these include measurable indicators?
A: Yes.

Wilson provided clarification with the process and stated that the study allows for the development of up to three scenarios. The SAC assistance with developing these scenarios are critical for the study because it is anticipated that all of these initiatives may be part of the LRTP and that it is a starting point to be ahead of the Federal legislation.

Q: Will it also include economic factors?
A: That is what we will be doing today. These indicators will be derived from the definition of sustainable transportation system, which will be developed by SAC in the later part of this meeting.

Q: What does it mean to use a scenario systems planning approach?
A: Scenario systems planning approach introduces the concept of “systems planning,” which is different from the traditional goal-based optimization approach. In “systems planning,” solutions and strategies are identified and selected to achieve a desired vision or target. As it relates to this study, the vision is to create a sustainable transportation system in Miami-Dade County.

Q: Is there a methodology approach developed?
A: The Project Team will work with the SAC to develop this methodology.

Role of SAC

Wilson Fernandez went over the role of the committee and stated that most of the review would happen outside of the meetings. Today we needed to define what a Sustainable Transportation System looks like.

Study Context

Jill Quigley went over the Study Context which includes the 2035 LRTP (4T’s strategy) and the 2010 Urban Mobility Model Report. She reviewed the historical and forecast transportation demand and supply parameters in relation to socioeconomic trends & mobility trends. Based on the data, she explained that while sustainable lane miles were added in the past the average speed had reduced and congestion had increased. Furthermore, VMT increased at a higher growth rate compared to population and employment. The 2035 LRTP anticipated that this trend would continue into the future.

She pointed out that the average trip length (in minutes) was not increasing proportionally to the increase in VMT and reduction in average peak hour speed because trip length reflected all trip purposes while only rush hour speeds (Home Based Work trips) were shown on the chart.

Questions and comments received during this time included:

There was discussion about the apparent inconsistency between VMT growth and the presumption of a built out roadway system. Jill answered part of this by referring to the information on the number of new roadway lanes miles proposed in 2035. There was also discussion about how the growth patterns have affected this. Specifically, Larry Foutz mentioned that this was because all the forecast population growth was in the southern part of the county while the job growth was concentrated in the northeast part of the county. He said such a travel pattern was not sustainable for the transportation system.

Q: Bill Cross from the South Florida Regional Transportation Authority asked if VMT's will be considered as one of the performance measures.
A: Yes, the 2035 LRTP will provide the baseline conditions with respect to vehicle miles traveled (VMT). Any improvement (or reduction) in VMT achieved by testing a combination of transportation strategies will be compared to the baseline condition.

Q: What factors are included in calculating the cost of congestion?
A: The financial implications of congestion include the cost of excess fuel consumed and lost productivity at work due to the time spent sitting in traffic.

C: Subrata Basu commented that the Study Purpose and some of the discussion do not quite match his understanding of the study and he would like to get through the presentation. He is specifically concerned that land use will not be considered.
A: Jill clarified that land use will be included however the study will not provide the recommendations for a preferred land use scenario.

C: Subrata commented on the land use and public transit relationship and that both should be addressed and that the goal should be to develop a system where both are linked. He mentioned that the LRTP is a long and static process where they start with old data and at the end of the study the land use does not match.

C: Subrata stated that he would like a method of a preferred way to connect transit with land use. This is the biggest thing we all need to work on.

C: Larry commented that the 3C (Comprehensive, Continuing and Cooperative) process works and the LRTP does include land use planning. Now with the Census data and result of the last model runs, Planning has better information to use.

C: Subrata would like to do some scenario planning and have an independent look at the process of a better way to do it and using a model run that can look at both. Who has done it in other places? How can it be done better?
A: Jill followed by stating that there will be some examples of case studies provided in the presentation of places that have done a better job of integrating land use and transit better.

Wilson reminded the group that we are not going back to the LRTP that we are starting with the data available and taking a look at new strategies to include into the next cycle of the LRTP.

C: Mayra Diaz, MDX representative - TDM is not that simple. We need to look at how to better use the existing system. Our land use is not going to change and the configuration will not change.

Subrata stated that it was a wrong premise to use and the group should consider bringing people to where jobs are and create job centers where people live. Non-motorized transit would occur if the facilities are available and accessible.

C: DERM representative - Alternative modes are also important to reduce emissions and the carbon footprint.

Sustainable Transport Definition

Jill Quigley began the exercise by asking the group to define the primary function, essential characteristics and desired characteristics of a Sustainable Transportation System.

Jill completed the exercise. The results are as follows.

Primary Functions	Essential Characteristics	Desired Characteristics
Move people and goods efficiently Provide access Support economy Support land-use & demand	Multi-modal, options Able to fund, maintain and operate Accessible Affordable Equitable Coordination with land-use Efficient (travel time, capacity utilization, fuel) Reliable Not harming to environment Appropriate carbon footprint (infrastructure and operations) Safe & Secure Comfort (transit) Renewable fuel sources Flexible Resilient to expected impacts of climate change	Efficiency (travel time, capacity utilization, fuel) Seamless connections Aesthetic Comfort Flexible Promotes healthy living Improves quality of life Fits in community context

Following the exercise Jill provided the group with a handout of definitions adopted by other agencies as samples to consider. She also stated that a summary of this meeting would be provided to everyone and an FTP site will be created for the group to use and share information.

Case Study Review

Vikas Jain from Jacobs provided the committee with an overview of various Case Studies from different cities.

Vikas highlighted studies that were in either the planning phase or implementation phase. The key transportation strategies being studied by these cities can be grouped under the following broad categories:

- Manage Traffic & Congestion
- Promote Education & Involvement of all transportation stakeholders
- Link transportation & land use in transportation plans
- Prioritize highway repairs & safety performance vs. new capacity
- Support non-motorized transportation

Jill commented that these studies are but a few samples of scenario planning studies available and asked the group to provide additional studies for review if they knew of any others.

Questions and comments received during this time included:

C: Many of the agencies present are signed on as partners of the Sustainable Communities Initiatives and the Regional Planning Council has received grant funding to develop a sustainable regional development plan and one component includes transportation.

Q: Will there be coordination for this process?
A: Yes there is coordination with the Regional Planning Council and others who are interested in our study, such as FDOT District 4.

Next Steps

As we move forward the work begins with developing the three scenarios and identifying the blend of strategies that will be incorporated together to run the models. We will need to select a good variety of variables for each scenario. That is the task of the group at the next SAC in person meeting. In the meantime, a literature review is scheduled for next month (February 2011). We will be providing the technical memo and a comprehensive list of strategies and performance measures for all to review.

Jill offered to take all the suggestions provided for the definition and provide the group with a draft definition for the group to review and edit. Bill Cross suggested that the consultant develop some goals and objectives or baseline targets for the study.

Wilson again thanked everyone for participating in this process.

Questions and comments received during this time included:

C: Scenarios to be tested should be financially, politically and technologically feasible.

C: We need to be careful to not repeat the Watershed study.

C: The whole purpose of this study is to get ahead of the curve if the federal government requires visioning in the next transportation legislation.

C: It is more exciting to be part of a study that is not required because there is greater freedom.

SIGN-IN SHEET

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Strategies for Integration of
Sustainability and Transportation System

Study Advisory Committee (SAC) Meeting

MIAMI-DADE COUNTY / MPO

May 11, 2011

1

Study Purpose

To identify and evaluate strategies to improve the sustainability of Miami-Dade County's transportation system *with an emphasis on accommodating future travel needs using transportation demand management strategies.*

2

Detailed Study Plan & Schedule

Where we are in the Study Process?

Activity	Year 2010 - 2011											
	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov
Preliminary Literature Review Results		SAC Meeting										
Final Literature Review Tech. Memo.			Deliverable									
Screening Analysis Tech. Memo.				Deliverable								
Selection of Scenarios						SAC Meeting						
Scenario Descriptions Tech. Memo.						Deliverable	TPC Meeting					
Scenario Evaluation: Modeling												
Scenario Evaluation: Identification of Secondary Impacts												
Scenario Evaluation: Order of Magnitude Costs										SAC Meeting		
Scenario Evaluation Results Tech. Memo.											Deliverable	
Draft Study Document/Executive Summary												Deliverable

Note: TPC Meeting in Dec. 2011 on study completion

3

Review of Previous Work

- Literature Review
- Definition of Sustainable Transportation

  For the purpose of this study, sustainable transportation means ***a transportation system that is able to meet today's needs and those of the future using the existing and committed infrastructure identified in the 2035 Long Range Transportation Plan.***

4

Sustainable Transportation Strategy

Screening Methodology

- Developed universe of sustainable transportation strategies
- Stratified sustainable transportation strategies into three groups
- Adopted a two-tiered screening approach
  - Tier One – Agreement with Local Plans
  - Tier Two – Prioritization within Local Context

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Sustainable Transportation Strategy

Screening Methodology

Tier One – Agreement with Local Plans

- GreenPrint, Office of Sustainability
- 2035 Long Range Transportation Plan, MPO
- Transit-Development Plan FY 2010-2020, MDT
- 2035 Long Range Transportation Plan, SEFTC
- South Florida Regional Freight Plan, SEFTC
- 2025 Florida Transportation Plan, FDOT
- 2006 Florida Strategic Highway Safety Plan, FDOT
- Miami-Dade Expressway Authority (MDX)

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Sustainable Transportation Strategy

Screening Methodology

Developed inspirational targets for **Tier Two** evaluation based on GreenPrint

Baseline: Cost Feasible 2035 LRTP

- Vehicle miles traveled (VMT) –
  25% reduction by 2035
- Vehicle hours traveled (VHT) –
  25 % reduction by 2035
- Single-occupant vehicle (SOV) travel –
  25% reduction by 2035
- Transit ridership –
  50% increase by 2035
- Bike/pedestrian trips –
  30% increase by 2035

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Sustainable Transportation Strategy

Screening Methodology

Tier Two – Prioritization within Local Context

- Conducted SWOL Analysis
  (Strength, Weakness, Opportunities, Limitation)
- Conducted online survey
  - SAC members
  - Project team members
- Assigned scores based on
  - Effectiveness
  - Ease of Implementation
  - Appropriateness

Score	Performance
3	Excellent
2	Very Good
1	Good
0	Fair
-1	Poor
-2	Very Poor
-3	Unacceptable

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Sustainable Transportation Strategy

Screening Methodology

Prioritized strategies based on average scoring

Example

Group	Category	Strategy	Strength	Weakness	Limitation	Effectiveness	Ease of Implementation	Appropri-ateness	Overall Average
Pricing or Behavior	Manage Traffic Congestion	A	Already in use in Miami-Dade County	Does not reduce need for travel	None	2	1	2	1.6
		X	May help reduce VMT	Mode shift may not include increased bike/ped trips	Difficult to evaluate	1	1	1	1.0
		L	Has shown to reduce VMT	May not be geographi-cally appropriate, high political sensitivity	Cannot be regulated by Miami-Dade County	2	-3	-3	0.5

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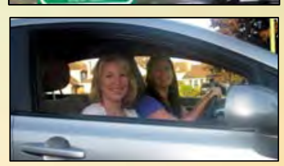
Sustainable Transportation Strategy

Screening Results

Results Summary (Strategies with only positive scores)

- Total # of strategies evaluated – 53
- Dropped out – 16 (12 in Pricing group, 4 in Bicycle & Pedestrian group, none in Efficient Resource Utilization group)
- Highest overall score: Park-and-ride lots
- Most effective: Smart Growth & TOD
- Easiest to implement: Fare policy (transit)
- Most appropriate: Smart Growth
- Detailed survey results included in the handout

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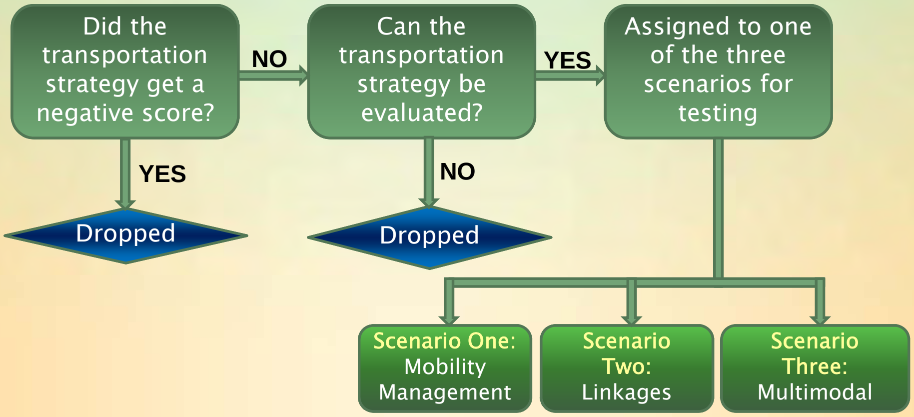
Scenario Development and Evaluation

Scenario Development Process



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Scenario Development and Evaluation

Scenario One: Mobility Management (Pricing/Behavior)

The focus of this scenario is on improving travel time and speeds for all vehicles.

Scenario Two: Linkages (Land use)

The focus of this scenario is on shortening trip lengths and reducing auto-dependence by improving the land use and transportation connection.

Scenario Three: Multimodal (Mode shift)

The focus of this scenario is on improving non-motorized travel and public transportation to encourage greater use of these modes.

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Scenario Development and Evaluation

Scenario One:
Mobility Management (Pricing/Behavior)

Strategies

- Fare policy (transit)
- Parking management (Variable Parking Pricing)
- Advanced arterial signal systems
- Variable pricing (Managed lanes/HOT lanes)

  Optional

  - High Occupancy Vehicle (HOV)
  - Shoulder-riding enhancements

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Scenario Development and Evaluation

Scenario Two:
Linkages (Land use)

Strategies

- Smart Growth
- Transit oriented development (TOD)

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Scenario Development and Evaluation

Scenario Two:
Linkages (Land use)

Methodology

- Reallocate growth (2015–2035) at district level in high capacity highway and transit corridors
- Reallocate growth (2015–2035) to create jobs (attractions) and housing (productions) balance at district level

Summit Districts

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Scenario Development and Evaluation

Scenario Three:
Multimodal (Mode Shift)

Strategies

- Park-and-ride lots
- Improved rider information (Real-time information), Improved bus shelters
- Transit signal priority
- Arterial bus rapid transit (BRT)

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Scenario Development and Evaluation

Performance Measures

- **Southeast Regional Planning Model (SERPM 6.5)**
  - Vehicle miles traveled (VMT)
  - Vehicle hours traveled (VHT)
  - Single-occupant vehicle (SOV) travel
  - Delay
  - Transit ridership
  - Average trip length by trip purpose

- **Spreadsheet & GIS based tools**
  - Air Quality & GHG emission
  - Transport cost (commute cost)
  - Loss of economic productivity
  - Equity

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Next Steps

- SAC Review
  - Screening Analysis Tech. Memo (May 2011)
  - Scenario Descriptions Tech. Memo (June 2011)
- TPC Meeting (June 2011)
- SAC Meeting (September 2011)

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Thank You

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Strategies for Integration of Sustainability and Transportation System

Miami-Dade Metropolitan Planning Organization
SAC Meeting #2
CITT Conference Room (10th Floor)
111 NW 1st Street
Miami, FL 33128
Wednesday, May 11th 2011

Introductions

Wilson Fernandez began the meeting by introducing himself as the project manager for the Study and thanking everyone for attending. He asked the participants to go around the room and introduce themselves. A list of the attendees is attached.

Wilson introduced the project Study's Project Manager from Jacob's Engineering, Jill Quigley.

Review of Study & Previous Work

Jill Quigley began by providing a reminder of the Study's purpose and an overview of the study schedule and referenced the activity of the past meeting. Jill provided the group the schedule of the study and next steps which include finalizing the three study scenarios.

Jill provided a list of literature used for the Study and provided the selected definition of Sustainable Transportation. She mentioned that all literature and materials are found in the FTP site.

The final definition was presented which Jill indicated was intentionally narrower in scope than the one the group had worked on previously. The narrower definition better represents the objectives and limitations of the Study. The SAC accepted the definition of Sustainable Transportation for application to this study.

Jill asked if there were any questions or comments from the SAC regarding the literature review. There were none. She mentioned the survey submitted to the SAC members. The results were used to determine the scenarios that will be modeled.

Strategy Screening

Jill introduced Vikas Jain who gave an overview of the Strategy Screening Results and the basis used to evaluate each strategy. The intent was to narrow the list of strategies that would be used to develop scenarios. Three scenarios were recommended: Mobility Management (pricing/behavior), Linkages (land use), and Multimodal (mode shift).

Vikas briefly explained the methodology for ranking the strategies: the effectiveness of the strategy at meeting the aspirational targets; the availability and appropriateness of that strategy for Miami-Dade County; and whether the strategy can be evaluated in a meaningful way.

Based on the initial results received from the survey, Vikas discussed the list of accepted strategies.

Wilson noted that some SAC members provided their survey results in the last 24-48 hours and these results are not included in the current list/presentation. Wilson requested the information be updated to reflect the surveys in the final results.

Vikas continued with the overview of the strategies and the rating of the scores and reasons for elimination of certain strategies. Strategies that received a negative score in any one of the three evaluation categories were dropped.

Scenario Development & Evaluation

Jill Quigley went through the Scenario Development Process (flow chart) to emphasize the rationale used for eliminating strategies. She asked SAC members to review the list and asked for feedback from the group regarding some strategies that were dropped, bearing in mind that some surveys had not been included and the final results were likely to change.

Questions and comments received during this time included:

C: After reviewing the list, most of the strategies dropped should be included and are not.

C: Those strategies should then be included for future visioning. Alternative fuels are limited to the study.

A: Wilson explained that while it is important to study technologies which reduce vehicle emissions such as alternative fuels, these strategies are not necessarily effective in terms of the goals/targets established for the Study. For example, vehicles which achieve high mileage per gallon of fuel may ultimately increase vehicle miles travelled (VMT). Therefore, these types of strategies may be deemed inappropriate for this study.

COMMENTS, QUESTIONS, AND ANSWERS

The following is used to designate comments, questions, and answers discussed during the meeting:

C – Comment

Q – Question

A – Answer

C: By reducing VMT/VHT you will have a lowering of emissions. Alternative fuel does not conclusively reduce VMT/VHT.

C: Bus Only lanes should be considered.

C: Please include the Miami-Dade County's Comprehensive Development Master Plan (CDMP) in the list of plans reviewed.

C: Off model techniques should be evaluated (e.g. van pool and car pool from air quality standards procedures, bicycle use from bus count records); estimates can be provided even if it cannot be modeled.

C: Federal governments will be forced to rethink funding for alternative fuel buses and operations.

C: MDT is planning and has funding for upgrades to the existing infrastructure for rail services, making rail cars safer & comfortable.

C: Port of Miami, evaluation of cargo on trucks vs. rail?

A: Clarification was given as to why some strategies cannot be evaluated/modeled. Improvement of infrastructure and vehicles for instance, is one area where there is not good information on quantifiable outcomes. An example from Tri-Rail was given.

C: Should make a statement in the study that preserving and maintaining the existing system, including infrastructure and vehicles, is a given.

Wilson stated that there may be movement on some of the strategy rankings based on the missing survey results. He explained that the study team is seeking consensus on the scenarios and their general concepts.

Jill stated that many of the eliminated strategies would be included in a comprehensive implementation plan, however; for the Study, specifically the modeling portion, the scope is limited to strategies than can be evaluated. Furthermore, the Study is not intended to evaluate detailed scenarios, but to compare general directions for the County to move in.

Jill went over each scenario individually:

Scenario One/Mobility Management:
This scenario looks at pricing and behavior strategies to improve travel time for all vehicles. The scenario would maximize the use of a HOT/managed lanes network.
Scenario Two/Linkages: looks at coordinating land use with transportation to shorten trips and reduce auto dependence.

Scenario Three/Multi-model: encourages increased transit ridership and greater use of non-motorized transportation.

Questions and comments received during this time included:

Scenario One:

C: The fare incentive strategy can be used to get more people to use transit as a way to balance the increased cost of driving a vehicle.

There was discussion about keeping Managed Lanes or using the options for HOV and shoulder-riding enhancements. Jill stated the study team recommends keeping the HOT managed lanes; however wanted to provide the group with other options.

Wilson stated that by the end of the meeting the group should achieve consensus on the three scenarios presented.

Scenario Two:

C: Please use the County's Comp Plan for this scenario

Vikas and Jill explained that a number of existing maps were reviewed to serve as the base map for the land use scenario. There is a concern that using the TAZ districts will be too much detail. The existing TAD map is from 2000 and considered outdated. The study team recommends using the recently developed Summit District map that is at an appropriate scale and was designed to evaluate transit benefits.

C: Planning department would like to review TOD & linkages and smart growth part needs to be worked together with the planning department staff.

Q: What numbers are you using for land, housing units, employment numbers, etc?

A: We are using data in the LRTP 2035 and only redistributing the growth incremental to year 2015.

Wilson stated that the SFRPC was currently engaged in the HUD study and there is really no guideline to use for this study. This study will be just a tool.

Jill stated that Jacobs would use information provided by the Planning department and incorporate it into Scenario Two: Linkages.

Scenario Three:

Q: How will you model improved bus shelters when you can't model infrastructure?

A: By assuming the effective wait times are reduced through greater transit rider information & bus shelters.

Q: What about bikes, trails and pedestrian in proximity to transit?

A: These cannot be evaluated.

C: Perhaps we should mention somewhere in the study that some of these items were unable to be evaluated but should not be discounted.

C: Ana Elias explained that the model is blind to variables that were not used in the specification of that model. For example, while transit customer satisfaction may be an important factor in increasing transit ridership, the model does not recognize this as an explanatory variable for transit ridership so that changes in customer satisfaction cannot be evaluated through the model.

C: Assumptions from Green print will be provided by DERM.

Q: Are shoulder improvements safe? Why aren't they used in Miami-Dade County?

A: FDOT provided input- these are safe in low speeds and only allowed in extreme congestion for buses and are currently employed in Miami-Dade County.

C: Designated bus only lanes can be incorporated in Scenario Three

C: Evolutionary development, as used in the 5 year plan, may be assumed in the Study for certain bus routes. In this way, "enhanced routes" would become designated bus-only lanes after some period of time.

Next Steps

Jill asked for consensus for the three scenarios. The Committee agreed to the concepts presented in each scenario. The next steps for the study were reviewed.

Q: Will the items in orange box be considered?

A: Yes

Wilson stated that we would try to keep the scenarios and include those that fit from the orange box.

Wilson went over the schedule and discussed the June TPC meeting as well as the final SAC meeting in September.

C: Larry requested the list of the items unable to be evaluated be shared with the group.

C: Perhaps TPC may need to hear an informational presentation first then go back to them

Wilson suggested including some strategies as appropriate, under each scenario based on the updated survey results and the committee's input. He reminded everyone that all survey results must by in by Friday.

Group was asked if they would like another meeting in July. All concurred.

Meeting adjourned.

Strategies for Integration of Sustainability and the Transportation System

Study Advisory Committee (SAC) Meeting - May 11, 2011

Sign-in Sheet

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Strategies for Integration of

Sustainability and Transportation System

Study Advisory Committee (SAC) Meeting

Today's Meeting

Discuss and agree on detailed scenario definitions that will be evaluated.

2

Detailed Study Plan & Schedule

Where we are in the Study Process?

Activity	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov
	Year 2010 - 2011											
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Scenario Evaluation: Modeling												
Scenario Evaluation: Identification of Secondary Impacts												
Scenario Evaluation: Order of Magnitude Costs										SAC Meeting		
Scenario Evaluation Results Tech. Memo.											Deliverable	
Draft Study Document/Executive Summary												Deliverable

Note: TPC Meeting in Dec. 2011 on study completion

Scenario 1: Mobility Management

This scenario considers:

- creation of a network of managed lanes on the County's expressway facilities;
- use of these lanes for express bus service network that will offer reduced fares;
- increased parking prices; and
- operational improvements.

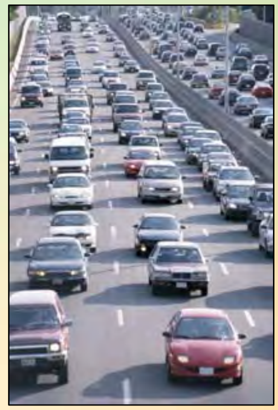
Scenario 1: Strategies

<u>Using SERPM</u>

- Managed/HOT Lanes
- Transit Fare Policy
- Variable Parking Pricing

<u>Off-Model</u>

- Motorist Information Systems
- Freight Operational Improvements



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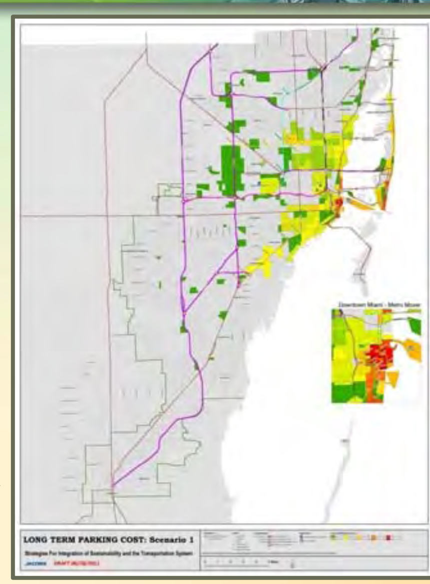
Scenario 1: Managed/HOT Lanes

- Create regional network on:
  - SR 826
  - SR 836
  - SR 112/I-195
  - HEFT (SR 821)
  - SR 874
  - SR 878
  - SR 924
  - I-95 (Existing & Extension)
- 2 lanes in each direction, taking one general purpose lane and shoulder
- Higher toll rate compared to regular toll lanes
  - Peak period: (Sum of all links) + $2.00*
  - Off-peak period: (Sum of all links) + $0.75*

*Average tolls on I-95 managed lanes



Scenario 1: Transit Fare Policy

- Express bus routes will o¸ erate on all mana¸ed lanes
- Headways of 10 minutes during peak and 60 minutes during off-peak periods
- Express bus route fares on these facilities will be reduced by 50% to $1.15
- Capital and O&M costs for buses will be subsidized by toll and parking revenue

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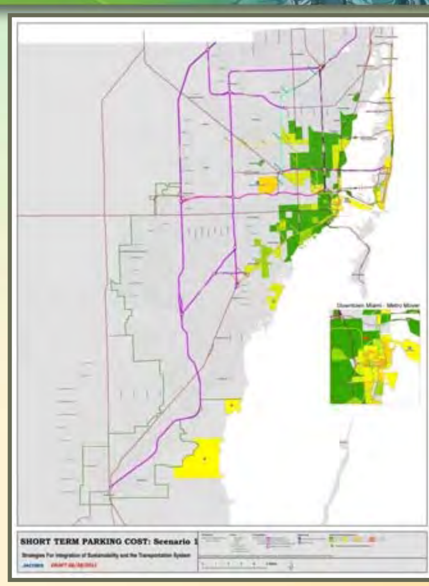
Scenario 1: Variable Parking Pricing

- Long-term parking costs:
  - Will be tripled in areas that currently charge $0.25 or more per hour on average; and
  - Will be $0.75 on average in new areas with employment densities of 25 employees per acre or greater and existing areas that charge less than $0.25 per hour.
- Short-term parking costs will be doubled in almost all areas.



Scenario 1: Off-Model Strategies

- Motorist information systems
- Freight operational improvements

A 10% decrease in vehicle hours of delay will be included to account for these strategies.

(Source: National Transportation Operations Council)

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Scenario 2: Linkages

This scenario considers:

- reallocating residential and employment densities to:
  - Transit Corridors;
  - Urban Centers and
  - Activity Corridors;
- adjusting the jobs-housing balance;
- implementation of Complete Streets; and
- promotion of bicycling.

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Scenario 2: Strategies

Using SERPM
- Transit-Oriented Development
- Smart Growth

Off-Model
- Complete Streets

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Scenario 2: Growth Reallocation

Population

3,278,155	Projected 2035
-2,668,507	Projected 2015
609,648	Reallocated

Employment

1,994,215	Projected 2035
-1,584,308	Projected 2015
409,907	Reallocated

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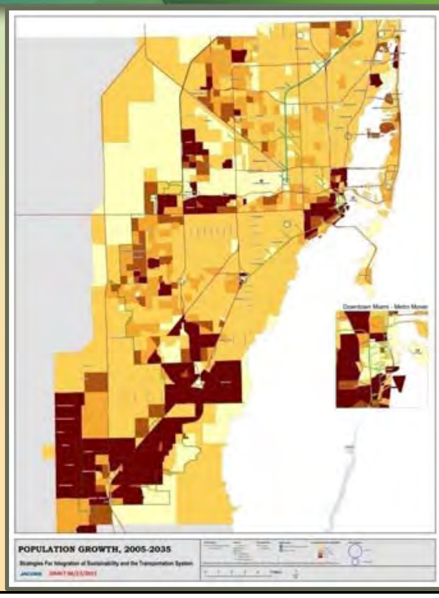
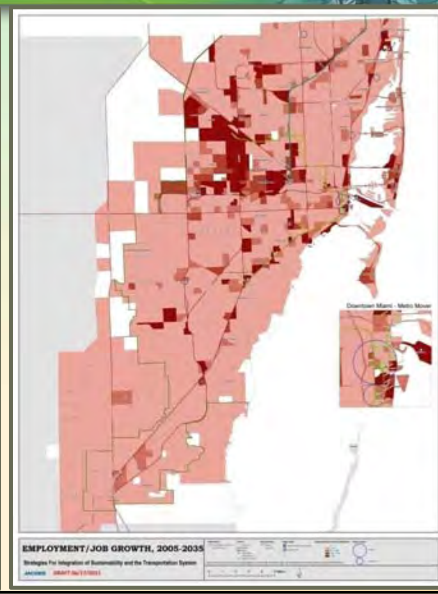
Scenario 2: 2035 Growth Patterns





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Scenario 2: 2015 to 2035 Growth

Area	2035 Population Growth in SERPM	2035 Population Growth as PROPOSED
Urban Core	18%	40%
Urban Fringe	27%	30%
Suburban	35%	20%
Exurban	21%	10%

- Employment allocation will be balanced with population growth

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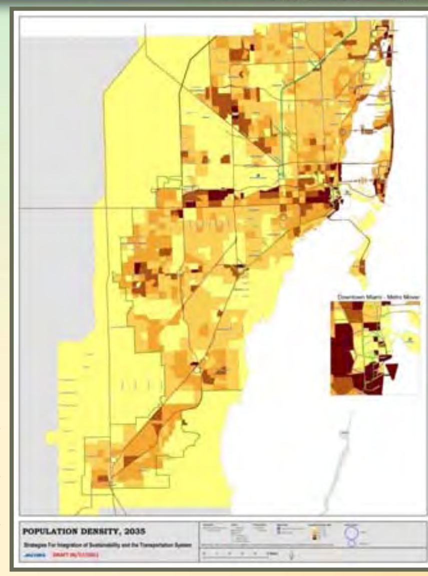
Scenario 2: TOD

- Redistribute as much population and employment to Regional, Metropolitan, and Community Urban Centers identified on CDMP
- Meet Federal Transit Administration guidance for a High Land Use Rating as follows:
  - >25 dwelling units per acre
  - FAR >2.5
- Do not exceed maximum thresholds established in CDMP as follows:

Regional Center	FAR > 4.0 in core ≥ 2.0 in edge	500 du/ac
Metropolitan Center	FAR > 3.0 in core ≥ 0.75 in edge	250 du/ac
Community Center	FAR > 1.5 in core ≥ 0.5 in edge	125 du/ac



Scenario 2: Smart Growth

- Redistribute any remaining employment or population to achieve overall county ratio of 1 job to each 1.5 households
  - Countywide 2005 Jobs to Household Ratio = 1.6
  - Countywide 2035 Jobs to Household Ratio = 1.7
- Focus of this redistribution will be to Activity Corridors identified in EAR, *such as*:
  - NW/SW 27, 42, 87, 107 & 137 Avenues
  - Bird Road
  - NW 103, 36/41 Streets
  - W. Flagler Street
  - Tamiami Trail
  - Coral Way
  - Kendall Drive
  - Coral Reef Drive
  - South Dixie Highway

Scenario 2: Off-Model Strategies

- Complete streets

No reduction in VMT* will be included to account for this strategy.

*Increasing population and jobs density results in a reduction of 10-15 percent automobile trips within the travel demand model.

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Scenario 3: Multimodal

This scenario considers:

- Improving the transit rider experience by providing real-time information and more comfortable stations;
- Increasing system-wide transit travel speeds;
- Creating a network of arterial bus rapid transit;
- Adding park-and-ride locations; and
- Promoting ridesharing and telecommuting.

18

Scenario 3: Multimodal

Using SERPM

- Im, roved rider information, bus shelters
- Transit signal priority
- Arterial bus rapid transit
- Park-and-Ride lots

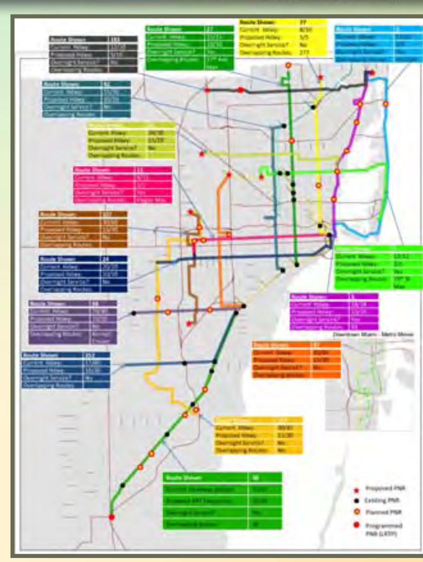
Off-Model

- Vanpool/carpool
- Telecommuting
- Car-sharing
- Parking cash-out
- Biking initiatives/programs

19

Scenario 3: Arterial BRT

- 15 BRT Corridors identified through:
  - Top 10 existing performing routes (MDT)
  - Top 10 performing routes in 2035 (SERPM)
  - BRT Corridor Selection (MPO, 2004)
- These BRT corridors include:
  - Biscayne Blvd/US 1
  - Collins Ave
  - Coral Way
  - Flagler St
  - Kendall Dr
  - Miami Gardens Dr
  - ~~NW 7th Ave~~
  - ~~NW 27th Ave~~
  - 42nd Ave
  - 87th Ave
  - ~~NW~~ 107th Ave
  - 137th Ave
  - ~~SW 26th St~~
  - 49th/103rd/95th St
  - 79th St
  - 152nd St



Scenario 3: Arterial BRT

- New headways will be an improvement over existing for BRT corridors.
- Station spacing will be approximately ½ mile.
- Local bus service on these corridors will be eliminated.
- Travel speed for BRT will be 25% faster than local bus service.
- Fare is reduced 50% from existing (2010) ticket fare during peak period.
- These new headways will be funded through the reinvestment of savings resulting from system-wide improvements in travel time. (Peak Vehicle Requirements will stay the same for the system.)

21

Scenario 3: Park-n-Ride, ITS & TSP

Park-and-Ride Lots

- Included locations from Miami-Dade Consolidated Park-and-Ride Facilities Plan, 2010.
- Identified new locations to coincide with proposed BRT corridors.

Improved transit rider information/bus shelters

- Remove penalty and weight on transfer wait times

Transit Signal Priority

- Implementation of a system-wide TSP with a 10% improvement in overall bus speeds

22

Scenario 3: Off-Model

- Telecommuting
- Car-sharing
- Vanpool/carpool & Parking cash-out
- Biking initiatives/programs

Recommend reduction of 10% of VMT for these combined strategies.

Source: Victoria Transport Policy Institute, Canada

Scenario Development and Evaluation

Performance Measures

- Southeast Regional Planning Model (SERPM 6.5)
  - Vehicle miles traveled (VMT)
  - Vehicle hours traveled (VHT)
  - Single-occupant vehicle (SOV) travel
  - Delay
  - Transit ridership (Mode split)
  - Average trip length by trip purpose
- Spreadsheet & GIS based tools
  - Air Quality & GHG emission
  - Transport cost (commute cost)
  - Loss of economic productivity
  - Equity

Thank You

Strategies for Integration of Sustainability and Transportation System

Miami-Dade Metropolitan Planning Organization
SAC Meeting #3
CITT Conference Room (10th Floor)
111 NW 1st Street
Miami, FL 33128
Wednesday, June 29, 2011The meeting began at 9:44 a.m.

In Attendance: Wilson Fernandez, Larry Foutz & Carlos Roa, Miami-Dade MPO; Napoleon Somoza & Mark Woerner, Miami-Dade DP&Z; Maria Batista, MDT; Derek Bradchulis, Miami-Dade DERM; Jose Gonzalez, City of Miami; Jim Murley, SFRPC; Rolando Jimenez, Miami-Dade Public Works Department; Rita Carbonell, HNTB; and Jill Quigley, Vikas Jain, Tara Blakey & Mireidy Fernandez, Jacobs

Introductions

Wilson Fernandez began the meeting by providing a brief overview of the steps the Study Advisory Committee (SAC) had taken thus far with regard to the subject of the integration of sustainability and transportation of county-wide areas in Miami-Dade.

Review of Study & Previous Work

Mr. Fernandez explained there were three scenarios that the study team had agreed upon. The SAC had asked to include some off-model strategies, which was accomplished and included in a presentation made to the TPC on June 6th.

Mr. Fernandez described the meeting on this present day as being important because after its conclusion, the goal is for the study team to incorporate the SAC's comments and begin testing out various scenarios using the model. He said this is why the review of conceptual scenarios needed to be done and for those scenarios to be defined for modeling purposes. Mr. Fernandez explained that for the better part of the summer, the study team will be conducting the testing.

Jill Quigley explained that the goal of this study is not to expand any infrastructure beyond what is being shown in the 2035 Cost Feasible Plan. She explained that objective of the meeting was to discuss and agree on detailed scenario definitions that will be evaluated. Ms. Quigley then presented the PowerPoint presentation that described the details of each of the scenarios.

Discussion of Scenarios 1, 2 & 3

Scenario 1 identifies a system of managed lanes with express bus service and increased parking prices to evaluate how travel demand and behavior is affected by pricing policies.

Maria Batista posed a question about the pricing being proposed for the express bus service. She pointed out that the $1.17 proposed fee appeared to be an odd figure and that it should be a rounded number. A bus fare of $1.15 was then agreed upon.

Jim Murley asked about whether there was any special treatment given to the airport and seaport, pertaining to the topic and intensity of activity at these locations. He also asked how tourist trips were treated in the model and suggested that these areas be treated differently in this scenario.

Mr. Foutz explained that the model treats airports and seaports as special generators. He said that significant numbers of trips are added on top off the trips generated based on jobs or employment for certain zones (special generators) to account for tourist trips. In case of beaches, additional service employees to serve tourists are included in the zonal data set.

Mr. Fernandez indicated that the airport entry/exit issue had come up previously and that it had been debated internally. He said there had been discussion about the possibility of adding entry/exit points along SR 836 because there is not one along 836 for the managed lane network but there is one on SR 112 and connecting to I-95 along the beach.

Mr. Fernandez stated that if the SAC felt that the airport is significant enough for entry and exit points, then that is valid input that will be considered. The way the study is being modeled is so that it is clear where the entry and exit points are on the map and perhaps a toll fee would apply. He also said that if an entry is added, what would take place would be doubling the toll between I-95 and SR 826/Palmetto Expressway.

Mr. Vikas Jain pointed out an example of how the entry/exit points would work. Say there are four lanes: each one gets a $0.25 charge. For the managed lanes, the same thing would apply plus paying $2.

Mr. Murley questioned the issue with rental cars and taxis to and from the airport.

Larry Foutz said there is a distance of nine miles on SR 112 and a three-mile segment on SR 836. As a result, there is good reason not to have a managed lane point at the airport because of the traffic.

Mr. Fernandez said that the points between 836 & 112 and 395 & 195 need to be deleted from the proposed map. He pointed out that I-75 had already been identified as one not being considered at all because it would impact such a small area of Miami-Dade.

Mr. Foutz said one option would be to toll the entry ramp as opposed to the thru way; that way people don't get penalized for the second toll. It might be a good idea to create an entrance ramp in the model and toll the ramp rather than the thru lane, he said. If that is able to happen, then tolling the airport would be a good idea.

Mr. Fernandez said the value of the 836 portion between Le Jeune Road to 826 is significant more for time and that this specific entry point would be added. He also pointed out that various concepts being discussed were adequate given the nature of the exercise being conducted. The purpose of this exercise, he explained, is to test these scenarios to determine their impacts and assist in identifying global policies that should be considered for the next Long Range Transportation Plan. He reiterated that the goal was to achieve the maximum benefit. It's important to add Le Jeune Road on the map and make those changes.

Mr. Fernandez stated that the study is not just about testing for reduction in VMT, it is also about identifying sustainable practices from a financial perspective. Therefore, for scenario one the cost to be able to implement this is not only on the managed lanes but includes the express bus service. The larger questions are whether this scenario could yield sufficient revenues and whether the option can absorb a capital improvement of this nature system-wide.

Ms. Quigley asked the SAC about the need for 30-minute off-peak period express bus service. After discussion, it was agreed to test 60 minute headways in the off-peak period and reduce the overall service hours.

Scenario 2 is the linking land use and transportation scenario in which projected growth in population and employment between 2015 and 2035 will be reallocated with the intent of shortening trip lengths and reducing overall travel demand. Mr. Fernandez stated scenario 2 focuses in on the growth within the core and fringe areas, within the Palmetto/826. Within the infill core area, that is where there are the metro services; there is the notion that this area has the infrastructure to be able to absorb this demand for travel. He said once the population reallocation occurs, then the employment balancing can be examined.

Ms. Batista stated that Killian Drive/104th should be added on the Smart Growth slide with the roads listed on the PowerPoint presentation.

Scenario 3 identifies a system of bus rapid transit (BRT) corridors and accompanying improvements with the intent of making transit quicker, more comfortable, and more convenient.

Ms. Quigley reviewed how the new BRT corridors were identified, based on top-performing routes currently and in the 2035 LRTP, and those corridors identified in the MPO's BRT Corridor Selection report. In response to comments, she indicated that both 79th Street and 7th Avenue are included.

Mr. Foutz stated that the parking cash-out impact is the same as increasing the price of parking. He recommended that an additional $0.25 be added to the parking price to reflect this strategy. Mr. Fernandez pointed out that the impact of parking cash-out is that there is no cost to the employee; in terms of demand, there is only one incentive program that doesn't charge employees. Employers incentivize it so that employees do not pay for parking so it would be essentially like riding transit for free and therefore increasing the parking price will not accurately reflect this.

Regarding bus fares, all fares would be reduced 50% from the current base fare, and not just the BRT corridors.

Mr. Fernandez added that this scenario was similar to what had occurred on U.S. 1 at the beginning of the South Dade busway. The question becomes, he said, does the corridor become a BRT corridor? There would be stops about every half-mile so that riders would be no farther than a quarter mile from any particular station. The advantage is that walk access to all the stops are still being provided. The crux is to be able to adapt these corridors as BRT corridors and putting that system in place with a limited number of stops or stations.

There was discussion about whether what is being proposed meets the definition of BRT if it does not have a dedicated guideway. Mr. Fernandez explained that a dedicated guideway is not required and promised to e-mail all members the most updated definition of BRT that has been released.

There was discussion about how to deal with the off-model strategies, particularly telecommuting, car-sharing, vanpool/carpool, and bicycle trips. It was agreed that the reductions in VMT would be taken from specific trip purposes. For telecommuting and vanpool/carpool, the appropriate reduction in VMT will be taken from home-based work trips. A reduction in VMT for non-home-based trips will be taken for car-sharing on the order of 15 trips for every car in the presumed car-share fleet. An overall appropriate VMT reduction will be taken for bicycle trips.

The SAC agreed to reconvene in September to review the results and agree on the tactics that were effective in order to formulate a fourth scenario that encompasses all the best parts of the three scenarios discussed.

The meeting adjourned at 11:23 a.m.

Strategies for Integration of Sustainability and the Transportation System

Study Advisory Committee (SAC) Meeting - June 29, 2011

Sign-in Sheet

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Strategies for Integration of

Sustainability and Transportation System

Study Advisory Committee (SAC) Meeting # 4

Today's Meeting

Review and discuss scenario evaluation results, including cost/revenue analysis prior to presentation to TPC.

2

Study Purpose

To identify and evaluate strategies, <u>not</u> to make policy or implementation recommendations.

3

Detailed Study Plan & Schedule

Where we are in the Study Process?

Activity	Year 2010 - 2011											
	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov
Preliminary Literature Review Results		SAC Meeting										
Final Literature Review Tech. Memo.			Deliverable									
Screening Analysis Tech. Memo.				Deliverable								
Selection of Scenarios						SAC Meeting						
Scenario Descriptions Tech. Memo.						Deliverable	T C & Meet ngs					
Scenario Evaluation: Modeling												
Scenario Evaluation: Identification of Secondary Impacts												
Scenario Evaluation: Order of Magnitude Costs											SAC Meeting	
Scenario Evaluation Results Tech. Memo.											Deliverable	
Draft Study Document/Executive Summary												Deliverable

Note: TPC Meeting in Dec. 2011 on study completion

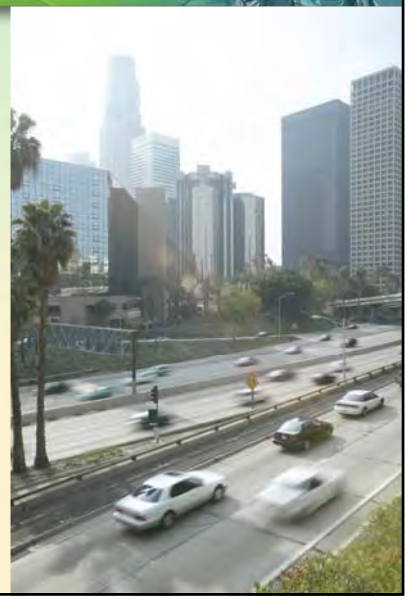
4

Scenario 1: Mobility Management

Emphasis: ***Effect of pricing policies on travel behavior.***

This scenario considers:

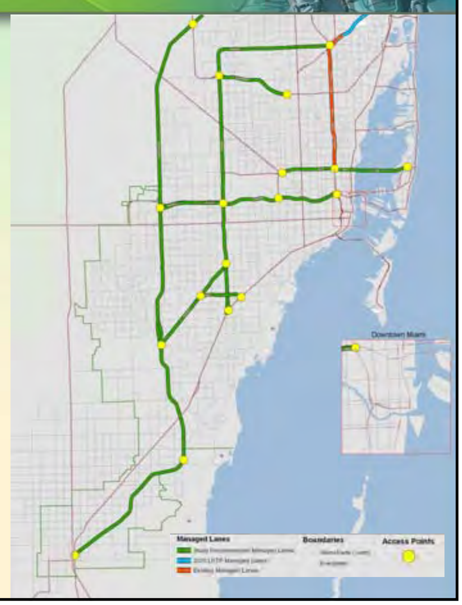
- Creation of a network of managed lanes on the County's expressway facilities;
- Use of these lanes for express bus service network that will offer reduced fares;
- Increased parking prices; and
- Operational improvements.



Scenario 1: Methodology – Managed Lanes

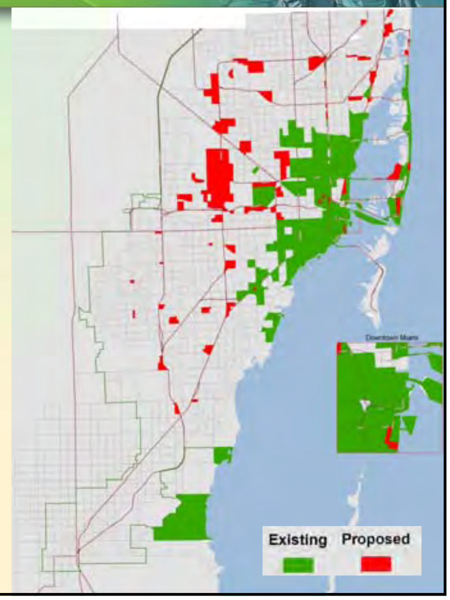
Create regional managed lanes network on MDX facilities by:

- Creating 2 lanes in each direction, taking one general purpose lane and shoulder – 356 lane miles
- Higher toll rate compared to regular toll lanes
  - Peak period: (Sum of all links) + $2.00
  - Off-peak period: (Sum of all links) + $0.75
- Operate express bus service in managed lanes – 12,300 daily revenue miles/700 revenue hours
  - Peak headways of 10 minutes and off-peak of 60 minutes
  - 50% fare reduction ($1.15)



Scenario 1: Methodology – Parking

- **Long-term parking costs** were tripled in existing areas and set at $0.75 in new areas.
  - Cost in areas with existing parking charge is $0 – $8.00
  - Cost in new parking areas is $0.75 – $24.00
- **Short-term parking costs** were doubled in existing areas and set at $0.25 in new areas.
  - Existing cost ranges from $0–$7.00
  - Scenario cost ranges from $0.25 – $14.00



QUESTIONS OR COMMENTS?

8

Scenario 2: Linkages

Emphasis:
Im, rovin, trans, ortation and land use connection.

This scenario considers:

- reallocating residential and employment densities to:
  - Transit Corridors;
  - Urban Centers; and
  - Activity Corridors;
- adjusting the jobs–housing balance.

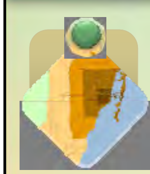
Scenario 2: Methodology

Scenario 2 Methodology – Step 1

Used growth increment from adopted 2035 LRTP for period between 2015 and 2035:

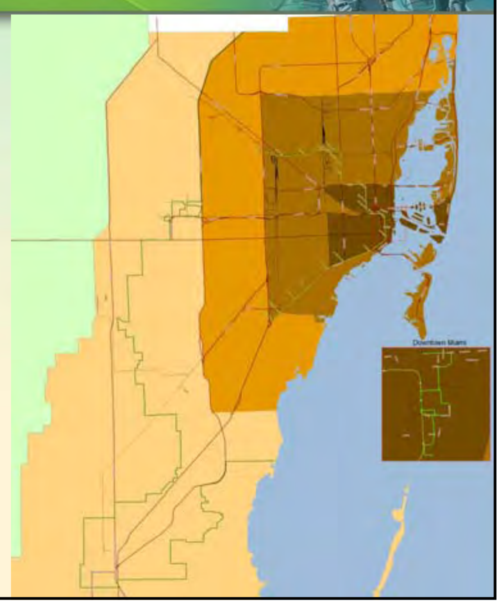
- Population – 609,648
- Employment – 409,907

Scenario 2 Methodology – Step 2

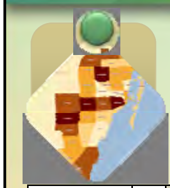


Four growth zones:

- Urban Core target is 40%
- Urban Fringe target is 30%
- Suburban target is 20%
- Exurban target is 10%



Scenario 2 Methodology – Step 3

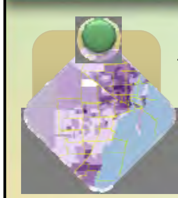


Allocated to Traffic Analysis Districts:

Iterative process to balance jobs and population

Description	TAD	Adopted 2035 Population	Reallocated 2035 Population	Absolute Change	Percent Change	Adopted 2035 Employment	Reallocated 2035 Employment	Absolute Change	Percent Change	Adopted 2035 Jobs-Housing	Reallocated 2035 Jobs-Housing
Aventura	1	126,012	124,973	-1,039	-0.8%	77,589	73,493	-4,096	-5.3%	1.5	1.4
Norwood	2	64,447	63,290	-1,157	-1.8%	23,631	25,222	1,591	6.7%	1.1	1.1
Miami Gardens	3	92,688	91,657	-1,031	-1.1%	18,841	27,374	8,533	45.3%	0.7	1.0
Miami Lakes	4	125,815	123,265	-2,550	-2.0%	52,680	48,457	-4,223	-8.0%	1.3	1.2
Hialeah Gardens	5	86,166	84,915	-1,251	-1.5%	42,333	39,148	-3,185	-7.5%	1.6	1.5
Hialeah (North)	6	157,038	169,193	12,155	7.7%	87,034	84,574	-2,460	-2.8%	1.7	1.5
West Little River	7	70,617	77,984	7,367	10.4%	33,284	33,453	169	0.5%	1.5	1.4
Miami Shores	8	85,256	93,969	8,713	10.2%	34,209	34,140	-69	-0.2%	1.1	1.0
Opa-Locka	9	39,527	39,224	-303	-0.8%	48,552	40,266	-8,286	-17.1%	3.9	3.2
Golden Glades	10	51,201	49,968	-1,233	-2.4%	30,542	32,165	1,623	5.3%	1.7	1.8

Scenario 2 Methodology – Step 4



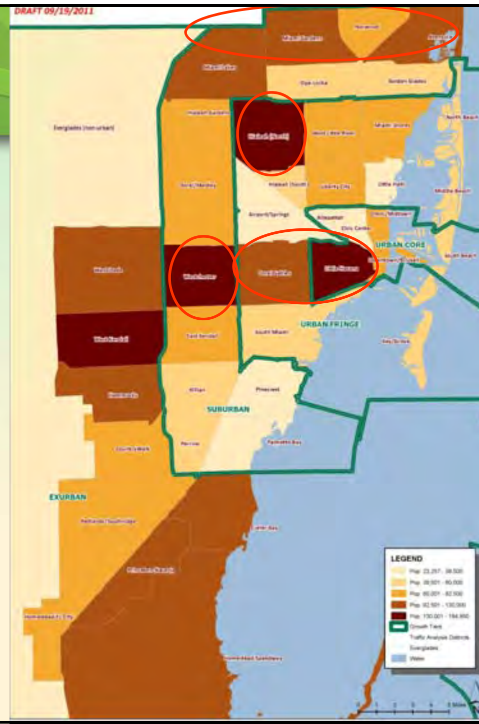
Allocated to Traffic Analysis Zones:

- 75% of growth was assigned to TAZs with one or more of the following:
  - Fixed guideway transit
  - Urban center (per CDMP)
  - Activity corridor (per CDMP)
- 25% of growth was assigned to remaining TAZs within the TAD.

Allapattah TAD #22		Total Population Growth 75%	17,411 13,059
TAZ #	Feature	75% Growth	25% Growth
441 & 442	Metrorail	1,041	
452 & 453	None		338
457-462	NW 27th Ave Activity Corridor	12,018	
463-466	None		4,014
	TOTALS	13,059	4,352

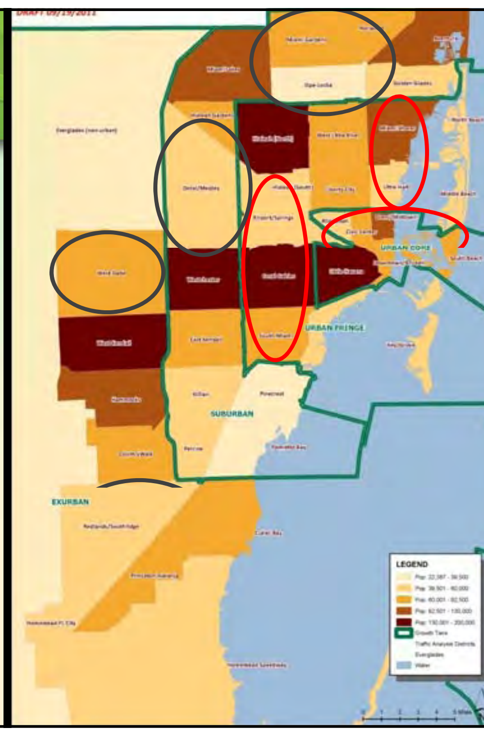
Scenario 2: Population

2035 Adopted



Scenario 2: Population

2035
Reallocated

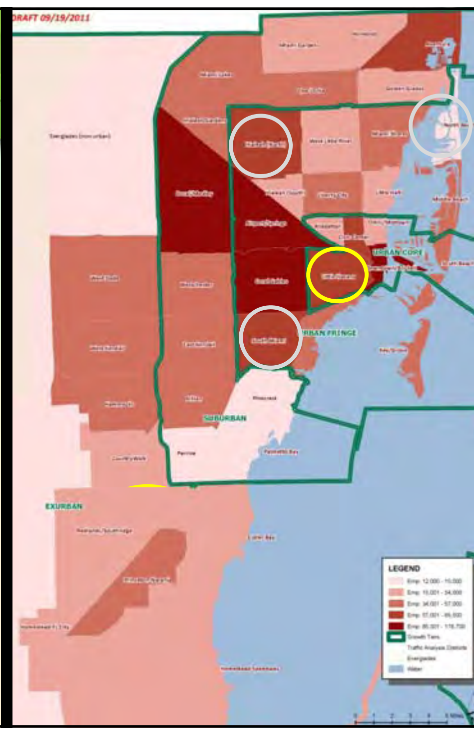


Scenario 2: Employment

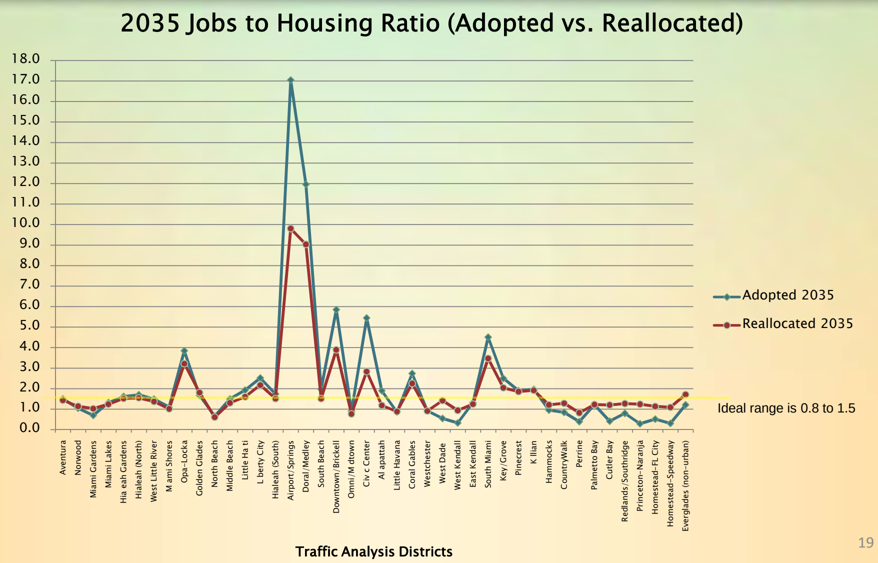
2035 Adopted

Scenario 2: Employment

2035 Reallocated



Scenario 2: Jobs-Housing Ratio



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QUESTIONS OR COMMENTS?

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Scenario 3: Multimodal

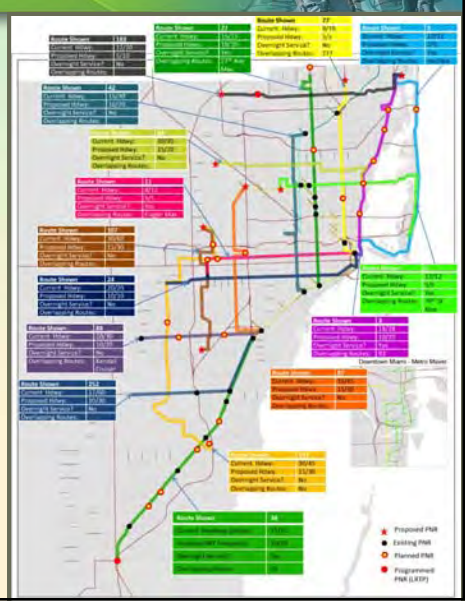
Emphasis: ***Improving transit rider experience***

This scenario considers:

- Provision of real-time information and more comfortable stations;
- Increasing system-wide transit travel speeds;
- Creating a network of arterial bus rapid transit;
- Adding park-and-ride locations; and
- Promoting ridesharing and telecommuting.

Scenario 3: Methodology

- 16 BRT Corridors
  - 549 route miles
  - 4,100 daily revenue hours
  - ½ mile station spacing
  - Improved headways
  - 25% faster travel speed than local bus
  - Fare is reduced 50% during peak period
- 8 new Park-n-Ride lots
- System-wide removal of penalty and weight on transfer wait times
- System-wide increased travel speed additional 10% to account for transit signal priority



QUESTIONS OR COMMENTS?

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Evaluation Results

- Used the Southeast Regional Planning Model (SERPM) for:
  - Travel demand (VMT)
  - Travel times (VHT)
  - Delay
  - Mode split
  - Transit ridership
  - Trip length
- Used off-model calculations for effects on:
  - Greenhouse gas emissions
  - Energy consumption
  - Productivity
  - Equity

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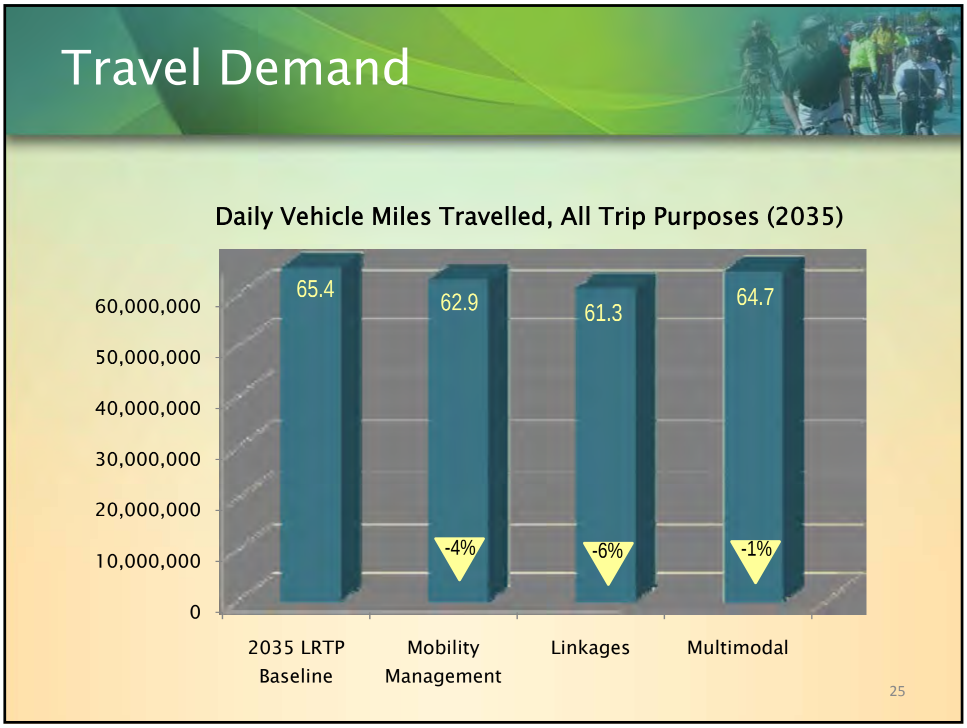
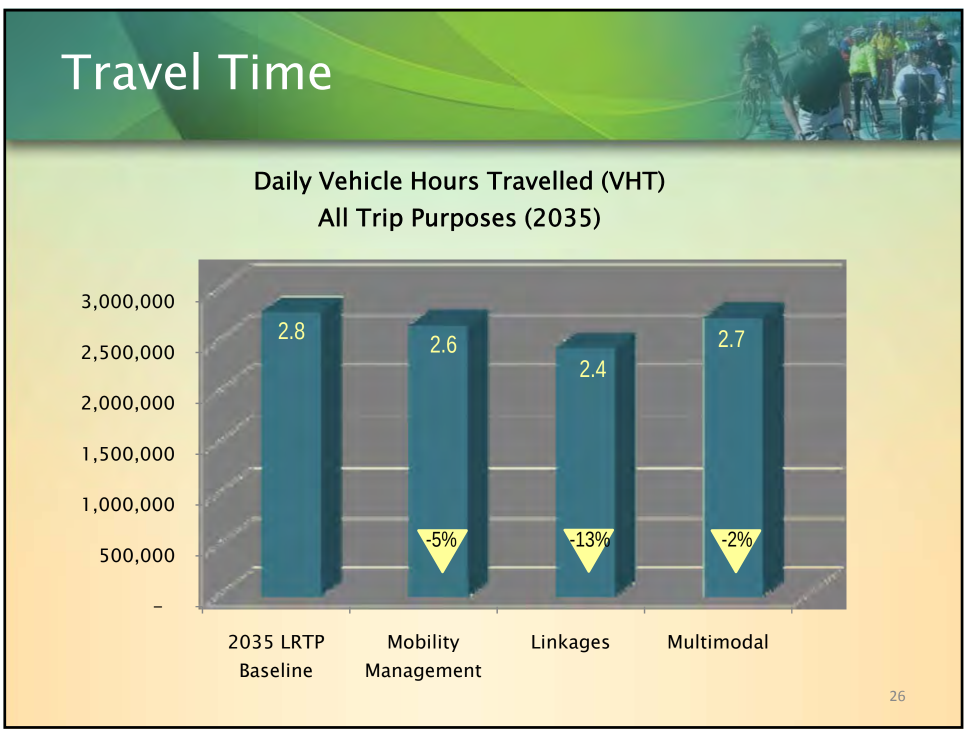
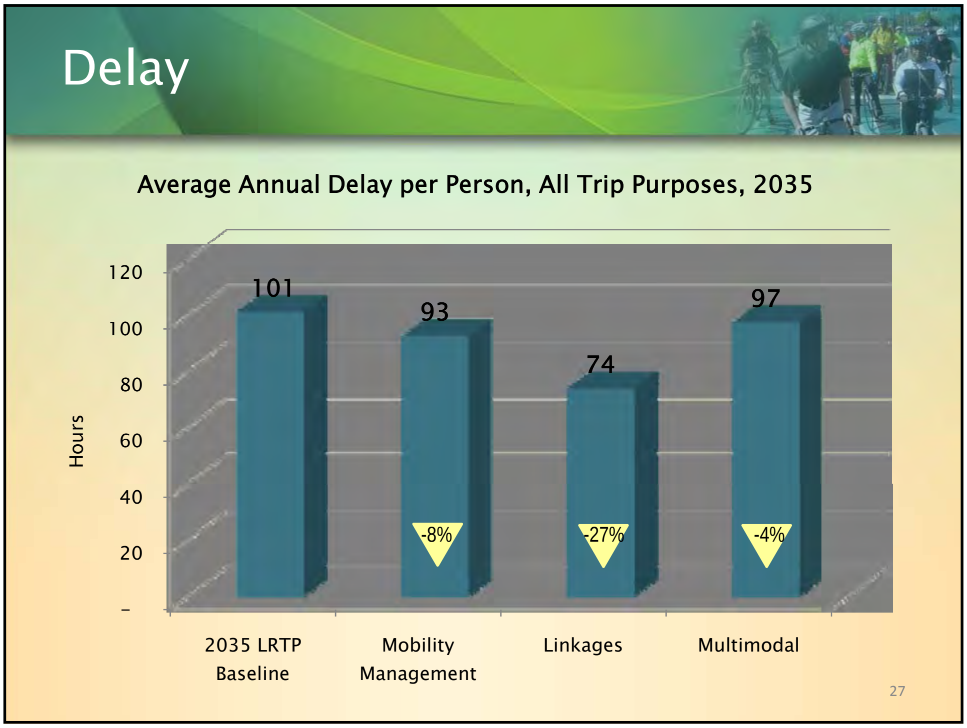
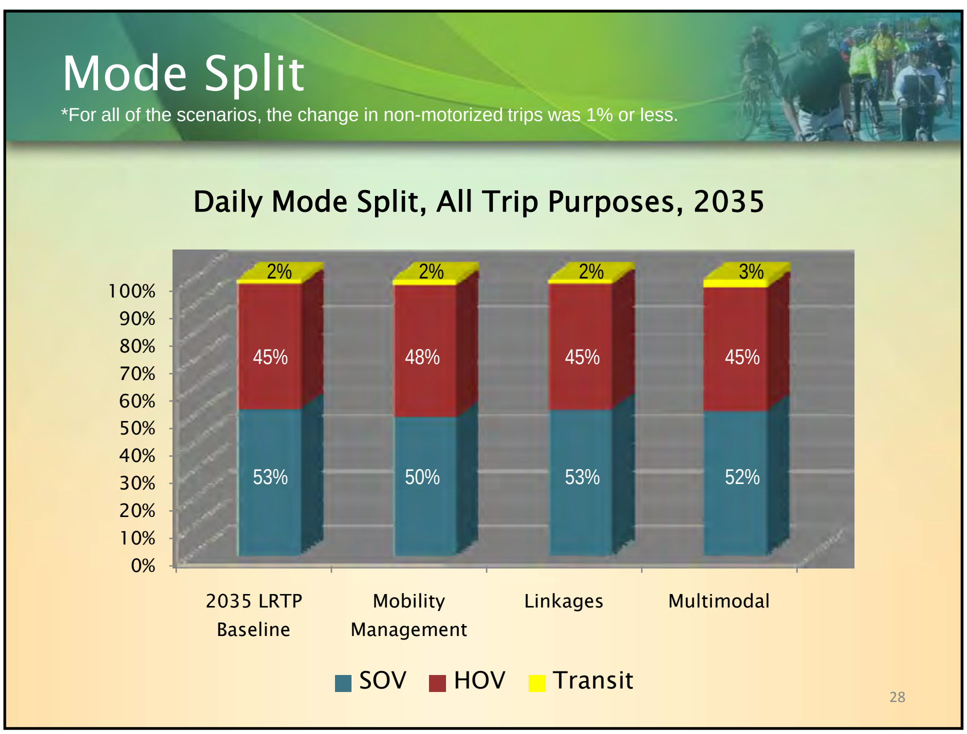
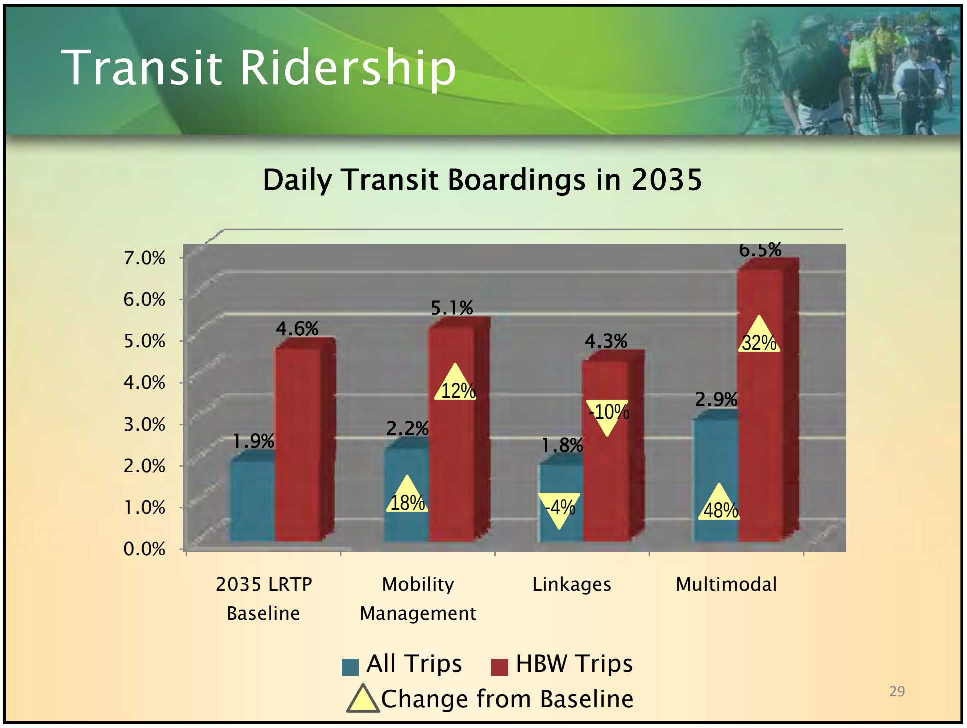
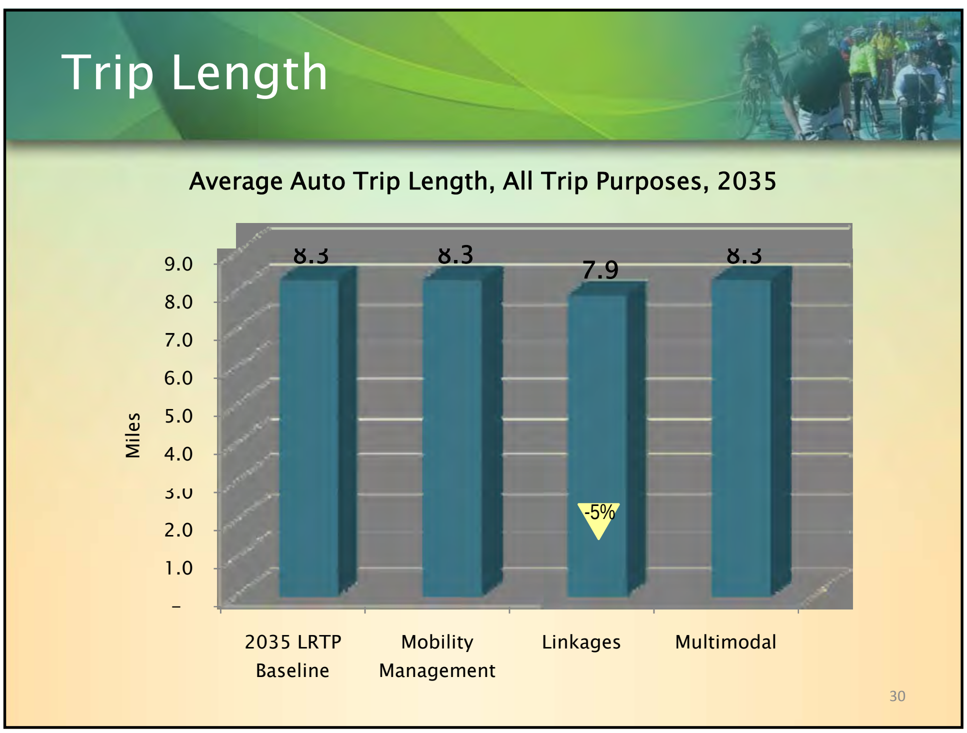

Travel Demand
Daily Vehicle Miles Travelled, All Trip Purposes (2035)
60,000,000
50,000,000
40,000,000
30,000,000
20,000,000
10,000,000
0
65.4
62.9
61.3
64.7
-4%
-6%
-1%
2035 LRTP Baseline
Mobility Management
Linkages
Multimodal
25


Travel Time
Daily Vehicle Hours Travelled (VHT)
All Trip Purposes (2035)
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
–
2.8
2.6
2.4
2.7
-5%
-13%
-2%
2035 LRTP Baseline
Mobility Management
Linkages
Multimodal
26


Delay
Average Annual Delay per Person, All Trip Purposes, 2035
Hours
120
100
80
60
40
20
–
101
93
74
97
-8%
-27%
-4%
2035 LRTP Baseline
Mobility Management
Linkages
Multimodal
27


Mode Split
*For all of the scenarios, the change in non-motorized trips was 1% or less.
Daily Mode Split, All Trip Purposes, 2035
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2%
2%
2%
3%
45%
48%
45%
45%
53%
50%
53%
52%
2035 LRTP Baseline
Mobility Management
Linkages
Multimodal
SOV
HOV
Transit
28

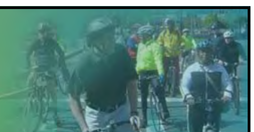

Transit Ridership
Daily Transit Boardings in 2035
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
1.9%
4.6%
2.2%
5.1%
18%
12%
1.8%
4.3%
-4%
-10%
2.9%
6.5%
48%
32%
2035 LRTP Baseline
Mobility Management
Linkages
Multimodal
All Trips
HBW Trips
Change from Baseline
29


Trip Length
Average Auto Trip Length, All Trip Purposes, 2035
Miles
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
–
8.3
8.3
7.9
8.3
-5%
2035 LRTP Baseline
Mobility Management
Linkages
Multimodal
30

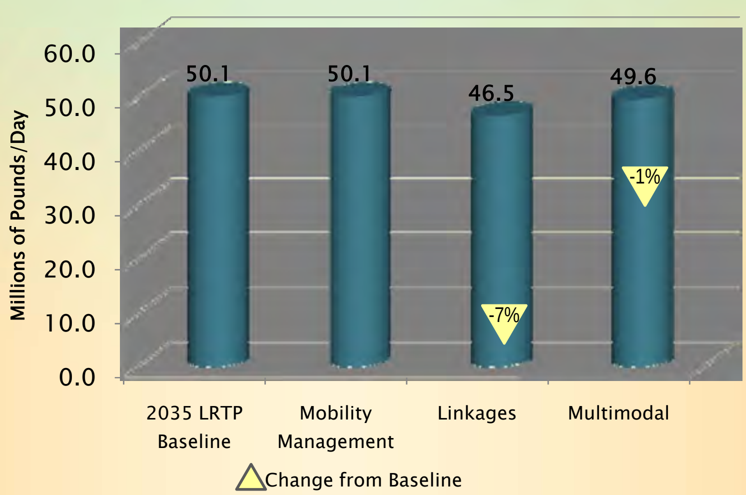
QUESTIONS OR COMMENTS?

31

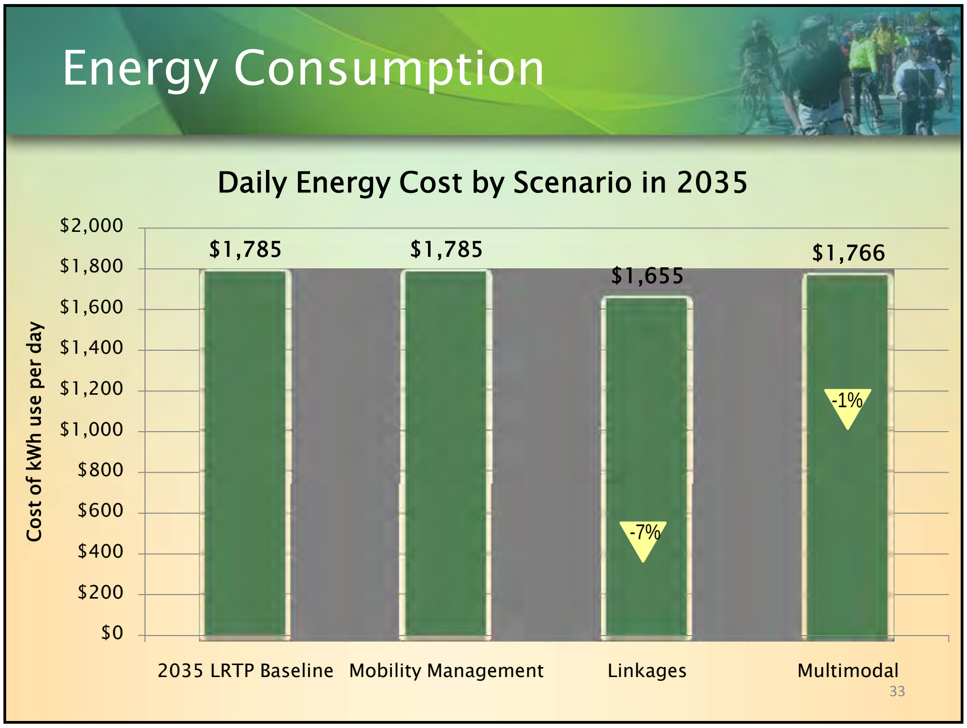
Greenhouse Gas Emissions

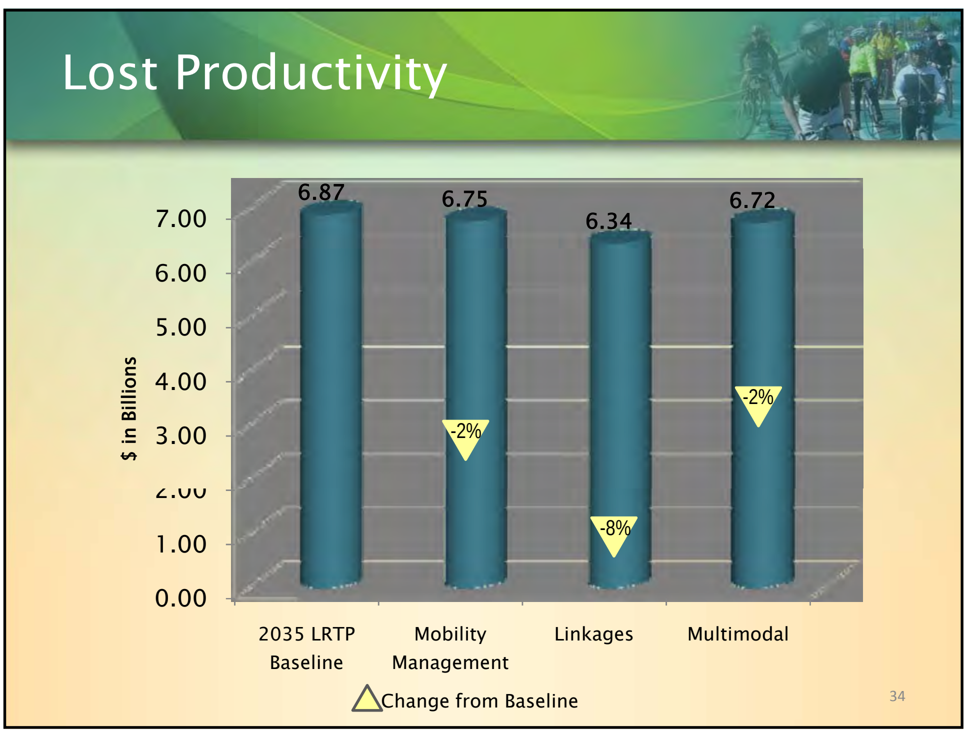


CO_2 Emissions (lbs/day), 2035



32


Energy Consumption
Daily Energy Cost by Scenario in 2035
Cost of kWh use per day
$2,000
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$0
$1,785
$1,785
$1,655
$1,766
-7%
-1%
2035 LRTP Baseline
Mobility Management
Linkages
Multimodal
33

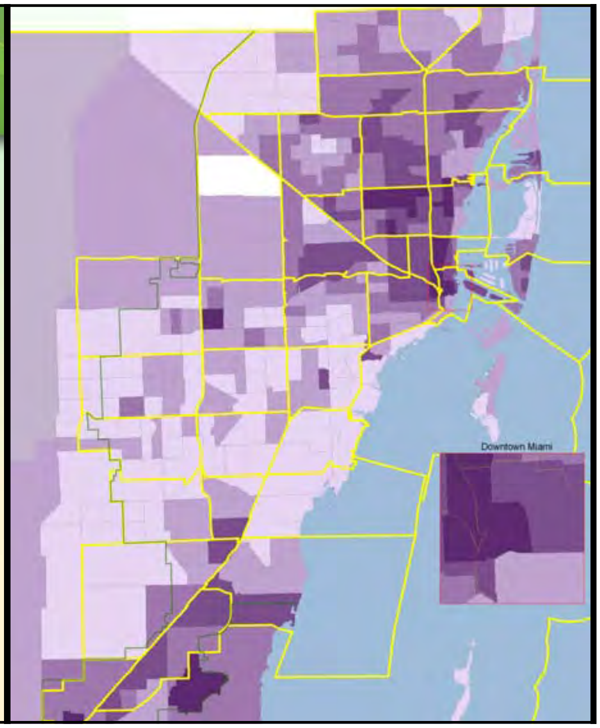

Lost Productivity
$ in Billions
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
6.87
6.75
6.34
6.72
-2%
-8%
-2%
2035 LRTP Baseline
Mobility Management
Linkages
Multimodal
Change from Baseline
34

Equity

- Low-income population
- 18% of County population is below poverty level
- Darker color indicates higher proportion of low-income persons in area

Census Tracts Population
% Below Poverty Level

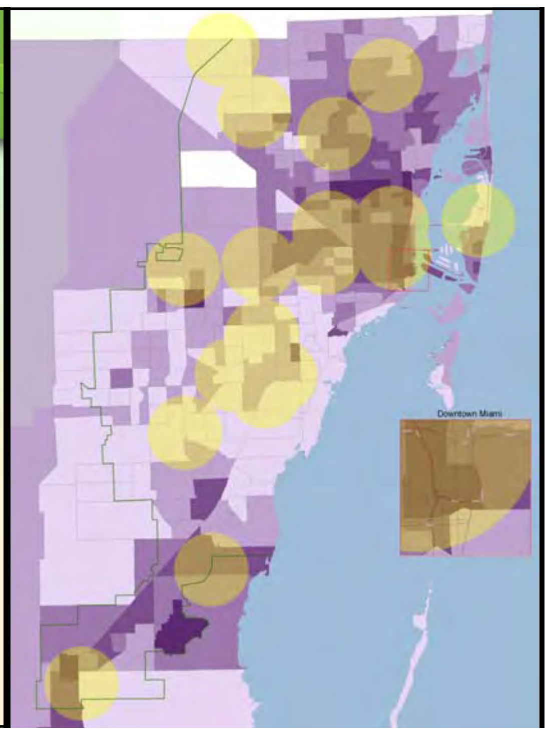
0% - 9%
10% - 17%
18% - 28%
29% - 44%
45% - 70%
No Population



Equity

Mobility Management

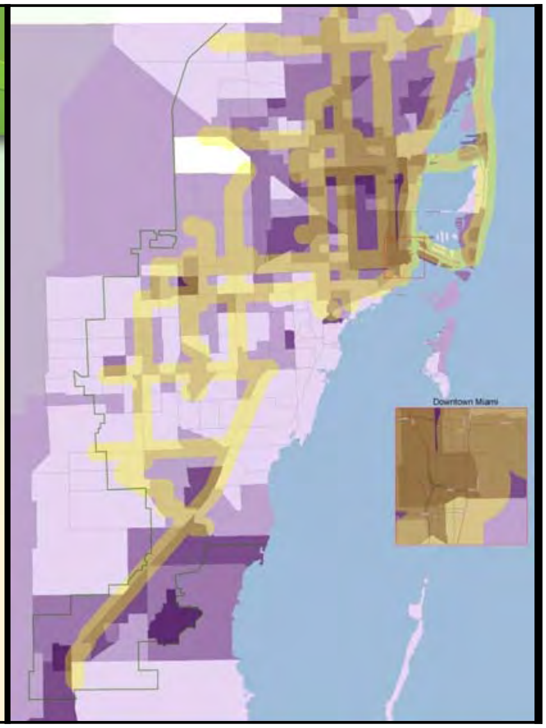
- 2 mile buffer from proposed express bus and managed lanes access points



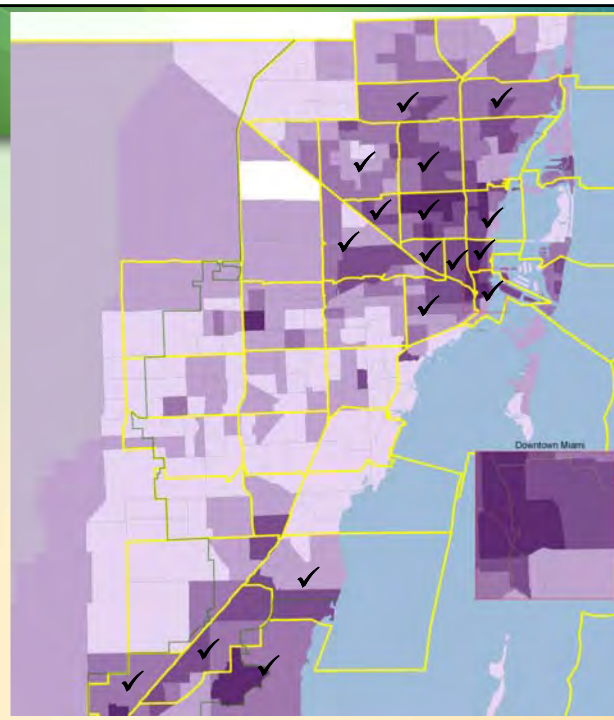
Equity

Multimodal

- 1/2 mile buffer from arterial BRT

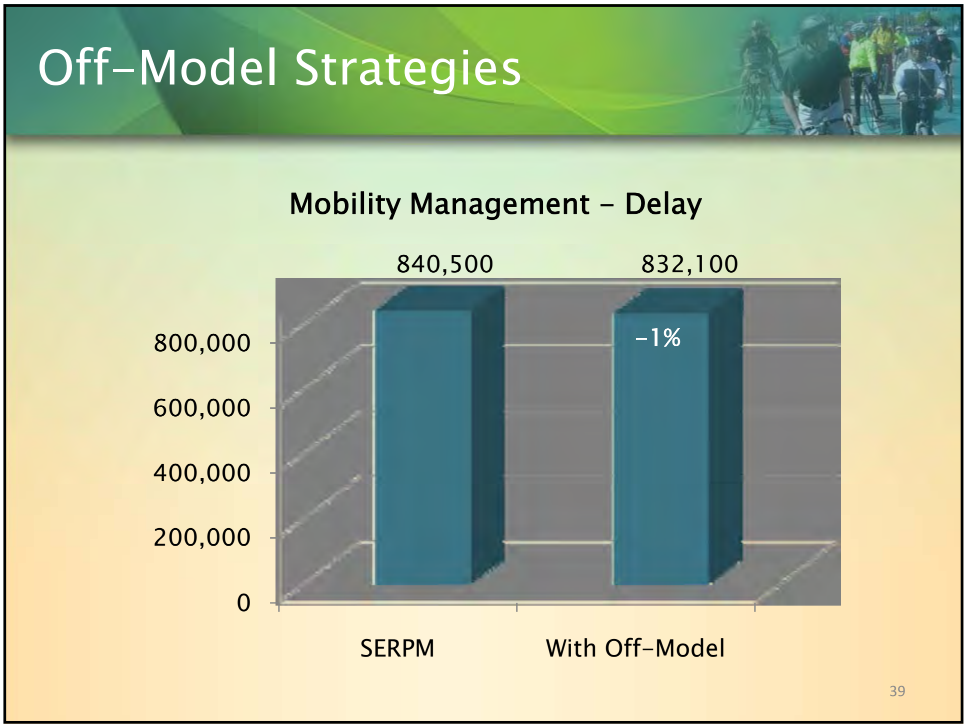


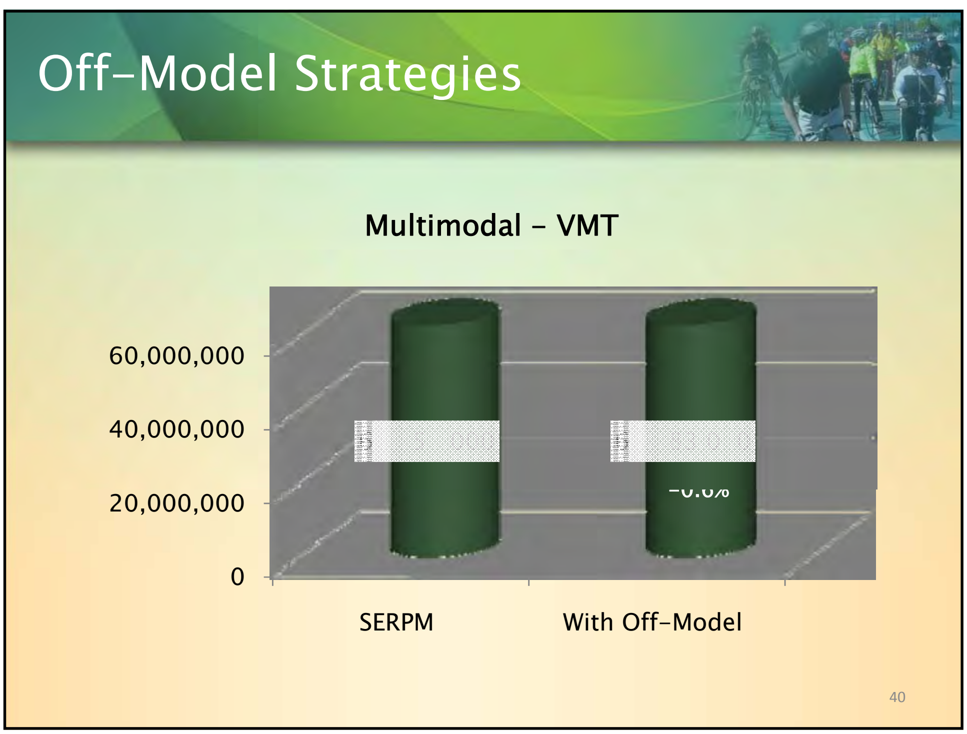
Equity



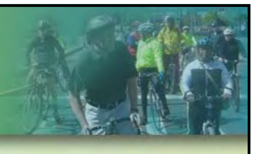
Linkages

- 51,000 jobs added to areas indicated
- Represents 12% of the reallocated employment growth


Off-Model Strategies
Mobility Management - Delay
840,500
832,100
-1%
800,000
600,000
400,000
200,000
0
SERPM
With Off-Model
39


Off-Model Strategies
Multimodal - VMT
60,000,000
40,000,000
20,000,000
0
SERPM
With Off-Model
40

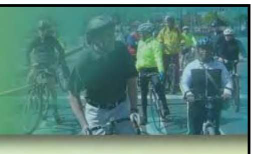
Aspirational Targets



Measure	Vehicle Miles Travelled	Bike & Pedestrian Trips	Transit Ridership	Single Occupancy Vehicles
*Targets**	*TBD*	*TBD*	*TBD*	*TBD*
Mobility Management	-4%	No change	+18%	-6%
Linkages	-6%	No change	-4%	-2%
Multimodal	-1%	No change	+55%	-1%
*Compared to baseline of 2035 LRTP				

QUESTIONS OR COMMENTS?

Cost/Revenue Analysis



Mobility Management Methodology

Managed Lanes

Capital Costs

Low end: I-95 Managed Lanes @ $16 million/mile

High end: Assumes additional contingency and soft costs

Annual O&M Costs

I-95 Managed Lanes – ~49% of revenue going towards O&M

Annual Revenue

Low end: All HOV2+ are registered and do not pay tolls

High end: All HOV2+ pay tolls

43

Mobility Management Methodology

Express Bus

Capital Costs for 60 ft. articulated bus

Low end unit cost: $800,000 (Characteristics of BRT for Decision Making, FTA)

High end unit cost: $950,000 (MDT)

O&M Costs

Low end: $90/revenue hour (MDT)

High end: $123/revenue hour (MDT)

Annual Revenue

Fare box collection: TBD

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Mobility Management Methodology

Parking

<u>Capital Costs</u>

$12,000 – $25,000 per unit
(Tri-Rail Parking Management Study, 2010)

<u>Annual O&M</u>

Miami Parking Authority FY 2010 Annual Report

<u>Annual Revenue</u>

Long-term parking revenue used Home Based Work trips

Short-term parking revenue used Home Based Work, Non-Home Based and Home Based Other trips

45

Mobility Management Results

Total Capital Costs = $1.5–$2.8 billion that buys:

- 356 lane miles of Managed Lanes ($1.4B – $2.7B)
- Seven (7) new Express Bus Routes ($101M – $120M)
  - 279 route miles of new service
  - 700 revenue hours daily
  - 12,300 revenue miles daily
  - 6,500 daily riders
  - 126 articulated buses
- 120 Parking Meters ($1.4M – 3.0M)

Annual O&M Cost = $92–$221 million

Annual Revenue Generation = TBD

46

Mobility Management Results

Annual O&M Cost = $92–$221 million

- Managed Lanes ($39M – $114M)
- Express Bus Routes ($16M – $22M)
- Parking ($37M – $85M)

Annual Revenue Generation = TBD

- Managed Lanes ($80M - $233M)
- Express Bus Routes (TBD)
- Parking ($147M – $169M)

47

Multimodal Methodology

Arterial Bus Rapid Transit (BRT)

<u>Capital Costs</u> for 60 ft. articulated bus
Low end: $800,000 (Characteristics of BRT for Decision Making, FTA, 2009)
High end: $950,000 (MDT)

<u>Annual O&M Costs</u>
Low end: $90/revenue hour (MDT)
High end: $123/revenue hour (MDT)

<u>Annual Revenue</u>
TBD

48

Multimodal Methodology

Transit Signal Priority (TSP)*

Capital Costs
$900–$1,100 per emitter
$10,800–$14,000 for receiver, phase selector, control box and controller

O&M Costs
$475–$610 per year

Real Time Passenger Information*

Capital Costs
$4,000–$10,000, including electronic display signs at bus shelters

O&M Costs
$1,160–$2,900 per year

*Source: Characteristics of BRT for Decision Making, FTA, 2009)

49

Multimodal Methodology

Park-and-Ride Lots

Capital Costs*

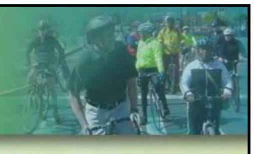
Surface parking:	$5,000–$7,500 per space
Structured parking:	$18,000–$20,000 per space

Annual O&M Costs*

Surface parking:	$250–$375 per space
Structured parking:	$900–$1,250 per space

*Source: Industry Standards

50



Multimodal Results

Total Capital Costs = $61–$90 million that buys:

- 16 Arterial Bus Rapid Transit Routes ($14M – $17M)
  - 549 route miles of A-BRT service
  - 4,100 revenue hours daily
  - 51,900 revenue miles daily
  - 279,000 daily riders
  - 18 additional articulated buses
- **Transit Signal Priority** ($29M - $38M)
  - On-board e ui ment for the entire 1 200 buses
  - 2,600 signalized intersections
- **Real Time Passenger Information** ($4M - $11M)
  1,000 bus shelters equipped with electronic display signs
- **Park-and-Ride Lots** ($13M - $34M)
  1,500 parking spaces

51

Multimodal Results

Annual O&M Cost = TBD million

Arterial BRT (TBD)

Transit Signal Priority ($1M - $1.5M)

Real Time Passenger Information ($1M - $3M)

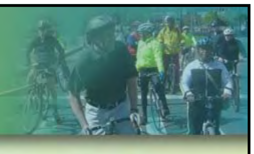
Park-and-Ride Lots ($0.7M - $1M)

Annual Revenue Generation = TBD

Arterial BRT (TBD)

52

Cost/Revenue Analysis



	Mobility Management		Multimodal	
	Low	*High*	*Low*	*High*
Capital Costs	$1.5 billion	$2.8 billion	$61 million	$90 million
Annual Revenue	$229 million	$403 million	TBD	TBD
Annual O&M Costs	$92 million	$221 million	TBD	TBD

All costs and revenues are in 2011 dollars.

Cost and revenue for Linkages were not calculated because there were no associated improvements.

QUESTIONS OR COMMENTS?

How will this information be used?

- Results can be used in upcoming studies, including:
  - Southeast Florida 2060 (SFRPC & TCRPC)
  - Managed lanes (MPO)
  - Parking rate study (FDOT)
  - Comprehensive planning activities (DPZ & cities)

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Thank You

Strategies for Integration of Sustainability and the Transportation System
Study Advisory Committee (SAC) Meeting - October 12, 2011
Sign-in Sheet

Name	Signature	E-mail ID	Phone	Address	Agency
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Medina, Lilia		limedina@miamigov.com			City of Miami
Pandya, Bhairvi		bpandya@miamigardens-fl.gov			Miami Gardens
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Samson, Kim		kim.samson@dot.state.fl.us			Turnpike
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Somoza, Napoleon		NVS@miamidade.gov			DP&Z
Steinmiller, Phil		phil.steinmiller@dot.state.fl.us			FDOT
Griner, Debbie ~~Torriente, Susanne M.~~ for OOS (SPEED)	Debbie G.	grinerd@miamidade.gov ~~SUSY@miamidade.gov~~			OOS
Villaamil, Vivian		vvillaamil@dadeschools.net			School Board

Name	Signature	E-mail ID	Phone	Address	Agency
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Niiia Cartaya	[illegible]	cartayn@miamidade.gov			MDT
Lynda Weston	[illegible]	westonl@sfrta.fl.gov	(954) 788-7923	800 NW 33rd St, Pompano, FL	SFRTA
Ganni Lodi	[illegible]	glodi@miamidade.gov	305-375-2341		MD - SPEED

Strategies for Integration of

Sustainability and Transportation System

Transportation Planning Council (TPC) Meeting

MIAMI-DADE COUNTY/ MPO

Study Purpose

To identify and evaluate strategies to improve the sustainability of Miami-Dade County's transportation system *with an emphasis on accommodating future travel needs using transportation demand management strategies.*

2

Detailed Study Plan & Schedule

Where we are in the Study Process?

Activity	Year 2010 - 2011											
	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov
Preliminary Literature Review Results		SAC Meetin										
Final Literature Review Tech. Memo.			De iverable									
Screening Analysis Tech. Memo.				Deliverable								
Selection of Scenarios						SAC Meetin						
Scenario Descriptions Tech. Memo.						Deliverable	TPC Meet ng					
Scenario Evaluation: Modeling												
Scenario Evaluation: Identification of Secondary Impacts												
Scenario Evaluation: Order of Magnitude Costs										SAC Meeting		
Scenario Evaluation Results Tech. Memo.											Del verable	
Draft Study Document/Executive Summary												Del verable

Note: TPC Meeting in Dec. 2011 on study completion

3

Literature Review

4

Sustainable Transportation Strategies

Category	General Strategy
Pricing/Behavior	Manage traffic & congestion
	Promote education and involvement of all transportation stakeholders
Efficient Resource Utilization	Support improvements in public transportation
	Link transportation & land use in transportation plans
	Prioritize highway repair and safety performance v/s new capacity
Pedestrian/Bicycle Zones	Support non-motorized transportation

5

Definition of Sustainable Transportation

For the purpose of this study, sustainable transportation means:

A transportation system that is able to meet today's needs and those of the future using the existing and committed infrastructure identified in the 2035 Long Range Transportation Plan.

6

Sustainable Transportation Strategy

Screening Methodology

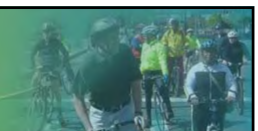
Tier One – Agreement with Local Plans

- 2006 Florida Strategic Highway Safety Plan, FDOT
- 2025 Florida Transportation Plan, FDOT
- 2035 Long Range Transportation Plan, MPO
- 2035 Long Range Transportation Plan, SEFTC
- Comprehensive Development Master Plan (CDMP)
- GreenPrint, Office of Sustainability
- Miami-Dade Expressway Authority (MDX)
- South Florida Regional Freight Plan, SEFTC
- Transit-Development Plan FY 2010-2020, MDT

7

Sustainable Transportation Strategy

Screening Methodology



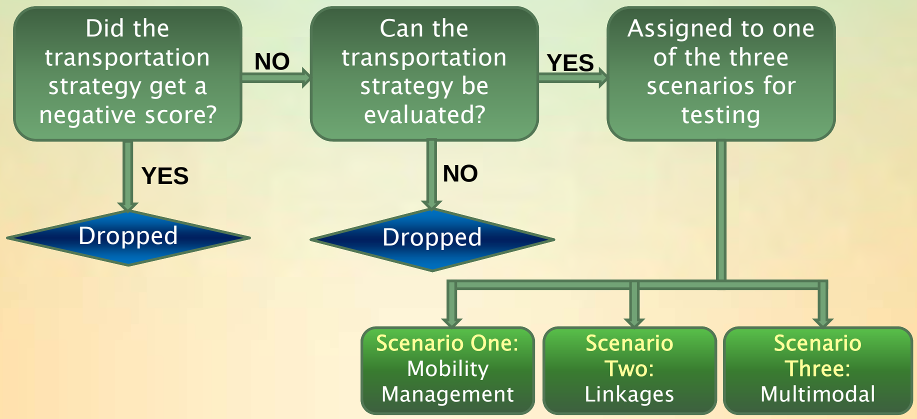
Tier Two – Prioritization within Local Context

- Conducted SWOL Analysis
  (Strength, Weakness, Opportunities, Limitation)
- Conducted online survey
  - SAC members
  - Project team members
- Assigned scores based on:
  - Effectiveness
  - Ease of Implementation
  - Appropriateness

Score	Performance
3	Excellent
2	Very Good
1	Good
0	Fair
-1	Poor
-2	Very Poor
-3	Unacceptable

8

Scenario Development Methodology



9

Scenario One: Mobility Management

Goal: Improving travel time and speeds for all vehicles.

Model based strategies
- Fare policy (transit)
- Parking management (Variable Parking Pricing)
- Advanced arterial signal systems
- Variable pricing (Managed lanes/HOT lanes)

Off-model strategies
- Motorist information systems
- Freight operations

10

Scenario Two: Linkages

Goal: Shortening trip lengths and reducing auto-dependence b im rovin_ the land use and trans ortation connection.

Model based strategies

- Smart Growth
- Transit oriented development (TOD)

Off-model strategies

- Complete Streets
- Biking initiatives/programs

Scenario Three: Multimodal

Goal: Improving passenger experience to encourage greater use of public transportation and increasing vehicle occupancy.

Model based strategies

- Park-and-ride lots
- Improved rider information /bus shelters
- Transit signal priority
- Arterial bus rapid transit (BRT)

Off-model strategies

- Vanpool/carpool
- Telecommuting
- Car-sharing
- Parking cash-out programs

Scenario Evaluation

Performance Measures

- **Southeast Re¸ional Plannin¸ Model ¸SERPM 6.5¸**
  - Vehicle miles traveled (VMT)
  - Vehicle hours traveled (VHT)
  - Single-occupant vehicle (SOV) travel
  - Delay
  - Transit ridership
  - Average trip length by trip purpose

- **Spreadsheet & GIS based tools**
  - Air Quality & GHG emission
  - Transport cost (commute cost)
  - Loss of economic productivity
  - Equity

13

Thank You

Strategies for Integration of
Sustainability and Transportation System

Transportation Planning Council (TPC) Meeting

Study Purpose

- To investigate sustainable transportation strategies and their effect on travel behavior.
- Three strategy scenarios were developed for this purpose.

2

Scenarios

Mobility Management

Emphasis: Effect of pricing policies on travel behavior.

Strategies: System of Managed Lanes
Express Buses
Increased Parking Costs

Linkages

Emphasis: Improving transportation and land use connection.

Strategies: Reallocation of Employment and Population Growth between 2015 and 2035
Adjusting Jobs-Housing Balance
Urban Infill

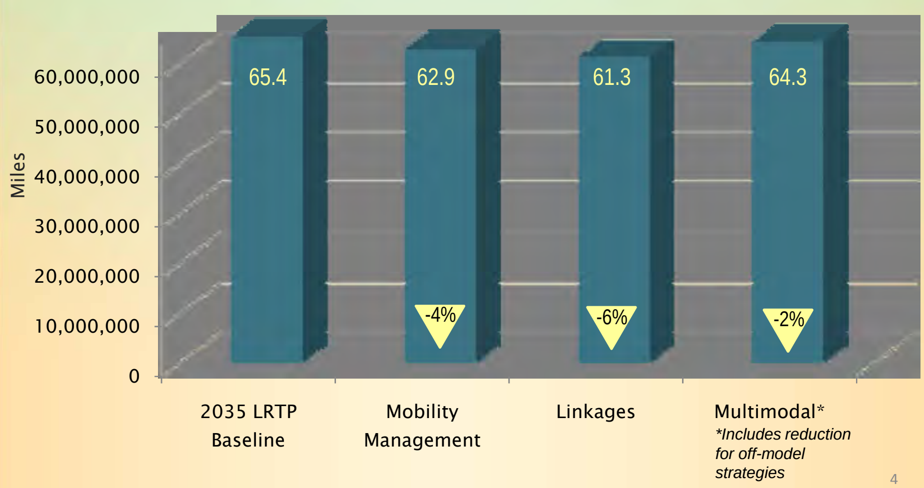
Multimodal

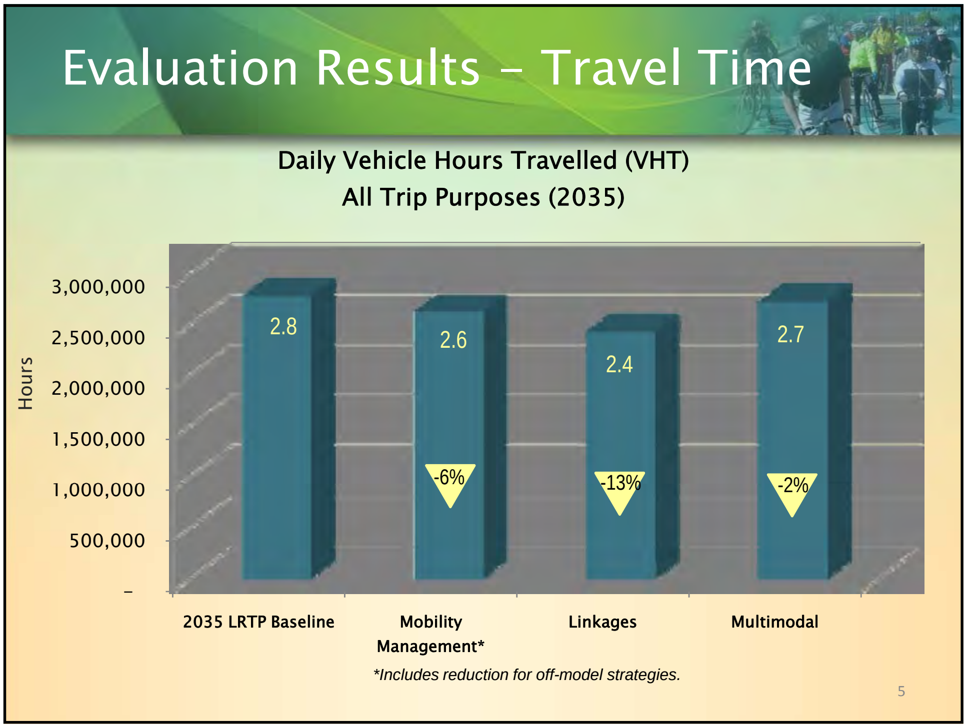
Emphasis: Improving transit rider experience.

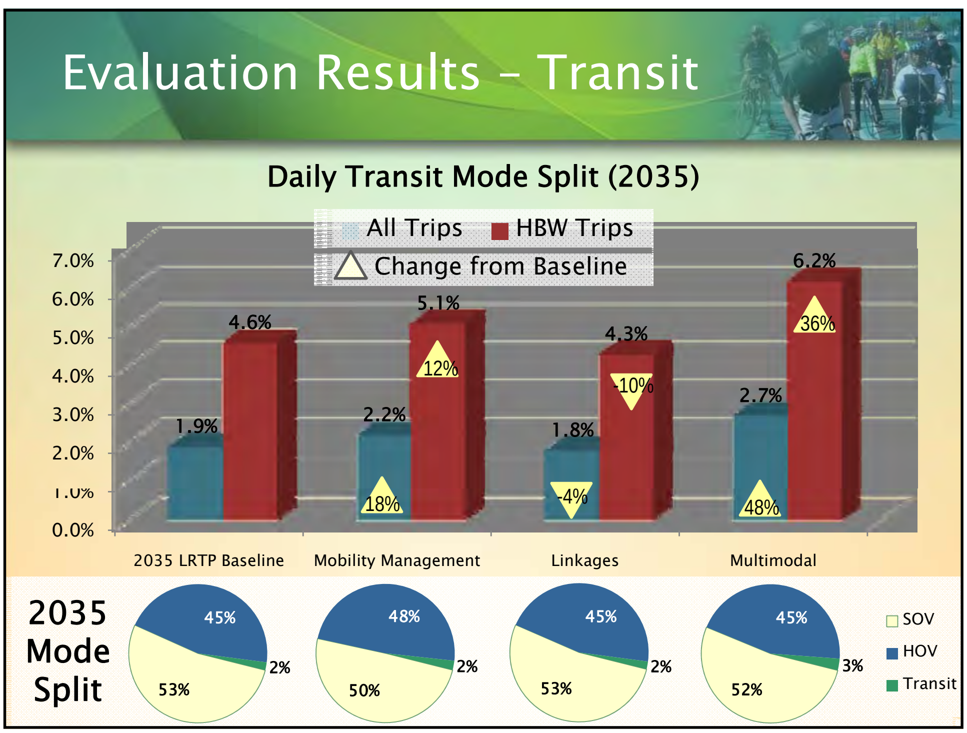
Strategies: Arterial Bus Rapid Transit Network
Transit Signal Priority
Improved Stations
Park-and-Ride Lots

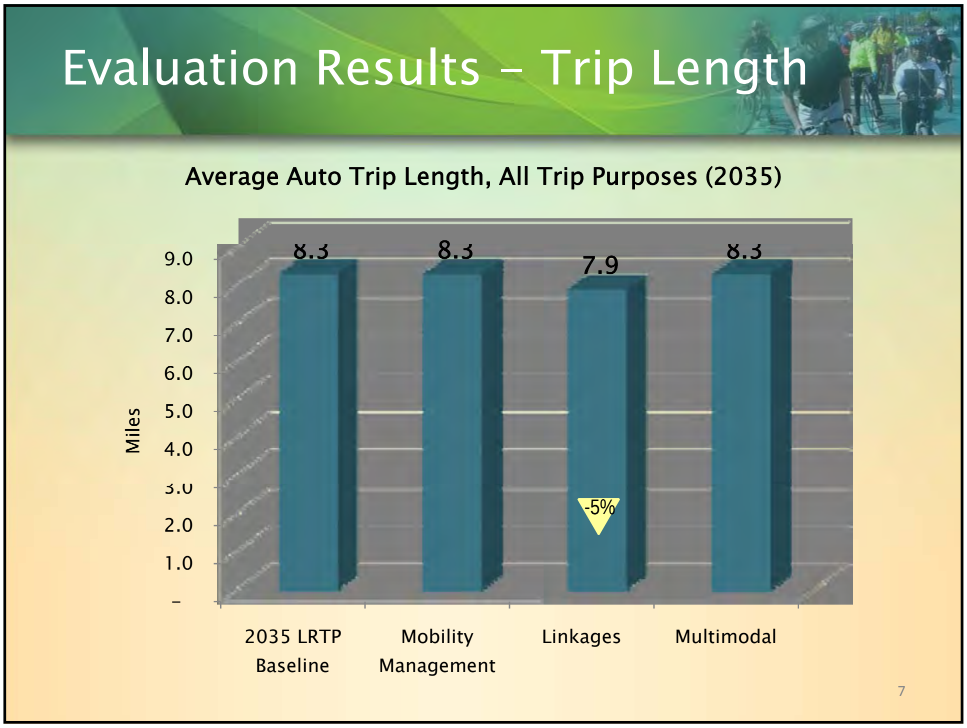
Evaluation Results –Travel Demand

Daily Vehicle Miles Traveled, All Trip Purposes (2035)

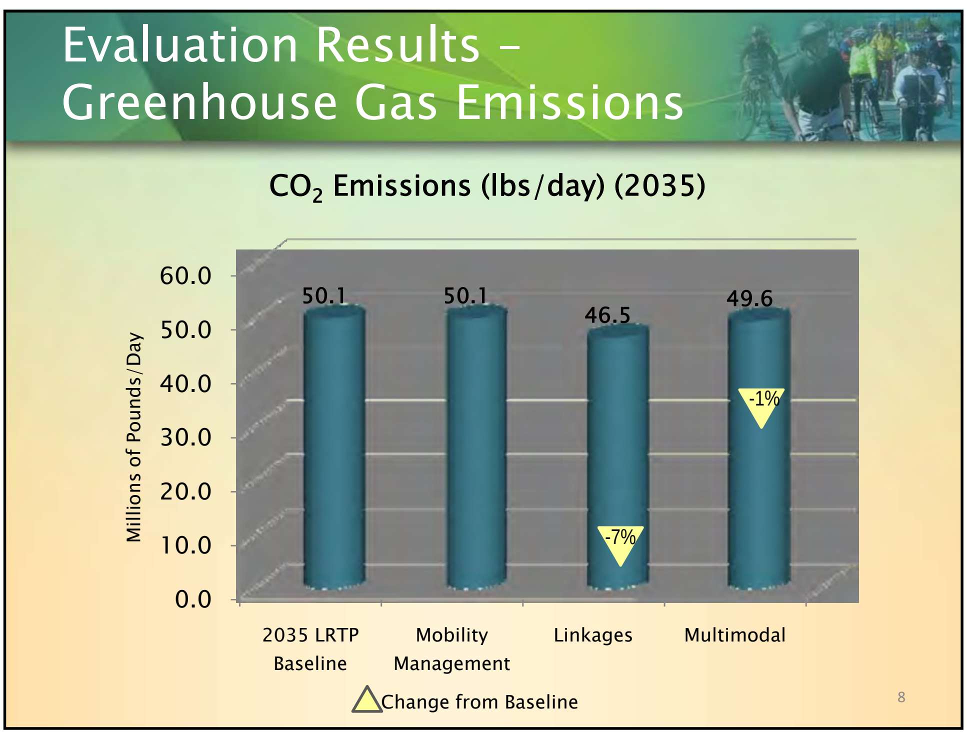



Evaluation Results – Travel Time
Daily Vehicle Hours Travelled (VHT)
All Trip Purposes (2035)
Hours
3,000,000
2,500,000
2,000,000
1,500,000
1,000,000
500,000
–
2.8
2.6
2.4
2.7
-6%
-13%
-2%
2035 LRTP Baseline
Mobility Management*
Linkages
Multimodal
*Includes reduction for off-model strategies.
5


Evaluation Results – Transit
Daily Transit Mode Split (2035)
All Trips
HBW Trips
Change from Baseline
7.0%
6.0%
5.0%
4.0%
3.0%
2.0%
1.0%
0.0%
1.9%
4.6%
2.2%
5.1%
1.8%
4.3%
2.7%
6.2%
18%
12%
-4%
-10%
48%
36%
2035 LRTP Baseline
Mobility Management
Linkages
Multimodal
2035 Mode Split
45%
53%
2%
48%
50%
2%
45%
53%
2%
45%
52%
3%
SOV
HOV
Transit

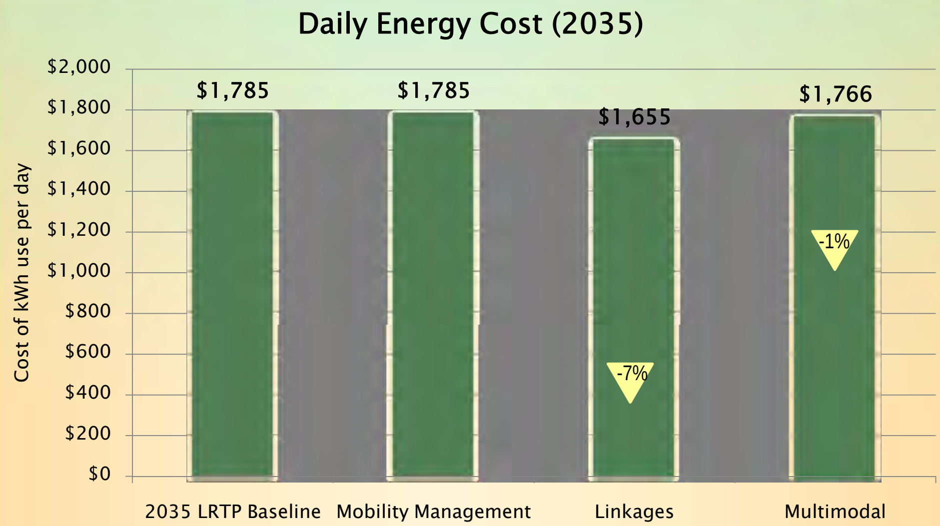


Evaluation Results – Trip Length
Average Auto Trip Length, All Trip Purposes (2035)
Miles
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
–
8.3
8.3
7.9
8.3
-5%
2035 LRTP Baseline
Mobility Management
Linkages
Multimodal
7



Evaluation Results – Greenhouse Gas Emissions
CO_2 Emissions (lbs/day) (2035)
Millions of Pounds/Day
60.0
50.0
40.0
30.0
20.0
10.0
0.0
50.1
50.1
46.5
49.6
-7%
-1%
2035 LRTP Baseline
Mobility Management
Linkages
Multimodal
Change from Baseline
8

Evaluation Results – Energy Consumption



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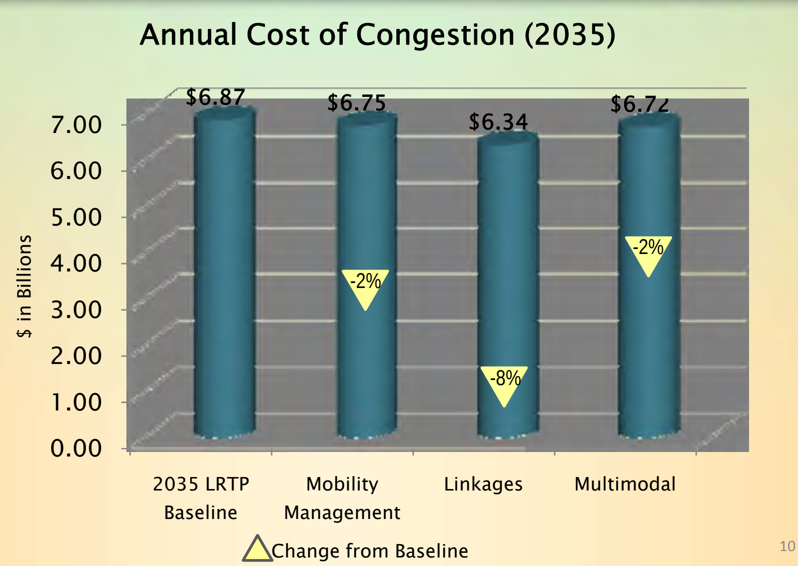
Evaluation Results – Lost Productivity



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Aspirational Targets

Measure	Vehicle Miles Travelled	Bike & Pedestrian Trips	Transit Ridership	Single Occupancy Vehicles
*Targets**	*-25%*	*+30%*	*+50%*	*-25%*
Mobility Management	-4%	No change	+18%	-6%
Linkages	-6%	No change	-4%	-2%
Multimodal	-2%	No change	+48%	-1%
*Compared to baseline of 2035 LRTP				

Mobility Management Cost/Revenue Results

Total Capital Costs: $1.5-$2.8 billion that buys:
- 356 lane miles of Managed Lanes ($1.4B-$2.7B)
- Seven (7) new Express Bus Routes ($101M $120M)
- 120 Parking Meters ($1.4M-$3.0M)

Annual O&M Cost: $92-$221 million
- Managed Lanes ($39M-$114M)
- Express Buses ($16M-$22M)
- Parking ($37M-$85M)

Annual Revenue Generation: $228-$404 million
- Managed Lanes ($80M-$233M)
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Multimodal Results

Total Capital Costs: $61-$90 million that buys:

- 16 Arterial Bus Rapid Transit Routes ($14M – $17M)
- Transit Signal Priority ($29M $38M) 1,200 buses and 2,600 intersections
- Real Time Passenger Information ($4M – $11M) 1,000 shelters
- Park-and-Ride Lots ($13M – $24M) 1,500 parking spaces

Annual O&M Cost: $14-$21 million

- Arterial BRT ($11M-$15M incremental over 2035 LRTP Baseline)
- Transit Signal Priority ($1M-$1.5M)
- Real Time Passenger Information ($1M-$3M)
- Park-and-Ride Lots ($0.7M-$1M)

Annual Revenue Generation: $2.5-$4 million

- Fare Box Revenues ($2.5M-$4M incremental over 2035 LRTP Baseline)

13

Conclusion

- Aspirational targets are too aggressive
- Affecting VMT, VHT, and ridership on a countywide basis is extremely difficult
- Results can be used in upcoming studies, including:
  - Southeast Florida 2060 Vision Plan (SFRPC & TCRPC)
  - Regional Managed Lanes (MPO)
  - Parking Rate Study (FDOT)
  - Comprehensive planning activities (DPZ & cities)

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Thank You

Comments from SAC members outside of SAC Meetings

Department of Planning and Zoning and the Office of Sustainability - June 2011

- Commented on the study purpose and scope of work; concept of sustainability in broader context; explained their understanding of Mobility Management or Transportation Demand Management (TDM) and various TMD strategies to improve the efficiency of the transportation system. Per the Department the ultimate goal of the study should be to develop a method for incorporating sustainability into the long range transportation planning process. TDM should be just one component of the sustainability standards.

- Given the revenue availability vis-à-vis revenue needed to accomplish all the transportation needs in the County, the 2035 Cost Feasible Plan (LRTP) had limited potential to become multimodal and sustainable. Recommended expanding the definition of sustainability by adopting an accepted definition from a state or federal transportation agency or working up a couple of options in between too narrow and too broad for the SAC to consider again. Suggested using the following factors as a guide for the development of sustainable transportation strategies:
    - National Strategy to Reduce Congestion on America's Transportation Network
    - SAFETEA-LU planning factors
    - Federal Livability Principles as guiding principles
    - Six (6) guiding principles from interagency partnership between U.S. HUD, U.S. DOT, and U.S. EPA.

- Inspirational Targets for Tier Two Evaluation: We don't recommend extrapolating them out because the GreenPrint 2015 goal of 10% increase in ridership was estimated based on the ridership increases to be gained from the Airport Link, Enhanced Bus Corridors, and a couple other initiatives.

- Scenario One: Mobility Management: Reconsider using the following strategies from the dropped strategies: Grade Separation and Intersection Improvements.

- Scenario Three: Multimodal: Recommend including Transit Fare Policy and Variable Parking Pricing in this scenario.

Sustainability, Planning and Economic Enhancement Department - December 2011.

- Provide a clear context for the definition of sustainable transportation: The definition of Sustainable Transportation should consider a broader context, including social, environmental and economic needs (the three pillars of sustainability) necessary to meaningfully integrate sustainability into the transportation system. This will also align this definition with that of "sustainability" used in other County's planning documents (GreenPrint and CDMP).

- As stated during the SAC meetings, the proposed 2015 GreenPrint (GP) targets can be referenced but shall not be extrapolated.

- Add “next steps” to the Summary section including recommended UPWP funded studies to support and further the integration of sustainability into transportation planning and programming.

City of North Miami - December 2011

- Congratulated the consultant and the MPO on an excellent piece of research. Suggested discussing the finding of this study at APA or ITE conferences, schools, and other venues. The Study explored what *could* be accomplished, or not, by following certain pronouncements and policies.

Miami Dade Expressway Authority – December 2011

- The scenario of managed lanes within MDX’s existing system is not in the agency’s future plans and is in conflict with our existing toll policy. Requested to remove any reference to MDX to that effect from the study presentations and final report.

APPENDICES.

Appendix B – Transportation Planning Commitee (TPC) Presentation

Strategies for Integration of

Sustainability and Transportation System

Transportation Planning Council (TPC) Meeting

MIAMI-DADE COUNTY/ MPO

June 6, 2011

1

Study Purpose

To identify and evaluate strategies to improve the sustainability of Miami-Dade County's transportation system *with an emphasis on accommodating future travel needs using transportation demand management strategies.*

2

Detailed Study Plan & Schedule

Where we are in the Study Process?

Activity	Year 2010 - 2011											
	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov
Preliminary Literature Review Results		SAC Meeting										
Final Literature Review Tech. Memo.			Deliverable									
Screening Analysis Tech. Memo.				Deliverable								
Selection of Scenarios						SAC Meeting						
Scenario Descriptions Tech. Memo.						Deliverable	TPC Meeting					
Scenario Evaluation: Modeling												
Scenario Evaluation: Identification of Secondary Impacts												
Scenario Evaluation: Order of Magnitude Costs										SAC Meeting		
Scenario Evaluation Results Tech. Memo.											Deliverable	
Draft Study Document/Executive Summary												Deliverable

Note: TPC Meeting in Dec. 2011 on study completion

3

Literature Review

4

Sustainable Transportation Strategies

Category	General Strategy
Pricing/Behavior	Manage traffic & congestion
	Promote education and involvement of all transportation stakeholders
Efficient Resource Utilization	Support improvements in public transportation
	Link transportation & land use in transportation plans
	Prioritize highway repair and safety performance v/s new capacity
Pedestrian/Bicycle Zones	Support non-motorized transportation

Definition of Sustainable Transportation

For the purpose of this study, sustainable transportation means:

A transportation system that is able to meet today's needs and those of the future using the existing and committed infrastructure identified in the 2035 Long Range Transportation Plan.

Sustainable Transportation Strategy

Screening Methodology

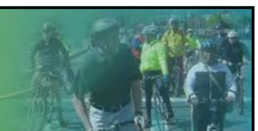
Tier One – Agreement with Local Plans

- 2006 Florida Strategic Highway Safety Plan, FDOT
- 2025 Florida Transportation Plan, FDOT
- 2035 Long Range Transportation Plan, MPO
- 2035 Long Range Transportation Plan, SEFTC
- Comprehensive Development Master Plan (CDMP)
- GreenPrint, Office of Sustainability
- Miami-Dade Expressway Authority (MDX)
- South Florida Regional Freight Plan, SEFTC
- Transit-Development Plan FY 2010-2020, MDT

7

Sustainable Transportation Strategy

Screening Methodology



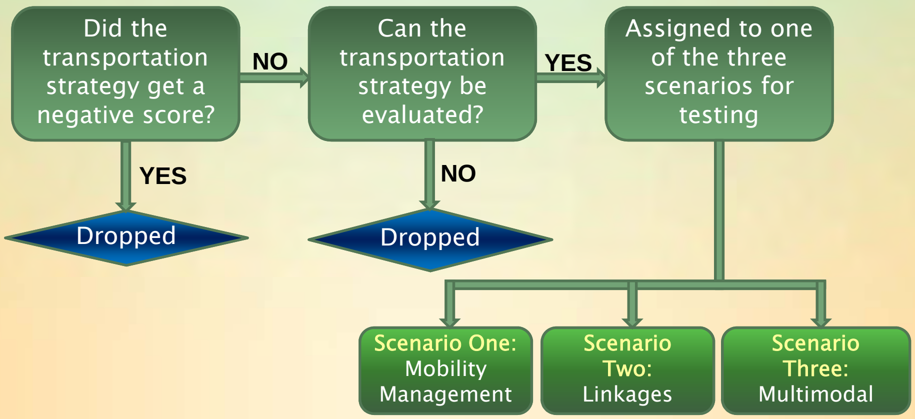
Tier Two – Prioritization within Local Context

- Conducted SWOL Analysis
  (Strength, Weakness, Opportunities, Limitation)
- Conducted online survey
  - SAC members
  - Project team members
- Assigned scores based on:
  - Effectiveness
  - Ease of Implementation
  - Appropriateness

Score	Performance
3	Excellent
2	Very Good
1	Good
0	Fair
-1	Poor
-2	Very Poor
-3	Unacceptable

8

Scenario Development Methodology



9

Scenario One: Mobility Management

Goal: Improving travel time and speeds for all vehicles.

Model based strategies
- Fare policy (transit)
- Parking management (Variable Parking Pricing)
- Advanced arterial signal systems
- Variable pricing (Managed lanes/HOT lanes)

Off-model strategies
- Motorist information systems
- Freight operations

10

Scenario Two: Linkages

Goal: Shortening trip lengths and reducing auto-dependence b im rovin_ the land use and trans ortation connection.

Model based strategies
- Smart Growth
- Transit oriented development (TOD)

Off-model strategies
- Complete Streets
- Biking initiatives/programs

Scenario Three: Multimodal

Goal: Improving passenger experience to encourage greater use of public transportation and increasing vehicle occupancy.

Model based strategies
- Park-and-ride lots
- Improved rider information /bus shelters
- Transit signal priority
- Arterial bus rapid transit (BRT)

Off-model strategies
- Vanpool/carpool
- Telecommuting
- Car-sharing
- Parking cash-out programs

Scenario Evaluation

Performance Measures

- **Southeast Regional Planning Model (SERPM 6.5)**
  - Vehicle miles traveled (VMT)
  - Vehicle hours traveled (VHT)
  - Single-occupant vehicle (SOV) travel
  - Delay
  - Transit ridership
  - Average trip length by trip purpose
- **Spreadsheet & GIS based tools**
  - Air Quality & GHG emission
  - Transport cost (commute cost)
  - Loss of economic productivity
  - Equity

13

Thank You

14

Strategies for Integration of

Sustainability and Transportation System

Transportation Planning Council (TPC) Meeting
Stephen P. Clark Center

December 5, 2011

Study Purpose

To investigate sustainable transportation strategies and their effect on travel behavior.

Three strategy scenarios were developed for this purpose.

2

Scenarios

Mobility Management

Emphasis: Effect of pricing policies on travel behavior.

Strategies: System of Managed Lanes
Express Buses
Increased Parking Costs

Linkages

Emphasis: Improving transportation and land use connection.

Strategies: Reallocation of Employment and Population Growth between 2015 and 2035
Adjusting Jobs-Housing Balance
Urban Infill

Multimodal

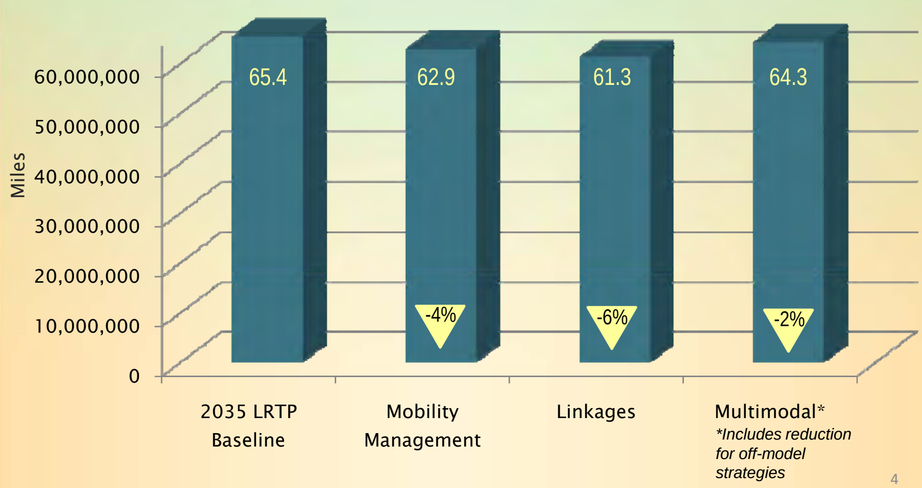
Emphasis: Improving transit rider experience.

Strategies: Arterial Bus Rapid Transit Network
Transit Signal Priority
Improved Stations
Park-and-Ride Lots

3

Evaluation Results –Travel Demand

Daily Vehicle Miles Traveled, All Trip Purposes (2035)



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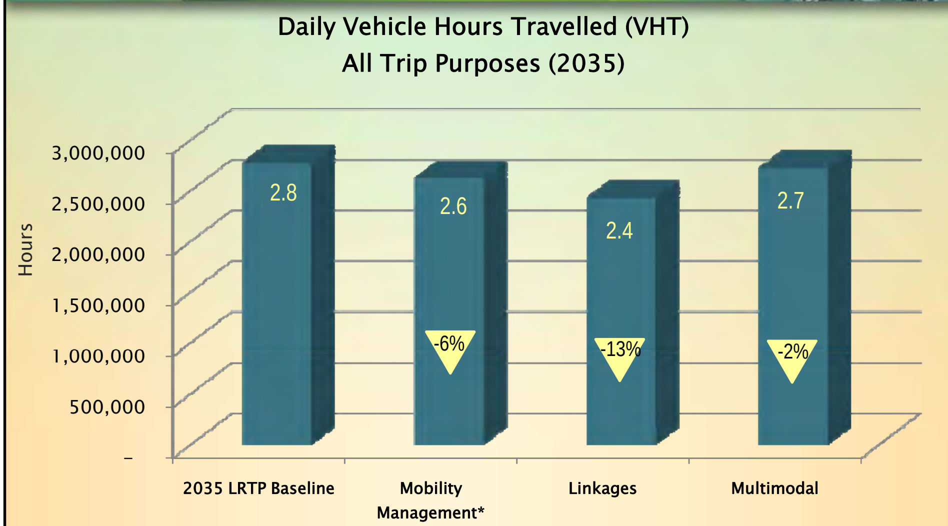
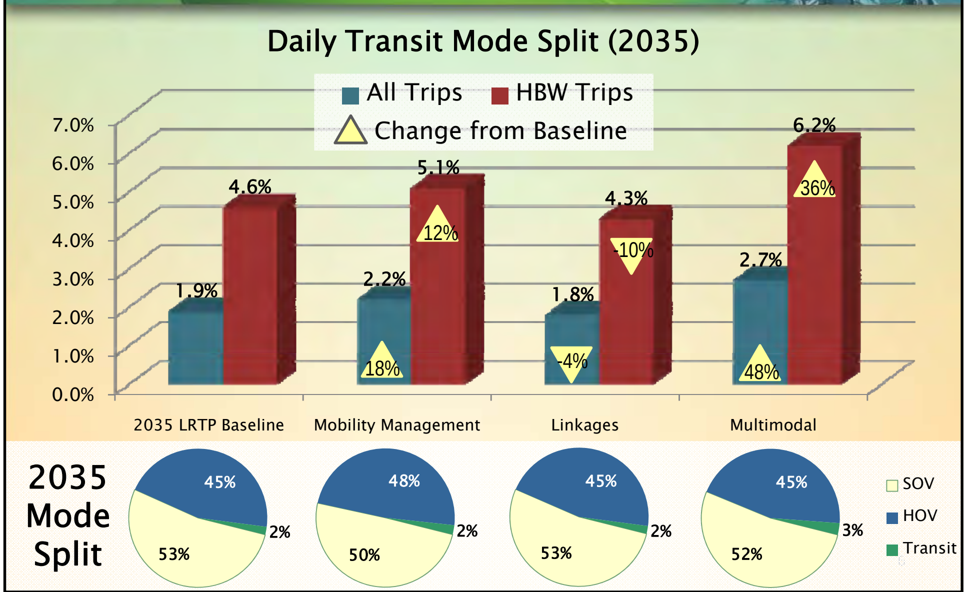
Evaluation Results – Travel Time



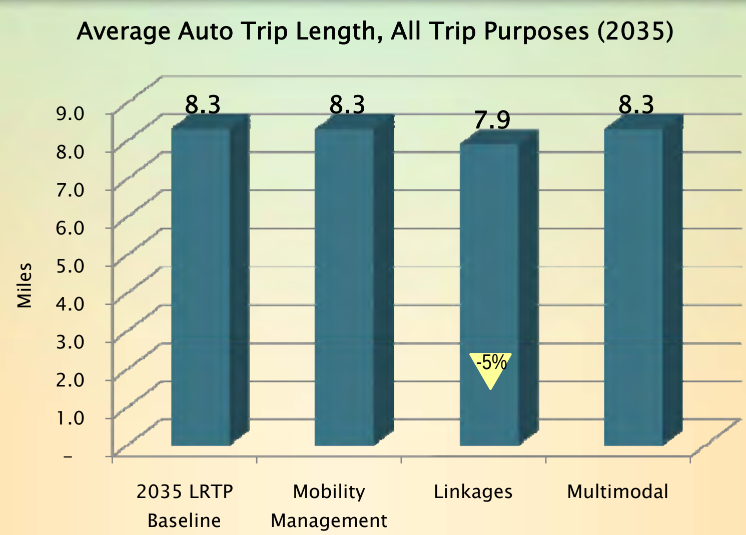
*Includes reduction for off-model strategies.

5

Evaluation Results – Transit

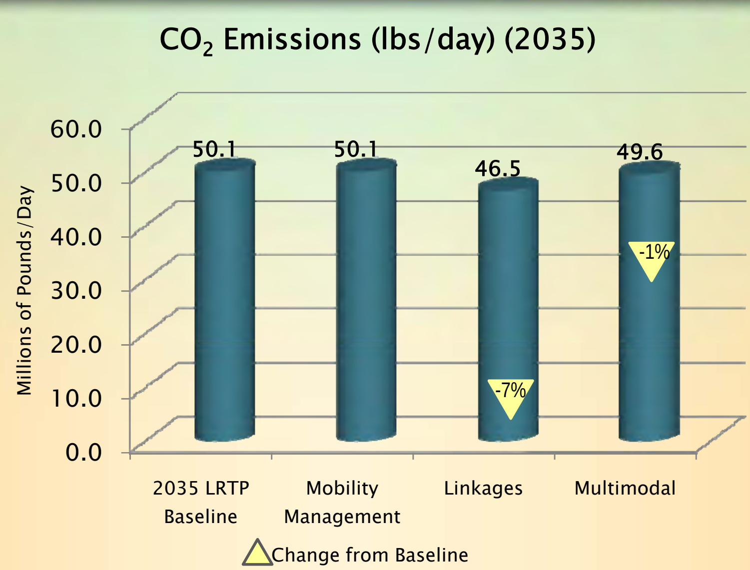


Evaluation Results – Trip Length



7

Evaluation Results – Greenhouse Gas Emissions



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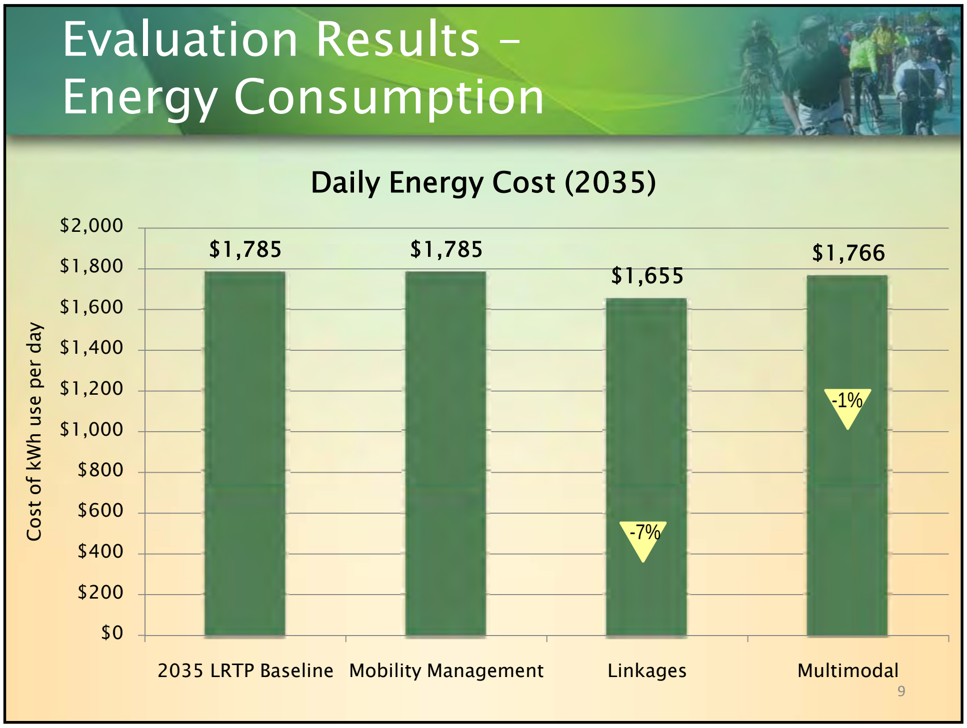
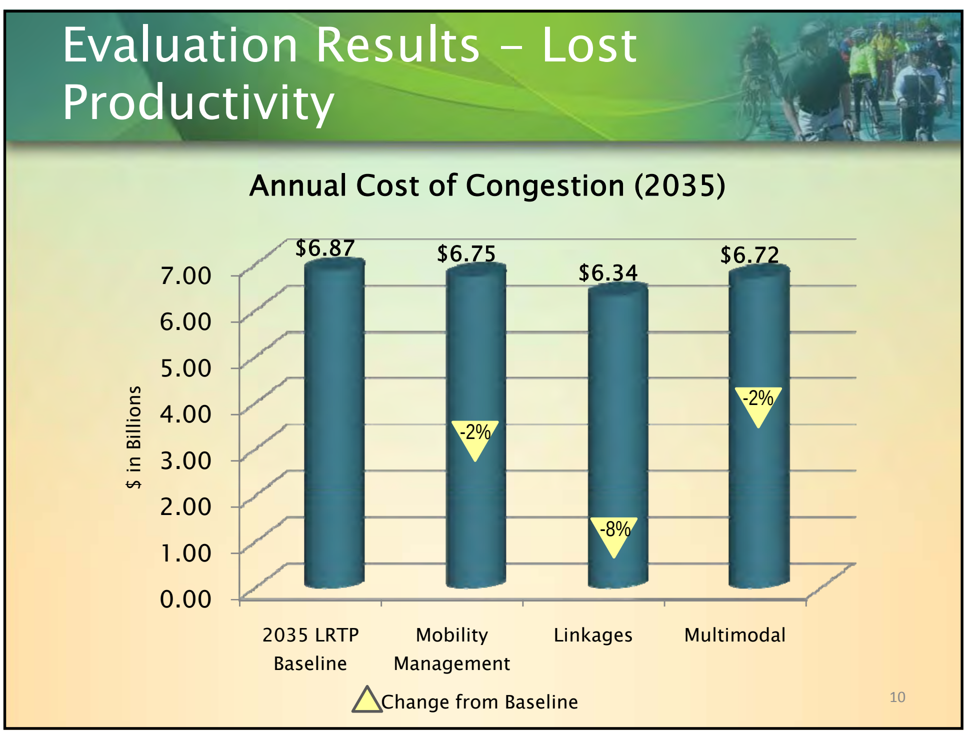

Evaluation Results –
Energy Consumption
Daily Energy Cost (2035)
Cost of kWh use per day
$2,000
$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$0
$1,785
$1,785
$1,655
$1,766
-7%
-1%
2035 LRTP Baseline
Mobility Management
Linkages
Multimodal
9


Evaluation Results – Lost
Productivity
Annual Cost of Congestion (2035)
$ in Billions
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
$6.87
$6.75
$6.34
$6.72
-2%
-8%
-2%
2035 LRTP Baseline
Mobility Management
Linkages
Multimodal
Change from Baseline
10

Aspirational Targets

Measure	Vehicle Miles Travelled	Bike & Pedestrian Trips	Transit Ridership	Single Occupancy Vehicles
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Total Capital Costs: $61-$90 million that buys:

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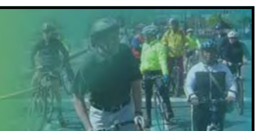
Conclusion



- Aspirational targets are too aggressive
- Affecting VMT, VHT, and ridership on a countywide basis is extremely difficult
- Results can be used in upcoming studies, including:
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  - Comprehensive planning activities (DPZ & cities)

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SUSTAINABLE
TRANSPORTATION
Thank You
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APPENDICES.

Appendix C – Literature Review Tech Memo

Literature Review and Case Studies

MIAMI-DADE MPO

Strategies for Integration of Sustainability and the Transportation System

JACOBS

Engineering Group, Inc.

Table of Contents

List of Tables

List of Figures

1.0 INTRODUCTION

Great strides have been achieved in utilizing transportation improvements to achieve some form of sustainability throughout the world. For the Miami-Dade MPO Study, a literature review was completed and case studies assembled to provide the following:

- A reference for trends and strategies;
- Understand focus areas and combinations of strategies;
- Identify which approaches have achieved success; and
- What sustainability means in the context of the transportation system.

The research began with a review of how sustainability is defined in regards to the transportation system. The results of this research are located in Appendix A. It was discovered that there is not a single accepted definition. However, there is similarity among the definitions in that they focus on the following:

- The system should be effective and efficient in providing its users with equitable and safe access to basic services;
- The system should promote economic development; and
- The system should not harm the environment.

As part of this study, a definition of sustainable transportation will be created with the assistance of the Study Advisory Committee (SAC). The purpose of this definition is to help direct the development of scenarios that will be evaluated. In addition, the SAC will assist in developing scenarios and determine how to evaluate them.

Once sustainable transportation was defined, research into different strategies for achieving sustainability began. Section 2.0 of this document provides a review of these strategies, which are categorized into three different groups: pricing/behavior, efficient resource utilization, and pedestrian and bicycle. Within each of these groups there are different categories. Managing traffic and congestion and promoting education and involvement of all stakeholders fits into the pricing/behavior group. Included in the efficient resource utilization group are the categories of supporting improvements in public transportation, linking transportation and land use in transportation plans, and prioritizing highway repair and safety performance. There is only one category included in the pedestrian and bicycle group and that is the support of non-motorized transportation.

After understanding these different strategies, research was conducted to identify different places within the U.S. and around the world where these strategies have been implemented or included in the long-range transportation planning process.

The case studies, included in Section 3.0, cover the following geographic areas:

- Portland, Oregon;
- London, England;
- Bogota, Colombia; and
- San Francisco, CA.

Figure 1: Map of Case Study City Locations

While there are many cities across the globe who have undertaken one or more of these sustainable transportation strategies, including Singapore, Paris, New York, Amsterdam, and Vancouver, these four cities were chosen because they illustrate initiatives that have been in development for long periods of time, encompass transportation solutions, and showcase successes.


A family enjoying a bike ride.

An additional area of review focuses on scenario planning. As part of the Miami-Dade MPO Study, scenarios will be modeled to assess impacts and benefits of travel and associated emissions. Use of travel models for sustainability is an emergent field. Scenario development examples will assist us in conducting scenario testing as part of this study. A review of studies already undertaken by other planning entities in the U.S. and abroad is included in Section 4.0 of this document.

The need to evaluate strategies and scenarios for sustainability stems from a recognition that new paradigms need to be identified. Historically, travel demand in Miami-Dade County has grown at a higher rate than population and job growth. Since 1980 vehicle miles traveled (VMT) and congestion has increased even after investing substantial dollars in transportation capacity improvements. These socio-economic and travel demand trends are forecast to continue in to the future. It has been established that a traditional strategy of adding capacity to meet travel needs is unsustainable. As a result, Miami-Dade County is proactively attempting to explore state-of-the-art strategies through this current effort.

Three appendices are attached to this report as follows.

Appendix A highlights definitions of sustainability in other regions.

Appendix B references relevant sustainability and transportation policy at a federal, state, and regional level.

Appendix C identifies applicable funding sources for sustainability and transportation programs.

2.0 Sustainability & Transportation Strategies

While there are innumerable strategies for moving towards sustainability in transportation, this section summarizes a range of the options available, including those that have been shown to be the most effective based on the Literature Review and Case Studies. The strategies are categorized into three groups as shown in the table below and organized in the previous case studies.

Table 1: Sustainable Transportation Strategy Categories

Group	Category
Pricing/Behavior	Manage traffic and congestion
	Promote education and involvement of all stakeholders
Efficient Resource Utilization	Support improvements in public transportation
	Link transportation & land use in transportation plans
	Prioritize highway repair and safety performance versus new capacity
Pedestrian & Bicycle	Support non-motorized transportation

Many of the strategies for moving toward sustainability could be classified under more than one of these categories. For example, widening sidewalks would support non-motorized transportation and could lead to reduced congestion. Strategies were designated to the category which was deemed the most directly related to that strategy. Accordingly, a strategy to widen sidewalks would be classified under Support non-motorized transportation.

2.1 Link Transportation and Land-use in Transportation Plans – (EFFICIENT USE OF RESOURCES)

Compact development is a relatively low-cost yet promising long-range strategy to mitigate climate change, reduce energy consumption, and reduce overall travel demand. Its promise, though, is dependent on how well it can leverage the momentum of changing market demand. Market studies show that the demand for compact development is growing. For example, the U.S. Environmental Protection Agency has documented continuing trends toward center city investment, finding that many cities have doubled or even tripled their capture of regional residential construction since 2000. In addition, market preference research for "generation Y" (people in their 20s) showed that 77% plan to live in the urban core, and one-third will pay more to live near shops, work, and entertainment. The strong urban preference of generation Y suggests very high demand for urban housing types. (ULI, 2010)

These trends are recognized in the County's CDMP which calls for a more compact and efficient urban form within the County's Urban Development Boundary and better integration of land use development and the transportation system.

An example of how compact development preserves open space and promotes variety in transportation choice.

Smart Growth and Transit Oriented Development (TOD) offer two similar compact land-use models, with TOD focusing on access to public transit.

Smart growth - Based on the experience of communities around the nation that have used smart growth approaches to create and maintain great neighborhoods, the Smart Growth Network developed a set of 10 basic principles -

1. Mix land uses
2. Take advantage of compact building design
3. Create a range of housing opportunities and choices
4. Create walkable neighborhoods
5. Foster distinctive, attractive communities with a strong sense of place
6. Preserve open space, farmland, natural beauty, and critical environmental areas
7. Strengthen and direct development towards existing communities
8. Provide a variety of transportation choices
9. Make development decisions predictable, fair, and cost effective
10. Encourage community and stakeholder collaboration in development decisions (EPA, 2010)

Transit Oriented Development (TOD) - According to FTA, TOD is compact, mixed-use development within walking distance of public transportation and is a key element of livable and sustainable communities. TOD increases transit ridership and reduces automobile congestion, providing value for both the public and private sectors.

Planned and existing TOD areas have been delineated in the County's greenPRINT plan and the City of Miami's zoning code, Miami 21.

2.2 Incentivize Low-carbon Modes, Manage Traffic and Congestion (PRICING/BEHAVIOR)

According to the 2010 Urban Mobility Report, Miami-Dade is the fifth most congested metropolitan area in the Nation in terms of travel time. In 2009 the financial cost of congestion experienced by County residents amounted to approximately $3.3 billion, and resulted in excess fuel consumption of 109 million gallons. As the population of Miami-Dade County continues to grow, so does the demand on the existing transportation system, which requires innovative investments and collaborative strategies to curtail the rising costs of congestion. (MPO)

A typical commute in Miami-Dade County.

Road Pricing and Tolling - Economists have long advocated road pricing as an efficient and equitable way to finance roads and other transportation programs, and encourage more efficient transportation. Road pricing has two general objectives - revenue generation and congestion management. (VTPI) The revenue generation component of road pricing leads to opportunities to create public-private partnerships that share the evaluation and risk responsibilities of maintaining existing roads and financing new infrastructure.

Variable Pricing: Variable pricing on toll facilities is a strategy used to manage congestion during peak periods. Motorists are charged higher tolls during the peak period and charged lower tolls or no tolls in the off-peak hours. The purpose of variable pricing is to spread peak hour demand over a greater time period to reduce the peaking characteristics of rush hour traffic flow. (TTI, 2001)

Cordon Tolling: Under Cordon Tolling, fees are paid by motorists to drive into a particular area, usually a city center. Some cordon tolls are only applied during peak periods, such as weekdays. It is not unusual for attempts to implement cordon tolling to fail due to lack of stakeholder buy-in.

The introduction of a road pricing initiative as part of a larger package of congestion relief measures is advised because it demonstrates to the public an understanding that road pricing alone will not solve urban congestion problems.

Parking Management - Parking management and parking pricing are effective ways to reduce automobile travel, and tend to be particularly effective in urban areas. In particular, since most urban-peak highway trips are for commuting, employee parking pricing can have a similar effect as a road toll. Analysis by Roth (2004) indicates that more efficient pricing of on-street parking would make urban driving more expensive but more efficient, due to lower levels of traffic congestion and the relative ease in finding a parking space near destinations, as well as providing new revenues. (VTPI)


Parking meters are an example of a parking pricing strategy.

Commuter Programs - Peak hour congestion on urban freeways is largely due to the predominance of the standard 8 AM to 5 PM work schedule. The structure of many large cities can also compound congestion as widely distributed workers funnel through a few congested corridors to several large activity centers. The peak hour trips associated with the 8 AM to 5 PM schedule not only saturate freeway corridors, but also saturate downtown streets, parking facilities, and elevators.

Variable Work Hours - This flexibility allows employees to shift trips to and from work either before or after the peak hour. Some programs allow participants to shift their schedule on a day to day basis, while other programs require that participants work a selected schedule on a routine basis. (TTI, 2001)

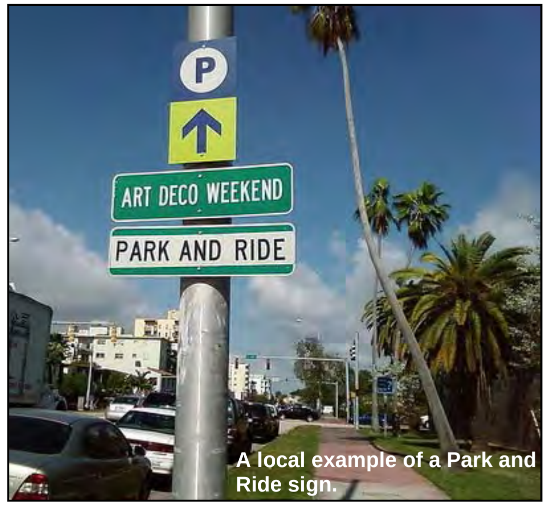
Telecommuting - Telecommuting allows workers to either eliminate a commute trip all together by working from home or to reduce trip length by working from a satellite office.

Ridesharing - Ridesharing programs provide a service of matching up potential carpoolers and/or vanpoolers through a database of interested participants based on the locations of their origins/destinations.

Vanpools - Vanpools use passenger vans to provide organized transit service to a registered group of individuals. Vanpools reduce congestion by organizing groups of individuals to share trips. Vanpools are most effective serving long distance commuters and are an effective tool for reducing vehicle miles of travel (VMT). Park and ride lots and park and pool lots often serve as meeting places for vanpool participants.

Park and Ride Lots - Park and ride lots are an important tool for encouraging carpool, vanpool, and transit usage by creating locations where people can leave their cars/bicycles and join up with higher occupancy vehicles.

Parking Cash-out Programs - Employers can become members of the *Best Workplaces for Commuters* program, which offers benefits to workers that encourage less reliance on driving, including cash in lieu of a parking. (ITDP, 2010)



A local example of a Park and Ride sign.

Distance Based Fees - Converting vehicle insurance and registration fees into distance-based charges provides a significant financial incentive to reduce driving, comparable to nearly doubling fuel prices. Unlike Road Pricing, distance-based fees affects all travel, not just travel on certain highways, and so provides congestion reduction benefits on surface streets without shifting traffic to other routes. (VTPI)

Reversible Lanes - In some situations it is possible to have a traffic lane that is reversed to carry traffic in the direction of maximum flow, for example, into a city center during the morning rush hour and outward during the evening rush hour.

Motorist Information Systems - Motorist information can include changeable message signs, radio reports and internet information about traffic conditions. These can reduce motorist stress by letting them anticipate conditions.

Ramp Metering - Ramp meters control the number of vehicles that can enter a highway ramp. This tends to maintain smoother traffic flow on highways.

Grade Separation & Intersection Improvements - Various strategies that increase intersection capacity can reduce congestion, since intersections are often a limiting factor in roadway traffic flow. These include additional lanes at the intersection approach, left- and right-turn lanes, and improved signal synchronization.

Grade separation can significantly increase roadway capacity. A typical arterial lane can carry less than 1,000 vehicles per hour, while a grade separated freeway can carry more than twice that amount. Grade separation of rail lines can increase traffic flow where railroad crossings are a major cause of traffic delay. (VTPI)

One-Way Streets - In some situations, converting from two-way to one-way streets can increase traffic flows and simplify intersections, although access to buildings may be less convenient.

Narrow Vehicles - Motorcycles and ultra narrow cars (less than 42 inches wide) can travel side-by-side, particularly under lower-speed conditions, and so allow more vehicles to travel per lane. (VTPI)

2.3 TRANSIT, BIKE, PEDESTRIAN (USE OF NON-MOTORIZED TRANSPORTATION)

Providing adequate infrastructure for bicyclists, pedestrians and transit is key for promoting the use of these alternative forms of transportation.

Public transportation can play an important role in confronting environmental challenges. According to the FTA, “Public transportation can improve air quality, reduce greenhouse gas emissions, facilitate compact development (conserving land and decreasing travel demand), and save energy among other benefits.” Public transportation can also improve the accessibility of employment and education opportunities. Since transit is a viable alternative to more resource exhaustive forms of transportation, it can be an integral component for moving towards sustainability, allowing for social equity and economic development while minimizing negative impacts to the environment.

The County’s *greenPRINT* Plan calls the acceleration of transit improvements “critical not only to realizing sustainability benefits for residents, but also to achieving emissions reductions needed to mitigate climate change.” Given that 68% of the County’s residents have never used mass transit (Miami-Dade 2010) the County should be proactive in promoting transit services and attracting transit users.

There are many ways to improve public transit service and encourage transit ridership besides increasing service, such as:

<u>Fare Policy</u> - An important element of transit service (both bus and rail) is fare structure and collection method. Differential fare structures often exist within a transit system to provide various services or to increase ridership in certain markets for a number of reasons. Discounted fares may be offered to support mobility options of various groups based on age, financial capacity, disabilities, or affiliation (students, employer, etc.). Discounts may be offered based on factors such as frequency of use, prepayment, and time commitment purchase (weekly pass, monthly pass, annual pass). Fare structures may also be differentiated based on trip characteristics such as trip location, length, and duration, time of trip (peak or off-peak, weekday or weekend), mode, and quality of service (express or local).

Transit Priority - Bus lanes, queue-jumper lanes, bus-priority traffic signals, and other measures, such as grade separation so transit is not delayed by cross-streets and traffic congestion, reduce delay to transit vehicles and can significantly improve travel times and reliability of service .

An example of a bus only lane using low cost pavement treatment.

Comfort and Convenience Improvements - Reduced crowding, better seats and cleaner vehicles can improve the users experience and encourage increased patronage. Transit stop enhancements including shelter (enclosed waiting areas, with heating in winter and cooling in summer), seating, wayfinding and other navigation tools, washrooms, refreshments, internet services, and other convenience features help to promote transit use.

An example of improved rider information in San Francisco.

Improved Rider Information and Marketing Programs - Real-time information on transit vehicle arrival and multi-modal access guides which include maps, schedules, contact numbers and other information on how to reach a particular destination by public transit can improve the experience of transit users.

The American Heart Association has estimated that every hour of walking may increase life expectancy by two hours. Of course, when residents get out of their car to walk and bike, carbon emissions are avoided as well. Infrastructure improvements, improving safety and promotional and education efforts can all help to encourage non-motorized trips.

The 2009 National Household Transportation Survey found that 50% of all trips are three miles or less and 28% of all trips are one mile or less – distances easily traversed by foot or bicycle. Yet 60% of trips under one mile are made by automobile. (National Complete Streets Coalition)

Complete streets - Complete streets are designed and operated to enable safe access for all users. Pedestrians, bicyclists, motorists and transit riders of all ages and abilities must be able to safely move along and across a complete street. Since each complete street is unique, it is impossible to give a single description. But ingredients that may be found on a complete street include sidewalks, bike lanes (or wide paved shoulders), special bus lanes, comfortable and accessible transit stops, frequent crossing opportunities, median islands, accessible pedestrian signals, curb extensions, and more.

Tree Canopy - Another strategy to promote outdoor activity, including pedestrian and bicycle travel, is to increase and improve the tree canopy. While Miami-Dade has the advantage of year-round warm weather, the County also has periods of extreme heat. Shadier bike paths and sidewalks will cool communities and get residents moving outside. It should also be noted that a community's green infrastructure provides many environmental, social and economic benefits including reducing the need for air conditioning, slowing stormwater runoff, improving air and water quality, protecting soil from erosion, storing atmospheric carbon, improving wildlife habitat and reducing noise levels, among others. (Miami-Dade, 2010)

A local example of how trees can create a more pleasant environment for bicyclists and pedestrians.

Traffic Calming - Traffic Calming is a system of design and management strategies that aim to balance traffic on streets with other uses. It is founded on the idea that streets should help create and preserve a sense of place and that their purpose is for people to walk, look, meet, play, shop and even work alongside cars. One benefit of traffic calming is that it can be applied inexpensively and flexibly. For example, traffic calming measures include painting lines, colors or patterns; using planters, bollards and other removable barriers; eliminating or adding parking; or installing sidewalk extensions with temporary materials.

Car Free Planning - Car free planning involves designing particular areas for minimal automobile use, including:

- Developing urban districts (such as a downtown or residential neighborhood) where personal automobiles are unnecessary and automobile traffic is restricted. Such restrictions can be part- or full-time and often include exceptions for delivery vehicles, taxis, and vehicles for people with disabilities.
- Housing developments where residents are discouraged from owning private cars.
- Pedestrian-oriented commercial streets where driving is discouraged or prohibited.
- Car free arterials for longer distance travel.
- Resorts and parks that encourage or require non-automotive access.
- Car free days and car free events.

- Temporary restrictions on driving, such as during an air pollution emergencies or a major sport event that would otherwise create excessive traffic problems.

2.4 Prioritize Highway Repair and Safety Performance Versus New Capacity (EFFICIENCY)

A typical roadway repair project, resurfacing.

Highways may be unsustainable not only due to impacts on land-use and congestion, but also because of impacts to people's safety and local ecology. Sustainable transportation plans may include repairs to highway networks that are conducive to fewer accidents, enhance storm-water management and promote wildlife corridors. Fewer accidents reduce negative externalities, i.e. social and economic cost borne by the general public. Better drainage, preserving the environment, and avoiding fragmentation of wildlife habitat by building new roads enhances the environmental capital for current and future generations. Therefore, in mature urban areas most of the federal transportation dollars should be spent in maintaining the existing infrastructure and increasing its efficiency using technology as opposed to building new roads or adding more highway lane miles. The Green Highways Partnership (GHP), launched in 2005 as a diverse, public-private partnership, claims that green highways are not defined by a list of requirements. Green highways are defined by an effort to go "beyond compliance" and leave the project area "better than before" through community partnering, environmental stewardship, and transportation network improvements in safety and functionality.

2.5 Promote Education and Involvement of All Transportation Stakeholders (PRICING/BEHAVIOR)

The creation of the community's well-being starts with the education and action of its citizens. (Williams, 2007) Precedents in other areas of American life, such as the reduction of smoking, the rise in recycling, and the reduction in drinking and driving, point to the fact that education can be effective.


Teaching a new generation about transit.

Some promote "social marketing" or education as a key to the eventual sustainability of our transportation system. They argue that Americans are bombarded with advertising that, for economic reasons, encourages them to purchase larger and less fuel-efficient vehicles and to use them for more and more reasons (McGovern 2004). In contrast, in parts of Europe and Australia and most recently in experiments in American cities such as Portland, Oregon (TravelSmart), willing households have had their travel choices "audited" by trained outsiders. Household members were helped to reorganize their weekly travel to take greater advantage of public transit, form trip chains that reduce the number of automobile cold starts, combine the trips of household members that were previously made independently of one another, and forgo some trips entirely. Some see this type of educational activity as promising for at least two reasons. The first is the direct shift in travel behavior toward sustainable mobility that they hope it will help to bring about. The second is the fact that education will, perhaps more gradually, contribute to changes in public policy by making more aggressive approaches to regulation more acceptable in the political arena than they are now. Others, of course, think that well-meaning experiments in consumer education are likely to result in little or no change in travel at the scale of our entire society, or worse, to interfere with individual freedom in a democratic society. (Wachs, 2004)

It would be difficult, however, to find fault in programs that garner increased public input into the transportation planning process. Innovative multimedia marketing campaigns and virtual meeting spaces can allow for the participation of the greatest number and variety of stakeholders leading to more sustainable transportation plans. Greater levels of involvement can ensure that the County's priorities in moving towards sustainability is in line with those of residents and local businesses, and that transportation plans will be supported.

3.0 CASE STUDIES

3.1 London, England

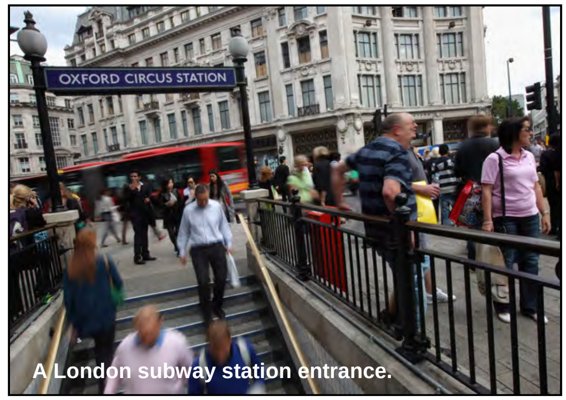
Key Transportation Strategies
London is at the cutting edge of implementing innovative sustainable transportation solutions. Learning from London's experience is useful for any city that plans to incorporate sustainability into their transportation systems planning process.

London's Mayor, Boris Johnson, has set out his vision for transport in London over the next 20 years with the launch of the Mayor's Transport Strategy (MTS). It prepares for predicted growth of 1.25 million more people and 0.75 million more jobs by 2031 and supports sustainable growth across London. Some of the key proposals and strategies under consideration and/or implementation are summarized in the table below.

Table 2: Transportation Strategies Examined in the London Case Study

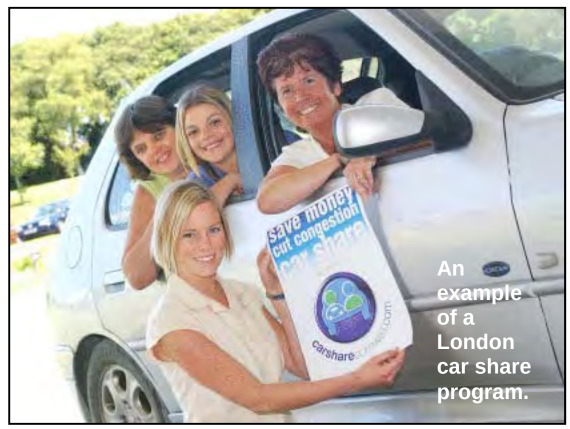
Group	Category	Sustainable Transportation Strategy
Pricing/Behavior	Manage traffic and congestion	Congestion pricing (Cordon charging); Car Clubs (Carsharing); Smoothing traffic flow; Better information; Reducing CO_2 emissions, including through the promotion of electric vehicles
	Promote education and involvement of all stakeholders	Personalized Travel Planning; Supporting the 2012 Olympic and Paralympic Games
Efficient Resource Utilization	Support improvements in public transportation	Transforming the Tube (subway); Enhancing rail, including Crossrail, Thameslink and the London Overground; Improving London's buses
	Link transportation & land use in transportation plans	Better streets and environment; Improved access to the transport system
	Prioritize highway repair and safety performance versus new capacity	Improving interchanges; New river crossings
Pedestrian & Bicycle	Non-motorized transportation	Barclays Cycle Superhighways; Bicycle sharing; The cycling revolution program; Making walking count program

Travel Demand Management



A London subway station entrance.

Travel demand management strategies have been a part of a wider response by the Mayor and Transport for London (TfL) to the challenges posed by climate change and mounting pressure on London's transport system from the forecast rise in population and employment. In 2005/06, there was a significant increase in the amount of future funding to support Travel Demand Management (TDM) projects, which Transport for London (TfL) continues to develop and implement in partnership with the London boroughs, businesses, schools and community groups. Funding had been increased from $26 million (US Dollars) in 2005/06 and $27 million (US Dollars) in 2006/07 to $38 million (US Dollars) in 2007/08 and $45 million (US Dollars) in 2008/09.



An example of a London car share program.

These projects, some of which are detailed below, aim to encourage people to switch to more environmentally friendly modes of travel. As such, they are vital to the long-term sustainability of London's transport system. (TfL)

- **Personalized Travel Planning** -Trials in Kingston, Sutton and Haringey in 2006/07 saw 56,000 households being given tailored travel advice, with at least 16% of respondents now using public transport more often and 24% walking and cycling more.

- **School Travel Plans** - Based on analysis of 300 plans completed in 2005/06 an average reduction of 5.5% in single occupancy car trips was achieved in just one year (equivalent to 1.9 million fewer car trips per year).

- **Car Clubs (Carsharing)** - TfL research among car club members in 2006 saw 20% of users having given up their own car and 30% having deferred purchasing a car as a direct result of their car club membership.

- **Workplace Travel Planning** - These plans support activities such as flexible working and teleconferencing. They typically achieve a 15-20% reduction in single occupancy car trips where employees are encouraged to change their travel to or during work. Employers that sustain plans over a prolonged period have seen even better results.

Congestion Charging (Cordon Charging) – London's Congestion Charging scheme was agreed upon in February 2002. Charging commenced in February 2003. Cameras at entrances, exits and around the zone read each automobile's license plate. The plates are checked against a database to work out whether the user has pre-paid the charge, is exempt, or has a 100% discount. If a match is found, any images of that vehicle are deleted from the database. Otherwise, the images are validated and a Penalty Charge Notice is sent to the registered owner of the vehicle. People residing within the congestion zone are offered a 90% discount.

By law, all surpluses raised must be reinvested into London's transportation infrastructure. On introduction, the scheme was the largest ever undertaken by a capital city. In fiscal years 2007, 2008 and 2009, over $162 million (US Dollars) in net revenue was reported. In October 2010, a number of other changes to the Congestion Charging scheme which took effect in January 2011 were introduced, including:

- Charge increase
- Congestion Charging Auto Pay
- Greener Vehicle Discount
- Extending the 100% discount for Electric Vehicles to include Plug in Hybrid Electric Vehicles (PHEVs)
- Implementing a $15 (US Dollars) registration and annual charge for 9+ seat 100% discount

The daily Congestion Charge rose on January 4, 2011 to $15 (US Dollars) per day if paid in advance or on the day of travel, $18 (US Dollars) if paid by midnight the charging day after travel, or $14 (US Dollars) if registered for Congestion Charging Auto Pay.

Figure 2: Map Showing Recent Changes to Congestion Zone

Congestion Charging Auto Pay is an automated payment system. It automatically records the number of charging days a vehicle travels within the charging zone each month and takes the charge from a registered debit or credit card on a monthly basis. The Greener Vehicle 100% Discount (GVD) allows a 100% discount from the Congestion Charge for cars that emit 100 g/km or less of CO_2 and that meet the Euro 5 standard for air quality. Users must register for the discount and pay $15 (US Dollars) a year per vehicle. Over the course of the next 12 to 18 months, it is anticipated that new electric and hybrid electric plug-in vehicles will be brought to market with significantly lower emission levels. In 2012, TfL plans to review developments in the market, with the intention of reducing the discount levels to 80 g/km or lower when the time is right.

While congestion has risen back to pre-charging level, it would be much worse without the charge. Widespread water and gas main replacement projects are the primary reason for the rise in congestion; as road capacity has been greatly reduced as have traffic management measures to help pedestrians and other road users. (TfL)

Bicycle Initiatives

Bicycling initiatives were also undertaken as part of London's strategy for achieving more sustainable transportation. Part of the Mayor's Transport Strategy is the aim to increase cycling in London by 400% by 2025 (compared to 2000 levels) thereby achieving the target of 5% of all journeys being made by bicycle. To support this aim, an extensive bicycle sharing and bicycle infrastructure program were implemented.

A Barclays bike share station.

Barclays Cycle Superhighways are new cycle lanes into central London linking outer London. They provide cyclists with safer, faster and more direct journeys into the city. The first two have been launched, with 10 more being introduced by 2015. Barclays Cycle Superhighways will be up to 9 miles in length, and will connect the outer boroughs to inner London. The pilot routes are both around 8 miles in length.

The Superhighways were built to:

- Improve cycling conditions for people who already commute by bike;
- Encourage those who do not already ride to do so;
- Help cut congestion;
- Relieve overcrowding on public transport; and
- Reduce emissions.

The lanes will be at least five feet wide and will continue through intersections. Advanced Stop Lines (ASLs) will be provided at signals to help cyclists get ahead of the traffic, and a number of junction layouts have changed to provide more space. Barclays Cycle Superhighways will provide thousands of new cycle parking spaces, free or subsidized Commuter Cycle Training, as well as better facilities for cyclists at work.

The estimated cost of delivering the two pilot Cycle Superhighways routes is $35 million (US Dollars); and this includes the Smarter Travel measures to encourage increased levels of cycling such as cycle training, maintenance and parking. The pilot routes will allow TfL to test all of the measures for their effectiveness, helping to determine the scope, detailed design and cost of the remaining routes

An example of a London street without a Cycle Superhighway.

Case Study:

3.2 Portland, Oregon, USA

Key Transportation Strategies

Portland was chosen as one of the case studies since it is one of the nation's "most livable cities" and a leader in sustainable development. The city is known for its innovative planning efforts that protect farm land and natural areas, revitalize commercial districts, preserve the character of residential neighborhoods, minimize its environmental footprint, and promote the use of alternative modes of transportation. By taking a regional planning approach that carefully considers the interrelation between land use and transportation, the Portland region is a national model for maintaining and creating vibrant communities.

Table 3: Transportation Strategies Examined in the Portland Case Study

Group	Category	Sustainable Transportation Strategy
Pricing/ Behavior	Manage traffic and congestion	Parking management in downtown Portland
	Promote education and involvement of all stakeholders	Implemented the *TravelSmart* program that audits travel plan of individual households and provides transportation solutions to meet their travel needs
Efficient Resource Utilization	Support improvements in public transportation	Designated downtown as free rail zone, Extensive network of rail and bus rapid transit system
	Link transportation & land use in transportation plans	Coordinated land use and parking regulations, Transit oriented development and zoning (including transfer of parking rights)

The numbers tell the story of this region's success. Between 1997 and 2007, TriMet transit ridership grew faster than the region's population, the amount of service provided, and the number of miles that people drove. This region has been bucking the national trend since 1996. During that time the average number of miles driven per person each day has grown nationwide, but it has shrunk in Portland. This fosters more economic activity through dollars saved on vehicle purchases and maintenance, along with a reduction in negative impacts from congestion and greenhouse gas (GHG) emissions, yielding not just local and regional benefits, but national and global ones as well.

Metro

Metro, the nation's only elected regional government, serves more than 1.5 million residents in Clackamas, Multnomah and Washington counties and the 25 cities in the Portland region. It was formed in 1979 to forge new strategies and innovative partnerships to build vibrant communities, promote economic growth and protect wildlife habitat. Metro provides regional services that include overseeing solid waste and recycling services, the management of public places like the Oregon Zoo, Portland Center for the Performing Arts, the Oregon Convention Center and the Portland Expo Center, and the stewardship of more than 12,000 acres of parks and natural areas.

A Portland streetcar.


An example of transit oriented development in Portland.

Metro is also charged with developing growth management and land use policies, creating an overall transportation plan and allocating federal funds through the Transportation Priorities program. The agency is responsible for approving the expenditure of these federal transportation funds—which have been pivotal in implementing the region's land use and transportation vision. Various committees with broad representation in the region advise Metro; this process assures local elected officials are directly involved in regional policy and investment decisions.

Joint Policy Advisory Committee on Transportation

Acting in concert, Metro and the Joint Policy Advisory Committee on Transportation (JPACT) serve as the region's Metropolitan Planning Organization (MPO). JPACT is a 17-member committee of elected officials and representatives of agencies involved in transportation that make recommendations to the Metro Council on transportation needs in the region. JPACT is charged with defining required regional transportation improvements, developing a consensus of governments on the prioritization of required improvements, and promoting and facilitating the implementation of indentified priorities. (TriMet, 2010)

Coordinated Parking and Land-use Strategies

By combining a variety of innovative off-street parking policies and regulations, Portland has for decades served as a model for effective parking management. The city's investment in extensive, reliable public transit infrastructure has enabled it to wean residents and commuters off private automobiles. Since 1992, the state has mandated that all localities guide their development with transit accessibility goals.

Portland's light rail vehicle.

Portland's proactive approach began in the early 1970's, when they city's downtown air quality violated federal carbon monoxide standards one out of every three days. This led to a freeze at 45,000 parking spaces in 1972. Thanks in part to this measure and to the improved technology of automobile exhaust systems, downtown Portland has not exceeded the carbon monoxide standard since 1984. In 1997, the city lifted the freeze replacing it with a more flexible system of parking maximums and minimums to manage, rather than prevent, parking space construction. Parking minimums are not applied to developments in the city's densest commercial neighborhoods, including downtown, and neighborhood commercial districts, and central residential districts. Similarly, minimums do not apply to any sites within 500 feet of a transit line that provides service at least every 20 minutes during peak hours. (ITDP, 2010)

All types of transit are free within Fareless Square downtown. TriMet agreed to provide Fareless Square in exchange for Portland placing price and quantity controls on downtown parking, thus allowing greater development density in the downtown core. The parking controls included:

- A cap on the total amount of parking available in the downtown area, with no minimum parking requirements for individual developments (through 1995).
- Metering all on-street parking.
- All public and private parking garages open to the public are pay-to-park.

Parking Regulations

A developer or owner also benefits from reduced minimums if willing to manage parking by arranging space sharing or bike parking in a facility. When the parking demands from two or more uses located near one another occur at different times, the city's zoning code allows a shared parking facility with fewer spaces than the combined, separate requirements for each use. Similarly, bicycle parking may substitute up to 25% of required car parking spaces. For every five bike parking spaces a developer builds, one fewer car parking space may be constructed.

A parking meter that accepts both cash and credit card payments.

"Limiting the number of spaces allowed promotes efficient use of land, enhances urban form, encourages use of alternative modes of transportation, provides for better pedestrian movement, and protects air and water quality," states the city's zoning code. Thus, parking maximums complement minimums in many neighborhoods. The city conducted a study to determine parking demand under different policy scenarios. Taking account of transit capacity, they calibrated parking requirements to meet their travel demand forecasts within the context of the entire transportation system and their land use objectives.

Consistent with the city and state's commitment to public transit, the maximums vary according to a site's distance from bus or light rail — closer to transit less parking is permitted. Several neighborhoods are therefore subject to low maximums.

Downtown office and retail developments, for example, are limited to one space per 1,000 square feet of floor space, and hotels may provide only one space per hotel room. Given this low limit, developers almost always build up to the maximum; no waivers to build above the maximum have been granted since 1974.

The city treats parking as a transferable entitlement. However, a developer choosing to build below the maximum or the owner of a historic building that lacks parking, may transfer its parking development rights to another property. In this model a developer may transfer (but not sell) parking rights up to the maximum allowed to another developer as long as the transfer agreement has been completed prior to the laying of the new development's foundation. For pre-existing buildings or for new development where a transfer agreement had not been made prior to the foundation laying the existing building may transfer up to 70% of the original entitlement to another developer. In return, the transferring property has the right to use its parking entitlement in the facility where the rights have been transferred but they must pay the prevailing rate for the privilege. This policy maintains city control over a district's parking supply yet allows developers the flexibility necessary to finance, build and operate new and existing developments. It also helps to consolidate facilities, reducing the number of curb cuts and intrusions into the pedestrian realm.

The impact of this group of programs and policies has been significant. The city reports that transit use increased from 20 to 25% in the early 1970's and to 48% in the mid-1990's. (ITDP, 2010)

Case Study:

3.3 Bogotá, Colombia

Key Transportation Strategies

Bogotá is a world leader in planning, designing, and implementing non-motorized transportation solutions. Bicycling and walking are intrinsically part of sustainable transportation strategies. Therefore, Bogotá was deemed an appropriate case study. Bogotá is home to 7 million people. About 85% of the people in the city do not use cars for their daily transport, the city invested heavily in non-motorized transport and transit to provide mobility and accessibility to its residents. Bogota's promotion of non-motorized travel is evidenced through their *Ciclovía* and *CicloRuta* programs. Bogotá is so transit friendly that people voted in favor of outlawing cars in the city during rush hour by 2015.

Table 4: Transportation Strategies Examined in the Bogota Case Study

Group	Category	Sustainable Transportation Strategy
Efficient Resource Utilization	Support improvements in public transportation	TransMilenio (24-mile) Bus Rapid Transit system
	Link transportation & land use in transportation plans	Higher density buildings along transportation corridors
Pedestrian & Bicycle	Non-motorized transportation	Ciclovía – (car free day): Outlawing cars in the city during rush hours; *CicloRuta* - a 188 mile network of 9-12 feet wide bidirectional protected bicycle lanes and adjoining pedestrian boulevards

Ciclovía

Ciclovía is a weekly, city-wide, car free day in Bogotá that puts 70 miles of roads, including La Septima, the city's main commercial center, off-limits to cars and has been running since 1974. More than two million people come out every week to bike and walk. *Ciclovía* is hosted every Sunday and holiday from 7 am to 2 pm on a network of connected, downtown Bogota streets. No infrastructure was required to make the streets car free. Permanent signs were installed on *Ciclovía* roads to inform the public. Temporary signs are positioned on *Ciclovía* days to alert drives to road closures. Lights and traffic rules are obeyed at the intersection of *Ciclovía* routes and roads that remain open to automobiles. Complementary services, such as on-street juice and food vendors, have been cited as an important piece of the *Ciclovía* experience.

The city built 70 miles of bicycle routes and closed several streets to cars and converting them into pedestrian malls. More drastically, the city began to restrict car use during rush hour, banning each car in the city from the downtown area two days a week, based on the license plate number. The results were dramatic: the average commute time dropped by 21 minutes, and pollution was reduced significantly. The city had been debating a multi-billion dollar subway system for decades. The leadership decided to invest in significantly cheaper rapid transit bus system that had turned Curitiba, Brazil into a model city for effective public transportation.

An example of a bicycle route in Bogota.

TransMilenio

The initial $350 million (US Dollars), 24 mile *TransMilenio* system was up and running in less than two years. The buses, running in separate lanes down the center of the city's main arteries, are able to carry 780,000 people a day at an average speed of 16 miles per hour, considerably outpacing cars and private buses. Estimates have found that the system saves people an average of 300 hours of commuting time annually.

An example of a bicycle lane in Bogota.

Unlike many subways or elevated trains, the *TransMilenio* operates at a profit. The city plans to add a number of new lines to the system by 2015, so that 85% of residents will live within 500 meters of a bus station

CicloRuta

CicloRuta - a 188 mile network of 9-12 feet wide bidirectional protected bicycle lanes and adjoining pedestrian boulevards, at the same time as constructing *TransMilenio.* The system is a best practice, not only because it has reduced car dependence and associated emissions, but it has also fundamentally changed behavior in the city. Along the transport corridors in the suburbs, higher density buildings of between three and seven stories encourage residents to travel by bicycle. These efforts appear to be working. Five percent of all trips in Bogotá are by bike, compared to 0.5% before CicloRuta.

The system is divided into three sections:

1. **The Main Network:** connects the key city centers, its main educational and work areas, with the most populated residential areas. It also connects with the secondary network. These lines are surroundings the more important road axes that they link the great city center with more the densely populated areas; axes cross-sectional and in the road axes that cross the city of North to the South; axes longitudinal.

2. **Secondary Network:** connects housing areas, parks and facilities and attractions with the main network. These paths are mostly designed to serve as feeders to TransMilenio. All main stations of TransMilenio have guarded bike parking facilities.

3. **Complementary Network:** this links recreational networks, and external routes to the system. These paths are located along the river banks which in turn are part of the system of Linear Parks of the City; including surrounding wetlands.

Performance
*CicloRuta*s play an important role for the poor people of the City. More than 23% of the trips made by the lowest income group in the city are pedestrian and by bikes. As the income level rises, there are less people walking or biking.

Separating the bicyclist from traffic has improved safety for bikes significantly. In Bogotá there has been a 33% decrease in deaths relating to bikes (from 115 in year 2001 to 77 in year 2004). This has occurred despite the large increase in *CicloRuta*s trips. In addition, injuries reduced 8.8% (2,754 in 2001 to 2,512 in 2004) despite a 38% increase in bike use.

Speed is often an interesting benefit: bikes mean speed is 11 miles per hour, while private vehicles run at 8 miles per hour.

Additionally, air quality improvement is helped with the use of *CicloRuta*s when people leave the car at home. It was calculated for Bogota a reduction in GHG of 36.6 thousand tones of CO_2. CicloRutas also helped to recover public space, along riverbanks, and wetlands - the city's 13 wetlands were occupied for years by illegal constructors, after construction of the CicloRutas development stopped in this precious natural environment.


An example of a *CicloRuta* in Bogota.

Case Study:

3.4 San Francisco, California, USA

Key Transportation Strategies

San Francisco, a city with over 800,000 residents, has evolved over the last half century from a municipality that once required one parking space for every new dwelling to one of the most innovative examples of parking management in the country. This has occurred through investment in transit, gradual replacement of off-street parking minimum requirements with maximums, parking unbundling, and proactive on-street parking management. High density development and a preponderance of buildings that pre-date off-street parking mandates has helped keep the number of autos per person relatively low. Gradual transformation in parking provides useful mechanisms that other cities can appropriately modify and implement in their jurisdictions.

Table 5: Transportation Strategies Examined in the San Francisco Case Study

Group	Category	Sustainable Transportation Strategy
Pricing/Behavior	Manage traffic and congestion	SF*park* pilot program; Parking management (on-street and off-street parking); Unbundling parking cost
Efficient Resource Utilization	Support improvements in public transportation	Invested in Bay Area Rapid Transit System
	Link transportation & land use in transportation plans	Zoning (parking maximums)

Off-street Parking

Due to its low residential population and high number of commuters, the city introduced many of its parking reforms downtown. Following the opening of the Bay Area Rapid Transit Authority (BART) rail line in 1973, the city authorized a cap of all downtown commuter parking spaces. Minimums do not apply to any use downtown, and a maximum of one space is permitted for every four downtown residential units. Similarly, parking may occupy no more than seven percent of an office building's gross floor area, about one space for every 20 office workers.

San Francisco has proceeded to eliminate residential minimum parking requirements through the adoption of neighborhood plans for districts close to the downtown, and first through the Mission Bay Redevelopment Plan in 1997. More recently, the 2005 Rincon Hill Plan was the first to eliminate minimum parking requirements for *all* uses in a residential neighborhood.

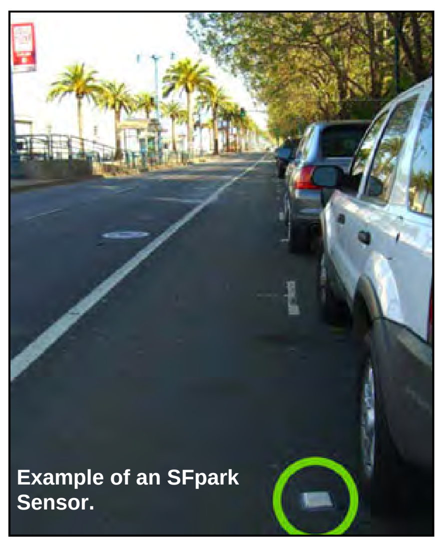

A parking meter displaying the SFpark logo.

Recent developments subject to residential parking maximums demonstrate that the maximums have a binding effect. Most developers build up to the maximum allowed number of spaces. The city's residential parking maximums range from 0.5 to one space per unit, depending on neighborhood factors such as access to transit and density; these were often converted from the existing minimum requirements.

"To some extent (parking maximums) have been achievable because they have been part of a larger package of policy and infrastructure and other changes for neighborhoods as prerequisite for development," reports Joshua Switzky of the San Francisco Planning Department. The drawback to comprehensive neighborhood planning, however, has been its slow pace. Several of the neighborhood plans recently implemented have taken nearly 10 years to complete, due to occasional funding gaps and the state's lengthy environmental review process.

The 2005 Rincon Hill Plan also mandated that developers unbundle parking spaces from residential units and dedicate parking spaces to car share and covered bicycle parking in larger residential developments. In April 2008 the city extended these reforms to the Hayes Valley, Duboce Triangle, and North Mission neighborhoods, and made unbundled residential parking a requirement throughout San Francisco.

Enforcement of parking unbundling is difficult and some developers have sought to circumvent the requirement. They legally unbundle the sale of a parking space from the residential unit but price the space well below market rate (such as for $100) to the buyer of a residential unit. The token sum leaves parking nearly free thus essentially bundled, but in compliance with the letter of the law. When parking spaces are unbundled, assessing the land they occupy has proven difficult. The city assessed unbundled parking spaces separate from the residential unit, but the spaces rather function more as easements. This is particularly the case when unbundled parking spaces are not independently accessible, that is, when parking spaces are "stacked" for greater efficiency.


Example of an SFpark Sensor.

Curbside Parking - San Francisco's SF*park*: Circle Less Live More

San Francisco probably has the most politically favorable environment for large scale parking reform of any major U.S. city. Though car use is high, the political boundaries of the dense city encompass very few car dependent areas. Prior to 2009, the city council / Board of Supervisors had already approved the highest curbside parking rates in the U.S. Curbside meter rates on neighborhood commercial strips were two to three times higher than New York or Chicago.

Despite this, meter rates were still politically sensitive, and apparently set too low because San Francisco continues to suffer from chronic curbside parking shortages. The resulting cruising and double parking led to heightened air pollution and significant bus service delays as documented in the SFMTA's Transit Effectiveness Project.

San Francisco's SF*park* is the largest, and by far the most sophisticated, curbside parking reform project underway in the United States. The San Francisco Municipal Transit Agency's (SFMTA) $24.75 million federally funded project encompasses 6,000 of San Francisco's 25,000 metered curbside parking spots in seven pilot neighborhoods. The heart of SF*park* is a Data Management System which sorts a tremendous amount of data collected from the networked array of remote sensors in all 6,000 parking spots. San Francisco installed new electronic, multi-space meters in 2009 and will activate parking spot sensors attached to the pavement sometime in 2010. These wireless sensors can detect whether a spot is occupied by a vehicle and report parking occupancy information in real time to a central computer. City officials and technology vendors say the parking sensors are so sensitive they can recognize the magnetic signature of individual vehicles. The project will produce valuable data about the effect of meter pricing on occupancy.

Paraphrasing the SFMTA, the city's transit provider and street manager:

> [SF*park*] "…will use pricing to help redistribute the demand for parking. The goal is to encourage drivers to park in garages and lots, and to almost always have one space available on every metered block. . . . With more availability, drivers will circle and double park less. Muni (buses) will be faster and more reliable, and greenhouse gas emissions reduced."

Putting the SFpark meters to good use.

The SFMTA's unstated hope is that SF*park* will change public attitudes towards metering through positive examples, and by providing better information and better customer service. It is expected that SF*park* will foster public support for a curbside parking system based on broader transportation goals rather than local politics.

SF*park* has three operational goals:

1. To provide real-time parking information.
2. "Just right" meter prices that mitigate parking demand.
3. Easy-to-pay meters and extended time limits for added convenience.

Additional goals include better ways to measure parking usage and better enforcement of parking rules. SFMTA internal surveys have shown that enforcement is erratic and poorly targeted, and as many as one third of vehicles are illegally parked at any given time. Data collected will provide real time information on turnover, length of stay, failure to pay and other illegal parking allowing the city to precisely and more effectively deploy enforcement personnel.

Changes in parking operations:

Rates are set based on occupancy targets. They may range from $0.25 to $6.00 per hour. Based on their effectiveness, rates will be reset in increments of up to $0.50 / hour every four.

- Rates will be set differently at different times of day and during special events to achieve the desired occupancy / availability objectives.

- Some meters are in effect longer than they had been. Again to ensure that occupancy and availability goals are met.
- Extended parking time limits
- Real-time information is available via web for curbside parking; information on off-street parking is available by web, variable message signs and SMS.
- More convenient payment methods are available: credit cards, pre-paid SFMTA smartcards and cash.

The SFMTA, overseen by the mayor, is the only major transit agency in the U.S. to control curbside parking and to receive all parking meter and fine revenue. Thus, the agency has a double financial incentive to properly manage curbside parking: it makes money from meters and fines, plus it saves money from bus operations when it reduces bus service delays caused by circling and double parked vehicles.

Before San Francisco shifted to digital meters over the last decade, it was losing $1.5 to $2.0 million a year to theft. As recently as 2007, the city was only collecting 22% of the maximum potential meter revenue it could, compared to 38% in San Diego and over 50% in Boston. (ITDP, 2010)

Table 6: San Francisco Hourly Parking Rates

Area	Pre-SF*park*	SF*park (Minimum-Maximum)*
Downtown/Commercial	$ 3.50	$ 0.25 to 6.00
Near Downtown	$ 3.00	$ 0.25 to 6.00
Neighborhood Retail	$ 2.00	$ 0.25 to 6.00

Table 7: Implementation Case Studies Summary

Category\City	San Francisco, CA	Portland, OR	London, U.K.	Bogota, Colombia
Manage traffic & congestion	Primary	Secondary	Primary	
Promote education and involvement of all transportation stakeholders		Secondary	Secondary	
Support improvements in public transportation	Secondary	Primary	Secondary	Primary
Link transportation & land use in transportation plans		Primary		Secondary
Prioritize highway repair and safety performance v/s new capacity				
Support non-motorized transportation		Secondary	Secondary	Primary

4.0 Scenario Planning

Along with performance indicators, scenario planning can be a useful tool for improved decision-making by allowing analyses of alternative future outcomes (scenarios) and consideration of their implications. Land use and transportation scenario analyses have become increasingly common in regional planning and often explore the potential benefits of increased density and the associated transportation outcomes.

Scenario planning exercises and observation of performance indicators go hand in hand in ongoing work towards sustainable transportation and livable communities. Through the development of desired scenarios, residents and policy makers outline their priorities and goals for the future. Performance indicators can then be selected to most effectively measure progress towards these goals. Performance measures can then be applied to a range of modeled future scenarios to gain insight on which strategies may have the greatest influence in moving towards the desired future, or vision. The indicators may also be used to track actual trends and, in turn, better inform subsequent iterations of the scenario planning process.

Each of these examples highlights communities that have tested the link between land use and transportation, as well as other factors such as demographics, economics, political environment, and environmental considerations, through scenario planning exercises. As previously noted, SAFETEA-LU encouraged the use of scenario planning in the long range transportation planning process. As a result, there are numerous examples to consider. The examples included in this report were selected as representative of the different parts of the United States, varying levels of integration between land use and transportation planning, and to illustrate different evaluation approaches.

4.1 Central Virginia 2035 LRTP

The Central Virginia MPO engaged in scenario planning in their LRTP process. The focus of this was on identifying different land use futures through public outreach. Several different alternatives were developed and tested, resulting in the identification of an Alternative Perspectives scenario. A variety of factors were used to compare the trend to the preferred alternative through the use of *CorPlan*. The transportation measures used include proximity to major roads, proximity to transit, enhanced walkable development, proximity to existing major employers, daily vehicle miles travelled compared to base year, and percent increase in VMT per household generated by new growth. Ultimately Alternative Perspectives scenario was not used in the 2035 LRTP cost feasible plan because it did not reflect existing land use policies. Additional work would be required to better integrate land use and transportation plan.

4.2 Chicago Metropolitan Agency for Planning (CMAP)

CMAP is a regional agency whose mission is to integrate land use and transportation in the seven county Chicago region. CMAP serves as the Chicago region's MPO as well as the region's Planning Commission, so its planning charge spans a variety of issues including Transportation, Land Use, Economic and Community Development, Environment and Natural Resources, Housing, and Human Service.

CMAP developed *Go to 2040*, the Chicago region's long-range comprehensive plan, which will also function as the regional transportation plan (RTP). The agency used a scenario planning based approach to develop the *Go to 2040* plan*.* The agency created three growth scenarios called *Reinvest, Preserve,* and *Innovate* with extensive public and stakeholder input. MetroQuest interactive software was used to develop the different growth scenarios. This software and the scenario planning exercise were branded as *Invent the Future*.

Different growth scenarios had varying levels of transportation investment accompanied with a unique land use development pattern. The three growth scenarios were modeled using the regional travel demand model and compared to understand how different packages of investment impacted regional growth and development in different ways. Table 8 below describes the three growth scenarios and transportation strategies considered for improving mobility under each scenario.

The performance of different scenarios was assessed with CMAP using variables and performance measures from the regional travel demand model and the agency's sustainability goals. A summary of their findings is presented in Table 9.

None of the scenarios were adopted or selected in its entirety, which was in line with the purpose of the scenario planning exercise. Instead the most effective strategies from each of the three scenarios were combined into a single scenario called the preferred Regional Scenario. Prior to the scenario planning exercise, a Regional Vision was developed and adopted. The strategies that make up the preferred Regional Scenario were selected because they were determined to be the best methods for achieving the Regional Vision. However, the preferred Regional Scenario was not used to identify specific policies, strategies, or projects.

Table 8: Chicago Area's Go To 2040 Scenarios

Growth Scenario	Land-use Strategy	Transportation Strategies
Reinvest: This scenario assumes significant infrastructure improvements in the transportation system and includes the highest level of investment in transportation capital facilities of the three scenarios.	Future growth is concentrated in the urban core of the 7-county region, transit-oriented development	• Capital improvements to transit facilities (increase travel speed for all transit vehicle types; Bus – queue-jump lanes, designated bus-only lanes, transit signal priority, off-board fare collection, and shoulder-riding enhancements, rolling stock; Rail – track and structure upgrade, electrical and communication system improvement, rolling stock) • Transit headway reduction • Freight operations improvements (intersection design changes, lengthening turning storage lanes, designated additional truck routes, removing delivery restrictions, planning for loading zones and truck access within site design, and designating parking and staging areas) • HOV/truck-only lanes • Arterial improvements in redeveloping and congested areas (areas with more than 3,000 households and jobs per square mile, roadways with v/c ration greater than one) • Pedestrian improvements in redeveloping areas
Preserve: assumes that the region invests heavily in existing transportation assets and that forecast growth and development can be accommodated by devoting transportation funds primarily to improving the performance of existing facilities.	Future growth primarily occurs in the first ring suburbs just outside the urban core but within the regions moderately dense area followed by second ring suburbs	• Transportation demand management • Parking policy • Car-sharing • Pedestrian and bicycle improvements • Transit system operations, including service extensions, headway reduction, and expanded paratransit • Highway system operations, including access management and increased intersection efficiency
Innovate: assumes that the region invests primarily in new intelligent transportation system (ITS) technologies in a new policy environment to enhance the performance of existing facilities. It includes both capital and non-capital investment in the area of technological improvements.	Future growth follows current land development pattern in that most of growth occurs outside the urban core with the highest percentage of growth occurring in the exurbs.	• Pricing (Variable pricing on expressways and parking) • Arterial operations (Advanced arterial signal systems) • Advanced transit (Transit signal priority, arterial rapid transit, travel information services) • Innovative polices (use of roundabouts and other innovative intersection treatments, application of context sensitive solutions, advanced vehicle technology, alternative fuels, and pedestrian improvements as part of new development)

Table 9: Performance of Go To 2040 Scenarios

Category	Indicator	Reinvest	Preserve	Innovate
Land consumption	Amount of agricultural land	Improves	Improves greatly	Improves
Infill Development	Number of new households in infill	Improves	Improves slightly	Stays the same
Open space access	Number of people in areas with 10 acres of open space per 1,000 people	Improves greatly	Improves	Improves
Imperviousness and runoff	Number of impervious acres added	Improves	Improves slightly	Improves slightly
Water use	Gallons of residential demand	Improves	Improves greatly	Improves
Congestion	Percent of VMT and VHT in congested conditions	Improves greatly	Improves slightly	Improves slightly
Air quality	Emissions of particulates and ozone	Worsens slightly	Improves slightly	Worsens slightly
Mode share	Mode share for transit, bicycling and walking	Improves slightly	Improves	Improves
Travel times	Average trip time by auto and transit	Improves	Mixed results	Mixed results
Jobs-housing access	Number of jobs accessed in 45 minutes by auto	Improves greatly	Improves slightly	Improves greatly
Environmental justice (EJ)	Number of new homes and jobs in EJ neighborhoods	Improves greatly	Improves slightly	Mixed results
Industry mix	Qualitative Analysis			
Scenario cost	Qualitative Analysis			

4.3 Denver Regional Council of Governments (DRCOG)

DRCOG is a nonprofit association of local governments dedicated to making the nine-county Denver region a great place to live, work and play. DRCOG is the regional planning commission for the Denver metro region. *Metro Vision* is the region's current plan to guide growth, transportation and environmental quality into the future and is the foundation of all of the regional council's long-range planning activities

DRCOG recently updated *Metro Vision* for the year 2035. As part of the update process, DRCOG explored future scenarios reflecting different land use and transportation policies. On the land use side, scenarios ranged from compact to expansive development patterns. On the transportation side, scenarios ranged from an emphasis on roadway improvements to an emphasis on transit improvements.

Performance of each scenario was evaluated on 12 outcome measures reflecting conditions in 2035. The measures relate to *Metro Vision* policy goals for land use, transportation, and environment. Specific measures are listed below:

- Additional land developed compared to 2030
- Public infrastructure cost
- Households and jobs within half-mile of high capacity transit
- Population and employment in urban centers
- Population and employment in Denver CBD (central business district)
- Vehicle miles traveled (VMT)
- Vehicle hours of delay
- Transit trips
- Low income/minority access to employment by transit
- Air pollutant emissions
- Water demand
- New wastewater treatment service


An example of Denver's bike-friendly streets.

Scenarios that favored compact development patterns and transit investments performed best on a variety of outcome measures including transportation system performance, infrastructure costs, accessibility and environmental impacts. In contrast, scenarios that significantly expanded the region's urban "footprint" did not perform as well and resulted in greater overload of key regional transportation facilities.

4.4 Gainesville Metropolitan Transportation Planning Organization (MTPO) 2020 LRTP

To complete its 2020 LRTP, the Gainesville MTPO embarked upon scenario planning to address concerns about projected high growth rates. Four alternative land use scenarios were developed, Compact, Radial, Town/Village Center, and Westward Growth, along with a base case or trend scenario. This process included several public workshops to identify the evaluation measures and discuss the results of the scenarios. Indicators used to assess the scenarios included vehicle emissions and amount of land consumed or affected by development. A preferred growth alternative was selected that combined the best of the Compact, Radial and Town/Village Center scenarios. Although the MTPO does not have land use authority, it adopted a new growth allocation model based on the results of this process. This case study illustrates better land use and transportation integration than Central Virginia case study, which abandoned its scenario planning exercise completely.

4.5 Nashville Metropolitan Planning Organization (MPO)

This example exemplifies a true land use-transportation planning nexus. The Nashville MPO is comprised of a seven county region. In 2007, the *Tri-County Transportation and Land Use Study* was undertaken to explore growth options for three of the MPO's member counties. This effort included public visioning workshops and used a GIS-based software package, *Community Viz*, to build a model for identifying potential regional growth areas.

The identification of these growth areas required three separate steps. First, the supply of buildable areas was identified. Next the development demand in each of these areas was determined. And finally, the suitability of each of these areas for growth was measured. Through public workshops, a preferred future land use scenario was identified and this was used as the basis for the modeling efforts for the 2035 Long Range Transportation Plan (LRTP).

Other sustainable transportation system policies included in the LRTP are Complete Streets and congestion management strategies. The following congestion management strategies were identified for implementation by the Nashville MPO.

- Increased multimodal transportation choices: includes increased frequency of service, extension of existing routes, new routes, transit priority and separate transit guideways.
- Bicycle and pedestrian facilities: increase the supply of these facilities.
- Roadway construction: building new roads or widening existing roads.
- Employment of intelligent transportation systems (ITS)

- Coordination with land use and urban design
- Employer-based TDM strategies such as staggered work hours, flexible scheduling, transit subsidies, on-site bicycle parking, on-site showers and work-site parking management
- Incident response and management
- Managed lanes and congestion pricing
- Collector street connectivity
- Access management

4.6 Sacramento Area Council of Governments (SACOG)

The SACOG is an association of local governments in the six-county Sacramento Region. It provides transportation planning and funding for the region, and serves as a forum for the study and resolution of regional issues. In addition to preparing the region's LRTP, SACOG approves the distribution of affordable housing in the region and assists in planning for transit, bicycle networks, clean air and airport land uses. As a forum for discussing issues facing the region, SACOG believes that the public should have a role in every project or plan at SACOG.

SACOG undertook a major effort to link transportation and land development more closely through the *Valley Vision Regional Blueprint Project*. In 2008, SACOG adopted the MTP for 2035, a long-range plan for transportation in the region that built on the *Blueprint*. As part of the update to the MTP, SACOG staff has developed three land use and transportation scenarios.

Eight simultaneous public workshops for the *TALL Order Forum: Moving the Region Forward* were held throughout the region connected through a satellite video system and bringing together 1,725 people to discuss what transportation options the area will need over the next 28 years. The workshop locations were spread out across the region so that people could give input on local and regional transportation investments.

The core of the evening’s activities focused on a series of group and individual exercises that allowed participants to provide direct input by reviewing three alternative scenarios for up to nine geographic corridors in the region, and choosing their preferences based on performance indicators, projects and features. Twenty-five performance indicators were presented for each scenario as shown in Table 10.

Table 10: Performance Indicators Presented at *Tall Order Forums*

Land-Use Inputs	Share of Growth in Center & Corridor Communities
	Share of Growth in Established Communities
	Share of Growth in Developing Communities
	Share of Growth in Residential Communities
	Share of Growth in Large-lot Single-family Homes
	Share of Growth in Small-lot, Single-family Homes
	Share of Growth in Attached Homes
Transportation Inputs	New or Expanded Roads
	Transit Service (Vehicle Service Hours, percent increase)
	Funding for Transit
	Funding for Road, Bike and Pedestrian Maintenance
	Funding for New Road Capacity
	Funding for Bike and Pedestrian Street Improvements
	Funding for Programs (e.g. Community Design, Air Quality, Travel Demand Mgmt)
Outcomes	Square miles of farmland converted to development
	Square miles of vernal pools affected by development
	Share of new homes near high-frequency transit
	Share of new jobs near high-frequency transit
	Total homes in environmental justice areas near high-frequency transit
	Transit costs recovered by ticket sales
	Share of trips by transit, bike, or walk *(percent increase per capita from 2008)*
	Vehicle miles traveled (VMT) *(percent change per capita from 2008)*
	Vehicle miles traveled in heavy congestion *(percent of total vehicle miles traveled)*
	Travel time spent in car per capita *(percent change from 2008)*
	Weekday passenger vehicle CO_2 emissions *(percent change per capita from 2005)*

Participants gave input through questionnaires and interactive keypad polling for real-time results during the event. Two-thirds of the 1,225 participants (812) completed the questionnaire asking them to choose their first and second priority principles for guiding the development of the MTP from a list of six principles. Participants could also define additional principles. Some of the most common themes identified included:

- Smarter land use—more mixed use and higher density, more bicycle and pedestrian accessibility
- Increased transit—more efficient and convenient transit (especially rail)
- Regional connections—better connections with transit, freeway enhancements, and bicycle paths.

The SACOG Board of Directors was also given the chance to comment on the three alternative scenarios for the nine corridors introduced to the community at the *TALL Order Forum*. After SACOG staff presented the results of community input on each corridor, the board used laptop computers to provide free-form comments that were captured in real-time and projected on screens to allow a structured discussion between Board members and written comments for staff review as part of further MTP development. For each corridor, Board members were asked individually to answer the following questions.

- What aspects of the three scenarios presented on November 16 do you like the most?
- Are there any additional ideas not included in the scenarios you think should be considered?
- Is there any additional information on costs and/or benefits of the scenarios that you would like staff to provide the Board?

4.7 Tel Aviv Transportation Research

An interesting study, from Tel Aviv, Israel, that examines the effectiveness of different sustainable transportation strategies was found. This study did not employ a regional transportation model to evaluate the effectiveness of the strategies, but rather the Delphi method. While no models were used to evaluate the scenarios, the survey process used to identify transportation strategies is relevant.

The 2003 research, as reported in Shiftan's *Scenario Building as a Tool for Planning a Sustainable Transportation System,* examined the potential policy measures that may contribute to a sustainable transportation system in Tel Aviv. The researchers identified 26 policies under five main categories as presented in Table 11.

The researchers created a matrix that was sent to 63 professionals in transportation, regional planning, economics, environment, and geography. The respondents were asked to rate each policy on its probability of implementation and then on its desirability in achieving stated goals. Based on the results, two scenarios were developed. An "*expected scenario*" based on the measures which were ranked as the most probable. And a "*desired scenario*" based on the measures ranked as most desirable. After the creation of the scenarios, a second survey was sent out to the same professionals asking them to further evaluate the desirability of the policy packages.

Table 11: Tel-Aviv Policies Identified for Moving Toward Sustainable Transportation

Category	Policies
Spatial Measures	(1) car-restricted, pedestrian-friendly zones, (2) high density land uses along main public transport corridors, (3) high density development near major public transport stations, (4) mixed land use development, and (5) high density development around the CBD area
Economic Measures	(1) heavy taxes on more than one vehicle per household, (2) high parking fees in CBD, (3) congestion pricing around the CBD, (4) heavy subsidization of public transport in order to decrease fares, (5) privatization of public transport, and (6) consideration of external costs in the evaluation of new projects.
Technological Measures	(1) incentives for buying zero emission vehicles, (2) intensive development of ITS systems, (3) a high quality public transport system based on buses and LRT, (4) a high quality public transport system based on a subway in the core area, (5) the development of communication infrastructure and local centers for telecommuting, and (6) increasing parking spaces in the core area by automated parking
Government Measures	(1) operating public transport daily, 24 hours a day, (2) reducing the development of new roads, (3) extensive development of new roads, (4) limiting parking spaces in zones that are well-served by public transport, and (5) granting a business license on the basis of the provision of adequate public transport for employees
Social and Behavioral Measures	(1) public information as an aid to trip planning (time tables, different means of travel, fastest path from-to destination), (2) information about the negative external effects of transportation on the environment, (3) information about how telecommuting can reduce the number of trips, (4) educational programs to increase public transport ridership and carpooling

Expected Scenario: The *Expected scenario* included a high level of transit service based on light rail (LRT) and buses; high density zones of population and employment located along the main corridors of this transit system, with the highest density near major stations; and the use of private cars was restrained through parking limitations (high prices and limited spaces) in the central business district (CBD) and adjacent areas. There were some pedestrian-friendly restricted car zones in other areas that are served by high quality public transportation. In this scenario, the road network was highly developed and included heavy use of ITS. A substantial expansion of electronic communication system infrastructure was included to promote telecommuting. Finally, a campaign of education programs was planned to explain the benefits of public transportation and trip planning and to increase public awareness of the possible negative effects of transportation on the environment.

The analysis of the *Expected scenario* ascribed the highest scores to the spatial and land use measures in terms of achievement of all goals. Among these measures, the development of high density areas of population and major activities near the public transport stations was deemed the best. The second best measure was the development of high density areas along the public transportation corridors. A statistical analysis showed a significant difference between the best and second best spatial measures.

The technological measures rated second best, with the two highest ranking measures being the development of a subway in the CBD and the development of a system based on LRT. The difference between these measures was not significant.

The economic and governmental policy measures received the same scores, except as related to environmental goals where the economic policy measures showed an advantage over the governmental measures. Neither the economic policies nor any of the governmental policies, performed significantly better than the others.

All of the educational measures received very low scores. One conclusion of the study is that sustainable development must be achieved through a combination of policy measures. An additional measure added by the experts during the survey was that a metropolitan transportation authority responsible for strategic transportation planning should be established.

Desired Scenario**:** The *desired scenario* included a high quality public transportation system based on LRT and buses or a subway. The land use element of this scenario focused on the development of high-density near major stations and strengthening the role of the CBD by increasing high-density land uses and enhancing areas of specialization. Other elements included car-restricted, pedestrian zones in central areas; either high parking fees in the CBD or congestion pricing around the core; limited parking in areas well served by public transportation; intensive use of ITS; and intensive use of zero emission vehicles. This scenario also includes the creation of a metropolitan transportation authority.

A detailed comparative analysis of the measures in the desired scenario was not conducted since the measures employed were based on those that scored the highest from the expected scenario package. The researchers did conclude, however, that the elements of the desired scenario did a better job of addressing existing problems, and that the implementation of this scenario would likely lead to a sustainable transportation system.

Table 12: Summary of Scenario Planning Studies

Category\City	Nashville, TN	Central Virginia, VA	Denver, CO	Sacra-mento, CA	Gaines-ville, FL	Minnesota	Chicago, IL	Tel Aviv, Israel
Manage traffic & congestion	Primary						Primary	Primary
Promote education and involvement of all transportation stakeholders						Primary	Secondary	Primary
Support improvements in public transportation	Primary		Primary	Primary			Secondary	Primary
Link transportation & land use in transportation plans	Primary	Primary	Primary	Primary	Primary		Primary	Primary
Prioritize highway repair and safety performance v/s new capacity							Primary	
Support non-motorized transportation	Secondary			Primary			Primary	Primary

Appendix A

Sustainability Definition Research

For this study defining a sustainable transportation system is essential to determining the characteristics of such a system and to investigate appropriate performance measures for evaluating sustainability. Furthermore, it helps refine the methodology for creating and evaluating different scenarios. Finally, the definition of sustainable transportation will help guide decision making throughout the process of this study.

Definitions of sustainability in general, and for a sustainable transportation system specifically, can be stated and expressed in numerous ways. Since the late 1980's several different definitions of sustainability have been presented. Earlier definitions of sustainability were broad-ranging and did not explicitly address sustainable transportation. Table A-1 describes some of the key sustainability definitions and its implications on sustainable transportation.

Table A-1: Sustainability and Transportation

Year	Source	Sustainability Definition	Extension of Sustainability Concept to Transportation Sector
1987	Brundtland report (United Nations World Commission on Environment and Development)	Sustainable development was defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs	Transport that meets the current transport and mobility needs without compromising the ability of future generations to meet these needs.
1992	Daly	Specifies parameters for any sector being sustainable	Transport is sustainable if it satisfies three conditions: (*a*) the rate at which it uses renewable resources does not exceed their rates of regeneration, (*b*) the rate at which it uses nonrenewable resources does not exceed the rate at which sustainable renewable substitutes can be developed, and (*c*) its rate of pollution emissions does not exceed the assimilative capacity of the environment.
1996	Schipper	No specific definition of sustainability	Sustainable transport is transportation where the beneficiaries pay their full social costs, including those that would be paid by future generations. Changes in travel are associated with a number of prominent externalities, including accidents, air pollution, congestion, noise, damage to species habitat, increases in carbon dioxide production, and the importation of oil. It is these externalities, and not transportation or travel per se, which threaten the sustainability of the system.

Sustainable transportation can be viewed as an expression of multi-dimensional, comprehensive, sustainable development. Transportation can be sustainable based on the kind of impact it has on environment and society, or it can also be a means of helping to achieve sustainability in other aspects of human endeavor. A transportation policy, however, should not be considered sustainable if it does not support the overarching goals and vision of the community.

Sustainable transportation will address local, regional, national, and global issues and therefore requires considerable coordination. Furthermore, sustainability is not a point that when reached, all is fine. Sustainability is better thought of as a continuum. A plan is sustainable, or it is not. If it is not sustainable, changes can be made to make it sustainable. If it is sustainable, by necessity it will be changing and evolving. Sustainability is not static—it is iteratively changing, based on evolving knowledge that connects science and planning. (Williams, 2007)

While there is no standard definition for a sustainable transportation system, there is emerging consensus that such a system should be effective and efficient in providing its users with equitable and safe access to basic social and economic services, should promote economic development, and not be harmful to the environment. Table A-2 shows several working definitions of sustainable transportation and sustainability.

Table A-2: Adopted Definitions for Sustainable Transportation (Jeon, 2005)

Organization	Definition of Sustainable Transport/Sustainability
Ontario Roundtable on Environment and Economy (ORTEE) 1995. Canada.	(1) Produce outputs (emissions) at a level capable of being assimilated by the environment. (2) Have a low need for inputs of non-renewable resources (where non-renewable are used, their use will be for non-consumptive investments and they will be recycled when no longer useful or needed). (3) Minimize disruption of ecological processes, land (and water area) use is also minimized as well as uses of sensitive habitats.
Organization for Economic Cooperation and Development (OECD) 1999.	Transportation does not endanger public health or ecosystems and meets needs for access consistent with (a) use of renewable resources below their rates of regeneration, and (b) use of non-renewable resources below the rates of development of renewable substitutes.
Transportation Association of Canada (TAC) 1999. Canada.	(1) In the *natural environmen*t: limit emissions and waste (that pollute air, soil and water) within the urban area's ability to absorb/recycle/ cleanse; provide power to vehicles from renewable or inexhaustible energy sources (such as solar power in the long run); and recycle natural resources used in vehicles and infrastructure (such as steel, plastic, etc.). 2) In *society*: provide equity of access for people and their goods, in this generation and in all future generations; enhance human health; help support the highest quality of life compatible with available wealth; facilitate urban development at the human scale; limit noise intrusion below levels accepted by communities; and be safe for people and their property. 3) In the *economy*: be financially affordable in each generation; be designed and operated to maximize economic efficiency and minimize economic costs; and help support a strong, vibrant and diverse economy.
California Department of Transportation (2001)	A sustainable transportation system meets the basic mobility and accessibility needs of current and future generations.
The Center for Sustainable Transportation	(1) Allows the basic access needs of individuals and societies to be met safely and in a manner consistent with human and ecosystem health, and with equity within and between generations;

Organization	Definition of Sustainable Transport/Sustainability
(CST) 2002. Canada.	(2) Is affordable, operates efficiently, offers choice of transport mode, and supports a vibrant economy; (3) Limits emissions and waste within the planet ability to absorb them, minimizes consumption of non-renewable resources, reuses and recycles its components, and minimizes the use of land and the production of noise.
Victoria Transport Policy Institute (VTPI) 2003. Canada.	Providing for a secure and satisfying material future for everyone, in a society that is equitable, caring, and attentive to basic human needs
Procedures for Recommending Optimal Sustainable Planning of European City Transport Systems (PROSPECTS) 2003.	A sustainable urban transport and land use system: (1) provides access to goods and services in an efficient way for all inhabitants of the urban area; (2) protects the environment, cultural heritage and ecosystems for the present generation, and (3) does not endanger the opportunities of future generations to reach at least the same welfare level as those living now, including the welfare they derive from their natural environment and cultural heritage.
Department of Sustainable Development. 2003. United Kingdom.	Sustainable development is about ensuring a better quality of life for everyone, now and for generations to come. This requires meeting four key objectives at the same time in the U.K. and the world as a whole: (1) social progress which recognizes the needs of everyone; (2) effective protection of the environment; (3) prudent use of natural resources, and (4) maintenance of high and stable levels of economic growth and employment.
World Business Council for Sustainable Development. 2004	...mobility that meets the needs of society to move freely, gain access, communicate, trade and establish relationships without sacrificing other essential human or ecological requirements today or in the future.

Major organizations such as the Organization for Cooperation and Economic Development (OECD) and the Center for Sustainable Transportation (CST) of Canada have adopted definitions for sustainable transportation. Many organizations, including the European Union (EU) and the International Association of Public Transport (UITP), have adopted the three part definition offered by the CST in 2002.

Appendix B

Sustainability and Transportation Policy

Federal, State and Local government entities have enacted policies and programs that support sustainable planning, often highlighting the linkage between land-use and transportation planning in moving towards sustainability.

2.1 Federal Sustainability Initiatives

'Livability' and 'sustainable communities' are phrases that are often used interchangeably, and often touted by the Obama Administration. The Administration has defined livable communities as "those in which transportation, housing, and commercial development investments are coordinated" (HUD, 2010). Livable communities are designed to "increase choices for transportation users, provide affordable connections from residences to employment centers and other key amenities, and enhance economic opportunities and environmental sustainability" (DOT, 2010).

Partnership for Sustainable Communities - In June 2009, the U.S. Department of Transportation (DOT) U.S. Department of Housing and Urban Development (HUD), and U.S. Environmental Protection Agency (EPA) announced that they were forming the interagency Partnership for Sustainable Communities. The three agencies agreed to collaborate to help communities become economically strong and environmentally sustainable.

This action marked a fundamental shift in the way the federal government structures its transportation, housing, and environmental spending, policies, and programs. The Partnership for Sustainable Communities established six livability principles that will act as a foundation for interagency coordination:

1. *Provide more transportation choices*. Develop safe, reliable and economical transportation choices to decrease household transportation costs, reduce our nation's dependence on foreign oil, improve air quality, reduce GHG and promote public health.

2. *Promote equitable, affordable housing*. Expand location- and energy-efficient housing choices for people of all ages, incomes, races and ethnicities to increase mobility and lower the combined cost of housing and transportation.

3. *Enhance economic competitiveness*. Improve economic competitiveness through reliable and timely access to employment centers, educational opportunities, services and other basic needs by workers as well as expanded business access to markets.
4. *Support existing communities*. Target federal funding toward existing communities – through such strategies as transit-oriented, mixed-use development and land recycling – to increase

community revitalization, improve the efficiency of public works investments, and safeguard rural landscapes.

5. *Coordinate policies and leverage investment*. Align federal policies and funding to remove barriers to collaboration, leverage funding and increase the accountability and effectiveness of all levels of government to plan for future growth, including making smart energy choices such as locally generated renewable energy.
6. *Value communities and neighborhoods*. Enhance the unique characteristics of all communities by investing in healthy, safe and walkable neighborhoods – rural, urban or suburban. (EPA)

Besides supporting coordinated planning, the Partnership agencies are working with state and local governments, nonprofit organizations, and other entities to learn about federal policies that have hampered their work. The Partnership plans to continue examining and, if necessary, modifying federal policies and actions on transportation, housing, and environmental protection to complement each other and to better reflect the Livability Principles. According to their literature, The Partnership for Sustainable Communities recognizes that effective decision-making about how and where growth occurs depends on understanding and properly addressing the unique needs of different socioeconomic groups. (EPA 2010)

Department of Transportation

President Obama's budget request for DOT in FY2011 totals $79 billion, a $2 billion increase over FY2010 levels. These resources will support DOT's top transportation goals:

- Safety on the roads and rails and in the air
- Making communities livable and sustainable
- Modernizing infrastructure (USDOT, 2010)

A major way DOT helps communities pursue livability aims is by issuing grants to eligible recipients for planning, vehicle purchases, facility construction, operations, and other purposes. DOT administers this financial assistance according to SAFETEA-LU authorization. The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) includes several provisions intended to enhance the consideration of environmental issues and impacts within the transportation planning process. Some of the planning provisions stipulate that certain elements and activities be included in the development of long-range transportation plans, including:

- Consultations with resource agencies, such as those responsible for land-use management, natural resources, environmental protection, conservation and historic preservation, which shall involve, as appropriate, comparisons of resource maps and inventories
- Discussion of potential environmental mitigation activities
- Participation plans that identify a process for stakeholder involvement, and
- Visualization of proposed transportation strategies where practicable (FHWA)

The competitive funding opportunities offered by the USDOT to support their sustainability goals are described in Appendix A.

On March 11, 2010 the DOT signed a policy statement on Bicycle and Pedestrian Accommodation Regulations and Recommendations. The DOT policy is to incorporate safe and convenient walking and bicycling facilities into transportation projects. “Because of the numerous individual and community benefits that walking and bicycling provide , including health, safety, environmental, transportation, and quality of life, transportation agencies are encouraged to go beyond minimum standards to provide safe and convenient facilities for these modes.” This policy is based on various sections in the United States Code (U.S.C.) and the Code of Federal Regulations (CFR) in Title 23 Highways, Title 49 Transportation, and Title 42 The Public Health and Welfare. These sections describe how bicyclists and pedestrians of all abilities should be involved throughout the planning process, should not be adversely affected by other transportation projects, and should be able to track annual obligations and expenditures on non-motorized transportation facilities.

Another recent policy change from FDOT involves the Federal Transit Administration’s (FTA) New Starts Program. FTA’s New Starts program funds locally planned, implemented, and operated rail and bus projects. In January 2010, DOT changed a rule that had required the New Starts program to consider cost-effectiveness above all other factors when selecting major transit projects to support. Changes will give meaningful consideration to a broader range of benefits transit can provide, including economic development, a healthier environment, and increased access to opportunities. (EPA, 2010)

Department of Housing and Urban Development

In February 2010, HUD launched the Office of Sustainable Housing and Communities to serve as the center point for HUD’s sustainability efforts and the main liaison to the Partnership. The Office of Sustainable Housing and Communities will support stronger, more sustainable communities by advancing policies that connect housing to jobs, foster local innovation, and support a clean energy economy.

There are two main areas of operation that work together to comprise the Office of Sustainable Housing and Communities: the Sustainable Communities Initiative and the Energy Innovation Fund which deals with the residential energy efficiency sector.

The objective of the Sustainable Communities Initiative is to stimulate more integrated and sophisticated regional planning to guide state, metropolitan, and local investments in land use, transportation and housing, as well as to challenge localities to undertake zoning and land use reforms.

Recent policy changes reflect HUD’s commitment to integrating sustainability into future growth. In May 2010 it was announced that HUD would employ the Leadership in Energy and Environmental Design for Neighborhood Development (LEED-ND) system to evaluate applications for its $3.25 billion in discretionary funding. LEED-ND is a system for rating and certifying neighborhoods that integrate housing with jobs and services, offer a range of transportation choices, and incorporate green building and green infrastructure. With this change, grant applications that emphasize sustainable communities can be awarded additional points. (EPA, 2010)

US Environmental Protection Agency

According to their website, the U.S. Environmental Protection Agency’s mission is to protect human health and the environment. Where and how we build communities has a major impact on the environment and on public health. By promoting more environmentally, economically, and socially sustainable communities, EPA can help protect our nation’s air, water, land, and people.

EPA aims to make sustainability the next level of environmental protection by drawing on advances in science and technology, applying government regulations and policies to protect public health and welfare, and promoting green business practices. (EPA)

Clean Air Act: Under the Clean Air Act, EPA establishes air quality standards to protect public health and the environment. EPA has set national air quality standards for six common air pollutants. These include:

- carbon monoxide,
- ozone,
- lead,
- nitrogen dioxide,
- particulate matter (also known as particle pollution), and
- sulfur dioxide.

EPA, state, local and tribal air quality planning agencies work together to identify areas of the US that do not meet the EPA's National Ambient Air Quality Standards (NAAQS). These areas, known as non-attainment areas, must develop plans to reduce air pollution. Each Year, EPA tracks air quality progress in non-attainment areas by reviewing changes in measured concentrations with respect to standards. It is important to note that EPA periodically reviews the standards and their scientific basis, and revises the standards as appropriate to protect public health and the environment.

The Clean Air Act takes a comprehensive approach to reducing pollution from motor vehicles by requiring manufacturers to build cleaner engines; refiners to produce cleaner fuels; and non-attainment areas to adopt and run passenger vehicle inspection and maintenance programs.

Congress required "conformity" in the Clean Air Act Amendments of 1990. In other words, transportation projects such as construction of highways and transit rail lines cannot be federally funded or approved unless they are consistent with state air quality goals. In addition, transportation projects must not cause or contribute to new violations of the air quality standards, worsen existing violations, or delay attainment of air quality standards.

***Smart Growth Implementation Assistance (SGIA) Program*:** Through the SGIA program, EPA solicits applications from state, local, regional, and tribal governments that want to incorporate smart growth techniques into their future development. Once selected, communities receive direct technical assistance from a team of national experts in one of two areas: policy analysis (e.g., zoning codes, school siting guidelines, transportation policies) or public participatory processes (e.g., visioning, design workshops, alternatives analysis). EPA tailors the assistance to the community's unique situation and priorities and provides the contractor team.

Water Quality: Green infrastructure is an approach to wet weather management that is cost effective, sustainable, and environmentally friendly. Green infrastructure management approaches and technologies aim to maintain or restore natural hydrology. Many of these approaches, including green streets, and other innovative stormwater management techniques, can also make neighborhoods safer, healthier, and more attractive. EPA has compiled a list of funding resources to help communities fund green infrastructure projects.

State Sustainability Initiatives

The State of Florida has been very aggressive in adopting environmental policies that support sustainability across various sectors. Former Governor Crist hosted a *Serve to Preserve* summit in Miami in July 2007, which addressed reducing emissions of greenhouse gases (GHG). The Governor signed in effect three Executive Orders to carry out commitments to reducing Florida's energy usage and GHG emissions:

1. Executive Order 07-126, "Leadership by Example: Immediate Actions to Reduce Greenhouse Gas Emissions from Florida State Government": directs the state government to reduce its emissions 10% by 2012, 25% by 2017, and 40% by 2025.

2. Executive Order 07-127, "Immediate Actions to Reduce Greenhouse Gas Emissions within Florida" commits Florida to be a leader in the reduction of GHG which will limit climate change.

3. Executive Order 07-128, "Florida Governor's Action Team on Energy and Climate Change" creates an Action Team to develop a comprehensive Energy and Climate Action Plan to reduce statewide GHG emissions.

Florida's Growth Management Act requires all of Florida's counties and municipalities to adopt 'Local Government Comprehensive Plans' that guide future growth and development. Comprehensive plans contain chapters that address future land use, housing, transportation, infrastructure, coastal management, conservation, recreation and open space, intergovernmental coordination, and capital improvements. The State's Growth Management Act authorizes the Department of Community Affairs (DCA), Division of Community Planning, to review comprehensive plans and plan amendments for compliance. The following agencies also review comprehensive plans and amendments and may issue recommended objections to the Department.

- Regional Planning Councils
- Water Management Districts
- Department of State
- Department of Transportation
- Department of Environmental Protection
- Agriculture and Consumer Services
- Florida Fish and Wildlife Conservation Commission

Florida Department of Transportation (FDOT)

The FDOT's mission is to provide a safe transportation system that ensures the mobility of people and goods, enhances economic prosperity and preserves the quality of our environment and communities. Efforts to promote sustainability include the Pedestrian and Bicycle Program, Florida's Highway Beautification Program, and safety programs.

The Pedestrian-Bicycle Program oversees the Florida School Crossing Guard Training Program, the Florida Traffic Safety Education Program, and the Safe Routes to School Program. District Pedestrian and Bicycle Coordinators and other District personnel assist with the pedestrian and bicycle aspects of FDOT projects and activities in the seven FDOT Districts. Safety Office staff coordinate development and dissemination of information about walking and cycling safety.

Florida Department of Environmental Protection (FDEP)

FDEP sustainability initiatives relating to transportation planning include their Coastal Management Program, Office of Environmental Education, and a Brownfields GeoViewer mapping tool.

Local Sustainability Initiatives

Southeast Florida, Miami-Dade County and Miami-Dade cities are involved in several initiatives to address climate change and promote sustainability in transportation. Most of the regional and county level initiatives focus on reducing GHG in order to curb climate change.

Southeast Florida Regional Climate Change Compact - The Southeast Florida Regional Climate Change Compact represents a joint commitment of Broward, Miami-Dade, Palm Beach and Monroe Counties to partner in mitigating the causes and adapting to the consequences of climate change. The Compact was formalized following the Southeast Florida Climate Leadership Summit, when elected officials came together to discuss challenges and strategies for responding to the impacts of climate change. The Compact outlines a collaborative effort to participate in a Regional Climate Team toward the development of a Southeast Florida Regional Climate Change Action Plan. The Compact also commits the Counties to work on federal and state climate policies and joint advocacy in Tallahassee and Washington, DC.

greenPRINT: Released in December 2010, *greenPRINT* is the Miami-Dade County's first Climate Action Plan. According to the Miami-Dade County website, “There are 137 separate initiatives outlined in *greenPRINT*, many of which will directly contribute to a reduction of GHG emissions. It is estimated that these initiatives will result in a reduction of 1.5 million metric tons of GHG emissions and an avoidance of 3.1 million metric tons over the next five years, and move us toward even deeper reductions in the future. These are our first collective and comprehensive steps to address climate change and to creating a resilient Miami-Dade County of tomorrow.” The two ‘Responsible Land Use & Smart Transportation’ goals delineated in the plan are:

- Use our land wisely, creating and connecting strong sustainable neighborhoods
- Provide more transportation options, reducing the time we spend in our cars

Miami-Dade County Office of Sustainability - Created in 2008, the Miami-Dade Office of Sustainability collaborates with County agencies, business groups, non-profit organizations and other partners to protect and enhance the County's distinct environmental quality and livability. The Office leads the development and implementation of *greenPRINT*.

Cool Counties Program - In 2007, twelve large U.S. counties, including Miami-Dade County, and the Sierra Club launched the "Cool Counties Climate Stabilization Declaration", a major new initiative to combat climate change. Signatory counties pledge to reduce GHG 80% by 2050. The Declaration also urges the federal government to require an 80% emissions reduction by 2050, and calls for vehicle fuel economy standards to be raised to 35 miles per gallon within a decade. (Fairfax County)

Anticipating accelerated reductions in later years, the County has adopted a target of 10% reduction in GHG by 2015. While the County has adopted GHG reduction initiatives through *greenPRINT*, and expects accelerated deployment efforts after the initial 2015 target, there is still a sizeable gap in forecasted GHG reduction scenarios and the Cool Counties commitment of an 80% reduction by 2050. In *greenPRINT,* the county asserts "While this may seem daunting, it emphasizes the need for continuous development of initiatives that will further GHG emissions reductions in future *greenPRINT* updates."

Miami-Dade County Climate Change Advisory Task Force (CCATF) - In July, 2006, the Board of County Commissioners established the Miami-Dade County Climate Change Advisory Task Force (CCATF), through the adoption of Ordinance 06-113. This unanimous action by the Board further cemented Miami-Dade County's commitment to continuing its greenhouse gas reduction efforts and established the County as a leader in climate change adaptation planning.

The CCATF serves as an advisory board to the Board of County Commissioners and is charged with identifying potential future climate change impacts to Miami-Dade County, while providing recommendations regarding mitigation and adaptation measures to respond to climate change. However, the Mayor and the Board are responsible for making the decisions to accept and implement the CCATF recommendations concerning climate change. The recommendations may then become a part *greenPRINT*.

Seven CCATF committees/subcommittees have been established to focus on specific areas of climate change mitigation and adaptation. In addition to the appointed members, there are various County and municipal liaisons and representatives from numerous universities, local businesses and environmental and regional organizations who participate in CCATF meetings and associated committee meetings.

> **Urban CO_2 Reduction Plan -** The 'Urban CO2 Reduction Plan', initially adopted in 1993, identifies 35 unique opportunities to improve County operations, reduce energy demand, improve our quality of life, and establish an example for the rest of the country to follow focusing on energy use, transportation, land use, and solid waste. Progress under the CO_2 Reduction Plan was reported annually to the Board of County Commissioners, with the latest report published in 2006.
>
> **ICLEI Local Governments for Sustainability -** In 1991, Miami-Dade County became a founding member of ICLEI - Local Governments for Sustainability, an association of over 1200 local government Members who are committed to sustainable development. Members come from 70 different countries and represent more than 569,885,000 people. ICLEI provides technical consulting, training, and information services to build capacity, share knowledge, and support local government in the implementation of sustainable development at the local level. The basic premise is that locally designed initiatives can provide an effective and cost-efficient way to achieve local, national, and global sustainability objectives. (ICLEI)

Miami-Dade County and the City of Miami have also documented plans for enhancing livability, including regulations on how new development should occur and plans that show support for non-motorized transportation. These documents each shed light on the region's vision of its future.

> **Comprehensive Development Master Plan -** The County's Comprehensive Development Master Plan calls for development and redevelopment to occur along transit corridors and designated urban centers. Urban centers are designed to contain businesses, employment, civic, and/or high-

or moderate-density residential uses within walking distance from transit stations. Roadways and other structures within the centers are designed to encourage pedestrian activity, safety and comfort. The proximity of housing and retail allows residents to walk or bike for some daily trips and encourages transit use for commuting. Ultimately, these centers are hubs for development intensification in Miami-Dade County, around which a more compact and efficient urban structure will evolve.

Miami-Dade County Parks and Open Space System Master Plan - This Park and Open Space System Master Plan envisions that great parks, public spaces, natural and cultural areas, streets, greenways, blueways, and trails can form the framework for a more sustainable community. Such a plan for the public realm cannot be considered as an isolated system, but one that is integrated into the overall fabric of the community.

Miami 21 - Miami 21, the Zoning Code for the City of Miami, is a Form-Based Code guided by tenets of New Urbanism and Smart Growth. Miami 21 represents the “Miami of the 21st Century” and aims to provide a holistic approach to land use and urban planning. The code includes regulations on thoroughfares and parking provision.

City of Miami Bicycle Initiatives - The Bicycle Action Committee (BAC) was formed in 2008 as a means to push Miami forward to becoming a Bicycle Friendly City. The BAC is composed of representatives from various City departments, business owners, and cycling advocates. The BAC was responsible for the creation of the 2008 Bicycle Action Plan which set in motion the 2009 Bicycle Master Plan that aims to make Miami a Bicycle Friendly City by 2012.

The Bicycle Master Plan will be the city's guiding document and one of the steps aimed at creating a diverse set of transportation alternatives and supports a lively, active city for all residents and guests. The master plan will include the development of bicycle parking standards/guidelines, an updated bicycle network map, educational materials, and evaluation tools for use by City staff involved in coordinating, planning, designing, and constructing bicycle lanes and facilities within the city's limits.

Appendix C

USDOT Competitive Funding Sources

Surface Transportation Program

The Surface Transportation Program (STP) (23 U.S.C. 133) is one of the main sources of flexible funding available for transit or highway purposes. The Surface Transportation Program provides flexible funding that may be used by states and localities for projects on any federal-aid highway, including the National Highway System, bridge projects on any public road, transit capital projects, and intracity and intercity bus terminals and facilities. It can be used for a broad array of highway purposes and flexibly used for major transit purposes as well. A few examples include buying buses or rail vehicles or constructing fixed guideway systems like light rail or heavy rail.

Congestion Mitigation and Air Quality (CMAQ) Program

The other major source of flexible funding is from the Congestion Mitigation and Air Quality Improvement Program (CMAQ) (23 U.S.C. 149). The CMAQ program supports transportation projects or programs that will improve air quality and relieve congestion in areas that do not meet National Ambient Air Quality Standards. Reducing pollution and other adverse environmental effects of transportation projects and transportation system inefficiency have been long-standing DOT objectives.

CMAQ funds may be used to establish new or expanded transportation projects or programs that reduce emissions, including capital investments in transportation infrastructure, congestion relief efforts, and diesel engine retrofits. Other CMAQ projects include operating assistance for new transit services, travel demand management strategies, traffic flow improvement programs that reduce emissions, and bicycle/pedestrian facilities and programs.

Transportation, Community and System Preservation Program

These discretionary funds, usually earmarked by Congress, may be used to carry out eligible projects to integrate transportation, community, and system preservation plans and practices that improve the efficiency of the transportation system of the United States; reduce the impacts of transportation on the environment; reduce the need for costly future investments in public infrastructure; provide efficient access to jobs, services, and centers of trade; examine community development patterns; and identify strategies to encourage private-sector development.

Public Transportation on Indian Reservations

Based upon an annual national competitive selection process, FTA awards Tribal Transit grants directly to federally-recognized Indian tribes. Recipients of Tribal Transit Program grants may use these funds for planning, capital and operating assistance for rural public transit services, and support for rural intercity bus service.

Paul S. Sarbanes Transit in the Parks Discretionary Grant Program

This program protects environmentally sensitive national parks, forests, wildlife refuges, and other federal lands while improving visitor experience through funding for public transportation and other alternative transportation. Administered by FTA in partnership with the Department of the Interior and the Forest Service, the program funds capital and planning expenses for alternative transportation systems such as shuttle buses and bicycle trails in national parks and public lands. The goals of the program are to conserve natural, historical, and cultural resources; reduce congestion and pollution; improve visitor mobility and accessibility; enhance visitor experience; and ensure access to all, including persons with disabilities.

The Surface Transportation Environment and Planning Cooperative Research Program (STEP)

The general objective of the STEP is to improve understanding of the complex relationship between surface transportation, planning and the environment. SAFETEA-LU provides $16.875 million per year for FY2006-FY2009 to implement this new cooperative research program. Due to obligation limitations, rescissions, and the over-designation of Title V Research in SAFETEA-LU, it is anticipated that approximately $12.8 million of the $16.875 million authorized will be available each year.

Transportation Enhancement (TE) Program

TE activities offer opportunities to help expand transportation choices and enhance the transportation experience through activities related to surface transportation, including pedestrian and bicycle infrastructure and safety programs, scenic and historic highway programs, landscaping and scenic beautification, historic preservation, and environmental mitigation. TE projects must relate to surface transportation and must qualify under one or more of the eligible categories.

Safe Routes to School Program

For infrastructure-related projects, eligible activities are the planning, design, and construction of projects that will substantially improve the ability of students to walk and bike to school. These include sidewalk improvements, traffic calming and speed reduction improvements, pedestrian and bicycle crossing improvements, on-street bicycle facilities, off-street bicycle and pedestrian facilities, secure bike parking, and traffic diversion improvements in the vicinity of schools (within approximately two miles). Such projects may be carried out on any public road or any bicycle or pedestrian pathway or trail in the vicinity of schools. Each state must set aside from its Safe Routes to School apportionment not less than 10% and not more than 30% of the funds for non infrastructure-related activities to encourage walking and bicycling to school. These include public awareness campaigns and outreach to press and community leaders; traffic education and enforcement in the vicinity of schools; student sessions on bicycle and pedestrian safety, health, and environment; and training of volunteers and managers of Safe Routes to School programs.

Recreational Trails Program (RTP)

This program provides funds to states to develop and maintain recreational trails and trail-related facilities for both non-motorized and motorized recreational trail uses. Federal transportation funds benefit recreation, including hiking, bicycling, in-line skating, equestrian use, cross-country skiing, snowmobiling, off-road motorcycling, all-terrain vehicle riding, four-wheel driving, or other off-road motorized vehicles.

National Highway System (NHS) Program

The NHS Program provides flexible funding that may be used by states and localities for projects to make improvements to rural and urban roads that are part of the NHS, including the Interstate System and designated connections to major intermodal terminals. NHS Program funds can be used to fund transit improvements in NHS corridors.

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APPENDICES.

Appendix D – Tech Memo 4 – Evaluation Results

Scenario Evaluation Results

MIAMI-DADE MPO WORK ORDER # GPC IV-12

JACOBS
Engineering Group, Inc.

November 2011
Technical Memorandum No. 4

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1.0 INTRODUCTION

The purpose of this study is to investigate sustainable transportation strategies and their effect on travel behavior. This study is not recommending any policies or implementation strategies but is rather a high level planning exercise conducted using a systems planning approach. It is important for the reader to note that given the scope of this study the scenarios developed were painted with a broad brush. The strategies included in each of the scenarios were selected because they go above and beyond the current plans. This study provides an opportunity to evaluate these different strategies outside of the process used to develop the Long Range Transportation Plan (LRTP), which is guided by federal regulations.

This technical memorandum documents the evaluation methodology, analysis and performance of the three sustainable transportation scenarios: Mobility Management, Linkages, and Multimodal. These scenarios were identified by the project team and defined with the assistance of Study Advisory Committee (SAC) members over the course of this study. The process for creating the three sustainable transportation scenarios is documented in Technical Memorandum Number 2 and 3.

Section 2 of this document describes the scenarios and the modeling approach used to evaluate the scenario. The Southeast Regional Planning Model (SERPM) Version 6.5.2 was used for all Travel Demand Modeling (TDM) applications and model-related results for the Miami-Dade County Sustainability Study. The SERPM area is comprised of Miami-Dade County, Broward County, and Palm Beach County. Because all scenarios for this project include applications exclusive to Miami-Dade County, the sub-area capabilities of the SERPM were used to concentrate the application and results specifically to the Miami-Dade County area.

Each of the scenarios was compared to a baseline that was defined as the Cost Feasible Plan from the adopted 2035 LRTP. For the baseline scenario, the 2035 Cost Feasible Model was run using all default parameters and files, as provided by the Florida Department of Transportation. This scenario, like all scenarios run for the purpose of this study, was run for Year 2035 using Alternative “R”. The evaluation results, including both model-related and off-model analyses, are provided in Section 3 of this document.

In addition to evaluating the system-wide performance of these scenarios, a high-level cost/revenue analysis was completed for the Mobility Management and Multimodal scenarios. The Linkages scenario was not included in the cost/revenue analysis since its focus is on the reallocation of growth and it does not include any modifications to the roadway or transit network. Section 4 of this document addresses the methodology and results of the cost/revenue analysis.

2.0 SUSTAINABILITY SCENARIO EVALUATION

Each scenario consists of a unique set of sustainable transportation strategies. Having non-overlapping strategies between the scenarios helped evaluate the impact of a given set of strategies and explain the performance of each scenario. Each of the three scenarios represents a different approach in moving towards a more sustainable transportation system in Miami-Dade County and therefore they will have differing results in terms of affecting travel demand.

All three scenarios were evaluated using the regional travel demand forecast model (SERPM v6.5) and compared against the 2035 LRTP adopted by Miami-Dade County in October 2009. Performance measures for evaluating the scenarios using SERPM included:

- Vehicle Miles Traveled (VMT)

- Vehicle Hours Traveled (VHT)
- Delay (Vehicle Hours) or Congestion
- Mode Split
- Transit Ride Ship
- Trip Length

In addition to using SERPM, certain strategies were evaluated using off-model techniques based on literature review and empirical data. Appropriate adjustments were made to performance measures to reflect local planning context.

Off model calculations were used to determine the impact on the following performance measures:

- Greenhouse gas (GHG) emission
- Energy consumption
- Productivity
- Equity

The following is a brief description of the scenarios along with the discussion of modeling methodology for different transportation strategies considered under each scenario.

2.1 Scenario 1: Mobility Management

The emphasis in the Mobility Management scenario was to understand the effect of pricing policies on travel behavior and their efficacy in affecting travel demand. The Mobility Management scenario created a series of managed lanes on the County's expressway facilities, establishing express bus service on these managed lanes at a discounted rate compared to current express bus fares, increasing both short and long-term parking prices in existing pay-to-park areas, as well as in some new areas based on the number of employees, and accounted for operational improvements to increase the travel speeds.

2.1.1 Regional Network of Managed Lanes

In this scenario, an extensive regional network of managed lanes (two managed lanes in each direction) comprising approximately 356 lane miles was created by taking one general purpose lane and the shoulder in each direction on the County's expressway and limited access facilities. These expressway or limited access facilities included I-75, SR 826, SR 836, SR 112/I-195, Turnpike, SR 874, SR 878, HEFT (SR 821), SR 924, and I-95 (existing and programmed) (Figure 1.1).

Average peak hour toll per trip ($2.00) and off peak hour toll per trip ($0.75) based on the I-95 Managed Lanes experience were used to determine the toll rate on managed lanes in this scenario. For facilities that are currently tolled by Miami-Dade Expressway (MDX) Authority and Florida's Turnpike Enterprise, the tolls in managed lanes were set using the following formula.

Peak hour toll rate on Managed Lanes = Existing (Year 2010) toll rate for the facility + $2.00
Off Peak hour toll rate on Managed Lanes = Existing (Year 2010) toll rate for the facility + $0.75

In other words, a premium was charged to use these managed lanes, which was an additional $2 on top of the existing toll during the peak period and an additional $0.75 during the off-peak period.

2.1.2 Express Bus Service

To provide an alternative to driving and attract choice riders, a regional network of express bus service was established. The concept of such an express bus service is similar to I-95 Express Bus service currently operated by Miami-Dade Transit (MDT). The express buses operate on the managed lanes network throughout the County. In addition to providing faster bus service between key destinations, transit fare was reduced by 50% ($1.15) compared to the existing (Year 2010) express bus service fare of $2.35. Buses operate at 10- and 60-minute headway during peak and off peak hours for a total service span of 14 hours per day providing approximately 12,300 daily revenue miles or 700 daily revenue hours of service.

2.1.3 Variable Parking Pricing

Both long-term and short-term parking rates were increased to deter driving. Figure 1.2 shows all of the areas affected by the variable parking pricing strategy.

Long-term Parking - Parking costs in existing long-term parking areas were increased three-fold and a minimum fee of $0.75 was set in new areas where a minimum density of at least 50 employees per acre is projected for the year 2035. The base year cost for long-term parking ranged from $0 to $8. In the Mobility Management scenario, this cost range was increased to $0.75 to $24.

Short-term Parking - For short-term parking costs, the price to park was doubled in all of the existing areas where paid parking was available. However, a short-term parking fee was not imposed in any new areas. The base year cost for short-term parking ranged from $0 to $7. In the Mobility Management scenario, this cost range was increased to $0.25 to $14.

2.1.4 Operational Improvements

This scenario included motorist information system and freight operational improvements to increase the efficiency of the existing and planned transportation infrastructure. These strategies would increase passenger and goods throughput on the County's transportation network. Since the regional TDM has limited sensitivity to test operational improvements, off model techniques were used to evaluate the impact of these strategies.

2.1.5 Model Methodology

In this scenario, the following three main modifications were incorporated into the TDM:

1. Coding of managed lanes facilities
2. Incorporating managed lane express bus routes into the TDM
3. Increased parking rates (short term and long term)

2.1.5.1 Coding of Managed Lanes - In order to easily identify the newly created managed lanes facilities, all new nodes created for this purpose were numbered 29,500+ (not to exceed 30,000 which would be interpreted as exclusive right-of-way within the SERPM). None of the new managed lanes were given exclusive access to managed lanes on other facilities, unless exclusive access is already anticipated to be in place under the LRTP Cost Feasible Plan. In other words, no new system-to-system access was modeled. To access an adjoining managed lanes facility, the path would need to consist of mainline facility links between managed lanes facilities. In SERPM, each managed lane link is identified as such by setting the HOT field equal to one. Please refer to Figure 1.1 for the managed lanes network.

2.1.5.2 Incorporating Managed Lanes Express Bus Routes Into the TDM - In order to resemble all aspects of this scenario with respect to the new managed lanes express buses, several SERPM elements were modified, mostly within the Transit Path building application. Incorporating the managed lanes express bus routes into the TDM involved additions/modifications to the following elements:

- Coding of managed lane express bus routes (Project Mode #11 was utilized)
- Revising and incorporating fare structure for Project Mode (#11)
- Applying the baseline speeds for Mode 6 (Express bus) to Project Mode (#11)
- Changing transit path-building mode where project mode paths are generated
- Modifying Max Legs by Mode catalog key

Managed Lane Express Bus Routes Coding - SERPM includes a place holder for a new transit mode to be analyzed within the model platform. This mode is defined as Project Mode #11 in both the PT (Public Transport) and TRNBUILD Modes. The Project Mode (#11) was used to classify all managed lane express bus routes specific to this scenario. All new transit routes were incorporated into the baseline transit line file (TROUTE_35R.LIN). A comprehensive list of managed lane express routes including start points, end points, and intermediate stops is included in Table 1.

Fare Structure for Project Mode #11 - In accordance with the fare proposed for the managed lane express bus routes, the fare for Project Mode #11 was revised to "115" to resemble the initial boarding fare of $1.15 (Transit Paths \ Network Preparation \ Exec. Order 8 – FUTRFARES_35R.DAT). Additionally, SERPM 6.5.2 currently does not incorporate the Project Mode fare as a part of the fare calculations within the transit path module. Therefore, the following scripts were modified to include fare calculations for Project Mode #11 into the transit path module (Transit Paths \ Transit Paths \ Mode 1-4\ Exec. Order 3):

- M1MAT00A.S
- M2MAT00A.S
- M3MAT00A.S
- M4MAT00A.S.

Baseline Speeds for Project Mode (#11) - Within the Transit Path application, baseline transit speed curves vary by transit mode, area type, and facility type. The default baseline speeds for transit routes classified as Project Mode (#11) are analogous to the baseline speeds for New Mode (#10). The New Mode is defined for transit facilities with exclusive right of way. Because the managed lane express routes are proposed to operate within the proposed right of way of the managed lanes (and other facilities as necessary), the baseline speeds for the Project Mode were modified to resemble the baseline speeds for the Express Bus Mode #6 (Transit Paths\Network Preparation\Exec. Order 2 – SDLAYUPD_35R.DAT).

Transit Path-Building for Project Mode (#11) - Again, because Project Mode (#11) for this purpose is to resemble express buses that operate within proposed right-of-ways similar to Express Bus Mode #6 (unlike the New Transit Mode that assumes exclusive right-of-way), the building of

Project Mode transit paths were changed to Mode 1 “preferring bus” instead of Mode 2 “preferring New Mode”. This change makes the Project Mode analogous to the Express Bus Mode in this respect. To incorporate this change, the following Pilot Program scripts were modified (Transit Paths \ Transit Paths \ Modes 1-2\Exec. Order 1):

- M1PIL00A.S
- M2PIL00A.S.

Max Legs by Mode - In order to resemble more of an Express Bus Mode, rather than a BRT/LRT route that operates on exclusive right-of-way, the default value of 2 for the “Max Legs by Mode” was set to 5, in order to resemble the Express Bus Mode (#6).

2.1.5.3 Increased Parking Rates (Short Term and Long Term) - In SERPM, parking rates are included in the Traffic Analysis Zone (TAZ) database input file (s65tazs_35.dbf). The TAZ database file includes fields “SPK_35” and “LPK_35”, for short-term (3-hour) parking cost and long-term (9 hour) parking cost, respectively. Both fields represent the respective cost in cents per TAZ. TAZs internal to Miami-Dade County are numbered 2701-4166. Therefore, the short-term and long-term parking cost fields were adjusted for TAZs 2701-4166 accordingly.

2.1.5.4 Off Model Strategies – Transportation strategies that could not be tested using the regional TDM in this scenario included freight and arterial roadway operational improvements. Adjustments to the VHT and Delay were made to the TDM output based on information obtained during the literature review. For these strategies, an additional 1% reduction in VHT and Delay was taken.

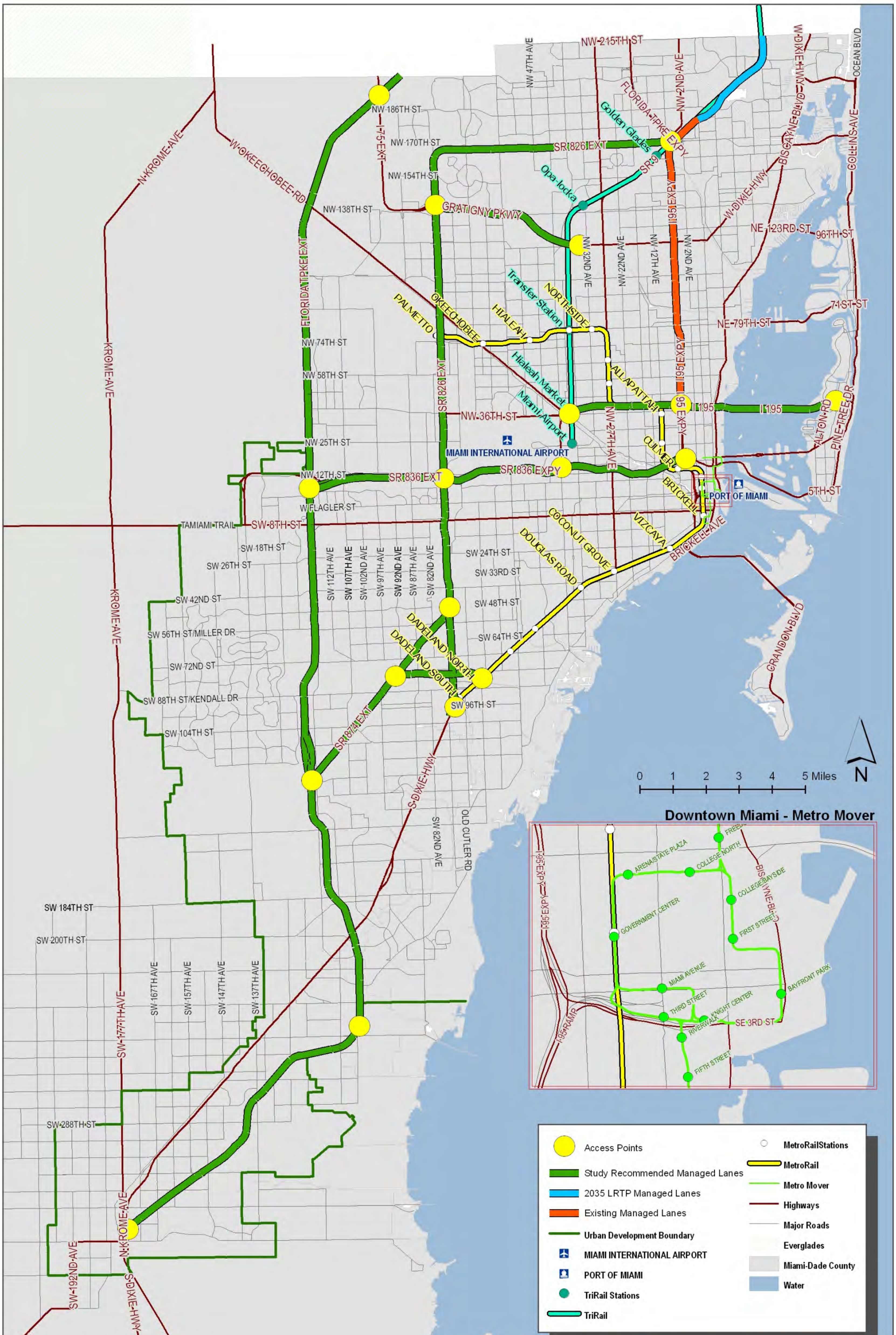


Figure 1.1 Managed Lanes Regional Network
Strategies For Integration of Sustainability and the Transportation System

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

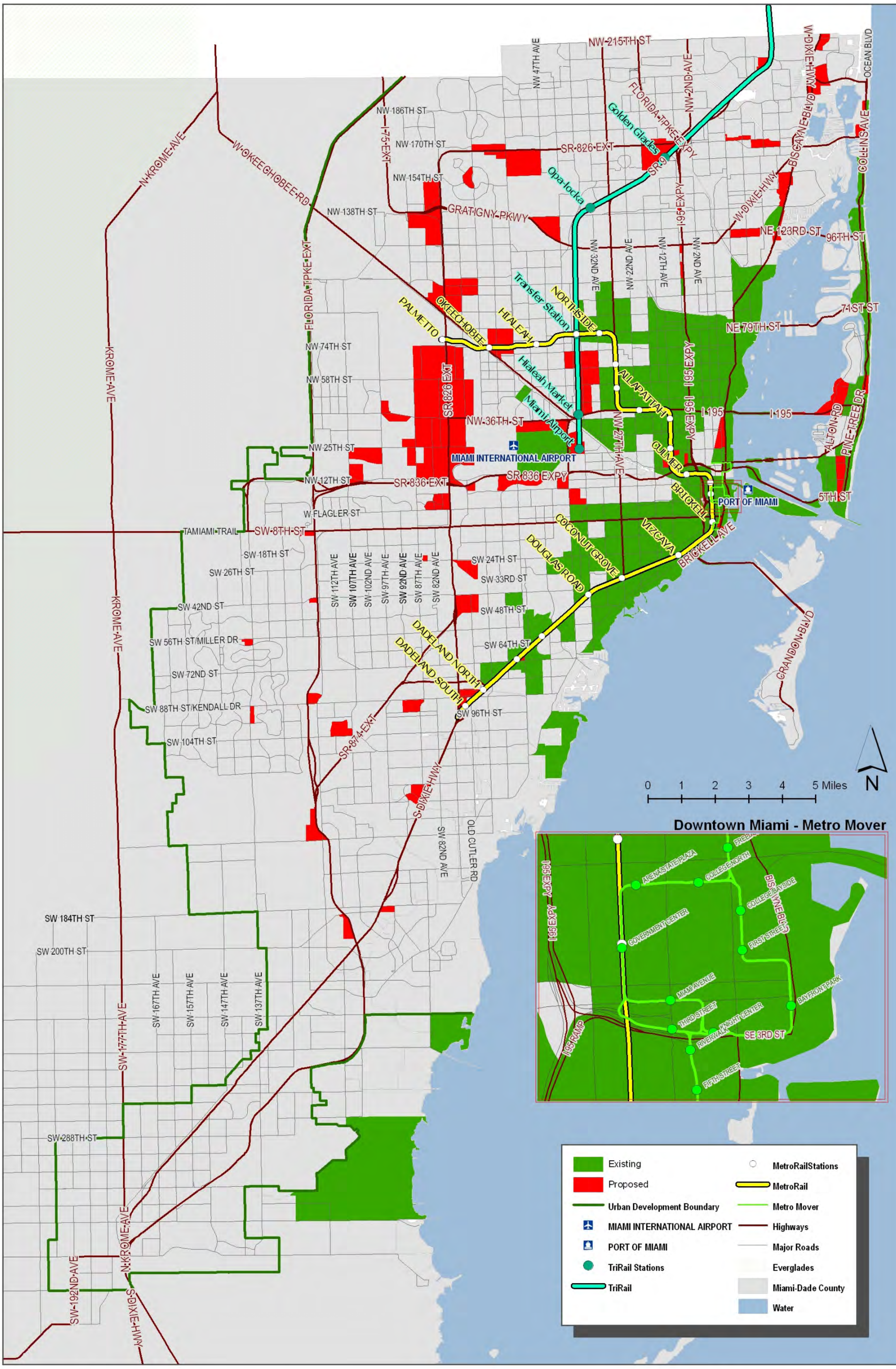


Figure 1.2 Pay-to-Park Areas
Strategies For Integration of Sustainability and the Transportation System

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

Table 1: Managed Lanes Express Bus Routes in Scenario 1

Model Route ID	Facility	From	To	Stops
M11L001MI M11L001MO	I-195	Collins / 41st St Airport	Airport Collins / 41st St	
M11L002MI	I-95	Golden Glades PNR	Collins / 41st St	
M11L003MI M11L003MO	SR 836	FIU/Dolphin Mall Gov Center	Gov Center FIU/Dolphin Mall	FIU, Dolphin Mall, Airport, Gov Center Gov Center, Airport, Dolphin Mall, FIU
M11L004MI M11L004MO	SR 826	Golden Glades PNR FIU/Dolphin Mall	FIU/Dolphin Mall Golden Glades PNR	Golden Glades, Dolphin Mall, FIU FIU, Dolphin Mall, Golden Glades
M11L005MI M11L005MO M11L006MI M11L006MO	HEFT	I-75 FIU FIU SW 344th/Busway	FIU I-75 SW 344th/Busway FIU	 FIU, Dolphin Mall, Coral Reef Dr, Coconut Palm Dr, SW 344th SW 344th, Coconut Palm Dr, Coral Reef Dr, Dolphin Mall, FIU
M11L007MI M11L007MO	SR 874	Mall of Americas SW 344th/Busway	SW 344th/Busway Mall of Americas	Mall of Americas, Coral Reef Dr, Coconut Palm Dr, SW 344th SW 344th, Coconut Palm Dr, Coral Reef Dr, Mall of Americas
M11L008MI M11L008MO	SR 826 Ext	Dolphin Mall Dadeland South	Dadeland South Dolphin Mall	Dolphin Mall, Mall of Americas, Dadeland South Dadeland South, Mall of Americas, Dolphin Mall

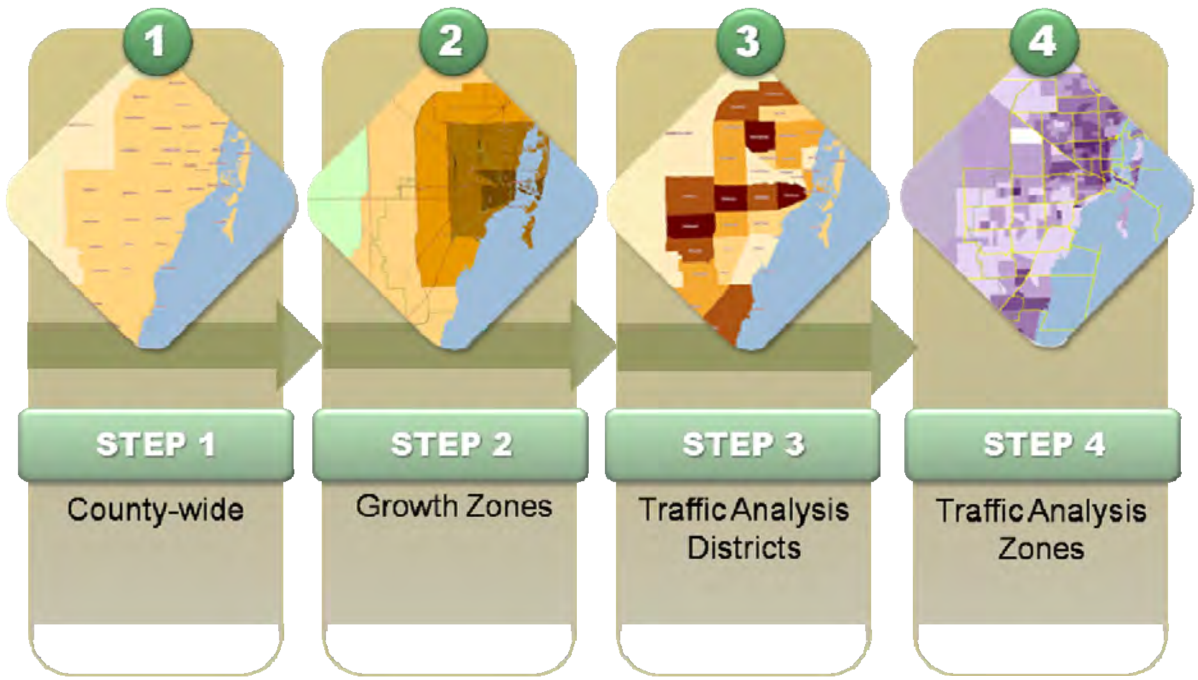
Notes: PNR = Park-n-Ride; FIU = Florida International University

2.2 Scenario 2: Linkages

The Linkages scenario attempts to better coordinate land use and transportation using smart growth and transit oriented development (TOD) principles to minimize people's travel needs. In this scenario, population and employment (jobs) growth forecast to occur between 2015 and 2035 was reallocated to urban centers and activity corridors identified in Miami-Dade County's Comprehensive Development Master Plan (CDMP) and to transit corridors. Population and employment were reallocated to achieve job-housing balance based Federal Transit Administration's (FTA) guideline of 0.8 to 1.5 jobs per household. Non-motorized improvements such as Complete Streets were considered to be an integral part of the Linkages scenario.

The growth allocation methodology was a four-step process as shown in Figure 1.3.

Figure 1.3: Population and Employment Reallocation Process



Step 1: Population and employment (job) growth increments between 2015 and adopted 2035 socio-economic data were calculated to determine the control total at the county level. It was assumed that between 2010 and 2015, the land development pattern would be dictated by permits that were already approved and infrastructure improvements identified and programmed by various agencies through their planning process. Based on population and employment (job) forecast for the 2035 LRTP, it was determined that population growth increment of approximately 609,650 and employment growth increment of approximately 409,910 was available for reallocation between 2015 and 2035.

Step 2: In this step, the County was divided into four growth zones – Urban Core, Urban Fringe, Suburban, and Exurban (Figure 1.4). The creation of these growth zones was based on the manmade barriers created with major transportation corridors and Traffic Analysis District (TAD) boundaries[1]. The Urban Core was identified as the area with the highest level of rail transit infrastructure and the Central

[1] The Traffic Analysis Districts were defined by the Miami-Dade MPO as required by the U.S. Census Bureau.

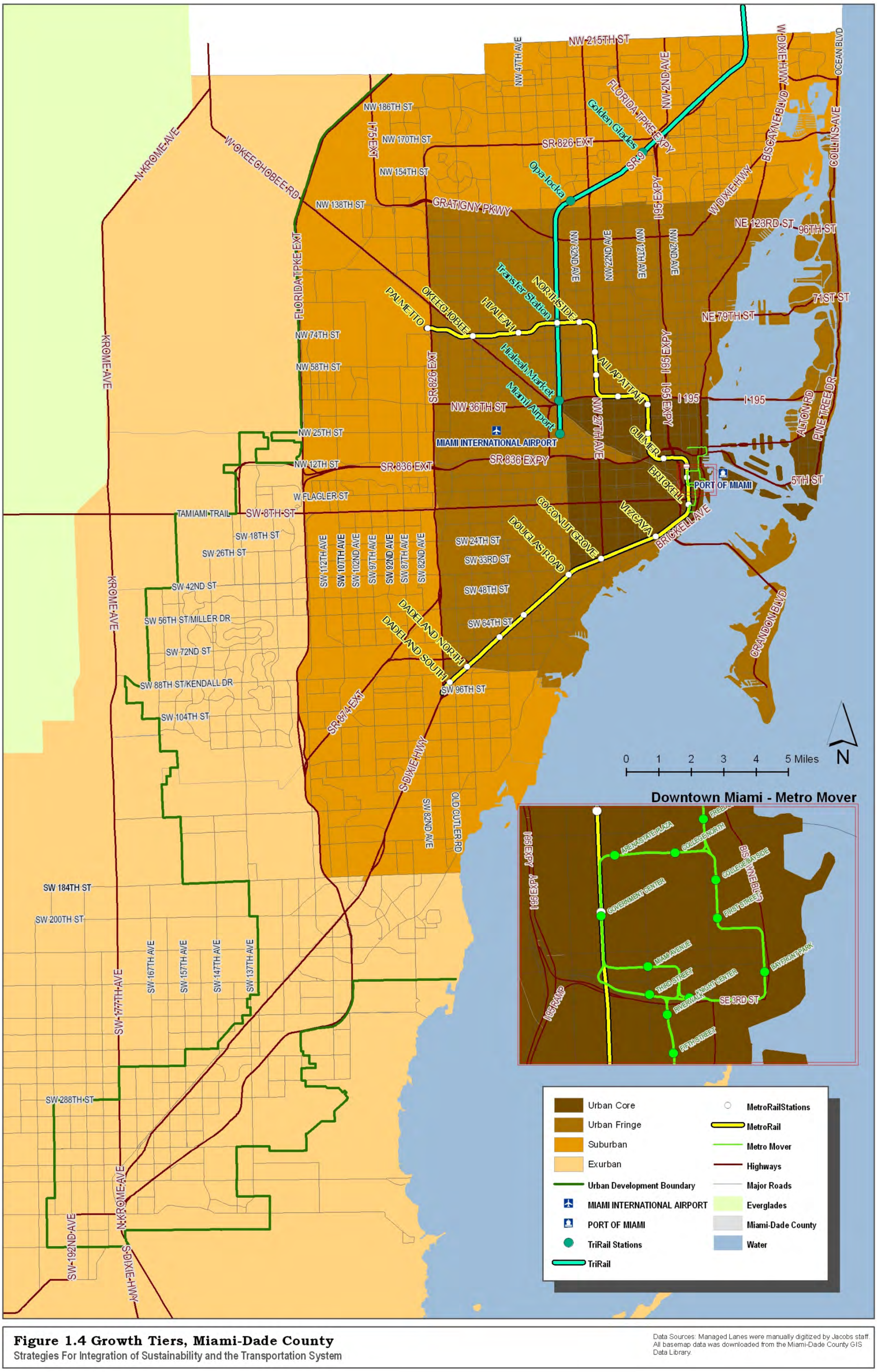


Figure 1.4 Growth Tiers, Miami-Dade County
Strategies For Integration of Sustainability and the Transportation System

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

Business District. The Urban Fringe is the area between the Urban Core and SR 826. This zone includes the remainder of the Metrorail and Tri-Rail systems. The Suburban zone is contained within the area between the Urban Fringe and Florida's Turnpike. The Exurban zone is the remainder of the area between the Suburban zone and the Urban Growth Boundary.

Population growth targets were established for each zone as shown in Table 2. The adopted 2035 land use data, which is based on recent growth patterns, shows that more than half of the population growth between 2015 and 2035 is projected to occur in the Suburban and Exurban growth zones, while the growth in the Urban Core of Miami-Dade County is the lowest of all four zones. To take advantage of the signification transportation infrastructure that exists in the Urban Core and Urban Fringe, higher population growth targets were set for those zones. In addition, large employment centers are also found in the Urban Core and Urban Fringe zones of the County. The Linkages scenario targets reverse the population growth pattern in Miami-Dade County.

Table 2: Population Growth Targets for 2035 by Growth Zone

Growth Zone	Adopted 2035 Population Growth	Reallocated 2035 Population Growth Target
Urban Core	18%	40%
Urban Fringe	27%	30%
Suburban	35%	20%
Exurban	21%	10%

Step 3: After zone level population growth targets were set, population and employment were allocated to TADs iteratively to achieve jobs-housing balance thresholds (0.8 to 1.5 jobs per household range) while meeting population growth targets at the zone level. So the zone level population served as the control total in step three. Adopted and reallocated 2035 population and employment (jobs) including jobs-households ratio at TAD level are included in Appendix I.

Step 4: In the final step, the TAD allocation was then further divided into the traffic analysis zones (TAZ). This was done based on the presence of certain features: fixed guideway transit, community centers and activity corridors. TAZs that had one or more of these features were allocated 75% of the growth with the remaining 25% being distributed among the other TAZs within the TAD. Table 3 illustrates TAD to TAZ allocation using TAD #22 as an example.

Table 3: Traffic Analysis District to Traffic Analysis Zone Growth Allocation Example

TAD #22 - Allapattah		Total Population Growth 17,411 75% 13,059	
TAZ #	**Feature**	**75% Growth**	**25% Growth**
441 & 442	Metrorail	1,041	
452 & 453	None		338
457-462	NW 27th Ave Activity Corridor	12,018	
463-466	None		4,014
	TOTALS	**13,059**	**4,352**

Figures 1.5 and 1.6 shows the 2035 adopted and reallocated population in Miami-Dade County. Under the adopted plan, the bulk of the growth is anticipated to occur in the exurban zone. Higher population concentrations are also found in the suburban zone, with fewer areas in the urban fringe and urban core. Under the reallocated scenario, population growth was effectively moved from the exurban and suburban areas into the urban fringe and urban core.

Figures 1.7 and 1.8 shows the 2035 adopted and reallocated employment (jobs) in Miami-Dade County. In the adopted plan, the highest employment is located in the urban core, urban fringe and suburban zones. In the reallocated scenario, employment growth was moved out of some of these higher employment areas. The intent was to get closer to the desired jobs-housing ratio, which meant moving some jobs out into areas with higher population.

Figure 1.9 shows the adopted jobs to housing ratio for each of the TADs with the blue line. The red line shows the new ratio based on the proposed scenario. The number of areas included in the yellow highlighted band fall within the ideal range of jobs-household ratio (0.8-1.5) with the proposed scenario. Only 12 out of the 42 areas (less than 30%) have higher ratios. There are certain areas which are large employment centers such Airport, Doral, Downtown, Civic Center, Coral Gables, and South Miami were it is extremely difficult to meet the ideal jobs-household ratio. The reason is two-fold, these areas are regional employment centers and they already have a large existing employment base.

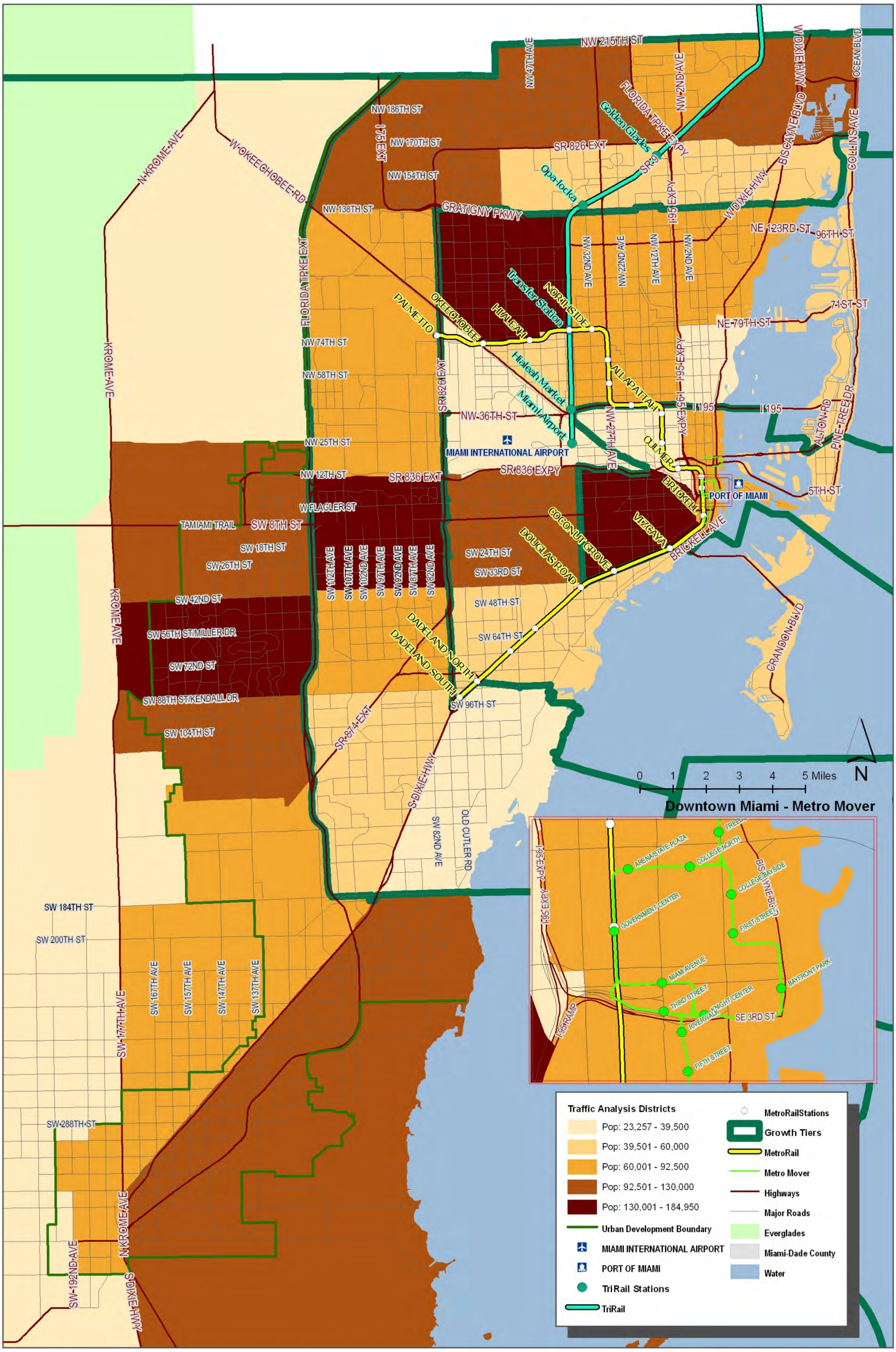


Figure 1.5 Linkages Scenario: 2035 Population (Adopted)
Strategies For Integration of Sustainability and the Transportation System

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

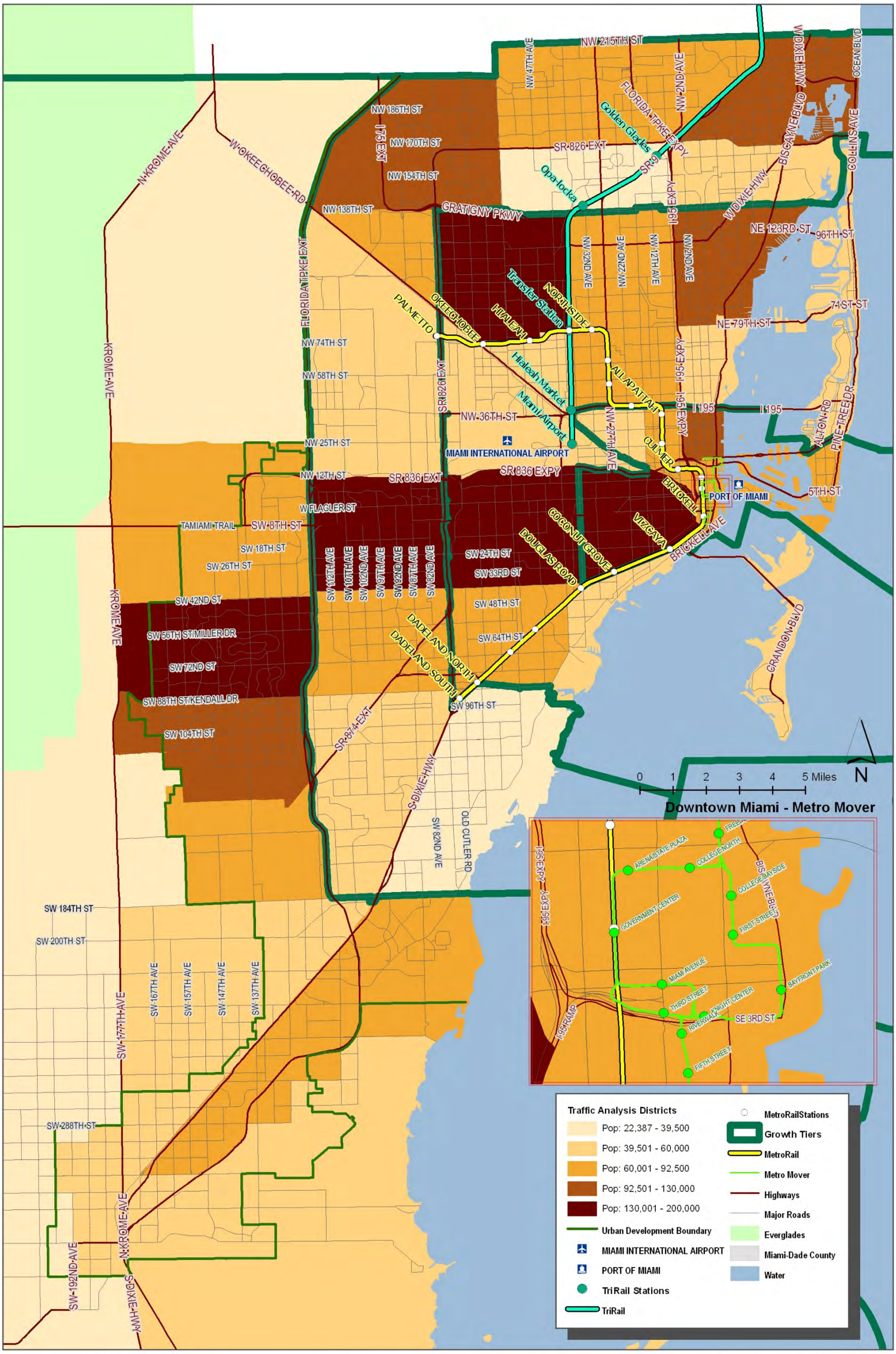


Figure 1.6 Linkages Scenario: 2035 Population (Reallocated)
Strategies For Integration of Sustainability and the Transportation System

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

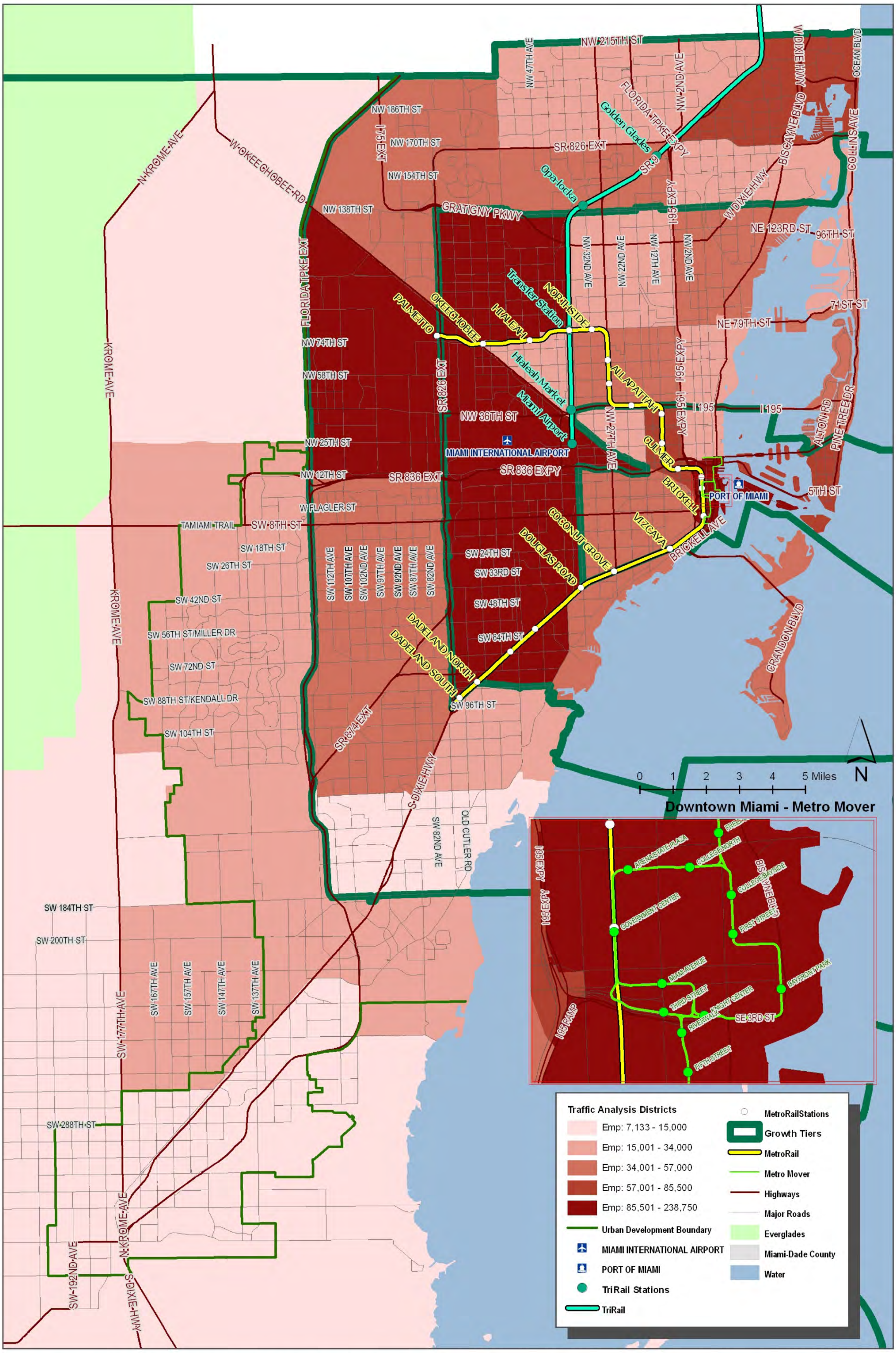


Figure 1.7 Linkages Scenario: 2035 Employment/Jobs (Adopted)
Strategies For Integration of Sustainability and the Transportation System

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

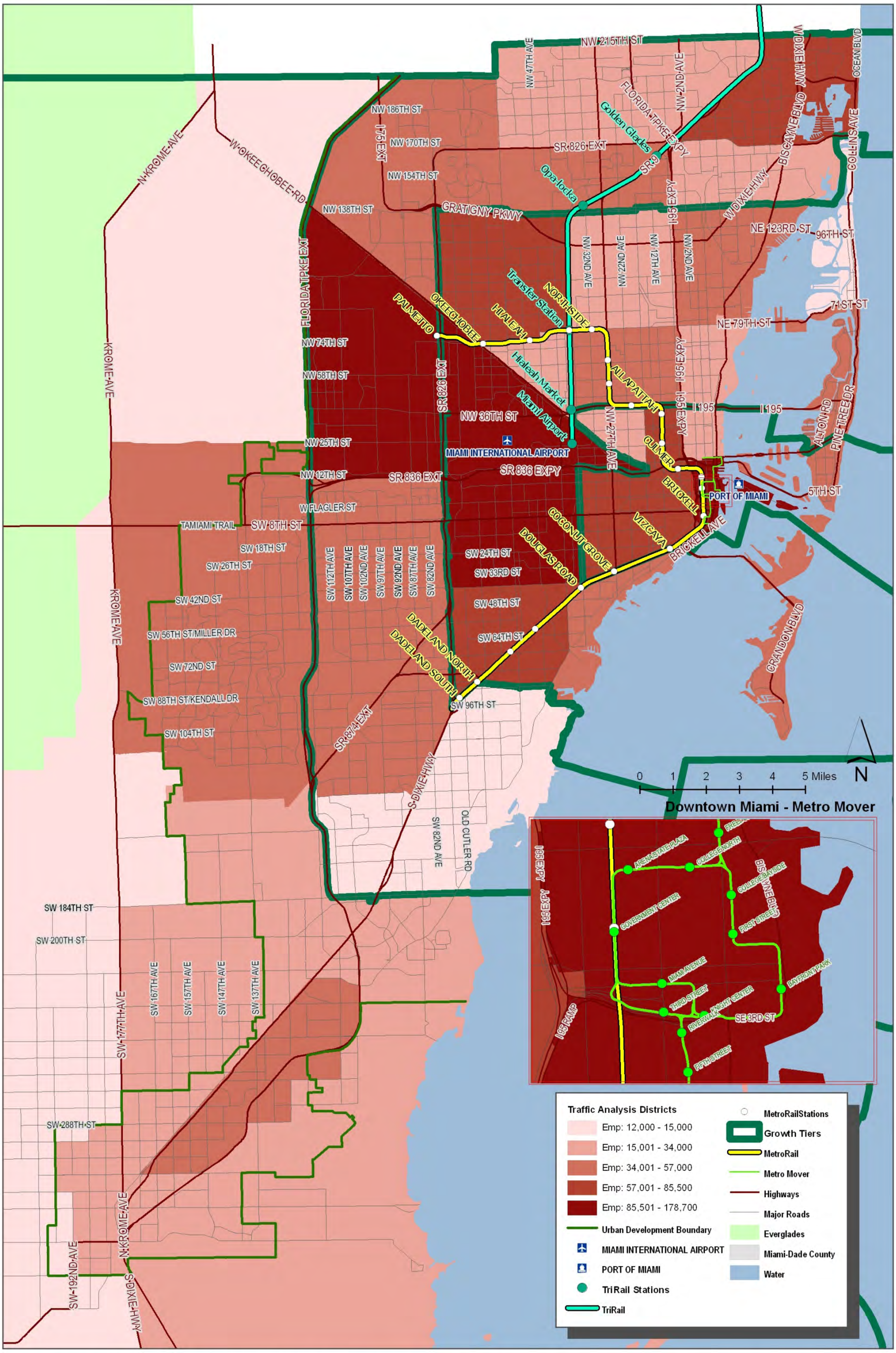
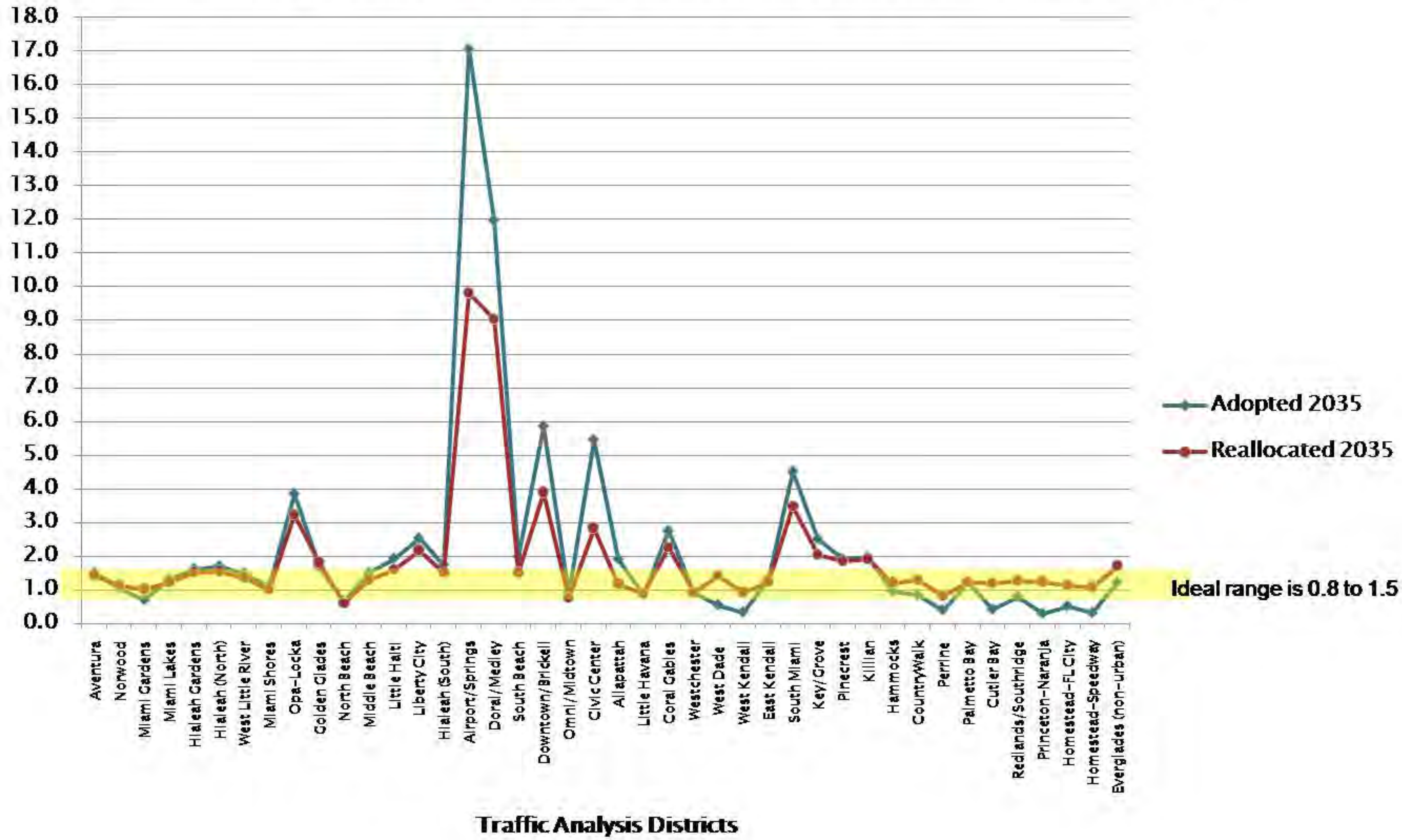


Figure 1.8 Linkages Scenario: 2035 Employment/Jobs (Reallocated)
Strategies For Integration of Sustainability and the Transportation System

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

Figure 1.9: Jobs-Housing Balance in 2035 (Adopted versus Reallocated)



2.2.1 Model Methodology

In SERPM the only change in the TDM run was made to the zonal socioeconomic database input file (s65tazs_35.dbf). For all internal traffic analysis zones (TAZs) within Miami-Dade County (TAZs 2701 4166), population and employment data was modified. Table 4 contains the comprehensive list of fields (with descriptions) within SERPM containing the population and employment data. These variables were changed based on their percentage share of the adopted 2035 TAZ data. This same percentage share was applied to the reallocated 2035 TAZ level data to compute and design the new TAZ land use data set for this scenario. No other transportation improvements beyond those programmed in the 2035 LRTP cost feasible plan were included in the highway and transit network. This helped evaluate and isolate the impact of land use changes only on the County's transportation infrastructure.

Table 4: Population and Employment Database Fields within SERPM

TAZ Database Field	Description
HHCO_35	Households without children (<18 years of age)
HHC1_35	Households with children
VC0_35	Vehicles in households without children category
VC1_35	Vehicles in households with children category
WC0_35	Workers in households without children category
WC1_35	Workers in households with children category
PC0_35	Persons in households without children category
PC1_35	Persons in households with children category
POP_35	***Total Population***
INDE_35	Industrial employment (SIC=1-39 & NAICS=11,21,23,31-33)
COME_35	Commercial employment (SIC=50-59 & NAICS=42,44-45,722)
SVCE_35	Service employment (SIC=40-49,60-99 & NAICS=22,48-49,51-56,61,62,71,721,81,99 & Government Employment)
TOTE_35	***Total Employment (SIC=1-99 & NAICS=11-99 & Government Employment)***

2.3 Scenario 3: Multimodal

The emphasis in the Multimodal scenario is on improving transit rider's experience and thereby attracting new transit riders. The Multimodal scenario created an arterial bus rapid transit (BRT) network, providing real time passenger information at enhanced bus shelters, improving system-wide bus speeds using transit priority signal (TSP), adding new park-and-ride locations, reducing transit fare, and promoting telecommuting, ride sharing, biking, and car sharing.

2.3.1 Arterial Bus Rapid Transit

In this scenario, a network of arterial BRT was created by redesigning existing local bus service on Miami-Dade County's 16 most productive corridors (Figure 1.10). The sixteen corridors were identified based on the top 10 performing routes, currently and in the year 2035 based on ridership forecasts, and those identified in the BRT corridor selection study conducted by the MPO (2004).

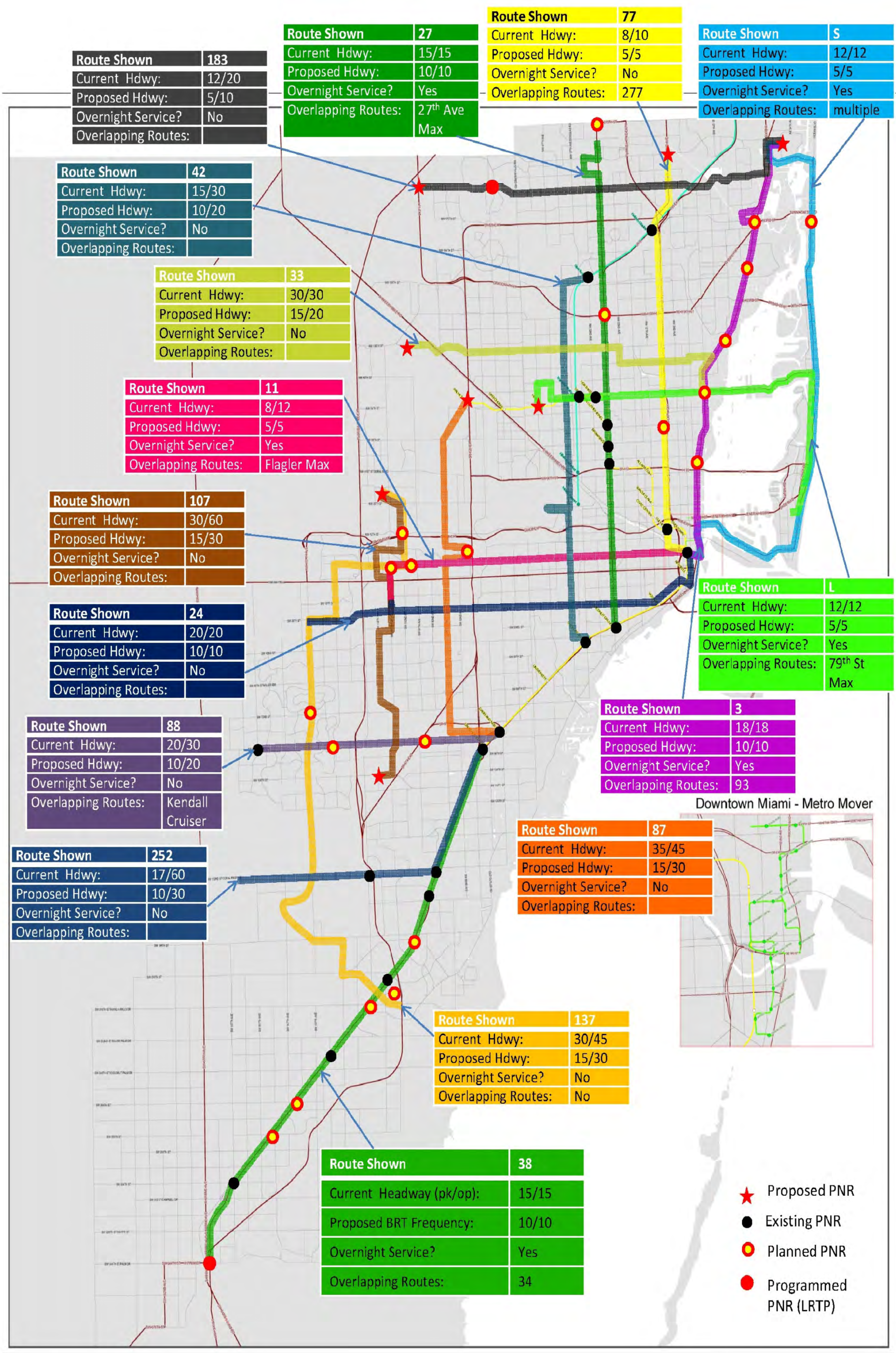


Figure 1.10 Arterial BRT Corridors
Strategies For Integration of Sustainability and the Transportation System

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

To provide this arterial BRT service, existing local bus service in the corridor was eliminated. This local bus route was replaced by faster bus service at improved headways. Depending on the corridor, the headways ranged from five minutes to 20 minutes during peak hour and five minutes to 30 minutes during off peak hours. Bus speeds were 25% faster when compared to the local bus speed. Faster speeds were achieved by more efficient bus stop spacing of one-half mile and providing TSP to buses. Furthermore, transit fare was reduced by 50% compared to the existing bus fare ($2.00). The Multimodal scenario added 549 route miles and approximately 4,100 daily revenue hours of premium bus service.

2.3.2 Real Time Passenger Information

Enhanced bus shelters were assumed to be equipped with electronic display panels that report real time bus arrival information on the BRT corridors. Having the bus arrival information available at bus stops would make waiting time more bearable for transit users. To evaluate this strategy in the model, the weight on the passenger wait times and the transfer penalties were removed. The basis for this is the notion people are better able to plan their trips and more willing to wait if they see the real wait times as opposed to their perception of what the wait times might be without this real time information.

2.3.3 Transit Signal Priority (TSP)

Buses were assumed to be equipped with transmitters and every signalized intersection had the necessary infrastructure to enable buses to use TSP throughout the transportation network in the County. Bus speeds were increased by 10% over the existing speeds on a system-wide basis to reflect this strategy in the model.

2.3.4 Park-and-Ride Lots

About 1,500 parking spaces were added in various locations along the arterial BRT corridors throughout Miami-Dade County to provide parking options for transit riders. These park-and-ride lot locations were selected based on those previously identified in the 2035 LRTP, the Miami-Dade Consolidated Park-and-Ride Facilities Plan, and where necessary to facilitate the use of the arterial BRT service.

2.3.5 Model Methodology

The modeling application for this scenario involved modifications to the following two main transit-related components:

1. System-wide transit enhancements
2. Conversion of bus / express / limited-stop routes into bus rapid transit (BRT) routes

2.3.5.1 System-Wide Transit Enhancements - Two enhancements to the overall transit system within Miami-Dade County were made in this scenario:

- Speed increase of ten percent (10%) for all transit modes
- Fare reduction of 50% for all transit modes

Speed Increase - The speed of all Miami-Dade transit routes were increased by ten percent (10%), namely: PT Modes 5 (Miami-Dade bus), 6 (express bus), and 13 (limited-stop bus). The transit speeds are used during the Transit Paths building module. Auto-transit speed curves are used to generate transit speeds. The transit speed increases were therefore incorporated after the transit speed lookup was performed for each applicable transit mode. In this way, the speed is adjusted within each loop iteration, ensuring the increase is applied throughout the modeling process (Transit Paths\Network Preparation\Exec. Order 3 – PRNET00B.S).

2.3.5.2 Fare Reduction - In addition to the speed increase of the overall Miami-Dade transit system, a fare reduction of fifty percent (50%) was applied to each Miami-Dade transit mode. Table 5 shows the default values contained within the fare file (FUTRFARES_35R.DAT) and the respective reductions that were made to the boarding and transfer fares for this scenario run.

Table 5: Default and Revised Fares for the Multimodal Scenario

Field Name	Description	Default Fare[1]	Scenario Fare[1]
Boarding Fares			
PalmTran	PalmTran - Regular 1-ride Fare	$1.50	$1.50
PalmTranPass	PalmTran - Regular Daily Pass Fare	$3.50	$3.50
BCT	BCT - Regular 1-ride Fare (2009 fare)	$1.50	$1.50
BCTPass	BCT - Regular Daily Pass Fare (2009 fare)	$3.50	$3.50
Metrobus	MetroBus - Regular 1-ride Fare	$2.00	***$1.00***
Metroexp	MetroBus Express - Regular 1-ride Fare	$2.35	***$1.15***
Metrorail	MetroRail - Regular 1-ride Fare	$2.00	***$1.00***
Metromover	Metromover - Free Ride	$0.00	$0.00
ProjMode	Insert fares for Project Mode	$0.00	***$1.15***
Transfer Fares			
Metro2BCT	MetroBus / BCT regular transfer	$0.50	***$0.25***
Metroxfer	MetroBus regular transfer	$0.50	***$0.25***
Metro2exp	MetroBus and Express transfer - assuming diff (35 cents) of metrobus and express fare plus normal transfer (50 cents)	$0.85	***$0.40***
Notes: [1]All fares are regular; no discount has been applied. Tri-rail feeder bus "Free" fares in transfer between tri-rail and feeder buses are handled in CV script (AMMAT00F.s)			

Source: SERPM 6.5, Technical Reports 1&2 – Model Data, Calibration and Validation (FDOT, October 2008).

2.3.5.3 Conversion of Bus / Express / Limited-Stop Routes Into Bus Rapid Transit (BRT) Routes - To model the BRT routes for the purpose of this scenario, the project mode 11 was utilized. Table 6 lists the 16 routes that were converted from their existing transit mode (Miami-Dade bus Mode 5, Express Bus Mode 6, or Limited-Stop Bus Mode 13) into the BRT Project Mode 11 for Scenario #3. The change was made in the transit route line file (TROUTE_35R.LIN).

In addition to coding these lines as Mode #11, the following changes were also incorporated into the SERPM in order to complete the conversion from the existing transit modes to the BRT routes:

- Headway increases for peak and off-peak periods
- Half-mile station spacing
- Additional park-and-ride lots
- Speed increase of 25%

Table 6: Route Lines Converted into BRT Project Mode 11 for Scenario #3

SERPM Route Line	Miami-Dade Transit Route
M13L177MD	183
M5L45MD	27
M5L76MI (SB) M5L76MO	77
M5L14MI (NB) M5L14MO (SB)	S
M5L57MI (SB) M5L57MO (NB)	42
M5L50MD	33
M5L33MI M5L33MO	11
M5L70MD	107
M5L43MI (EB) M5L43MO (WB)	24
M5L81MD	88
M5L19MD	252
M5L11MI (EB) M5L11MO (WB)	L
M5L23MI (SB) M5L23MO (NB)	3
M5L80MD	87
M5L93MD	137
M13L17MI M13L17MO	38

Source: SERPM 6.5, Technical Reports 1&2 – Model Data, Calibration and Validation (FDOT, October 2008).

Headway Increases during Peak and Off-Peak Periods - As part of the route line conversions to BRT, increases in headways are also proposed during both the peak and off-peak periods. Therefore, the default headways included in the 2035 transit line file (TROUTE_35R.LIN) were modified accordingly. Table 7 shows the 2035 original SERPM headways and the proposed headways for the respective converted BRT routes.

Half-Mile Station Spacing - In accordance with the scenario specifications, all BRT Project Mode transit routes were ensured to provide, at a minimum, half-mile spacing between all stops along the route. Wherever necessary, additional stops were incorporated into the transit line file (TROUTE_35R.LIN) for these routes.

Additional Park-and-Ride Lots - As part of this scenario, park-and-ride (PNR) lots are proposed to be located at each end of the BRT routes. Therefore, additional PNR lots were incorporated into the highway network input file (S65_35.NET) as necessary. In order to provide unconstrained capacity for these new lots, the related attributes for these nodes were defined as shown in Table 8. It should be noted, that a maximum driving distance of 5 miles (SERVICEMILES=5) was assumed to be reasonable for this application.

Table 7: Original and Proposed Headways for BRT Routes

	SERPM 2035 Default Headways		Scenario #3 Proposed Headways	
Route	Peak	Off-Peak	Peak	Off-Peak
183	30	45	5	10
27	30	30	10	10
77	8	25	5	5
	8	20	5	5
S	12	12	5	5
	12	12	5	5
42	30	60	10	20
	30	60	10	20
33	25	30	15	20
11	8	12	5	5
	8	12	5	5
107	30	65	15	30
24	40	40	10	10
	40	40	10	10
88	30	60	10	20
252	20	30	10	30

Table 8: Node Attributes for New Park-and-Ride Locations

Node Attributes	Description	Unconstrained Value
STATIONNUMBER	Station ID Number	> 5000
SERVICEMILES	Maximum driving distance (miles)	5
PARKINGSPACES	Parking spaces	9999
PARKINGCOSTAM	All day (peak) parking cost (cents)	0
PARKINGCOSTMD	Midday (off-peak) parking cost (cents)	0
TERMTIMEPNR	Added park-and-ride impedance (terminal time - minutes)	0
TERMTIMEKNR	Added drop-off impedance (terminal time - minutes)	0
ACTIVEFLAG	Station Usage (1=yes, 0=no)	1

Speed Increase - All newly defined BRT Project Mode routes are proposed to operate at an increased speed of 25%. Therefore, similarly to the speed increase application for the other Miami-Dade transit modes, the speeds for the Project Mode routes were increased by 25% after the transit speed lookup was performed from the auto-transit curves (Transit Paths\Network Preparation\Exec. Order 3 – PRNET00B.S).

Similar to the Mobility Management scenario, the following changes were incorporated into the SERPM to complete the modeling application related to the Multimodal scenario:

- Revising and incorporating fare structure for Project Mode (#11)
- Applying the baseline speeds for Mode 6 (Express bus) to Project Mode (#11)
- Changing transit path-building mode where project mode paths are generated
- Modifying Max Legs by Mode catalog key

Please refer to the respective sections under the Mobility Management scenario for model application details.

2.3.5.4 Off model Strategies - Transportation strategies that could not be tested using the regional TDM in this scenario included vanpool/carpool with parking cash out programs, telecommuting, car sharing, and biking programs/initiatives. Adjustments were made to the TDM output for VMT on the basis of literature review and empirical data to account for these transportation strategies during the scenario evaluation phase. To account for the addition of parking cash out programs to the existing vanpool/carpool service offered by South Florida Commuter Services, an additional 1.5% reduction in single occupant Home Based Work trips was taken. For telecommuting, an additional one half percent reduction in Home Based Work trips was taken. A car sharing fleet size of 500 vehicles was assumed that allowed for a reduction of 7,500 personal autos, which equated to an additional reduction of 62,017 VMTs. To account for additional bicycle and pedestrian trips, an additional 19,649 VMTs were reduced based on an estimated average bicycle trip length of two miles and a mode share of 0.46%.

3.0 EVALUATION RESULTS

As described in Section 2 of this technical memorandum, sustainable transportation scenarios were evaluated on a host of performance measures using the regional TDM and off model calculations. The following is a description and comparison of evaluation results for the Mobility Management, Linkages, and Multimodal scenarios against Miami-Dade County's adopted cost feasible 2035 LRTP.

3.1 Travel Demand Model (SERPM)

Metrics for gauging county-wide travel demand and system-wide congestion included VMT, VHT, delay (Vehicle Hours of Delay), mode split, transit ridership, and trip length.

3.1.1 Vehicle Miles Traveled (VMT)

Daily VMT represent the total travel demand on an average weekday in Miami-Dade County. Figure 1.11 indicates that travel demand reduces across all three scenarios compared to 2035 LRTP. The largest reduction of approximately 6% is forecast for the Linkages scenario, followed by Mobility Management and Multimodal scenario at 4% and 2% respectively.

Overall reduction in VMT in the Linkages scenario results from a reduction in the trip length of home based work (HBW) trips. In the Mobility Management scenario, shifting to carpool/vanpool is responsible for reducing the VMT. This shift to high occupancy vehicle (HOV) mode can be attributed to higher cost of driving (tolls) and higher parking cost. For the Multimodal scenario, the VMT reduction is caused by mode shift for HBW trips.

Accounting for off-model strategies in the Multimodal scenario, VMT is be further reduced by 0.5%, which represents a total reduction of approximately 372,000 or 1.6% when compared to 2035 LRTP baseline. Reduction for individual strategies is shown in Table 9 below. Appendix II provides detailed calculations and assumptions for VMT adjustments for each transportation strategy included in the Multimodal scenario.

Figure 1.11: Daily Vehicle Miles Traveled (VMT), All Trip Purposes, 2035

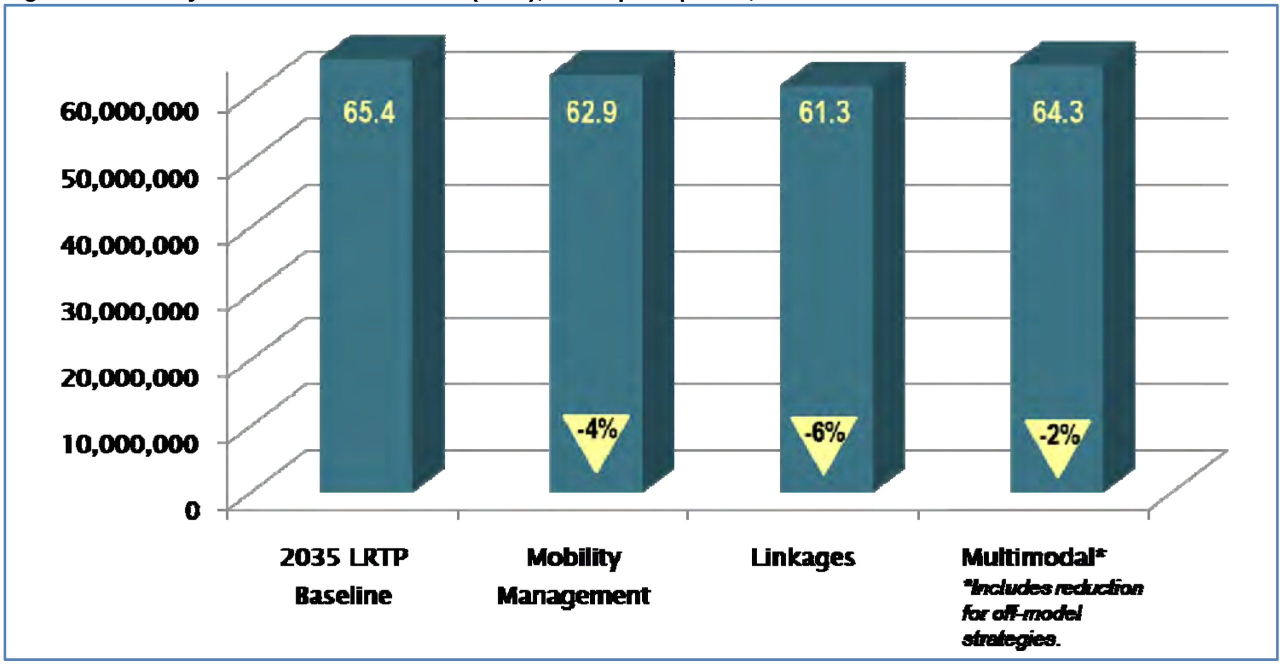


Table 9: Multimodal Scenario Off Model Strategies

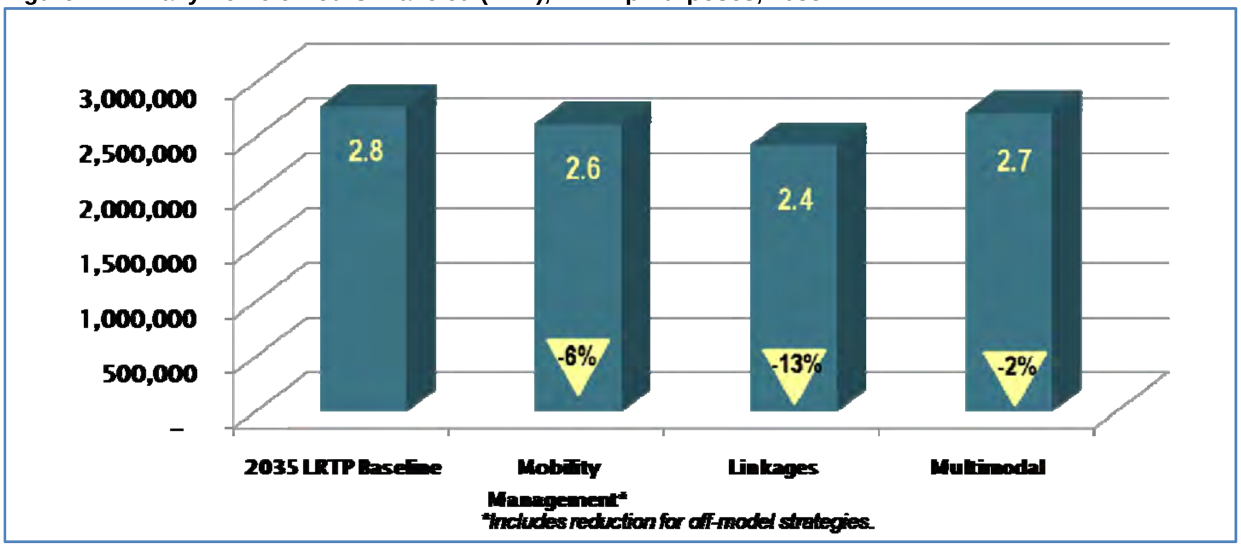
Transportation Strategy	VMT Reduction (Off Model Adjustment)
Carpool/vanpool with parking cash out programs	210,000
Telecommuting	80,000
Car sharing	62,000
Biking initiatives/programs	20,000
Total	372,000
SERPM VMT Output = 64,655,000	**With Off Model Adjustment VMT = 64,283,000**

3.1.2 Vehicle Hours Traveled (VHT)

VHT is the total number of hours that all cars spend on the road during an average weekday. Figure 1.12 shows the system-wide measurement of VHT in the County. The results are similar to those for VMT, with the Linkages scenario showing the greatest reduction of approximately 13% compared to the 2035 LRTP baseline. It should be noted that the model-based reduction in VHT for the Mobility Management and Multimodal scenarios is marginally higher (at 5% and 1% respectively) compared to corresponding VMT reduction in these scenarios, indicating that these scenarios are reducing congestion and travel time even if they are not affecting the total number of miles traveled. For the Linkages scenario, the VHT reduction is more than double the VMT reduction. This is due to the shorter trip lengths observed under this scenario and the shifting to non-motorized transport modes for certain travel needs.

Accounting for off-model strategies (Motorist Information Systems and Freight Operational Improvements) in the Mobility Management scenario, the delay can be further reduced by one percentage point (840,500 million x 1%) to 8,405 hours on a system-wide basis.

Figure 1.12: Daily Vehicle Hours Traveled (VHT), All Trip Purposes, 2035



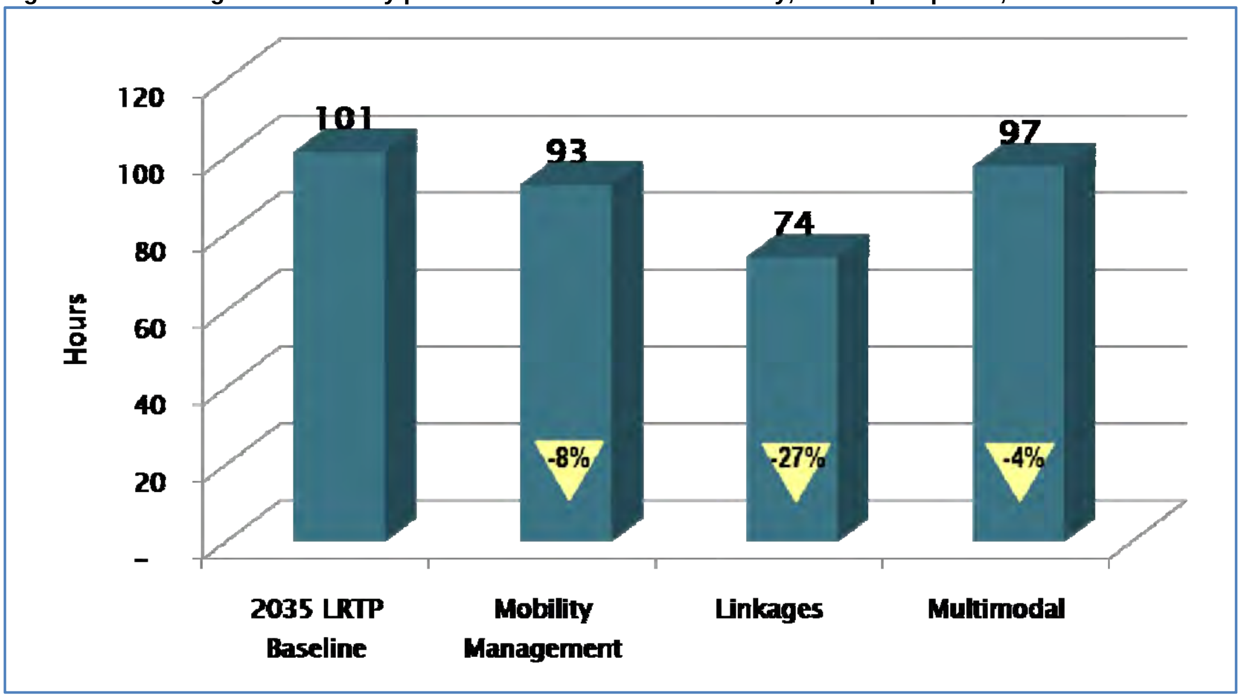
3.1.3 Delay (Vehicle Hours of Delay)

Average annual delay per person measures the time Miami-Dade travelers spend sitting in traffic congestion over the entire year. Based on the Texas Transportation Institute's (TTI) 2010 Mobility Report, average delay per person in the County was approximately 40 hours. By 2035, annual delay is forecast to more than double under most scenarios (Figure 1.13). The Linkages scenario is more successful in relieving congestion compared to the other scenarios. The Mobility Management scenario receives one extra percentage point reduction due to the off-model strategies discussed under VHT above, resulting in an eight percent reduction overall.

3.1.4 Mode Split

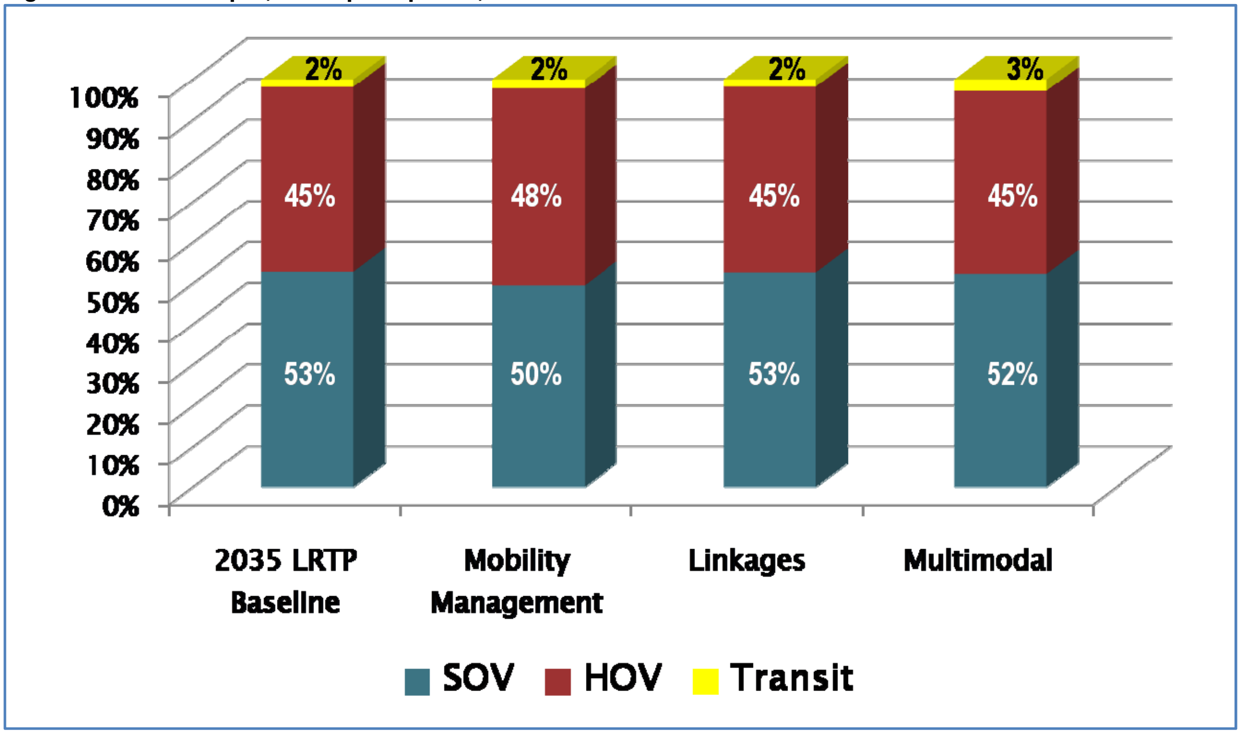
Mode split measures the proportion of person trips that uses each of the different means of transportation: single occupant vehicle (SOV), high occupancy vehicle (HOV), transit, and bicycle/pedestrian. For the Mobility Management scenario, as shown in Figure 1.14, HOV use increased by three percentage points possibly resulting from increased costs for both driving and parking. In the Multimodal scenario, modal split increases by one percentage point, indicating approximately 50% increase in transit ridership. A corresponding one percentage point reduction in SOV travel is noted. The increased travel speed for transit, increased frequencies, and reliability helps make transit slightly more competitive with driving.

Figure 1.13: Average Annual Delay per Person in Miami-Dade County, All Trip Purposes, 2035



Mode split is one metric where the Linkages scenario does not outperform the other scenarios. In this scenario population and jobs were reallocated to achieve a better jobs-housing balance; however no other transportation improvements were programmed. In other words, this scenario did not deter driving by increasing the cost of driving via tolls or parking fee and/or improve transit service.

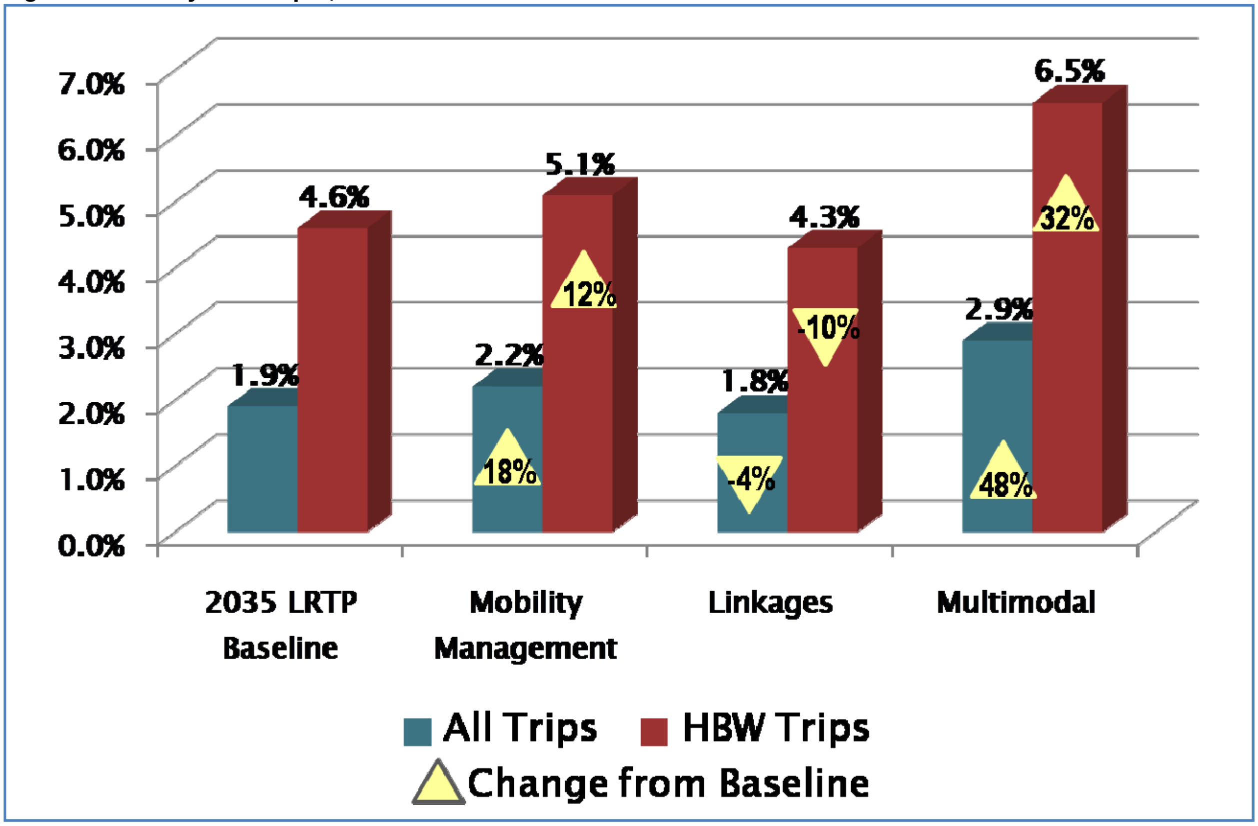
Figure 1.14: Mode Split, All Trip Purposes, 2035



3.1.5 Transit Ridership

Transit ridership measures the number of daily boardings (unlinked transit trips) on all modes of transit in Miami-Dade County. While it may seem that transit mode split changed marginally between different scenarios compared to the 2035 LRTP baseline; in fact, there was a substantial increase in transit ridership for both the Mobility Management and Multimodal scenarios (Figure 1.15). The increase in transit ridership for home based work (HBW) trips was even higher for these scenarios in comparison to the 2035 LRTP baseline. In the case of the Linkages scenarios, the forecast indicated a reduction in transit ridership, which seemed counter intuitive. However, this anomaly was compensated by an increase in non-motorized HBW trips and as well as marginal reduction in total person trips in the Linkages scenario.

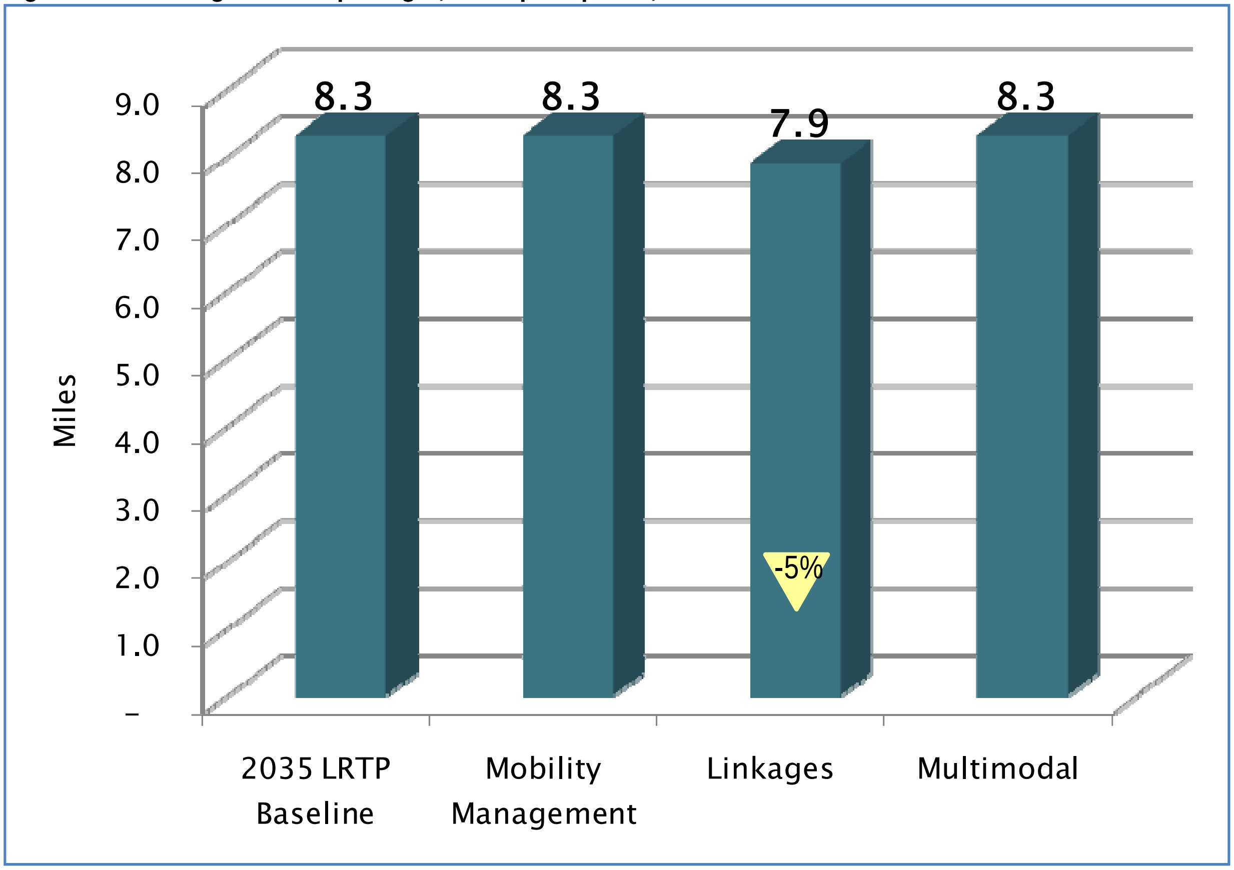
Figure 1.15: Daily Mode Split, 2035



3.1.6 Trip Length

Average auto trip length (the average distance traveled in miles) remained constant at 8.3 miles in the Mobility Management and Multimodal scenarios, as shown in Figure 1.16. In the Linkages scenario, the average auto trip length was reduced to 7.9 miles, which is approximately five percent. Considering that the auto trip length is all trip purposes, a five percent reduction for the Linkages scenario is significant.

Figure 1.16: Average Auto Trip Length, All Trip Purposes, 2035



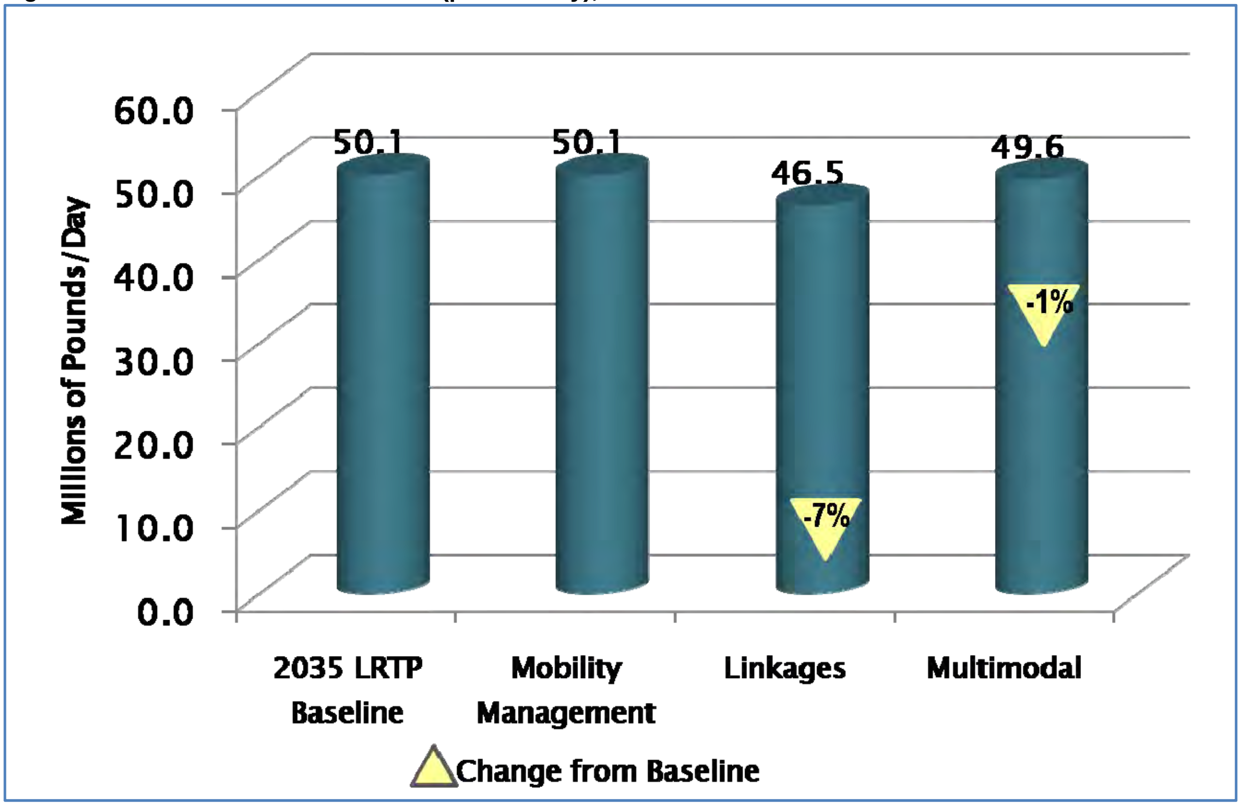
3.2 Off Model Techniques

Off model techniques included analysis tools such as spreadsheets and Geographic Information System (GIS) software used to derive numbers for GHG emission, energy consumption, productivity, and equity.

3.2.1 Greenhouse Gas (GHG) Emission

Carbon dioxide is the key player in climate change and sea level rise. The transportation sector accounts for approximately 30% of GHG emissions. Miami-Dade County is proactive and has set ambitious GHG reduction targets in various sustainability initiatives at the county level. As shown in Figure 1.17, the Linkages and Multimodal scenarios have positive impacts on GHG reduction, reflecting the shift from driving to other modes in both scenarios, as well as the shorter trip lengths observed in the Linkages scenario. The Mobility Management scenario has similar GHG emissions as the 2035 LRTP Baseline. GHG emissions were calculated for each scenario by multiplying passenger miles for that mode times emission rates from CATO Institute's *Policy Analysis*, "Does Rail Transit Save Energy or Reduce Greenhouse Gas Emissions?", published April 14, 2008.

Figure 1.17: Carbon Dioxide Emission (pounds/day), 2035



3.2.2 Energy Consumption

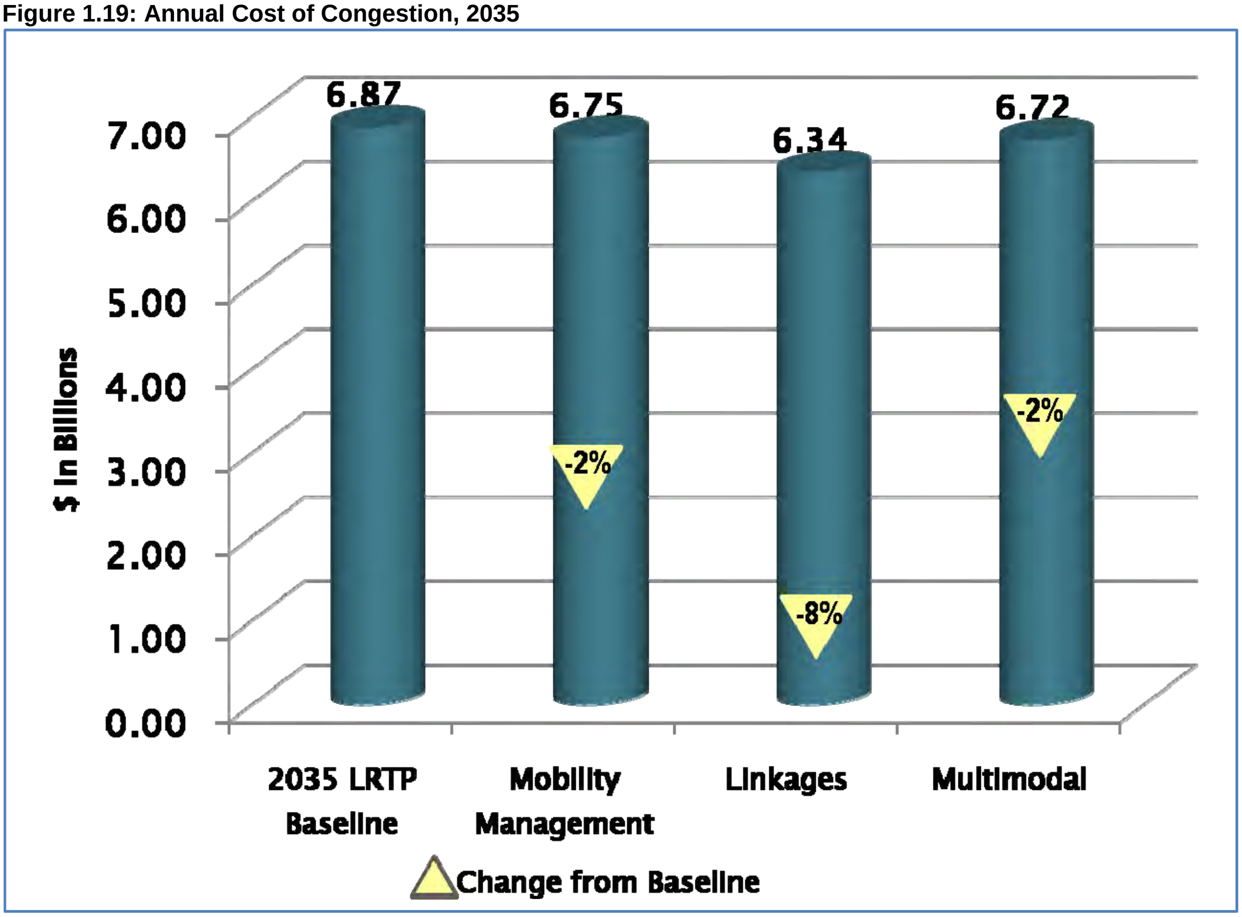
To calculate the daily energy cost, the average kilowatt per hour rate from Florida Power & Light (FPL) was multiplied by the daily energy use under each scenario. Both the Linkages and Multimodal scenarios show (see Figure 1.18) a reduction in energy used, while the Mobility Management scenario stays the same as the 2035 LRTP Baseline.

3.2.3 Lost Productivity

Lost productivity represents the time lost by commuters due to traffic congestion and excess fuel consumed because of idling. Lost productivity was calculated using TTI's factors for average hourly wage, average fuel consumption multiplied by vehicle hours of delay from the regional TDM. Per TTI's 2010 Mobility Report, Miami-Dade County lost approximately $3.2 billion due to congestion in 2010. Figure 1.19 shows that these losses will more than double over the next 25 years in the 2035 LRTP Baseline, Mobility Management and Multimodal scenarios. Under the Linkages scenario, the loss still increases but does not quite double.

Figure 1.18: Daily Energy Cost, 2035

Figure 1.19: Annual Cost of Congestion, 2035



3.2.4 Equity

Adversely impacting or providing access to low income population in Miami-Dade County based on different types of transportation improvements in various scenarios was used for this metric. Equity analysis can become extremely complex, but for this planning exercise high level spatial analysis was conducted using Geographical Information System (GIS).

3.2.4.1 Mobility Management Scenario - For this scenario the approach was to check if access/egress points for managed lanes were provided such that geographic areas having large concentration of low income population in the County did not receive negative impacts of localized congestion; while at the same time they had an opportunity to use the express bus service as an alternative to paying higher tolls and parking costs for commute trips. GIS analysis included creating a two-mile buffer around managed lanes access/egress location and creating an overlay with the low income population thematic map (using 2000 US Census data). Darker areas have larger concentration of low income population (Figure 1.20). For this scenario, the low income population was not disproportionately impacted.

3.2.4.2 Linkages Scenario - In this scenario the idea was to ensure that jobs reallocation did not result in net job loss in geographic areas having high concentration of low income population. Overlaying traffic analysis districts (TAD) and low income population thematic map, it was estimated that 51,000 jobs were added in high concentration low income population areas. This represented approximately 12% of the total employment (jobs) reallocation (Figure 1.22).

3.2.4.3 Multimodal Scenario - For the Multimodal scenario, the concept from an equity standpoint was to provide low income population access to premium transit service (arterial BRT) as well as ensure that elimination of local bus service in the arterial BRT corridors did not negatively impact low income population. GIS analysis included creating a half-mile buffer around arterial BRT stations and creating an overlay with the low income population thematic map. Darker areas have larger concentration of low income population (Figure 1.23). Low income population was not disproportionately impacted.

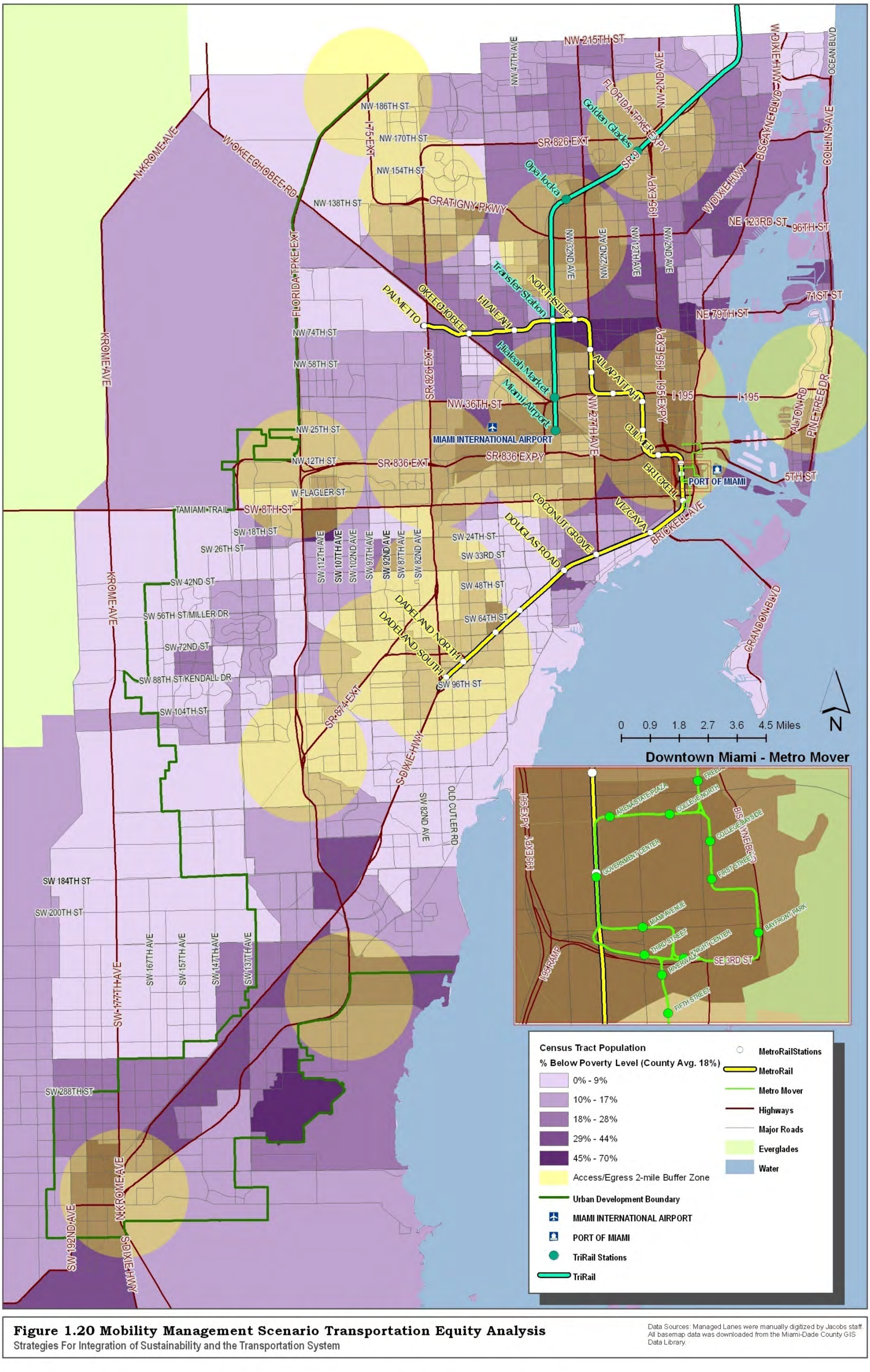


Figure 1.20 Mobility Management Scenario Transportation Equity Analysis
Strategies For Integration of Sustainability and the Transportation System

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

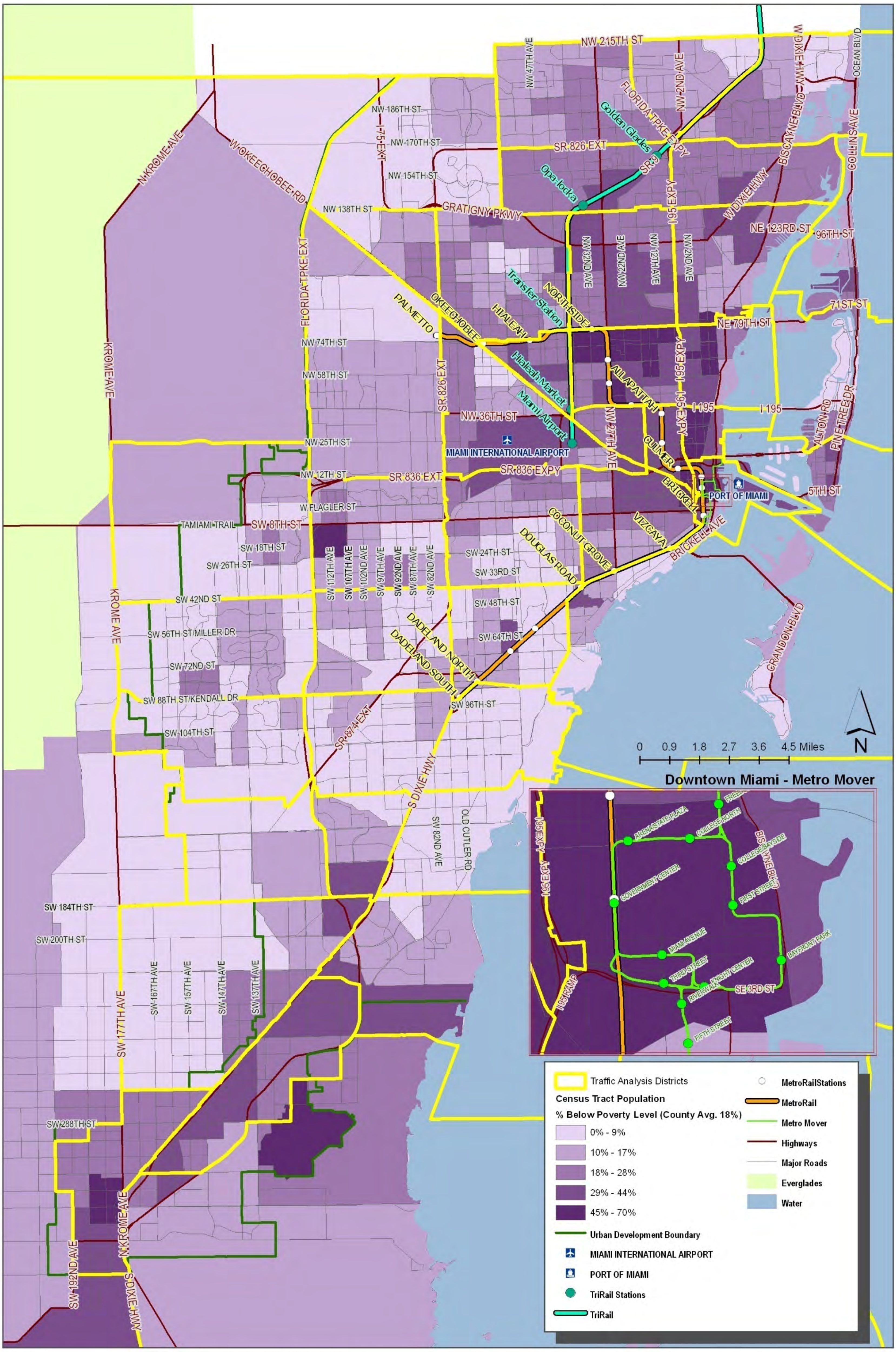


Figure 1.21 Linkages Scenario Equity Analysis
Strategies For Integration of Sustainability and the Transportation System

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

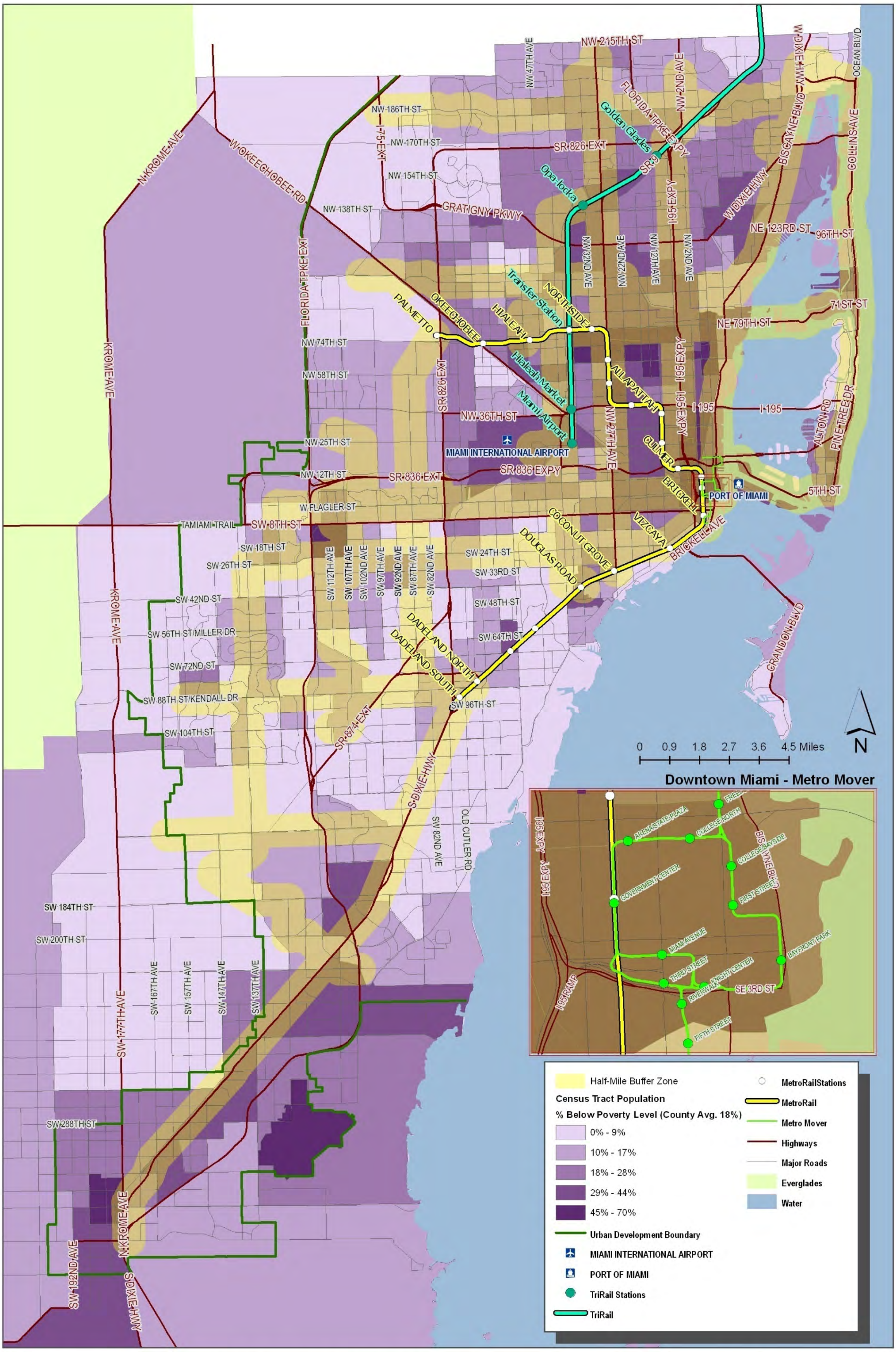


Figure 1.22 Multimodal Scenario Transportation Equity Analysis
Strategies For Integration of Sustainability and the Transportation System

Data Sources: Managed Lanes were manually digitized by Jacobs staff. All basemap data was downloaded from the Miami-Dade County GIS Data Library.

4.0 COST-REVENUE ANALYSIS

Order of magnitude costs and revenues were developed to understand the financial implications of the program of transportation projects indentified in different scenarios. It should be noted that these costs and revenues are system-wide preliminary planning level estimates. Wide ranges for costs and revenues were developed given the pre-conceptual definition of individual projects and lack of any level of engineering design. Below is a description of the cost and revenue estimation methodology for each scenario and resulting total capital cost and annual operating and maintenance cost as well as corresponding revenue streams. All cost and revenue numbers are in present day cost, which is 2011 dollars.

4.1 Scenario 1, Mobility Management

4.1.1 Cost & Revenue Estimation Methodology

For the Mobility Management scenario, cost and revenue estimates for managed lanes, express bus, and variable parking pricing strategies were developed.

4.1.1.1 Managed Lanes **-** As described in Section 2.1.1, a regional network of managed lanes was created in this scenario consisting of two lanes in each direction by taking one general purpose lane and shoulders on the County's limited access facilities. It is assumed that no additional right-of-way (ROW) would be required to accommodate managed lanes. Transitioning between managed lanes between different facilities does not include any special construction for ramps. Such transition would require drivers "weaving" for a short distance using the general purpose lanes.

Capital cost for managed lanes includes, striping, resurfacing, Intelligent Transportation System (ITS) infrastructure for providing real-time toll collection technology, pylons, and maintenance of traffic (MOT). The low end of the cost range was based on I-95 Managed Lanes project, which cost $16 million per mile. The high end cost assumed contingency and soft costs in addition to the low end cost, which resulted in an estimated $30 million per mile.

Operations and maintenance (O&M) cost were also based on I-95 Managed Lanes project experience as documented in the fiscal year (FY) 2010 Revenue Report. This report indicates that approximately 49% of the revenue is applied to O&M. This percentage was applied to the low and high end of the revenue forecast to create annual O&M range.

Revenue was estimated using SERPM. Forecast 2035 traffic volume for managed lanes obtained from the traffic assignment step of the modeling process was multiplied by toll rates for corresponding managed lane segments. Traffic volume was stratified based on auto occupancy into single occupant vehicle (SOV), high occupancy vehicle with two passengers (HOV2), and high occupancy vehicle (HOV) with more than two passengers (HOV2+). Auto occupancy for HOV2+ is approximately 3.2 passengers per vehicle. For creating the low end of the range, it was assumed that all HOV2+ are registered in the South Florida Commuter Services (SFCS) database and do not pay tolls, while for the high end all HOV2+ were assumed to pay tolls.

4.1.1.2 Express Bus **-** Express bus service was provided using the regional managed lanes network in the Mobility Management scenario. Buses provided "closed door service" between origin-destination pairs at 10/60 minute headway during peak/off peak hours respectively. Daily span of service was 14 hours with six hours during peak period and eight hours during off peak period. Peak vehicle requirement (PVR) for express bus service was estimated to be 126 buses including 20% spare ratio.

The range of capital costs for 60 feet articulated buses was obtained from Characteristics of BRT for Decision Making, FTA (2009) report for the low end ($800,000) and Miami-Dade Transit (MDT) for the high end ($950,000).

The range for the O&M costs was based on Miami-Dade Transit's base costs and incremental costs per revenue hour. The low end estimate used was $90 per revenue hour and the high end estimate used was $123 per revenue hour.

Fare box collection for express bus service was determined using annualized ridership from the TDM (SERPM) and fare policy for this scenario.

4.1.1.3 Variable Parking Pricing - Capital costs for this strategy include the purchase and installation of parking meters in existing surface parking lots and on-street parking spaces. Specific parking lots or streets where parking meters would be installed were not identified. Currently, the Miami Parking Authority owns 29,300 parking spaces. It was assumed that approximately 30,000 additional parking spaces would be metered in areas where this policy was implemented. The number of parking meters required was calculated based on the standard of one parking meter per 250 spaces. Unit capital cost was obtained from the South Florida Regional Transportation Authority, which estimated between $12,000 and $25,000 per unit.

O&M costs were based on the Miami Parking Authority's FY 2010 Annual Report, which was estimated at approximately 25% of annual revenue. This cost includes maintenance and repair of parking facilities and staff.

Annual parking revenue was developed based on vehicles trips by trip purpose at traffic analysis zone (TAZ) level obtained from the regional TDM (SERPM v6.5). Long-term parking revenue used 50% of the Home Based Work trips. Short-term parking revenue used 20% of the Home Based Work trips, 20% of Home Based Other trips, and 10% of Non Home Based trips.

4.1.2 Cost & Revenue Estimation Results

Based on the data sources and methodology explained above, the total capital costs for the program of projects identified in the Mobility Management scenario was estimated to be between $1.5 billion to $2.8 billion (2011 dollars), while annual O&M cost ranged from $92 million to $221 million (2011 dollars). Annual revenue was forecast between $228 million to $404 million (2011 dollars). Cost and revenue associated with specific improvements are described in Table 10 along with the assets it creates.

Table 10: Mobility Management Scenario Cost & Revenue Estimates

Total Capital Costs	**$1.5 - $2.8 billion that buys:**
	356 lane miles of Managed Lanes ($1.4B - $2.7B)
	Seven new Express Bus Routes ($101M - $120M) 279 route miles of new service 700 revenue hours daily 12,300 revenue miles daily 6,500 daily riders 126 articulated buses
	120 Parking Meters ($1.4M - $3.0M)
Annual O&M Costs	**$92 - $221 million**
	Managed Lanes ($39M - $114M)
	Express Bus Routes ($16M – $22M)
	Parking ($37M - $85M)
Annual Revenue	**$228 - $404 million**
	Managed Lanes ($80M - $233M) Express Bus Routes ($1M - $2M) Parking ($147M - $169M)

4.2 Scenario 2, Linkages

In this scenario, population and employment (jobs) were reallocated to achieve better land use-transportation coordination. Complete Streets policy was considered to be an integral part of Linkages scenario. However, in this scenario transportation improvement projects were not included. Consequently, cost and revenue estimates associated with Linkages were not calculated. However, it is recognized that land use changes will require political will and cost associated with public outreach and participation.

4.3 Scenario 3, Multimodal

4.3.1 Cost & Revenue Estimation Methodology

For this scenario, cost and revenue estimates for arterial BRT, real time passenger information, transit signal priority, and park-and-ride lots were developed.

4.3.1.1 Arterial Bus Rapid Transit - The concept of creating an arterial BRT network and providing premium transit service on the 16 most productive corridors was based on the hypothesis that eliminating overlapping local bus route, reducing bus stop density while maintaining access for patrons, and increasing bus speeds would yield buses that could be reassigned to these arterial BRT corridors. Few additional buses would be required even with aggressive headways on arterial BRT corridors when such reallocation of buses would occur. Consequently, the capital and O&M costs for this strategy could be controlled significantly.

Similar to the Mobility Management scenario, the range of capital costs for 60 feet articulated buses was obtained from Characteristics of BRT for Decision Making, FTA (2009) report for the low end estimate of $800,000, and Miami-Dade Transit (MDT) for the high end estimate of $950,000.

As with the Mobility Management scenario, the range for O&M costs was based on Miami-Dade Transit's base costs and incremental costs per revenue hour. The low end estimate used was $90 per revenue hour and the high end estimate used was $123 per revenue hour.

Similarly, Miami-Dade Transit's fare box recovery ratio of 23% was used to determine the fare box collection for the arterial BRT system.

4.3.1.2 Transit Signal Priority (TSP) - Unit capital and O&M costs for transit signal priority (TSP) were obtained from Characteristics of BRT for Decision Making, FTA (2009). The capital costs include $900 to $1,100 per emitter and $10,800 to $14,000 per receiver, phase selector, control box and controller. Approximately 2,600 signalized intersections in Miami-Dade County were equipped with TSP infrastructure in this scenario. The O&M costs were between $475 and $610 per year.

4.3.1.3 Real Time Passenger Information - Unit capital and O&M costs for real time passenger information technology was obtained from Characteristics of BRT for Decision Making, FTA (2009). The capital costs range from $4,000 to $10,000, including the electronic display sign at bus shelters. The O&M costs were between $1,160 and $2,900 per year. Approximately 1,000 bus stops in the arterial BRT corridors were equipped with electronic display panels for relaying bus arrival information.

4.3.1.4 Park-and-Ride Lots - Capital and O&M costs for park-and-ride lots were developed using industry standard unit costs. The capital costs for surface parking are estimated between $5,000 and $7,500 per space. For structured parking the capital costs are estimated to be between $18,000 and $20,000 per space. O&M costs for surface parking are estimated between $250 and $375 per space, while surface parking estimates are between $900 and $1,250 per space. Based on park-and-ride demand derived from the regional travel demand forecast (SERPM v6.5), the total number of parking spaces were determined. Unit cost was multiplied by the number of parking spaces to calculate the total capital and associated O&M cost.

4.3.2 Cost & Revenue Estimation Results

Based on the data sources and methodology explained above, the total capital costs for the program of projects identified in the Multimodal scenario was estimated to be between $61 million to $90 million (2011 dollars), while incremental annual O&M cost from the 2035 LRTP baseline ranged from $13 million to $21 million (2011 dollars). And annual revenue was forecast between $2.5 million to $4 million (2011 dollars). Cost and revenue associated with specific improvements are described in Table 11 along with the assets created.

Eighteen (18) additional buses were required when all transit improvements were tested in the TDM. The 2035 LRTP baseline forecast indicated fleet size requirement of approximately 1,250 buses. Approximately one third of this fleet (419 buses) was reallocated to the arterial BRT corridors. These 419 buses were made available by eliminating local and duplicative service in the arterial BRT corridors. Since headways were more aggressive in the arterial BRT corridors compared to the local bus service that was eliminated, it spiked the peak vehicle requirement (PRV) for arterial BRT corridors to 488 buses, i.e. 69 additional buses (488-419=69). Furthermore, implementing TSP throughout the County increased bus speeds system-wide and that yielded 51 buses. Therefore, the net requirement of buses was reduced from 69 to 18 (69 – 51 = 18 buses).

Table 11: Multimodal Scenario Cost & Revenue Estimates

Total Capital Costs	**$61 - $90 million that buys:**
	16 Arterial BRT Routes ($14M - $17M) 549 route miles of arterial BRT service 4,100 revenue hours daily 51,000 revenue miles daily 279,000 daily riders 18 additional articulated buses
	Transit Signal Priority ($29M - $38M) On-board equipment for the entire 1,200 buses 2,600 signalized intersections
	Real Time Passenger Information ($4M - $11M) 1,000 bus shelters equipped with electronic display signs
	Park-and-Ride Lots ($13M - $34M) 1,500 parking spaces
Annual O&M Costs	**$3 - $6 million**
	Arterial BRT ($42,000 - $57,000 incremental over 2035 LRTP Baseline)
	Transit Signal Priority ($1M – $1.5M)
	Real Time Passenger Information ($1M - $3M)
	Park-and-Ride Lots ($0.7M - $1M)
Annual Revenue	**$13 - $21 million**
	Express Bus Routes ($2.5M - $4M)

5.0 SUMMARY

Table 12 on the following page provides a summary of all the scenarios compared to the 2035 LRTP baseline across all performance measures.

5.1 What Do the Results Mean?

The intent of this study was not to select a specific scenario for implementation or even further review; however, there are a few observations worth noting.

1. VMT, VHT and mode split are difficult to affect system-wide.
2. Pricing policies are effective at increasing HOV use and the use of transit for Home Based Work trips.
3. Better linking land use and transportation can help to reduce:
    a. The overall number of trips;
    b. Trip lengths;
    c. Hours of delay; and
    d. GHG emissions.

Table 12: Summary of Scenario Evaluation Results

Evaluation Criteria	2035 LRTP Baseline	Scenario 1: Mobility Management	Scenario 2: Linkages	Scenario 3: Multimodal
Vehicle Miles Travelled (VMT), Daily	65,355,000	62,925,000	61,293,000	64,283,000
Absolute Change from LRTP		(2,430,000)	(4,062,000)	(1,072,000)
Percent Change from LRTP		-4%	-6%	-2%
Vehicle Hours Travelled (VHT), Daily	2,778,000	2,622,000	2,428,000	2,723,000
Absolute Change from LRTP		(155,490)	(350,000)	(55,000)
Percent Change from LRTP		-6%	-13%	-2%
Average Annual Delay (hours)/Person	101	93	74	97
Absolute Change from LRTP		(8)	(27)	(4)
Percent Change from LRTP		-8%	-27%	-4%
Mode Split				
Single Occupant Vehicle (SOV)Person Trips	5,780,000	5,415,000	5,675,000	5,725,000
SOV Percentage	53%	50%	53%	52%
High Occupant Vehicle (HOV)Person Trips	4,959,000	5,281,000	4,913,000	4,911,000
HOV Percentage	45%	48%	45%	45%
Transit	202,500	239,550	193,500	300,100
Transit Percentage	2%	2%	2%	3%
Transit Mode Share				
All Trip Purposes	2%	2%	2%	3%
Home Based Work Trips	5%	5%	4%	6%
Transit Boardings Change Compared to Baseline				
Total Transit		18%	-4%	48%
Home Based Work		12%	-10%	32%
Trip Length (in miles)	8.3	8.3	7.9	8.3
Absolute Change from LRTP		0.0	-0.4	0.0
Percent Change from LRTP		0%	-5%	0%
Greenhouse Gas Emissions (CO2 lbs/day)	50,093,000	50,087,000	46,478,000	49,554,000
Absolute Change from LRTP		-6,000	(3,615,000)	(539,000)
Percent Change from LRTP		0%	-7.2%	-1.1%
Energy Cost, US dollars in kilowatt hours	1,785	1,785	1,655	1,766
Absolute Change from LRTP		0	(130)	(19)
Percent Change from LRTP		0%	-7%	-1%
Cost of Congestion/Lost Productivity, US $	$6.9 billion	$6.7 billion	$6.3 billion	$6.7 billion
Absolute Change from LRTP		-$0.2 billion	-$0.6 billion	-$0.2 billion
Percent Change from LRTP		-2%	-8%	-2%

4. Simply putting increased residential density and employment next to transit will not increase transit use without also making transit more competitive with other modes of transportation.
5. Transit ridership was most affected by:
    a. Increased bus frequency;
    b. Improved bus speeds; and
    c. Improved reliability.

As noted at the beginning of this document, this exercise was designed to conduct a high-level investigation of different sustainable transportation strategies. The results of this study could be affected by additional efforts in any of the following areas:

1. A more in-depth analysis of the market for managed lanes;
2. A detailed analysis of existing pay-to-park area usage and fees, markets for additional pay-to-park areas, and the ability of people to accept new or adjusted parking fees;
3. An enhanced analysis of express bus markets to better determine routes, stops, and destinations;
4. A more thorough review of existing land use patterns and land suitability for absorbing additional residential densities and employment;
5. Evaluation of and improvements to access to existing premium transit stations;
6. More detailed analysis of potential arterial BRT corridors to determine where such routes would be most successful;
7. A market analysis for new park-and-ride facilities; and
8. The use of additional analysis tools such as the Surface Transportation Efficiency Analysis Module (STEAM 2.0), Social Cost of Alternative Land Development Scenarios (SCALDS), and Spreadsheet Model for Induced Travel Estimation – Managed Lanes (SMITE-ML).

In addition, greater reductions in GHG emissions may have been achieved through the use of alternative fuel vehicles. However, a key component of this study was to consider the financial sustainability of Miami-Dade County, which thereby limited the assumptions regarding the amount of capital funding available to implement such policies as total bus fleet replacement or the expansion of Metrorail throughout the county.

5.2 How Will the Results be Used?

The results of this effort should be used to inform upcoming studies such as the Southeast Florida 2060 Vision Plan being developed by the South Florida and Treasure Coast Regional Planning Councils; an analysis of the ability to implement tolled managed highways with rapid/enhanced bus routes and ridesharing programs being conducted by the Miami-Dade MPO; a study on parking being conducted by the Florida Department of Transportation, District 6; and future comprehensive planning activities conducted by the Miami-Dade Department of Permitting, Environment and Regulatory Affairs and the municipalities within Miami-Dade County.

One additional observation made during this study is the separation that exists between transportation agencies within Miami-Dade County. For example, under current conditions the Mobility Management scenario could not be implemented without an agreement between Miami-Dade Transit and the Miami-Dade Expressway Authority (MDX) that would allow for the use of toll funds for transit improvements and operations. Currently MDX will allow MDT to operate express buses on its facilities, but without some additional revenue sources MDT is limited in its ability to provide these services. Thus, another potential use for this study is to assist in starting interagency discussions about such issues that may allow some of the strategies tested here to move closer to reality.

Appendix II: Population & Employment Reallocation at Traffic Analysis District Level

Linkages Scenario Population, Employment and Jobs-Housing Ratio Comparisons for 2035 by Traffic Analysis District

Description	TAD	Estimated 2015 Population	Adopted 2035 Population	Reallocated 2035 Population	Absolute Change	Percent Change	Estimated 2015 Employment	Adopted 2035 Employment	Reallocated 2035 Employment	Absolute Change	Percent Change	Adopted 2035 Jobs-Housing Ratio	Reallocated 2035 Jobs-Housing Ratio
Aventura	1	114,011	126,012	124,973	-1,039	-0.8%	59,912	77,589	73,493	-4,096	-5.3%	1.5	1.4
Norwood	2	55,982	64,447	63,290	-1,157	-1.8%	19,789	23,631	25,222	1,591	6.7%	1.1	1.1
Miami Gardens	3	88,003	92,688	91,657	-1,031	-1.1%	15,604	18,841	27,374	8,533	45.3%	0.7	1.0
Miami Lakes	4	109,867	125,815	123,265	-2,550	-2.0%	40,308	52,680	48,457	-4,223	-8.0%	1.3	1.2
Hialeah Gardens	5	75,171	86,166	84,915	-1,251	-1.5%	30,999	42,333	39,148	-3,185	-7.5%	1.6	1.5
Hialeah (North)	6	142,122	157,038	169,193	12,155	7.7%	69,767	87,034	84,574	-2,460	-2.8%	1.7	1.5
West Little River	7	65,351	70,617	77,984	7,367	10.4%	28,165	33,284	33,453	169	0.5%	1.5	1.4
Miami Shores	8	81,336	85,256	93,969	8,713	10.2%	28,852	34,209	34,140	-69	-0.2%	1.1	1.0
Opa-Locka	9	36,788	39,527	39,224	-303	-0.8%	35,739	48,552	40,266	-8,286	-17.1%	3.9	3.2
Golden Glades	10	46,314	51,201	49,968	-1,233	-2.4%	24,921	30,542	32,165	1,623	5.3%	1.7	1.8
North Beach	11	36,326	42,837	45,350	2,513	5.9%	12,811	15,292	14,927	-365	-2.4%	0.7	0.6
Middle Beach	12	43,875	49,197	56,508	7,311	14.9%	35,749	42,219	42,095	-124	-0.3%	1.5	1.3
Little Haiti	13	37,601	39,122	46,624	7,502	19.2%	21,115	25,663	25,346	-317	-1.2%	1.9	1.6
Liberty City	14	57,735	63,638	72,172	8,534	13.4%	38,462	51,343	50,096	-1,247	-2.4%	2.5	2.2
Hialeah (South)	15	40,191	44,102	51,020	6,918	15.7%	19,604	24,772	24,892	120	0.5%	1.7	1.5
Airport/Springs	16	28,097	30,153	44,340	14,187	47.0%	108,683	144,688	122,432	-22,256	-15.4%	17.1	9.8
Doral/Medley	17	41,905	61,376	58,957	-2,419	-3.9%	167,804	238,746	173,237	-65,509	-27.4%	12.0	9.0
South Beach	18	40,456	46,826	60,355	13,529	28.9%	46,146	57,297	56,555	-742	-1.3%	2.0	1.5
Downtown/Brickell	19	40,208	66,099	89,955	23,856	36.1%	141,103	167,388	151,512	-15,876	-9.5%	5.9	3.9
Omni/Midtown	20	36,411	68,415	98,595	30,180	44.1%	18,380	24,069	29,439	5,370	22.3%	0.9	0.8
Civic Center	21	27,398	33,939	64,708	30,769	90.7%	55,309	63,664	63,116	-548	-0.9%	5.5	2.8
Allapattah	22	27,981	28,579	45,392	16,813	58.8%	17,039	21,224	20,942	-282	-1.3%	1.9	1.2
Little Havana	23	137,812	168,703	199,995	31,292	18.5%	46,542	55,931	68,009	12,078	21.6%	0.9	0.9
Coral Gables	24	111,962	123,911	139,033	15,122	12.2%	105,775	130,212	120,582	-9,630	-7.4%	2.7	2.3
Westchester	25	151,287	184,968	180,519	-4,449	-2.4%	47,484	56,265	53,822	-2,443	-4.3%	0.9	0.9
West Dade	26	84,647	105,106	88,962	-16,144	-15.4%	13,947	17,370	37,715	20,345	117.1%	0.6	1.4
West Kendall	27	135,110	159,787	140,657	-19,130	-12.0%	13,462	15,811	38,715	22,904	144.9%	0.3	0.9
East Kendall	28	78,673	83,788	83,545	-243	-0.3%	32,105	37,935	35,727	-2,208	-5.8%	1.3	1.2
South Miami	29	44,717	49,749	60,960	11,211	22.5%	69,964	88,329	84,771	-3,558	-4.0%	4.5	3.5
Key/Grove	30	39,214	44,222	51,847	7,625	17.2%	38,614	47,770	46,018	-1,752	-3.7%	2.5	2.0
Pinecrest	31	21,170	23,257	22,388	-869	-3.7%	13,163	15,988	14,974	-1,014	-6.3%	1.9	1.9
Killian	32	50,791	57,022	55,663	-1,359	-2.4%	34,654	41,199	39,182	-2,017	-4.9%	2.0	1.9
Hammocks	33	90,853	107,798	95,167	-12,631	-11.7%	26,420	33,003	36,819	3,816	11.6%	1.0	1.2
CountryWalk	34	69,403	79,873	72,485	-7,388	-9.2%	16,176	20,446	28,060	7,614	37.2%	0.9	1.3
Perrine	35	41,575	53,775	52,537	-1,238	-2.3%	6,158	7,133	14,307	7,174	100.6%	0.4	0.8
Palmetto Bay	36	27,818	31,323	30,254	-1,069	-3.4%	10,677	12,905	12,488	-417	-3.2%	1.2	1.2
Cutler Bay	37	66,576	111,962	75,822	-36,140	-32.3%	13,258	16,087	31,083	14,996	93.2%	0.4	1.2
Redlands/Southridge	38	51,124	78,492	54,206	-24,286	-30.9%	17,178	21,009	23,120	2,111	10.0%	0.8	1.3
Princeton-Naranja	39	71,412	129,557	83,740	-45,817	-35.4%	10,519	13,616	37,257	23,641	173.6%	0.3	1.2
Homestead-FL City	40	49,760	78,057	57,157	-20,900	-26.8%	11,440	13,588	21,838	8,250	60.7%	0.5	1.1
Homestead-Speedway	41	47,847	101,698	57,709	-43,989	-43.3%	9,557	12,330	24,411	12,081	98.0%	0.3	1.1
Everglades (non-urban)	42	20,628	32,057	23,094	-8,963	-28.0%	10,955	12,228	12,440	212	1.7%	1.2	1.7
	TOTALS	**2,665,507**	**3,278,155**	**3,278,155**			**1,584,308**	**1,994,215**	**1,994,215**				

Appendix II - Adjustments for Off-model Strategies

Evaluation: Off-model Strategies

Scenario #1 - Mobility Management (Managed Lanes)

	2035 LRTP Baseline	Mobility Management	Multimodal	Linkages
Delay (Vehicle Hours)	908,500	840,500	875,500	663,500
% Delay	0.0%	-7.5%	-3.6%	-27.0%

Transportation Strategy	% reduction	Reduction in Delay (Veh-Hrs)
Motorist Information System Freight Operation Improvements	1%	8,405

	2035 LRTP Baseline	Mobility Management	Multimodal	Linkages
Delay (Vehicle Hours)	908,500	832,095	875,500	663,500
% Delay	0.0%	-8.4%	-3.6%	-27.0%

Scenario #2 - Linkage (Land Use)

Complete Streets	No reduction in VMT[1]

[1]Increasing population and jobs density results in a reduction of 10-15 percent automobile trips within the travel demand model.

Scenario #3 - Multimodal (BRT) - With Reduced Metrorail Fare

	2035 LRTP Baseline	Mobility Management	Multimodal	Linkages
Vehicle Mile Traveled (VMT)	65,355,000	62,925,000	64,655,000	61,293,000
		-3.7%	-1.1%	-6.2%
Managed Lanes (VMT)	680,500	3,440,000	674,500	573,013
		405.5%	-0.9%	-15.8%

	% reduction in HBW Trips (SOV only)	HBW Trips (SOV only)	Reduction in HBW trips	VMT Reduction
Vanpool/carpool with Parking cash-out	1.5%	1,740,000	25,404	210,065

HOV and HOV 2+ account for approximately 10 percent of HBW trips per SERPM

As of Sept. 14, 2011 per SFCS vanpool and carpool had saved 47 million miles of travel (VMT) since January 1, which is approximately 210,760 miles per avg. weekday

Since vanpool/carpool and ridesharing program already exist in South Florida, adding financial incentives will further reduce the VMT by the same amount on a daily basis.

	% reduction in VMT	VMT (HBW Trips[2])	VMT Reduction
Telecommuting	0.50%	16,005,366	80,027

[2] Average auto trip length for Multimodal scenario (8.3 miles) times the number of HBW highway trips less trips for carpool/vanpool strategy

Source: Victoria Transport Policy Institute

	Fleet Size	Reduction in # of Personal Autos[3]	Avg. Auto Trip Length[4]	VMT Reduction
Car-sharing	500	7500	8.3	62,017

[3] Each car in the car share fleet takes off one (1) personal automobile of the road

[4] Average auto trip length for Multimodal scenario

	% reduction in Person Trips	HBW (Person Trips[5])	Reduction in person trips	VMT Reduction
Biking initiatives/programs	0.46%	2,066,296	9,505	19,649

Bike/walk percent mode share for Miami-Fort Lauderdale Metropolitan Area is 0.46 percent

[5] Average trip length for bike trips assumed to be two (2) miles.

	2035 LRTP Baseline	Mobility Management	Multimodal	Linkages
Vehicle Mile Traveled (VMT)	65,355,000	62,925,000	64,283,000	61,293,000
		-3.7%	-1.6%	-6.2%
Managed Lanes (VMT)	680,500	3,440,000	674,500	573,000
		405.5%	-0.9%	-15.8%

Summary for off-model transportation strategies

	2035 LRTP Baseline		Mobility Management		Multimodal		Linkages	
Strategy	VMT	Delay	VMT	Delay	VMT	Delay	VMT	Delay
Motorist Information System	-na-	-na-	-na-	8,405	-na-	-na-	-na-	-na-
Freight Operation Improvements	-na-	-na-	-na-		-na-	-na-	-na-	-na-
Complete Streets	-na-	-na-	-na-	-na-	-na-	-na-	0	0
Vanpool/carpool with Parking cash-out	-na-	-na-	-na-	-na-	210,000	-na-	-na-	-na-
Telecommuting	-na-	-na-	-na-	-na-	80,000	-na-	-na-	-na-
Car-sharing	-na-	-na-	-na-	-na-	62,000	-na-	-na-	-na-
Biking initiatives/programs	-na-	-na-	-na-	-na-	20,000	-na-	-na-	-na-

The delay (congestion) in Scenario 1 (Mobility Management) is -8.4 percent when motorist information systems and freight operational improvements are accounted for (assumption is 1% reduction for these strategies). So delay decreases from -7.4 percent to -8.4 percent when the off-model strategies are considered. I think this is reasonable.

There is no reduction in either delay or VMT for Scenario 2 (Linkages).

For Scenario 3, VMT reduction is as follows:
Vanpool/carpool with Parking cash-out - 210,065 Tele-commuting - 80,027 Car sharing - 62,017 Biking initiatives/programs - 16,697. So the total VMT reduction is 371,805. The total VMT reduction including the credit for off-model strategies is -1.6 percent. So VMT reduction goes from -1.1 percent to -1.6 percent because of off-model adjustments or it decreases of 0.5 percent for all the four strategies.