AN ANALYSIS OF THE ECONOMIC IMPACTS OF FLORIDA HIGH SPEED RAIL

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and

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INTRODUCTION

This report, *An Analysis of the Economic Impacts of Florida High Speed Rail,* is one of three documents produced reporting on the impacts of Florida high speed rail. Two studies, with a shared executive summary, were carried out to analyze the impacts of Florida high speed rail. This initiative was undertaken during the first half of 1997, by the Center for Economic Forecasting and Analysis (CEFA) at Florida State University (Tallahassee) and the Center for Urban Transportation Research (CUTR) at the University of South Florida (Tampa). The three documents consist of two technical reports and an executive summary. The two technical reports each share introductory materials and background information then present findings in their respective areas. The technical study and executive summary titles are:

An Analysis of the Economic Impacts of Florida High Speed Rail

Travel Time, Safety, Energy, and Air Quality Impacts of Florida High Speed Rail

Executive Summary: An Analysis of the Impacts of Florida High Speed Rail

This research effort is in response to a request from the Florida Department of Transportation (FDOT) and the FLORIDA OVERLAND EXPRESS (FOX), the franchisee to construct and operate Florida high speed rail, to support continued project planning. Thus, this effort produced an analysis that provides additional, specific technical information regarding the impacts of the FOX project based on the high speed rail plan as outlined in the FOX proposal and subsequent franchise agreement between FOX and Florida Department of Transportation. This report addresses specific impacts of interest to planners, the public and decision makers. These economic impacts are discussed and quantified in their respective units of measure; jobs (expressed as person years of employment), wages and salaries (expressed in 1997 dollars), and economic output (also expressed in 1997 dollars).

This report is organized to briefly describe the transportation market in Florida and the FOX plan, followed by a more substantial discussion of the methodology and findings of the analysis.

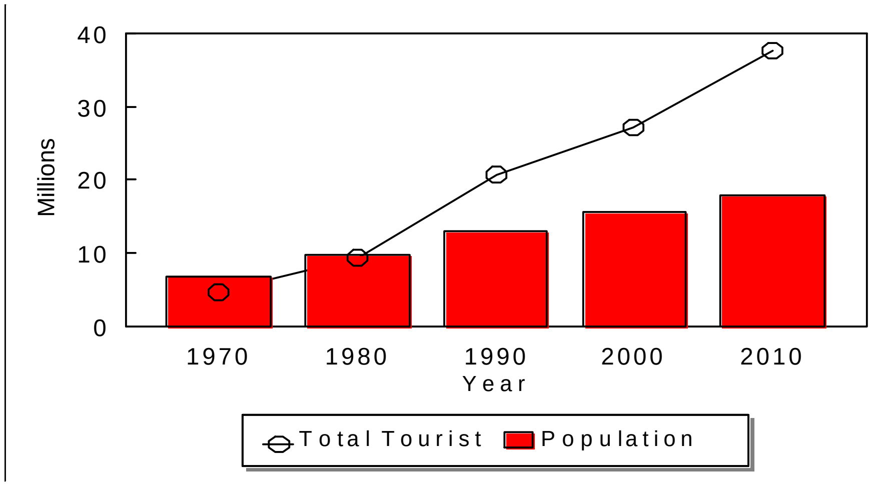
BACKGROUND

Florida has experienced population and tourism growth over the past few decades virtually unrivaled elsewhere in the United States. Population has grown from 5.0 million in 1960 to 12.9 million in 1990 and is continuing to grow at a pace roughly twice as fast as the population as the U.S. Considerable progress has been made in expanding Florida's highways, ports, airports and public transportation systems. Flat topography, the absence of freeze-thaw cycles and a relatively young existing infrastructure have helped; however, growing demand has continued to outpace the supply of new transportation capacity. As the inventory of facilities grows, the cost of maintenance requires an increasing share of revenues. Urbanization has dramatically increased costs of right-of-way for facility widening. Congestion has increased the costs of maintaining traffic flow while repairing or widening facilities and utility relocation and environmental mitigation have dramatically increased the cost for roadway expansion. The costs and consequences of unlimited expansion of Florida's roadways are more than can be borne by our environment and by the taxpayers. A number of Florida’s urbanized regions are nearing the physical and environmental limits for expanding their highway and airport capacity.

Figure 1 shows the growth in total population and tourism in Florida since 1970 and projected to 2010. Between 1990 and 2010 Florida population is expected to increase by 38 percent. Population growth is expected to continue to favor the coastal and central Florida areas resulting in larger and more dense urbanized areas. Tourism is expected to grow even more rapidly with an anticipated increase of 82 percent between 1990 and 2010. The Associated Press reports that Florida had 7.2 million foreign tourists in 1995. The renowned attractions of Florida, a combination of sunshine, beaches and a huge and growing list of attractions and accommodations, will virtually assure continued attractiveness as the baby boom ages and the international population expands in numbers and has growing disposable income.

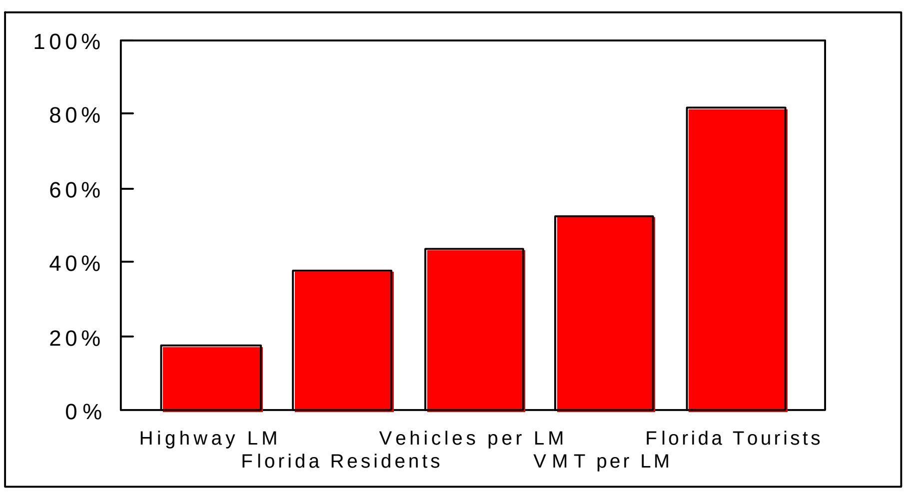
This increase in population and tourists will be facing an increasingly strained transportation system. Not only has population grown but travel per capita has increased. And the infrastructure investments have not kept pace. As shown in Figure 2, highway lane miles (LM), is forecasted to only increase 19 percent between 1990 and 2010. In that same time period vehicle miles of travel (VMT) and the number of vehicles are expected to grow dramatically. Vehicle miles of travel per highway lane mile is expected to increase 52 percent. Air travel expansion has also dramatically outpaced population growth and continued pressure for intercity travel capacity is expected to remain strong in Florida.

Figure 1. Population and Tourism Growth, 1990 - 2010



Source: CEFA and CUTR.

Figure 2. Travel Demand Growth, 1990 - 2010



Source: CEFA and CUTR.

The High Speed Rail Alternative

The Florida Department of Transportation has aggressively sought alternatives to meet the travel needs of Florida residents and tourists while still being responsible stewards of the environment and public resources. In this search, the prospect of implementing a high speed rail system for Florida originated in 1982 and is currently mandated by the 1992 Florida High Speed Rail Transportation Act. Florida is not alone in considering high speed rail, a number of states and regions are exploring a variety of rail technologies and corridors. A common goal is to identify markets where travel volumes and distances are such that rail services can be competitive with highway and air travel options. This may provide an opportunity to lessen the pressure on both roadway and air travel as these facilities are heavily congested in several urban areas.

As time has passed, the prospect of a high speed rail system has grown more attractive. Modern rail technology has proven itself in an increasing number of travel markets across the globe. Florida's rapid population and tourism growth, flat topography, cluster of large urbanized areas, and growing densities have created a travel market that, in part, may best be served by a transportation system that includes high speed rail. Rapid development also motivates moving ahead with a system at this time while the cost and availability of rights-of-way are still reasonable. Other motivations for moving ahead include a desire to use the investment to help shape future development near stations and to complement the growing interest in public transit as an alternative to automobile travel. A traveler choosing to travel by HSR instead of auto may be further reducing roadway travel and its negative impacts as transit alternatives might be the logical choice for travel within the urban areas visited by HSR travelers.

The proposed Florida high speed rail project is not envisioned as a single cure-all for the pressing travel congestion problems facing the state. High speed rail is, however, recognized as one of several pivotal transportation investments needed within the integrated infrastructure of the state to resolve these growing concerns.

The Florida High Speed Rail Project

In 1996, the Florida Department of Transportation entered into a public-private partnership with FLORIDA OVERLAND EXPRESS (FOX), a consortium of four of the world's largest and most respected international engineering, construction and rail equipment companies, to implement a high speed rail system linking Tampa-Orlando-Miami. The Florida Department of Transportation and FOX are currently in the process of finalizing studies of ridership, route alignment, construction costs and financing.

The Florida High Speed Rail System is designed to provide approximately 320 miles of electrified track connecting Florida's largest urban areas. The system is intended to be an integral part of the state's overall transportation infrastructure by linking air, auto, taxi, shuttle vans, bus, and existing rail and transit systems in a way that will meet future resident and tourist travel needs. The Florida high speed rail project will serve as an important link in what may be the United States' first multi-modal transport system that includes high speed rail.

The system proposes connections with five major airports, the highway system and growing regional rail and bus transit systems across the state's largest metropolitan areas. The counties directly served by this proposed high speed rail system are forecast to contain more than 45% of the state's 15.5 million people by the year 2000 and over 58% of tourist development tax revenues are predicted to be collected in counties with direct FOX service. FOX will serve a very large share of the state's major tourism attractions including cruise ships, beaches, urban centers and theme parks.

Figure 3 is a graphic provided by FOX that indicates the system characteristics and the candidate alignments under study.

The proposed system is planned to utilize the newest generation of French TGV rail equipment. The system will consist of ten car train sets, including two power cars, seven passenger coaches and a lounge car with food service. The coach vehicles will be 61' - 4" long and 9' - 6" wide. A train set would have seating capacity for 295 passengers. The system will serve seven stations as shown in Figure 4. The peak operating speed for the system is 200 miles per hour with an average scheduled travel speeds shown in Table 1 for each station pair.

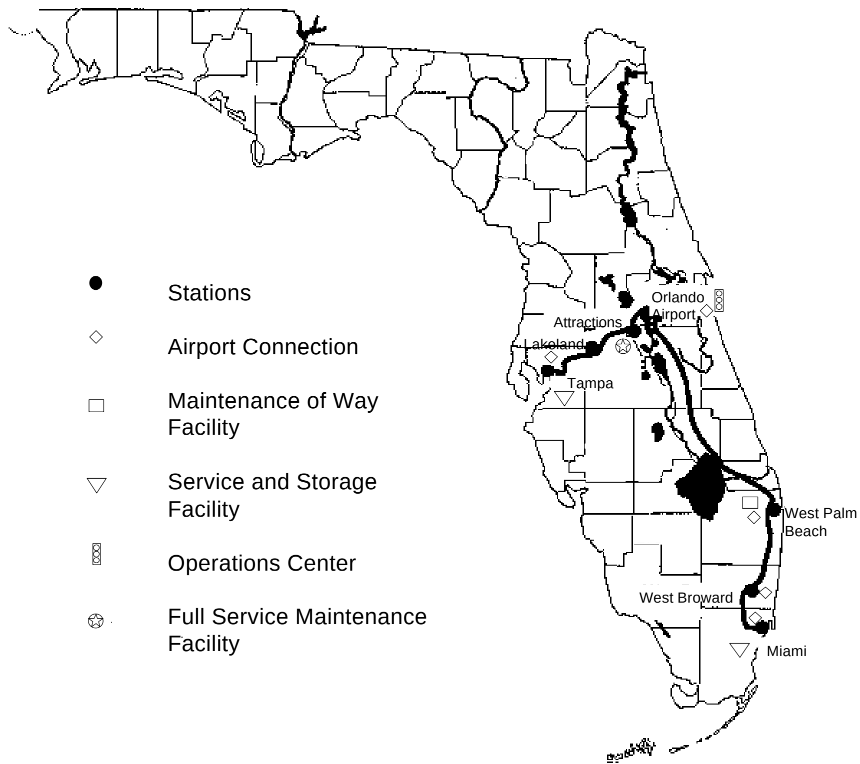
Figure 3. FOX System and Project Description

FOX's High Speed Rail

- 320 Dedicated Route Miles
- 7 Stations including 2 Airport Intermodal Facilities
- 21 Train Sets
- 295 Passengers Per Train
- Top Operating Speed 200 mph
- Trains Can Operate Every 5 Minutes
- Interconnects With Local Transit at All Stations
- Commences Operation 2004
- 5.3 Billion ($1995) Total Project Cost

Source: FOX

Figure 4. FOX Stations and Facilities



Source: FOX.

Table 1. FOX Schedule Speeds and Distances

Stations		Miami	Fort Lauderdale	West Palm Beach	Orlando Airport	Orlando Attractions	Lakeland
Tampa	*Miles*	319	286	227	84	73	32
	Minutes	145	132	113	55	37	18
Lakeland	*Miles*	287	255	196	52	41	
	Minutes	125	112	93	35	17	
Orlando Attractions	*Miles*	246	214	155	11		
	Minutes	103	90	71	13		
Orlando Airport	*Miles*	235	203	144			

	Minutes	85	72	53			
West Palm Beach	*Miles*	92	59				
	Minutes	44	23				
Fort Lauderdale	*Miles*	33					
	Minutes	17					

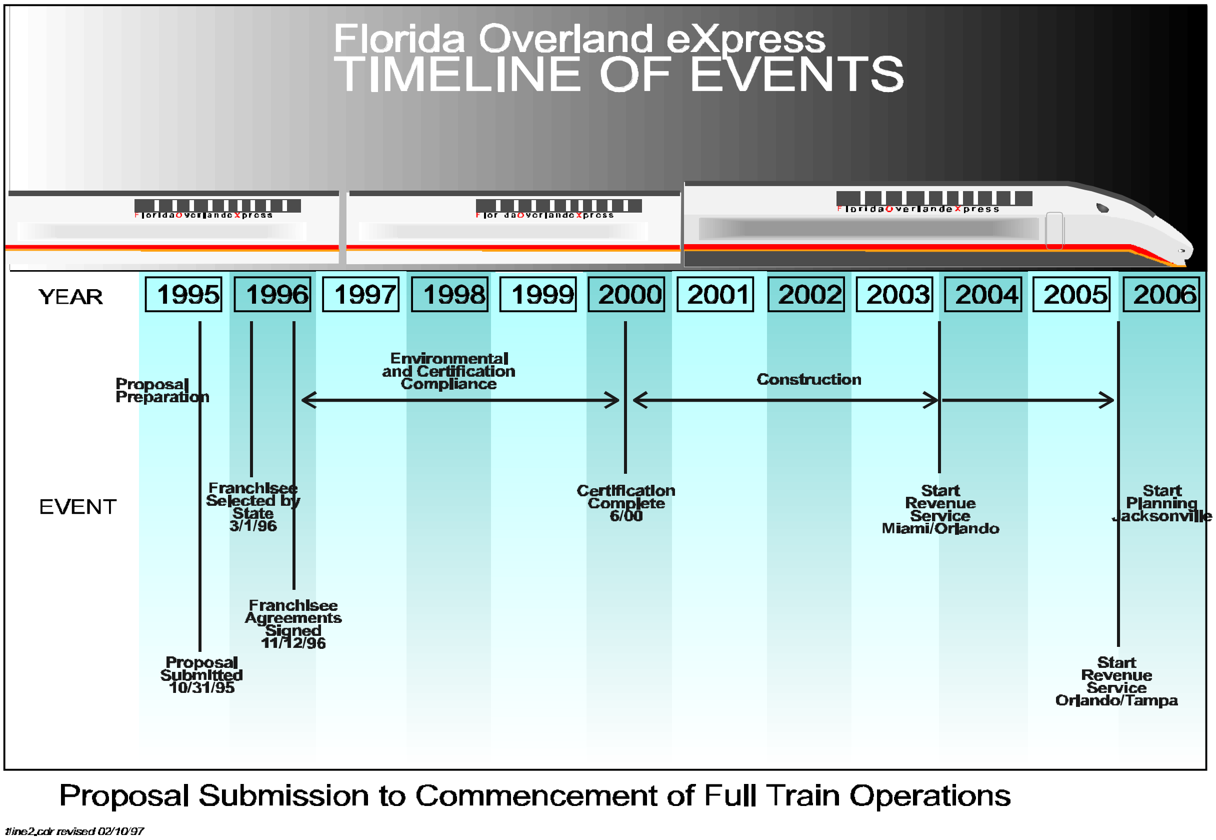
Source: FOX.

Schedules would provide service at least every hour, getting more frequent over time as demand increased. Service would be provided 365 days per year at least 18 hours per day. Fares are anticipated to be competitive with or lower than airline fares with pricing designed similar to airlines with yield management targeted to several different travel markets. Ticketing would be integrated with other ground travel and air providers.

The system would be completely grade separated with no at-grade crossings of roadways, other rail lines or pedestrian or other access. Stations would offer a full service environment with ticketing, access and egress mode services, amenities, and services designed to meet many traveler needs. Smaller in scale than commercial airports, rail stations would enable relatively quick arrival and departure times.

The schedule for the implementation of the FOX program is shown in Figure 5. The proposed schedule for Florida's high speed rail project has environmental and engineering studies on-going through 1999 and construction slated to begin in 2000. The first passengers will be able to travel from Miami to Orlando beginning in 2004.
Service would start on the Orlando to Miami leg in 2004 and in 2006 the full phase one alignment from Tampa to Miami would be in place. The prospect of future system expansion to northeast or southwest Florida and perhaps other locations has been considered; however, impacts from those facilities are not included in this analysis. Table 2 provides information developed by FOX summarizing the overall project.

Figure 5. FOX Implementation Time Line



Source: FOX.

Table 2. FLORIDA OVERLAND EXPRESS Project Summary

Source: FOX.

Impacts of Florida High Speed Rail

As a precursor to estimating the economic impacts, this study looked at the transportation benefits expected from the project. These benefits are of interest both because they subsequently contribute to economic impacts, and independently, as safety, air quality and energy use are among the important considerations in making transportation investments.

Transportation benefits accrue to persons choosing to use HSR and for non-users of the system that benefit from the presence of this transportation alternative. These benefits take two forms. The first is benefits to the HSR traveler beyond the cost of the fare including consumer surplus, safety, environmental and other savings. Second, there are economic and other savings for non-high speed rail travelers using existing transportation modes in the form of reductions in congestion and air pollution as a result of some air and auto travelers switching to this new high speed rail mode.

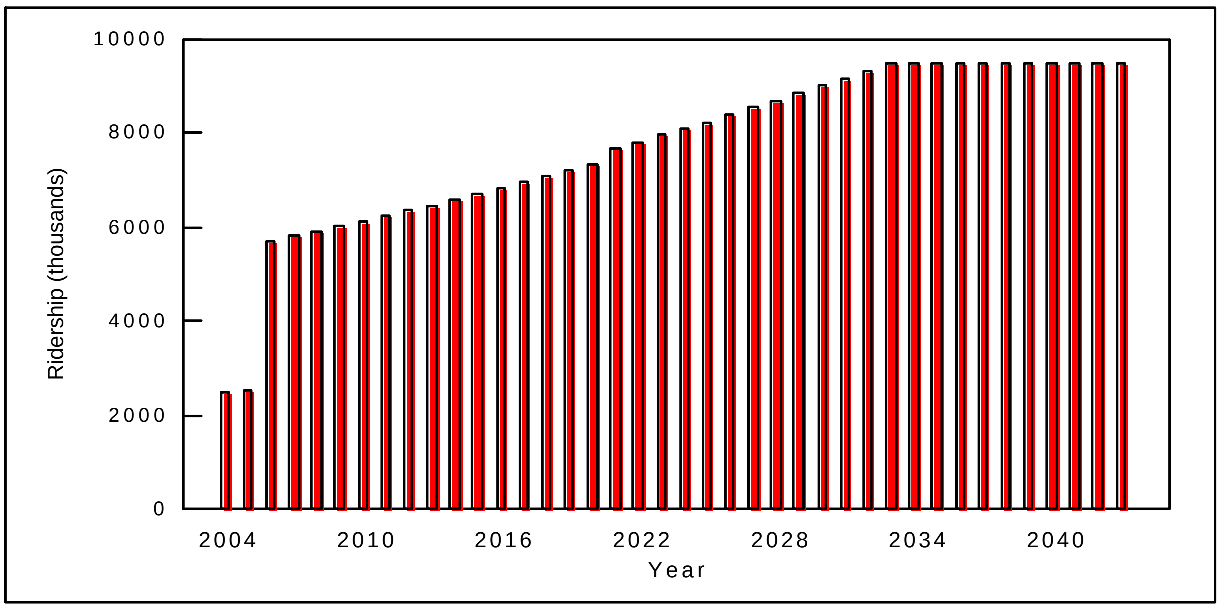
HSR Travel and Traveler Benefits

Florida High Speed Rail is projected to carry approximately 6.13 million one-way trips in the year 2010. This will result in approximately 16,780 daily trips, averaging 182 miles. Forty-six percent of the ridership will be concentrated in the Orlando-Miami segment, with 36 percent and 18 percent in the Tampa-Orlando and Tampa-Miami segments, respectively. Fifty-seven percent of these trips would be made for business purposes, the remainder being tourism and personal travel. Of the total ridership, 31 percent are estimated to shift to high speed rail from air travel, 45 percent would shift from auto, and 24 percent would be new trips induced due to the cost and convenience of high speed rail. Of intercity travel between the Florida cities served, approximately 5 percent of highway traffic will be served by high speed rail, while approximately 80 percent of air traffic will be diverted to high speed rail. HSR ridership represents about 11 percent of the total travel that starts and ends in the cities served in the Tampa-Orlando-Miami corridor.

The average fare is projected to be approximately $64 per trip or $0.35 per passenger mile in 1997 dollars. Figure 6 shows the trend of HSR ridership over the first few decades of operation. Several studies have developed ridership forecasts for high speed rail in Florida over the past several years. The source of ridership estimates for this analysis is the ridership forecast included in the FOX Pre-Certification Post Franchise Agreement and supporting documents. This forecast utilized the extensive forecasting work that was carried out by KPMG Peat Marwick in 1993 and further modeling work carried out by SOFRERAIL, a French firm involved in high speed rail planning.

Based on that forecast, HSR will serve approximately 1.1 billion passenger miles of travel in 2010, helping meet needs in a state that currently has over 127 billion vehicle miles of travel on roadways. As portrayed by these statistics, HSR would provide a large amount of service and carry a large ridership, yet in the context of the total travel demand of the State, its role, like that of any single project, is more modest.

Figure 6. Florida High Speed Rail Ridership



Source: FOX and FDOT Pre-Certification Post Franchise Agreement (PCPFA) and supporting documents.

METHODOLOGY

This section describes the methodology used in this analysis. The description includes discussion of the theory of economic impact assessment, the analytical model, inputs to the model, methods for estimating the inputs, and the analytical steps used in developing forecasts.

The State of the Art of Economic Impact Assessment

Transportation fulfills many social needs and is considered an essential component of the infrastructure of a civilized society. It also makes a significant economic contribution to the community. These benefits accrue directly and indirectly to those who regularly use the transportation investments as well as to those who may not directly use a given transportation facility.

This report provides an objective analysis of the economic impacts that are forecast to result from the FOX system. There is no standard methodology for such an analysis and studies have varied greatly in their approach. However, in the more objective research, certain standards are evolving. It is useful to understand the consequences of all the resource flows associated with a project but, it is also critical to evaluate the economic impacts in the context of the alternative uses to which funds might be put. The basic premise of objective economic impact assessment is that benefits flow from improvements in transportation systems (e.g., reduced travel time and cost), and from new dollars attracted to an area, not simply from the mere expenditure or movement of funds within a given area. Thus, simply taking taxpayer or private sector dollars and spending them on transportation as opposed to some alternative use will not necessarily create positive economic impacts. Realizing net positive benefits requires the inflows of new resources and/or the realization of benefits to travelers that result in savings. (See CUTR 1997 for more on this discussion).

The economic impacts measured in this report are only a portion of the total economic benefits that can accrue to Florida. An investment such as high speed rail can deliver the transportation benefits and economic impacts as outlined in the remainder of this report and it can have other consequences beyond those easily estimated. The full impact of such an investment is realized if the state, individual communities, businesses and the public embrace and fully leverage this investment with complementary policies and investments. High speed rail can be a stimulus for development of new industries in Florida. It can be a motivating factor for economic development and growth management activities and a calling card to attract new business and additional tourists to Florida. It can serve as a critical element in a vision of a sustainable and economically vigorous Florida. It can symbolize a willingness to invest in new ideas, use creative public private partnerships and demonstrate innovative approaches to problem solving. It offers the example of a safe, efficient, and environmentally friendly way to meet our transportation needs and complements public transportation investments in our urban areas. Some of these benefits are a fairly straightforward result of going ahead with the investment. For example, large numbers of construction and operations jobs will occur as a result of a decision to implement. Other economic impacts are dependent on the ridership materializing and the transportation benefits being realized by travelers. Still others are dependent on how the public, decision makers, and business community choose to leverage this investment by their decisions to use, serve, locate near, co-market with or otherwise take advantage of this investment.

Figure 7 schematically shows the flows of money that will occur as a result of a decision to implement the FOX system. It is from understanding these flows of money and the consequences that they have on the economy that we can estimate the economic impacts of the project on the state of Florida and the various regions. As the graphic indicates, a project of this magnitude will have a complex interaction with the economy of Florida. Funds come from several sources both within and outside the state of Florida. The principle stimulus effects on the state of Florida come from new funds entering the state and from the economic benefits associated with the transportation services that are provided. Thus, the equity investment by the FOX consortium, the contribution of federal funds and the economic benefits associated with the improved transportation are the principle positive stimulus effects. In addition, unlike other projects that need continued subsidies, this project is forecast to generate a return on the investment that is subsequently assumed to be reinvested in later years.

The cash flows into and from the project are characterized by a series of arrows. Monies come into the project from several sources: FOX, the federal government, the state government, debt issued, and fare revenues. The largest source of funds is fare revenues. Spending by the project returns dollars to the state and other locations. Debt is repaid, capital dollars are spent on constructing and maintaining the system and perhaps expanding it, operating costs are paid over the lifetime of the franchise, and both the state and FOX receive a return on their investment in the project. In addition to these economic flows, the transportation services provided create their own economic impacts. As characterized in the circle on Figure 7, ridership on the FOX system creates two significant economic stimuli. First it generates the fare revenues that play a major role in the cash flows discussed, and second, it generates additional benefits in terms of consumer surplus, travel time and cost savings, energy and air quality savings, safety benefits etc. that ultimately have an economic impact of their own. These transportation benefits result in savings to businesses and individuals that have real value. In economic modeling terms, that value is characterized by increases in business productivity and regional attractiveness that save dollars for businesses and attract additional spending to Florida. These resources become part of the state's overall economy as indicated by the large arrow in Figure 7.

Table 3 indicates the spending program associated with the high speed rail system. Table 4 summarizes the diversion of travel to the proposed high speed rail system.

Table 3. Florida High Speed Rail Spending and Revenues Summary (1997 - 2043)

Sources of Funds	Amount (mil.)	Spending Category	Amount (mil.)
FOX Investment	$ 349	Capital and Vehicle Costs	$ 9,141
Federal Investment	$ 300	Operations	$ 16,608
State Investment	$ 6,556	Debt Payment	$ 18,943
Passenger Fares & Other Revenues	$ 53,414	Return on Investment	$ 22,642
Borrowed Funds	$ 7,406	Reserves	$ 691
Total	$ 68,025	Total	$ 68,025

Source: FOX.

Table 4. Travel Diverted to the High Speed Rail System through 2043

Source of Travel	Passenger Miles (millions)
Highway Travel Reductions	19,002
Air Travel Reductions	24,238

Source: CEFA and CUTR.

Figure 7. Economic Impacts of Florida High Speed Rail

Source: CEFA and CUTR.

Risks and Uncertainties

This analysis relies on data on project costs (construction and operations) and ridership that were generated during the development of the FOX proposal and subsequent Pre-Certification Post Franchise Agreement and supporting documents. The planning and engineering work that has produced these numbers represents the culmination of several years and several millions of dollars of investment. Given the importance of these estimates to the overall feasibility and impacts of the FOX project, additional work is underway to update the ridership forecasts and refine the implementation cost of the proposed system. However, the economic impacts presented in this report are premised on the spending and ridership projections developed by FOX to date and used as the basis of the franchise agreement with the State of Florida. Over the life of the project, changes in estimates of annual ridership, fare revenues, or costs could cause significant changes in the resultant financial feasibility and the subsequent economic impacts of the FOX project. The fare revenues generated by the riders of the system are critical in ensuring that paying for the system is not a drain on other revenue sources. Similarly, the presence of significant numbers of riders is a prerequisite to realizing the travel time and congestion reduction benefits that such a system can produce. Subsequent review of economic impact estimates may be appropriate if ongoing ridership forecasting and engineering cost analysis determine that there are significant differences from current forecasts.

Choice of Analytical Tools

For this economic impact analysis the project team selected two methodologies to use in analyzing economic impacts. An initial multiplier analysis was carried out using the RIMS II multipliers. This analysis, presented in Appendix A, provided a quick assessment of the economic impacts of the capital and operating spending associated with the FOX project. The statewide multipliers used in that analysis were obtained from the 1992 Regional Input-Output Modeling System (RIMS II), United States Department of Commerce. This RIMS II assessment was also used as a point of comparison with early economic simulation analysis in order to aid the researchers in evaluating results. Thus, using both methods enabled a cross check of reasonableness.

The economic simulation tool used in the final analysis reported in this document, is the Regional Economic Models, Inc. (REMI) model. This model, described below, was chosen because it is the most highly regarded analytical tools used for this type of analysis. It is used extensively in the public, private, and academic sectors and has withstood extensive review and evaluation over the past several years. It is also a tool used extensively in Florida.

Description of the REMI Model

The sections below are extracted and edited from documentation describing the REMI model. Additional reference material and the model documentation are cited in the reference section of this report.

REMI has developed a methodology commonly used in socioeconomic modeling systems over the last fifteen years. Its staff has been devoted to two purposes. First, they have dedicated the bulk of their resources toward an ongoing research effort that has enabled them to stay at the forefront of regional socioeconomic modeling. Second, they provide high quality client support, including extensive model documentation, unlimited phone consulting to explain input requirements, the use and interpretation of the model, and training sessions for clients.

REMI models are customized to the particular client's region. The models include state and county-specific data for industry-specific wage rates, production costs, employment, profitability and sales prices, as well as consumer prices, housing prices, employment opportunity, population, state and local government spending, investment, income, personal consumption, and many other variables. The wide use of this versatile methodology by clients (with data specific to their region) has resulted in the most well-tested and documented modeling system available for regional economic impact analysis.

The widespread use of the REMI methodology throughout the U.S. also has led to extensive documentation of the value of REMI model use in socioeconomic analysis. A $200,000 study, commissioned by the South Coast Air Quality Management District (SCAQMD) and carried out by the Massachusetts Institute of Technology, evaluated the REMI methodology for determining the impacts of implementing air pollution controls on the Los Angeles Basin (SCAQMD, 1993). This study (hereafter referred to as "the MIT study") evaluated REMI and other socioeconomic analysis models for SCAQMD, and came to the conclusion:

> *"REMI has the following seven features often unavailable in many other microcomputer-based regional forecasting models:*
>
> - *it is calibrated to local conditions using a relatively large amount of local data, which is likely to improve its performance, especially under conditions of structural economic change.*
> - *it has an exceptionally strong theoretical foundation.*
> - *it actually combines several different kinds of analytical tools (including economic-base, input-output, and econometric models), allowing it to take advantage of each specific method's strengths and compensate for its weaknesses.*
> - *it allows users to manipulate an unusually large number of input variables and gives forecasts for an unusually large number of output variables.*
> - *it allows the user to generate forecasts for any combination of future years, allowing the user special flexibility in analyzing the timing of economic impacts.*
> - *it accounts for business cycles.*
> - *it has been used by a large number of users under diverse conditions and has proven to perform acceptably."*

The models incorporate the advantages of the REMI methodology first developed more than 15 years ago. The model has been continuously improved by the creator of the modeling methodology and the founder of REMI, Dr. George I. Treyz.

The Regional Economic Models, Inc. (REMI) Economic-Demographic Forecasting and Simulation 53-sector Model (EDFS-53) is designed with the objective of improving the quality of research-based decision making in the public and private sectors. It is calibrated to many subnational areas for forecasting and policy analysis by government agencies, consulting firms, nonprofit institutions, universities and public utilities throughout the United States. Simulations with the model are used to estimate the economic and demographic effects of economic development programs, transportation, infrastructure investments, environmental improvement, energy and natural resource conservation programs, state and local tax changes, and other policy initiatives.

The structure of the model incorporates inter-industry transactions and endogenous final demand feedbacks. In addition, the model includes substitution among factors of production in response to changes in relative factor costs, migration in response to changes in expected income, wage responses to changes in labor market conditions, and changes in the share of local and export markets in response to changes in regional profitability and production costs. The essence of the REMI model is the extent that theoretical structural restrictions are used instead of individual econometric estimates based on single time-series observations for each region. The explicit structure of the model facilitates the use of policy variables that represent a wide range of policy options and the tracking of the policy effects on all the variables in the model.

The REMI model has been in use since 1980. A continuous research effort to refine, expand and improve the model has been underway since that time. The model and supporting research is documented in professional journals, including *The American Economic Review, The Review of Economics and Statistics, Growth and Change*, and *The Journal of Regional Science.* The current structure of the REMI EDFS model is set forth in an article in *The International Regional Science Review* and in a book entitled *Regional Economic Modeling*.

Measuring Economic Change

In applying the REMI model the analysis relies on measuring the change in economic activity between a base forecast and the particular test or tests conducted by the analyst. Thus, in this application, sets of REMI economic projections extrapolated to 2043 were employed. Albeit forty-seven-year projections by any econometric model must be considered to be highly speculative. The reliance on measuring the change in impacts associated with the changing input variables diminishes the need to have as high a degree of confidence in the absolute value of the forecasted economic conditions. The findings are indicative of the relative magnitudes of the economic impacts under different conditions. The first, the "Baseline forecast," simply projects the current Florida economy forward forty-seven years (See Appendix B). The difference between the subsequent forecasts and the baseline forecasts provide the information reported in the economic impact study.

Regional Descriptions

The state was divided into six regions to illustrate the economic impacts of the high speed rail on a localized basis. To the extent possible, regional planning council boundaries were used for the economic analysis with a couple of exceptions. First, Dade and Broward Counties were separated into separate regions due to the size and complexity of their economies. Second, Polk County which has 28.18 miles of track was included into Other Regions of Florida rather than the Central Florida Region due to data limitations.

Table 5 shows, by region, the amount of track and other infrastructure to be built and operated and the counties and major cities that make up each region. Of the approximately 319 miles of track, almost two-thirds are located in two regions -- 37.5 percent in the Treasure Coast Region and 28.5 percent in the East Central Florida Region.

Table 6 shows the population trends for the regions and state over the past 16 years. Over this time period, the state grew by an average of more than 315,000 people per year which represents an annual growth rate of 2.6 percent. The East Central Region which contains Orlando was the fastest growing region in the state with an annual growth rate of 3.9 percent. It was followed closely by the Treasure Coast Region which grew at an annual rate of 3.7 percent. It is interesting to note that the fastest growing regions are also those where two-thirds of the high-speed rail track will be located.

A comparison of the 1996 population estimates for each region is shown in Figure 8. Before comparing the regions it should be noted again that some of the regions are multi-county regions while others are single counties. Caution should be used when comparing the Tampa Bay Region, which is made up of four counties, with a single-county region like Broward or Dade.

With the exception of Other Regions, which contains 51 counties, the most populous region is Tampa Bay with 2.41 million people in 1996, followed closely by East Central with 2.39 million. Treasure Coast and Broward are the least populous regions with 1.43 million and 1.45 million people, respectively.

Table 5. Regional Characteristics

Regions	Facilities	Track Miles	Counties	Major Cities
Tampa Bay	Tampa Intermodal Station Connection to Tampa Airport Direct connection HART line local transit Service and storage facility	26.7	Hillsborough Pinellas Pasco Manatee	Tampa St. Petersburg Clearwater New Port Richey Bradenton
East Central	Intermodal Stations (Attractions & Orlando Airport) Direct connection to Orlando Airport Direct connection to LYNX bus and rail system Full service maintenance facility Operations center	90.95	Brevard Lake Orange Osceola Seminole Volusia	Palm Bay Melborne Leesburg Orlando Kissimmee Daytona Beach
Treasure Coast	West Palm Beach Intermodal Station (joint FOX/Tri-Rail station) Connection to West Palm Beach Airport Maintenance of way facility	119.75	Indian River Martin Palm Beach St. Lucie	Vero Beach Stuart West Palm Beach Boca Raton Ft. Pierce Port St. Lucie
Broward County	West Broward Intermodal Station Connection to Fort Lauderdale Airport	33.50	Broward County	Ft. Lauderdale Hollywood
Dade County	Miami Intermodal Station (direct connection Tri-Rail, Amtrak and Metro Dade transit) Direct connection to Miami Airport Service and Storage facility	20.00	Dade County	Miami Miami Beach Coral Gables Hialeah
Other Regions	Lakeland Intermodal Station	28.18	51 other Florida Counties	

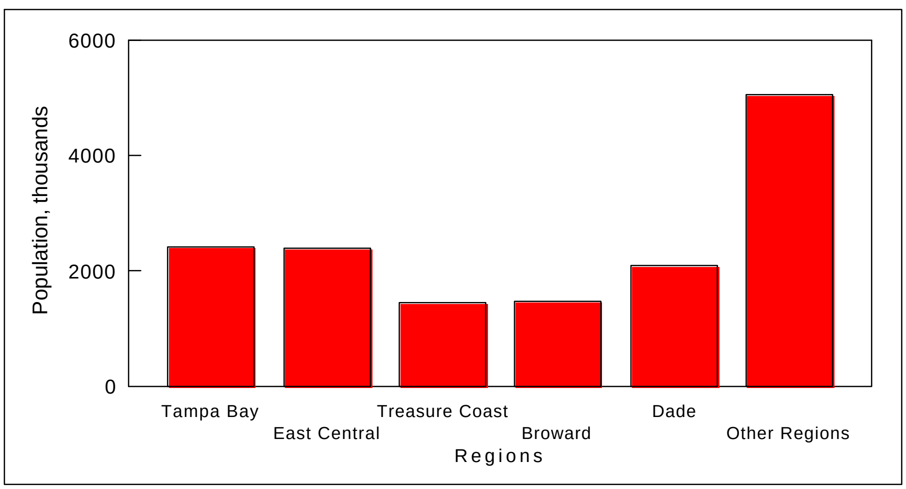
Source: FOX, CEFA, and CUTR.

Table 6. Regional Population Trend, 1980 - 1996

Region	Population (thousands)		Change 1980-1996	
	1980	1996	Annual Average Change (thousands)	Annual Growth Rate (percent)
Tampa Bay	1,730.9	2,410.0	42.4	2.1%
East Central	1,305.5	2,393.4	68.0	3.9%
Treasure Coast	800.4	1,434.5	39.6	3.7%
Broward	1,025.5	1,454.0	26.8	2.2%
Dade	1,641.7	2,093.4	28.2	1.5%
Other Regions	3,291.6	5,054.6	110.2	2.7%
State Total	9,795.6	14,839.9	315.3	2.6%

Source: CEFA and CUTR.

Figure 8. Florida Population, 1996



Source: Table 6.

Employment characteristics for the regions and state are provided in Table 7. Between 1980 and 1996 Florida's private non-farm employment increased by more than 172,900 annually which represents an annual growth rate of 3.5 percent. The regions with the fastest population growth were also the ones with the fastest employment growth. East

Central's employment grew by an annual average rate of 4.7 percent while Treasure Coast's grew by an annual rate of 4.2 percent. The slowest growing economy over this period was Dade with an annual growth of 1.5 percent.

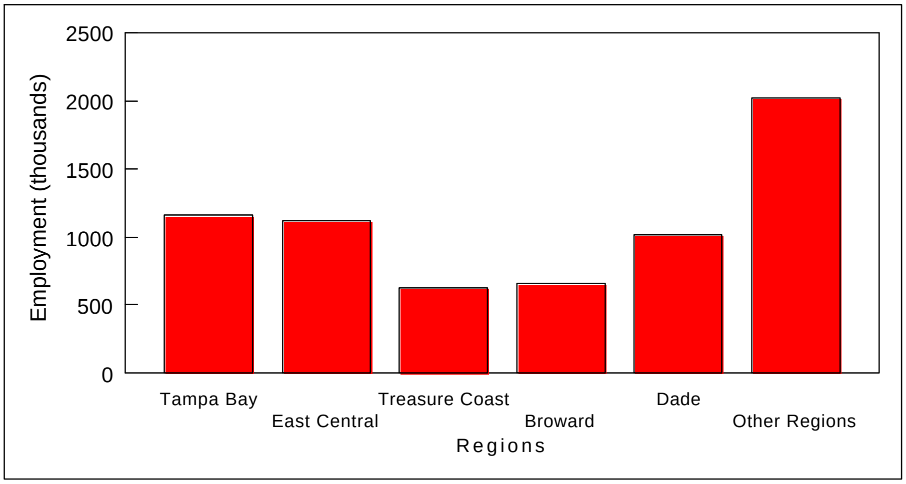
Excluding the Other Regions, there were three regions with similar employment levels in 1996 as shown in Figure 9. The Tampa Bay Region had the largest employment base with 1.15 million, followed closely by East Central with 1.11 million, and Dade with 1.01 million. It is interesting to note that Dade County while having employment levels within 100,000 of Tampa Bay and East Central, trails in population by more than 300,000 people.

Table 7. Regional Non-Farm Employment Trend, 1980-1996

	Total Non-Farm Employment (thousands)		Change 1980-1996	
Region	1980	1996	Annual Average Change (thousands)	Annual Growth Rate (percent)
Tampa Bay	649.5	1,155.1	31.6	3.7%
East Central	534.3	1,114.7	36.3	4.7%
Treasure Coast	326.2	631.0	19.0	4.2%
Broward	408.5	657.0	15.5	3.0%
Dade	791.7	1,011.8	13.8	1.5%
Other Regions	1,116.0	2,022.8	56.7	3.8%
State Total	3,826.3	6,592.4	172.9	3.5%

Source: CEFA and CUTR.

Figure 9. Florida Non-Farm Employment, 1996



Source: Table 7.

Impact Variables

Impact variables in this analysis are those that measure spending changes and transportation benefits associated with HSR. These impact variables are summarized below:

HSR System Development

- The total construction cost of the HSR system, including certification and engineering (a factor was included, indicating what share of total costs would be expended within the state).

- The operation and maintenance costs of the HSR system (a factor was included, indicating the share of total costs to be expended within the state).

User Benefits

- Increases in business productivity due to lower HSR travel cost for business travelers as compared to alternative modes.

- Increases in the relative attractiveness of Florida due to additional mode choice for non-business travelers.

Non-User Benefits

Non-user benefits include highway user congestion savings, highway air pollution savings, and air traveler congestion savings. These benefits have different implications to trips for business and other purposes:

- Increases in business productivity due to reduction in highway business travel delays.

- Reduction in non-business highway travel delays and resulting in improvements in Florida attractiveness.

Automobile Operating Cost Savings

- Reduction in automobile operating spending by HSR system users diverted from highways.

State Contribution

- Reduction in consumer spending due to state contributions.

Reinvestment of Net Operating Revenue

- The State's share of net operating revenue to be used for reinvestment in system expansion.

The statewide values of these impact variables are detailed in Table 8.

Table 8. Statewide Values of Impact Variables (millions of 1997 dollars)

	1997	1998	1999	2000	2001	2002	2003	2004
FHSR System Development								
Roadways	0.0	0.0	0.0	18.9	26.3	33.9	18.7	7.3
Construction	0.0	0.0	21.1	291.0	699.4	731.4	697.7	312.3
Catenary	0.0	0.0	0.0	0.0	60.3	75.7	45.6	7.7
Telecommunication & Signaling	0.0	0.0	0.0	0.0	80.0	98.0	58.0	9.0
Substations	0.0	0.0	0.0	0.0	26.1	30.6	17.5	2.2
Rolling Stock	0.0	0.0	0.0	31.0	41.4	31.0	0.0	0.0
Insurance	0.0	0.0	0.0	2.8	2.8	2.8	2.8	2.8
Right of Way - Land	0.0	0.0	0.0	94.0	126.3	161.6	0.0	0.0
Right of Way - Acquisition	0.0	0.0	0.0	8.5	11.4	14.6	0.0	0.0
Cert., Eng., and Management	50.6	59.2	88.3	103.1	100.6	107.3	81.3	27.6
Maintenance & Operation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	80.9
FHSR User Benefits								
Business	0.0	0.0	0.0	0.0	0.0	0.0	0.0	45.5
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0
Highway Congestion Savings								
Business	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8
Highway Air Pollution Savings								
Business	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Air Traveler Congestion Savings								
Business	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9
Auto Operating Cost Savings								
Tires, Tubes, and Parts	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(1.4)
Repair	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(4.8)
Insurance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(1.1)
Fuel Taxes, Parking, & Tolls	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(3.5)
Fuels	0.0	0.0	0.0	0.0	0.0	0.0	0.0	(6.7)
State Contribution	0.0	0.0	0.0	0.0	(68.4)	(68.4)	(68.4)	(68.4)
Reinvestment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 8. Statewide Values of Impact Variables (continued)

	2005	2006	2007	2008	2009	2010	2011	2012
FHSR System Development								
Roadways	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
Construction	36.8	0.0	0.0	0.0	0.0	0.0	4.5	10.4
Catenary	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.9
Telecommunications & Signaling	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.1
Substations	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
Rolling Stock	0.0	9.7	12.9	9.7	0.0	0.0	0.0	0.0
Insurance	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Right of Way - Land	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.8
Right of Way - Acquisition	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
Cert., Eng., and Management	20.8	0.0	0.0	0.0	0.0	0.0	1.2	2.8
Maintenance & Operation	82.3	142.8	145.1	146.6	147.9	149.2	150.0	150.6
FHSR User Benefits								
Business	48.0	108.1	117.4	123.6	128.8	134.3	137.2	140.2
Other	26.4	59.5	64.6	68.0	70.9	73.9	75.5	77.1
Highway Congestion Savings								
Business	4.3	9.7	10.5	11.0	11.5	12.0	12.2	12.5
Other	4.0	7.5	8.1	8.5	8.8	9.2	9.4	9.6
Highway Air Pollution Savings								
Business	0.9	2.1	2.2	2.3	2.4	2.5	2.6	2.6
Other	0.6	1.0	1.1	1.1	1.2	1.2	1.2	1.3
Air Traveler Congestion Savings								
Business	5.5	13.9	14.9	15.6	16.3	16.9	17.3	17.7
Other	5.1	9.2	9.9	10.5	10.9	11.3	11.6	11.8
Auto Operating Cost Savings								
Tires, Tubes, and Parts	(1.5)	(3.4)	(3.7)	(3.9)	(4.0)	(4.2)	(4.3)	(4.4)
Repair	(5.4)	(11.9)	(12.8)	(13.5)	(14.0)	(14.6)	(14.9)	(15.2)
Insurance	(1.2)	(2.6)	(2.9)	(3.0)	(3.1)	(3.3)	(3.3)	(3.4)
Fuel Taxes, Parking, & Tolls	(3.9)	(8.7)	(9.4)	(9.8)	(10.2)	(10.7)	(10.9)	(11.1)
Fuels	(7.5)	(16.6)	(17.9)	(18.8)	(19.6)	(20.4)	(20.8)	(21.3)
State Contribution	(68.4)	(68.4)	(68.4)	(68.4)	(68.4)	(68.4)	(68.4)	(68.4)
Reinvestment	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 8. Statewide Values of Impact Variables (continued)

	2013	2014	2015	2016	2017	2018	2019	2020
FHSR System Development								
Roadways	0.7	0.7	0.8	1.0	1.3	1.6	1.8	2.1
Construction	16.2	16.8	19.2	25.3	31.4	37.5	43.6	49.7
Catenary	1.3	1.4	1.6	2.1	2.6	3.1	3.6	4.1
Telecommunication & Signaling	1.8	1.8	2.1	2.8	3.4	4.1	4.8	5.4
Substations	0.6	0.6	0.7	0.9	1.1	1.3	1.6	1.8
Rolling Stock	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insurance	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3
Right of Way - Land	2.9	3.0	3.4	4.5	5.5	6.6	7.7	8.8
Right of Way - Acquisition	0.3	0.3	0.3	0.4	0.5	0.6	0.7	0.8
Cert., Eng., and Management	4.3	4.5	5.1	6.7	8.4	10.0	11.6	13.2
Maintenance & Operation	151.3	152.0	152.8	153.5	174.3	175.2	175.9	176.7
FHSR User Benefits								
Business	143.3	146.4	149.6	152.9	158.9	162.3	165.8	169.3
Other	78.8	80.5	82.3	84.1	87.4	89.3	91.2	93.1
Highway Congestion Savings								
Business	12.8	13.1	13.4	13.7	14.1	14.4	14.7	15.0
Other	9.8	10.0	10.3	10.5	10.8	11.1	11.3	11.6
Highway Air Pollution Savings								
Business	2.7	2.8	2.8	2.9	3.0	3.0	3.1	3.2
Other	1.3	1.3	1.3	1.4	1.4	1.5	1.5	1.5
Air Traveler Congestion Savings								
Business	18.0	18.5	18.9	19.3	20.0	20.4	20.8	21.3
Other	12.1	12.4	12.6	12.9	13.5	13.8	14.1	14.4
Auto Operating Cost Savings								
Tires, Tubes, and Parts	(4.5)	(4.6)	(4.7)	(4.8)	(4.9)	(5.1)	(5.2)	(5.3)
Repair	(15.6)	(15.9)	(16.3)	(16.6)	(17.1)	(17.5)	(17.9)	(18.3)
Insurance	(3.5)	(3.5)	(3.6)	(3.7)	(3.8)	(3.9)	(4.0)	(4.1)
Fuel Taxes, Parking, & Tolls	(11.4)	(11.6)	(11.9)	(12.2)	(12.5)	(12.8)	(13.1)	(13.3)
Fuels	(21.8)	(22.2)	(22.7)	(23.3)	(23.9)	(24.4)	(25.0)	(25.5)
State Contribution	(68.4)	(68.4)	(68.4)	(68.4)	(68.4)	(68.4)	(68.4)	(68.4)
Reinvestment	8.2	18.9	29.6	30.5	35.0	46.1	57.1	68.2

Table 8. Statewide Values of Impact Variables (continued)

	2021	2022	2023	2024	2025	2026	2027	2028
FHSR System Development								
Roadways	2.3	2.6	2.8	3.5	3.7	4.0	4.3	4.5
Construction	55.8	61.9	68.1	83.6	89.5	97.3	103.2	109.1
Catenary	4.6	5.1	5.6	6.9	7.4	8.0	8.5	9.0
Telecommunication & Signaling	6.1	6.8	7.4	9.1	9.8	10.6	11.3	11.9
Substations	2.0	2.2	2.4	3.0	3.2	3.5	3.7	3.9
Rolling Stock	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insurance	0.4	0.4	0.5	0.6	0.6	0.7	0.7	0.7
Right of Way - Land	9.8	10.9	12.0	14.7	15.8	17.1	18.2	19.2
Right of Way - Acquisition	0.9	1.0	1.1	1.3	1.4	1.5	1.6	1.7
Cert., Eng., and Management	14.9	16.5	18.1	22.3	23.8	25.9	27.5	29.1
Maintenance & Operation	177.5	178.6	179.4	180.2	181.2	182.0	183.1	184.1
FHSR User Benefits								
Business	171.8	174.3	176.7	179.2	181.7	184.2	186.7	189.2
Other	94.5	95.9	97.2	98.6	100.0	101.3	102.7	104.0
Highway Congestion Savings								
Business	15.1	15.4	15.8	16.2	16.6	17.0	17.4	17.7
Other	11.4	11.7	12.0	12.3	12.6	12.9	13.2	13.5
Highway Air Pollution Savings								
Business	3.2	3.3	3.4	3.4	3.5	3.6	3.7	3.7
Other	1.5	1.5	1.6	1.6	1.6	1.7	1.7	1.7
Air Traveler Congestion Savings								
Business	21.5	22.0	22.5	23.1	23.6	24.2	24.8	25.1
Other	14.1	14.5	14.8	15.2	15.5	15.9	16.3	16.6
Auto Operating Cost Savings								
Tires, Tubes, and Parts	(5.3)	(5.4)	(5.6)	(5.7)	(5.8)	(6.0)	(6.1)	(6.2)
Repair	(18.3)	(18.8)	(19.2)	(19.7)	(20.2)	(20.6)	(21.1)	(21.4)
Insurance	(4.1)	(4.2)	(4.3)	(4.4)	(4.5)	(4.6)	(4.7)	(4.8)
Fuel Taxes, Parking, & Tolls	(13.4)	(13.7)	(14.0)	(14.4)	(14.7)	(15.1)	(15.5)	(15.7)
Fuels	(25.6)	(26.2)	(26.9)	(27.5)	(28.2)	(28.8)	(29.5)	(30.0)
State Contribution	(68.4)	(68.4)	(68.4)	(68.4)	(68.4)	(68.4)	(68.4)	(68.4)
Reinvestment	79.3	90.4	101.6	112.7	123.9	152.2	162.9	177.0

Table 8. Statewide Values of Impact Variables (continued)

	2029	2030	2031	2032	2033	2034	2035
FHSR System Development							
Roadways	4.8	5.0	5.4	5.5	5.6	5.6	5.7
Construction	115.1	121.1	129.5	131.7	134.4	136.4	138.3
Catenary	9.4	9.9	10.6	10.8	11.0	11.2	11.4
Telecommunication & Signaling	12.5	13.2	14.1	14.4	14.7	14.9	15.1
Substations	4.1	4.3	4.6	4.7	4.8	4.9	4.9
Rolling Stock	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Insurance	0.8	0.8	0.9	0.9	0.9	0.9	0.9
Right of Way - Land	20.3	21.3	22.8	23.2	23.7	24.0	24.4
Right of Way - Acquisition	1.8	1.9	2.1	2.1	2.1	2.2	2.2
Cert., Eng., and Management	30.7	32.2	34.5	35.1	35.8	36.3	36.8
Maintenance & Operation	184.9	185.9	187.1	188.1	189.1	189.1	189.1
FHSR User Benefits							
Business	191.6	194.1	196.6	199.1	201.6	204.1	204.1
Other	105.4	106.8	108.1	109.5	110.9	112.2	112.2
Highway Congestion Savings							
Business	18.1	18.5	19.0	19.2	19.6	19.6	19.6
Other	13.8	14.1	14.5	14.4	14.8	14.8	14.8
Highway Air Pollution Savings							
Business	3.8	3.9	4.0	4.1	4.2	4.2	4.2
Other	1.8	1.8	1.9	1.8	1.9	1.9	1.9
Air Traveler Congestion Savings							
Business	25.7	26.3	26.9	27.3	27.9	27.9	27.9
Other	17.0	17.5	17.9	17.7	18.1	18.1	18.1
Auto Operating Cost Savings							
Tires, Tubes, and Parts	(6.3)	(6.5)	(6.7)	(6.7)	(6.9)	(6.9)	(6.9)
Repair	(22.0)	(22.5)	(23.0)	(23.2)	(23.8)	(23.8)	(23.8)
Insurance	(4.9)	(5.0)	(5.1)	(5.2)	(5.3)	(5.3)	(5.3)
Fuel Taxes, Parking, & Tolls	(16.1)	(16.4)	(16.8)	(17.0)	(17.4)	(17.4)	(17.4)
Fuels	(30.7)	(31.4)	(32.2)	(32.4)	(33.2)	(33.2)	(33.2)
State Contribution	(68.4)	(68.4)	(68.4)	(68.4)	(68.4)	(68.4)	(68.4)
Reinvestment	187.8	198.6	209.4	220.3	235.7	239.7	244.7

Source: CEFA and CUTR.

Regional Allocation

The statewide values of the impact variables were disaggregated to the six regions. Most variables were disaggregated proportionately according to route milage in each region, as shown in Table 9. These include:

- Operation and Maintenance Expenses
- User Benefits
- Non-User Benefits
- Automobile Operating Cost Savings
- State Contribution

Table 9. Route Milage by Region and Segment

Regions	Route Milage	Distribution: Entire Route	Distribution: Segments
Statewide	319.09	100%	
Tampa - Orlando Attractions	83.84	26.27%	100%
Tampa Bay	26.70	8.37%	31.85%
East Central - West	28.95	9.07%	34.53%
Other Regions	28.18	8.83%	33.61%
Orlando Attractions - Miami	235.25	73.73%	100%
East Central - East	62.00	19.43%	26.35%
Treasure Coast	119.75	37.53%	50.90%
Broward County	33.50	10.50%	14.24%
Dade County	20.00	6.27%	8.50%

Source: FOX spreadsheet, ROWCOST.wk4, which shows milage posts.

Other variables were distributed differently. Specifically,

- Reinvestment of net operating revenue was assumed to be in the other regions.

- System development costs associated with stations and maintenance facilities were allocated to the regions where these facilities will be located.

High Speed Rail System Development

This and the following sections describe how the individual impact variables were measured for this analysis.

Construction

Construction costs include all capital costs incurred in the development of the FHSR system, except for vehicle acquisition. FOX provided estimated capital costs in two spreadsheets:

- FIN_EST.WK1, a LOTUS file, that contains capital costs in 1995 dollars by segments and detailed cost categories;

- HSRCAS~1.WK4, also a LOTUS file, that contains capital costs in 1995 dollars by segments, broad cost categories, and years from 1997-2005;

Capital costs from these spreadsheets were itemized by the following 20 industry sectors:

1. Certification
2. ROW land
3. ROW acquisition
4. Mobilization/Demobilization
5. Earthworks
6. Roadways
7. Structures
8. Main line
9. Stations
10. Maintenance facility
11. Catenary & Substations
12. Telecommunication & Signaling
13. Systems testing & Commissioning
14. Construction management services
15. Program management services
16. Construction operating costs and profit
17. Maintenance equipment
18. Program management for maintenance equipment and rolling stock

19. Hazardous materials
20. Insurance

These detailed sectors were aggregated into industry sectors that are available in the REMI model. The final set of industry sectors is shown in Table 8.

Construction costs were separated into those that go outside the state and those that remain in the state. Based on FOX's estimation, construction costs assumed to go outside of Florida include those on:

- materials for main line, except for ties;
- maintenance equipment;
- 50 percent of materials for catenary;
- 40 percent of materials for telecommunications and signaling;
- 10 percent of certification and engineering is assumed to go outside the state; and
- 80 percent of spending on construction insurance is assumed to go outside the state.

Rolling Stock

Capital costs for rolling stock include the purchasing cost for 21 train sets and costs involved in having them ready for operation. It was assumed by FOX that 20 percent of spending on rolling stock will remain in the state for assembly.

Operating and Maintenance

Annual total operating costs for 2004-2043 come from the PCPFA (Pre-Certification Post-Franchise Agreement) Base Case Model, provided by FOX. Components of these costs are not provided.

Consumer Surplus of New Mode

This describes the basic methodology and assumptions used in applying the basic methodology to measuring FOX user benefits.

Basic Methodology

The methodology computes changes in consumer's surplus when demand is represented by discrete choice models (Small, Kenneth A, and Harvey S. Rosen, "Applied Welfare Economics with Discrete Choice Models," *Econometrica*, 49, 1981, pp. 105-130).

Consumer's surplus is a concept in economics that measures the difference between what a traveler is willing to pay for trip making and what it costs to him. If, for example, making a trip from Orlando to Miami via FOX is worth $250, but it costs only $200 dollars to a traveler (This is the generalized cost, including fare, in-vehicle time, terminal waiting time, and other components of monetary and time costs), the consumer's surplus of this particular trip would be $50 to him. An individual's demand curve gives the willingness to pay at different levels of trip making. The total amount of consumer's surplus at a particular level of trip making is the area to the left of his demand curve and above the cost of trip making.

One of the most used discrete choice models in transportation research is the multinomial logit model for mode choices (Ben-Akiva, Moshe, and Steven R. Lerman, *Discrete Choice Analysis: Theory and Application to Travel Demand*, the MIT Press, 1985). One behavioral assumption of these models is that an individual chooses the mode that would give him the highest level of utility. The level of utility an individual would get from a mode depends on observed characteristics of the mode, including monetary costs and time spent traveling and waiting, and on unobserved, random factors. The observed component of utility may be written as follows:

$$U_m = \beta c_m + \alpha_1 ivt_m + \alpha_2 wt_m \tag{1}$$

where

c_m	=	monetary cost of trip making per unit of time via mode m
ivt_m	=	in-vehicle-time of trip making per unit of time via mode m

wt_m = waiting time of trip making per unit of time via mode m
$\beta, \alpha_1, \alpha_2$ = coefficients to be estimated

For commuting mode choices, the cost variables would be measured for the round trip per weekday. Alternatively, U_m may be written as

$$U_m = \beta\left(c_m + \frac{\alpha_1}{\beta} ivt_m + \frac{\alpha_2}{\beta} wt_m\right) \tag{2}$$

The three terms in the parentheses give the generalized cost of making one trip via mode m:

$$G_m = c_m + \frac{\alpha_1}{\beta} ivt_m + \frac{\alpha_2}{\beta} wt_m \tag{3}$$

The probability of an individual choosing mode m is given by:

$$P_m = \frac{e^{\beta G_m}}{\sum_k e^{\beta G_k}} \tag{4}$$

The denominator above gives the maximum utility an individual can get from the choice situation. Assuming that only one trip is made per unit of time, this maximum utility can be used in the basic methodology to measure the consumer's surplus to an individual as follows:

$$CS = -\frac{1}{\beta} \sum_m e^{\beta G_m} \tag{5}$$

where -β is the marginal utility of income. The economic benefits of a policy or program to an individual per unit of time would be the change in CS as a result of changes in the generalized costs due to the policy or program. This measure is independent of the chosen mode.

Assumptions

Applying the basic methodology to estimating the user benefits of FOX requires the following, which are discussed individually below.

- Specification of the demand model;
- FOX ridership by source and trip purpose for forecast year 2010;
- Generalized costs with and without FOX; and
- Extrapolating economic benefits for non-forecast years.

Specification of the Demand Model

For this analysis, it is assumed that a choice is made among highway, air, and high speed rail for making each one-way trip between a pair of origin and destination. If we let G_C, G_A, G_H be the generalized costs per one-way trip for car, air, and high speed rail, respectively, the consumer's surplus per trip can be measured by the following:

$$CS = -\frac{1}{\beta}\left[e^{\beta G_C} + e^{\beta G_A} + e^{\beta G_H}\right] \qquad (6)$$

where β was obtained from FDOT's *Florida High Speed and Intercity Rail Market and Ridership Study*, Florida Department of Transportation, 1993. The FDOT study estimated separate models for business trips and other trips. These models give a β value of -0.02078 for business trips and -0.01675 for other trips.

The development of high speed rail would result in a decrease in G_H from an infinitely large value G^B_H (an infinitely large value is equivalent to services not being available) to a finite one $G^A_{H.}$ HSR may also result in changes in G_C and G_A from G^B_C and G^B_A to G^A_C and G^A_A. For each trip shifted from car or air to high speed rail, the economic benefit is the change in consumer's surplus given by

$$\Delta CS = \frac{1}{\beta}\left[\left(e^{\beta G_C^B} + e^{\beta G_A^B}\right) - \left(e^{\beta G_C^A} + e^{\beta G_A^A} + e^{\beta G_H^A}\right)\right] \quad (7)$$

Only two terms appear in the first pair of parentheses above because the exponential value of an infinitely large negative number is zero. For induced high speed rail trips, the economic benefit is assumed to be half of that for diverted trips.

The total economic benefits of all high speed rail trips for a given trip purpose between a given pair of origin and destination can be measured by the following:

$$B = \frac{\left(N_C + N_A + \tfrac{1}{2} N_I\right)}{\beta}\left[\left(e^{\beta G_C^B} + e^{\beta G_A^B}\right) - \left(e^{\beta G_C^A} + e^{\beta G_A^A} + e^{\beta G_H^A}\right)\right] \quad (8)$$

where N_C, N_A, and N_I are the numbers of high speed rail trips that are diverted from cars, diverted from air, and induced, respectively, for that trip purpose and origin-destination pair. These economic benefits may be summed over trip purposes (business versus others) and over origin-destination pairs to get the overall economic benefits for the entire corridor.

A similar methodology was used by Charles River Associates (CRA) for estimating the user benefits of the proposed high speed ground transportation system in California (telephone conversation with Mark Kiefer of CRA). CRA's methodology differs from the one used here is that it estimates the user benefits for each bi-mode market (i.e., HSR versus air, HSR versus highway, etc.) and then sums them to get the total user benefits. A version of CRA's methodology is in "Estimating User Benefits for High Speed Ground Transportation Systems," Brand et al., *Compendium of Technical Papers, 1994*, 64th ITE Annual Meeting, Dallas, Texas, October 16-19, 1994.

FOX Ridership by Source and Trip Purpose for Forecast Year 2010

FOX ridership by source for 2010 was obtained from the FOX proposal to FDOT (FLORIDA OVERLAND EXPRESS, *Florida High Speed Transportation System*, Proposal presented to FDOT High Speed Transportation Program, October 1995, Appendix Table II-1.13 and Table II. A-5). Appendix Table II-1.13 gives ridership by source and origin-destination pairs for all trip purposes. Information in Table II.A-5 was used to separate ridership by trip purposes (business versus other). For example, Appendix Table II-1.13 gives a total ridership of 1,671 between Orlando and Miami in 2010 with 401, 605, and 665 being diverted from car, diverted from air, and induced, respectively, while Table II.A-5 gives a 43-57 split for trips between business and other purposes. Minor modifications in these forecasts were subsequently made by SOFRERAIL, adjusting the sensitivity analysis and the totals slightly. These final numbers are show in Figure 6 in this report.

Computing Generalized Costs with and without FOX

Two major assumptions were made in how generalized costs for FOX users are estimated because of inadequate information for forecast year 2010. First, the generalized costs of trips made on car and air modes do not differ between with and without the high speed rail. This assumption tends to underestimate economic benefits because the presence of high speed rail tends to reduce them. Second, the generalized costs of car and air modes are 10 percent higher than that of high speed rail for forecast year 2010. The rationale is that we have more information on high speed rail than the other modes for computing generalized costs with reasonable confidence. The generalized costs of car and air modes are higher for FOX users because they would not shift modes otherwise. The exact percentage difference in generalized costs between high speed rail and other modes is somewhat arbitrary, lacking data for an estimate. Sensitivity tests were done with different percentages of markup. A percent markup was chose based on these tests.

Additional assumptions were used in computing the generalized cost of high speed rail for FOX users. These include:

1). Terminal time = 12 minutes
2). Auto access distance = 10 miles
3). Auto egress distance = 5 miles
4). Access parking cost = 4 dollars (1995)
5). Egress taxi cost 7 dollars (1995)
6). FOX users paying economy fares

Business = 75%
Other = 95%

7).	Auto driving cost	=	$0.14 per mile (1995)
8).	Auto access speed	=	30 mph
9).	Value of time savings (line-haul, access, egress, terminal)		
	Business	=	$56 per hour (1995)
	Other	=	$15 per hour (1995)

The assumptions on terminal time, auto access and egress distances, access parking cost, auto driving cost, and auto access speed were adopted from FDOT's *Florida High Speed and Intercity Rail Market and Ridership Study,* 1993. The unit values of time savings represent simple averages of those estimated as part of the FOX proposal for different station pairs as shown in Appendix Table II-1.12. FOX's estimates were based on the 1992 survey of intercity travel in Florida as part of the FDOT study mentioned above. Sensitivity tests were also conducted with different values of time. The percentages of FOX users paying economy fares were assumed to be reasonable.

Extrapolating Economic Benefits for Non-Forecast Years

The estimated economic benefits for 2010 were extrapolated to other years according to changes in ridership. Changes in ridership were approximated by changes in projected fare revenues in constant dollars by FOX. Nominal fare revenues came from *Pre-Certification Post-Franchise Agreement,* by and between FDOT and FOX, November 12, 1996.

Non-User Benefits

Two types of non-users were considered: remaining highway users and remaining air travelers. Estimation of non-user benefits is summarized in Figure 10.

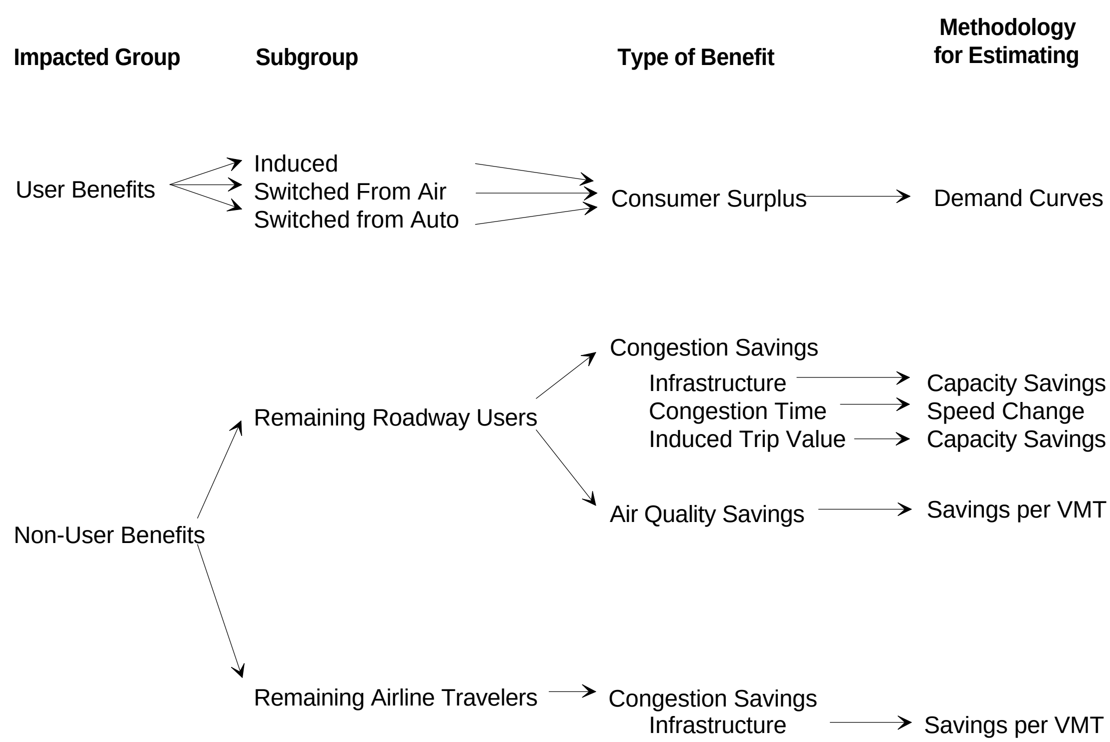
The basic information used in estimating non-user benefits is passenger miles diverted from highway and air, respectively. The number of passenger miles diverted was estimated with two types of information: distance between station pairs and ridership diverted from highway and air by station pairs (Tampa-Orlando, etc.), trip purpose (business and others), and year (2004-2043).

Information on distances between station pairs came from a spreadsheet from FOX that contains milage posts and station location along the FHSR system: ROWCOST.WK4.

Distances for selected station pairs were shown in Table 1.

Ridership information was derived from the FOX proposal, PCPFA, and subsequent supporting documents. Specifically, Appendix Table II-1.13 of the proposal provides information on the sources of total ridership for the year 2010: diversion from highway, diversion from air, and induced travel. The distribution of ridership among these sources is shown in Table 10.

Figure 10. Summary of Estimating Transportation Benefits
VMT = Vehicle Miles of Travel



Source: CEFA and CUTR.

Tables II.A-2 and II.A-3 of the proposal provide business and other purpose ridership, respectively, by station pairs for 2004-2020. For years 2021-2043, ridership is assumed to grow at the same rate as fare revenues in real terms. Fare revenues grow at 1.85 percent annually for 2021-2033 and stays flat for 2034-2043. Information on fare revenues comes from the PCPFA Base Case Model. Selected ridership information is shown in Table 10.

Table 10. FHSR Ridership for 2010 by Trip Purpose, Source, and Selected Station Pairs

Station Pairs	Ridership in Thousands						Total
	Business			Other			
	Car	Air	Induced	Car	Air	Induced	
Tampa - Orlando	164.8	248.7	273.4	217.4	328.0	360.5	1592.7
Orlando - Miami	648.2	28.1	193.1	233.7	10.1	69.6	1182.8
Miami - Tampa	20.9	168.0	56.0	12.5	100.7	33.6	341.5
System Total	1565.6	1065.7	851.3	1188.3	808.3	646.1	6126.0

Source: FOX and FDOT Pre-Certification Post Franchise Agreement and other documents.

Highway User Benefits

Highway user benefits take two forms: reduction in travel delays and improved air quality. The estimation of these two forms is discussed separately below.

Congestion Savings

When some highway users change mode to use the FHSR, they free up capacity on existing highways. The benefits of this diversion to remaining users may be estimated with alternative approaches. Three approaches were used: infrastructure savings, congestion time savings, and induced travel value. They are assumed to be equivalent. The average of their results gives the congestion savings to remaining highway users due to the FHSR.

Infrastructure Savings

One approach to measuring congestion savings due to diversion of highway users to the FHSR is to measure the cost of providing the freed up capacity by diverted highway users. Estimating the infrastructure savings involves several steps:

- The first step uses data on FHSR ridership diverted from highway by station pairs to calculate the number of FHSR passenger miles diverted from highway. This was done for each year over 2004-2043 and for business and other purposes separately.

- The second step estimates the amount of vehicle miles reduced, which was estimated with information on passenger miles diverted from automobiles and information on vehicle occupancy for intercity travel in Florida. The estimation of passenger miles diverted was discussed earlier. Vehicle occupancy was derived from the 1992 Statewide Survey of Intercity Travel in Florida as shown in Exhibit D-5, Florida High Speed and Intercity Rail Market and Ridership Study: Technical Appendices, 1993. The overall occupancy was 2.2 for all purposes. Vehicle occupancy was assumed to be 1.5 and 2.5, respectively, for business and other purposes, which are consistent with the overall occupancy and the share of intercity trips for business purposes (28.5 percent) as reported in Exhibit D-1.

- The third step estimates lane miles capacity freed up as a result of vehicle miles reduced. This is done as follows:

$$LM = \frac{VMT}{C} \frac{K_{100}}{365} \qquad (9)$$

where:

LM	=	lane miles freed up
VMT	=	annual vehicle miles reduced
C	=	lane capacity, 2200 vehicles per hour
K_{100}	=	k factor, 0.11, representing the proportion of average annual daily traffic occurring in the 100th-highest hour of the year

- The fourth step estimates the annual cost per lane mile of highway, including operation/maintenance costs and annualized capital costs. This is done as follows:

$$AC = CC * a + OM \tag{10}$$

where:

AC	=	annual cost per lane mile
CC	=	capital cost at $2,012,520 per lane-mile
a	=	amortization factor, assuming a 30 year life at 7 percent
OM	=	annual cost for operation/maintenance at $20,000 per lane mile

- The final step estimates the cost of freed up capacity by combining the results from steps 3 and 4.

<u>Congestion Time Savings</u>

Another approach to measuring congestion savings is to measure congestion time savings as a result of changes in travel speeds for remaining highway users. The estimation involved the following steps:

- The first step assumes a 4-lane highway parallel to the FHSR between Tampa and Orlando and Miami with an operating speed of 70 miles per hour with the FHSR.

- The second step estimates percent reduction in vehicle miles traveled as a result of diversion of highway users to the FHSR.

- The third step estimates decreases in speed from 70 miles per hour without the FHSR. Speed was assumed to decrease by the same percentage as vehicle miles traveled.

- The fourth step estimates time saved for remaining highway users who travel during peak periods, which are assumed to include 40 percent of all vehicle miles traveled.

- The last step estimates the dollar value of time saved. The value of time used was $56 per hour for business purposes and $15 per hour for other purposes, which are the same as those used in estimating FOX user benefits. See discussion there on why these values were chosen.

Induced Travel Value

The dollar value of freed up capacity to induced travel was estimated by applying an average value per passenger mile to the total amount of passenger miles diverted from highway travel. Three steps were involved in the estimation:

- The first step uses data on FHSR ridership diverted from highway travel by market segments to calculate the number of FHSR passenger miles diverted from automobiles. This was done for each year in 2004-2043 and for business and other purposes separately.

- The second step estimates an average value of induced travel per passenger mile. A Seattle study by ECONorthwest estimated that a reasonable value for travel ranges from 7 cents per passenger mile in 1994 to 12 cents per passenger mile in 2020. The range from a 1994 study by Litman is 3 cents to 17 cents per passenger mile. A value of 7 cents per passenger mile in 1995 dollars was used for this estimation.

- The last step uses the results from the first two steps to calculate total value of freed up capacity to induced travel.

Air Quality

The dollar value of improved air quality was estimated by applying an average cost of air pollution per vehicle mile traveled to the total amount of vehicle miles reduced. The estimation was done separately for business and non-business trips. An average cost of 1.7 cents per vehicle miles traveled was assumed. The same unit cost was also used by Economic Research Associates in an economic impact study of the HSR proposed in California. The amount of vehicle miles reduced was estimated in estimating congestion savings for highway users.

Air Traveler Congestion Savings

Aviation sector savings take the form of reduction in travel delays to remaining air travelers. The reduction in travel delays results from freed up air capacity because of diversion of air travelers to the FHSR system. The dollar value of this reduction in travel delays was measured by the infrastructure costs to provide the freed up air capacity. Other approaches to measuring this dollar value of reduction in travel delays were not used because of lack of readily available data. The calculation involved three steps:

- The first step uses data on FHSR ridership diverted from air by market segments to calculate the number of FHSR passenger miles diverted from air. This was done for each year in 2004-2043 and for business and other purposes separately.

- The second step uses information on costs of air infrastructure provided by both public and private sectors to calculate some average infrastructure cost per passenger mile for business and other purposes separately.

- The last step uses the results from the first two steps to calculate aviation sector savings.

The main assumption here on parameter values is that infrastructure cost is 7 and 5 cents per passenger mile for business and non-business purposes, respectively. These average costs are based on a review of airline operating costs data for US domestic commercial carriers. Cost allocation information includes several categories that include capital costs including vehicle leases and airport landing fees. Detailed data on capital costs are not available and short-haul, smaller aircraft flights like those in Florida may not be typical of industry averages. In addition, there are some who feel that the aging aircraft fleets, airport facilities and air control systems are evidence that the industry is not investing in capital in proportion to the fully amortized capital costs. Total domestic airline operating costs (including aircraft lease and airport landing fees) is approximately $0.13 per passenger mile. For purposes of this analysis the 7 and 5 cents per passenger mile estimates were used.

Automobile Operating Cost Savings

Diversion of highway users to the FHSR reduces spending on automobile operation. This reduction of spending reduces economic activity through the state and has a negative impact on employment, jobs, and gross output. This reduction in automobile spending was estimated by applying unit costs to the amount of vehicle miles reduced. A unit cost of 16 cents per vehicle mile was used. This number was documented in the economic impact study by Economic Research Associates for the HSR proposed in California.

State Contribution

The state will contribute $70 million annually in nominal terms from 1999 though 2001 and a four percent increase thereafter until 2039. Although the contribution will come from existing funding sources, they can be spent within the state on alterative uses without the FHSR. This analysis assumed that consumer spending will be reduced by the same amount.

Reinvestment of Net Operating Revenue

The FHSR was projected by FOX to generate net operating revenues for 2013-2043 after operating and maintenance expenses and debt payments. These revenues will be allocated between the State and FOX with a 80-20 split. The State's share was assumed to be reinvested in an extension of the FHSR from Orlando to Northeast or Southwest Florida.

Translation of Impact Variables into REMI Variables

Some of the impact variables can be directly used in the REMI model, while others need to be converted before being entered in the REMI model. Specifically, impact variables that measure transportation benefits for business travelers (HSR users and non users) need to be converted into a REMI variable that represents productivity gains; impact variables that measure transportation benefits for non-business travelers (both HSR users and non users) also need to be converted into a REMI variable that represent Florida attractiveness; and all others, which represent changes in spending, can be directly used. Table 11 shows the correspondence between the impact and REMI variables for this analysis.

Impact variables that measure transportation benefits were converted as follows, following REMI's recommendation. Transportation benefits for business travelers by region were divided by the total amount of production in that region to obtain a percentage. This percentage was then input into the REMI model as a relative productivity adjustment for all business sectors. Transportation benefits for non-business travelers by region were divided by the total amount of wages and salaries in that region. The result was then multiplied by 0.351, which represents the sum of REMI's internal migration coefficients. The final result was then input into the REMI model as an attractiveness factor for migration into the region.

The values of REMI variables for each region are shown in Appendix C.

Table 11. Input Variables and Their Use in Analytical Steps

Impact Variable (in dollars)	REMI Variable				Steps
	Description	Unit	Type	No.	
HSR System Development					
Roadways	new roads	$	translator	37	1,2,3,4
Construction	new non-building facilities	$	translator	40	1,2,3,4
Catenary	electric distributing system	$	translator	85	1,2,3,4
Telecommunications/Signalin g	telephone apparatus	$	translator	90	1,2,3,4
Substations	electrical equipment and supplies	$	translator	95	1,2,3,4
Insurance	insurance carriers	$	translator	167	1,2,3,4
ROW/land	real estate	$	translator	169	1,2,3,4
ROW Acquisition	legal services	$	translator	198	1,2,3,4
Cert/eng/management	engineering and architecture	$	translator	210	1,2,3,4
Rolling Stock	railroad equipment	$	translator	105	1,2,3,4
Operating and Maintenance	railway transportation	$	translator	265	1,2,3,4
FHSR User Benefits					
Business Travel	relative productivity adjustment	%	regular	1320	2,3,4
Other Travel	migration amenity factor	%	population	11	2,3,4
Highway Congestion Benefits					
Business Travel	relative productivity adjustment	%	regular	1320	2,3,4
Other Travel	migration amenity factor	%	population	11	2,3,4
Highway Air Pollution Savings					
Business Travel	relative productivity adjustment	%	regular	1320	2,3,4
Other Travel	migration amenity factor	%	population	11	2,3,4
Air Traveler Congestion Savings					
Business Travel	relative productivity adjustment	%	regular	1320	2,3,4
Other Travel	migration amenity factor	%	population	11	2,3,4
Auto Operating Cost Savings					
Tires, tubes and parts	tires, tubes and parts	$	translator	222	2,3,4
Auto repair	auto repair	$	translator	259	2,3,4
Auto insurance	auto insurance	$	translator	261	2,3,4
Fuel taxes, parking, tolls	highways, state & local government	$	translator	342	2,3,4
Fuels	demand change in petroleum products	$	regular	669	2,3,4
State Contribution	decrease in purchasing power	$	regular	960	3,4
Reinvestment	Allocated to system cost categories	$			4

Source: CEFA and CUTR.

REMI Analytical Steps

The final REMI analysis was divided into four cumulative steps, each step including one more set of impact variables than the previous one. These steps are summarized in Table 12 and discussed in the following paragraphs.

Table 12. Analytical Steps

Step	Impact Variables
1	System Development
2	System Development Automobile Operating Cost Savings Transportation Benefits
3	System Development Automobile Operating Cost Savings Transportation Benefits State Contribution (reductions in consumer spending)
4	System Development Automobile Operating Cost Savings Transportation Benefits State Contribution (reductions in consumer spending) Reinvestment

Source: CEFA and CUTR.

Step One

The first is to enter into the modeling software category by category estimates of FOX-HSR construction and operation expenditures for each year of the project franchise. For example during the construction phase 1997-2004 each major expenditure category such as land purchase, road building, station development is identified and assigned a REMI input variable type. Similarly over the life of the project (2005-2043) each major expenditure required to operate the HSR system, such as rolling stock and operation and maintenance is identified and also assigned a REMI input variable type (see Table 11).

Assignment of these variable types allows the REMI software to take these HSR expenditure inputs and translate them into economic impact outputs. Each dollar expended on this project interacts with each region's unique industrial mix multipliers and thereby translates these economic variable inputs into direct and indirect project generated increased employment, earnings and production outputs. This first step impact assessment is similar to the kinds of impacts measured by the RIMS II input-output modeling described in Appendix A and compares favorably with those estimates.

Step Two

The REMI modeling software allows for dynamic simulation of multiple positive and negative project cash flows into a single analytical framework and therefore more realistically measures a project final marginal economic costs and benefits. This powerful feature allowed researchers to simulate the effects of project transportation benefits and disbenefits with the positive economic impacts of step one. In this step the *reductions* in automobile related economic activity (reduced spending on fuel and other vehicle operating costs, auto accidents and so forth) result in *decreases* (or disbenefits) in economic activities across the regions. These reductions in economic activities were combined with the estimated positive economic effects of enhanced transportation savings associated with use of the HSR mode over the auto and air modes.

Transportation benefits were translated into REMI variables as guided by the REMI model creator and distributor. Each benefit is a measure of the region's relative enhanced economic productivity and attractiveness. Business travelers' gains are measured by use of a regular policy variable 1320 which translates time savings into real productivity gains across all industrial sectors (see Table 11). Non-business traveler consumer surplus is translated into enhanced relative regional economic attractiveness which stimulates a regions' economic migration coefficient population policy variable 11.

By assigning these two (opposing) economic stimulation benefit and disbenefit factors separate REMI input variable types for each year they are forecast to occur (as in step 1) they are translated into regional gains and losses in employment, income and productivity output. These gains and losses are obviously relative to their scale across each year of the project and are simultaneously integrated into the economic stimulation estimated in step 1.

Step Three

Financing the Florida HSR infrastructure will require annual public gas tax expenditure of $70 million revenues over the 1999-2039 time period. Economic theory indicates that use of public tax revenues results in declines in consumer spending proportionate to those tax collections. The REMI model can estimate the *reductions* in economic activity associated with this decline in consumer spending through a decrease in the regular policy variable 960 (see Table 11). Step 3 in this analysis estimated these public tax related declines in consumer purchasing power combined with the economic impacts of Steps 1 and 2.

Step Four

Finally ridership and revenue forecasts project a positive cash flow for this project beginning in 2013. That is, the Florida FSR project is expected to generate enough revenues to pay all of the anticipated operation and capital expenditure annual debt payments after the first nine years and generate a growing dollar profit thereafter. The estimated magnitude of this positive cash flow will start at $8.2 million in 2013 and grow to $244.7 million by 2035. It is possible that a significant share of these surplus project revenues will be reinvested to provide expanded HSR service to other regions of Florida. The most likely initial areas for expanded service include the northeast and southwest regions of the state.

Step 4 in this analysis treats eighty percent of these annual system generated revenue surplus as reinvestment dollars to expanding HSR services beyond the current corridor boundaries. New HSR reinvestment spending for construction and development across these other regions of Florida were assumed to be proportionate across the same variables identified in the Miami-Tampa corridor (see Table 11). No incremental investment for operation or rider benefits or subsequent additional project cash flows were simulated in this reinvestment Step. As with the earlier phases of this analysis the economic impacts of this final step was simultaneously integrated into this comprehensive REMI modeling analysis. This final step completed the comprehensive REMI modeling methodology and the conclusions of this final simulation for both the state of Florida as a whole and for each of the six regions of the state are reported in the Findings section of this report. Detailed statewide and regional model economic impact output results are provided separately in Appendices D and E for the interested reader.

FINDINGS

This section provides a profile of the final employment, wages and private non-farm output impacts on the Florida economy emanating from investments in the construction and operation of the Florida-FOX High Speed Rail Project. The total employment, wages and salaries and private non-farm output estimates are each provided for each year of the HSR franchise. A detailed description of the four step REMI modeling procedure and variable inputs used to complete this analysis are provided in the methodology section of this report.

Statewide Impacts

Table 13 provides REMI estimates of the economic impacts from Step 1, which includes the direct construction and operation expenditures associated with developing and operating the HSR system from Miami to Tampa . Table 14 provides the enhanced employment, wages and output increases associated with Step 2, which includes increased transportation benefits and disbenefit for each year of the franchise combined with Step 1. Table 15 provides the employment, wages and output reductions associated with Step 3, which includes $70 million state gasoline tax revenues (that translates into REMI model consumer spending power declines in each year of investment) combined with Steps 1 and 2. Finally, Table 16 provide final REMI model forecasts of employment, wages and private non-farm output increases associated with HSR project excess revenue reinvested in a new HSR alignment in Florida combined with each earlier step. The discussion provided in this section will focus on Step 4 economic impacts with a brief description of regional impacts in the next section.

Table 13. Economic Impacts of the Florida High Speed Rail: State of Florida (Step 1)

Year	Total Employment person years	Wages & Salaries millions of 1997 $	Private Non-Farm Output millions of 1997 $
1997	1,745	58.2	120.2
1998	1,964	72.0	136.5
1999	3,303	120.7	240.1
2000	11,512	363.4	1,031.3
2001	22,060	716.8	2,142.2
2002	22,728	783.8	2,267.0
2003	16,063	616.8	1,577.2
2004	5,239	273.5	561.0
2005	(675)	65.8	(15.3)
2006	(1,059)	16.6	(32.8)
2007	(398)	9.7	19.5
2008	115	8.8	57.4
2009	476	9.5	80.0
2010	902	17.6	115.6
2011	1,254	26.8	145.6
2012	1,512	35.0	168.3
2013	1,699	41.8	185.4
2014	1,832	47.0	197.9
2015	1,921	50.4	206.6
2016	1,977	52.3	212.6
2017	2,119	57.3	233.2
2018	2,116	57.5	234.0
2019	2,094	57.4	233.2
2020	2,053	57.3	230.7
2021	2,003	57.4	227.7
2022	1,950	57.9	224.7
2023	1,891	58.4	221.1
2024	1,826	58.8	217.0
2025	1,757	58.9	212.3
2026	1,687	58.7	207.6
2027	1,625	59.0	203.8
2028	1,569	59.4	200.5
2029	1,520	59.7	197.6
2030	1,473	60.0	195.1
2031	1,433	60.4	193.0
2032	1,409	61.1	192.7
2033	1,401	62.5	193.7
2034	1,396	63.6	194.4
2035	1,394	64.6	195.4
2036	1,394	64.6	195.4
2037	1,394	64.6	195.4
2038	1,394	64.6	195.4
2039	1,394	64.6	195.4
2040	1,394	64.6	195.4
2041	1,394	64.6	195.4
2042	1,394	64.6	195.4
2043	1,394	64.6	195.4
Total	138,031	5,033.3	14,987.2

Source: CEFA and CUTR.

Table 14. Economic Impact of the Florida High Speed Rail: State of Florida (Step 2)

Year	Total Employment person years	Wages & Salaries millions of 1997 $	Private Non-Farm Output millions of 1997 $
1997	1,745	58.2	120.2
1998	1,964	72.0	136.5
1999	3,303	120.7	240.1
2000	11,512	363.4	1,031.3
2001	22,060	716.8	2,142.2
2002	22,728	783.8	2,267.0
2003	16,063	616.8	1,577.2
2004	4,848	260.0	582.5
2005	(835)	53.6	33.0
2006	(1,452)	(6.7)	55.3
2007	(378)	(8.1)	154.2
2008	504	(1.2)	232.7
2009	1,211	7.7	292.6
2010	1,952	23.7	363.0
2011	2,621	41.2	424.4
2012	3,147	57.0	474.1
2013	3,571	70.6	515.3
2014	3,919	82.1	550.0
2015	4,200	91.2	579.1
2016	4,432	98.4	603.6
2017	4,731	108.2	643.2
2018	4,887	113.0	661.5
2019	5,009	117.3	676.8
2020	5,099	121.1	689.5
2021	5,184	125.2	701.4
2022	5,246	129.1	712.6
2023	5,295	132.6	722.4
2024	5,342	136.1	732.0
2025	5,375	139.0	740.5
2026	5,404	141.6	748.7
2027	5,456	145.2	759.3
2028	5,522	149.3	771.3
2029	5,582	153.1	782.5
2030	5,639	156.9	794.0
2031	5,702	160.9	806.1
2032	5,804	166.5	821.7
2033	5,901	172.1	837.5
2034	6,027	178.9	853.2
2035	6,134	185.2	866.9
2036	6,134	185.2	866.9
2037	6,134	185.2	866.9
2038	6,134	185.2	866.9
2039	6,134	185.2	866.9
2040	6,134	185.2	866.9
2041	6,134	185.2	866.9
2042	6,134	185.2	866.9
2043	6,134	185.2	866.9
Total	259,523	7,714	33,630

Source: CEFA and CUTR.

Table 15. Economic Impacts of the Florida High Speed Rail: State of Florida (Step 3)

Year	Total Employment person years	Wages & Salaries millions of 1997 $	Private Non-farm Output millions of 1997 $
1997	1,745	58.2	120.2
1998	1,964	72.0	136.5
1999	3,303	120.7	240.1
2000	11,512	363.4	1,031.3
2001	20,534	676.1	2,026.8
2002	21,218	748.9	2,151.7
2003	14,531	580.7	1,459.1
2004	3,295	222.9	461.7
2005	(2,415)	15.5	(90.8)
2006	(3,065)	(45.6)	(72.2)
2007	(2,039)	(48.1)	22.3
2008	(1,203)	(42.3)	96.2
2009	(550)	(34.8)	151.0
2010	135	(20.4)	216.2
2011	744	(4.6)	271.9
2012	1,219	9.5	316.6
2013	1,595	21.5	353.1
2014	1,896	31.3	383.1
2015	2,135	39.0	407.9
2016	2,324	44.7	428.3
2017	2,585	53.0	463.6
2018	2,706	56.7	478.0
2019	2,795	59.7	489.9
2020	2,857	62.5	499.2
2021	2,917	65.6	508.1
2022	2,955	68.5	516.1
2023	2,980	70.9	523.0
2024	3,006	73.3	529.8
2025	3,021	75.2	535.7
2026	3,032	76.8	541.3
2027	3,063	79.2	549.1
2028	3,109	82.0	558.1
2029	3,148	84.5	566.5
2030	3,185	86.9	575.1
2031	3,230	89.5	584.4
2032	3,311	93.4	596.8
2033	3,386	97.2	609.2
2034	3,490	102.2	621.8
2035	3,577	106.8	632.4
2036	3,577	106.8	632.4
2037	3,577	106.8	632.4
2038	3,577	106.8	632.4
2039	3,577	106.8	632.4
2040	3,577	106.8	632.4
2041	3,577	106.8	632.4
2042	3,577	106.8	632.4
2043	3,577	106.8	632.4
Total	165,849	5,146.5	25,548.0

Source: CEFA and CUTR.

Table 16. Economic Impacts of the Florida High Speed Rail: State of Florida (Step 4)

Year	Total Employment person years	Wages & Salaries Millions 1997$	Private Non-Farm Output Millions 1997$
1997	1,745	58.2	120.2
1998	1,964	72.0	136.5
1999	3,303	120.7	240.1
2000	11,512	363.4	1,031.3
2001	20,534	676.1	2,026.8
2002	21,218	748.9	2,151.7
2003	14,531	580.7	1,459.1
2004	3,295	222.9	461.7
2005	(2,415)	15.5	(90.8)
2006	(3,065)	(45.6)	(72.2)
2007	(2,039)	(48.1)	22.3
2008	(1,203)	(42.3)	96.2
2009	(550)	(34.8)	151.0
2010	135	(20.4)	216.2
2011	907	0.3	287.6
2012	1,586	21.1	352.5
2013	2,157	40.1	408.6
2014	2,456	51.2	439.2
2015	2,763	61.8	471.2
2016	3,149	74.5	511.9
2017	3,603	90.2	567.3
2018	3,907	101.3	601.3
2019	4,179	111.9	632.7
2020	4,418	122.3	661.6
2021	4,654	133.1	689.9
2022	4,867	143.7	717.3
2023	5,063	154.0	743.6
2024	5,581	175.1	803.6
2025	5,744	185.3	827.1
2026	5,966	197.0	857.2
2027	6,145	207.4	882.9
2028	6,340	218.0	910.2
2029	6,533	228.3	937.5
2030	6,731	238.7	965.9
2031	7,024	252.5	1,004.2
2032	7,144	260.6	1,023.4
2033	7,284	268.9	1,045.3
2034	7,440	277.5	1,065.6
2035	7,587	285.7	1,084.5
2036	7,587	285.7	1,084.5
2037	7,587	285.7	1,084.5
2038	7,587	285.7	1,084.5
2039	7,587	285.7	1,084.5
2040	7,587	285.7	1,084.5
2041	7,587	285.7	1,084.5
2042	7,587	285.7	1,084.5
2043	7,587	285.7	1,084.5
Total	252,888	8,853	35,118

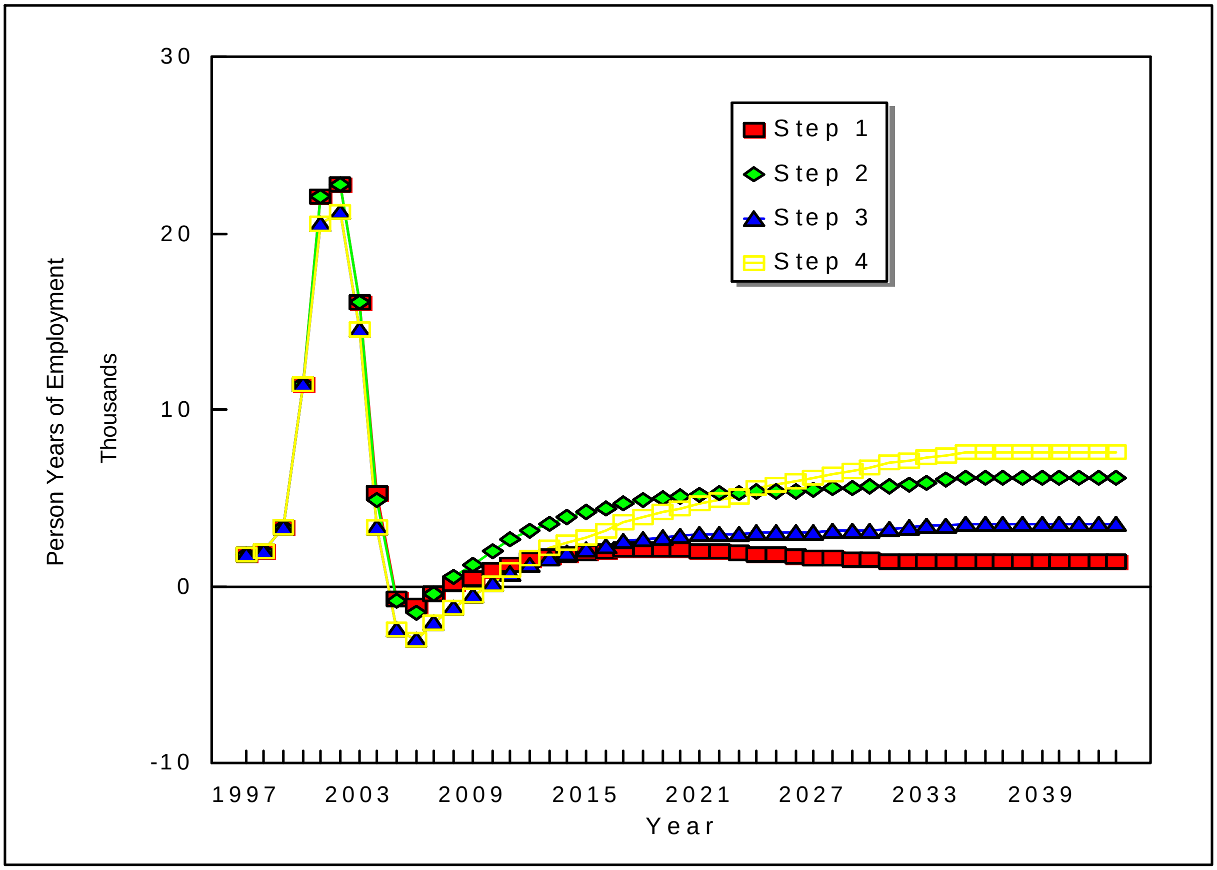
Source: CEFA and CUTR.

Figure 11 provides a profile of the cumulative REMI projected employment shifts each Step incrementally generates. There is an initial construction surge in HSR related employment activities in the early years of the project (1997 through 2004) followed by a decline in new employment created by this project (2005 through 2009) followed by gradual and growing employment recovery through 2043. These short term declines in new job creation are explained by the interaction of economic market forces of labor supply and demand within each region responding to the initial massive capital construction dollar volume infusions. Prior to this large construction related cash infusion employment markets are in balance. The price paid labor is in equilibrium with the amount of labor available in the market. When the billions in construction investments begin to pour into the Florida HSR corridor regions many new prospective employees are attracted to come from outside these regions to where these new jobs are now being offered. Wage rates may increase slightly to attract new employees to help to meet these new employment demands and that in turn generates additional immigration of labor.

When the construction period is complete the reduction in new job creation (since the massive construction activities are now over) generates the opposite economic reaction. There is an initial surplus of workers in this region's labor market and additional new labor from outside the region is not as attracted to migrate into this region (although normal immigration of labor would likely continue). Since this surplus of labor cannot find as many jobs in the region they then tend to return to pre-construction migration patterns and look to other regions to re-deploy these excess employment levels. This creates short term dislocated employment where the HSR project is not creating as many new jobs of the kind initially required for construction activities. The ongoing operations activities cannot initially absorb the numbers and categories of employees (construction crews etc.) within its operations. Thereafter over the period 2010 through 2043 HSR operations gradually increase direct and indirect employment across the corridor overcome this short term dislocation and begin employing considerable numbers of Floridians across a wide spectrum of industries.

This initial $5.3 billion investment in corridor construction and development generates significant employment increases in each year of construction that peaks in 2002 with 21,218 jobs in the Step 4 final analysis. Total HSR related construction activities are estimated to create 78,102 direct and indirect total job years of employment over this 1997-2004 construction period. The ensuing period of HSR operation over the 2005 through

Figure 11. Statewide Employment Impacts



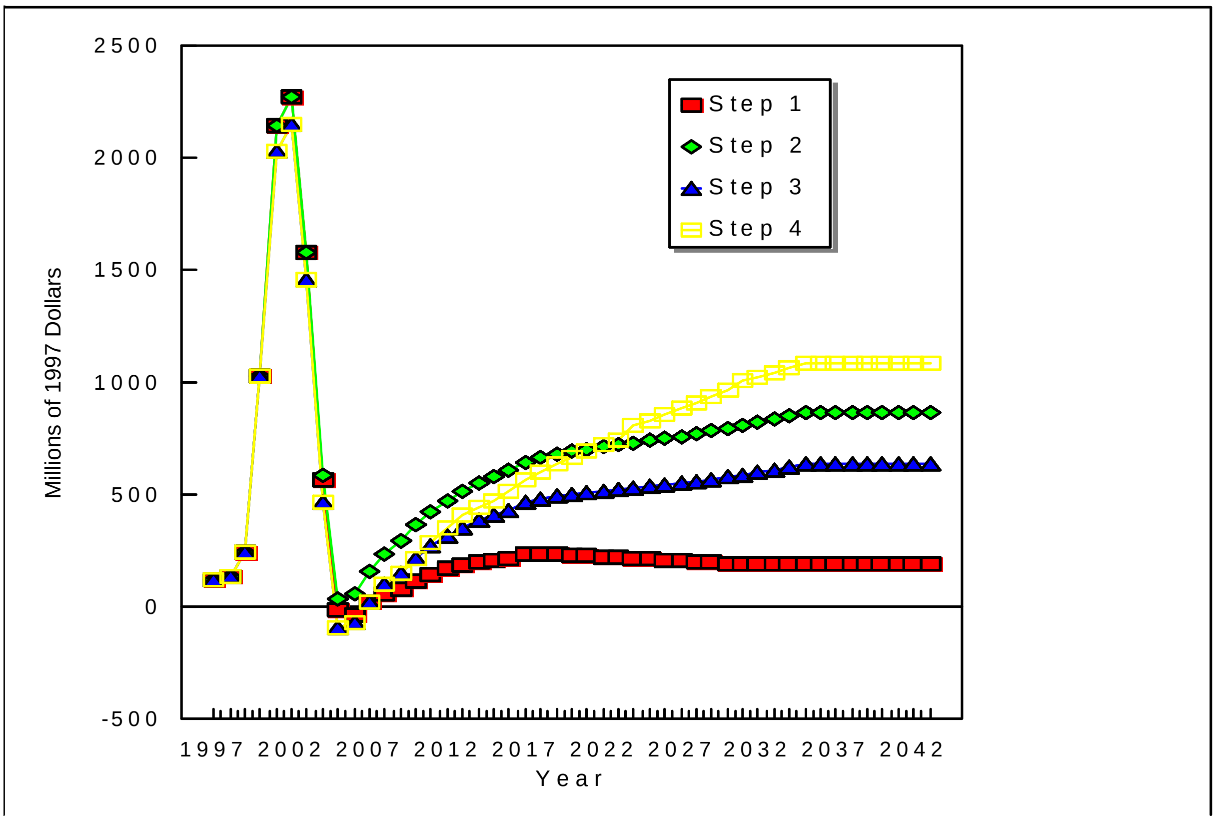
Source: Tables 13-16.

2043, including the short term five year dislocation period, result in an additional HSR project generated 167,200 additional direct and indirect total job years of employment across Florida. In total the Florida HSR project will generate 252,888 direct and indirect job years of employment across the state over the period of the franchise (See Table 16)

An identical pattern of wage and salaries forecast emerges from the REMI generated regional HSR induced project economic stimulus. This initial $5.3 billion investment in corridor construction and development generates significant wage and salaries increases in each year of construction that peaks in 2002 with $749 million in final HSR earnings in the Step 4 final analysis. Total HSR related construction activities are estimated to create $2.8

billion direct and indirect total job earnings and wages over this 1997-2004 construction period. The ensuing period of HSR operation over the 2005 through 2043, including the short term five year dislocation period, result in an additional HSR project generated direct and indirect job earnings and wages of $5.7 billion of wage earnings across Florida. In total the Florida HSR project will generate over $8.5 billion direct and indirect job related wages across the state over the period of the franchise. (See Table 16 and Figure 12)

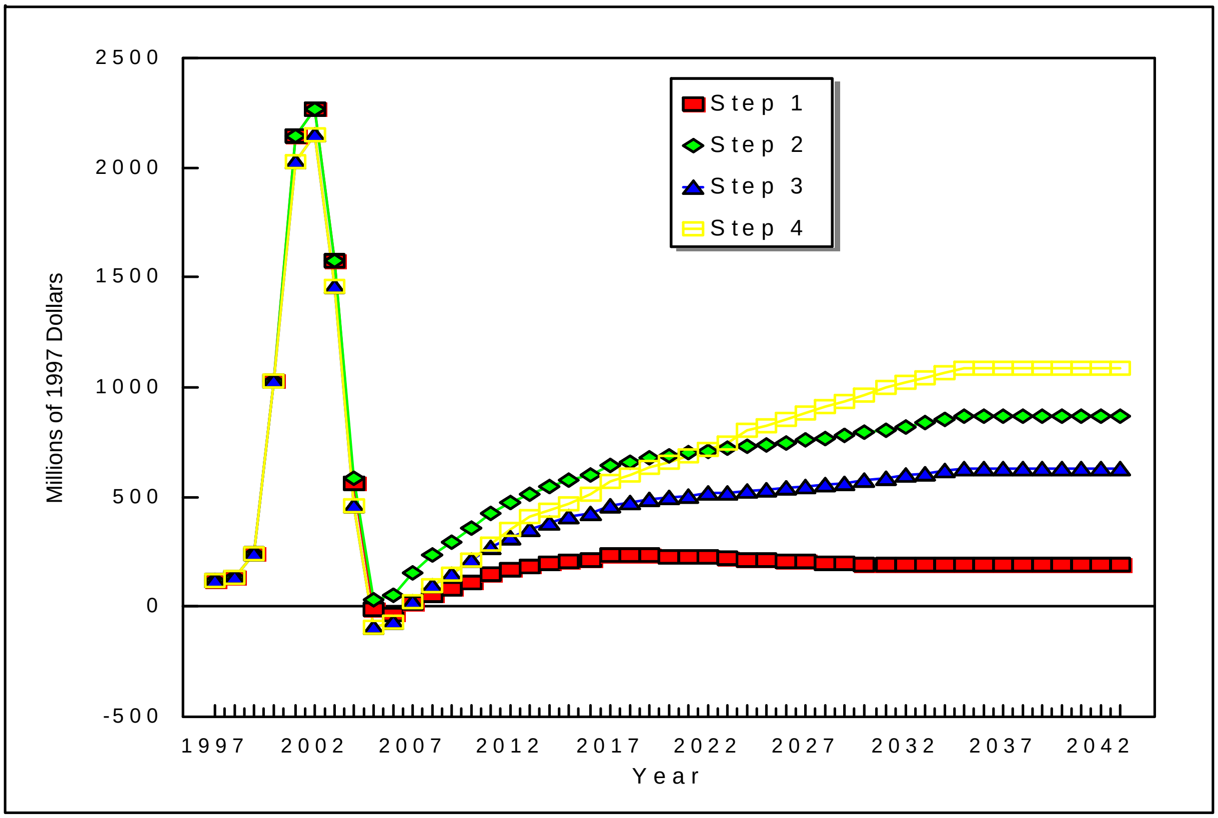
Figure 12. Statewide Wage and Salary Impacts



Source: Tables 13-16.

HSR project generated additional direct and indirect private non-farm output of $26.4 billion across Florida. In total the Florida HSR project will generate over $34 billion direct and indirect private non-farm output related gains across the state over the period of the franchise. (See Table 16 and Figure 13).

Figure 13. Statewide Economic Output Impact



Source: Tables 13-16.

Regional Impacts

As described in the Methodology section of this report the REMI model analysis described in this section generally distributes economic investments and operational expenditures among the regions proportionate to the linear miles of HSR track planned for that region. Therefore the REMI model generates direct and indirect employment, wages and output in similar proportions.

Also as the Methodology section described, five of the regions (Tampa Bay, East Central Florida, Treasure Coast, Broward County, and Dade County) roughly cover the planned HSR corridor alignment. The exception to this rule is a brief portion of the alignment in central Florida that passes through Polk county. This section of the alignment is attributed to the sixth region that encompasses all of the remaining "other regions" of Florida. The REMI model generates both region specific economic impacts and extra regional impacts from each regional specific construction or operational dollar expended. Therefore the sixth "other" Florida region picks up a variety of economic impacts from each of the other regions. For example labor migrates in and out and among each of the six regions and materials and services are supplied to and from and among all regions as industrial structure and demands dictates. This combined with the Polk county share of the HSR alignment partitioned to the sixth region generate considerable economic stimulus to (and from) this sixth region.

Finally, in Step 4 of the analysis the reinvestment of HSR related revenue surplus to "new" HSR alignments elsewhere in Florida also generate substantial economic stimulus to the sixth region. Steps 1 through 3 (those not including the reinvestment option) reflect proportional economic stimulus to corridor alignment in the Other Regions. The final step creates this substantial reinvestment that generates a considerable increase in economic stimulus in this region (relative to the others) and therefore a considerable increase in employment, earnings and output in that region.

Tables 17-20 and Figures 14-16 provide final Step 4 results of the Florida HSR induced increases in annual regional employment, earnings and output over the years of the franchise. Excluding the reinvestment expenditures described above in the other regions of Florida the largest HSR alignment is in the East Central and Treasure Coast regions. Total construction and operations employment for these regions are 58,661 and 44,253 person years over the period of the franchise or average annual employment of 1,249 and 942 person years respectively. Employment impacts in the other regions vary from 15,097 to 23,136 in total person years in Dade and Tampa and from a low of 321 to 492 per year in these regions. The Other Regions (with reinvestment included) generated 96,043 jobs with an annual average of 2,043 person years of employment created due to HSR franchise investments.

Total construction and operations wages and earnings for these regions vary between $.56 to $1.78 billion for Dade and East Central Florida respectively over the period or average annual earnings of between $12 to $38 million per year over the period of the franchise. The Other Regions (with reinvestment included) generated total franchise earnings of $3.86 billion in total annual earnings and a period average earning of $82 million annually.

Finally, total direct and indirect non-farm output generated from the Florida HSR construction and operations for these regions vary between $2.54 to $8.26 billion for Dade and East Central Florida respectively over the period or average annual output of between $54 to $176 million per year over the period of the franchise. The Other Regions (with reinvestment included) generated total franchise earnings of $10.95 billion in total annual output and a period average output of $233 million annually.

Note that the sum of regional impacts differs from statewide impacts as directly reported by REMI and shown in Table 16. The difference results from the deflators used in converting REMI results, which are in 1992 dollars, into 1997 dollars. Specifically, the deflator used for converting statewide impacts differ from deflators used for converting regional impacts.

Table 17. Economic Impacts of the Florida High Speed Rail Project: Regional Summary (Step 1)

Regions	Employment person years			Wages & Salaries millions 1997 $			Total Non-Farm Output millions 1997 $		
	Cons-truction	Ope-rations	Total	Cons-truction	Ope-rations	Total	Cons-truction	Ope-rations	Total
Tampa Bay	9,136	7,102	16,238	303	269	572	846	925	1,771
East Central	24,748	14,915	39,663	867	551	1,418	2,341	1,951	4,292
Treasure Coast	24,254	10,062	34,316	876	367	1,243	2,420	1,271	3,691
Broward County	9,712	5,589	15,301	366	215	581	935	716	1,651
Dade County	7,533	6,383	13,916	303	284	587	770	945	1,715
Other Regions	9,231	9,369	18,600	292	341	633	824	1,137	1,961
Total	84,614	53,420	138,034	3,007	2,027	5,034	8,136	6,945	15,081

Source: CEFA and CUTR.

Table 18. Economic Impacts of the Florida High Speed Rail Project: Regional Summary (Step 2)

Regions	Employment person years			Wages & Salaries millions 1997 $			Total Non-Farm Output millions 1997 $		
	Cons-truction	Ope-rations	Total	Cons-truction	Ope-rations	Total	Cons-truction	Ope-rations	Total
Tampa Bay	9,098	21,521	30,619	302	591	893	848	2,944	3,792
East Central	24,635	57,162	81,797	863	1,392	2,255	2,348	7,708	10,056
Treasure Coast	24,130	43,890	68,020	871	1,021	1,892	2,430	7,086	9,516
Broward County	9,659	15,271	24,930	364	446	810	936	2,405	3,341
Dade County	7,509	14,742	22,251	302	581	883	771	2,407	3,178
Other Regions	9,192	22,725	31,917	291	689	980	829	3,140	3,969
Total	84,223	175,311	259,534	2,993	4,720	7,713	8,162	25,690	33,852

Source: CEFA and CUTR.

Table 19. Economic Impacts of the Florida High Speed Rail Project: Regional Summary (Step 3)

Regions	Employment			Wages & Salaries millions 1997 $			Total Non-Farm Output millions 1997 $		
	Cons-truction	Ope-rations	Total	Cons-truction	Ope-rations	Total	Cons-truction	Ope-rations	Total
Tampa Bay	8,430	11,972	20,402	285.3	330.1	615.4	793.8	2,069.3	2,863.1
East Central	22,847	30,828	53,675	824.6	732.8	1,557.4	2,216.8	5,577.0	7,793.8
Treasure Coast	22,522	21,188	43,710	833.9	429.8	1,263.7	2,308.7	5,174.7	7,483.4
Broward County	8,968	5,581	14,549	346.1	157.5	503.6	881.1	1,532.5	2,413.6
Dade County	6,913	6,175	13,088	284.4	278.1	562.5	716.8	1,499.5	2,216.3
Other Regions	8,424	12,009	20,433	272.0	384.7	656.7	770.3	2,172.1	2,942.4
Total	78,104	87,753	165,857	2,846.3	2,313.0	5,159.3	7,687.5	18,025.1	25,712.6

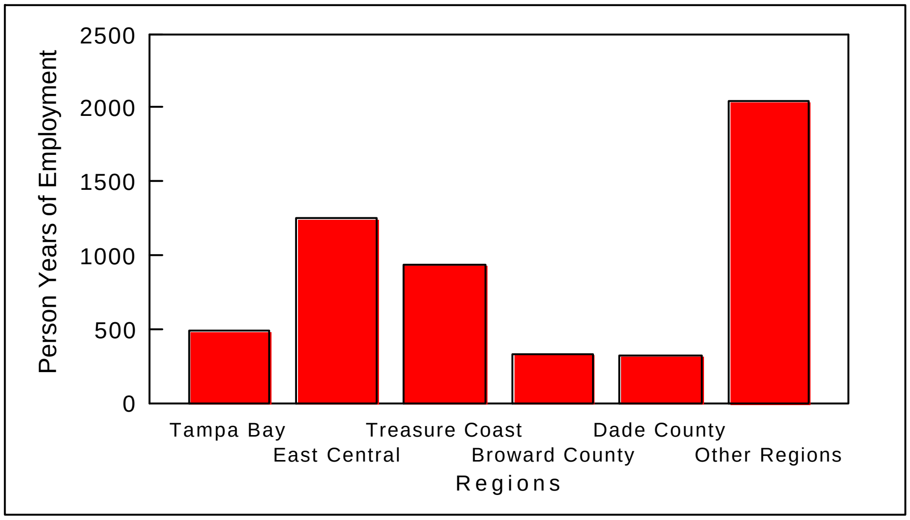
Source: CEFA and CUTR.

Table 20. Economic Impacts of the Florida High Speed Rail Project: Regional Summary (Step 4)

Regions	Employment			Wages & Salaries millions 1997 $			Total Non-Farm Output millions 1997 $		
	Cons-truction	Ope-rations	Total	Cons-truction	Ope-rations	Total	Cons-truction	Ope-rations	Total
Tampa Bay	8,430	14,706	23,136	285	446	731	794	2,372	3,166
East Central	22,847	35,834	58,681	822	961	1,783	2,217	6,044	8,261
Treasure Coast	22,522	21,731	44,253	834	451	1,285	2,309	5,263	7,572
Broward County	8,968	6,712	15,680	346	212	558	881	1,675	2,556
Dade County	6,913	8,184	15,097	284	382	666	717	1,819	2,536
Other Regions	8,424	87,619	96,043	273	3,585	3,858	770	10,176	10,946
Total	78,104	174,786	252,890	2,844	6,037	8,881	7,688	27,349	35,037

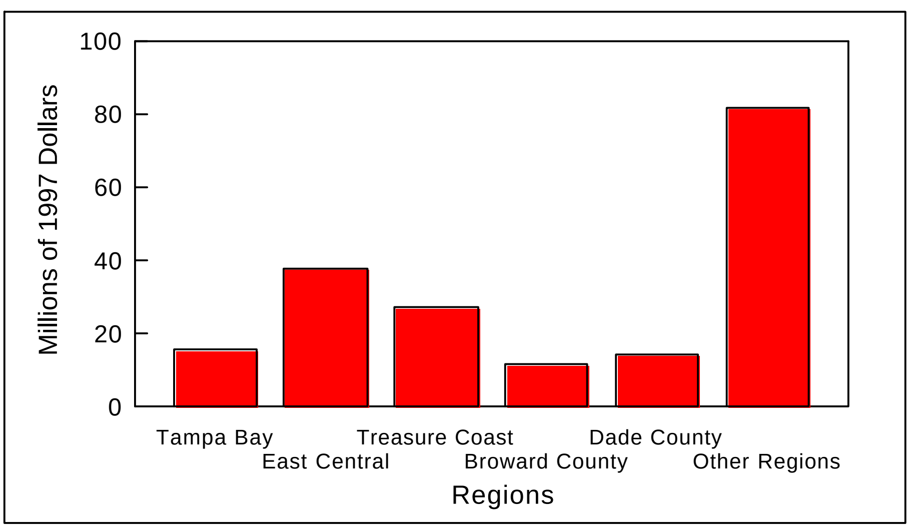
Source: CEFA and CUTR.

Figure 14. Regional Employment Impacts per Year



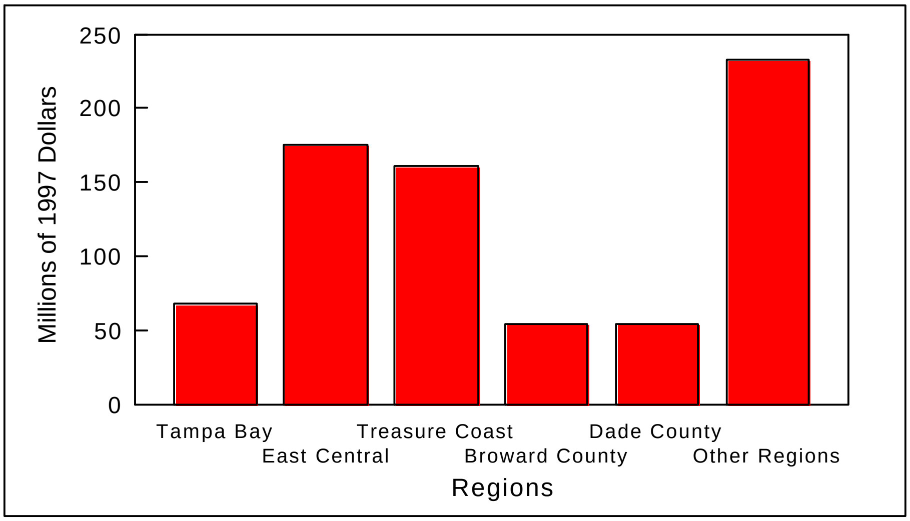
Source: Table 20.

Figure 15. Regional Wage and Salary Impacts per Year



Source: Table 20.

Figure 16. Regional Output Impacts per Year



Source: Table 20.

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