The Economic Impact and Benefits of the Central Florida Expressway Authority Five-Year Work Plan
FY 2024 – FY 2028

Project Number
USF Project 2117-2235-00

Prepared For

CENTRAL FLORIDA EXPRESSWAY AUTHORITY

February 2024

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of the
Central Florida Expressway Authority
Five-Year Work Plan
FY 2024 – FY 2028

Prepared for:

CENTRAL FLORIDA EXPRESSWAY AUTHORITY

Prepared by:

Sisinnio Concas, PhD

CUTR

Center for Urban Transportation Research
University of South Florida
4202 E. Fowler Ave., CUT 100, Tampa, FL 33620
Website: www.cutr.usf.edu

Final Report
February 2024

Disclaimer

This research was conducted under a grant from the Central Florida Expressway Authority. The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the Central Florida Expressway Authority.

Executive Summary

To manage and operate its program of system improvements, the Central Florida Expressway Authority (CFX) annually updates its *Five-Year Work Plan*. The Work Plan strategically identifies those projects to be funded during the next five years and serves as an integral part of the *2045 Expressway Master Plan*. The Work Plan projects are intended to maintain and enhance the current system and improve travel and safety conditions for users. In addition to travel improvement benefits to system users, the Work Plan investment can also provide a substantial contribution to the economic growth of the region and the state.

Objective

CFX commissioned this study to estimate the economic impacts and benefits of implementing the 2024-2028 *Five-Year Work Plan* strategic investments. This study reports the estimated economic impact of project expenditures and the monetary value of travel improvement benefits associated with the construction and operation of current system improvements, system expansion, investments in intelligent transportation systems, and other improvements.

Key Findings

Results of this study include a broad range of travel improvement performance and economic impact indicators at both the regional and state levels.

Spending Impacts

The Work Plan's economic impact is substantial in contributing to economic growth, as measured by $6.4 billion[1] in gross business sales and $3.5 billion in gross domestic product (GDP) for the five-counties of Brevard, Lake, Orange, Osceola, and Seminole. In addition, the Work Plan also stimulates economic activities in counties adjacent to the study area.

When including the rest of the state, the Work Plan's contribution results in a total impact of $7.1 billion in gross business sales, $3.8 billion in GDP, and 7,157 full time equivalent (FTE) jobs.

Employment impacts primarily center in the professional and business services and the construction sectors, but spill over to other sectors as well. By providing safe and efficient connectivity throughout the region, the Work Plan strategic transportation infrastructure investments can support relevant industry sectors attracting high-wage, highly skilled workers.

Travel Improvement Benefits

The Work Plan will produce substantial benefits in travel time reductions, increased safety, and reduction in harmful emissions. Under the current travel forecasting scenario, improvements and expansions to the current system would save each household on average 69 travel hours annually, or about $1,044 per year.

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[1] All monetary amounts are reported in 2022 dollars unless otherwise indicated.

The expected travel time improvements would also save households $89.5 million in out-of-pocket costs ($77 per household). These savings are a result of lower fuel costs because of less congestion, and, avoided medical expenses due to fewer traffic crashes. Savings in fuel and medical costs represent money available for other household expenditures. These savings would generate an added $64.7 million a year in GDP, an impact that is likely to linger after the Work Plan investment schedule.

Summary of Impacts and Benefits

The Work Plan investment expenditures significantly contributes to regional economic growth.
- $7.1 billion in gross business sales
- $3.8 billion in gross domestic product (GDP)
- 7,157 jobs
- 214 million in local and state tax revenue

As a result of the Work Plan, area households and business will realize:
- $1.4 billion in travel time savings
- An average savings of 69 travel hours a year per household ($1,044 in time savings)
- $106 million in avoided crash costs
- $104 million in fuel cost savings
- $18.7 million reduction in harmful emissions
- Curb CO2 emissions by about 1.2 percent in the region

Table of Contents

List of Figures

List of Tables

Chapter 1
Introduction

1.1 Project Background

The Central Florida Expressway Authority (CFX) was established in 2014 with an expanded mandate to build and maintain a regional transportation network that connects Brevard, Lake, Orange, and Seminole counties. The CFX system consists of 125 centerline miles and eight named expressways, comprising 865 lane miles, 73 interchanges, 14 mainline toll plazas, 5 mainline toll gantries, 74 ramp toll plazas and 343 bridges [1].

To manage and operate its program of system improvements, CFX annually updates its *Five-Year Work Plan* (Work Plan) [2]. The Work Plan strategically identifies those projects to be funded during the next five years and serves as an integral part of the *2045 CFX Master Plan*. The Work Plan projects are intended to maintain and expand the current system and improve travel and safety conditions for users. In addition to travel improvement benefits to system users, the Work Plan investments also substantially contribute to the economic growth of both the region and the state.

1.2 Study Objectives

The objective of this report is to estimate the economic impacts and benefits associated with the Work Plan for Fiscal Years 2024 - 2028. These estimates will help CFX:

- Assess the contribution of the Work Plan to the level of economic activity in the counties of Brevard, Lake, Orange, Osceola, Seminole, and the rest of the State.
- Determine the economic benefits of the Work Plan to users of CFX's facilities in terms of travel time savings, pollution emissions, and health and safety cost changes.

The following sections of this report describe the methodology used to estimate the economic impact and benefits of the Work Plan and the estimation results.

Chapter 2
Methodology

2.1   Introduction

The term *economic impact* is used extensively to describe and quantify the economic activities attributable to an organization and its investments. It is important to differentiate between economic "value" and economic "impact". In simple terms, economic value is created when a product or service is consumed within a specific region's geographic boundary; however, an economic impact occurs when products or services consumed are produced by industries located within this geographic boundary.

Investment in transportation infrastructure can affect a region's economy in two ways: (1) through the spending pattern of the purchases of goods and services, and (2) through cost savings and business productivity changes that might be realized as investments improve the current transportation network. These impacts can be estimated using input-output (I-O) accounting tables. These tables produce multipliers that are used to compute the total direct, indirect, and induced effects on jobs, output, and income impacts generated per dollar spent on the Work Plan.

While economic impacts encompass a wide range of effects across many sectors of a region's economy, other factors can significantly contribute to economic growth, although they do not directly affect the flow of dollars in the economy. These benefits include travel time savings and changes in health and safety costs, such as pollution emission costs and accident costs. While some travel time savings can affect the flow of income generated depending upon the purpose of travel (business versus personal), the reduction of pollution emissions and accidents creates a value that does not directly affect the economy. This study estimates their value to users and distinguishes them from the economic impact analysis results. Typically, these benefits are directly incorporated into other assessments, such as a benefit-to-cost ratio project prioritization or evaluation.

The following sections detail the study's approach to estimate the economic impacts and benefits of the Work Plan.

2.2   Analysis Approach

Figure 2-1 summarizes the approach to evaluation adopted in this study. First, the Work Plan expenditures are evaluated and their economic impact estimated using an I-O model. Then, travel improvement impacts are assessed. Travel improvements from the Work Plan strategic system expansion and maintenance projects result in direct user benefits in terms of improved travel times, reduced delays, and decreased exposure to crashes. Spending less time in congested travel reduces vehicle operating costs to travelers and businesses. In turn, reduced expenditures on fuel can translate into out-of-pocket cost savings. The resulting savings can then be allocated to the consumption of goods and services in other sectors of the local economy. In effect, this is equivalent to a reallocation of household expenditures within the impact area. The analysis in this study considers the indirect and induced effects of this reallocation.
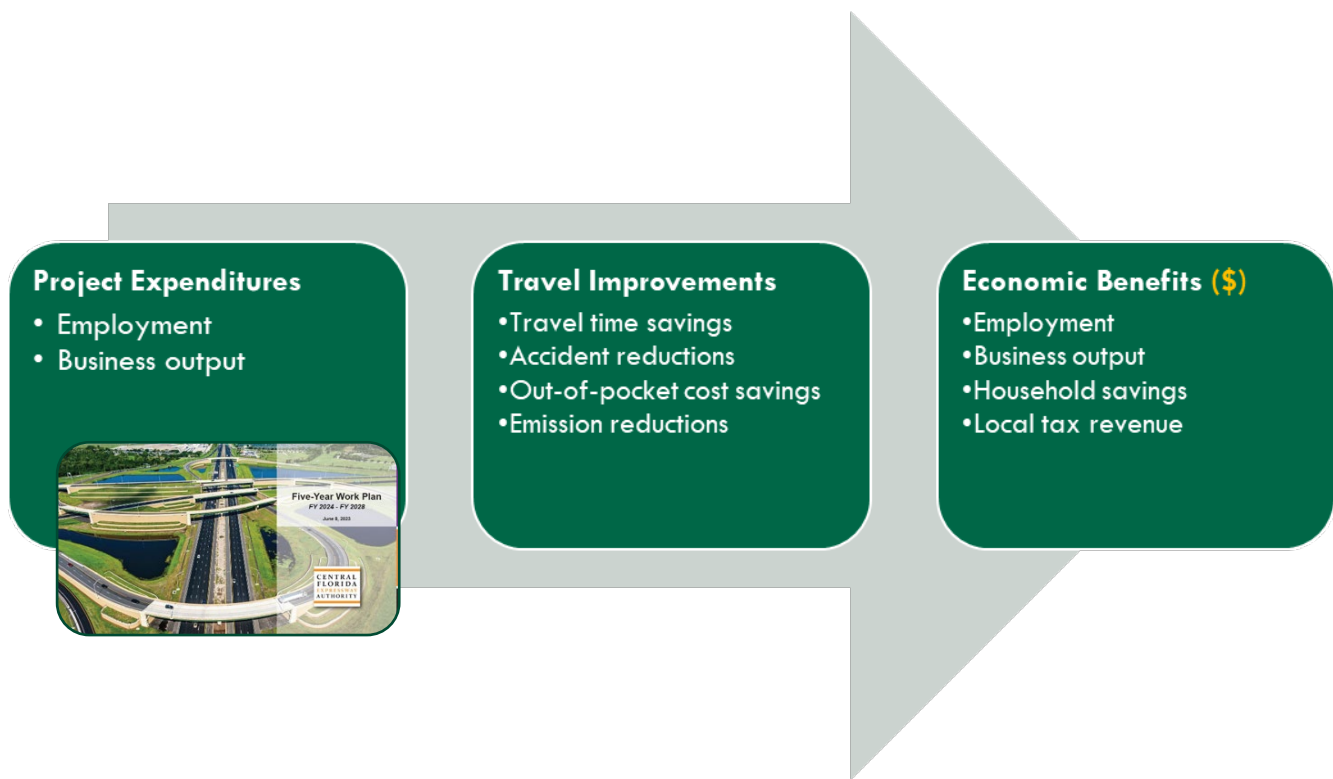
Figure 2-1 Economic Impact and Benefit Evaluation Framework

1.1.1   Choice of Input-Output Model

This study makes use of the IMPLAN model to generate I-O tables and multipliers. IMPLAN and the associated datasets are supported by the IMPLAN Group LLC.[2] IMPLAN is a widely used, nationally recognized input-output economic impact model. Appendix A provides a more detailed explanation of the IMPLAN model and I-O analysis.

The I-O model estimates changes in the total local economic activity caused by economic changes in the area. In this analysis, the economic activities associated with the Work Plan require the purchase of goods and services from the local economy. These purchases cause changes in the overall economic activity of the region. The I-O model assesses the new level of overall economic activity. As an example, when a business purchases goods from a second business, the first business is helping support the second. The model estimates all levels of activity supported by the first business.

1.1.2   Indirect and Induced Impacts

Direct investment in capital infrastructure results in a demand for spending in the economy, directly affecting the demand for goods and services of businesses. These businesses rely on other businesses to purchase inputs. Indirect impacts measure the economic activity of secondary businesses producing goods and services as a result of primary businesses' production of goods and services. The wages of workers of primary and secondary businesses generate additional retail sales for businesses, resulting in additional induced impacts. Changes in household spending spanning from improvements in the transportation network (i.e., household cost savings), also generate indirect and induced impacts.

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[2] www.implan.com

2.3   Estimation of Expenditure Impacts

Expenditure impacts relate to changes in economic activity resulting from changes in local spending brought about by investing in the projects funded by the Work Plan. Thus, the direct impact of the Work Plan is defined as the initial change in output, or gross sales that occur in the impact area as a result of the plan's implementation. To be considered an impact, the change must occur within the boundaries of the impact area and result solely from Work Plan expenditures.

The Work Plan's injection of dollars into the local economy can directly support jobs in heavy construction, specialized services required for planning (architectural and engineering), and maintenance and landscaping services. It also stimulates the purchase of products that lead to further impacts on economic activity. This study employs the following measures of economic impacts:

1. Employment
2. Total output
3. Value added
4. Labor income
5. Fiscal

2.3.1   Employment

This type of impact represents the creation (or support) of jobs in the impact area. Total employment consists of the annual average full-time and part-time employees working in each sector of the local economy. For reporting purposes, the I-O employment estimates are converted into full-time equivalents (FTE) using appropriate conversion tables provided by IMPLAN.[3]

1.1.1   Total Output

Total industry output measures the value of production of goods and services by businesses in the local economy. Total industry output is equivalent to total business sales plus what businesses place into (or remove from) inventory. Total output measures how the region's economy would be affected by the direct impacts generated by the Work Plan.

2.3.2   Value Added

Total value added is equivalent to gross domestic product. It is a subset of total output that measures total output minus the cost of labor and materials. Total output is analogous to the definition of Gross Domestic Product (GDP) as identified by the Bureau of Economic Analysis, and measures only the value of final goods and services [3]. In economic analysis, value added is the preferred impact measure of contribution to economic growth generated by investments.

2.3.3   Labor Income

Total income includes employee compensation and other income. Total employee compensation represents the total payroll costs, including wages and salaries, paid to workers by employers, as well as benefits such as health and life insurance, retirement payments, and non-cash compensation. Total other income includes income generated by self-employed individuals, corporate profits,

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[3] See here for a complete explanation of the FTE employment conversion: https://support.implan.com/hc/en-us/articles/115002782053-IMPLAN-to-FTE-Conversions

payments for rents, royalties and dividends, as well as profit generated by corporations. Labor income represents an important share of a region's total income.

2.3.4 Fiscal

Fiscal estimates are strictly tied to the impact area data as provided by the IMPLAN model. These values are based on the average taxes for all the industries within the model, the average taxes associated with households, and the average taxes and transfers associated with each government institution defined by the model.

2.3.5 Definition of Impact Area

Economic impact study regions vary in size from single counties to multiple states, depending on the nature of the study and the industries assessed. The choice of the study area must strike a balance between covering an area large enough to capture the most important aspects of the impact, but not so large that unconnected economic activities mask the impacts. For the purposes of this study, the core of the study area for this analysis consists of the five counties where the CFX operates: Brevard, Lake, Orange, Osceola and Seminole.

The Work Plan also produces impacts that go beyond the core study area because the Work Plan expenditures are assumed to affect counties outside of those comprising the core impact area. These "spillover" effects are estimated throughout the rest of the state, in addition to the impact in the core study area.

2.4 Estimation of Travel Improvement Impacts

The impact of the Work Plan spans beyond the contribution to local economic dynamics brough about by the construction of the proposed projects. Once built and put into operation, capacity expansion and improvement of current facilities will benefit travelers, households, and businesses located in the impact area. An improved transportation network can reduce distances between origin and destination, save time during congested periods, improve travel time reliability, reduce crash risks, and lower vehicle operating expenses.

This study considers the following travel improvement benefits:

- Travel time savings
- Reductions in crashes
- Reductions in tailpipe emissions
- Reductions in excess fuel consumption

To quantify benefits from travel improvements, CUTR researchers relied on CFX's traffic consultant estimates of changes in vehicle miles of travel (VMT) and vehicle hours of travel (VHT). Chapter 4 provides a detailed description of estimated travel improvement benefits.

2.5 Household and Business Cost Savings

Travel improvements can reduce congestion and save household out-of-pocket costs as they spend less time on congested travel. These savings are equivalent to a reduction in the cost of living (i.e., an

increase in household disposable income) that can result in indirect and induced impacts on the flow of dollars within the area.

Another benefit of travel improvements is a reduction in out-of-pocket medical expenses associated with a reduced incidence of automobile accidents. As with the savings from lower vehicle operating and maintenance costs, the private savings associated with reduced medical expenses, increase disposable household income and have indirect and induced economic impacts.
This study estimates the direct and induced impacts of reduced household vehicle operating costs (i.e., fuel costs) and out-of-pocket medical expenses.

2.6   Other Benefits

Changes in business productivity costs stem from travel time improvements affecting the movement of goods and services in the impact area. In an urban area, worsening congestion can lead to substantial increases in commercial travel time. This can induce businesses to capital and labor substitution, loss of competitiveness, and in some cases relocation outside the congested area. Transportation investments directed at reducing congestion can result in increased market accessibility and can have agglomerative effects. An improved transportation network might affect business and household relocation decisions. Improved travel time and reliability of travel might incentivize new businesses to locate within the impact area and existing businesses to reap the benefits of improved market accessibility. Lower commuting travel time might influence households to relocate from other areas, thus affecting labor and real estate markets.

A theoretical and empirical framework to evaluate additional benefits from congestion reduction has been formalized by the National Cooperative Highway Research Program (NCHRP) Project 2-21 [4]. This project sought to develop a framework for estimating the cost of congestion to businesses in U.S. cities and urban areas. The framework goes beyond the usual method of accounting for user expense and travel time cost savings. The research effort produced Report 463, which provides a framework to account for the direct and indirect productivity costs associated with travel time variability, worker time availability, and all effects that congestion imposes on freight travel, just-in-time production processes, and market accessibility.

As part of the direct costs, the framework recognizes that businesses absorb some of the direct travel costs of all business-related travel, including the value of time for drivers. All other costs related to congestion that do not directly affect the cost of doing business are defined as indirect costs. For example, an indirect cost would be a reduction in business activity resulting from the effect congestion might have on the attractiveness of an area. Another indirect cost can include increased emission levels generated by increased congestion, which undermines the livability of an area and affects labor force participation. Congestion, by negatively affecting freight travel time and travel time reliability, induces business to substitute between labor and capital inputs. Report 463 provides a framework for the empirical estimation of the relationship between business activity and congestion levels by applying the concept of elasticity of substitution with respect to travel time changes. These elasticities measure the extent to which businesses might be willing to pay a premium for specialized goods, services, and labor.

While this study estimates the impact of congestion on businesses by estimating changes in business travel times, it does not consider the long-run impacts from travel time improvements in terms of changes in labor and capital productivity, and it does not consider impacts resulting from increased market accessibility. Tailoring the approach to business productivity impact estimation detailed in Report 463 would require detailed freight traffic data at a highly disaggregated level that is beyond the scope of this study. Furthermore, although relevant, the estimation of these impacts is better suited for an evaluation of CFX's long range plan, which will have greater long-term impacts than the *Five-Year Work Plan*.

Chapter 3
Spending Impacts

This section describes the analytical approach to estimating the impacts associated with the Work Plan expenditures. It provides a description of the Work Plan and a detailed analysis of project expenditures that are required to analyze the plan's overall economic impact.

3.1   Overview of the Five-Year Work Plan

The FY 2024-2028 Work Plan is developed from prior Work Plans and the *2045 Expressway Master Plan*. It identifies the projects that CFX anticipates funding during the next five years. The Work Plan is key to managing CFX's program of system improvements, enhancement, and rehabilitation. During the development of the Work Plan, a Work Plan document is prepared by CFX's technical staff [2]. The report produces a list of projects grouped in the following ten categories:

1. Existing System Improvements
2. System Expansion Projects
3. Interchange Projects
4. Facilities Projects
5. Transportation Technology Projects
6. Information Technology Projects
7. Signing and Pavement Markings
8. Renewal and Replacement Projects
9. Landscape Projects
10. Non-System Projects

This study relies on project cost data from the most recent version of the Work Plan to obtain detailed information on each of the projects [2]. In the document, this information is provided under the "Section 5 Project Information." The total value of the Work Plan is $3.87 billion (2022 dollars) with yearly expenditures allocated according to Figure 3-1.[4]

Figure 3-2 shows that 58.4 percent of the Work Plan expenditures will go toward system expansion projects, 24.3 percent will go to system improvements, with the remainder allocated to all other project categories. Although this information is useful to CFX for updating its financial models and assisting in the projection of fund balance, for this analysis the project costs need to be categorized by expenditure type. Project costs consist of expenditures such as preliminary engineering, project development and environment study (PD&E), design, right-of-way (ROW) acquisition, construction, maintenance, and landscaping.

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[4] While in inflated dollars the Work Plan totals $4.01 billion, the 2022 dollar value is $3.87 billion as reported in the Work Plan.
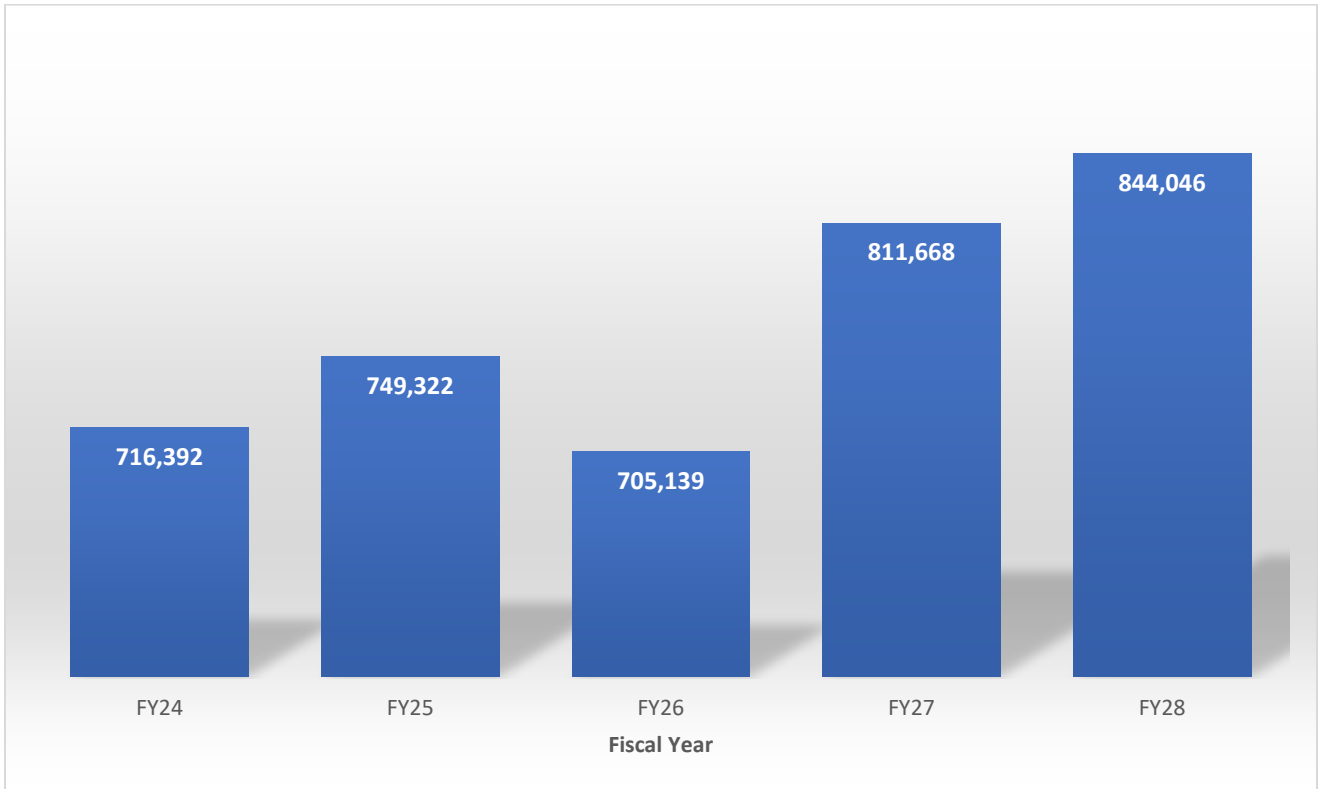
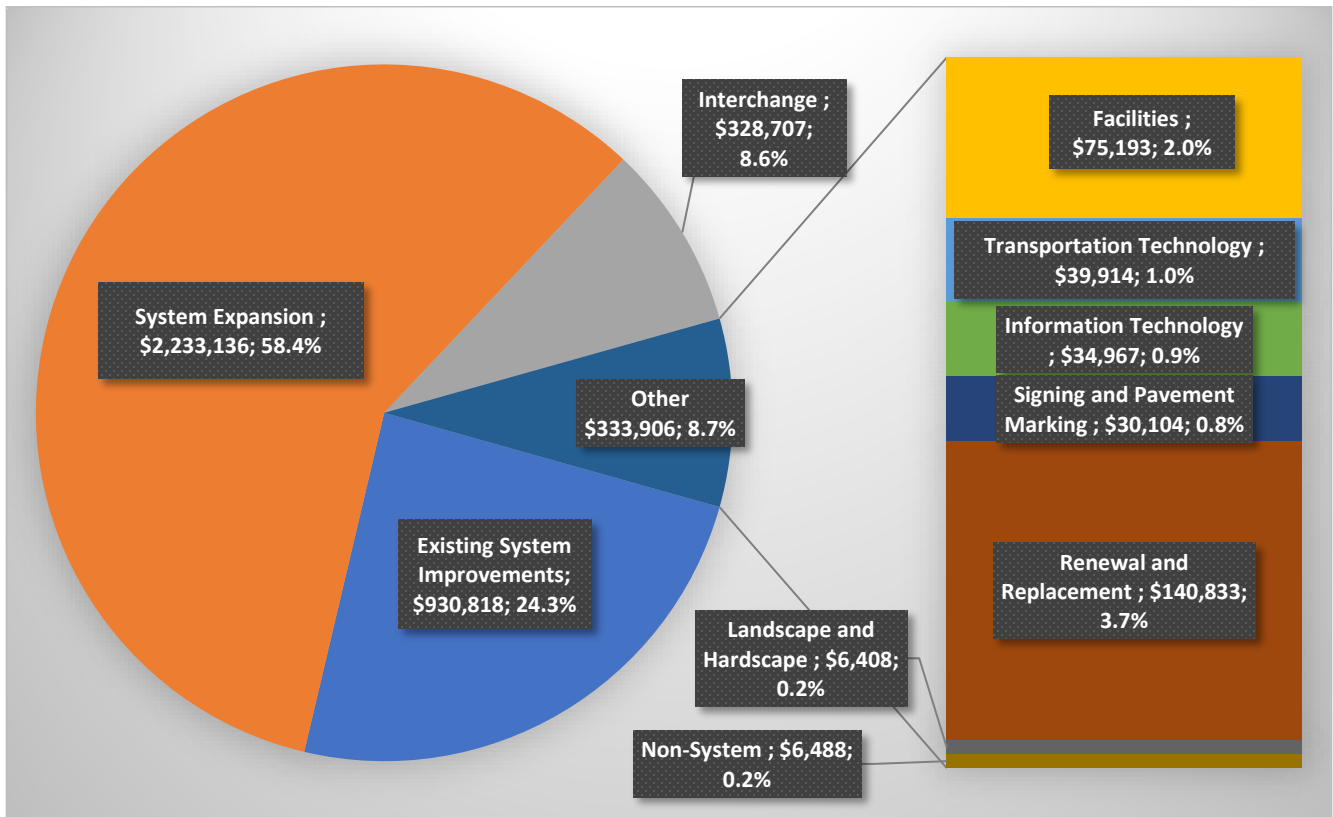Figure 3-1: Five-Year Work Plan Expenditures (thousands of dollars)

Figure 3-2: Work Plan Expenditure Allocation (thousands of dollars)

9

3.1.1 Mix of Capital Investment Expenditures

Table 3-1 reports the expenditure data by fiscal year. To prepare the data for input in the estimation process, the Work Plan's $3.87 billion expenditures in project costs must be disaggregated by expenditure type. A detailed analysis of Section 5 of the Work Plan [2] provided cost information on each project activity, which distinguishes between the following:

- Engineering, administration, and legal (EAL)
- Construction
- PD&E Study
- ITS software implementation
- Toll equipment acquisition and replacement
- Right-of-way (ROW) acquisition
- Landscaping and maintenance
- Utilities

Table 3-1: Work Plan Expenditure Breakdown (thousands of dollars)

Work Plan Expenditure Type	FY24	FY25	FY26	FY27	FY28	Total
Engineering, Administration and Legal (EAL)	93,766	123,574	117,677	115,430	102,544	**552,990**
Construction*	404,361	489,163	546,133	654,067	708,861	**2,802,585**
Landscaping Installation and Maintenance	1,263	6,444	14,242	17,917	10,534	**50,400**
Toll Equipment Acquisition and Replacement	6,775	6,625	0	11,300	2,475	**27,175**
ITS Implementation	17,277	32,450	7,130	3,780	6,280	**66,917**
Right of Way**	196,220	103,270	35,070	16,510	18,280	**369,350**
Total	**719,662**	**761,525**	**720,252**	**819,004**	**848,974**	**3,869,417**

*Includes Utilities

**Includes mitigation: attorney fees or compensation

This study treats expenditures to purchase land under ROW acquisition as a transfer of resources among parties within the impact area that does not influence business activities or create jobs. Only the ROW expenditures that pay for real estate appraisal services (10% of ROW) and legal services (10% of ROW) are considered as having an impact.

Table 3-2 reports the total expenditures that are assumed to have a direct impact in the area and throughout the state. Using the 2022 North American Industrial Classification System (NAICS), the expenditures are assigned to specific industry sectors and then matched those sectors to the corresponding IMPLAN I-O model industry sectors. Table A-1 in Appendix A describes the NAICS industry sectors with the corresponding IMPLAN industry codes.

Table 3-2: Work Plan Expenditures Considered for Impact Analysis (thousands of dollars)

Expenditure Type	Industry Sector		Total	Share of Total (%)
	NAICS	IMPLAN		
Engineering, Administration and Legal (EAL)	541300	457	552,990	15.5
Construction*				
Construction of new highways and streets	233293	54	2,742,407	76.7
Maintenance and repair construction	N.A.	60	60,178	1.7
Landscaping Installation and Maintenance	561730	477	50,400	1.4
Toll Equipment Acquisition and Replacement	334290	303	27,175	0.8
ITS Implementation	5415110	459	66,917	1.9
Right of Way**				
Real Estate Services (10%)	531000	447	36,935	1.0
Legal Services (10%)	5411000	440	36,935	1.0
Total			**3,573,937**	**100.0**

Source: CFX/CUTR Aggregation

This study uses the 2022 IMPLAN accounting tables to build the I-O model to reproduce the economic activity of the core impact area and the resto of the State. The accounting tables provide the baseline model upon which to estimate changes in the demand for goods and services generated by the Work Plan expenditures.

Economic Impact of Spending

Table 3-3 summarizes direct, indirect, induced, and total impacts in terms of output, income, and employment. The output impact is $7.1 billion and represents the total production of goods and services in the impact area produced by the total expenditures anticipated in the Work Plan. Total industry output measures the value of the production of goods and services by businesses in the local economy. Total industry output is equivalent to total business sales plus what businesses place into (or remove from) inventory. Of the total impact on output, approximately 90 percent, or $6.4 billion, occurs within the study area and the remaining impact occurs as spillover effects in the rest of the state.

Table 3-3: Total Impacts by Type

Impact Type	Output ($,million)	Labor Income ($,million)	Value Added ($,million)	Average Annual Employment[†]
Direct	3,574	1,380	1,920	4,034
Indirect	1,736	485	863	1,331
Induced	1,809	536	1,053	1,791
Total	*7,119*	*2,401*	*3,836*	*7,157*

[†]*Full Time Equivalent, estimated using 5-year average expenditures*

The total impact on value added (or GDP) is $3.8 billion with about $3.5 billion occurring within the study area and about $350.4 million occurring as spillover effects in the rest of the State. Value added measures the value of gross profits and is a measure of wealth created by the Work Plan. The Work

Plan expenditure also generates wages and other income of approximately $2.2 billion within the study area and $350.4 million in the rest of the state for a total impact of $2.4 billion. Figure 3-3 shows the impact by fiscal year, following the investment schedule of the Work Plan.

	FY24	FY25	FY26	FY27	FY28
■ Labor Income	381	470	466	534	549
■ Value Added	609	740	743	857	886
■ Output	1,127	1,364	1,380	1,598	1,650
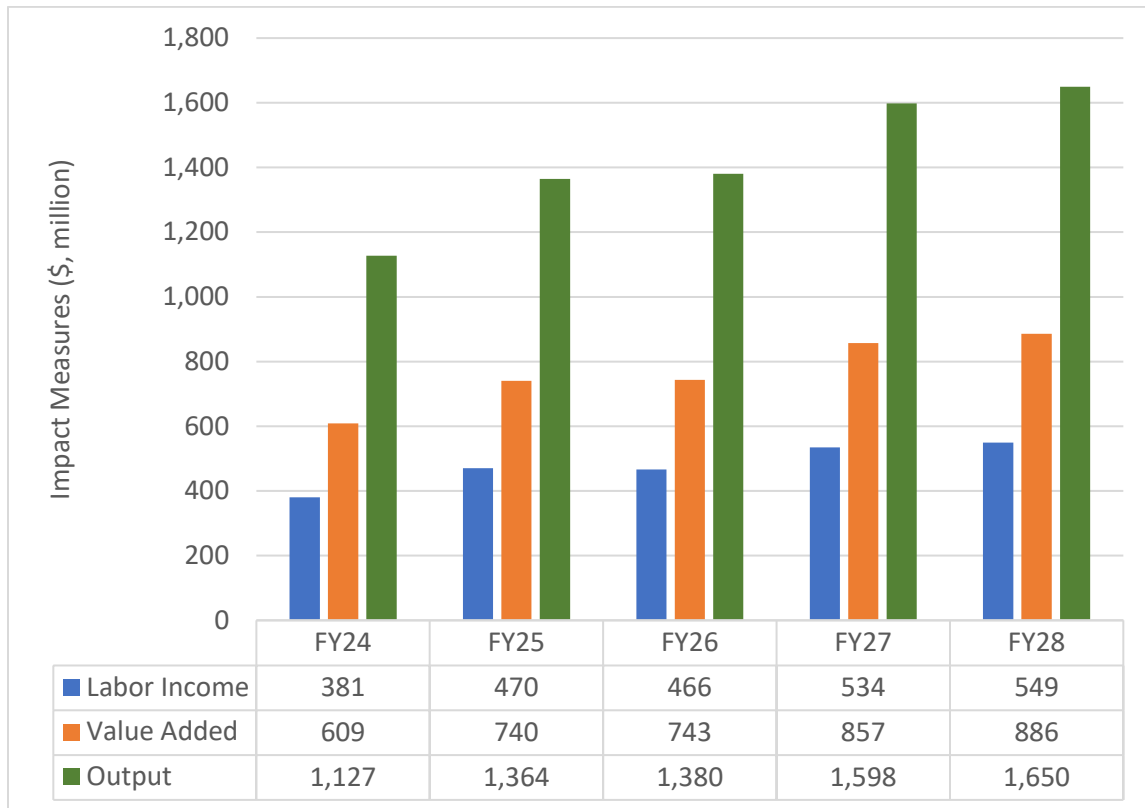
Figure 3-3: Work Plan Impact by Fiscal Year

3.1.2 Employment Impact by Industry and Occupation

The Greater Orlando area is diversifying its economy with a stronger emphasis on biotechnology and life sciences, research, and high-tech industries, in addition to a strong tourism industry. Over the last three years, employment in five counties increased by 3.8 percent overall compared to 2.9 percent statewide, with significant growth concentrated in the Management of Companies and Enterprises (7.3%), Professional, Scientific and Technical Services (4.6%), and Professional Business Services sectors (4.3%). Research conducted on the relationship between jobs and economic growth suggests that highly skilled jobs help generate and support a large number of unskilled jobs [5]. By providing safe and efficient connection throughout the region, the Work Plan strategic transportation infrastructure investments can support quickly growing industry sectors attracting high-wage, highly skilled workers and residents.

As detailed in Table 3-3, the Work Plan will support approximately 7,157 jobs, 87.9 percent (6,674) of which are within the study area and the remaining 7.2 percent (483) throughout the rest of the state.

Figure 3-4 shows a breakdown of job impacts by major industry group. The impact on jobs depends on the mix of project investment included in the Work Plan. The employment impact is mostly concentrated in construction (45.2%) and professional and business services (14.0%), with indirect and induced effects on several relevant industry sectors, such as business and administrative support

services (6.5%), transportation and warehousing (3.9%), real estate and insurance (3.5%), and accommodation and food services (3.4%).
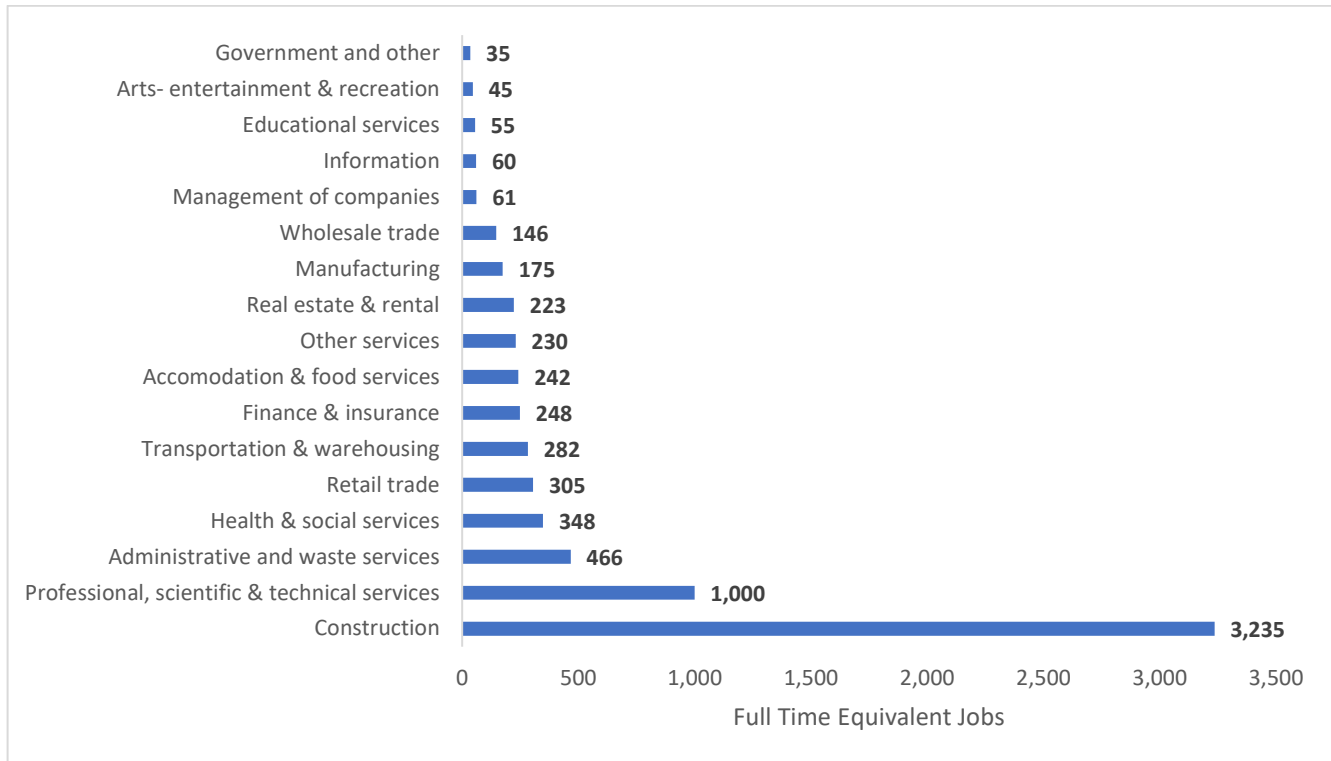
Figure 3-4: Work Plan Employment Impact by Industry

3.1.3 Impacts on State and Local Taxes

Table 3-4 summarizes the impact of the Work Plan on local and state tax revenues. The largest impact of $113.0 million comes from sales tax revenues collected in the impact area. The collection of $64.8 million in property taxes constitutes about 30.3 percent of the total government revenue impacts. Corporate taxes contribute approximately $10.2 million to revenues.

Table 3-4: Local and State Fiscal Impact (thousands of dollars)

Revenue Source	Total Impact ($, million)
Sales Tax	113.0
Property Tax	64.8
Motor Vehicle Tax	2.3
Corporate Profit Taxes	10.2
Other Taxes*	23.6
Total	*213.8*

* Fines and fees (non-tax)

Chapter 4
Travel Improvement Impacts

The 2022 CFX Customer Survey revealed that 90 percent of the CFX users prefer to use the expressways to save time and about 85 percent use the system because is less congested [6]. The Work Plan investments directed at improving the existing system or adding new capacity could produce substantial benefits to the region and its travelers [6].

According to the U.S. Census, the five counties of Brevard, Lake, Orange, Osceola and Seminole counties are home to 3.2 million residents or about 15.2 percent of the State's population [7]. During 2019-2021, the population in these counties grew by approximately 4.3 percent, compared to 2.1 percent for the state of Florida. Increased economic and population growth results in additional traffic growth and pressure on the region's transportation network. According to the Texas Transportation Institute *2021 Urban Mobility Report*, the Orlando urban area ranks among the most congested areas in the U.S., with each peak period traveler annually wasting about 61 hours in traffic and 25 gallons of fuel due to congestion delays, costing the average commuter about $1,261 dollar per year [8].[5]

This section of the report describes the approach to estimate benefits to highway users as Work Plan projects are built and put into operation. These benefits phase in based on the project construction schedule reported in the Work Plan. Travel improvements that directly affect user travel times, safety, and reductions in emissions are considered benefits that do not produce a flow of money into the economy. Other improvements that produce out-of-pocket cost savings to individuals and businesses are assumed to produce indirect and induced impacts on the local area. These are discussed at the end of this section.

Direct User Benefits

The total value of travel benefits depends on the changes in travel conditions brought about by the Work Plan and by the projected changes in the baseline traffic patterns of the region. To estimate changes in travel conditions, CFX's traffic engineers run a travel demand model for a build versus no-build alternative.

Table 4-1 summarizes these results and reports estimates in travel conditions based on annual average figures for the 2025-2045 forecast period. Overall, the table shows that the Work Plan is expected to reduce travel times occurring during congestion periods, reduce emissions, and improve safety.

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[5] This study uses 2019 data from the TTI Urban Mobility Report because of the temporary and skewing impact the COVID-19 pandemic had on travel during 2020.

Table 4-1: Forecasted Travel Improvement Changes 2035 - 2045

Travel Changes	Without Work Plan	With Work Plan	Change	Change (%)
Vehicle miles of travel (million)	31,764	32,261	497	1.6%
Vehicle hours of travel (million)	1,261	1,216	-45	-3.6%
Crashes				
Fatalities	388	385	-3	-0.8%
Injuries	24,164	23,994	-170	-0.7%
Property damage only	58,389	57,987	-402	-0.7%
Excess Fuel Consumption (gallons, million)				
Private Vehicles	593	572	-21	-3.6%
Commercial Vehicles	141	136	-5	-3.6%
Emissions (metric tons)				
Atmospheric Carbon Dioxide (CO2)	19,075,322	18,913,727	-161,596	-0.8%
Nitrous Oxide (N2O)	415.5	410.5	-4.9	-1.2%
Methane (CH4)	399.0	396.5	-2.5	-0.6%
Particulate Matter (PM2.5)	162.6	161.3	-1.3	-0.8%
Sulfur Dioxide (SO2)	92.1	91.3	-0.8	-0.9%

Source: CUTR calculations based on Authority traffic engineers' forecasts

All figures represent annual averages for 2035-2045 conditions

Next, these changes in travel conditions are translated into quantifiable user benefits. The benefits are assumed to occur yearly after the construction phase, under the assumption that travel occurs for 364 days. Appendix C describes in more detail the formula used to estimate user benefits and the original data sources.

4.1.1 Travel Time Savings

The value of travel time savings is equal to the opportunity cost of time spent in a motor vehicle for work or non-work related purposes; time that could be spent on other activities, such as leisure, family time, or more work. In this context, the Work Plan benefits CFX users by reducing average travel time per trip. This study considers the cost associated with travel time spent commuting and for other purposes. It also estimates travel time savings associated with commercial travel. The value of travel time savings is the product of the following:

- Changes in vehicle hour of travel (VHT)
- Vehicle occupancy rate
- Value of time, measured in dollars per hour, by trip purpose
- Percent of travel by trip purpose and mode

Travel time savings for non-work purposes are valued at 50 percent of the prevailing average wage rate. Travel time savings for commuting purposes are valued at 100 percent of the prevailing average wage rate. This evaluation is consistent with recommendations by the U.S. Department of Transportation [9]. The 2022 prevailing average wage rate for the impact area is provided by the current Bureau of Labor Statistics and is equal to $27.2 per hour [10]. This study uses the 2022 National Household Travel Survey to estimate the percent of travel for work and personal purposes

[11]. These percentages are used to weigh the total value of travel time savings. Table C-1 in Appendix C reports the results of this estimation.

4.1.2 Health and Safety

Changes in health and safety costs associated with crashes represent another relevant component of the benefits associated with travel improvements. These include monetary costs, such as property and personal injury damages caused by collisions and cost avoidance activities, as well as nonmonetary costs, such as pain and loss of productivity.

A considerable number of the state's motor vehicle accidents occur in the five-county study area, accounting for a significant share of the state's injuries and fatalities. Between 2019 and 2022, an average of 93,255 motor vehicle crashes were recorded, amounting to approximately 13.0 percent of the total crashes in the state. Of these crashes, about 29.2 percent (27,198) reported some form of injury, representing 16.5 percent of the total injury crashes for the state (164,785). Crashes with fatalities represent about one-half percent of the total accidents 434 fatalities, accounting for 13.4 percent of the fatalities in the state (3,240).

Table 4-2: Accidents by Severity Type

Crash Category	5-County Study Area	State	Percent of State (%)
Fatal	434	3,240	13.4
Injury*	27,198	164,785	16.5
Property damage only	65,623	551,075	11.9
Total	**93,255**	**719,100**	**13.0**

Source: Source: S4 Analytics; 2019, 2021, and 2022 averages

*Includes total possible, incapacitating, non-incapacitating injuries

This study estimates the change in comprehensive health and safety costs associated with changes in the number of vehicle crashes resulting from the Work Plan. CFX traffic engineers travel forecasts show that the Work Plan system improvements and expansion will result in an increased use of CFX facilities away from arterials and other less safe roads, reducing exposure to crashes. Historically, CFX facilities are characterized by lower crash rates compared to other facilities, such arterials or unrestricted roads. This study estimates the total change in accident cost as the product of three values:

- Change in VMT by facility type estimated by the travel demand forecasting model
- Accident rates (in million per VMT) by facility type and severity type
- Cost of accident by severity type

Crash rates are positively related to traffic density, vehicle speeds, and roadway characteristics. For example, Kockelman [12] reports a nonlinear positive relationship between crash rates and vehicle speeds. Wang and Kockelman [13] find that crash rates vary according to vehicle type with light-duty vehicles (minivans, pickups, and sport utility vehicles) being associated with higher crash rates.

Litman [14, 15] provides empirical evidence that crashes increase with annual vehicle mileage and that mileage reduction reduces crashes and crash costs.

This study uses estimates in accident rates, measured in crashes per million VMT, from historical traffic accident data covering the years 2019,2021, and 2022 provided by the Florida Department of Transportation Signal Four Analytics.[6] Crash unit cost estimates come from Table A-1 Table A-2 of the USDOT Benefit-Cost Guidance for Discretionary Grant Programs, adjusted to reflect 2022 dollar amounts [16]. Economic costs include loss of human capital, market productivity, household productivity, medical care, property damage, legal costs, and travel delay. Table C-2 in Appendix C reports the results of the accident cost savings estimation.

4.1.3 Pollution Emission Costs

Air pollution costs are costs associated with emissions produced by motor vehicle use. Motor vehicles produce various harmful emissions that have a negative effect at local and global levels. Exhaust air emissions cause damage to human health, visibility, materials, agriculture, and forests [15, 17]. This study considers carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), particulate matter ($PM_{2.5}$), and sulfur dioxide (SO_2) as major sources of motor vehicle pollutants having major repercussions on the health and livability of residents. The cost of pollution to the study area residents is the product of the following values:

- Changes in VMT as estimated by the travel demand forecasting model
- Changes in excess fuel consumption under congested travel
- Emission rates, measured in US metric tons per mile and per gallon of fuel by fuel type
- Emission costs, measured in $/metric ton

Emission rates are produced by a 2035-2045 run of the Environmental Protection Agency (EPA) Motor Vehicle Emission Simulator (MOVES4) model reflecting future conditions for the five counties of Brevard, Lake, Orange, Osceola and Seminole.[7]

Pollution emission costs are measured in damages related to health and visibility impacts, and physical impacts on the environment. Emission costs are measured in $ per metric ton and account for damages related to health and visibility impacts and physical impacts on the environment. This study adopts the societal cost estimates produced by the U.S. Environmental Agency attributable to a ton of carbon dioxide (CO_2), Methane (CH_4), and nitrous oxide (N_2O). Estimates of societal costs associated with particulate matter ($PM_{2.5}$) and Sulfur Dioxide (SO_2) come from Fann et al. (Fig. 2, pp. 145) [18]. EPA cost estimates consider the long-term damage costs because of climate change, changes in net agricultural productivity, human health, property damages from increased flood risk, and changes in energy system costs, such as reduced costs for heating and increased costs for air conditioning. Table C-4 in Appendix C reports the results of emission cost estimation.

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[6] https://www.flhsmv.gov/traffic-crash-reports/crash-dashboard/
[7] https://www.epa.gov/moves

4.1.4 Excess Fuel Consumption

The total cost of excess fuel consumption is equal to the total annual gallons of excess fuel consumed multiplied by the cost of fuel. Changes in fuel consumption account for vehicle fuel efficiency under congested conditions. This study uses the average gasoline (for all formulations) pre-tax price for sale to end users produced by the U.S. Energy Information Administration (EIA) [19].

4.1.5 Direct User Benefits Estimates

Table 4-3 reports the results of the direct user benefit analysis, valued at about $1.6 billion per year. The results indicate that most of the benefits accrue due to travel time ($1.4 billion/year), followed by reductions in accident and excess fuel consumption costs. These savings are likely to increase when approaching the 2045 forecast design year. Travel time savings measure the value of time that is lost due to congestion and that the Work Plan travel improvements help recoup; time that households can dedicate to other uses, such as leisure or personal time.

Table 4-3: Direct User Benefits

Cost Savings Category	($,Million/year)
Travel Time	
To Households	1,209.3
To Businesses	177.0
Fuel Costs	
To Households	78.9
To Businesses	24.7
Accident Costs	106.1
Pollutant Emissions	18.7
Total	**1,614.7**

Businesses will also benefit from the network improvements, with travel time savings of about $102 million annually. Businesses might be able to convert these savings into additional sales, resulting in increased productivity. This study does not capture these benefits for the reasons explained in the last section of Chapter 2 in this report.

It is relevant to differentiate between the monetary impacts of Chapter 3, which are defined as economic impacts, versus the monetary values estimated in this section. Benefits associated with reductions in accidents, decreased pollutant emissions, and time spent on travel (which could be dedicated to other activities) do not directly affect the flow of money into the local economy. That is, they do not directly increase business sales. These benefits are relevant for project evaluation purposes, when comparing the cost of investment versus potential benefits produced.

On the other hand, savings in out-of-pocket costs, such as fuel and out-of-pocket medical expenses, have impacts that spill over to the rest of the local economy.

Household Cost Savings

Gasoline and out-of-pocket medical expense savings due to reduced travel times and improved travel conditions and accident reductions are equivalent to change in personal disposable income toward

other goods and services. The reallocation of this consumer spending across all sectors within the impact area is proportionate to the baseline consumer spending on these categories of goods and services. This approach recognizes that baseline consumer spending depends on household income levels. It assumes that household out-of-pocket medical costs amount to 10 percent of accident costs [20]. This impact is net of the reduction in gasoline sales resulting from the gallons saved due to congestion improvements discussed in this section.

Under the current travel forecasting scenario, improvements of the current system would save each household $77 per year in fuel and crash-related medical costs. These out-of-pocket cost reductions represent money saved to use on other household expenditures. These savings, combined with the annual travel time benefits, provide these households with some gains in purchasing power.

Table 4-4 reports an estimated additional $110.8 million in annual total output and $64.7 million in additional GDP with the support of 548 jobs per year. These estimates represent the additional indirect and induced effect generated by increased household disposable income.

Table 4-4: Household Cost Savings Indirect and Induced Impacts

Impact Type	Output ($,million)	Labor Income ($,million)	Value Added ($,million)	Employment
Induced Effect	110.8	32.6	64.7	548

Chapter 5
Conclusions

The economic impact of the *Five-Year Work Plan* is substantial in its contribution to economic growth in the five counties of Brevard, Lake, Orange, Osceola and Seminole, with spillover effects throughout the state of Florida. The total economic impact measured $7.1 billion in total output (gross business sales), $3.8 billion in local gross domestic product, and support 7,157 jobs.

In addition to the impact generated by infrastructure investment spending, the construction and implementation of the strategic projects identified by the Work Plan can produce substantial benefits in terms of travel time reductions, increased safety, and a reduction in harmful emissions. Under the current travel forecasting scenario, improvements and expansions to the current system would save each household on average 69 hours in travel annually, or $1,044 per year. Each households would also save $77 in out-of-pocket costs due to reduced medical expenses because of fewer accidents. Savings on fuel and vehicle medical costs represent money saved to use on other household expenditures.

Businesses would also benefit from improved travel conditions. The conservative estimates presented in Chapter 4 only considered the travel time savings related to freight movement across the region. This study did not consider the long-term economic implications of increased accessibility to other markets, or potential increases in business productivity from improved travel times. Tailoring the approach to estimating the impact of business productivity improvements would require detailed freight traffic data at a highly disaggregated level. This more comprehensive effort would be beneficial to assess the contribution of a long-term plan, such as the 2045 Master Plan.

Appendix A
Choice of Input-Output Model

Input-output (I-O) modeling, originally introduced by Leontief [21], describes commodity flows from producers to intermediate and final consumers. It depicts an economic system as a set of tables where the total industry purchases of commodities, services, employment compensation, value added, and imports are equal to the value of the commodities produced. Purchases for final use (final demand) drive the model. Industries producing goods and services for final demand purchase goods and services from other producers. These other producers, in turn, purchase goods and services. This buying of goods and services (indirect purchases) continues until leakages from the region (imports and value added) stop the cycle. These indirect and induced effects (the effects of household spending) can be mathematically derived. The derivation is called the Leontief inverse. The resulting sets of multipliers describe the change of output for each regional industry caused by a one dollar change in final demand for any given industry.

To conduct economic impact analysis, I-O tables can be acquired by the Bureau of Economic Analysis [22] or by the IMPLAN Group, LLC[23]. IMPLAN is a web-based software that allows the user to develop local level input-output models to assess the economic impact of new firms moving into an area, construction expenditure impacts, firm relocation, and many more activities. The IMPLAN model accounts closely follow the accounting conventions used in the "Input-Output Study of the U.S. Economy" by the Bureau of Economic Analysis and the rectangular format recommended by the United Nations.

The Work Plan economic impact analysis of this report makes use of the IMPLAN model. The reason is that IMPLAN presents a high degree of flexibility in both geographic coverage and model formulation. IMPLAN databases combined with the IMPLAN professional software system allow the user to develop local level input-output models that can estimate the economic impact of new firms moving into an area, professional sports teams, recreation and tourism, and many other activities. The data and software also generate a complete set of social accounting matrices for advanced computable general equilibrium model and tax analysis.

IMPLAN databases are available at the county level and cover several industry sectors. This study uses the 2022 IMPLAN County Data files that report economic data for 546 industry sectors.
IMPLAN provides a means to assess economic impacts caused by changes made to the accounting expenditure matrix for the region analyzed. By entering a change, say, in expenditure in one industry sector, the analyst can see how this affects the overall economic structure of the region. The effects are measured by the same metric used to express the elements composing the original database matrix. The changes are measured in terms of the following:

- Industry Output
- Employment
- Value Added
- Final Demands

Industry output is a single number in dollars, or millions of dollars, for each industry present in the region. The dollars represent the value of an industry's production. Employment is listed as a single number of jobs for each industry. Data are usually derived from the ES202 employment security data and supplemented by county business patterns and REIS data. It includes both temporary and permanent jobs. For reporting purposes, these employment estimates are converted to full time equivalent (FTE) jobs using a conversion calculation table provided by IMPLAN.[8]

Value added is a subset of total output and is equal to total output minus the cost of material and labor. It represents a measure of the contribution of production factors and is often used as a measure of economic activity (also defined as GDP). There are four sub-components of value added:

1. Employee Compensation
2. Proprietary Income
3. Other Property Type Income
4. Indirect Business Taxes

Employee compensation describes the total payroll costs (including benefits) of each industry in the region. It includes the wages and salaries of workers paid by employers, as well as benefits such as health insurance and life insurance. Proprietary income consists of payments received by self-employed individuals as income. Other types of income include payments for rents, royalties, and dividends. Indirect business taxes consist of excise taxes, property taxes, fees, licenses, and taxes paid by businesses.

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[8] https://support.implan.com/hc/en-us/articles/115002782053-IMPLAN-to-FTE-Conversions .

Appendix B
Tables of Direct, Indirect, and Induced Multipliers

Chapter 2 of this report describes how the Work Plan project expenditures are processed and inputted in IMPLAN. Analysts categorize expenditures and then assign them to specific industry sectors. Running the model then produces a set of multipliers to estimate direct, indirect, and induced impacts. The three tables below report output, value added, and employment multipliers, respectively. Multipliers are aggregated at the North American Industry Classification System (NAICS) two-digit level with the corresponding IMPLAN industry sector.

Table B-1 Total Output Multipliers

NAICS Industry	Description	Direct Effects	Indirect Effects	Induced Effects	Total Effects
11	Ag, Forestry, Fishing, Hunting	1.00	0.17	0.374	1.54
21	Mining	1.00	0.72	0.286	2.00
22	Utilities	1.00	0.42	0.165	1.59
23	Construction	1.00	0.33	0.409	1.73
31-33	Manufacturing	1.00	0.38	0.308	1.69
42	Wholesale Trade	1.00	0.52	0.384	1.90
44-45	Retail Trade	1.00	0.42	0.418	1.84
48-49	Transportation & Warehousing	1.00	0.42	0.386	1.81
51	Information	1.00	0.66	0.350	2.01
52	Finance and Insurance	1.00	0.68	0.428	2.11
53	Real Estate and Rental	1.00	0.37	0.148	1.52
54	Professional, Scientific and Technical Services	1.00	0.47	0.586	2.05
56	Management of Companies	1.00	0.45	0.645	2.10
56	Administrative and Support Services	1.00	0.60	0.536	2.13
61	Education	1.00	0.36	0.669	2.03
62	Health & Social Services	1.00	0.40	0.609	2.01
71	Arts, Entertainment & Recreation	1.00	0.30	0.490	1.79
72	Accommodations & Food Services	1.00	0.41	0.419	1.83
81	Other Services	1.00	0.35	0.604	1.96
92	Government Enterprises	1.00	0.39	0.417	1.80

Table B-2 Total Value Added Multipliers

NAICS Industry	Description	Direct Effects	Indirect Effects	Induced Effects	Total Effects
11	Ag, Forestry, Fishing, Hunting	0.71	0.09	0.213	1.02
21	Mining	0.14	0.38	0.163	0.69
22	Utilities	0.52	0.22	0.094	0.84
23	Construction	0.53	0.18	0.233	0.95
31-33	Manufacturing	0.34	0.20	0.176	0.72
42	Wholesale Trade	0.54	0.28	0.219	1.05
44-45	Retail Trade	0.63	0.24	0.239	1.11
48-49	Transportation & Warehousing	0.50	0.23	0.220	0.95
51	Information	0.42	0.34	0.200	0.96
52	Finance and Insurance	0.36	0.32	0.244	0.93
53	Real Estate and Rental	0.68	0.20	0.085	0.96
54	Professional, Scientific and Technical Services	0.60	0.25	0.335	1.19
56	Management of Companies	0.61	0.25	0.368	1.23
56	Administrative and Support Services	0.48	0.32	0.306	1.10
61	Education	0.67	0.20	0.382	1.25
62	Health & Social Services	0.62	0.22	0.347	1.18
71	Arts, Entertainment & Recreation	0.72	0.17	0.280	1.17
72	Accommodations & Food Services	0.57	0.23	0.239	1.04
81	Other Services	0.63	0.19	0.345	1.17
92	Government Enterprises	0.59	0.20	0.238	1.03

Table B-3 Total Employment Multipliers*

NAICS Industry	Description	Direct Effects	Indirect Effects	Induced Effects	Total Effects
11	Ag, Forestry, Fishing, Hunting	8.1	0.72	2.08	10.9
21	Mining	1.81	3.33	1.59	6.73
22	Utilities	0.69	1.28	0.92	2.89
23	Construction	5.77	1.62	2.27	9.66
31-33	Manufacturing	2.15	1.64	1.71	5.5
42	Wholesale Trade	2.35	2.55	2.14	7.04
44-45	Retail Trade	8.1	2.01	2.32	12.43
48-49	Transportation & Warehousing	6.76	2.3	2.15	11.21
51	Information	1.75	2.96	1.94	6.65
52	Finance and Insurance	4.33	3.17	2.38	9.88
53	Real Estate and Rental	2.3	1.8	0.82	4.92
54	Professional, Scientific and Technical Services	5.26	2.33	3.26	10.85
56	Management of Companies	4.15	2.1	3.58	9.83
56	Administrative and Support Services	7.76	3.1	2.98	13.84
61	Education	12.47	1.55	3.72	17.74
62	Health & Social Services	7.62	2	3.38	13
71	Arts, Entertainment & Recreation	11.17	1.74	2.72	15.63
72	Accommodations & Food Services	9.25	1.88	2.33	13.46
81	Other Services	11.77	1.62	3.36	16.75
92	Government Enterprises	3.35	1.74	2.32	7.41

per million $ of direct expenditures

Appendix C
Travel Improvement Impacts, Assumptions, and Data Sources

Travel Time Savings

The value of time measures the opportunity cost of time spent on a motor vehicle for work or non-work related purposes; time that could be spent on other activities, such as leisure or other more work. The value of travel time savings is obtained by multiplying the total annual travel time savings (person hours travelled) by the value of time ($/hour) by travel purpose. Table C-1 details the calculations applied to estimate travel time savings.

Table C-1 Estimation of Travel Time Savings

Category	Travel Time Savings (Vehicle Hours Traveled) Daily	Annual	Vehicle Occupancy	(Person Hours Traveled) Daily	Annual	Value of Time[†††] ($/hour)	Travel Time Savings ($) Daily	Annual
Private								
Personal[†]	95,884	34,901,805	2.0	195,604	71,199,682	13.6	2,655,563	966,624,833
Commuting[†]	19,639	7,148,562	1.3	24,549	8,935,703	27.2	666,557	242,626,715
Total Private[‡] (A)	115,523	42,050,367		220,152	80,135,385		3,322,120	1,209,251,548
Commercial[‡] (B)	7,496	2,728,549	1.0	7,496	2,728,549	64.9	486,188	176,972,294
Total (A+B)	**123,019**	**44,778,916**		**227,648**	**82,863,934**		**3,808,307**	**1,386,223,841**

† Split based on the 2022 National Household Travel Survey (17.1% work; 83.9% other)

‡Split based on the 2022 Florida Traffic Information database using annual VMT for the study area split by vehicle type (91.7% private motorvehicle;6.1% commercial;2.2% other)

†††Value of time based on travel purpose (50% of prevailing wage rate for personal; 100% of prevailing wage for commuting).

Value of commercial travel time is from 2021 TTI Urban Mobility Scorecard.

Wage rates for Orlando-Kissimmee were obtained from the Bureau of Labor Statistics (https://www.bls.gov/oes/current/oessrcma.htm)

Vehile hours travelled reflect 2035 to 2045 modeled traffic conditions

- Change in delay is measured as the change in vehicle of hours of travel under congestion and is obtained from the Expressway Authority traffic engineers by modeling changes in traffic levels with vs. without the Work Plan projects.
- Average vehicle occupancy is taken from the 2022 National Household Travel Survey person trip file, which reports the number of travel day person trips by trip purpose. These data are available online using the Table Designer feature at https://nhts.ornl.gov/
- The private versus commercial travel split data are from the 2022 Florida Traffic Information Database, available from the Florida Department of Transportation at https://www.fdot.gov/statistics/trafficinfo/default.shtm
- The average prevailing wage rate for the five counties is obtained from the Bureau of Labor Statistics at https://www.bls.gov/oes/current/oessrcma.htm

Accident Cost Savings

Accident costs savings are estimated as the net change (Δ) in health and safety costs associated with vehicle crashes. To estimate these changes, the total social cost per accident by severity type is multiplied by the change number of crashes in each severity class; its product summed over all severity classes *i* and facility type *k*

$$Total\ Health\ and\ Safety\ Costs = \sum Total\ Crash\ Cost_i\ x\ \Delta in\ Number\ of\ Crashes_{ik}$$

Table C-2 displays the calculations applied to estimate changes in accident cost savings. Changes in crashes are estimated by computing the difference between the number of crashes with the Work Plan and the number of crashes without the Work Plan. The estimates rely on crash exposure rates by facility type (measured in crashes per million VMT) derived from historical crash data from Signal Four Analytics [24].

Table C-2 Accident Cost Savings

Crash Type	Accidents[†] Without Work Plan	Accidents[†] With Work Plan	Difference	Cost per accident ($)[‡]	Cost Savings ($)	Share of Total	Medical Costs[†††]
Fatal	388	385	-3	14,819,396	44,458,188	41.9%	
Injury	24,164	23,994	-170	349,619	59,435,242	56.0%	
Property damage only	58,389	57,987	-402	5,452	2,191,764	2.1%	
Total	*82,941*	*82,366*	*-575*	*15,174,467*	*106,085,193*		*10,608,519*

†CUTR calculations

‡USDOT B-C Analysis Guidance, Table A-1, pp. 37; property damage value from Table A-2 (adjusted to current $)

†††CUTR calculations based on estimates from Blincoe et al. (2015), adjusted to current $

††† Assumes 10% of total cost of injury crashes

Crash Costs

Crash cost estimates come from Table A-1 and Table A-2 of the USDOT Benefit-Cost Guidance for Discretionary Grant Programs, adjusted to reflect 2022 dollar amounts [16]. The tables provide recommended monetized values for fatalities and injuries by crash type following departmental guidelines on estimating the value of a statistical life (VSL) [25]. Economic costs consist of loss of human capital, market productivity, household productivity, medical care, property damage, legal costs, and travel delay and include the "willingness to pay" or intangible costs to avoid these events. The last column of Table C-2 reports the estimates of reduced out-of-pocket costs to households resulting from the safety improvements (i.e., reduced crash exposure) and reflect estimates of direct medical costs resulting from non-fatal crashes. It assumes that household out-of-pocket medical costs amount to 10 percent of accident costs [13]. These estimates are subsequently entered into the I-O model as household cost savings to estimate indirect and induced impacts to the study area.

Changes in Pollution Emission Costs

Table C-4 details the calculations of savings in pollution emissions. For each mode *i* and each pollutant *k*, the total pollution cost *PC* is equal to:

$$\Delta\, PC_{ik} = \sum \left(\frac{grams_{ik}}{gallon}\right)(\Delta\, Gallons\ of\ Fuel_i)\left(\frac{\$}{gram_k}\right) + \sum \left(\frac{grams_{ik}}{mile}\right)(\Delta\, VMT_i)\left(\frac{\$}{gram_k}\right)$$

The first part of the formula estimates the change (Δ) in pollutions generated by excess fuel consumption related to time spent in congested conditions (see fuel cost savings), while the second part of the formula estimates the additional emissions generated by increased VMT from the transportation improvements.

Table C-4 Changes in Pollution Emission Costs

Pollutant	Annual Changes in Emissions (metric tons)†			Reduction in Costs‡	
	VMT Based	VHT Based	Total	($/metric ton)	($/year)
Atmospheric Carbon Dioxide (CO2)	126,160	-287,755	-161,596	61.7	-17,766,942
Nitrous Oxide (N2O)	1.8	-6.7	-4.9	22,051	-147,732
Methane (CH4)	2.8	-5.3	-2.5	1,764.09	-9,377
Particulate Matter (PM2.5)	1.1	-2.3	-1.3	333,638	-783,358
Sulfur Dioxide (SO2)	0.6	-1.4	-0.8	27,803	-38,964
Total	**126,166**	**-287,771**	**-161,605**		**-18,746,372**

†CUTR calculations based on EPA MOVES4 emission rates for the 5-county study area

‡CUTR calculations based on unit cost estimates from EPA (2017) and Fann et al (2012), adjusted to current $

Emission Costs

Emission costs are measured in dollars per metric ton and account for damages related to health and visibility impacts and physical impacts on the environment. This study adopts the societal cost estimates produced by the U.S. Environmental Agency attributable to a ton of carbon dioxide (CO_2), Methane (CH_4), and nitrous oxide (N_2O). Estimates of societal costs associated with particulate matter ($PM_{2.5}$) and Sulfur Dioxide (SO_2) come from Fann et al. (Fig. 2, pp. 145) [18]. EPA cost estimates consider the long-term damage costs because of climate change, changes in net agricultural productivity, human health, property damages from increased flood risk, and changes in energy system costs, such as reduced costs for heating and increased costs for air conditioning.

Fuel Cost Savings

Table C-5 summarizes the estimated changes in fuel costs. This study estimates changes in fuel costs associated with private and commercial travel. The change in excess fuel consumption is measured in total gallons saved because of Work Plan travel improvements resulting in reduced vehicle hours of travel in congested conditions. The calculation assumes Using TTI Urban Mobility Report estimates of excess fuel consumed and total vehicle delay for the Orlando-Kissimmee Metropolitan Statistical Area to estimate wasted fuel by mode per VHT [8].

Table C-5 Changes in Fuel Costs

Category	Gallons Saved† (gallons/year)	Fuel Cost†† ($/gallon)	Fuel Cost Savings ($/year)
Fuel Cost Savings			
Private Vehicles	21,076,960	3.7	78,891,060
Commercial Vehicles	5,010,540	4.9	24,651,856
Operating Cost Savings			
Total	**26,087,500**		**103,542,916**

†*CUTR calculations based on Authority traffic engineers' forecasts*

††*Energy Information Administration* https://www.eia.gov/petroleum/gasdiesel/

Impact of Household Out-of-Pocket Cost Saving Economic Impact

Gasoline and out-of-pocket medical expense savings due to reduced travel times and improved travel conditions and accident reductions are equivalent to change in personal disposable income toward other goods and services. The reallocation of this consumer spending across all sectors within the impact area is proportionate to the baseline consumer spending on these categories of goods and services. This approach recognizes that baseline consumer spending depends on household income levels. This impact is net of the reduction in gasoline sales resulting from the gallons saved due to congestion improvements discussed in this section.

The estimated $89.5 million in household out-of-pocket cost savings are allocated within the I-O model based on the household income cohort distribution. The I-O model estimates the resulting indirect and induced impacts to the study area, withs spillover effects to the rest of the state. Table C-5 Reports the results of the households' savings economic impact analysis.

Table C-6 Household Allocation of Out-of-Pocket Cost Savings

Impact Type	Output ($,million)	Labor Income ($,million)	Value Added ($,million)	Employment
Induced Effect	110.8	32.6	64.7	548

References

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