CAMBRIDGE SYSTEMATICS

Southeast Florida Road and Transit User Cost Study

2014 Update

report

prepared for

Florida Department of Transportation District Four

prepared by

Cambridge Systematics, Inc.

June 2014

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1.0 Introduction

Localized values for travel time and vehicle operating costs for the traveling public in Southeast Florida are critical to understanding and communicating the value of transportation improvements. These two components – travel time values (TTV) and vehicle operating costs (VOC) – together make up the majority of road and transit user costs (RTUC).

The Southeast Florida Road and Transit User Cost (SEFRTUC) Study researched national sources and methodologies for TTV and VOC, and localized the values to best represent conditions in Southeast Florida. The study area included Miami-Dade, Broward, Palm Beach, Martin, St. Lucie, and Indian River Counties.

This study developed travel time values that can be applied to various travel market segments, and vehicle operating costs that can be applied to various vehicle types which can be applied in the evaluation of benefits related to proposed transportation system improvements.

This report summarizes the research findings on TTV and VOC for automobile, commercial vehicle and transit travel market segments, and provides an overview of a Road and Transit User Cost Calculator Tool developed to bring this information together in one location for the application of these findings in project evaluation. The reader is referred to ten detailed project memoranda included in the Appendix which provide far greater detail on the development of these values.

All values in this report have been benchmarked to year 2010 values, using Consumer Price Index (CPI) for incomes and cost values. The User Cost Calculator Tool allows estimation of road and transit user cost of any target year later than 1980 (or 2010, for the auto and commercial VOC calculator, due to available fuel efficiency projection) by utilizing key variables such as national average/median wage, CPI, average fuel price, automobile price, vehicle fleet composition, and transit user income, etc. The calculator also provides the functionality to project key components such as wage, CPI, fuel price, and vehicle fleet composition, etc., by using historical data.

The study was first completed in year 2009. This 2014 update uses recent data and research to refresh key inputs and projections. Several new components are introduced into the study to address recent transportation planning needs:

- Managed lane user TTV,
- Freight driver TTV categorized by cargo types,
- VOC based on different fuel types, and
- Safety components of auto and truck VOC.

2.0 Travel Time Values

This section presents a set of proposed travel time values for user transportation cost analyses in Southeast Florida. The derivation of these values for a core set of travel market segments is presented. Additional travel time value estimates are provided for different vehicle class and roadway functional classifications. The findings of a survey of local drivers is discussed in Section 2.3, and the travel time values derived from the literature review presented in this section are then brought together in a proposed set of values in for use in South Florida. Details for this literature review are available in Appendix A.1. Methodologies applied for TTV calculations for auto and commercial drivers are presented in Appendix C.1.

Based on existing researches, the previous SEFRTUC study defined TTV of different travel market segments as proportions of personal income. According to a recently adopted revision[1] on travel time valuation from United States Department of Transportation (U.S.DOT), annual household income is recommended for estimation of personal trip TTVs, while hourly wage is recommended for estimation of business trip TTVs. Such changes are reflected in this update.

2.1 AUTOMOBILE AND COMMERCIAL DRIVERS

Core Travel Market Segments

A national literature review was conducted to identify prior work on determining the value of travel time to road users in highway user benefit analysis procedures. Based on the review findings, a set of travel time values for four "core" travel market segments was developed. Core travel market segments refer to travel purposes with distinct values of time that are often applied in user benefit analysis, according to the literature review. These market segments are:

1. **Commuter Travel –** Travel to and from the place of work;
2. **On-the-Clock Travel –** Travel undertaken in the conduct of a job;
3. **Personal Travel –** Local, non-work travel conducted by residents; and
4. **Personal Travel –** Visitor, non-work travel conducted by nonresidents.

The derivation of travel time values for these travel market segments is described below. Additionally, travel time values from these core travel market segments

[1] Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis

can be expanded to other travel market segments by developing a correspondence table of weights that assign the proportion of core travel market segment travel to other travel market segments. The derivation of these weights is presented in the discussion of travel time values by travel demand model trip purposes and in a separate discussion of travel values by vehicle class and functional classification.

Core Market Segment Travel Time Values

The core travel market segment values were derived by 1) obtaining a single median wage across all industries and counties in Southeast Florida; and 2) for each travel market segment, discounting the hourly wage by the appropriate factor from the previous literature review. Table 2-1 presents a median household income of $46,139 for Southeast Florida, and $44,932 for Florida, based on the 2010 U.S. Census (Census). Southeast Florida managed lane users median wage is extracted from the 2009 95 Express Survey, and inflated to 2010 dollar using CPI. Florida Single Unit Truck (SUT) and Combination Unit Truck (CUT) drivers' median wages are available from Bureau of Labor Statistics. The median wage is adjusted to gross wage using a conversion factor[2] between wage and gross wage (including all fringe benefits) released by Bureau of Labor Statistics. These income values are adjusted to Southeast Florida and Florida market in 2010 dollar value using CPI.

Table 2-1 Income by Source
2010 Dollars

	Median Annual Wage	Source
National Median Household Income	$50,380	Census
Florida Median Household Income	$44,932	Census
Southeast Florida Median Household Income	$46,139	Census
Southeast Florida Managed Lane User Median Household Income	$70,005	I-95 Managed Lane Survey
Florida Single Unit Truck Driver Median Gross Wage (with all benefits)	$38,364	Bureau of Labor Statistics
Florida Combination Unit Truck Driver Median Gross Wage (with all benefits)	$47,469	Bureau of Labor Statistics

[2] Employer Costs for Employee Compensation news release text, Bureau of Labor Statistics, 2014. Link: http://www.bls.gov/news.release/ecec.nr0.htm

Managed Lane Travel Time Values

Surveys conducted by South Florida Commuter Services have identified income levels for users of 95 Express in Miami-Dade County, which is currently being extended to the north. Phase 2 is under construction from Golden Glades Interchange in Miami-Dade County to Broward Boulevard in Broward County, and is expected to be completed and open to traffic late 2014. Phase 3 will extend the facility from Broward Boulevard to Linton Boulevard in Palm Beach County.

The Florida Department of Transportation has conducted a couple of studies to evaluate Value of Travel Time Savings (VTTS)[3] and Value of Reliability (VOR)[4]. The study indicates that per hour VTTS is valued at 49% of hourly household income while VOR is rated at around 80%-100% value of time. Accordingly, managed Lane User travel time value is reflected by the equation below:

$TTV_{(ML)} = VOT + VTTS + VOR$, where

- VOT: same method as general purpose lane users
- VTTS: Travel time savings valued as 49% of hourly household income
- VOR: Travel time reliability valued as 100% of hourly household income

Managed lane user travel time saving[5] for I-95 Managed Lane is found to be 25 minutes per hour traveled comparing with general purpose lane users combining AM and PM peak hours. Reliability is defined as the 95th – 50th range measurement of traveler's travel time. Currently, there is not specific report of reliability measurement from I-95 Managed Lane. A nominal reliability value can be applied, and should be replaced with future study findings. It should be noticed that the module calculating user values from travel time saving and reliability is designed for managed lane facility only. For application such as regional demand model, these values should remain 0.

Travel time values for users of the managed lanes are higher than for general traffic, reflecting the variable tolls they pay to achieve a specified minimum travel speed. Comparable travel time values are shown in Table 2-2 and Table 2-3.

Table 2-2 presents the conversion of the Southeast Florida and Florida annual income into TTVs by travel market segment, excluding on-the-clock travel. After converting the median household income into an hourly income, values for each

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[3] Improving Value of Travel Time Savings Estimation for More Effective Transportation Project Evaluation, 2011.

[4] Synthesis of Research on Value of Time and Value of Reliability, 2009

[5] 2012 I-95 Managed Lanes Monitoring Report, March 2013

travel market segment were obtained by applying a discount factor derived from the Census and CPI. The values also were inflated to 2010 dollars using CPI. The percent of income rate by travel market segment is derived from the American Association of State Highway and Transportation Officials (AASHTO) "red book," the *User Benefit Analysis for Highways* Manual (2003).

- Personal local travel is valued at 50 percent of the income level. That proportion is used here.
- Commute travel factors range from 60 percent for carpool drivers to 40 percent for carpool passengers. The 60 percent figure is used here.
- Personal long-distance travel is valued at 70 percent of income. Long-distance travel is interpreted here to apply to a mix of recreational-oriented visitor travel and other types of personal travel covering distances greater than those traveled by commuters. The 70 percent figure may be interpreted to imply that visitors with a limited amount of vacation time are spending a good deal of money to accomplish recreational objectives and, therefore, value their time at a higher rate compared to personal local travel, and are willing to pay more to avoid congested travel than are local residents.

The 70 percent figure quoted above may be appropriate for special studies where the number of short-term visitors is known. However, there are a large number of visitors who spend several weeks to several months in Florida as part-time residents. In this case, the value of time for these visitors should be the same as that for full-time residents. The value of time for longer-term visitors is reported below as 50 percent of the U.S. income rate. Note that Florida managed lane user incomes are derived from Southeast Florida managed lane user incomes and the median income ratio of Florida to Southeast Florida from the Census.

Table 2-2 TTV for Commuter and Personal Travel
2010 Dollars

	National Median	General Purpose		Managed Lane		Percent of Wage Rate
		SEFL	FL	SEFL	FL	
Household Income	$50,380	$46,139	$44,932	$70,005	$68,173	
Commuter	$14.53/hr	$13.31/hr	$12.96/hr	$20.19/hr	$19.67/hr	60%
Local – Personal	$12.11/hr	$11.09/hr	$10.80/hr	$16.83/hr	$16.39/hr	50%
Local – Visitor	$12.11/hr	$12.11/hr	$12.11/hr	$18.38/hr	$18.38/hr	50%

Note: Hourly household incomes are calculated by dividing the annual household income by 2,080 hours.

On-the-clock travel is valued at 100 percent of the hourly gross wage rate, and includes direct wages and all other benefits. The annual wages for on-the-clock travel shown below in Table 2-3 correspond to total compensation (including all benefits). Based on this information, the median on-the-clock trip in Southeast Florida is valued at $20.81 per hour in 2010 dollars, $20.26 for Florida. Managed

lane user on-the-clock values are derived by scaling the general purpose values with a ratio between managed lane user incomes from 95 Express Survey and Southeast Florida median income from the Census.

Table 2-3 TTV for On-the-Clock Travel
2010 Dollars

On the Clock TTV Component	General Purpose		Managed Lane	
	SEFL	FL	SEFL	FL
Median Annual Gross Wages	$43,276	$42,143	$65,661	$63,943
TTV	$20.81/hr	$20.26/hr	$31.57/hr	$30.74/hr

Other Market Segment Travel Time Values

The core TTVs shown above have been expanded to other travel market segments, which can be used in travel demand forecasting or for sketch planning analyses. Table 2-4 and Table 2-5 present TTVs by trip purposes and core market segmentations. Trip purposes listed here are consistent with SERPM 7 outputs[6]. Note that these TTVs are derived from previous study findings with different trip purposes set from SERPM 6. The correspondence to the core travel market segments is developed by estimating the percentage of each trip purpose that is commute, local, or on-the-clock travel. The percentages were derived by consensus with a group of travel demand forecasters and planners intimately familiar with the regional demand model and travel patterns in Southeast Florida. TTVs with the same segmentations for Florida market are available in the SEFRTUC Calculator. Florida market TTVs are derived from Southeast Florida market TTVs based on income ratio between the two geographic levels from the Census.

[6] Southeast Regional Planning Model 7.0 Activity-Based Model Users Guide, Apr 2013.

Table 2-4 Southeast Florida General Purpose User TTV by Trip Purpose
2010 Dollars

	Commute	Local Personal	Visitor Personal	On-the-Clock	Average (Per hour)
	$13.31	$11.09	$12.11	$20.81	
Discretionary	0%	90%	10%	0%	$11.19
Eating Out	0%	90%	10%	0%	$11.19
Escort	0%	30%	70%	0%	$11.80
Home	0%	90%	10%	0%	$11.19
Maintenance	0%	100%	0%	0%	$11.09
School	0%	100%	0%	0%	$11.09
Shop	0%	90%	10%	0%	$11.19
University	0%	95%	5%	0%	$11.09
Visiting	0%	10%	90%	0%	$12.01
Work	100%	0%	0%	0%	$13.31
Work-Based	0%	5%	0%	95%	$20.32
Work Related	0%	0%	0%	100%	$20.81

Table 2-5 Southeast Florida Managed Lane User TTV by Trip Purpose
2010 Dollars

	Commute	Local Personal	Visitor Personal	On-the-Clock	Average (Per hour)
	$20.19	$16.83	$18.38	$31.57	
Discretionary	0%	90%	10%	0%	$16.98
Eating Out	0%	90%	10%	0%	$16.98
Escort	0%	30%	70%	0%	$17.91
Home	0%	90%	10%	0%	$16.98
Maintenance	0%	100%	0%	0%	$16.83
School	0%	100%	0%	0%	$16.83
Shop	0%	90%	10%	0%	$16.98
University	0%	100%	0%	0%	$16.83
Visiting	0%	10%	90%	0%	$18.22
Work	100%	0%	0%	0%	$20.19
Work-Based	0%	5%	0%	95%	$30.83
Work Related	0%	0%	0%	100%	$31.57

To compute these values, the average values by trip purpose shown in Table 2-4 and Table 2-5 were weighted by the proportion of travel by trip purpose, which occurs in each time period (Table 2-6 and Table 2-7). The proportions of travel by each trip purpose and time period are derived from previous study and the *Southeast Florida Regional Travel Characteristics Study (2000)*.

Table 2-6 Southeast Florida General Purpose User TTV by Time Period
2010 Dollars

	6:00 a.m.-9:00 a.m.	9:00 a.m.-3:00 p.m.	3:00 p.m.-7:00 p.m.	7:00 p.m.-10:00 p.m.	10:00 p.m.-6:00 a.m.	TTV/Hour
Discretionary	8%	8%	8%	8%	8%	$11.19
Eating Out	5%	10%	5%	10%	5%	$11.19
Escort	3%	3%	3%	3%	3%	$11.80
Home	5%	10%	20%	20%	35%	$11.19
Maintenance	5%	5%	5%	3%	3%	$11.09
School	10%	3%	5%	3%	3%	$11.09
Shop	3%	16%	13%	13%	3%	$11.19
University	10%	5%	5%	5%	5%	$11.09
Visiting	5%	15%	15%	10%	5%	$12.01
Work	30%	5%	15%	5%	10%	$13.31
Work-Based	8%	10%	3%	10%	10%	$20.32
Work Related	8%	10%	3%	10%	10%	$20.81
Average	$13.36	$13.30	$12.20	$13.26	$13.33	

Table 2-7 Southeast Florida Managed Lane User TTV by Time Period
2010 Dollars

	6:00 a.m.-9:00 a.m.	9:00 a.m.-3:00 p.m.	3:00 p.m.-7:00 p.m.	7:00 p.m.-10:00 p.m.	10:00 p.m.-6:00 a.m.	TTV/Hour
Discretionary	8%	8%	8%	8%	8%	$16.98
Eating Out	5%	10%	5%	10%	5%	$16.98
Escort	3%	3%	3%	3%	3%	$17.91
Home	5%	10%	20%	20%	35%	$16.98
Maintenance	5%	5%	5%	3%	3%	$16.83
School	10%	3%	5%	3%	3%	$16.83
Shop	3%	16%	13%	13%	3%	$16.98
University	10%	5%	5%	5%	5%	$16.83
Visiting	5%	15%	15%	10%	5%	$18.22
Work	30%	5%	15%	5%	10%	$20.19
Work-Based	8%	10%	3%	10%	10%	$30.83
Work Related	8%	10%	3%	10%	10%	$31.57
Average	$20.27	$20.18	$18.51	$20.12	$20.22	

Single- (SUTs) and combination-unit trucks (CUTs) are typically not used for personal use. Therefore their travel time should be valued at 100 percent gross wage level ($18.94 and $23.43). Light-duty trucks are used both for personal and commercial use. In Table 2-8, per-person values and per-vehicle values by core travel market segment and vehicle type are shown. These are the values that

would be used for benefit calculations, in which vehicle hours, instead of person hours, are the unit of measurement calculations. A discounted inventory value is added to the single-unit and combination-unit truck values. These values are calculated from the 2002 Commodity Flow survey tabulations and the 1997 Vehicle Inventory and Use tabulations for the State of Florida, and are based on the value of goods shipped by ton per mile. On managed lanes, average occupancy for personal vehicles and buses are derived from *95 Express Managed Lane Monitoring Report (2009)* and 95 Golden Glades Park & Ride Survey (2009). General purpose lane user occupancy is derived from the 2009 National Household Travel Survey; the average bus occupancy (15.32) is calculated from 2012 National Transit Database for the Miami-Dade Transit Agency. Occupancies for trucks were derived from HERS.

Table 2-8 Per Hour TTV by Travel Purpose and Vehicle Type
2010 Dollars

	General Purpose Lanes		Managed Lanes			
	Personal Vehicles	Buses	Personal Vehicles	Buses	SUTs	CUTs
Commute	25%	15%	45%	70%		
Local/Personal	55%	70%	35%	15%		
Visitor/Personal	10%	10%	10%	10%		
On-the-Clock	10%	5%	10%	5%	100%	100%
TTV Per-Person Per Hour	$12.72	$12.01	$19.97	$20.08	$18.94	$23.43
Average Occupancy	1.67	15.32	1.22	25.66	1.2	1.2
Inventory Cost	-	-	-	-	$0.16	$0.25
TTV Per Vehicle Per Hour	$21.24	$184.02	$24.36	$515.14	$22.89	$28.37

Travel Time Values for Different Commodity Types

For single- and combination-unit trucks, the user cost methodology has been modified to add a segmentation reflecting commodity types with different sensitivities to value of time. As shown in Table 2-9 below, the groupings are reflected below by Standard Classification of Transported Goods (SCTG) code:

- High sensitivity: commodities with extreme time-sensitivity as a result of perishability,
- Medium sensitivity: goods not necessarily damaged by time delays, but with high on-time delivery expectation, and
- Low sensitivity: non-perishable household and other goods whose deliveries are acceptable close to scheduled date.

Table 2-9 Commodity Time Sensitivity Factor by Group

Time Value Sensitivity	SCTG Codes	Examples	Time Value Factor
High	01-07, 43	Live animals, flowers, fruit	1.66
Medium	08-26, 31-33	Alcohol, chemicals, minerals	1.00
Low	27-30, 34-42	Paper, electronics, furniture	0.75

Note: Developed from Value of Time for Road and Commercial Vehicles, University of Leeds, 2001.

These factors are applied as multiplier to truck driver TTVs in Table 2-8 to reflect regional truck driver TTVs. Table 2-10 shows top ten commodity compositions for Southeast Florida and Florida.

Table 2-10 Commodity Composition (Truck Equivalent)

Southeast Florida		Florida	
Commodity Type	Proportion	Commodity Type	Proportion
Non-metallic mineral products	16%	Gravel	14%
Waste/scrap	14%	Non-metallic mineral products	13%
Gravel	11%	Waste/scrap	12%
Gasoline	5%	Other food stuffs	5%
Cereal grains	5%	Other agricultural products	4%
Other food stuffs	5%	Natural sands	4%
Natural sands	5%	Fertilizers	4%
Fuel oils	3%	Gasoline	4%
Other agricultural products	3%	Coal-n.e.c.	3%
Coal-n.e.c.	2%	Articles-base metal	3%

Source: Freight Analysis Framework 3.4.

Market Segment Travel Time Values by Roadway Classification

Table 2-11 presents travel time values by roadway functional classification and by vehicle type. To compute these values, travel by core TTV category was distributed over four vehicle types (auto/motorcycle, bus, single-unit truck, and combination unit truck). The TTVs were then weighted by the proportion of travel by vehicle type and functional class, which was derived from an analysis of Florida Department of Transportation (FDOT) District 4's traffic monitoring system. The values are inflated to 2010 dollars using SSA wages.

Table 2-11 TTVs by Roadway Functional Classification and Vehicle Type
2010 Dollars

	Personal Vehicles	Buses	Single-Unit Trucks	Combination-Unit Trucks	Per-Vehicle TTVs
Rural Principal Arterial – Interstate	80.1%	0.6%	2.8%	16.6%	$20.93
Rural Principal Arterial – Other	89.7%	0.4%	2.9%	7.0%	$20.63
Rural Minor Arterial	93.2%	0.2%	2.9%	3.6%	$20.31
Rural Major Collector	88.9%	0.3%	3.7%	7.1%	$20.44
Principal Arterial – Interstate	92.2%	0.6%	2.4%	4.8%	$20.99
Urban Principal Arterial – Other Freeways/Expressways	94.7%	0.5%	2.2%	2.7%	$20.87
Urban Other Principal Arterial	97.1%	0.2%	1.7%	1.0%	$20.40
Urban Minor Arterial	97.8%	0.2%	1.2%	0.8%	$20.42
Urban Collector	95.9%	0.4%	1.6%	2.1%	$20.72
Occupancy	**1.67**	**15.32**	**1.2**	**1.2**	

2.2 TRANSIT USERS

An extensive national and international literature review was conducted to determine the value of travel time to transit users relative to that of automobile and commercial vehicle users. Findings of the literature review are presented in the Appendix A.2.

Existing literature was reviewed to determine TTVs for transit users within the United States and throughout the world. Factors influencing TTVs were identified, and proposed values were established for such factors based on the research conducted. Three geographic levels were used for the purpose of comparison: Southeast Florida, Florida, and United States.

The methodology applied by the accompanying travel time value calculator for application in Southeast Florida transit user benefit analysis is as follows:

- Determine application;
- Determine travel market segments; and
- Determine transit user TTVs.

Full details on the methodology are provided in Appendix C.2. Table 2-12 presents travel time values of transit users.

Table 2-12 Per Hour TTV for Transit User Cost Analysis
2010 Dollars

1-Market Segment TTVs	SEFL	FL	US	Bus	95X	Tri-Rail	MetroRail
All Travel Market Segments	$8.92	$8.04	$14.45	$5.17	$13.79	$12.67	$6.72
2-Market Segment TTVs	**SEFL**	**FL**	**US**	**Bus**	**95X**	**Tri-Rail**	**MetroRail**
Personal	$8.88	$7.98	$14.32	$5.15	$13.73	$12.69	$6.74
On-the-Clock	$10.90	$10.72	$21.14	$6.07	$17.16	$11.42	$5.49
3-Market Segment TTVs	**SEFL**	**FL**	**US**	**Bus**	**95X**	**Tri-Rail**	**MetroRail**
Commuter	$10.40	$9.29	$17.12	$5.79	$16.39	$15.11	$7.76
All Local	$7.30	$6.62	$11.40	$4.49	$10.95	$10.18	$5.69
On-the-Clock	$10.90	$10.72	$21.14	$6.07	$17.16	$11.42	$5.49
4-Market Segment TTVs	**SEFL**	**FL**	**US**	**Bus**	**95X**	**Tri-Rail**	**MetroRail**
Commuter	$10.40	$9.29	$17.12	$5.79	$16.39	$15.11	$7.76
Local - Personal	$6.93	$6.19	$11.40	$3.86	$10.91	$10.06	$5.17
Local - Visitor	$11.40	$11.40	$11.40	$11.40	$11.40	$11.40	$11.40
On-the-Clock	$10.90	$10.72	$21.14	$6.07	$17.16	$11.42	$5.49
7-Market Segment TTVs	**SEFL**	**FL**	**US**	**Bus**	**95X**	**Tri-Rail**	**MetroRail**
Commute Peak Hour	$12.02	$10.73	$19.77	$6.69	$18.92	$17.45	$8.96
Commute Off-Peak	$9.19	$8.21	$15.12	$5.12	$14.47	$13.34	$6.85
Local - Personal Peak Hour	$8.06	$7.20	$13.26	$4.49	$12.69	$11.70	$6.01
Local - Personal Off-Peak	$6.08	$5.43	$10.00	$3.38	$9.57	$8.83	$4.53
Local - Visitor Peak Hour	$13.26	$13.26	$13.26	$13.26	$13.26	$13.26	$13.26
Local - Visitor Off-Peak	$10.00	$10.00	$10.00	$10.00	$10.00	$10.00	$10.00
On-the-Clock	$10.90	$10.72	$21.14	$6.07	$17.16	$11.42	$5.49
Waiting/Transfer Time Values	**SEFL**	**FL**	**US**	**Bus**	**95X**	**Tri-Rail**	**MetroRail**
	$10.90	$10.72	$21.14	$6.07	$17.16	$11.42	$5.49

2.3 TRAVEL TIME VALUE SURVEY FINDINGS

As part of the original SEFRTUC study, a survey was conducted between December 2004 and January 2005 to verify localized TTVs. The 2014 update did not include any survey study. The following content of Section 2.3 keeps original 2004/2005 survey findings and values. All dollar values in this section are in 2004 dollars.

Survey Purpose

The purpose of the survey was to verify TTVs reflecting local conditions. The principal utility of the survey was to adjust travel time values the consultant team obtains from the literature review and other sources to local conditions, reflecting the input of local travelers. Appendix B presents the survey in details.

Survey Design

The survey encompassed a subset of the stratifications such as different time periods; different types of roadways (arterials, toll ways, freeways); and by mode (highway, transit, non-motorized) for a region covering Miami-Dade, Broward, Palm Beach, Martin, St. Lucie and Indian River counties, and included a limited number of demographic and travel market segment stratifications depending on the sample size allowed. First, the Southeast Florida value of time telephone survey was administered to a random sampling of 5,000 households in the six-county SEFRTUC region. This pool of households was drawn upon until the target of 200 completed surveys was achieved. To ensure that as large a proportion of the working population as possible was contacted, calls were only made only during the early evening during the week and all day and evening during the weekends. Only 10 percent of all households contacted were not able to complete the survey once the survey got underway. The survey was administered during the time period between December 1, 2004 to December 13, 2004, and January 8, 2005 to January 30, 2005.

The survey instrument consisted of a set of questions on socioeconomic and current trip-making characteristics and a set of stated-preference questions from which the values of time were to be derived. Employed respondents were asked to report the travel time of their latest work trip and to indicate whether, as employees, they had flexibility in the time they reported to work. Both employed and nonworking individuals also were asked to report the travel time of their most recent non-work trip. Using these most recent work and non-work trips as points of reference, the stated-preference survey questions asked respondents whether they would, if they had the choice, continue to make their trip as they do now, or would be willing to pay a toll or tax to save varying amounts of time as given in the survey. The work and non-work sections each presented respondents with four choice experiments. In all, there were 308 usable work trip choice experiments and 762 non-work choice experiments.

Survey Findings

The main findings from the survey are the following:

1. Travel time values for all trips fall in the range of $8.00 to $12.00, which is quite consistent with previous findings from national sources that have been adjusted for use in Southeast Florida.
2. Respondents attach a higher value to work trips than non-work trips ($12.00 versus $8.00, when unweighted or $7.40 and $10.30 when weighted by age distribution in the population).
3. Higher-income respondents have a higher value of time than lower-income residents ($16.70 versus $7.80 unweighted by age distribution, and $11.20 versus $8.70 when weighted by age distribution in the population).

4. These results can be applied to the SEFRTUC study to develop TTV factors that could be used for analyses using high-/low-income travel market segments, or travel market segment stratifications, based on age, trip length, or possibly other stratifications.

Validation of TTVs with Survey Results

To determine whether the travel time values extracted from the literature review were consistent with the values of Southeast Florida travelers, a household interview survey of 200 Southeast Florida residents was conducted in January 2005. The methods, analyses, and findings derived from the survey are described in detail in this section. Using standard market research techniques, travel time values were derived from the survey for the work and non-work travel market segments. Values for travel market segments based on income and age also were estimated, and are shown in Table 2-13. Overall, older individuals were overrepresented in the survey response pool and younger individuals were underrepresented. To compensate for this, the survey responses were weighted by population age group quintile. The weighted and unweighted TTVs are presented in Table 2-13. The weighting produces significant changes in the TTV for households with incomes greater than $40,000. This is because of the disproportionate number of older households with higher incomes who responded to the survey, as compared with the actual proportion of these households that exists in the population. It is expected that the weighted TTVs for respondents 50 years of age or older would drop for the same reason as well.

Table 2-13 Selected Travel Time Values from Analysis of SEFRTUC Survey

	Unweighted	Weighted	TTV Per Hr from Lit. Review (2004 $)	Adjusted Values
Travel Market Segment 1-Purpose				
Work	$11.92	$10.32	$12.69	N/A
Non-work	$8.32	$7.37	$10.58	N/A
Travel Market Segment 2 – Income				
$40k or greater	$16.67	$11.17	N/A	$11.27
Under $40k	$7.78	$8.72	N/A	$8.79
Travel Market Segment 3 – Age				
50 years old or more	$10.17	N/A	N/A	$11.08
Under 50 years old	$8.33	N/A	N/A.	$9.03

The literature review and the survey-derived TTVs (whether weighted or unweighted) for work trips corresponded very well. All values fall within the $10.00 to $13.00 per hour range. The non-work values from the survey were lower than the ones derived from the literature review, however, amounting to about 40 percent of the wage rate. This is in contrast to the AASHTO "*red book*,"

which suggests that non-work trips should be valued at 50 percent of the wage rate.

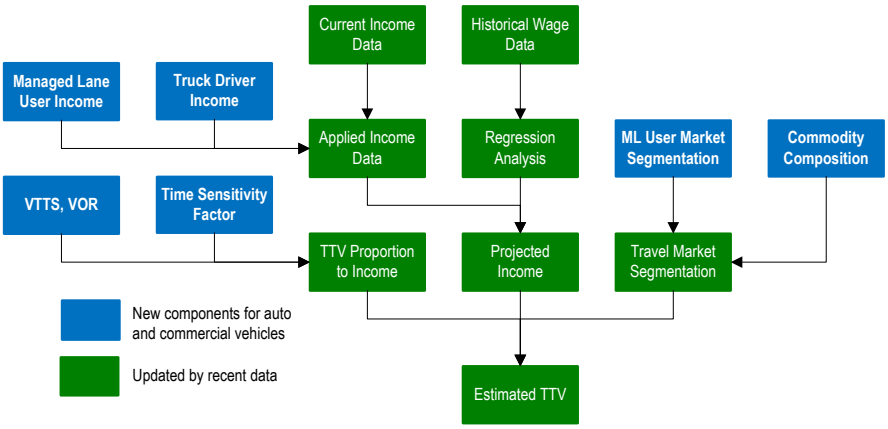
It was recommended retaining the AASHTO "*red book*" values for work and non-work travel. The two sets of results were close enough for planning purposes to leave them as they are from the red book. The income and age-based TTVs were adjusted so that they would produce the same total user costs as the work and non-work trips, since the trip purpose, income, and age-based TTVs all characterize travelers from the same population. To determine this adjustment, the estimated TTVs were simply factored upwards to match the weighted average TTV for workers and non-workers in each subcategory.

2.4 TRAVEL TIME VALUE METHODOLOGY FLOW CHART AND ASSUMPTIONS

The key methodologies applied in the development of TTVs of road users and transit users are similar. Median incomes of road users and transit users are established based on existing database from agencies such as Florida Department of Transportation, SSA, and Census Bureau. An extensive review of literature identified that travel time value is proportional to traveler's income depending on trip time, trip purpose, trip mode, etc. Travel time values were then developed by applying such proportions to median income level.

Historical income data was applied to develop a regression equation to project income level of future years. The regression analysis produced a strong fit of historical income data indicating good reliability of the projections. Users can change target year into any future year. The calculator will compute future year wages based on projection equations and apply future wages to TTV proportions identified by literature review to estimate target year TTVs. Considering inconsistency of historical income data and unknown economic conditions in the future, the calculator allows users to override income data and income projection by providing input boxes and setting up priority rules. TTVs will be estimated based on user input rather than historical data if requested. Figure 2.1illustrates the methodology applied for TTV development.

Figure 2.1 Travel Time Value Methodology Flow Chart



Due to limited data availability, assumptions are made to accommodate project needs. Key assumptions of developing travel time values are summarized as below:

- The ratio of median transit user income to overall median income does not change among different geographic level (regional, statewide, and nationwide);
- Travel market segmentations are the same for different geographic level;
- Travel time value market segmentations are the same for different geographic level;
- TTV proportion to income level does not change throughout years; and
- Transit user TTV proportion to income level does not change among different modes.

3.0 Vehicle Operating Costs

3.1 AUTOMOBILES

Introduction

Based on the review of highway user benefit analysis procedures presented in the literature review, a set of vehicle operating costs was developed. These costs are built up from the essential components of Vehicle Operating Costs (VOC) that are relevant for Southeast Florida and are stratified by classes of vehicles. The study area included Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties in FDOT District 4 and Miami-Dade County in District 6.

In this update, one new dimension and one new component is brought into the VOC calculation. The new dimension added is VOC variance based on different vehicle fuel types. One new component is driving safety cost. The safety cost replaces the insurance cost included in the existing version of the road user calculator.

Vehicle Fuel Types

In recent years, along with significant increase in oil price and environmental awareness, investment in alternative fuel vehicles (AFV) has become more economically viable. Although vehicles using traditional fuel sources such as gasoline and diesel are still the overwhelming majority on the road, market penetration rates of AFV are on the rise. According to the estimate of 2013 Annual Energy Outlook published by U.S. Energy Institute Administration, in 2010, AFVs were about 4.8 percent of the light-duty vehicles in stock and 7.4 percent of the new light-duty vehicles sold. In 2040, assuming that current laws and regulations remain generally unchanged throughout the projection period, those numbers are estimated to rise to 15 percent and 15.3 percent respectively. Given AFV's share in existing, and more importantly, in future fleet, and AFV's different operating costs compared with those of vehicles using gasoline and diesel, vehicle fuel types are added as a new dimension into the calculator in this update. Because of the difficulty in collecting the costs for freight trucks using alternative fuel sources, this dimension is only added to light-duty vehicles. As a result, in addition to the previous small/medium/large vehicle classification, light-duty vehicles will further broken down by their fuel types. A total of six types of AFVs are included in this calculator based on availability of cost information, and different AFV's existing and future market share:

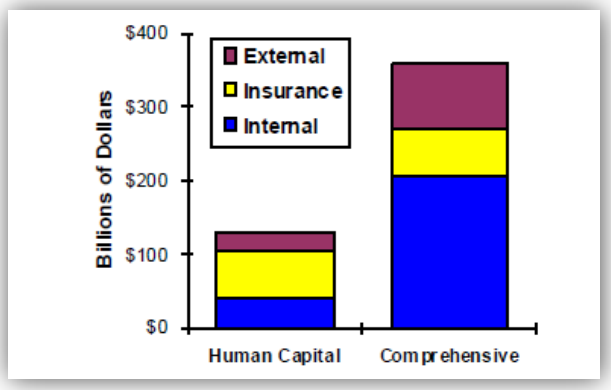
- Gasoline Vehicle
- Diesel Vehicle

- Ethanol (E85) Vehicle
- Electric Vehicle
- Hybrid Vehicle
- Natural Gas (CNG/LNG) Vehicle

Safety

Safety costs, or crash costs, measure economic damages caused by vehicle crashes (fatal, injury, and property damage only crashes). There are two perspectives for measuring crash costs: human capital method and comprehensive approach. Human capital crash cost estimates include the monetary losses associated with medical care, emergency services, property damage, and lost productivity. Comprehensive crash costs include the human capital costs in addition to nonmonetary costs related to the reduction in the quality of life in order to capture a more accurate level of the burden of injury. Comprehensive costs are also generally used in analyses conducted by other federal and state agencies outside of transportation[7]. Figure 3.1 depicts the difference between human capital crash costs and comprehensive crash costs. In this figure, internal costs are damages borne by the individual vehicle user while external costs are damages and risks borne by other road users. Insurance costs, internal at the individual level and external to premium payers as a group, cover damages compensated by the insurance company. In the existing tool, insurance costs are used to account for the users' cost for any accidents. In this update, human capital crash costs are deemed more appropriate and are used to replace insurance costs.

Figure 3.1 Human Capital Crash Costs vs. Comprehensive Crash Costs



Source: *Transportation Cost and Benefit Analysis II*, Victoria Transport Policy Institute, Aug 2013

[7] Highway Safety Manual 1st Edition, Appendix A Crash Cost Estimates, as of April 2009

Under the human capital method, different costs are estimated for crashes at different severity level.

Table 3-1 Human Capital Crash Cost Estimates by Crash Severity

Crash Type	2001 Human Capital Crash Costs
Fatal	$1,245,000
Disabling Injury	$111,400
Evident Injury	$41,900
Possible Injury	$28,400
Property Damage Only	$6,400

Source: Highway Safety Manual 1st Edition, Appendix A Crash Cost Estimates, as of April 2009

In Florida, number of crashes at the State and County levels are reported annually. However, the number of injuries are not provided for different injury severities (disabling, evident, and possible injuries). Therefore, the average cost of the three injury severity levels are used as the cost for injury crashes.

Vehicle Operating Cost Components

A total of eight major VOC components were estimated for the State of Florida and the Southeast Florida region. Additionally, four cost factors were identified as relevant to the study area. VOC components and cost factors (in brackets) include the following:

- Fuel (function of speed, and stop-and-go conditions);
- Fuel taxes;
- Maintenance and repairs (function of mileage, and stop-and-go conditions);
- Tires (function of mileage, and stop-and-go conditions);
- Depreciation;
- Finance charges;
- Safety (function of mileage); and
- Licensing and registration.

Data were obtained from public agencies such as AASHTO, the U.S. Environmental Protection Agency, and the U.S. Census Bureau, U.S. Energy Information Administration, and private agencies such as the American Automobile Association, Runzheimer International, the Black Book, the Kelly Blue Book, Intellichoice, and Edmunds. Details of data and literature are shown in Appendix D.1.

Results

Current year (2014) VOC estimates in Florida in general and in the southeast region in particular are presented in this section (Table 3-2 through Table 3-5). Because vehicle operating costs among different fuel vehicle types are mainly between electric vehicles and non-electric vehicles. A comparison of difference between statewide and local costs also is presented (Table 3-6).

Table 3-2 Generalized Vehicle Operating Cost (Gas) – Southeast Florida
2010 Dollars

	Vehicle Size		
	Small	Medium	Large
Attributes			
Vehicle Lifespan (Years)	11.4	11.4	11.4
City Condition Speed (mph)	21	21	21
% of Highway over Total Mileage	40%	40%	40%
Mileage per Year	12,500	12,500	12,500
Cost Per Year			
Fuel Cost	$1,290	$1,321	$1,610
Fuel Tax	$267	$273	$333
Maintenance and Repairs	$612	$652	$719
Tires	$139	$174	$180
Safety	$1,443	$1,443	$1,443
Depreciation	$2,145	$2,618	$2,877
Finance Charges	$426	$520	$571
License and Registration	$72	$83	$97
Annual Total Vehicle Operating Cost	**$6,394**	**$7,084**	**$7,830**

Source: Cambridge Systematics, Inc.

Table 3-3 Generalized Vehicle Operating Cost (Electric) – Southeast Florida
2010 Dollars

	Vehicle Size		
	Small	Medium	Large
Attributes			
Vehicle Lifespan (Years)	11.4	11.4	11.4
City Condition Speed (mph)	21	21	21
% of Highway over Total Mileage	40%	40%	40%
Mileage per Year	12,500	12,500	12,500
Cost Per Year			
Fuel Cost	$344	$360	$539
Fuel Tax	$0	$0	$0
Maintenance and Repairs	$612	$652	$719
Tires	$139	$174	$180
Safety	$1,443	$1,443	$1,443
Depreciation	$3,380	$4,111	$5,446
Finance Charges	$671	$816	$1,082
License and Registration	$72	$83	$97
Annual Total Vehicle Operating Cost	**$6,661**	**$7,639**	**$9,506**

Source: Cambridge Systematics, Inc.

Table 3-4 Generalized Vehicle Operating Cost (Gas) – Florida Statewide
2010 Dollars

	Vehicle Size		
	Small	**Medium**	**Large**
Attributes			
Vehicle Lifespan (Years)	11.4	11.4	11.4
City Condition Speed (mph)	21	21	21
% of Highway over Total Mileage	40%	40%	40%
Mileage per Year	12,500	12,500	12,500
Cost Per Year			
Fuel Cost	$1,290	$1,321	$1,610
Fuel Tax	$212	$217	$264
Maintenance and Repairs	$613	$653	$720
Tires	$139	$174	$180
Safety	$1,223	$1,223	$1,223
Depreciation	$2,145	$2,618	$2,877
Finance Charges	$426	$520	$571
License and Registration	$72	$83	$97
Annual Total Vehicle Operating Cost	**$6,120**	**$6,809**	**$7,542**

Source: Cambridge Systematics, Inc.

Table 3-5 Generalized Vehicle Operating Cost (Electric)– Florida Statewide
2010 Dollars

	Vehicle Size		
	Small	**Medium**	**Large**
Attributes			
Vehicle Lifespan (Years)	11.4	11.4	11.4
City Condition Speed (mph)	21	21	21
% of Highway over Total Mileage	40%	40%	40%
Mileage per Year	12,500	12,500	12,500
Cost Per Year			
Fuel Cost	$344	$360	$539
Fuel Tax	$0	$0	$0
Maintenance and Repairs	$613	$653	$720
Tires	$139	$174	$180
Safety	$1,223	$1,223	$1,223
Depreciation	$3,380	$4,111	$5,446
Finance Charges	$671	$816	$1,082
License and Registration	$72	$83	$97
Annual Total Vehicle Operating Cost	**$6,442**	**$7,420**	**$9,287**

Source: Cambridge Systematics, Inc.

Table 3-6 Regional to Statewide VOC Ratios
Percent

	Vehicle Size (Gasoline)			Vehicle Size (Electric)		
Vehicle Class	**Small**	**Medium**	**Large**	**Small**	**Medium**	**Large**
Fuel Cost	100%	100%	100%	100%	100%	100%
Fuel Tax	126%	126%	126%	100%	100%	100%
Maintenance and Repairs	100%	100%	100%	100%	100%	100%
Tires	100%	100%	100%	100%	100%	100%
Insurance	118%	118%	118%	118%	118%	118%
Depreciation	100%	100%	100%	100%	100%	100%
Finance Charges	100%	100%	100%	100%	100%	100%
License and Registration	100%	100%	100%	100%	100%	100%
Overall	104%	104%	104%	103%	103%	103%

Source: Cambridge Systematics, Inc.

Generalized vehicle operating cost estimates for District 4 and Miami-Dade County and Florida in general also were developed. These costs were developed by weighting vehicle operating costs for small-, medium-, and large-size vehicles by their respective market shares in Southeast Florida. Information on vehicle shares for small, medium, and large vehicles is based on input from the Florida Department of Motor Vehicles. The split of vehicle market share between different vehicle fuel sources within small/medium/large vehicle classes comes from 2013 Annual Energy Outlook published by the U.S. Energy Information Administration. Ratios of vehicle operating costs by vehicle type to generalized vehicle operating costs for small-, medium-, and large-size vehicles were then computed to compare average costs to costs by vehicle type (Table 3-7 and Table 3-8). These ratios are particularly useful in applications where only generalized vehicle operating cost estimates are available, and there is a need for vehicle operating costs by vehicle type.

Table 3-7 Ratio of VOC by Vehicle Type to Average Vehicle Operating Costs for All Personal Vehicle Types in Southeast Florida

Cost Components	Southeast Florida (2010 Dollars Per Mile)	Ratio		
		Small	Medium	Large
Fuel Cost	$0.11	$0.10	$0.10	$0.13
Fuel Tax	$0.02	$0.02	$0.02	$0.03
Maintenance and Repairs	$0.05	$0.05	$0.05	$0.06
Tires	$0.01	$0.01	$0.01	$0.01
Safety	$0.12	$0.12	$0.12	$0.12
Depreciation	$0.22	$0.17	$0.21	$0.24
Finance Charges	$0.04	$0.03	$0.04	$0.05
License and Registration	$0.01	$0.01	$0.01	$0.01
Per Mile Total Vehicle Operating Cost	**$0.59**	**$0.51**	**$0.57**	**$0.63**
Annual Vehicle Operating Cost ($/year)	**$7,402**	**$6,397**	**$7,079**	**$7,857**

Source: Cambridge Systematics, Inc.

Table 3-8 Ratio of VOC by Vehicle Type to Average Vehicle Operating Costs for All Personal Vehicle Types in Florida

Cost Components	Florida (2010 Dollars Per Mile)	Ratio		
		Small	Medium	Large
Fuel Cost	$0.11	$0.10	$0.10	$0.13
Fuel Tax	$0.02	$0.02	$0.02	$0.02
Maintenance and Repairs	$0.05	$0.05	$0.05	$0.06
Tires	$0.01	$0.01	$0.01	$0.01
Safety	$0.10	$0.10	$0.10	$0.10
Depreciation	$0.22	$0.17	$0.21	$0.24
Finance Charges	$0.04	$0.03	$0.04	$0.05
License and Registration	$0.01	$0.01	$0.01	$0.01
Per Mile Total Vehicle Operating Cost	**$0.57**	**$0.49**	**$0.54**	**$0.61**
Annual Vehicle Operating Cost ($/year)	**$7,124**	**$6,125**	**$6,806**	**$7,572**

Source: Cambridge Systematics, Inc.

Findings

Overall, vehicle operating costs in Southeast Florida are slightly higher ($7,402 per year) than average statewide figures ($7,124 per year), as indicated in Table 3-7 and Table 3-8. Safety costs are the leading causes of the difference. This is primarily due to the high crash rates in the southeast Florida region than the rates statewide.

The findings also indicate that total vehicle costs are size-dependent as initially expected. The overall cost of operating and maintaining are:

- Small-sized vehicles are 13.6 percent below average vehicle operating costs in Southeast Florida and 14.0 percent below vehicle operating costs throughout the State;
- Medium-sized vehicles are 4.4 percent below average vehicle operating costs in Southeast Florida and 4.5 percent below vehicle operating costs throughout the State; and
- Large-sized vehicles are 6.1 percent above average vehicle operating costs in Southeast Florida and 6.3 percent above vehicle operating costs throughout Florida.

Vehicle depreciations accounted for the largest portion of vehicle operating costs, ranging from 28.7 percent for small-sized cars to roughly 38.2 percent for large-sized vehicles in Southeast Florida, and from 34.7 percent for small-sized cars to 39.3 percent for large-sized vehicles across the State. Fuel costs, another major cost factor, accounted for about 16.9 percent of total costs for small-sized cars and 20.7 percent for large-sized cars in Southeast Florida. On average, safety costs accounted for 20.4 percent of overall costs for small-sized cars and up to 16.4 percent for large-sized vehicles throughout the State.

3.2 COMMERCIAL VEHICLES

VOCs for Generalized Traveling Conditions

Generalized travel conditions, in terms of vehicle mix, vehicle age, vehicle-miles traveled, stop-and-go conditions, and speed were developed to generate VOCs. A spreadsheet calculator was developed separately to estimate generalized VOCs for various scenarios based on the following factors:

- Annual average mileage;
- Average vehicle lifespan;
- Average speed scenarios; and
- Tire change frequency scenarios.

These data were collection from public agencies such as AASHTO, FHWA, and MNDOT. Details are available in Appendix D.2.

For the purpose of this effort, average vehicle operating cost estimates were developed based on the following generalized traveling conditions:

- **Vehicle Mix –** According to findings from the Florida Department of Highway Safety and Motor Vehicles and 2002 Vehicle Inventory and Use Survey (VIUS), the automobile (including Sports Utility Vehicles)/ commercial vehicle mix in the State consists of small- (6.0 percent), medium-(41.2 percent), large-sized vehicles (42.6 percent); single-unit trucks (5.9 percent); and combination-unit trucks (4.3 percent).

- **Vehicle Lifespan –** The average vehicle lifespan is five years for single- and combination-unit trucks. This average is based on findings from Mark Berwick's Truck Costs for Owner/Operators study.
- **Vehicle Miles Traveled –** The average yearly travel distance for single- and combination-unit trucks is 13,500 miles and 68,900 miles respectively[8]. This yearly travel distance was used to compute commercial vehicles operating costs per mile driven.
- **Speed –** The average city condition travel speed was set to 21 mph[9].

Operating costs for single-and combination-unit trucks for Florida and the southeast region of the State are presented in Table 3-9 and Table 3-10.

Results indicate that single- and combination-unit trucks operating costs are slightly higher in southeast Florida compared to the rest of the State. Vehicle operating costs are leading the State by 1.6 percent for single-unit trucks and 2.9 percent for combination-unit trucks. This is primarily due to higher fuel taxes (14.5 percent) and safety cost (11.8 percent) for both types of commercial vehicles (Table 3-11).

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[8] Highway Statistics 2010, Office of Highway Policy Information, FHWA, http://www.fhwa.dot.gov/policyinformation/statistics/2010/vm1.cfm

[9] EPA Ratings for selected vehicle model, based on average city speed of 21 mph.

Table 3-9 Generalized Vehicle Operating Cost – Southeast Florida
2010 Dollars

Vehicle Class	Truck	
	Single-Unit Truck	Combination-Unit Truck
Attributes		
Vehicle Lifespan (years)	5	5
City Condition Speed (mph)	21	21
% of Highway over Total Mileage	70%	80%
Mileage per Year	13,500	68,900
Cost Per Mile		
Fuel Cost*	$0.16	$0.35
Fuel Tax	$0.03	$0.07
Maintenance and Repairs*	$0.08	$0.10
Tires*	$0.03	$0.04
Safety	$0.12	$0.12
Depreciation	$0.78	$0.19
Finance Charges	$0.17	$0.04
License and Registration	$0.02	$0.02
Total Vehicle Operating Cost	**$1.38**	**$0.93**
Annual Total Vehicle Operating Cost	**$18,645**	**$63,909**

Source: Cambridge Systematics, Inc.

Table 3-10 Generalized Vehicle Operating Cost – Florida
2010 Dollars

Vehicle Class	Truck	
	Single-Unit Truck	Combination-Unit Truck
Attributes		
Vehicle Lifespan (years)	5	5
City Condition Speed (mph)	21	21
% of Highway over Total Mileage	70%	80%
Mileage per Year	13,500	68,900
Cost Per Mile		
Fuel Cost*	$0.16	$0.35
Fuel Tax	$0.03	$0.06
Maintenance and Repairs*	$0.08	$0.10
Tires*	$0.03	$0.04
Safety	$0.10	$0.10
Depreciation	$0.78	$0.19
Finance Charges	$0.17	$0.04
License and Registration	$0.02	$0.02
Total Vehicle Operating Cost	**$1.36**	**$0.90**
Annual Total Vehicle Operating Cost	**$18,355**	**$62,089**

Source: Cambridge Systematics, Inc.

Table 3-11 SE Florida Region to Statewide VOC Ratios
Percent Difference

	Truck	
Vehicle Class	**Single-Unit Truck**	**Combination-Unit Truck**
Fuel Cost	100%	100%
Fuel Tax	114%	114%
Maintenance and Repairs	100%	100%
Tires	100%	100%
Safety	118%	118%
Depreciation	100%	100%
Finance Charges	100%	100%
License and Registration	100%	100%
Total Vehicle Operating Cost	102%	103%

Source: Cambridge Systematics, Inc.

3.3 TRANSIT VEHICLES

Transit vehicle operating costs were determined from National Transit Database (NTD) data. Each year, transit agencies of the nation report to NTD their data such as operating costs, service provided, and funding. Such data can be utilized directly toward estimating transit vehicle operating costs. Therefore, literature review is not necessary for this study purpose.

Research was undertaken to ascertain specific figures for operational expenses of public transit across various technologies in use for Southeast Florida, the State of Florida, and the United States, as a whole. The National Transit Database (NTD) was the primary source of data for this work. Individual costs associated with operating public transit are provided for the study area of Southeast Florida, the State, as well as the nation.

The research shows that, while South Florida spends more on Motorized Bus than Florida does on the statewide level, the operational expenses are relatively low in most categories, as compared to the national average. Operational expenses for Demand Response services are typically lower than the national average.

Cost values of different technologies for the local, state, and national areas are shown in Table 3-12. Differences in cost per trip values are frequently due to the density of the area and the propensity to use public transit. Differences in cost per mile values are a partial result of the cost of doing business in a particular area, taking into account wages, fuel costs etc.

Table 3-12 Transit Cost Metrics

2010 Dollars

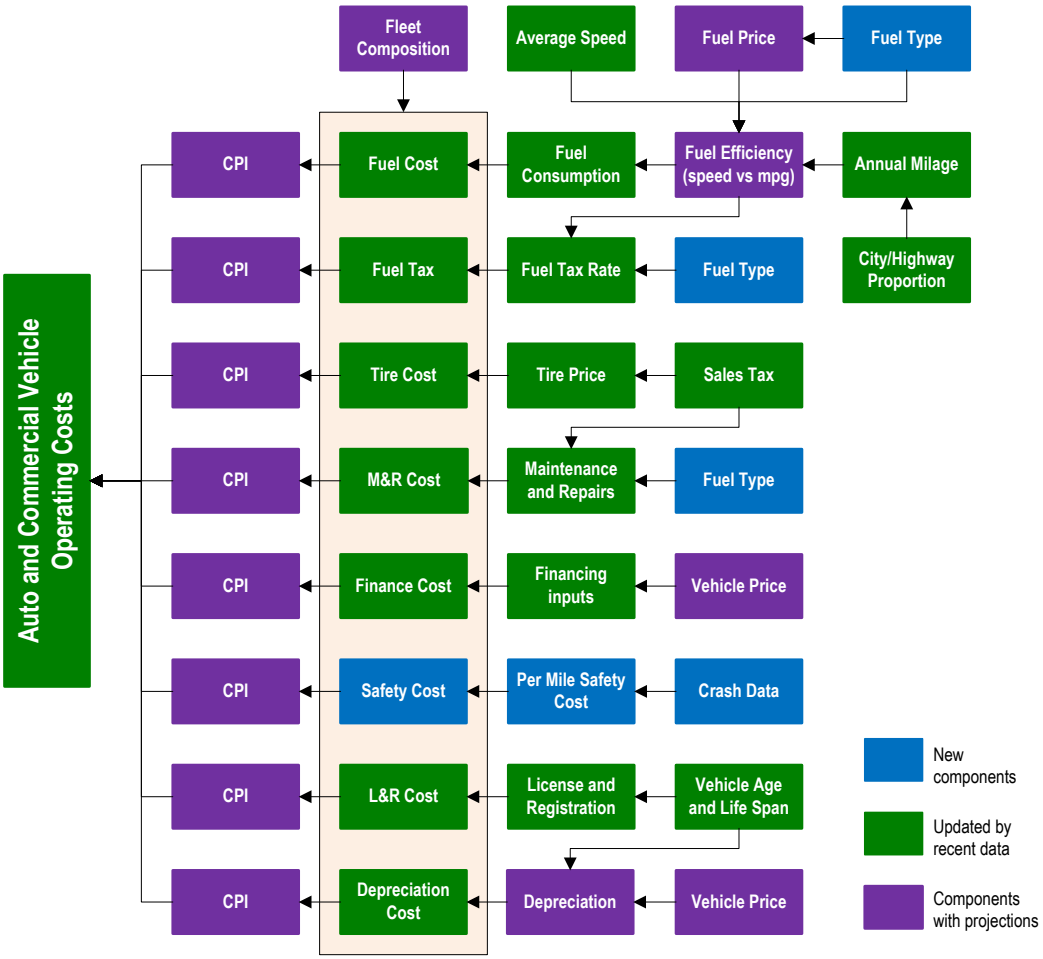
	Motorized Bus	Commuter Rail	Heavy Rail	Demand Response
Cost/Passenger Trip				
National	$3.42	$40.77	$1.76	$25.11
State	$3.38	$13.18	$3.87	$25..61
Local	$3.36	$13.18	$3.87	$22.14
Cost/Revenue Mile				
National	$10.37	$57.81	$10.34	$3.92
State	$7.00	$17.93	$10.62	$4.00
Local	$8.48	$17.93	$10.62	$3.95
Cost/Revenue Hour				
National	$124.42	$1957.63	$207.38	$58.92
State	$95.82	$543.17	$251.48	$60.46
Local	$111.01	$544.27	$251.57	$60.30

Source: National Transit Database 2012

3.4 VEHICLE OPERATING COST METHODOLOGY FLOW CHARTS AND ASSUMPTIONS

Methodologies applied in the development of the two VOC calculators are quite different. For auto and commercial vehicles, operating costs are allocated into finite components. Data collection has been done for each component. These components are then combined to reach annual vehicle operating costs, and per mile costs by dividing total cost by annual mileages. Major cost components that vary throughout years include fuel price and vehicle depreciation. Historical gasoline price data was collected and a regression analysis is provided for reference of future gasoline. In addition, a speed vs. fuel efficiency curve from California Life-Cycle Benefit/Cost Analysis Model (Cal B/C model) is used to related vehicle fuel cost with average travel speed. The U.S. Energy Information Administration releases future vehicle price projection by vehicle size and engine type. Alternatively, historical vehicle prices have been updated and a regression analysis for future vehicle price is provided as a reference. Vehicle depreciation costs are developed by combining vehicle prices with depreciation rates. Other cost components, such as tire, safety, and maintenance, are developed by applying historical and projected CPI growth rate. Figure 3-1 shows the methodology flow chart of auto and commercial vehicle operating costs.

Figure 3.2 Auto and Commercial VOC Methodology Flow Chart



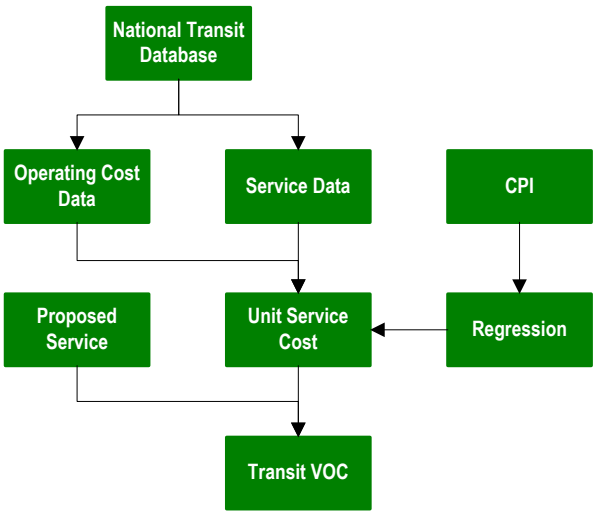
The methodology for developing transit VOC is quite straight-forward. Every year, more than 600 transit agencies across the U.S. report their operation statistics to the National Transit Database (NTD). Such information includes[10]:

- Operational characteristics – vehicle revenue hours and miles, unlinked passenger trips and passenger miles, etc.
- Service characteristics – service reliability and safety, etc.
- Capital revenues and assets – sources and uses of capital, fleet size and age, and fixed guideways, etc.
- Financial operating statistics – Revenues, Federal, state and local funding, costs, etc.

[10] http://www.ntdprogram.gov

In recent years the NTD has grown to include safety, security, and rural transportation data. These data together with inflation rates developed from CPI were used to obtain average unit transit operating cost (cost per passenger, cost per revenue mile, and cost per revenue hour). Figure 3.3 presents the methodology flow chart of transit VOCs.

Figure 3.3 Transit VOCs Methodology Flow Chart



Due to limited data availability, assumptions are made to accommodate project needs. Key assumptions of developing vehicle operating costs include:

- Assume all vehicle depreciation over year follow a similar pattern.
- Assume city/highway fuel efficiency ratios do not change significantly throughout years.
- Assume average age of cars and trucks do not change significantly throughout years.
- Assume allocation of different vehicle size do not change significantly throughout years.

4.0 Road and Transit User Cost Calculator

As part of the effort to develop localized road user costs in Southeast Florida, Cambridge Systematics developed a consolidated road and transit user cost calculator to estimate VOCs and TTVs for various scenarios based on a range of factors. This section describes and provides guidance and direction on how to use the SEFRTUC calculator.

As indicated in the Appendices A through E, both the methodology and cost factors were based on an extensive review of academic and practitioner literature on user benefit analysis, from consideration of the data needed for developing localized values, as well as input from FDOT District 4 Systems Planning staff.

The calculator is updated using Microsoft Excel 2010, and is provided as a separate stand-alone file to this document. It is recommended that users set screen resolution into 1280x1024 or higher, so that most horizontal page extents are fully visible without the requirement of zooming in or out. In addition, users should keep these worksheets protected since pages contain macros and formulas. Users can unprotect any sheet(s) if desired.

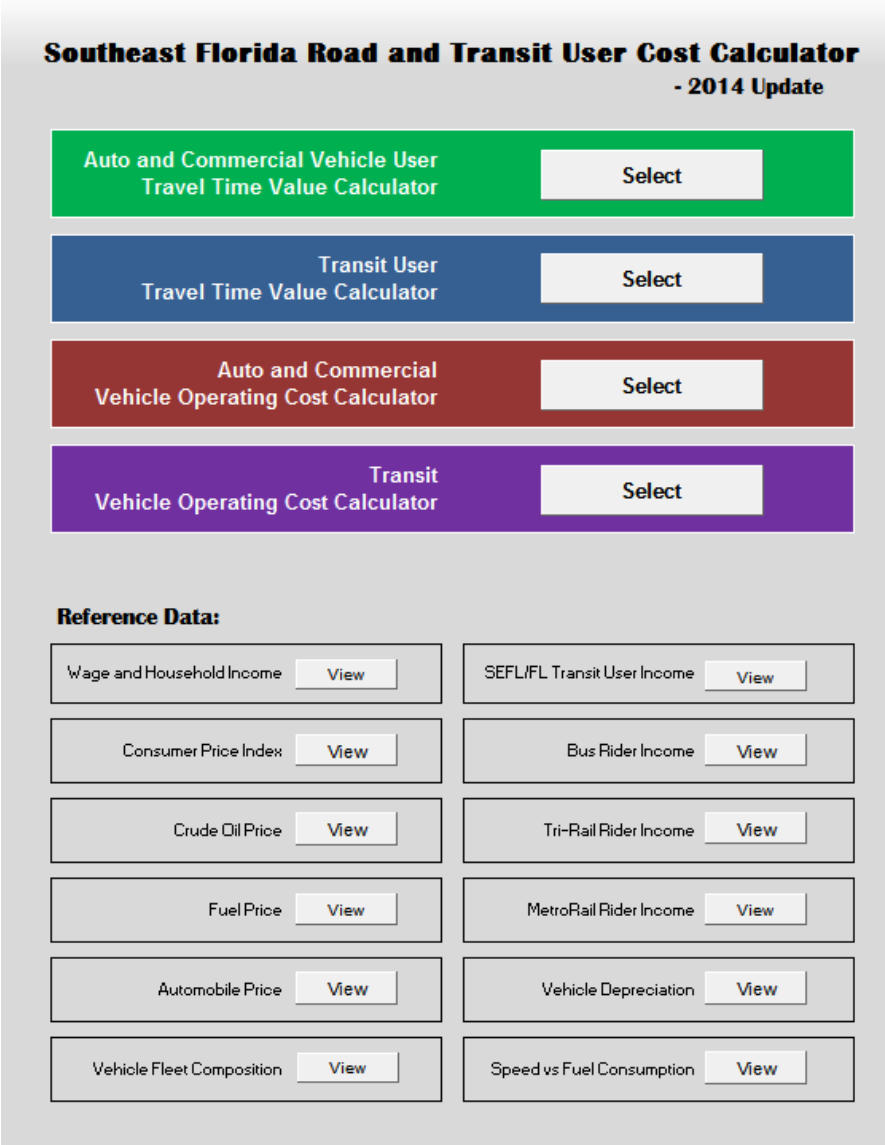
Please keep a backup copy of the calculator to retrieve in case of editing errors when sheets are unprotected.

Figure 4.1 shows a screenshot of the calculator's main operation panel. The calculator elements are as follows:

- Auto and commercial vehicle users travel time value calculator
- Transit user travel time value calculator
- Auto and commercial vehicle operating cost calculator
- Transit vehicle operating cost calculator
- Reference Data
    - Historical and projected median/average wages and median household income
    - Historical and projected Consumer Price Index
    - Historical and projected crude oil price
    - Historical and projected gasoline price
    - Historical and projected automobile price
    - Vehicle fleet composition

- Southeast Florida transit user income
- Bus rider income
- Tri-Rail rider income
- MetroRail rider income
- Vehicle depreciation
- Vehicle speed vs. fuel consumption

Figure 4.1 SEFTRUC Calculator Main Panel

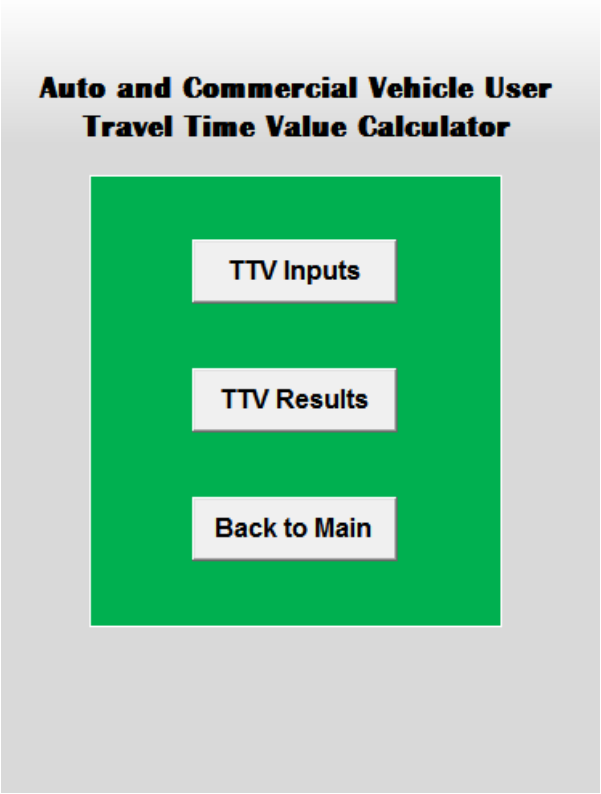


4.1 TRAVEL TIME VALUE CALCULATOR

Auto and Commercial Vehicle User

The auto and commercial vehicle user travel time value calculator includes two components: "TTV Inputs" and "TTV Results," as shown in Figure 4.2. Methodologies applied in the development of this calculator are described in Appendix C.1.

Figure 4.2 Auto and Commercial Vehicle User TTV Calculator Panel



The "TTV Inputs" allows users to determine the application:

- Current and target year
- Household incomes and wages
- Inflation factors
- Core travel market segments
- Market proportion
  - Vehicle type
  - Facility type (managed lanes and general purpose lanes)
  - Trip purpose

  - Time period
- Freight commodity
  - Commodity composition
  - Sensitivity to time

Cells in light green are unlocked and left changeable. The currently recommended input data are based on extensive research as specified in Appendix A.1. The default values have been updated with recently released data. Users may elect to update all or part of these inputs with additional data sources beyond what have been identified. Users are able to change the target year of TTVs. The calculator will automatically update the TTVs applying a relative wage factor.

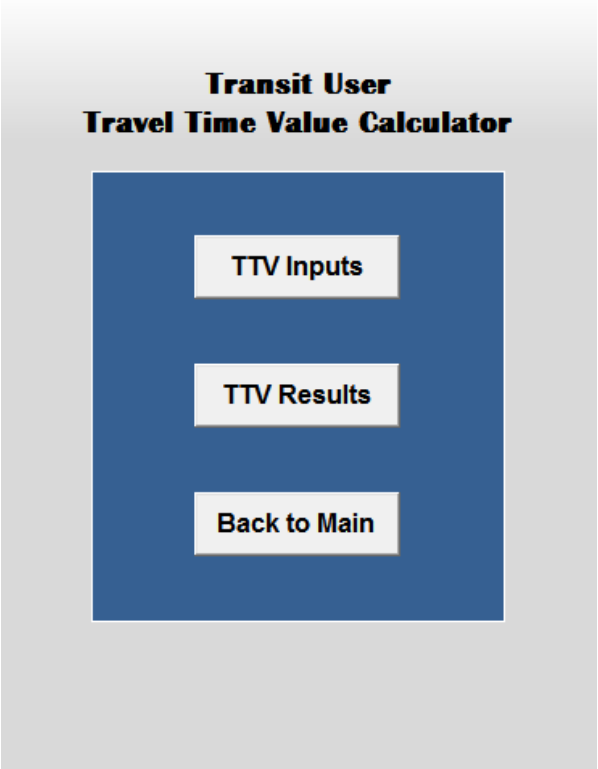
The other component, "TTV Results," should ideally be password-protected to ensure that formulas and other assumptions are not accidentally altered or erased. Travel time values in Southeast Florida and Florida region for the any current year and target are presented on this page. Default current and target years are set to 2014 and 2040 respectively.

A "Back" button is provided on each page except for the main page shown in Figure 4.1, allowing users to go back to the previous page of the calculator.

Transit User

Similarly, as shown in Figure 4.3, the transit user TTV calculator also includes two components: "TTV Inputs" and "TTV Results." "TTV Inputs," directs users to the input page. The format and style of this worksheet is the same as the one for auto and commercial vehicle users. Light blue cells are designed for available user inputs. The current inputs are identified through an extensive amount of research available in Appendix A.2. Sources of default inputs applied in the calculator are provided at the end of each input table. Users may elect to update all or part of these inputs.

Figure 4.3 Transit User TTV Calculator Panel



"TTV Results" provides side by side comparison of these TTVs for Southeast Florida, Florida, and nationwide level. In addition, by using recent survey findings, the calculator provides TTV for bus, 95X bus, Tri-Rail, and MetroRail riders. This output page also is protected from editing. Methodologies applied in this calculator are described in Appendix C.2.

4.2 VEHICLE OPERATING COSTS

Automobile and Commercial Vehicle Users

The calculator estimates generalized vehicle operating costs for various scenarios based on the following input factors whose default values and their sources are available from a number of public and private agencies, and are provided in the calculator:

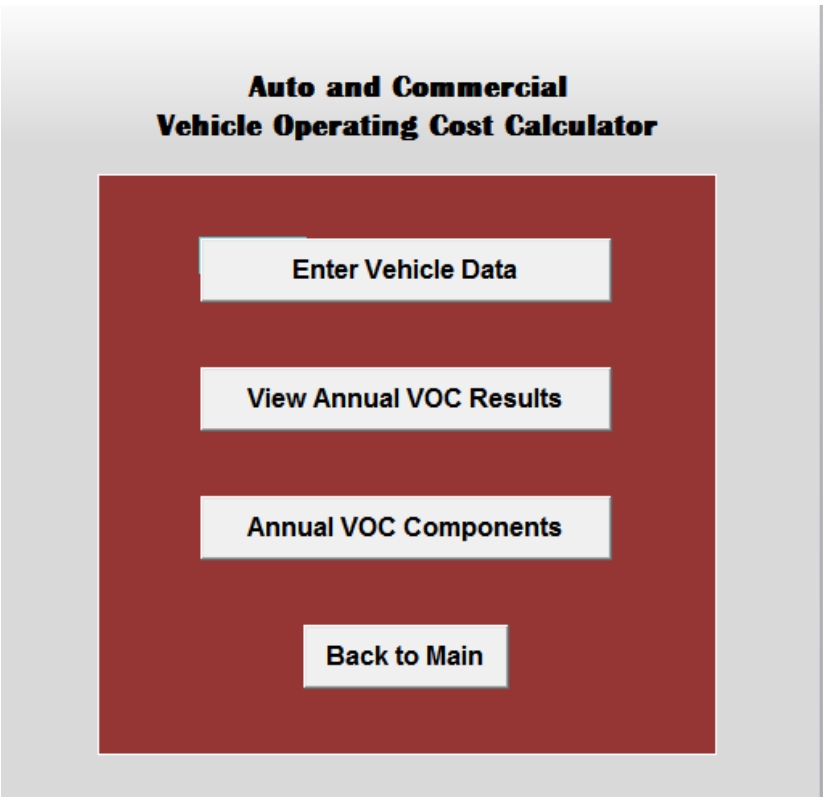
- General inputs:
  - Annual mileage
  - Average speed
  - Proportion of highway mileage over total mileage
  - Average age of fleet

- Tire costs
- License and registration
- Vehicle price
- Financing cost
- Sales tax
- Engine (fuel) types
  - Gasoline
  - Diesel
  - Hybrid
  - Electric
  - Compressed natural gas (CNG)
  - Flex fuel(E85)
- Fuel cost
- Fuel tax
- Fuel economy
- City/highway fuel efficiency factor
- Maintenance and repairs
- Fleet composition
- Safety cost

Research results supporting proposed input values can be found Appendix D.1 and Appendix D.2. However, users are recommended to review and update the "Enter Vehicle Data" worksheet to account for inflation, technological advancements, and other variables that affect vehicle operating costs. Cells in pink/light red are open for user inputs.

Figure 4.4 shows a screenshot of the calculator's panel. "View Annual VOC Results" contains current year and target year annual and per mile VOCs by vehicle type for Southeast Florida and Florida. It is recommended that the result worksheet remain password-protected.

Figure 4.4 Auto and Commercial VOC Calculator Panel



The "Annual VOC Components" page includes the followings:

- Fuel Costs – per mile fuel costs
- Fuel Tax – per mile Federal, State, and local fuel taxes
- Tires – per mile costs of tires
- Maintenance and Repairs – per mile costs of regular maintenance and repair work
- Depreciation – based on depreciated value from new to end of five years
- Finance Charge– per mile cost of financing a vehicle
- Safety Costs –per mile safety related expenses
- License and Registration –per mile cost of vehicle registration and new license issuance

Ideally, the eight worksheets should also be protected. All changes to inflation, other transportation cost increases/decreases (technological advancements that may positively affect fuel efficiency for example), and other traveling conditions such as speed variation and miles driven per year, should be limited to "Enter Vehicle Data" page. Detail methodologies applied in building the calculator are documented in Appendix E.1 and Appendix E.2.

Transit Vehicles

The fourth module estimates generalized transit vehicle operating costs is shown in Figure 4.5. Button "Enter Transit Scenario Data" leads users to data input pages for five different transit modes, as shown in Figure 4.6, bus, demand response, commuter rail, light rail, and heavy rail. Click a corresponding button to go to each input page. On input pages, cells in light purple are for users to define proposed transit service by mode.

Figure 4.5 Transit VOC Calculator Operation Panel

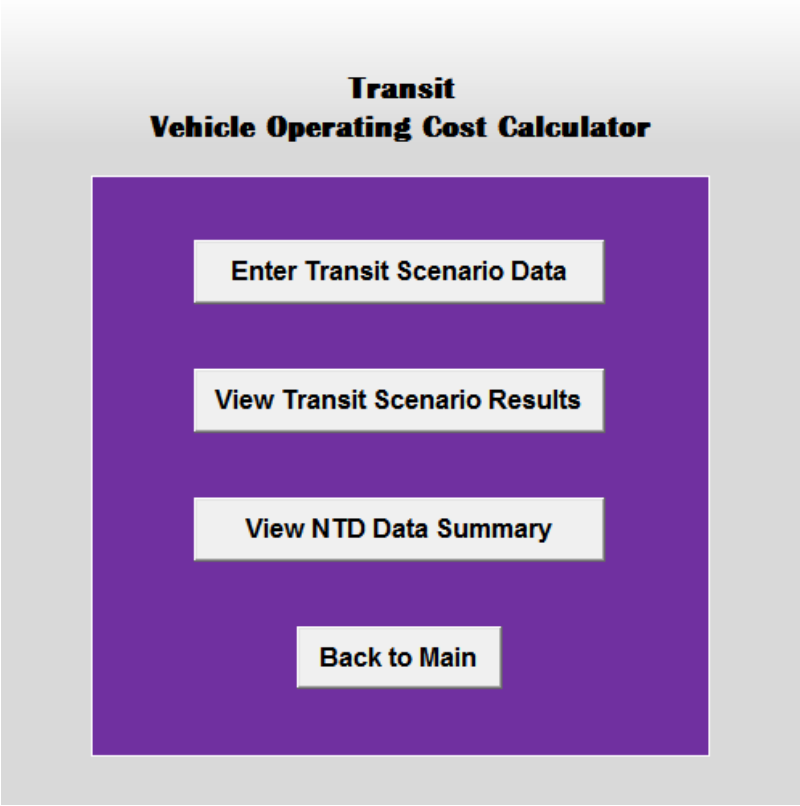
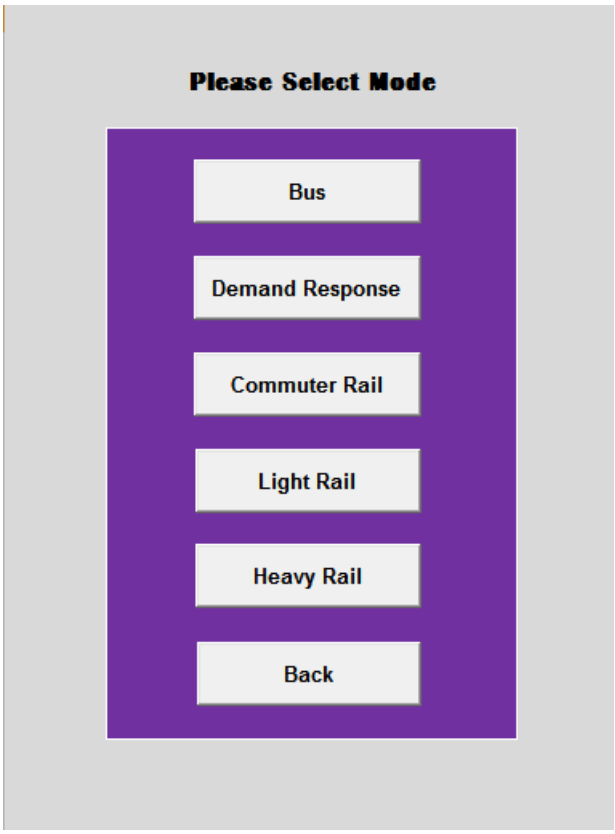


Figure 4.6 Mode Selection Window of Transit VOC Calculator



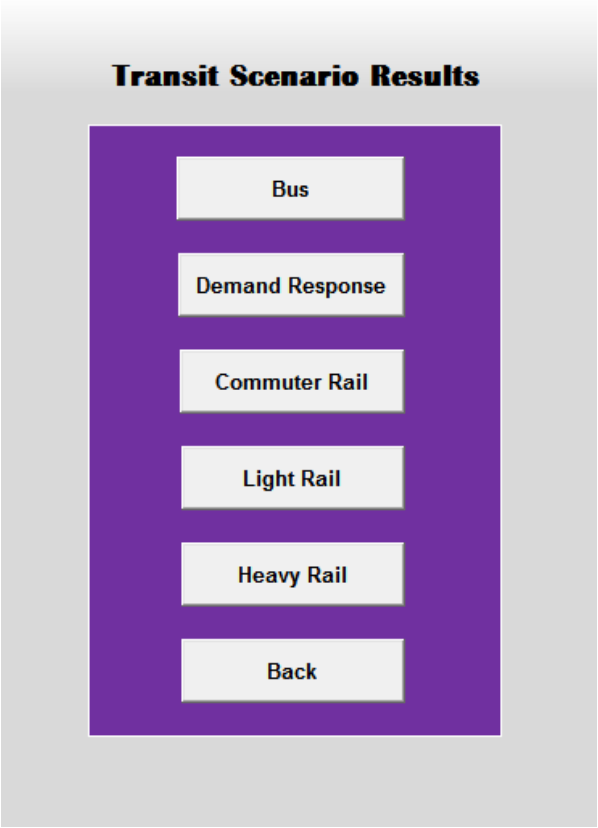
Each transit input page is divided into two blocks. In the first block, users are asked to enter service data for each proposed transit route. Total annual revenue miles are then calculated according to service input. In the second block, users will enter transit expense data. There are three entering options: estimated expense per revenue mile, estimated percent change, and estimated annual expense. Users will enter the best available data for each of the expense item or category. If data is not available for an expense item or category, the calculator will use the default number indicated in the dark grey cell.

The default values are based on 2012 expenses reported by transit agencies throughout the country to the National Transit Database (NTD), and were deflated to 2010 dollars. In some instances, users may have two or more data entries for an expense item or category. The calculator prioritizes these inputs in the following manner: "NEW ESTIMATED EXPENSE" is higher than "ESTIMATED PERCENT CHANGE," which is in turn higher than "TOTAL ROUTE ANNUAL EXPENSE." Users can reset the current input page by clicking the "clear input" button. After finishing all the inputs, click "Back" in mode selection sheet to navigate to the transit VOC calculator main page for further actions.

Button "View Transit Scenario Results" directs users to output pages. Total annual revenue miles, estimated total annual operating cost, and unit operating

costs (in dollars per revenue mile) for each transit mode are provided in this worksheet. Again, cells in this worksheet contain formulas and are not recommended to be changed.

Figure 4.7 Transit Scenario Results



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Button "View NTD Data Summary" brings users to the page that summarizes transit VOC data based on the following input variables from 2012 National Transit Database (NTD):

- Operators' wage;
- Other salaries and wages;
- Fringe benefits;
- Services;
- Fuel and lube;
- Tires and other;
- Others materials and supplies;
- Utilities;

- Casualty and liability;
- Tax;
- In report purchased transportation;
- Separate report purchased transportation;
- Miscellaneous expense;
- Expense transfer; and
- ADA-related expense.

The procedures and tools used during the extraction of data and building of this calculator have been introduced in Appendix E.3. Default values used for input sheets came from the NTD summary. It is recommended that the NTD summary sheet to be updated annually, upon the release of the new year's NTD. Appendix E.4 introduces and summarizes operating costs of existing transit technologies in Southeast Florida region. Appendix E.5 further reviews the nationwide operation cost of the region's proposed transit technologies.