Appendix B

■ B.1 Approach to Calculating Florida Rail Plan Performance Measures

Appendix B summarizes FDOT's original approach to calculating a set of performance measures for passenger and freight rail projects being considered for inclusion in the 2010 Florida Rail System Plan.

Background

FDOT is developing the Florida Rail System Plan that details a set of rail projects FDOT expects to fund, and when these are planned to occur. Projects can occur in one of five time periods:

- 1 to 5 years (these projects already are established);

- 6 to 10 years;

- 10 to 20 years;

- more than 20 years; or

- not recommended for state funding.

FDOT funds a variety of different types of rail improvement projects. Generally speaking, these include passenger-rail, grade-crossing, and freight-capacity improvements.   In determining what projects to fund in each period, FDOT seeks to establish how well the projects support the five basic goals that have been established for the rail system plan:

- Safety and Security;

- Quality of Life and Environmental Stewardship;

- Maintenance and Preservation;

- Mobility and Economic Competitiveness; and

- Sustainable Investments.

Performing these projects is expected to generate direct transportation benefits (e.g., reduced travel time and operating costs), economic development benefits (e.g., jobs), and a variety of other benefits, some of which may be difficult to quantify precisely (e.g., promoting responsible land use).   A set of key quantitative and qualitative performance measures have been established for each of the goals listed above that will

assist FDOT in prioritizing the candidate rail projects. Given details on each project, and projections of the key performance measures, FDOT will determine which projects to include in the Florida Rail System Plan.

The analytical approach used for calculating quantitative performance measures relies largely on work performed previously for FDOT. Previously, FDOT used the Freight Rail Improvement Calculator (FRIC) for quantifying benefits for certain types of freight rail improvements. This tool does not calculate the full range of measures required for the present effort, but does have models that can be utilized for calculating certain measures for certain project types.

Further, FDOT has developed an approach for calculating the macroeconomic benefits of its work program, and elements of this approach can be utilized for calculating measures related to rail investments. The macroeconomic benefits calculation approach FDOT uses relies on models from the Federal Highway Administration (FHWA) Highway Economic Requirements System (HERS), run with Florida data, to quantity benefits of changes to the highway system. Also as part of this effort, REMI models have been used to calculate statewide economic development benefits given a set of direct transportation benefits. To the extent that rail projects may have the effect of removing auto and/or truck traffic from the road network, the approach used in calculating macroeconomic benefits can be used for helping calculate measures related to rail projects.

Rail Plan Performance Measures

Table B.1 details the performance measures being calculated for each candidate project considered for inclusion in the Florida Rail System Plan. The table lists the performance measures for each of the five categories listed above; the units of measure; whether the measure is calculated for passenger rail, grade crossing and/or freight capacity projects; and additional notes. Note that a number of the measures are quantified with a yes/no or other categorical value and will be populated for each project manually. Where a measure has a quantitative value, this will be calculated using the approach described in the next section. Further, a number of measures related to freight improvements cannot be calculated for freight quiet zone projects, as noted in the table.

Table B.1   Florida Rail System Plan Performance Measures

Goal Area	Indicator	Units	Calculate for Project Type? (Y/N)			Notes
			Pass.	Grade Cross	Frt.	
Safety and Security	Crash Reduction from Auto/ Truck Diversion	$	Y	N	Y	Auto diversion for passenger, trucks for freight, not calculated for quiet zones
	Reduced Exposure to Grade Crossings	minutes	N	Y	N	
	Use of Intelligent Transportation Management Technologies	Yes/No	Y	Y	Y	Not calculated for quiet zones
Quality of Life and Environmental Stewardship	Change in Auto/Truck Fuel Consumption	Gallons of Fuel	Y	N	Y	Not calculated for quiet zones
	Change in Auto/Truck CO_2	Tons of CO_2	Y	N	Y	Not calculated for quiet zones
	Encourages Noise Reduction	Yes/No	N	N	Y	Relevant for freight quiet zones only
	Status of Environmental Screening Process	Categorical	Y	Y	Y	
	Project Included in Land-use Plans	Yes/No	Y	Y	Y	
	Project Included in State Transportation Plan	Yes/No	Y	Y	Y	
	Project Included in LRTP	Yes/No	Y	Y	Y	
	Project Included in County/ Municipal Improvement Plan	Yes/No	Y	Y	Y	
Maintenance and Preservation	Train Capacity Increase	Percent	N	N	Y	Calculated for rehab, 286,000 upgrade, accessibility only
	Consistent with Asset Management Approach	Yes/No	Y	Y	Y	Calculated for work on existing assets only
	Support Modernized Rail System Management and Operation Technologies	Yes/No	Y	Y	Y	

Table B.1   Florida Rail System Plan Performance Measures (continued)

Goal Area	Indicator	Units	Calculate for Project Type? (Y/N)			Notes
			Pass.	Grade Cross	Frt.	
Mobility and Economic Competitiveness	Auto VMT Reduction	VMT	Y	N	Y	Not calculated for quiet zones
	Truck VMT Reduction	VMT	Y	N	Y	Not calculated for quiet zones
	Reduced Travel Time Cost	$	Y	N	Y	Not calculated for quiet zones
	Reduced Vehicle Operating Cost	$	Y	N	Y	Not calculated for quiet zones
	Increase in Passenger Rail Ridership	Passengers	Y	N	N	Specified by project nominee
	Increase in Freight Ton-Miles	Net Ton-Miles	N	Y	Y	Specified by project nominee
	GDP Growth	$	Y	Y	Y	
	Jobs Created as a Result of the Project	Total Number of Jobs	Y	Y	Y	Specified by project nominee
Sustainable Investment	Project Underwent Public Review	Yes/No	Y	Y	Y	
	Support from Stakeholders	Categorical	Y	Y	Y	
	Status of Application for Funding	Categorical	Y	Y	Y	
	Eligible for Federal Funding	Yes/No	Y	Y	Y	
	Eligible for State Funding	Yes/No	Y	Y	Y	
	Non-Federal State/Federal Funding Available and Programmed for Project	Yes/No	Y	Y	Y	
	Supports Underserved Areas	Yes/No	Y	Y	Y	
	Project of Statewide Significance	Yes/No	Y	Y	Y	

Analytical Approach

Below is a summary of the approach recommended for calculating the quantitative measures identified in Table B1, organized by performance measure. The performance measures are listed in the same order as presented in Table B1, with the exception of auto and truck VMT reduction, which are discussed first as these measures are in turn used to calculate other measures. Note that unless otherwise specified all costs are in 2006 dollars.

Auto Vehicle Miles Traveled (VMT) Reduction

For passenger rail projects, the reduction is auto VMT is calculated as follows:

AUTOKVMTD = 365 * (TRAINRIDERSAFTER – TRAINRIDERSBEFORE)/AVGVEHOCC *
    AVGPASSENGERTRIPLEN/1,000

where:

AUTOKVMTD = annual VMT reduction for autos (thousands of miles)
TRAINRIDERSAFTER = daily train ridership after the project
TRAINRIDERSBEFORE = daily train ridership before the project
AVGVEHOCC = average vehicle occupancy for autos, 1.46 based on the value used for the prior FDOT analysis
AVGPASSENGERTRIPLEN = average passenger trip length in miles

Note that auto trips are assumed to be the same length as passenger rail trips. In practice, the auto trip that a rail trip replaces may be either shorter or longer than the corresponding auto trip, but the rail trip length is used as the based-available estimate of the auto trip length.

Truck VMT Reduction

For freight rail projects, the reduction in truck VMT is calculated as follows:

TRUCKKVMTD = (TRAINTONMILESAFTER – TRAINTONMILESBEFORE)/
AVGTONSPERTRUCK

where:

TRUCKKVMTD = annual VMT reduction for autos (thousands of miles)
TRAINTONMILESAFTER = thousands of net ton-miles per year shipped by rail after the project
TRAINTONMILESBEFORE = thousands for net ton-miles per year shipped by rail before the project
AVGTONSPERTRUCK = average net tons per truck, 20 based on FRIC defaults

As in the case of autos, truck trip lengths are assumed to be the same length as corresponding train trips.

Crash Reduction from Auto/Truck Diversion

Passenger and freight rail projects that result in diversion of autos and trucks from the road network are expected to reduce vehicle crashes. To calculate this reduction, the reduction in vehicle miles traveled (VMT) is calculated as described above, and this is

multiplied by a unit crash cost in dollars per 1,000 VMT calculated from HERS for the FDOT Macroeconomic Analysis described previously.

The crash-cost reduction resulting from the auto VMT reduction is calculated as:

ABENFAUTOSAFETY = AUTOKVMTD * CRCOST

where:

ABENFAUTOSAFETY = annual crash-cost reduction for autos ($)
CRCOST = cost of crashes per 1,000 VMT, $157 based on the prior FDOT analysis

Likewise, the crash-cost reduction resulting from truck VMT reduction is:

ABENFTRUCKSAFETY = TRUCKVMTD * CRCOST

where:

ABENFTRUCKSAFETY = the annual crash-cost reduction for trucks in dollars

Reduced Exposure to Grade Crossings

The model previously developed for FRIC has been used for modeling the reduced exposure to grade crossings, which is a proxy for safety and travel-time benefits. The reduced exposure is calculated as follows:

DBENFCROSSINGTIME = (AADT/1,440) * (CROSSMINB^2 * TRAINSB – CROSSMINA^2 * TRAINSA)/4 * NUMCROSS

where:

DBENFCROSSINGTIME = Daily reduction in grade crossing waiting time in vehicle minutes
AADT = average annual daily traffic per grade crossing
CROSSMINB = average time at crossing before project
TRAINSB = daily trains before project
CROSSMINA = average time at crossing after project
TRAINSA = daily trains after project
NUMCROSS = number of grade crossings impacted

Change in Fuel Consumption

The Environmental Protection Agency (EPA) model Motor Vehicle Emissions Simulator (MOVES) has been run for Florida to determine average gasoline-equivalent miles per gallon for Florida autos (MPGAUTO) and trucks (MPGTRUCK). Based on these constants, the change in fuel consumption may be estimated as follows:

AFUELSAVINGS = AUTOKVMTD/MPGAUTO + TRUCKKVMTD/MPGTRUCK

where:

AFUELSAVINGS = annual fuel savings in thousands of gallons of fuel

Note this is the savings in fuel resulting from auto and truck diversions, but does not account for any increases in fuel consumption from increased train travel.

Change in Carbon Dioxide (CO_2)

The savings in CO_2 generation corresponding to the fuel savings may be calculated using the constant value of 8,788 grams of CO_2 per gallon of gasoline (or 9.687 tons of CO_2 for every 1,000 gallons of gasoline) specified by EPA (http://www.epa.gov/otaq/climate/ 420f05004.htm). This is calculated as follows:

ACO2SAVINGS = AFUELSAVINGS * CO2PG

where:

ACO2SAVINGS = annual CO_2 savings in tons of CO_2
C02PG = tons of CO_2 per 1,000 gallons of fuel

Train Capacity Increase

Projects that upgrade a line to support heavier 286,000 pound (286K) cars (versus the typical limit of 263,000 pounds), or that increase clearances to allow intermodal containers to be double-stacked have the effect of increasing train capacity. The train capacity increase is assumed to be 10 percent for 286K upgrades and 65 percent for double-stack improvements. Other train capacity improvements should be user-specified in terms of the percent increase in net train capacity.

Reduced Travel-Time Cost

Passenger and freight rail projects that either speed up existing rail traffic and/or result in diversion of autos and trucks from the road network are expected to reduce travel time. To calculate this reduction, the savings from reduction in existing trips is added to the reduction in vehicle miles traveled (VMT) calculated as described above, multiplied by a unit value of time in dollars per 1,000 VMT calculated from HERS for the FDOT Macroeconomic Analysis described previously.

The travel-time savings for passenger travel is calculated as:

ABENFPASSTT = 365 * (TRAINRIDERSBEFORE * (TRAINTIMEBEFORE – TRAINTIMEAFTER) * VOTPERSONAL + (TRAINRIDERSAFTER –

TRAINRIDERSBEFORE)) * (TTCOSTAUTO * AVGPASSTRIPLEN/
(1,000 * AVGVEHOCC) – TRAINTIMEAFTER* VOTPERSONAL)

where:

ABENFPASSTT = annual passenger travel-time benefit ($)
TRAINTIMEBEFORE = average time per train trip in hours before project
TRAINTIMEAFTER = average time per train trip in hours after project
VOTPERSONAL = personal value of time in, $11.77/hour based on the previous FDOT
analysis
TTCOSTAUTO = auto travel-time cost per 1,000 VMT, $490 calculated based on the
previous FDOT analysis

For rail, the inventory cost for rail freight has been estimated based on prior analyses
performed by Cambridge Systematics. The value of time for truck is that used for the
prior FDOT analysis, and includes driver time and inventory costs. The travel-time
savings for freight is calculated as:

ABENFFREIGHTTT = 1,000 * TRAINTONMILESBEFORE/AVGTRUCKTRIPLEN *
(TRAINTIMEBEFORE – TRAINTIMEAFTER) * VOTRAILFREIGHT +
(TRAINTONMILESAFTER – TRAINTONMILESBEFORE) * TTCOSTTRUCK/
AVGTONSPERTRUCK – 1,000* (TRAINTONMILESAFTER –
TRAINTONMILESBEFORE)/AVGTRUCKTRIPLEN * TRAINTIMEAFTER *
VOTRAILFREIGHT

where:

ABENFFREIGHTTT = annual freight travel-time benefit ($)
AVGTRUCKTRIPLEN = average truck trip length in miles
VOTRAILFREIGHT = freight inventory cost, $0.39/ton-hour based on the previous
analyses
TTCOSTTRUCK = truck travel-time cost per 1,000 VMT, $690 calculated based on the
previous FDOT analysis

Reduced Vehicle Operating Cost

In the case of operating costs, no reductions are predicted for existing passengers or
freight. However, diversions of autos and trucks from the road network result in
operating cost reductions calculated using the approach from the previous FDOT analysis.
These savings are partially offset by increased rail operating costs. For rail, an average
operating cost of $0.36 per passenger-mile was calculated based on statistics published by
the American Public Transit Association (APTA). Also, an average cost of $0.046 per ton-
mile was calculated through waybill analysis.

The reduced vehicle operating cost for passenger travel is:

ABENFAUTOOP = AUTOKVMTD * OPCOSTAUTO – 365 * (TRAINRIDERSAFTER – TRAINRIDERSBEFORE) * AVGPASSTRIPPLEN * OCPASS

where:

ABENAUTOOP = annual operating cost benefit for passenger travel ($)
OPCOSTAUTO = auto operating cost per 1,000 VMT, $326 based on the prior FDOT analysis
OCPASS = average operating cost per passenger per mile

The reduced vehicle operating cost for freight is:

ABENFTRUCKOP = TRUCKKVMTD * OPCOSTTRUCK – 1,000 * (TRAINTONMILESAFTER – TRAINTONMILESBEFORE) * OCFREIGHT

where:

ABENFTRUCKOP = annual operating cost benefit for freight travel ($)
OPCOSTTRUCK = truck operating cost per 1,000 VMT, $1,161 based on the prior FDOT analysis
OCFREIGHT = average cost per ton-mile of freight

Gross Domestic Product (GDP) Growth

Future GDP growth can projected as a result of savings in business-related travel within Florida. Based on the results of the prior FDOT analysis, each dollar of business-related savings in travel time, operating, or safety costs is projected to generate approximately $2.40 in GDP growth. Using this multiplier, GDP growth can be calculated as follows:

ABENFGDP = GDPMULT * (ECOFRACAUTO * ECOFRACAUTOFL * (ABENFPASSTT + ABENFAUTOOP + ECOFRACSAFETY * ABENFAUTOSAFETY) + ECOFRACTRUCKFL * (ABENFTRUCKTT + ABENFTRUCKOP + ECOFRACSAFETY * ABENFTRUCKSAFETY))

where:

ABENFGDP = annual GDP growth attributable to the project
GDPMULT = GDP multiplier, $2.40 based on the prior FDOT analysis
ECOFRACAUTO = fraction of auto travel related to business, 0.119 based on the prior FDOT analysis
ECOFRACAUTOFL = fraction of auto/passenger benefits internal to Florida, 0.9963 based on the prior FDOT analysis
ECOFRACSAFETY = fraction of safety benefits related to business, 0.3450 based on the prior FDOT analysis
ECOFRACTRUCKFL = fraction of truck/freight benefits internal to Florida, 0.9185 based on the prior FDOT analysis