MISSOURI

state rail plan

DRAFT

TECHNICAL MEMORANDUM #5

Economic Analysis of Rail Investments

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Prepared for:

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Prepared by:

HNTB Corporation

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1 Introduction

This Technical Memorandum is offered in support of the Missouri State Rail Plan. The report is intended to assess strategically significant economic and trade conditions relevant to Missouri's rail investment in the life of the plan. The report is organized to utilize available data, forecasts, and other tools to describe Missouri's existing rail system in its economic context. Critical issues within the scope of the report include:

- The role and impact of existing and forecast inbound rail freight in Missouri's economy
- The role and impact of existing and forecast outbound rail freight in Missouri's economy
- The role and impact of existing and forecast internal rail freight in Missouri's economy
- The nature of existing and forecast rail freight moving through Missouri
- The role and impact of passenger rail service development in Missouri's economy

This document also provides key findings included in the Missouri State Rail Plan regarding the potential economic implications of additional future freight and passenger rail investment in the state, and how such investment may lead to earnings, output, and employment levels above and beyond the current baseline forecast. **Appendix A** includes a general technical discussion of how rail forecast numbers are computed in the plan.

1.1 Missouri's Economic Base

Missouri's existing and future rail utilization is primarily determined by the growth or decline of industries which trade in commodities moving by rail. Industries such as coal and mining, non-metallic minerals, crops and agricultural products, and some chemicals tend to be more directly dependent on outbound rail access than others. However, industries highly dependent on consuming commodities moved by rail, such as crop production, chemical manufacturing, many types of construction and retail, and various service sectors, also can determine the level of rail freight activity in the state.

Table 1 summarizes Missouri's economic base using the location quotient technique. Industries with a location quotient of greater than 1.0 are more concentrated within Missouri than in the rest of the United States, whereas those with a location quotient of less than 1.0 are industries less concentrated in the state. Location quotients provide some guidance regarding the specialization within Missouri's economy, and how specialization in certain industries supports sales (outflow) from Missouri establishments, as well as jobs in Missouri's economy.

Table 1: Missouri's Economic Base in 2010

Basic vs. Non Basic (From LQ)	Industry	Industry Concentration (LQ)	Net Outflow ($millions)	Total Jobs Supported by Net Exports
Basic Industries	Leather & Allied Products	1.82	-$505	0
	Transportation Equipment	1.73	-$5,084	0
	Food Products	1.71	$6,500	68,651
	Beverage & Tobacco Products	1.59	$1,444	7,120
	Publishing Industries (except Internet)	1.56	$603	6,643
	Furniture & Related Products	1.45	-$372	0
	Animal Production	1.42	-$576	0
	Crop Production	1.41	$723	16,635
	Printing & Related Support Activities	1.4	$179	2,439
	Electric Equipment, Appliances, etc.	1.39	-$430	0
	Fabricated Metal Products	1.35	$500	4,420
	Plastics & Rubber Products	1.26	-$240	0
	Machinery Manufacturing	1.21	$1,352	12,657
	Internet & data process services	1.2	$1,496	11,232
	Nonmetallic Mineral Products	1.19	-$18	0
	Amusement & Recreation	1.19	$858	19,123
Marginal Industries	Monetary, Financial, & Credit Activity	0.98	-$113	0
	Insurance Carriers & Related Activities	0.98	-$1,054	0
	Broadcasting	0.95	-$82	0
	Professional Scientific, Technical, Services	0.95	-$610	0
	Support for Agriculture & Forestry	0.92	-$215	0
	Government & non NAICs	0.92	-$1,463	0
	Waste Management & Remediation	0.79	-$317	0
	Paper Manufacturing	0.78	-$1,357	0
	Primary Metal Manufacturing	0.78	-$2,088	0

Source: EDR TREDIS System (2010 Data) (From FAF3 and Vectors from Minnesota IMPLAN Group);
In 2010 dollars.
LQ: Location quotient.

Even if there are not changes in Missouri's overall industry mix, significant growth or decline in Missouri's trading partners can lead to significant changes in rail demand in the state. This is especially true for diverse commodity groups such as waste and scrap material and hazardous materials. **Table 2** summarizes those economic sectors in Missouri which are expected to have the most significant change in their composition within the state's economy between the years 2011 and 2041, according to the Moody's forecasts. The Moody's forecasts are used in this analysis not only because they contain detailed county level data (not shown here), but also

because they provide sufficient details to support commodity flow forecasting for each of Missouri's domestic trading partners, as described in **Appendix A**.

The overall nature of forecast growth and change in Missouri's economy provides a context for understanding the nature of anticipated growth or decline in commodities shipped into and out of the state by rail in future years.

Table 2: Missouri's Industry Shifts According to Moody's Forecasts

Missouri Industries	Industry Sector	2001 Employment	2011 Employment (Estimated)	2001-2011 Growth Rate (Compounded Annually)	2041 Employment (Estimated)	Projected Growth Rate (Compounded Annually)
Growth Sectors	Waste Mgmt. Services	5,359	4,352	-2.1%	11,958	3.4%
	Support Activities-Mining	58	252	15.9%	652	3.2%
	Other Information Serv.	706	927	2.8%	2,237	3.0%
	Motion Picture & Recording	4,046	3,488	-1.5%	7,349	2.5%
	Wholesale Electronic Markets	17,984	25,566	3.6%	49,644	2.2%
	Admin & Support Serv.	123,741	136,619	1.0%	245,915	2.0%
	Heavy and Civil Eng. Construction	17,879	13,265	-2.9%	23,188	1.9%
	Broadcasting	6,405	5,965	-0.7%	10,200	1.8%
	Oil and Gas Extraction	15	27	5.8%	45	1.8%
	Social Assistance	44,463	57,476	2.6%	94,738	1.7%
	Ambulatory Health Care Services	82,924	105,832	2.5%	173,569	1.7%
	Specialty Trade Contractors	90,336	72,530	-2.2%	106,126	1.3%
	Food Services & Drinking Places	183,006	203,223	1.1%	293,505	1.2%
	Data Processing Serv.	9,230	9,279	0.1%	13,242	1.2%
	Publishing Industries	21,547	14,404	-4.0%	19,766	1.1%
Other Sectors	Pipeline Transp.	221	271	2.1%	209	-0.9%
	Transp. Equip. Manuf.	57,968	34,438	-5.1%	25,460	-1.0%
	Textile Mills	487	324	-4.0%	233	-1.1%
	Truck Transportation	42,359	36,217	-1.6%	25,958	-1.1%
	Textile Product Mills	3,049	2,505	-2.0%	1,722	-1.2%
	Couriers & Messengers	9,010	7,824	-1.4%	5,361	-1.3%
	Primary Metal Manufacturing	11,341	6,669	-5.2%	4,467	-1.3%
	Rental & Leasing Serv.	12,827	10,533	-2.0%	6,860	-1.4%
	Air Transportation	10,456	3,604	-10.1%	1,989	-2.0%
	Apparel Manufacturing	4,979	2,399	-7.0%	1,061	-2.7%
	All Other Industries	1,540,922	1,452,997	-0.6%	1,640,280	0.4%
	All Industries	**2,301,318**	**2,210,987**	**-0.4%**	**2,765,733**	**0.8%**

Source: Moody's Forecasts 2011

2 Missouri's Inbound Rail Freight Market and Forecast

Based on the 2008 U.S. DOT Freight Analysis Framework and the Minnesota IMPLAN Group, Inc. IMPLAN® ratios of output on earnings and employment, commodities shipped into Missouri by rail supported more than $24.5 billion of output from Missouri's industries, more than $7 billion in wage income earned by Missouri households and more than 150,000 Missouri jobs. Many of these jobs are in service industries which do not ship goods by rail directly, but whose value chains and business processes are highly dependent on certain elements entering the state by rail. **Table 3** provides a summary of the industries in Missouri producing the largest number of jobs using business processes dependent on inbound rail movements. The table also gives the rail-enabled output and personal income in those industries, as well as the percentage of transportation services or costs paid by the industry which are for goods moving by rail.

Table 3: Inbound Rail Dependency of Missouri Industries

NAICS	Industry Description	Output Share of Rail Shipped Commodities ($millions)	Employment Output Share of Rail Shipped Commodities	Wage Income Share of Rail Shipped Commodities ($millions)	% Rail of All Modes
920	Government and Non-NAICs	$2,512	35,300	$1,870	18%
230	Construction	$2,119	16,286	$772	13%
481-487	Transportation	$1,985	13,171	$703	33%
561	Administrative and Support Services	$699	11,349	$357	27%
621-624	Health Care and Social Services	$893	10,674	$471	11%
111	Crop Production	$567	7,229	$47	23%
441-454	Retail Trade	$393	6,104	$162	14%
336	Transportation Equipment	$4,109	5,517	$561	17%
721-722	Accommodations, Eating and Drinking	$303	5,449	$100	6%
811-812	Repair, Maintenance, and Personal Services	$384	4,421	$127	13%
	All Other Industries	$10,548	34,933	$1,928	12%
	Total	**$24,513**	**150,434**	**$7,097**	**15%**

Source: EDR TREDIS System (2008) (From FAF3 and Vectors from Missouri IMPLAN Group); in 2010 dollars

2.1 Commodities Supplied to Missouri by Rail

In 2011, it is estimated more than 65.7 million tons of freight was supplied to Missouri by rail (**Table 4**). Eighty one percent of this tonnage (more than 53.3 million) is estimated to be coal with other major inbound rail commodities including farm products, food and kindred products, chemicals and allied products, primary metals and transportation equipment.

Table 4 shows the forecast for commodity growth in Missouri's inbound rail freight traffic to 2031 and 2041 based on projected growth in Missouri counties and their national and international trading partners. The 2041 forecast for the top ten commodities by tonnage shipped to Missouri is also shown. Based on these forecasts, the commodity mix is expected to diversify by 2031 and 2041, with coal accounting for 72 percent of inbound commodities by 2031 (with the same share in 2041), and the most significant long-term growth will be in hazardous materials, chemicals and allied products, and primary metals.

Table 4: Missouri's Top Ten Inbound Commodities for 2011, 2031 and2041

Commodity	2011 Tonnage	2031 Tonnage	2041 Tonnage	Share of 2041 Tonnage	20 Year CAGR%	30 Year CAGR%
Coal	53,340,146	66,450,521	75,899,776	72.0%	1.1%	1.2%
Chemicals or Allied Products	1,588,632	3,348,225	4,547,760	4.3%	3.8%	3.6%
Hazardous Materials	965,391	2,598,689	3,094,608	2.9%	5.1%	4.0%
Primary Metal Products	1,218,539	2,242,222	2,546,150	2.4%	3.1%	2.5%
Farm Products	1,956,645	2,676,166	2,439,412	2.3%	1.6%	0.7%
Food or Kindred Products	1,893,251	2,382,629	2,195,840	2.1%	1.2%	0.5%
Transportation Equipment	1,102,960	1,436,007	1,894,646	1.8%	1.3%	1.8%
Clay, Concrete, Glass, or Stone Products	610,158	1,042,429	1,313,518	1.2%	2.7%	2.6%
Pulp, Paper, or Allied Products	763,693	829,302	928,145	0.9%	0.4%	0.7%
Lumber or Wood Products, excluding Furniture	907,551	806,740	835,771	0.8%	-0.6%	-0.3%
All Other Commodities	*1,388,774*	*8,250,946*	*9,782,700*	*9.3%*	*9.3%*	*6.7%*
Total	**65,735,737**	**92,063,876**	**105,478,327**	**100.0%**	**1.7%**	**1.6%**

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

CAGR: Compound Annual Growth Rate

Tables 5 and 6 show those commodity markets in Missouri for which the inbound rail utilization to Missouri is expected to change most significantly over the next 20 to 30 years. Inbound commodities for which Missouri's rail freight market is expected to grow most rapidly in the 20- and 30-year span of the analysis include fabricated metal products and electrical machinery and supplies. There is also expected to be significant growth in hazardous materials, miscellaneous freight shipments, and empty carriers entering Missouri by rail, primarily attributable to economic growth in key trading partners shipping these to Missouri. Fifteen percent of the hazardous material entering Missouri comes from Texas, and is expected to grow significantly as Texas' economy grows at a rate beyond the U.S. as a whole. Furthermore, 79 percent of the empty containers entering Missouri come from either Utah (57 percent) or Texas (22 percent), both of which are expected to be among the fastest growing states in manufacturing in rail commodities according to the Moody's forecast. Overall, Missouri is expected to ship less leather and allied products, apparel and textile products, printed matter, lumber and wood products and furniture into

the state by rail in future years. Many of these commodities decline both for inbound and outbound trade, as the industries producing and shipping these commodities by rail are expected to decline overall nationally according to the Moody's forecast.

Table 5: 20-year Changes in Inbound Rail Shipments to Missouri by Commodity Group (2011 to 2031)

Top Increasing / Declining Flows	Commodity	Net Change in Tonnage	20 Year CAGR%
Top 5 Increasing Commodity Flows 2011-2031	Fabricated Metal Products	39,172	10.7%
	Miscellaneous Freight Shipments	192,267	10.1%
	Hazardous Materials	1,633,298	5.1%
	Electrical Machinery, Equipment or Supplies	12,444	4.3%
	Containers, Carriers or Devices, Shipping, Returned Empty	33,637	4.1%
5 Most Decreasing Commodity Flows 2011-2031	Leather or Leather Products	-15	-3.6%
	Apparel or Other Finished Textile Products	-983	-1.9%
	Furniture or Fixtures	-276	-1.2%
	Printed Matter	-143	-0.9%
	Lumber or Wood Products, excluding Furniture	-100,811	-0.6%
Other Flows	All Other Commodities	24,519,548	1.6%
Total Forecast Change	**All Commodities**	**26,328,138**	**1.7%**

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)
CAGR: Compound Annual Growth Rate

Table 6: 30-year Changes in Inbound Rail Shipments to Missouri by Commodity Group (2011 to 2041)

Top Increasing / Declining Flows	Commodity	Net Change in Tonnage	30 Year CAGR%
Top 5 Increasing Commodity Flows 2011-2041	Fabricated Metal Products	47,039	7.6%
	Miscellaneous Freight Shipments	233,360	7.2%
	Hazardous Materials	2,129,217	4.0%
	Electrical Machinery, Equipment or Supplies	19,214	3.8%
	Containers, Carriers or Devices, Shipping, Returned Empty	52,693	3.7%
5 Most Decreasing Commodity Flows 2011-2041	Leather or Leather Products	-18	-3.1%
	Apparel or Other Finished Textile Products	-1,236	-1.7%
	Printed Matter	-267	-1.3%
	Lumber or Wood Products, excluding Furniture	-71,779	-0.3%
	Furniture or Fixtures	-17	0.0%
Other Flows	All Other Commodities	37,334,384	1.6%
Total Forecast Change	**All Commodities**	**39,742,590**	**1.6%**

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)
CAGR: Compound Annual Growth Rate

2.2 Locations and Trading Partners for Missouri's Inbound Rail Freight

Tables 7, 8 and 9 show the estimated and anticipated concentration of inbound rail commodities by Missouri counties in 2011, 2031, and 2041. The major trade centers in Jackson and Franklin counties, as well as St. Louis City and St. Louis County, are the largest destinations for inbound rail freight tonnage, collectively accounting for two thirds of Missouri's inbound rail freight tonnage. Bates County is a particularly significant rail dependent county because, while it has a very small share of the state's overall population (or employment), it is the destination of more than nine percent of the state's inbound rail freight—almost all of which is coal. New Madrid, Macon and Henry counties are other less populous counties in Missouri, with a higher concentration of inbound rail consumption than most other counties in the state.

The mix of rail-inbound rail-dependent counties in Missouri is not expected to change significantly in the 20-year horizon of the plan; however, as the Bates County economy grows in less rail dependent industries, it is expected its share of rail inbound freight will decline somewhat.

Table 7: Top Ten Rail Inbound Counties in Missouri by Tonnage - 2011

Destination	Rail Tonnage	Share of 2011 Tonnage	Employment	Employment Share
Jackson	20,648,585	31.4%	354,539	12.6%
Franklin	12,822,173	19.5%	39,400	1.4%
Bates	6,001,442	9.1%	4,998	0.2%
St. Louis City	5,543,829	8.4%	229,054	8.1%
St. Louis County	4,345,595	6.6%	599,184	21.3%
New Madrid	4,344,212	6.6%	8,633	0.3%
Macon	3,234,505	4.9%	6,620	0.2%
Henry	2,010,499	3.1%	9,092	0.3%
Jasper	1,579,405	2.4%	61,146	2.2%
Buchanan	1,413,017	2.1%	50,212	1.8%
All Others	3,792,476	5.8%	1,449,365	51.5%
Total	**65,735,737**	**100.0%**	**2,812,242**	**100.0%**

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

Table 8: Top Ten Rail Inbound Counties in Missouri by Tonnage - 2031

Destination	Rail Tonnage	Share of 2031 Tonnage	Employment	Employment Share
Jackson	32,796,127	35.6%	407,599	12.6%
Franklin	18,413,235	20.0%	51,233	1.6%
St. Louis City	7,721,549	8.4%	227,301	7.1%
Bates	6,590,527	7.2%	4,917	0.2%
St Louis County	5,635,271	6.1%	698,128	21.7%
New Madrid	4,980,746	5.4%	7,327	0.2%
Macon	3,988,539	4.3%	5,935	0.2%
Jasper	2,426,195	2.6%	69,615	2.2%
Henry	2,270,198	2.5%	8,553	0.3%
Buchanan	1,979,490	2.2%	51,111	1.6%
All Others	5,261,999	5.7%	1,690,966	52.5%
Total	**92,063,876**	**100.0%**	**3,222,686**	**100.0%**

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

Table 9: Top Ten Rail Inbound Counties in Missouri by Tonnage - 2041

Destination	Rail Tonnage	Share of 2041 Tonnage	Employment	Employment Share
Jackson	37,328,454	35.4%	438,076	12.7%
Franklin	22,507,169	21.3%	57,089	1.7%
St. Louis City	8,693,875	8.2%	229,860	6.7%
Bates	7,050,900	6.7%	4,929	0.1%
St. Louis County	6,539,503	6.2%	741,512	21.6%
New Madrid	5,403,872	5.1%	6,868	0.2%
Macon	4,514,007	4.3%	5,613	0.2%
Jasper	2,823,938	2.7%	76,571	2.2%
Henry	2,413,378	2.3%	8,250	0.2%
Buchanan	2,193,605	2.1%	50,397	1.5%
All Others	*6,009,625*	*5.7%*	*1,820,513*	*52.9%*
Total	**105,478,327**	**100.0%**	**3,439,677**	**100.0%**

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

Tables 10, 11, and 12 show the 2011, 2031, and 2041 estimated inbound freight demand to Missouri from key trading partners. The tables also show the dominant commodity traded with each partner, and the share of overall trade which is in the dominant commodity. While commodities shipped into Missouri by rail come from various locations, more than 81 percent of Missouri's inbound freight in 2011 comes from Wyoming, almost all of which (98.8 percent) is coal. Other significant sources of inbound rail freight to Missouri include Iowa and North Dakota, which

ships primarily food and farm products into Missouri; Texas, which ships chemicals and allied products; and Utah, also ships coal into Missouri.

In the long term, coal from Wyoming is expected to represent a smaller share of overall inbound rail to Missouri (down to 73 percent of inbound tonnage by 2031), allowing for a more diverse commodity profile in the future. Economic growth in Washington and New Jersey is expected to make these partners much higher sources of inbound freight by 2041 than they were in 2011. However, the level of commodity detail in the STB waybill data characterizes Missouri's inbound rail from these locations as "Freight All Kinds" – hence further study of Missouri's rail trade relationships with these states may be warranted beyond the current plan.

Table 10: Top Ten Origins of Missouri Rail Inbound Rail Shipments - 2011

Origin	Total Tons	Share of 2011 Tonnage	Highest Commodity %	Commodity Type
Wyoming	53,559,039	81.5%	98.8%	Coal
Iowa	1,162,205	1.8%	68.3%	Food or Kindred Products
North Dakota	1,079,157	1.6%	63.9%	Farm Products
Texas	935,463	1.4%	39.4%	Chemicals or Allied Products
Utah	820,581	1.2%	51.5%	Coal
Arkansas	698,594	1.1%	24.3%	Clay, Concrete, Glass, or Stone Products
Arizona	677,613	1.0%	99.1%	Transportation Equipment
Kansas (excluding Topeka & Kansas City)	660,200	1.0%	65.0%	Farm Products
Minnesota	519,726	0.8%	57.0%	Food or Kindred Products
Louisiana	388,673	0.6%	29.6%	Chemicals or Allied Products
All Others	5,234,488	8.0%	Various	
Total	**65,735,737**	**100.0%**		

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

Table 11: Top Ten Origins of Missouri Rail Inbound Rail Shipments - 2031

Origin	Total Tons	Share of 2031 Tonnage	Highest Commodity %	Commodity Type
Wyoming	67,402,375	73.2%	97.8%	Coal
Washington	2,846,064	3.1%	95.3%	Freight All Kinds
New Jersey	2,548,681	2.8%	95.8%	Freight All Kinds
North Dakota	1,627,710	1.8%	68.1%	Farm Products
Texas	1,554,482	1.7%	46.7%	Chemicals or Allied Products
Iowa	1,469,289	1.6%	70.5%	Food or Kindred Products
Utah	1,452,369	1.6%	38.1%	Primary Metal Products
San Francisco, California	1,237,428	1.3%	74.4%	Freight All Kinds
Kansas (excluding Topeka & Kansas City)	904,953	1.0%	60.1%	Farm Products
Arizona	897,993	1.0%	99.0%	Transportation Equipment
All Others	10,122,531	11.0%	Various	
Total	**92,063,876**	**100.0%**		

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

Table 12: Top Ten Origins of Missouri Rail Inbound Rail Shipments - 2041

Origin	Total Tons	Share of 2041 Tonnage	Highest Commodity %	Commodity Type
Wyoming	77,250,457	73.2%	97.5%	Coal
Washington	3,341,550	3.2%	95.8%	Freight All Kinds
New Jersey	2,988,907	2.8%	95.9%	Freight All Kinds
Texas	2,033,509	1.9%	52.0%	Chemicals or Allied Products
Utah	1,750,903	1.7%	37.8%	Primary Metal Products
North Dakota	1,506,801	1.4%	68.2%	Farm Products
San Francisco, California	1,450,920	1.4%	74.8%	Freight All Kinds
Iowa	1,354,422	1.3%	70.9%	Food or Kindred Products
Arizona	1,190,906	1.1%	99.2%	Transportation Equipment
Louisiana	1,131,688	1.1%	55.5%	Chemicals or Allied Products
All Others	11,478,264	10.9%	Various	
Total	**105,478,327**	**100.0%**		

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

Tables 13 and 14 show the trading partners with which Missouri's inbound rail freight trade is expected to change the most significantly by 2031 and 2041, respectively. In addition to the growth in trade with New Jersey and Washington, Missouri is expected to see an increase in trade with the Indiana portion of the Chicago region, Virginia, and San Francisco, California. While some of these locations are not expected to be in the top ten trading partners for Missouri, the Moody's forecasts suggest these partners will experience growth in industry sectors shipped to Missouri by rail, and further study into these trading relationships may be warranted. Trade areas expected to decline as sources of inbound rail to Missouri include the Sacramento, California region; the Memphis, Tennessee region; and the Cleveland, Ohio region. However, declines in demand for shipments to Missouri from these two regions are not expected to be of a magnitude comparable to growth in the top growing trading partners.

Table 13: Inbound Rail Shipments to Missouri by Origin (2011 - 2031)

Top Increasing / Declining Flows	Origin	Net Change in Tonnage	20 Year CAGR%
Top 5 Most Increasing Flows 2011-2031	New Jersey	2,337,779	13.3%
	Washington	2,520,610	11.5%
	Chicago	513,203	10.7%
	Virginia	92,877	10.1%
	San Francisco, California	1,042,988	9.7%
Top 4 Most Decreasing Flows 2011-2031	Sacramento, California	-1,733	-3.6%
	Memphis, Tennessee	-10,747	-1.4%
	Cleveland, Ohio	-383	-0.3%
	British Columbia, Canada	-6,889	-0.1%
Other Flows	All Other Locations	19,840,434	1.4%
Total Forecast Change	**All Locations**	**26,328,139**	**1.7%**

Source: 2006 Waybill and EDR Estimates Extrapolated using IMPLAN Data and Moody's Forecasts

Table 14: Inbound Rail Shipments to Missouri by Origin (2011 - 2041)

Top Increasing / Declining Flows	Origin	Net Change in Tonnage	Compound Annual Growth Rate
Top 5 Most Increasing Flows 2011-2041	New Jersey	2,778,005	9.2%
	Washington	3,016,096	8.1%
	Indiana Portion of Chicago, Illinois Region	606,838	7.5%
	Virginia	109,895	7.1%
	San Francisco, California	1,256,481	6.9%
Top 3 Most Decreasing Flows 2011-2041	Sacramento, California	-2,043	-3.1%
	Memphis, Tennessee	-19,276	-1.9%
	Cleveland, Ohio	-99	-0.1%
Other Flows	All Other Locations	31,996,692	1.4%
Total Forecast Change	**All Locations**	**39,742,590**	**1.59%**

Source: 2006 Waybill and EDR Estimates Extrapolated using IMPLAN Data and Moody's Forecasts

3 Missouri's Outbound Rail Freight Market and Forecast

Based on the 2008 U.S. DOT Freight Analysis framework and IMPLAN ratios of output to earnings and employment, commodities shipped out of Missouri by rail supported more than $24.2 billion of output from Missouri's industries, more than $3 billion in wage income earned by Missouri households, and more than 67,000 Missouri jobs. Unlike inbound rail, outbound rail supports the state's economy by making markets for goods produced in Missouri available, enabling Missouri establishments to produce output, and supporting jobs and earnings for Missouri's workers. Most of these jobs are in Missouri's manufacturing sectors, some of which are basic to the state's economy and others of which may be growth sectors (as described in **Section 1.1** of this report). **Table 15** provides a summary of the industries in Missouri producing the largest number of jobs in business processes dependent on outbound rail movements, also giving the rail-enabled output and personal income in those industries, as well as the percentage of transportation services or costs paid by the industry to move goods by rail.

Table 15: Rail Outbound Dependency for Missouri Industries

Top 10 Job-Creating Rail Outbound Rail Shipments from Missouri (Output, Value Added, Employment and Income Attributable to Rail, and Rail Share Overall)					
NAICS	Industry Description	Output Share of Rail Shipped Commodities ($millions)	Employment Output Share of Rail Shipped Commodities	Wage Income Share of Rail Shipped Commodities ($millions)	Percent Rail of All Modes
111	Crop Production	$2,242	28,572	$184	34%
336	Transportation Equipment	$13,682	18,367	$1,869	48%
333	Machinery Manufacturing	$4,153	12,438	$755	25%
311	Food Products	$1,749	3,161	$165	11%
332	Fabricated Metal Products	$304	1,122	$66	5%
321	Wood Products	$92	591	$19	9%
325	Chemical Manufacturing	$655	540	$54	4%
212-213	Mining and Support Activities	$130	373	$37	19%
326	Plastics and Rubber Products	$97	350	$19	3%
211	Oil and Gas Extraction	$131	315	$6	2%
	All Other Industries	$988	1,480	$126	1%
	Total	**$24,223**	**67,308**	**$3,300**	**15%**

Source: EDR TREDIS System (2008) (From FAF3 and Vectors from IMPLAN Group); in 2010 dollars

3.1 Commodities Shipped From Missouri by Rail

In 2011, it is estimated more than 19.0 million tons of freight were supplied to the rest of the world from Missouri by rail. Sixty three percent of this tonnage (more than 11.9 million tons) is concentrated in the top four commodities of transportation equipment (17 percent), farm products (18 percent), clay, concrete, glass or stone products (10 percent) and food or kindred products (17 percent).

Table 16 shows the forecast for commodity growth in Missouri's outbound rail freight traffic to 2031 and 2041 based on projected growth both in Missouri counties and their national and international trading partners. The 2041 forecast for the top ten outbound commodities by tonnage is also shown. The commodity mix shipped out of Missouri by rail is expected to diversify overall (with the top four commodities representing only 61 percent by 2041); however, growth in trade with car manufacturing nodes in Texas (supplied by Missouri firms) is expected to significantly increase the transportation equipment share of outbound rail tonnage from 17 percent in 2011 to more than 30 percent in 2031 and 2041.

Table 16: Top Ten Outbound Commodities in 2011, 2031 and 2041

Commodity	2011 Tonnage	2031 Tonnage	2041 Tonnage	Share of 2041 Tonnage	20 Year CAGR%	30 Year CAGR%
Transportation Equipment	3,297,508	6,646,113	9,541,550	30.2%	3.6%	3.6%
Farm Products	3,360,179	4,044,426	3,491,590	11.0%	0.9%	0.1%
Clay, Concrete, Glass, or Stone Products	1,961,465	2,720,443	3,114,451	9.9%	1.6%	1.6%
Food or Kindred Products	3,289,334	3,331,213	2,998,101	9.5%	0.1%	-0.3%
Waste Hazardous Materials or Waste Hazardous Substances	1,366,105	2,247,904	2,681,571	8.5%	2.5%	2.3%
Waste or Scrap Materials	1,532,247	1,964,876	2,118,197	6.7%	1.3%	1.1%
Non-metallic Minerals	1,222,890	1,685,852	1,892,874	6.0%	1.6%	1.5%
Chemicals or Allied Products	495,285	1,034,177	1,251,980	4.0%	3.7%	3.1%
Hazardous Materials	514,147	925,252	1,115,932	3.5%	3.0%	2.6%
Primary Metal Products	384,814	562,433	584,814	1.9%	1.9%	1.4%
All Others	1,621,013	2,466,926	2,809,759	8.9%	2.1%	1.9%
Total	**19,044,988**	**27,629,613**	**31,600,820**	**100.0%**	**1.9%**	**1.7%**

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)
CAGR: Compound Annual Growth Rate

Tables 17 and 18 show those commodity markets in Missouri for which the outbound rail utilization from Missouri is expected to change the most significantly by 2031 and 2041, respectively. Outbound commodities where Missouri's rail freight market is expected to grow the most rapidly in the 20- and 30-year time period of the analysis include: electrical machinery, equipment or supplies, chemicals or allied products, fabricated metal products, and transportation equipment. Many of these commodities are also among the fastest growing inbound commodities

shown in **Tables 5 and 6**. This is because these industries are integral to Missouri's economy which (1) rely heavily on rail to access markets and inputs; and (2) are expected to grow nationally over the life of the plan and beyond. There is also expected to be significant growth in containers shipped out of the state (just as there is an expected growth in containers shipped into the state), which is largely a function in the overall growth of freight activity.

Missouri is expected to ship less textile mill products, apparel and other finished textile products, furniture, lumber or wood products, and pulp, paper and allied products from the state in the future than it does today. As stated earlier, many of these are expected to be declining industries nationally for which Missouri's rail markets are likely to reflect some share of the overall decline.

Table 17: 20-year Changes in Outbound Rail Shipments from Missouri by Commodity Group (2011-2031)

Top Increasing / Declining Flows	Commodity	Net Change in Tonnage	20 Year CAGR%
Top 5 Increasing Commodity Flows 2011-2031	Electrical Machinery, Equipment, or Supplies	23,550	4.9%
	Containers, Carriers or Devices, Shipping, Returned Empty	29,969	3.8%
	Chemicals or Allied Products	538,892	3.8%
	Fabricated Metal Products	16,214	3.6%
	Transportation Equipment	3,348,605	3.6%
Top 5 Decreasing Commodity Flows 2011-2031	Textile Mill Products	-13,094	-2.6%
	Apparel or Other Finished Textile Products	-3,597	-2.4%
	Furniture or Fixtures	-416	-1.7%
	Lumber or Wood Products, excluding Furniture	-29,052	-0.6%
	Pulp, Paper, or Allied Products	-2,498	-0.4%
Other Flows	All Other Commodities	4,676,485	1.4%
Total Forecast Change	**All Commodities**	**8,585,058**	**1.9%**

Source: 2006 Waybill and EDR Estimates Extrapolated using IMPLAN Data and Moody's Forecasts
CAGR: Compound Annual Growth Rate

Table 18: 30-year Changes in Outbound Rail Shipments from Missouri by Commodity Group (2011-2041)

Top Increasing / Declining Flows	Commodity	Net Change in Tonnage	20 Year CAGR%
Top 5 Increasing Commodity Flows 2011-2041	Electrical Machinery, Equipment, or Supplies	41,482	4.6%
	Containers, Carriers or Devices, Shipping, Returned Empty	56,034	3.8%
	Transportation Equipment	6,244,043	3.6%
	Small Packages, LTC or LTL	25,681	3.3%
	Fabricated Metal Products	25,017	3.2%
Top 5 Decreasing Commodity Flows 2011-2041	Apparel or Other Finished Textile Products	-5,238	-2.7%
	Textile Mill Products	-14,504	-2.0%
	Furniture or Fixtures	-413	-1.1%
	Printed Matter	-916	-0.9%
	Lumber or Wood Products, excluding Furniture	-34,776	-0.5%
Other Flows	All Other Commodities	6,219,723	1.1%
Total Forecast Change	**All Commodities**	**12,556,133**	**1.7%**

Source: 2006 Waybill and EDR Estimates Extrapolated using IMPLAN Data and Moody's Forecasts
CAGR: Compound Annual Growth Rate

3.2 Locations and Trading Partners for Missouri's Outbound Rail Freight

The major trade centers in Jackson and Franklin counties, as well as St. Louis City, are among the largest producers of outbound rail freight tonnage in Missouri. Of the major trade centers, Jackson County produces more than half (54.9 percent) of Missouri's outbound tonnage. This is significantly disproportional to the 12.6 percent share of the state's employment in Jackson County. With employment of only 50,212, Buchanan County produces more than a million tons of outbound rail (7.3 percent of Missouri's outbound rail overall). The majority of Buchanan County's outbound rail is farm products (61 percent) and food and kindred products (34 percent) reflecting the economic base supported by rail. All of the other counties in the top 10 account for relatively small shares of Missouri's overall outbound tonnage, but the disproportionate concentration of rail tonnage to their population shares suggest these counties have a special economic dependence on freight rail access and efficiency.

The mix of rail-outbound rail-dependent counties in Missouri is not expected to change significantly in 20 years; however, as Buchanan County's economy grows in less rail dependent industries, it is expected its share of rail outbound freight will decline somewhat. **Tables 19, 20 and 21** show the estimated and anticipated concentration of outbound rail commodities by Missouri counties in 2011, 2031, and 2041.

Table 19: Top Ten Rail Outbound Counties in Missouri by Tonnage - 2011

Origin	Rail Tonnage	Share of 2011 Tonnage	Employment	Employment Share
Jackson	9,096,044	54.9%	354,539	12.6%
Buchanan	1,644,773	7.3%	50,212	1.8%
St. Louis City	1,568,980	5.3%	229,054	8.1%
Franklin	846,078	5.3%	39,400	1.4%
Ste. Genevieve	664,343	4.9%	6,798	0.2%
Scott	549,435	3.5%	15,537	0.6%
Carroll	437,765	2.2%	3,658	0.1%
Pike	429,564	2.2%	7,492	0.3%
Saline	366,287	1.9%	10,442	0.4%
Stoddard	293,095	1.6%	12,639	0.4%
All Others	3,146,350	11.0%	2,082,471	74.1%
Total	**19,042,714**	**100.0%**	**2,812,242**	**100.0%**

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

Table 20: Top Ten Rail Outbound Counties in Missouri by Tonnage - 2031

Origin	Rail Tonnage	Share of 2031 Tonnage	Employment	Employment Share
Jackson	14,588,265	52.8%	407,599	12.6%
St. Louis City	2,353,909	8.5%	227,301	7.1%
Buchanan	1,738,955	6.3%	51,111	1.6%
Franklin	1,204,397	4.4%	51,233	1.6%
Scott	987,963	3.6%	13,734	0.4%
Ste. Genevieve	779,647	2.8%	6,542	0.2%
Pike	667,949	2.4%	7,070	0.2%
Saline	509,703	1.8%	9,529	0.3%
Carroll	481,477	1.7%	2,793	0.1%
Jefferson	421,826	1.5%	69,256	2.1%
All Others	3,893,681	14.1%	2,376,517	73.7%
Total	**27,627,772**	**100.0%**	**3,222,686**	**100.0%**

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

Table 21: Top Ten Rail Outbound Counties in Missouri by Tonnage - 2041

Origin	Rail Tonnage	Share of 2041 Tonnage	Employment	Employment Share
Jackson	17,809,545	56.4%	438,076	12.7%
St. Louis City	2,747,186	8.7%	229,860	6.7%
Buchanan	1,557,734	4.9%	50,397	1.5%
Franklin	1,342,479	4.2%	57,089	1.7%
Scott	1,119,027	3.5%	12,968	0.4%
Ste. Genevieve	880,796	2.8%	6,377	0.2%
Pike	788,124	2.5%	6,830	0.2%
Saline	495,075	1.6%	9,103	0.3%
Jefferson	472,360	1.5%	78,689	2.3%
St Louis	460,840	1.5%	741,512	21.6%
All Others	3,925,682	12.4%	1,808,776	52.6%
Total	**31,598,848**	**100.0%**	**3,439,677**	**100.0%**

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

Tables 22, 23, and 24 show the 2011, 2031, and 2041 estimated outbound freight demand from Missouri to key trading partners. The tables also show the dominant commodity traded with each partner and the commodity's share of overall trade. While commodities shipped out of Missouri by rail go to various locations, nearly half (49.2 percent) of Missouri's outbound freight in 2011 goes to either Texas (33.6 percent) or the Los Angeles, California region (15.6 percent). While trade to Texas is diverse in nature, with the predominant commodity (farm products) accounting for less than a third of outbound rail tonnage, the outbound tonnage to the Los Angeles region is more concentrated in transportation equipment. As can be seen in **Table 22**, transportation equipment is the predominant commodity at a number of the top trade locations in the west, including not only the Los Angeles region, but also the San Francisco region, Arizona and Utah. Expansion of the transportation equipment market in Texas by 2031 and 2041 is expected to be a source of considerable growth in Missouri's outbound rail tonnage. Increases in tonnage to Kansas is also anticipated, representing an emerging market for clay, concrete, glass, or stone products from Missouri shipped by rail. The other major locations of rising outbound rail shipments to which Missouri is currently shipping waste or hazardous materials by rail are locations such as: Kansas, Arkansas, the Memphis, Tennessee region, New Jersey, Illinois, and Iowa.

Table 22: Top Ten Destinations of Outbound Rail Shipments - 2011

Destination	Total Tons	Share of Tons	Highest Commodity %	Commodity Type
Texas	13,446,155,646	33.6%	31.0%	Farm Products
Los Angeles,	6,247,381,652	15.6%	83.1%	Transportation Equipment
San Francisco, California	2,936,655,075	7.3%	60.3%	Transportation Equipment
Arizona	1,659,036,716	4.1%	45.7%	Transportation Equipment
Oregon	1,273,901,268	3.2%	28.2%	Freight All Kinds
Colorado	1,168,768,313	2.9%	33.5%	Miscellaneous Products of Manufacturing
California (non-metro areas)	1,056,099,663	2.6%	49.4%	Food or Kindred Products
Utah	1,009,472,091	2.5%	48.4%	Transportation Equipment
Oklahoma City, Oklahoma	995,128,207	2.5%	41.8%	Food or Kindred Products
Washington	878,702,084	2.2%	42.8%	Freight All Kinds
All Others	9,404,477,286	23.5%	Various	
Total	**40,075,778,000**	**100.0%**		

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

Table 23: Top Ten Destinations of Outbound Rail Shipments - 2031

Destination	Total Tons	Share of Tons	Highest Commodity %	Commodity Type
Texas	7,295,322	26.4%	48.1%	Transportation Equipment
Kansas Portion of Kansas City Region	1,576,806	5.7%	51.7%	Clay, Concrete, Glass, or Stone Products
Los Angeles	1,459,844	5.3%	88.1%	Transportation Equipment
Kansas (excluding Topeka & Kansas City)	1,257,507	4.6%	60.3%	Waste Hazardous Materials
Arkansas	1,204,069	4.4%	39.2%	Waste or Scrap Materials
San Francisco, California	946,196	3.4%	51.6%	Transportation Equipment
Memphis, Tennessee	903,171	3.3%	63.1%	Waste Hazardous Materials
New Jersey	860,791	3.1%	63.2%	Waste Hazardous Materials
Illinois Portion of St. Louis Region	798,096	2.9%	44.6%	Waste or Scrap Materials
Iowa	791,347	2.9%	47.5%	Waste Hazardous Materials
All Others	10,534,624	38.1%	Various	
Total	**27,627,774**	**100.0%**		

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

Table 24: Top Ten Destinations of Outbound Rail Shipments - 2041

Destination	Total Tons	Share of Tons	Highest Commodity %	Commodity Type
Texas	9,051,686	28.6%	59.7%	Transportation Equipment
Los Angeles	1,830,291	5.8%	90.9%	Transportation Equipment
Kansas Portion of Kansas City Region	1,742,886	5.5%	51.9%	Clay, Concrete, Glass, or Stone Products
Kansas (excluding Topeka & Kansas City)	1,344,897	4.3%	67.2%	Waste Hazardous Materials
Arkansas	1,145,451	3.6%	45.2%	Waste or Scrap Materials
San Francisco, California	1,144,252	3.6%	53.7%	Transportation Equipment
Memphis, Tennessee	1,021,815	3.2%	66.5%	Waste Hazardous Materials
New Jersey	1,006,687	3.2%	64.5%	Waste Hazardous Materials
Iowa	864,091	2.7%	51.9%	Waste Hazardous Materials
Illinois Portion of St. Louis Region	827,546	2.6%	50.9%	Waste or Scrap Materials
All Others	11,619,244	36.8%	Various	
Total	**31,598,848**	**100.0%**		

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

Tables 25 and 26 show the trading partners with which Missouri's outbound rail freight trade is expected to change the most significantly by 2031 and 2041, respectively.

Some locations not expected to reach the top 10 destinations of Missouri's outbound rail tonnage are expected to experience significant growth in the next 20 to 30 years. In particular, Virginia, Montana, the Indiana portion of the Chicago region and non-metropolitan areas of Ohio are regions of the U.S with an industry composition and forecasts suggesting rail markets could be rapidly increasing over time.

Maine, South Carolina, Wisconsin, Arkansas and non-metropolitan areas of Oklahoma are regions expected to experience significant declines in markets for commodities shipped from Missouri by rail. Further study of the commodities traded to these locations and their outlook may be warranted to assess the dynamics and potential implications of these markets over time.

Table 25: Outbound Rail Shipments from Missouri by Destination (2011-2031)

Top Increasing / Declining Flows	Destination	Net Change in Tonnage	20 Year CAGR%
Top 5 Most Increasing Flows 2011-2031	Virginia	188,641	5.6%
	Montana	24,921	4.4%
	Indiana Portion of the Chicago Region	26,859	4.0%
	Non-metropolitan Areas of Ohio	54,004	3.6%
	San Francisco, California	454,180	3.3%
Top 5 Most Decreasing Commodity Flows 2011-2031	South Carolina	-4,090	-0.8%
	Cincinnati, Ohio	-299	-0.4%
	Maine	-1,339	-0.4%
	Alberta, Canada	-677	-0.3%
	Wisconsin	-2,886	-0.2%
Other Flows	All Other Locations	7,845,745	1.8%
Total Forecast Change	**All Locations**	**8,585,060**	**1.9%**

Source: 2006 Waybill and EDR Estimates Extrapolated Using IMPLAN Data and Moody's Forecasts
CAGR: Compound Annual Growth Rate

Table 26: Outbound Rail Shipments from Missouri by Destination (2011-2041)

Top Increasing / Declining Flows	Destination	Net Change in Tonnage	30 Year CAGR%
Top 5 Most Increasing Flows 2011-2041	Virginia	290,048	4.7%
	Montana	40,708	4.0%
	Chicago	31,780	3.0%
	Utah	232,036	2.9%
	San Francisco, California	652,236	2.9%
Top 5 Most Decreasing Commodity Flows 2011-2041	Non-metropolitan Areas of Oklahoma	-118,401	-1.1%
	Maine	-3,968	-0.8%
	South Carolina	-4,672	-0.7%
	Wisconsin	-8,166	-0.5%
	Arkansas	-86,023	-0.2%
Other Flows	All Other Commodities	113,112,895	1.7%
Total Forecast Change	**All Commodities**	**12,556,134**	**1.7%**

Source: 2006 Waybill and EDR Estimates Extrapolated Using IMPLAN Data and Moody's Forecasts
CAGR: Compound Annual Growth Rate

4 Missouri's Internal Freight Rail Markets

While internal movements account for less than three percent of Missouri's overall rail freight activity, there are some commodities and trading relationships within Missouri for which access to intra-state trading partners plays a strategic role. Based on the 2008 Freight Analysis Framework, the production and use of commodities moving by rail between origins and destinations within Missouri supports $75 million in output from Missouri firms, $12 million in income to Missouri households and more than 500 Missouri jobs. **Table 27** shows the industries where intra-state freight movement has the greatest impact on jobs, and the associated impact on industry output and household earnings.

Table 27: Rail Internal Dependency for Missouri Industries

Top 10 Job-Creating Rail Internal Rail Shipments to Missouri (Output, Value Added, Employment and Income Attributable to Rail, and Rail Share)						
NAICS	Industry Description	Output Share of Rail Shipped Commodities ($millions)	Value Added Share of Rail Shipped Commodities ($millions)	Employment Output Share of Rail Shipped Commodities	Wage Income Share of Rail Shipped Commodities ($millions)	% Rail of All Modes
111	Crop Production	$19	$9	235	$2	1.6%
112	Animal Production	$4	$1	49	$0	0.2%
721-722	Accommodations, Eating & Drinking	$2	$1	33	$1	0.1%
230	Construction	$4	$2	33	$2	0.1%
311	Food Products	$17	$3	31	$2	0.3%
920	Government & non NAICs	$2	$2	31	$2	0.1%
621-624	Health Care & Social Services	$2	$1	25	$1	0.1%
321	Wood Products	$3	$1	16	$1	0.8%
441-454	Retail Trade	$1	$1	11	$0	0.1%
531	Real Estate	$2	$1	7	$0	0.6%
	All Others	$20	$7	51	$3	0.1%
	Total	**$75**	**$28**	**521**	**$12**	**0.2%**

Source: EDRG TREDIS System (2008 data) (From FAF3 and Vectors from Missouri IMPLAN Group); in 2010 dollars

The majority of Missouri's internal rail freight tonnage is either farm products (42 percent) or non-metallic minerals (23 percent). Clay, concrete, glass and stone products also comprise a significant share (15 percent) with other commodities comprising less than 10 percent for any given commodity. These shares are expected to remain generally stable beyond the life of the plan, with shares of 32 percent, 31 percent and 16 percent, respectively by 2041. **Table 28** summarizes the composition of Missouri's internal rail freight commodities and their anticipated growth by the years 2031 and 2041, respectively.

Table 28: Commodity Summary of Internal Rail Movements (2011-2041)

Commodity	2011 Tonnage	2031 Tonnage	2041 Tonnage	Share of 2041 Tonnage	20 Year CAGR%	30 Year CAGR%
Farm Products	954,064	984,641	839,792	31.5%	0.2%	-0.4%
Non-metallic Minerals	529,792	653,354	830,999	31.2%	1.1%	1.5%
Clay, Concrete, Glass, or Stone Products	334,104	436,765	436,144	16.4%	1.3%	0.9%
Chemicals or Allied Products	56,472	136,711	188,937	7.1%	4.5%	4.1%
Food or Kindred Products	175,032	211,087	177,834	6.7%	0.9%	0.1%
Waste or Scrap Materials	44,154	103,823	135,037	5.1%	4.4%	3.8%
Coal	157,335	75,535	33,841	1.3%	-3.6%	-5.0%
Hazardous Materials	6,258	8,186	9,846	0.4%	1.4%	1.5%
Pulp, Paper, or Allied Products	4,185	7,310	6,895	0.3%	2.8%	1.7%
Transportation Equipment	2,628	3,229	3,607	0.1%	1.0%	1.1%
All Others	7,570	5,463	3,445	0.1%	-1.6%	-2.6%
Total	**2,271,595**	**2,626,105**	**2,666,377**	**100.0%**	**0.7%**	**0.5%**

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)
CAGR: Compound Annual Growth Rate

Rail freight between St. Francois County and St. Louis City is the most prevalent freight movement within the state in 2011 and is expected to remain so through 2041 with internal movement (primarily of non-metallic minerals) within Ste. Genevieve as the second most prevalent movement. Other significant movements include internal rail freight activity within Jackson County, between Grundy and Jackson counties, and between St. Louis and Buchanan counties**. Tables 29, 30 and 31** show the forecasts for the top trading pairs among Missouri counties in 2011, 2031 and 2041, respectively.

Table 29: Trading Pair Summary of Internal Rail Movements - 2011

County Origin	County Destination	Tonnage	Share of Internal Tonnage	Cumulative Share
St. Francois	St. Louis City	455,030	20.0%	20.0%
Ste. Genevieve	Ste. Genevieve	298,656	13.1%	33.2%
Jackson	Jackson	168,748	7.4%	40.6%
Grundy	Jackson	155,564	6.8%	47.5%
Chariton	Jackson	115,289	5.1%	52.5%
Holt	Jasper	93,842	4.1%	56.7%
Saline	Jackson	74,813	3.3%	60.0%
Jackson	Buchanan	73,101	3.2%	63.2%
Howard	Jackson	68,339	3.0%	66.2%
Livingston	Jackson	55,757	2.5%	68.6%
All Others		712,457	31.4%	100.0%
Total		**2,271,595**	**100.0%**	

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

Table 30: Trading Pair Summary of Internal Rail Movements - 2031

County Origin	County Destination	Tonnage	Share of Internal Tonnage	Cumulative Share
St. Francois	St. Louis City	557,534	21.2%	21.2%
Ste. Genevieve	Ste. Genevieve	394,397	15.0%	36.2%
Grundy	Jackson	159,847	6.1%	42.3%
Chariton	Jackson	115,807	4.4%	46.7%
St Louis	Buchanan	103,316	3.9%	50.7%
Holt	Jasper	95,410	3.6%	54.3%
Jackson	Buchanan	91,645	3.5%	57.8%
Jefferson	Jefferson	91,132	3.5%	61.3%
Jackson	Jackson	85,886	3.3%	64.5%
Saline	Jackson	73,888	2.8%	67.4%
All Others		857,242	32.6%	100.0%
Total		**2,626,105**	**100.0%**	

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

Table 31: Trading Pair Summary of Internal Rail Movements - 2041

County Origin	County Destination	Tonnage	Share of Internal Tonnage	Cumulative Share
St. Francois	St. Louis City	721,167	27.0%	27.0%
Ste. Genevieve	Ste. Genevieve	385,896	14.5%	41.5%
St Louis	Buchanan	142,784	5.4%	46.9%
Grundy	Jackson	135,694	5.1%	52.0%
Jefferson	Jefferson	119,896	4.5%	56.5%
Chariton	Jackson	94,426	3.5%	60.0%
Holt	Jasper	83,130	3.1%	63.1%
Jackson	Buchanan	74,490	2.8%	65.9%
Saline	Jackson	62,565	2.3%	68.3%
Jackson	Barry	55,003	2.1%	70.3%
All Others		791,327	29.7%	100.0%
Total		**2,666,377**	**100.0%**	

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

5 Pass Through Freight Activity

Missouri's freight rail lines accommodate significant pass-through traffic. This is traffic which does not have any impact on the state's economy (beyond jobs associated with maintaining the rail lines), but supports the overall efficient movement of goods in the United States. Just as coal from Wyoming is Missouri's top inbound rail commodity, Missouri's rail lines carry millions of tons of coal from Wyoming on to states south and east. In 2011, coal from Wyoming to destinations in Texas, Illinois, Arkansas, Oklahoma and Louisiana comprised fully 56 percent of the rail tonnage moving through Missouri. By 2041, pass-through movements are expected to be somewhat more diverse, with coal from Wyoming comprising only 42 percent of the tonnage on Missouri's freight rail system, and transportation equipment from the Illinois portion of the St. Louis region to the San Francisco area rising to account for 10 percent of rail tonnage by 2041. The rise in transportation equipment from the St. Louis area to San Francisco is consistent with the earlier finding of significantly increasing outbound rail from the St. Louis area in Missouri to San Francisco and other California regions.

Tables 32, 33, and 34 summarize 2011, 2031, and 2041 estimates of top origin-destination trading pairs utilizing Missouri's freight rail system.

Table 32: Trading Pair Summary of Through Rail Movements - 2011

County Origin	County Destination	Tonnage	Share of Internal Tonnage	Cumulative Share
Wyoming	Texas	43,453,562	20.0%	20.0%
Wyoming	Non-metropolitan Areas of Illinois	31,504,643	14.5%	34.5%
Wyoming	Arkansas	19,895,630	9.2%	43.6%
Wyoming	Non-metropolitan Areas of Oklahoma	15,611,366	7.2%	50.8%
Wyoming	Tulsa, Oklahoma	6,743,966	3.1%	53.9%
Los Angeles, California	Chicago, Illinois	5,792,863	2.7%	56.6%
Texas	Chicago, Illinois	5,182,517	2.4%	59.0%
Wyoming	Louisiana	4,322,485	2.0%	61.0%
Remainder of Illinois	Texas	4,225,298	1.9%	62.9%
Illinois Portion 0f Chicago Region	Los Angeles, California	4,063,299	1.9%	64.8%
All Others		76,546,343	35.2%	100.0%
Total		**217,341,972**	**100.0%**	

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

Table 33: Trading Pair Summary of Through Rail Movements - 2031

County Origin	County Destination	Tonnage	Share of Internal Tonnage	Cumulative Share
Wyoming	Texas	61,351,576	18.4%	18.4%
Wyoming	Non-metropolitan Areas of Illinois	34,136,488	10.3%	28.7%
Wyoming	Arkansas	30,662,803	9.2%	37.9%
Illinois Portion of St. Louis Region	San Francisco, California	30,216,260	9.1%	47.0%
Wyoming	Non-metropolitan Areas of Oklahoma	15,180,684	4.6%	51.6%
Wyoming	Tulsa, Oklahoma	13,643,309	4.1%	55.7%
Los Angeles	Chicago, Illinois	12,846,050	3.9%	59.5%
Texas	Chicago, Illinois	11,270,692	3.4%	62.9%
Texas	Illinois Portion of St. Louis Region	7,607,779	2.3%	65.2%
Illinois Portion of St. Louis Region	Texas	5,130,474	1.5%	66.7%
All Others		110,675,753	33.3%	100.0%
Total		**332,721,868**	**100.0%**	

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

Table 34: Trading Pair Summary of Through Rail Movements - 2041

County Origin	County Destination	Tonnage	Share of Internal Tonnage	Cumulative Share
Wyoming	Texas	64,620,098	16.8%	16.8%
Illinois Portion of St. Louis Region	San Francisco, California	38,868,680	10.1%	27.0%
Wyoming	Non-metropolitan Areas of Illinois	32,308,438	8.4%	35.4%
Wyoming	Arkansas	32,007,797	8.3%	43.7%
Los Angeles, California	Chicago, Illinois	20,118,289	5.2%	49.0%
Wyoming	Tulsa, Oklahoma	16,713,247	4.4%	53.3%
Texas	Chicago, Illinois	16,097,177	4.2%	57.5%
Wyoming	Non-metropolitan Areas of Oklahoma	15,667,774	4.1%	61.6%
Texas	Illinois Portion of St. Louis Region	11,518,677	3.0%	64.6%
Canada	Texas	6,777,438	1.8%	66.4%
All Others		129,124,759	33.6%	100.0%
Total		**383,822,374**	**100.0%**	

Source: 2006 STB Waybill (Extrapolated Based on IMPLAN and Moody's Forecast)

6 Identification of Investment Opportunities

A key component of the Missouri State Rail Plan is the identification and prioritization of rail projects for the state. This section contains a summary of needs for freight, passenger and shared corridor infrastructure improvements and presents basic assumptions and choices associated with Missouri's rail investment strategy for rail infrastructure improvements. This investment strategy is intended to act as a guide for Missouri DOT in selecting future projects as funding becomes available. The Passenger Rail Investment and Improvement Act (PRIIA) of 2008 requires state rail plans to include short- and long-range investment programs.

Because Missouri does not have a comprehensive set of rail programs with detailed needs lists, concepts for potential passenger and freight rail opportunities were developed through stakeholder outreach; a consideration of projects for which funding has been sought in the past; and recent state, regional and national rail studies. For the purposes of economic analysis, these potential investment opportunities are organized into investment scenarios as summarized in **Table 35**.

Table 35: Missouri Rail Investment Packages

Investment Package	Description
Scenario 1: Preserve Existing Service	• The **Missouri River Runner** will continue to operate at current levels (two round trips per day) with all projects currently funded with federal grants completed. These improvements will ensure quality service with new passenger rail cars and a high on-time performance (90 percent). Ridership can be expected to continue to grow at a rate consistent with the previous five years (10 - 15 percent per year) until the maximum capacity of the train sets (approximately 350 passengers per train) is reached. • **Lincoln Service –** Illinois will complete construction of currently funded improvements on the St. Louis to Chicago corridor which will allow maximums speeds of 110 mph reducing travel times from 5 hours 40 minutes to 4 hours. • The two long distance trains serving Missouri, the **Southwest Chief** and the **Texas Eagle**, will continue to operate on the existing routes and schedules with no changes to the service.
Scenario 2: Expand Missouri River Runner Service	• A third round trip is added on the **Missouri River Runner** between St. Louis and Kansas City. • **Feeder bus service** is added between Jefferson City and Columbia and between St. Joseph and Kansas City connecting to all three round trip trains. • All other services remain the same as the maintenance level in Scenario 1.

Scenario 3: Future Service	• **Missouri River Runner** service is upgraded according the Midwest Regional Rail Initiative recommendations:
	  • Maximum speeds increased to 90 mph
	  • Six round trips per day
	• Conventional (79 mph maximum speed) service implemented on the "**Missouri Triangle**:"
	  • St. Louis to Springfield (one round trip per day)
	  • Kansas City to Springfield (one round trip per day)
	  • Feeder bus service between Springfield and Branson
	• Extend the Illinois Zephyr and Carl Sandburg services between Chicago and Quincy to Hannibal (two round trips per day).

Scenario 4: Freight Improvement	If a program were made available to support selected rail and rail-to-barge projects essential for contingent development, representative projects considered for modeling purposes include: • The KCT North-South Terminal Project. • Semo Port enhancements for which state funding has already been sought, including loop track, construction, bridge, track improvement and rail business park access. • Track and bridge improvements in Ste. Genevieve/New Bourbon County enabling further development of the non-metallic mineral industry the area. • Pemiscot County rail extension and rail harbor service. • Jefferson County rail improvements in Herculaneum, Crystal City and Pevely, supporting development of non-metallic mineral manufacturing, mining and transportation industries in the area.

Table 36 summarizes the investment levels associated with each investment package for passenger and freight over the 20 year planning period. The table separates Missouri's investment share from federal and private sector railroad investments required for each investment package. The $93.3 million "Maintain Existing Service" investment package includes a continuation of existing services, with the only incremental (new) expenditure shown as the outlays expected to be made in Missouri associated with improving the Lincoln Service. The outlays associated with each investment package are assumed new outlays above and beyond spending at current levels, which are assumed not to change over the life of the plan except in the event of new funding as analyzed for each package.

Table 36: Investment in Missouri's Economy

Cost Assumptions Regarding Passenger Rail Improvement Scenarios					
Infrastructure Investments & Programs	Investment Levels		Sources		
Project or Investment Description	Total Construction Outlay ($millions)	Average Annual O & M ($millions)	% of Revenue from Existing Sources	% of New Revenue Raised from MO Economy	% of New Revenue from Private or Federal Sources
Scenario 1: Maintain Existing Service	**$93.3**	**$8.0**	**9.4%**	**0.0%**	**90.6%**
Scenario 2: Expanded Missouri River Runner	**$153.0**	**$3.0**	**0.0%**	**3.4%**	**96.6%**
Scenario 3: Future Service	**$1,524.0**	**$9.5**	**0.0%**	**20.0%**	**80.0%**
Scenario 4: Freight Improvement	**$199.9**	**$7.7**	**0.0%**	**0.0%**	**100.0%**

In Constant 2012 dollars

7 Defining Economic Impacts and Benefits

The economic analysis of choices presented in the Missouri State Rail Plan includes two principal types of analysis. These include:

7.1 Analysis of Impacts

This includes the analysis of how money, spent on rail improvement, works its way into and through Missouri's economy, creating jobs, personal income, value-added gross state product, and increased economic output in the state's economy.

7.2 Analysis of Benefits

This includes the analysis of how the improved transportation performance achieved through rail investments leads to greater economic efficiency and saves money for Missouri households and businesses.

Within the context of this plan, **impacts** can be understood in economic terms as transfers of output and economic activity from elsewhere in the United States into Missouri, inasmuch as any given investment package can lead to federal or private spending in Missouri's economy which would have otherwise occurred elsewhere. Impacts are always traced back to dollars invested in Missouri's economy from some outside source. This is especially true in the Freight Improvement investment package, where significant impacts are found from enhanced rail access which would be expected to make sites for industrial development available to attract jobs to Missouri from other states. These improvements are not expected to make the freight rail system faster, safer or more efficient, but are expected to give Missouri an advantage in growing its share of national earnings, output, and employment.

Benefits can be understood as actual societal benefits accruing because of how the money invested in rail is being spent. Benefits represent a monetization of the reduction in travel time, operating costs and environmental costs, and the reduction in crashes, all of which accrue due to the mix of projects considered in any given investment package. Benefits are always traced back to a quantifiable improvement in some transportation performance measure which can be achieved by the mix of projects implemented. The majority of benefits in Missouri's rail investment packages are associated with passenger rail improvements which take cars off the road and provide transportation savings from reduced vehicle travel costs.

8 Criteria for Economic Analysis

The relative economic appeal of any given investment package is understood in terms of its overall beneficial impact on Missouri's economy from both the standpoint of economic impact (jobs, income, value-added and output) and economic benefits (time, cost, safety and environmental improvement) achieved by the mix of projects in the package. This section describes how these criteria are represented in the analysis, and how the findings presented in the plan are associated with particular economic criteria underlying the findings of the economic analysis.

8.1 Establishment of Analysis Criteria

Many of the investments considered in the Missouri State Rail Plan are expected to be effective as bundles or programs. For this reason, projects are analyzed as part of the Maintain Existing Service, Expanded Missouri River Runner and Expanded Future Service or Freight Improvement investment packages described in **Table 35**. Each project is analyzed in terms of its relative pay-off to Missouri's transportation system and economy in comparison to a continuation of current conditions.

Because dollars invested in the state from federal or private sources have a positive impact on the state's economy, rail investment level itself is one criterion for analyzing the relative utility of the different packages. However, the simple infusion of money into Missouri for rail construction and operation outlays alone does not fully describe the criteria by which Missouri might wish to consider the appropriate investment level. Additional criteria include outside investment in Missouri by industries, potential adverse impacts of taxes, and reduced transportation costs.

8.1.1 Outside Investment in Missouri's Economy by Railroads and the Federal Government

Most of the packages rely on raising enough state revenue to induce federal or private railroad spending in the state. For this reason, one criterion distinguishing between the scenarios is the level of new federal or private investment available in each package and its expected impact on the state's economy. Key criteria which may be satisfied by outside investment in any given service package include:

- Outside Investment: defined for this plan as dollars of additional federal and railroad investment in Missouri's economy associated with each package
- Employment: defined for this plan as Missouri jobs
- Earnings: defined for this plan as personal income accruing to Missouri residents
- Output: defined for this plan as the value of goods produced in Missouri's economy

8.1.2 Potential Adverse Effects of Taxes

The above mentioned criteria must be understood within the context of an off-setting criterion of the adverse economic consequences of raising revenue sources within the state to qualify for the matches associated with achieving the positive impacts which come from

outside investment. For the packages which would entail raising revenues from Missouri's economy to cover "unmet state" investment needs, it is important to understand the degree to which the adverse economic effects of taxation may be offset by the jobs, earnings, value-added gross domestic product and output enabled by the matching federal or private investment in the state. Criteria affected by raising additional taxes from within Missouri include:

- Tax revenues: Dollars of additional tax revenue needed over the life of the plan
- Employment
- Earnings
- Output
- Economic value-added gross domestic product

8.1.3 Reduced Costs on Missouri's Overall Transportation System

This economic analysis will help determine to what degree the different packages enable transportation system efficiencies in the long term. Specifically, the different rail investment levels have been analyzed to determine the degree to which they reduce highway passenger and truck vehicle miles and vehicle hours of travel (VMT and VHT respectively), and the associated environmental, safety and other operating costs in the state's transportation system. Key indicators include:

- VMT and VHT reduction on the state's highway system for passenger cars and trucks
- Reductions in vehicle operating costs, safety, travel time/reliability and emissions which may result from modal diversion of passengers or freight

8.1.4 Economic Benefits of Transportation Efficiencies

The investment packages have been analyzed to determine the extent and nature of expected transportation efficiency performance benefits in the system and whether those benefits equal or surpass the operating and capital improvement cost associated with the various investment packages. The transportation efficiencies are represented in terms of the dollar value to the state's economy of the reduced (or increased) user costs described in **Section 8.1.3**.

8.2 Analysis of Benefits

Section 10 explores the four investment packages within the context of the above criteria. One of the challenges of analyzing the comparative benefits of the investment packages is the limited nature of forecasting models and data available to assess the degree of modal diversion which may occur for inter-city trips due to higher rail speeds, added passenger rail capacity and the added capacity associated with the freight projects. While the analysis of tax and spending impacts represents a straightforward input-output analysis, the assessment of user-benefits is based on some general assumptions derived from national freight networks including the FAF highway network and the North American Transportation Atlas Database (NORTAD) U.S. rail network, within the context of Amtrak ridership data, and the population employment and trade flow forecasts discussed in **Sections 1 through 5** of this memorandum.

9 Methods and Assumptions for Calculating Impacts and Benefits

9.1 Methods and Assumptions for Calculating Impacts

To estimate the economic impact of investment in rail transportation projects in Missouri, the project profiles given in **Table 35** (with the associated costs described in **Table 36**) were used as the input source to model the impact results in Economic Development Research Group's Transportation Regional Economic Impact System (TREDIS). TREDIS incorporates transportation performance assumptions with the input-output methodology of IMPLAN®. Buyer-supplier relationships are used to determine how direct investment spending percolates through the economy and creates additional spending activity through suppliers (indirect spending), and wage spending by employees associated with the impacted industries (indirect).

The general approach used to determine the economic impact of a series of different economic investment packages involved the following steps:

1. Summarizing, for the life of the plan, the total dollars spent on rail infrastructure and services under each package.
2. Applying appropriate assumptions regarding what percentage of this spending occurs within Missouri, and in which Missouri industries the spending occurs.
3. Using ratios from IMPLAN® to estimate the number of jobs, and the amount of personal income rail spending will create in the state's economy.
4. Using multipliers from IMPLAN® to calculate how this spending works its way through Missouri's economy. The multipliers can be understood as providing a measure of the 'ripple effects' of this spending working its way through Missouri.
5. Using the same methodology as described above to determine the impact of tax increases associated with each package, and subtracting the adverse impacts of tax increases from the beneficial impacts if investment is to arrive at a net economic impact from the different spending levels. This adjustment is implicit in all findings reported in **Section 10**.

9.2 Methods and Assumptions for Calculating Benefits

The general approach used to determine the economic benefit of a series of different economic investment packages involved the following steps:

1. Developing background assumptions about anticipated future trends in passenger car and truck VMT and VHT at the statewide level, using current trends. This includes an assumption about modal shares, passenger car and truck traffic growth for rail and highway modes based on historic trends and overall population growth in areas currently or potentially served by the packages.
2. Ascertaining potential changes from baseline conditions likely to occur with different funding scenarios in terms of passenger VMT and VHT. Any significant changes in rail speed or capacity which may increase the rail mode's share of passengers or freight tonnage are analyzed. Personal miles of travel are adjusted to account for potential modal diversions from truck to rail or vice versa. Rail VHT is also adjusted to account for

increased travel speeds for packages where investments are expected to increase travel speeds.

3. Applying appropriate travel time cost factors to changes in VHT by mode, and appropriate vehicle operating cost factors to changes in VMT by mode. Because passenger cars and trucks have different safety, environmental, reliability, travel time characteristics and per-mile travel costs, the different modal shares, speeds and routings found in Step 2, result in different overall user costs or savings in Step 3.
4. Developing a time series of impacts accruing by year based on Amtrak historical growth factors and anticipated population and employment growth in areas served, and applying an appropriate discount rate (3 percent) to report user benefits of any given package. As highway traffic demand increases over time, so does the potential level and overall benefit of diverting highway traffic to rail. The analysis assumes trips diverted from highway to rail will increase over the life of the plan at the same rate as other highway trips.
5. Summarizing and classifying user benefits into safety, logistics, reliability, travel time, operating cost and other categories based on the cost factors applied for each of these categories in Step 3.

The analysis of user benefits is given in 2012 constant dollars, and is based on Amtrak[1] ridership data combined with NORTAD[2] rail network travel time and distance assumptions in relation to U.S. DOT FAF3 network highway travel time and distance assumptions, analyzed in conjunction with capacity changes taken from the following:

- Midwest Regional Rail Initiative study on high-speed rail [3]
- Passenger inter-city cross-modal elasticities from the U.S. Conference of Mayors High Speed Rail study[4]
- Cost factors available from EDR's TREDIS system[5]

The analytical framework above was used for estimating societal and user benefits of both preserving existing passenger rail service and for estimating passenger rail expansion benefits. On the freight rail side, societal benefits were estimated for the preservation of existing freight rail service. Input data limitations prevented the quantification of societal expansion benefits of proposed freight rail improvements.

9.3 Factors and Intermediate Calculations

From the figures above, critical factors driving the economic benefits include the assumed compounded annual traffic growth rate of 2.5 percent (based on historic U.S. DOT highway

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[1] Amtrak 2010 ridership data, provided to Missouri DOT in January 2011
[2] North America Transportation Atlas Data Base provided by US Bureau of Transportation Statistics, 2011
[3] Economic Impacts of the Midwest Regional Rail System, Transportation Economics and Management Systems, Inc. and HNTB, November 2006.
[4] The Economic Impact of High Speed Rail on Cities and their Metropolitan Areas, U.S. Conference of Mayors, 2011
[5] Transportation Regional Economic Development System, licensed by EDR Group to Missouri DOT, September 2010 - February 2011

statistics controlled for population growth), and an assumed percent congested of 2.5 percent (based on national conditions and performance data). User benefits are discounted at 3 percent.

Table 37 and **Table 38** show the per-mile value assumed operating costs and per-hour value of assumed travel time costs by trip purpose.

Table 37: Vehicle Operating and Environmental Societal Costs of Transportation

Purpose	Vehicle Operating Costs			Environmental Costs		
	Free Flow Cost $/mile	Congested Cost $/mile	Congested or Idle Cost $/mile	Free Flow Cost $/mile	Congested Cost $/mile	Congested or Idle Cost $/mile
MODE: Truck Freight						
Freight	$1.23	$1.50	$4.62	$0.05	$0.07	$0.21
MODE: Rail Freight						
Freight	$8.62	$0.00	$0.00	$0.38	$0.00	$13.98
MODE: Passenger Car						
On-the-Clock	$0.42	$0.48	$1.51	$0.03	$0.03	$0.09
Commute	$0.42	$0.48	$1.51	$0.03	$0.03	$0.09
Personal/ Recreational	$0.42	$0.48	$1.51	$0.03	$0.03	$0.09
MODE: Passenger Rail						
On-the-Clock	$0.00	$0.00	$0.00	$0.01	$0.00	$0.50
Commute	$0.00	$0.00	$0.00	$0.01	$0.00	$0.50
Personal/ Recreational	$0.00	$0.00	$0.00	$0.01	$0.00	$0.50

Source: Appendix B : TREDIS ® Data Sources and Default Values. Page 13.

Table 38: Accident and Hourly Societal Costs of Transportation

Purpose	Accident Costs			Hourly Costs			
	$ per Fatalities Accident	$ per Personal Injury Accident	$ per Property Damage Accident	Crew Cost Factor ($/hour per crew member)	Passenger Cost Factor ($/hour per occupant)	Freight Logistics Factor ($/hour per ton)	Buffer Time Cost Factor ($/hour per vehicle trip)
MODE: Truck Freight							
Freight	$6,297,098	$87,656	$41.23	$0.00	$0.53	$0.00	$41.23
MODE: Rail Freight							
Freight	$6,297,098	$87,656	$3,316	$41.23	$0.00	$0.53	$0.00
MODE: Passenger Car							
On-the-Clock	$6,297,098	$87,656	$3,316	$41.23	$0.00	$0.53	$0.00
Commute	$6,297,098	$87,656	$3,316	$41.23	$0.00	$0.53	$0.00
Personal/ Recreational	$6,297,098	$87,656	$3,316	$41.23	$0.00	$0.53	$0.00
MODE: Passenger Rail							
On-the-Clock	$6,297,098	$87,656	$3,316	$38.62	$29.17	$0.00	$29.17
Commute	$6,297,098	$87,656	$3,316	$38.62	$22.49	$0.00	$22.49
Personal/ Recreational	$6,297,098	$87,656	$3,316	$38.62	$11.24	$0.00	$11.24

Source: Appendix B-1 : TREDIS ® Data Sources and Default Values. Page 13.

Further documentation of assumed factors and their application is available in the TREDIS Data Sources and Default Values as well as the TREDIS Overview documentation, provided to Missouri DOT with this technical memorandum. These documents detail how factors are applied and give further detail regarding their original sources and currency.

10 Economic Comparison of Investment Packages

The economic effects of the different investment packages in Missouri's State Rail Plan can be broadly understood in three categories:

1. The economic impact and ongoing benefit of simply continuing service at today's levels relative to the economic consequences of losing rail service altogether.
2. The impact of rail expenditures made in Missouri's economy under each package (including new federal and private investment in Missouri), in relation to any adverse impacts of raising taxes to qualify for federal or private matches.
3. The potential system-level transportation performance/efficiency benefits of significant expansions to Missouri's rail system.

This section encapsulates the findings for these types of economic effects as presented in the rail plan document itself. It is included in this technical memorandum to place the findings within the context of the underlying forecasts, methods and assumptions on which they are based.

10.1 Benefits of Preserving Current Service

The availability of rail transportation supports significant efficiencies for Missouri's people and businesses. For many commodity shipments, and individual person-trip purposes, rail is far more efficient in terms of travel time and cost advantages than other alternatives. While rail accounts for only a small share of Missouri's overall transportation system, Missouri has a significant economic stake in preserving and maintaining its rail network and services.

Based on trends from Amtrak's reported ridership data and population forecasts for U.S. counties from Moody's, Missouri's rail network is expected to carry more than 805,000 passengers in 2031. According to the 2006 STB waybill sample (with growth factors from Moody's), Missouri's freight rail network is projected to carry more than 311 million tons in 2012 (71 percent of which is pass through traffic and does not involve transactions in Missouri's economy). If all of these trips had to be carried by passenger cars and trucks (for commodities moved by truck) on Missouri's highway system, it would place an additional 137 million vehicle miles[6] of travel on Missouri's highways this year. Over the life of the plan, if Missouri's rail trips and tonnage had to be carried by the highway system, this diversion of trips would create more than 3.5 billion additional vehicle miles of truck travel on Missouri's highway system. The additional vehicle operating costs, travel time costs, safety, environmental, reliability and other costs of moving Missouri's rail passengers and freight to highway modes would be expected to total more than $1.07 billion over the life of the plan.

The majority of the highway costs accrue to freight movements due to the higher vehicle operating and crew costs of shifting freight from rail to truck. Loss of rail service in Missouri would be

[6] All findings of highway mileage/VMT associated with shifting rail movements to highway are based on origin-destination pairs from Amtrak data (provided by Missouri DOT in 2012), Estimates from the U.S. DOT Freight Analysis Framework (FAF3), 2011 or U.S. DOT waybill data, 2006., converted to the equivalent minimum time and distance paths as shown on NAATD network, 2010 roadway networks, with growth rates based on Moody's economic forecast and distribution trade patterns from Minnesota IMPLAN group.

expected to generate more than $440 million[7] in additional freight costs due to highway travel. On the passenger side, there would be an expected $775 million in additional highway user costs. However, nearly 20 percent of the additional highway user costs would be offset by the travel time savings from the increased speed of passenger car travel in comparison to current train services.

Shifting Missouri's rail passenger and freight traffic to the highway system through the year 2031 would be expected to cost the state's economy 1,000 jobs with cumulative economic losses to the state of more than $1.9 billion in economic output, and approximately $988 million in lost income.[8] These losses account for the transportation inefficiency of diverting existing rail traffic to highways. Additional investment in Missouri's rail system will not only prevent the economic and job losses which would occur without the system in place, but may also create additional efficiencies, benefits and economic opportunities for Missouri's households and businesses.

10.2 Economic Impacts of Rail System Investment

The investment packages identified above represent different levels of state, federal and private investment in Missouri's rail system. Because opportunities often exist to attract federal and private matching funds into Missouri's economy, this section explores the statewide impacts associated with each investment package. The impacts account for both the effect of additional spending brought into the state, as shown in **Table 36**, as well as the overall impact of the transportation efficiencies on earnings, output and employment achieved by Missouri's private sector as a result of improved rail service.

The analysis also considers the adverse impacts of raising taxes or user fees to generate the required state match which would likely be needed to achieve the levels of outside investment given for each service package. However, for the Maintain Existing Passenger Service scenario, it is assumed the 9.4 percent of funding needed to support this scenario comes from existing committed sources and does not represent a shifting of funding away from other state programs.

Because this analysis is made from the standpoint of Missouri's economy, the impacts given in this section are not limited to reporting only net new economic benefits to the United States as a whole, but include the transfer of jobs, earnings, output, income and value-added gross domestic product into Missouri which may have otherwise occurred elsewhere in the U.S. if Missouri did not receive the outside investment associated with each investment package.

Table 39 summarizes the overall net economic impact of spending, efficiency gains from the investments, contingent development (in the case of freight) and associated tax increases which would be required to implement each of the rail investment packages (including direct, indirect and induced impact of new spending less the offsetting impact of state taxes raised to support the needed state matches).

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[7] All costs are shown in 2012 constant dollars.

[8] TREDIS Consulting Group; Division of Economic Development Research Group, Inc. Web: http://www.tredis.com

Table 39: Net Economic Impact of Investment Scenarios After Tax Impact

Project or Investment Description	Missouri Earnings (Cumulative 2011-2031) ($millions)	Missouri Output (Cumulative 2011-2031) in ($Millions)	Missouri Jobs (Average for 2011-2031)
Scenario 1: Maintain Existing Service	$190	$481	195
Scenario 2: Expanded Missouri River Runner	$277	$922	334
Scenario 3: Future Service	$5,181	$14,000	6,242
Scenario 4: Freight Improvements	$19,128	$85,214	16,224

The Maintain Existing Service scenario shows positive impact for Missouri's economy, even though the investment level in rail does not increase. This is largely because it is anticipated Missouri will benefit from the improvements to the Lincoln Service, and Missouri households and businesses will enjoy a better economic climate as a result. The Expanded Missouri River Runner scenario is shown to have positive impacts on Missouri's economy, which result both from the assumed additional outside revenue supporting the service, as well as from the transportation efficiency of the service.

The Future Service scenario has an even more significant impact on state output. Scenario 3 has nearly 18 times the impact on Missouri' Earnings as Scenario 2, as shown in **Table 39**, while relying on only 10 times the total construction outlay as shown in **Table 36**. This is primarily because the Future Service scenario involves a significantly higher flow of outside money into Missouri. As will be shown in the subsequent analysis on transportation benefits, while the influx of money assumed by this scenario could generate significant jobs in Missouri's economy, the societal benefit of the services offered does not rise in proportion to the money spent and jobs created.

The analysis also shows the greatest positive impacts on the state's economy would likely come through funding the freight access enhancements. These enhancements are expected to have more robust impacts than other investments because they are part of economic development strategies specifically intended to bring additional jobs into the state.

Consequently, funding the freight improvement package would not rely only on reduced transportation costs to generate impact in the state's economy, but also would bring mining, nonmetallic mineral manufacturing, and crop production jobs to many rural counties. The Kansas City North-South Terminal Port project is an especially significant element of this package. It brings more than $243 million of direct jobs to the Kansas City region's transportation sector over the life of the plan.

10.3 Societal Benefits from Investing in Missouri's Rail System

In addition to bringing new jobs and economic impact to Missouri through federal and private investment in the rail system, the investment packages of the state rail plan also provide opportunities to improve the overall efficiency of Missouri's transportation system, creating net societal benefits from investment at different levels. Some investments are expected to have significant and quantifiable improvements in both travel operating costs (i.e., vehicle operating costs, safety, emissions and reliability), and travel time savings.

10.4 Comparative Benefits of Passenger Rail Investment Packages

Each of the investment packages is found to offer different economic efficiencies (or inefficiencies) relative to today's conditions over the life of the plan. This section summarizes the comparative benefits of each package. All findings of highway VMT associated with shifting rail movements to highway are based on origin-destination pairs from Amtrak data (provided by Missouri DOT in October 2011), and estimates from the U.S. DOT Freight Analysis Framework (FAF3) and U.S. DOT waybill data. This data was converted to the equivalent minimum time and distance paths as shown on the NORTAD and FAF3 networks for rail and highway times and distances.

Scenario 1 – Maintain Existing Service: The Maintain Existing Service scenario, by assuming implementation of the high-speed Lincoln Service from St. Louis to Chicago, is expected to shift 2.45 million passenger VMT and more than 38,000 passenger VHT from Missouri's highway system to the Amtrak system over the life of the plan. This is expected to create a societal benefit (within Missouri) of $53.49 million above what would have been the case if the Lincoln Service were not implemented. Approximately 62 percent of these societal benefits are expected to be in the form of reduced personal travel time, 17 percent due to reduced business travel time, 15 percent is attributable to reduced motor vehicle operating costs, and the remaining 6 percent is due to reduced highway crash incidence.

Scenario 2 – Expanded River Runner: Over the life of the plan, the Expanded River Runner scenario offers approximately $149.1 million in societal benefits above and beyond the benefits which accrue from today's rail conditions and performance. The benefits accrue because of modal diversion resulting from the increased access and capacity of the Missouri River Runner. Overall to 2031, these passenger improvements have the potential to shift nearly 40 million VMT and nearly 634,000 passengers VHT from Missouri's highway system to the rail system.

Scenario 3 – Future Service Scenario: The Future Service scenario offers more than $205.2 million in societal benefits above and beyond today's conditions and performance. This includes all the benefits of the Lincoln Service from Scenario 1 and the expanded Missouri River Runner service from Scenario 2. It also includes the benefits of significantly enhanced speed on the Missouri River Runner to 90 mph, increasing frequencies from two to six per day, implementing new services between St. Louis, Kansas City and Springfield (the Missouri Triangle), adding feeder bus routes, and extending the Chicago – Quincy service to Hannibal. All of these improvements combined are expected to yield a shift of 463 million VMT and 1.33 million VHT from Missouri's highway system.

Scenario 4 – Freight Improvement Scenario: Unlike the passenger scenarios, the strategic goal of the freight scenario is to attract additional economic activity to Missouri. For this reason, Scenario 4's payoff is primarily measured in terms of Economic Impact (earnings, output and employment attracted to the state), and not in societal benefit. In other words, the freight scenario is not aimed to make business operations more efficient, or to save money to residents and businesses, but instead is simply designed to enable more economic activity to occur in Missouri which otherwise would have occurred elsewhere. The one notable exception is the KCT North-South Terminal project in Kansas City. This project is expected to create societal benefit by enabling more efficient use of rail lines, reducing fuel consumption, emissions and highway truck crashes. These benefits are estimated to have a present value of just over $189.8 Million, according to the TIGER III application[9] submitted for the project.

Table 40 provides a comparative summary of the user benefits available over the life of the plan for all four investment packages as they relate to each benefit category (i.e., preservation, rail expansion, passenger rail expansion, operation and maintenance, etc.). As discussed in **Section 9.2**, input data limitations prevented the quantification of societal expansion benefits of proposed freight rail expansion improvements.

Table 40: Estimated User Benefits of Passenger Rail Investment Packages

Benefit Classes	Investment Packages (in 2012 $millions)			
	Scenario 1: Preserve Existing Service	Scenario 2: Expanded Missouri River Runner	Scenario 3: Future Service	Scenario 4: Freight Improvement
Passenger Preservation Benefit	$776	$776	$776	$776
Freight Preservation Benefit	$444	$444	$444	$444
Expansion Benefit	$53	$149	$2,045	$189.8
Overall Benefits of Package	**$1,273**	**$1,369**	**$3,265**	**$1,410**
Total Improvement Costs	$92	$227	$1,394	$200
Total Operating & Maintenance Costs	$122	$169	$306	$118
Total State Dollars Spent	$20	$13	$340	$0.00
Total $ Spent	**$214**	**$409**	**$1,700**	**$318**

Source: TREDIS, Present values in 2012 dollars in millions and KCT TIGER III Application, 2012

[9] Kansas City Regional TIGER III Application (attachment E-1 P. 7, Table 2) Submitted by Kansas City Terminal Railway Company, October 2012. **The TIGER application reported construction and other jobs as "benefits" – however for the purposes of the state rail plan, these are classified as "direct impacts" and are included in the overall impacts shown in Table 39. The $189.8 benefit represents the share of the $227.2 Million (discounted at 3% as shown in Table 2 of the TIGER III application) accounted for by transportation efficiency, fuel savings and safety benefit.

11 Conclusions

Overall, the transportation efficiencies of preserving Missouri's rail system in the condition it is in today is expected to protect nearly 1,000 jobs, provide $1.9 billion in economic output, and add $988 million in personal income over life of the state rail plan.

The net economic impact of rail investments can be significant in terms of earnings, output and job creation. The estimated economic impacts of the three passenger rail investment scenarios range from $190 million to $5.18 billion in earnings. Passenger rail output impacts range from $481 million to $14 billion and job creation impacts are estimated to range from 195 to 6,242 net new jobs. The enhanced freight access scenario is estimated to have an earnings impact of $19.12 billion, an output impact of $85.2 billion and the potential to create up to 16,224 net new jobs.

Investing in improved rail operations also can provide societal and user benefits by reducing vehicle operating costs, travel time, safety and environmental costs of utilizing the state's highway system by diverting existing highway trips to the rail network. Passenger rail investments such as the "Expanded Missouri River Runner" scenario, new service in the "Missouri Triangle," and additional feeder bus routes also can have substantial user benefits depending on the level at which these improvements are funded. The potential new benefits of investing in expanded passenger service range from $53.5 million to $2.05 billion over the life of the plan, with the societal benefits of freight investment potentially as high as $189.8 Million.

While the economic impact and economic benefits offered in this state rail plan are of a general nature (and are based on broad assumptions from previous analyses), the analysis suggests Missouri's economy would enjoy net benefits and positive impacts from the investments considered in the plan, with societal benefit and positive impact increasing with the level of investment. For jobs, the analysis suggests there may be particular leverage in funding strategically selected freight-to-barge improvements which generate new economic activity in the state of an order of magnitude beyond the original investment.

Overall, the economic analysis demonstrates significant loss of service from today's levels is likely to have an adverse effect on the state's economy, and investment at or beyond the "Maintain Existing Service" scenario can prevent any adverse effects of underfunding.

Appendix A: Process Derivation of Freight Forecasts

Starting/Base Tonnage Flow Assumptions (Based on STB Waybill Data)

The commodity flow forecasts used in the Missouri State Rail Plan begin with county level commodity flow data at the two digit Standard Transportation Commodity Code (STCC) level from the 2009 U.S. DOT Surface Transportation Board (STB) waybill sample. These data report in detail the tonnages of all commodities into, out of, through and within Missouri for a time series leading up to 2009.

Based on a review of this time series for consistency with other data sources (including Minnesota IMPLAN group, WISER Trade and the U.S. DOT Commodity Flow Survey) and long-term trends in freight markets, it was determined that economic restructuring had created a commodity mix (and a trade pattern) which was abnormal for the industry given disruptions in the rail industry's performance in 2008 and 2009. For this reason the 2006 commodity flow data (prior to the disruption) was used as a statistical base year from which freight forecasts were developed for the plan.

The 2006 county-to-county rail trade pattern represented in the waybill data were post-processed with the selective admission of records coded as "unknown" as to whether the Missouri portion of an inter-modal trip was on the rail mode or not. Background sources including the 2007 Commodity Flow Survey and WISER trade were used to estimate the share of these records for each commodity and county-to-county trading pair was reasonable for 2006 data.

The result was a county-to-county rail tonnage trade matrix at the two digit STCC level.

Development of County-to-County Trade Growth Factors and Flows

Using Moody's county level base year and forecast output levels for each 2-digit North American Industry Classification System (NAICS) industry in the United States and IMPLAN® county-to-county input-output trade tables, EDR Group simulated the base and future year county-to-county and industry-to-industry trade patterns expected for 2031 and 2041. A doubly constrained growth factor approach was used to balance production and consumption growth factors for producing and consuming industries in each trading county according to the IMPLAN® input/output framework.

The result of this process was a set growth factor for county-to-county and industry-to-industry trade in the United States from 2006 to 2011, 2031 and 2041. By applying these factors, EDR group arrived at future year trade flows (in dollar terms) between U.S. counties by trading industry and location. These trade estimates (in dollar terms) were then converted from NAICS to STCC using a crosswalk provided by IMPLAN®, yielding county-to-county dollars of trade estimate for every STCC. Finally, dollars-per-ton estimates (from FAF3) were applied to convert dollars of trade into tonnage traded between U.S. counties for each two-digit STCC category. This process yielded growth factors from 2006 to 2011, 2031 and 2041 for each STCC and each Missouri county's trade with every other county represented in the waybill data. Counties outside of Missouri were aggregated to FAF regions for computational efficiency. By applying these growth

factors to the 2006 waybill data, 2031 and 2041 forecasts of trade by two-digit STCC were then compiled representing every possible paring of Missouri counties and U.S. FAF3 regions.

Because some commodities to not map directly to industries in the NAICS to STCC crosswalk provided by IMPLAN (such as hazardous materials, 'freight all kinds' and 'miscellaneous freight shipments'), these commodities are assumed to grow at the same rate as overall trade between the counties as shown in the STB waybill data.

For through movements, background national growth rates by commodity group and FAF3 region-to-region pair were used also based on the Moody's forecast as described above. For movements between Missouri counties and Canada and Mexico, not represented in the Moody's and IMPLAN sources,), FAF3 data were used and added to the forecast database (disaggregated to Missouri counties by two-digit STCC proportional to each county's overall share of the commodity being traded).

These results were checked for reasonableness, resulting in modifications in two areas The transportation equipment commodity group was modified to represent overall national growth given the Moody's forecast for Texas counties with which Missouri trades this commodity with the most were deemed overly aggressive (creating an outlier in the data). Also, forecasts for coal were checked against both historic trends and overall national forecasts for coal consumption. The Moody's results under-estimate Missouri's demand for coal so the overall national growth in coal demand was used to drive the growth of coal shipments into Missouri counties.

TREDIS® Transportation Economic Development Impact System

TREDIS® Data Sources and Default Values

Version 3.6.4

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TREDIS Software Group
Economic Development Research Group, Inc.
2 Oliver Street, 9th Floor, Boston, MA 02109 USA
Tel: 1.617.338.6775
Fax: 1.617.338.1174
e-mail: info@tredis.com

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1 TREDIS v3.6.4 Documentation

This document is part of a suite that describes and supports TREDIS v3.6.4. It has two purposes. First, it indicates where TREDIS draws on default factors, providing source and reference information and information as to when to overwrite defaults. Second, for the broader set of background data contributing to final results, it discusses how this is incorporated into various modules and provides references to further information. Other documents in the suite include:

- *TREDIS Overview* – this explains some of the theoretical background and architecture at the executive level, putting its functionality in the context of economic modeling and objectives.

- *TREDIS User's Manual* – the user manual provides technical assistance with the model's online interface, including how to create a project, add, modify, and delete scenario data, and navigate through the results

- *TREDIS Case Studies* – these documents assist the user in modeling particular types of situations, addressing which input values to use for different impact type, potential data sources for their inputs, and how to interpret results in the context of the projects' overall goals.

- *TREDIS Technical Documentation* – this group of documents provides technical detail as to how inputs and background data are processed into final results, including a discussion of some of the underlying economic theory.

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2 Why Default Values?

TREDIS is a fully multi-modal analysis system, designed to allow users maximum flexibility in defining transportation investment and policy scenarios, with the ultimate purpose of estimating how these scenarios affect transportation and economic outcomes. This flexibility across passenger and freight modes requires that users have the ability to model detailed transport characteristics such as operating performance, unit cost factors, freight and passenger loadings, safety, or emissions factors (among many others). But with this flexibility also comes a need to ensure that reasonable values are adopted to generate believable results.

Moreover, final results – economic impacts or benefit/cost ratios – can be sensitive to specific default factors. As such, it is critical to make such factors fully transparent to users (with references) and provide guidelines as to appropriate ranges and when to deviate from those ranges. This need for transparency extends further, to cover all data sources used to generate final results – even those that cannot be changed as part of an investment or policy scenario. As will be discussed, these include baseline economic data and relationships, market access and connectivity factors, economic forecasts, and freight flows. This document describes TREDIS default data with precisely these goals in mind.

2.1 When to Use or Override Default Values

Analysts may rely on the default values for fixed factors unless they have reason to override them. However, they should understand that it is fully appropriate to override the defaults when:

- the study involves types of vehicles (and associated operating cost factors) that are different from the default average (e.g., transit system using mini-buses instead of standard buses; airport with general aviation rather than commercial aircraft); or
- the study area has vehicle passenger occupancy rates and/or freight loads that are different from the assumed defaults; or
- the study is being done in Canada, using Canadian rather than US dollars; or
- the study is being done in a state or province that has wage and income levels significantly different from the assumed national average, and the applicable government agency prefers to use values of time that reflect local wage rates; or
- the sponsoring agency dictates that different assumptions to be used

However, even when these situations apply, the new factors should remain within a reasonable range. In this document, where appropriate, upper and lower bounds are suggested to define the reasonable range based on: (a) the range of commonly available vehicle sizes and types, and (b) the range of operating cost and time valuation factors observed in published literature. Analysts are warned to be careful about using values outside of these ranges.

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3 TREDIS Default Data

TREDIS comes pre-loaded with an extensive database of information on the current characteristics of your study area(s) and modes. Broad categories, each of which is described below, are listed in the following table.

Default Database	Changes By	Fixed or Adjustable
Current Economic Patterns	Study Region	Fixed
Economic Forecasts	Study Region	Adjustable
Freight Flows	Study Region	Fixed[1]
Regional Accessibility and Connectivity Factors	Study Region	Adjustable
Unit Transportation Cost Factors	Mode, Trip Purpose	Adjustable
Modal Characteristics	Mode, Trip Purpose	Adjustable[2]

[1] *Average commodity mix and loading (tons/veh) can be modified as part of scenario design*

[2] *Modal characteristics are not automatically populated into scenario tables; factors are provided here for general guidance*

3.1 Current Economic Patterns

For U.S. applications, economic patterns are typically supplied by IMPLAN[1]. For each study region defined in TREDIS, this source describes industry production for each of the 55 sectors listed in Appendix A. Production is measured by four variables:

- *Output* – these are final sales, or total revenues, by industry. Depending on the industry, sales can be to any combination of other businesses, households, or the federal/state/local government.

- *Value Added* – this metric describes the value of goods sold by an industry over and above the value of goods purchased by it. It is generally used as a broad measure of value creation by an industry, including wage income, employee benefits, profits, and tax payments. Summed across all industries, total regional value added is precisely "Gross Regional Product".

- *Income* – this is total compensation (including benefits) to all employees of an industry, including business owners (proprietors).

- *Employment* – this is the total head count of workers in an industry, including self-employed, railroad workers, and agriculture workers. Because employment is measured as employee head count, it is important to note that a single individual with two part-time jobs is counted twice, regardless of which industries those jobs are in. Therefore, the job count is typically higher than "full-time-equivalent" employment.

[1] IMPLAN is a registered trademark of Minnesota IMPLAN Group.

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Beyond these industry metrics, IMPLAN data is used in a number of other places in TREDIS. This default data includes:

- *Economic Multipliers* – these are region-specific factors that translate a direct economic change into total economic impacts, including indirect (inter-industry supply-chain) effects, and induced (wage spending) effects. In IMPLAN, multiplier impacts are applied with source and target industry detail, meaning that it is possible to determine the effect of direct spending in one sector (say, construction) on another (say, retail).

- *Industry Make/Use Tables* – these are region-specific factors that indicate which commodities a single industry uses to produce its final goods, as well as which commodities are made by the industry. As such, they translate industry activity to commodity activity, which is used in TREDIS' Freight Module, as well as in determining which industries are affected by projects affecting freight modes.

- *Tax Receipts* – for Tax Module subscribers, IMPLAN is used to determine how changes in economic activity lead to changes in federal and state/local tax revenues. These are based on the current pattern of transfer payments in IMPLAN's social accounting structure.

Detailed descriptions and source information for all IMPLAN data is provided in the "Knowledge Base" section of IMPLAN's website (https://implan.com/V4/Index.php).

3.2 Economic Forecasts

The TREDIS forecasting module is typically supplied with Moody's Economy Dot Com (MEDC) projections, which include employment and value added forecasts for each TREDIS industry (see Appendix A for a list). For simplicity, economic projections are shown in TREDIS as indexes from the base year for each region. As with many other defaults, forecasts can be overwritten by users.

Moody's state and county forecasts are ultimately based on their U.S. National economic model (http://www.economy.com/store/samples/macromodel.pdf). This national forecast is combined with state, metro, and county data to allocate growth forecasts down to sub-national regions. The benefit to this approach is geographic consistency – that is, employment and value added always aggregates up (from counties to states and from states to national) without double-counting.

Allocations of employment and value added to states and counties are made based on the same government data sources used by IMPLAN to develop current economic characteristics. These sources include Bureau of Labor Statistics (BLS), Current Employment Survey (CES), and the Quarterly Census of Employment and Wages (QCEW), and Bureau of Economic Analysis (BEA).

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3.3 Freight Flows

The TREDIS Freight Module is typically supplied with data from Freight Analysis Framework (FAF), published by Federal Highway Administration (FHWA). The FAF database describes commodity flows for an entire year in terms of total tonnage and the value. This broad picture of commodity flows is indexed by a number of attributes. These include:

- *Origin and Destination* – FAF divides the United States into 114 regions. These may be states, metro areas, or "rest of state" areas. In addition, FAF defines 7 international regions. All commodity flows have an explicit origin and destination.

- *Commodity Description* – flows are indexed as one of 42 commodity types. These correspond to two-digit Standard Classification of Transported Goods (SCTG) groupings.

- *Transportation Mode* – all FAF flows are indexed as one of 7 transportation modes. These are truck, rail, marine, air, truck-rail intermodal, other intermodal, and pipeline/unknown.

Detailed definitions and descriptions of these indices are available in the following link (http://ops.fhwa.dot.gov/freight/freight_analysis/faf/faf2userguide/index.htm).

The current TREDIS version (v3.6.4) uses FAF^2 data. Thus, flows were calibrated using the 2002 Commodity Flow Survey (CFS) and the 2002 Vehicle Inventory and Use Survey (VIUS). However, all flows reflect 2008 economic activity. Since the initial calibration, FAF has published updated annual flow tables reflecting the growth in economic activity since the initial calibration year. The entire 2008 commodity flow database can be downloaded at (http://ops.fhwa.dot.gov/freight/freight_analysis/faf/faf2_pro.htm). The following link describes how the FAF gets updated for each year's data: (http://ops.fhwa.dot.gov/freight/freight_analysis/faf/faf2provisional_2008/rpt/index.htm)

Since the release of TREDIS v3.6.4, FHWA released FAF^3, which was calibrated using the 2007 Commodity Flow Survey. This data will be incorporated into future TREDIS versions.

3.4 Market Access and Connectivity Factors

The TREDIS Market Access module estimates how transportation system changes affect the region's economic geography – i.e., how the region's economy improves if businesses have better access to labor, customers, suppliers, and international markets (see separate documentation for further description). The statistical relationships applied by this module were estimated using a database of accessibility and connectivity factors for each US county. These factors are shown in Report 3a, and are also the default values used to populate the Market Access Input table which is used to define Scenarios. The sources and methodology behind each default value used in this module are described below.

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Population accessible within a 40 minute drive time – this variable is used as a proxy for labor market and consumer market access. TREDIS uses ESRI's Business Analyst Online service to calculate this factor and produce the corresponding map shown on Report 3a. For each individual county, the drive time is calculated from the population-weighted centroid of the county. Using population as a weight to determine the county's center better reflects the true center of economic activity in the county. From this point, ESRI calculates the area that can be reached within a 40 minute drive-time (with "average" network congestion), and sums total population within the area. Population estimates are based on census block-group and zip code data, with estimates adjusted to current (2010) levels. The following link discusses ESRI's population-location methodology (http://www.esri.com/library/whitepapers/pdfs/esri-data-tapestry-segmentation.pdf).

Employment accessible within a 3-hour drive time – this variable is used as a proxy for access to industrial supply chains. The three hour threshold is based on industry surveys indicating that this is about as far apart as two businesses can be and still have same-day truck delivery cycles. This default factor and corresponding map are estimated from the population-weighted centroid using ESRI's Business Analyst Online service. The following ESRI article describes how the database of business activity is maintained and located on maps (http://www.esri.com/library/whitepapers/pdfs/esri-data-business-locations.pdf)

Airport activity level (annual operations) – this variable reflects the total number of takeoffs plus landings per year at the nearest facility with domestic air-carrier traffic. This database is updated using the AirNav website (http://airnav.com/).

Average drive time to rail intermodal facility (minutes) – Oak Ridge National Laboratory's Center for Transportation Analysis gathered and published a list of U.S. intermodal rail facilities (these are available at http://cta.ornl.gov/transnet/Intermodal_Network.html; see http://cta.ornl.gov/transnet/terminal_doc/index.htm for methodology). For each county, drive-time was calculated by ESRI between the population-weighted centroid and the nearest rail facility.

Average drive time to domestic airport (minutes) – the list of airports with commercial service is from FAA (http://www.faa.gov/airports/airport_safety/airportdata_5010/). For each county, drive-time was calculated by ESRI between the population-weighted centroid and the nearest airport with domestic air-carrier traffic.

Average drive time to marine port facility (minutes) – Marine facilities were available from the same source as for rail facilities (see above).). For each county, drive-time was calculated by ESRI between the population-weighted centroid and the nearest rail facility.

Average drive time to international land border (minutes) – WISER Trade (http://www.wisertrade.org/home/index.jsp) was used to identify the 25 most active U.S. land border gateways in terms of commodity movements (by $). These were each given latitude/longitude coordinates. Drive-times were then calculated by ESRI from each U.S. County's population-weighted centroid to the nearest facility.

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Average drive time to international airport (minutes) – WISER Trade was used to identify the 25 most active airports for international import/export activity (by $ value of commodity movements). These were each given latitude/longitude coordinates. Drive times were then calculated by ESRI from each U.S. County's population-weighted centroid to the nearest facility.

3.5 Unit Transportation Cost Factors

Transportation cost factors are used to determine how changes in the volume and quality of trips translate to cost savings to households and businesses. These fall into four basic groups, all of which vary by mode and trip purpose:

Type	Can be Modified by	Default Factor
Time Cost Factors	Project, mode, trip purpose	Crew Time Cost ($/crewmember-hour)
		Passenger Time Cost ($/passenger-hour)
		Freight Time Cost ($/ton-hour)
		Buffer Time Cost ($/hr per vehicle trip)
Vehicle Cost Factors	Project, mode, trip purpose	Vehicle Mileage-based Operating ($/mile)
		Vehicle Time-based Operating Cost ($/hr.)
		Cost per Collision ($/occurrence)
		Cost per Personal Injury ($/occurrence)
		Cost per Fatality ($/occurrence)
		Environmental/Emissions Cost ($/mi)
Accident Rates	Scenario, mode, trip purpose	Collision Rate (occurrence/VMT)
		Injury Rate (occurrence/VMT)
		Fatality Rate (occurrence/VMT)
Vehicle Loadings*	Scenario, mode, trip purpose	Average Crew Size
		Average Passenger Occupancy
		Average Freight Cargo (tons)

** Vehicle loading factors are provided for guidance, but are not automatically populated into the corresponding fields in the Travel Demand Characteristics input table (Scenario Page). All other factors automatically load into the appropriate TREDIS table.*

Interpreting Default Values for Economic Concepts

TREDIS, because it uses the same basic transportation cost factors for both benefit/cost analysis and economic impact analysis, has to carefully distinguish social benefits from business impacts for all modes. This affects the way that default values are expressed in the table that follows. This includes the following effects:

- Values may appear higher than those used in some previous studies due to updating. While the system typically calculates benefits and impacts over a long time horizon (e.g., 25-30 years), all analysis is done in constant dollars. Currently, default values and ranges are expressed in constant 2009 or 2010 dollars, and findings on default

values from earlier studies have been adjusted upward to reflect those constant year values.

- Values are sometimes different for traveler benefit valuation and total economic impact. Different trip purposes are assigned to different benefit and impact classes. Time savings for personal travel is classified as a social benefit value that affects benefit/cost ratios but does not have any impact on the flow of income in the economy. Time savings for business travel is classified as a business operating cost change affecting both benefit/cost ratios and economic impacts. Time savings for commuting has elements of both of these classifications (a social benefit for affected households, but also an element of wage rate impact for businesses), as explained in the footnotes.

- Some but not all values are increased by the role of fringe benefits in long-term impacts. Fringe benefits come into play in different ways for different trip classes. For economic impact studies, the valuation of business travel time is measured as the long-term business cost. While delay in the short-term may cause workers to put in more hours to complete deliveries, continued delays over a long-term period will require affected businesses to hire more workers to complete a given set of deliveries. Hence the need to add fringe benefit costs in the long-term business travel time value. Other classes of travel also have time valuations pegged to wage rates, but they do not lead to additional worker hiring so their values do not incorporate fringe benefits.

The table which follows shows default values for each factor, along with the normally acceptable range. These ranges were set on the basis of actual variation observed in vehicle sizes (affecting occupancy and operating costs) and the observed range of time valuation factors used in studies over the past decade. The table also denotes whether the various factors are normally used in (1) traditional benefit/cost studies focusing on traveler benefits and/or (2) economic impact analysis.

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Economic Impact Modeling Factor	Default Value		Acceptable Range	Factor in traveler benefits	Factor in economic impacts
Crew Time Cost ($/hr per crew member) – the business cost of labor for professional drivers and paid crew (including cost of wages plus fringe benefits). <See note A>	Car: Truck: Bus: Rail-transit: Rail-freight: Aircraft: Ship:	$21.60 $25.02 $22.31 $30.84 $33.42 $77.84 $42.33	18 – 25 18 – 40 15 – 30 20 – 45 20 – 45 50 – 99 25 – 50	X X X X X X X	X X X X X X X
Average Crew Size (number) – including professional driver/ pilot and supporting paid crew. (This should be customized for the applicable location and type of vehicles.) <See note B>	Car: Truck: Bus: Rail-transit: Rail-freight: Aircraft: Ship:	0.0 1.2 1.0 2.0 2.0 4.7 (no default)	0 – 1 1 – 2 1 – 2 1 – 4 1 – 4 1 – 12 1 – 1,000	N.A.	N.A.
Passenger Time Cost ($/hr per occupant) – the business opportunity cost, or user valuation, of the average passenger's time. This is in addition to the passenger vehicle operating cost per hour. The same values apply for in-vehicle and out-of-vehicle time (except for transit OVTT = out-of-vehicle). <See note C>	<u>Ground Transport:</u> *(car-truck-bus-rail)* On-the-Clock: Commute *=user benefit* *+wage premium* Personal: *(transit OVTT* <u>Air Transport:</u> Business Commute Personal	 $27.50 $21.20 *$10.60* *$10.60* $10.60 *$21.20)* $40.10 $33.30 $33.30	*( ) = public transit* 20 (10) – 40 16 (8) – 35 10 (5) – 16 *(10 – 16)* 25 – 50 20 – 40 20 – 40	 X X - X X X X X	 X X X -- -- X X --

Economic Impact Modeling Factor	Default Value		Acceptable Range	Factor in traveler benefits	Factor in economic impacts
Buffer Time Cost ($/hr) – the business opportunity cost, or user valuation, of lost scheduling time due to unreliable travel conditions (i.e., effect of ~~s~~chedule padding”). <See note D>	Passenger Modes: *Same as above* Truck Freight: non-mfg goods Non-dur. mfg: Durable mfg.:	 $0.75 $2.25 $5.00	 0 - 2 0 - 5 0 - 15	 X X X	 X X X
Average Passenger Occupancy (number) – the total number of occupants excluding professional driver and supporting paid crew. (Note: in most cases, the car driver is counted as an occupant and not a crew member.) <See note E>	Car: Truck: Bus: Rail-pass: Rail-freight: Aircraft: Ship:	1.5 0 10.5 120 0 105 (no default)	0 – 5 0 – 4 1 – 60 1 – 600 0 – 4 0 – 400 0 – 1,000	N.A.	N.A.
Freight Logistics Time Cost ($/hr. per ton) – business opportunity cost of freight delay, including shipper inventory, dock handling & consignee schedule disruption. <See note F>	Truck & Air only non-mfg goods: Non-dur. mfg: Durable mfg.:	 $0.75 $1.50 $2.50	 0 - 2 0 - 4 0 - 8	 -- -- --	 X X X
Average Freight Cargo (tons) – the total number of tons of freight per vehicle <See note G>	Truck: non-mfg: Truck: mfg goods: Rail-freight: Aircraft: Ship:	1.0 17.5 3,024 4.6 14,000	0 – 10 8 – 25 25 – 5,000 0 – 6 0 – 30,000	N.A.	N.A.
Vehicle Mileage-based Operating Cost: Free Flow ($/mile) – the average per-mile cost of vehicles’ fuel, tires, maintenance, and depreciation for travel in free-flow conditions. <See note H>	Car: Truck: Bus: Train: Air: Ship:	$ 0.58 $ 1.18 $ 1.45 $ 8.21 $16.45 $25.00	0.30 – 0.90 0.9 – 1.5 1 – 2 5 – 12 5 – 25 1 – 100	X X X X X X	X X X X X X

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Economic Impact Modeling Factor	Default Value	Acceptable Range	Factor in traveler benefits	Factor in economic impacts
Vehicle Mileage-based Operating Cost: Congested ($/mile) – the per-mile costs of roadway vehicles operating under congested roadway conditions. <See note I>	Car: $0.64 Truck: $1.46 Bus: $1.55	0.35 – 1.2 1.15 – 1.75 1 – 2	X X X	X X X
Vehicle Time-based Operating Cost: ($/hour) – the average per-hour cost of vehicles' fuel, tires, maintenance, and depreciation for travel. <See note J>	Air: $3,650.00 Ship: $260.00	3,000 – 4,000 200 – 1,000	X X	X X
$ per Accident <See note K>	<u>Cars and Trucks:</u> Prop Damage $ 3,160 Pers. Injury $ 83,520 Fatality $ 6,000,000 • *Econ cost* *$1,221,500* • *Social adder* *$4,778,500*	1,000 – 5,000 80,000 – 250,000 $ 2.6m – 8.5m	X X X X	X X X --
***Accident Rates*:** All rates shown are per 100m Vehicle Miles Traveled <See note L>	<u>Passenger Car /Truck:</u> Prop Damage 206 /198 Pers. Injury 90 /12 Fatality 1.5 /0.4 <u>Public Transit:</u> Pers. Injury 585 Fatality 7.6 <u>Air Travel:</u> Pers. Injury 0.184 Fatality 0.012	100 – 300 50 – 150 0 – 5 400 – 800 0 – 20 0 – 1 0 – 1	N.A.	N.A.

Economic Impact Modeling Factor	Default Value	Acceptable Range	Factor in traveler benefits	Factor in economic impacts
Environmental Cost: Mileage-Based ($/vmt) — cost of air pollution and greenhouse gases per vehicle-mile of travel <See note M>	Car: $0.028 Truck: $0.05	0 – 1 0 – 1	X X	-- --

Notes:

- **Crew wages** are drawn from the BLS National Compensation Survey (issued June 2007) for applicable transport occupations, with 40% added for fringe benefits (national average in those occupations). Values for truck drivers, bus drivers and train engineers are published BLS values for those occupations, plus fringe benefits. Values for aviation are based on weighted average of $34.11/hr. for flight attendants and $94.47/hr. for pilots, plus fringe. Values for marine (ferry or freighter) are based on weighted average of $13.11 for sailors and $30.04 for ship engineers, plus fringe. Source: http://www.bls.gov/ncs/ocs/sp/ncbl0910.pdf

- **Default crew size** for all modes are drawn from typical values for New York City, San Francisco and Chicago, as reported in Chester, Mikhail, Institute of Transportation Studies, UC Berkeley, 2008.

- **Values of time** shown here are generally consistent with methods for valuing *user travel time benefits* as followed by HERS and BCA.Net software, as well as CUTR and USDOT guidance. However, values have also been updated to reflect 2007 wage rates (average of all occupations, not just transport occupations), based on BLS wage data. Also, additional long-term business costs (beyond the user value of travel time) have been added in the form of fringe benefit costs for "on-the-clock travel" and wage premiums paid by employers for commuting in higher-cost congested areas. As a result, car/light truck "on-the-clock" travel time is calculated as a business cost valued at 100% of the national average wage rate plus 30% fringe. Both commuting and personal travel time are treated as a non-money user benefit with a value set at 50% of the wage rate (no fringe added). For economic impact analysis only, there is an additional allowance for the effect of higher commuting cost on employer cost in the form of a wage rate premium valued at another 50% of the wage rate per hour without fringe (per research by Zax et al.). For public transit, the wider range reflects possible variation in riding conditions, as noted by CUTR: "*Transit travel time should be valued at 25 – 35 percent of prevailing wage under comfortable conditions (when sitting), but can be significantly higher for crowded transit vehicles (100% of wage rate) or for waiting under unpleasant conditions (up to175% of wage rate)*." For out-of-vehicle transit time, TREDIS uses 100% of the wage rate, but allows for a wider range of values.

- **The costs of travel time variability** (non-recurring delay) is calculated using the concept of "buffer time", which is defined as the additional schedule time needed to ensure an on-time arrival 95% of the time (19 out of every 20 trips) versus the average travel time. For example, If a weekday commute normally (i.e., on average) takes 30 minutes to complete, but unplanned congestion causes 5% of trips (about 1 per month) to take 45 minutes, then the commuter must schedule 45 minutes for the trip on the average day to ensure an on-time arrival (even though it is likely to only to take 30 minutes). This trip therefore requires 15 minutes of "buffer time". For passenger travel, buffer time has been shown to be valued similarly to travel time unless a schedule constraint exists (see CUTR). For Freight Trucks, the value of buffer time

can vary widely for carrier types and commodity, but is generally higher than passenger travel (relative to travel time). USDOT reports that the value of reliability can vary from 20% to 250% of "standard" delay (http://ops.fhwa.dot.gov/freight/documents/improve_econ.pdf).

- **Typical passenger loadings** for all modes are drawn from typical values for New York City, San Francisco and Chicago, as reported in Chester, Mikhail, Institute of Transportation Studies, UC Berkeley, 2008.

- **Freight logistics cost** is estimated on the basis of values assigned for recurring travel time delay from HEAT documentation, based on literature review and additional research by Cambridge Systematics and EDR Group. These logistics cost values, added to crew cost and vehicle operating cost, yield total freight costs per hour in line with TTI congestion studies.

- **Typical Cargo loadings** for trucks come from the USDOT Comprehensive Truck Size and Weight Study; data for rail is from the Association of American Railroads www.aar.org/PubCommon/Documents/AboutTheIndustry/Statistics.pdf ; data for water transport is based on 1000 TEUs per ship at 14 tons per TEU from InfoMare and NY/NJ port; data for air transport from Bureau of Transportation Statistics.

- **Vehicle operating cost per mile: for free flow conditions is defined for cars as an average** of small, medium and large cars and SUV; source AAA. Truck cost is based on FHWA Truck Size and Weight Study, with cost/mile ranging from $1.03 - $1.38 depending on speed.

- **Vehicle operating cost per mile: for congested road conditions** is based on auto fuel consumption estimates from US EPA and truck fuel consumption estimates from Berwick and Farooq (2003), using an assumptions of stop-and-go travel conditions (as defined by US EPA at www.fueleconomy.gov and with a long-term (30-year) fuel cost of $4.00 per gallon.

- **Per hour operating cost** is to be used for modes where vehicle operating cost is most easily measurable on a time-basis (air and marine). The operating cost/hour for water freight cost/mile ranges from $242/hour for 11,000 ton vessel to $491/hour for 265,000 ton vessel; default represents a 90,000 ton vessel. 2008. Airline costs are from www.airlines.org/economics/cost+of+delays/

- **Accident costs** are derived from the following sources: total fatality cost including both money costs and social value of lost life (lifetime earnings) is from "Treatment of the Economic Value of a Statistical Life in Departmental Analysis – 2009 Annual Revision," USDOT, Memorandum to Modal Administrators, March 18, 2009. http://ostpxweb.dot.gov/policy/reports/VSL%20Guidance%20031809%20a.pdf.

- Detailed values for injury and property damage are drawn from Blincoe, L. et al. (2002). *The Economic Cost of Motor Vehicle Crashes, 2000* (Table 2) and then

updated from 2000 dollars to 2008 dollars by the CPI change (25%). http://thedesignstate.com/wp-content/uploads/2009/04/economicimpact2000.pdf The difference between total fatality valuation and fatality cost is attributed to social valuation of lost life.

- **Accident rates** are from Bureau of Transportation Statistics: http://www.bts.gov/publications/national_transportation_statistics/#chapter_2.

- **Environmental costs** per VMT can include a wide variety of air pollution, water pollution, noise pollution and land quality/use impacts. However, the default values shown here include only costs associated with air pollutants defined by the Clean Air Act (NOx - nitrogen oxides, SO_2 - sulfur dioxide, PM - particulate matter and VOC - volatile organic compounds) plus greenhouse gases.

- For the Clean Air Act pollutants, the total cost per VMT is estimated to be 1.1c for cars and 3.9c for large trucks (source: FHWA: *1997 Federal Highway Cost Allocation Study Final Report Addendum*, Federal Highway Administration, USDOT, 2000, Table 12. For greenhouse gases, the total cost per VMT is estimated to be 1.7c for cars and 2.4c for trucks based on Littman (Todd Littman: "Climate Change Emission Valuation for Transportation Economic Analysis," VTPI, 2009 and drawing from *Transportation Energy Data Book*, Oak Ridge National Laboratory, 2008). Also shown in Table 5.10.7-2 of Littman: Transportation Cost and Benefit Analysis II – Air Pollution Costs, Victoria Transport Policy Institute, updated 2009. Note that there are also some studies that have derived values based on changing market values for emission credits; these sources have been used to derive estimates as high as 5c per VMT for cars and 26c/vmt for trucks.

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4 USER INPUTS

The following list shows available user inputs. See TREDIS User Guide and appropriate Case Studies for more explicit guidance on sources for these inputs.

Available Modes - sub-modes may be defined as desired (examples in parentheses)

- Cars (may split by trip purpose: work, commute or personal):
- Trucks (may split delivery vans, light trucks, heavy trucks, multiple trailer, etc.)
- Transit (may split by trip purpose or sub-mode: van, regular bus, BRT, light rail, etc.)
- Rail (may split freight, commuter rail, inter-city passenger, high speed rail, etc.)
- Marine (may split passenger ferry, car ferry, barge, freighter, cruise ship, etc.)
- Air (may split general aviation, air taxi/charter, freight, prop, regional jets, full size commercial airliners, jumbo jets, etc.),

Modal Characteristics

- Avg. Vehicle occupancy (passengers)
- Avg. Driver/crew size (commercial services)
- Avg. Cargo carried (tons)
- Avg. fare, toll, road user fee or freight fee
- Cargo mix (default or user-selected commodity mix)
- Operating costs/mile (or per km)
- Fuel economy (miles/gallon or per liter)
- Emission rates (various pollutants and CO, per mile or per km)

Traffic Characteristics

- Volume, speed or average trip distance
- Baseline traffic growth rate (annual rate)
- VMT vehicle miles traveled (or VKT vehicle kilometers traveled)
- VHT vehicle hours traveled
- Congestion levels (volume/capacity ratio, or percent of major routes congested)
- Reliability (time variability or buffer time)
- Safety (accident rates: mortality, injury, property damage)
- Induced travel

Origin/Destination Patterns

- Fraction of trips internal to study area (local origin and destination)
- Fraction of trips with coming into the study area (outside origin, local destination)
- Fraction of trips leaving the study area (local origin, outside destination)
- Fraction of trips passing through the study area (outside origin and destination)

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Access Characteristics

- Size of labor and shopper markets (population within 40 minute travel time)
- Size of same day truck delivery market (employment within 3-hour travel time)
- Average road access time to commercial airports (and activity scale of the airport)
- Average road access time to marine port
- Average road access time to an intermodal rail terminal
- Average road access time to international gateway airport

Policy, Program or Project Attributes

- Regulation or Restrictions on Use of Facility or Equipment (e.g., truck lanes, carpool lanes, bridge weight limits, airport runway limits, port vessel size limits)
- Charges for Use of Facility or Equipment: Tolls, Taxes, Fees (per vehicle, per trip, per mile, or per fuel unit; for specific facilities or areas)
- Cost of Constructing or Reconstructing Facility & Purchasing Equipment (total, over time, by type)
- Cost of Operating Facility & Equipment (total, allocation over time, budget elements)
- Public/private partnership roles (finance, operation, revenue collection)
- Contingent development (dependent on transport access investment)

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Appendix A: TREDIS Sectoring Scheme

NAICs Sector(s)	Description
111	Crop Production
112	Animal Production
113	Forestry & Logging
114	Fishing, Hunting & Trapping
115	Support for Agriculture & Forestry
211	Oil & Gas Extraction
212-213	Mining & Support Activities
221	Utilities
230	Construction
311	Food Products
312	Beverage & Tobacco Products
313	Textile Mills
314	Textile Product Mills
315	Apparel Manufacturing
316	Leather & Allied Products
321	Wood Products
322	Paper Manufacturing
323	Printing & Related Support Activities
324	Petroleum & Coal Products
325	Chemical Manufacturing
326	Plastics & Rubber Products
327	Nonmetallic Mineral Products
331	Primary Metal Manufacturing
332	Fabricated Metal Products
333	Machinery Manufacturing
334	Computer & Electronic Products
335	Electric Equipment, Appliances, etc.
336	Transportation Equipment
337	Furniture & Related Products
339	Miscellaneous Manufacturing

NAICs Sector(s) Cont'd	Description
420	Wholesale Trade
441-454	Retail Trade
481-487	Transportation
491-493	Mail, package delivery & warehousing
511	Publishing Industries (except Internet)
512	Motion Picture & Sound Recording
513	Broadcasting
514	Internet & data process svcs
521-523	Monetary, Financial, & Credit Activity
524	Insurance Carriers & Related Activities
525	Funds, Trusts, & Other Financial Vehicles
531	Real Estate
532	Rental & Leasing Services
533	Lessors of Nonfinancial Intangible Assets
541-551	Professional Scientific, Technical, Services
561	Administrative & Support Services
562	Waste Management & Remediation
611	Educational Services
621-624	Health Care & Social Services
711-713	Amusement & Recreation
721-722	Accommodations, Eating & Drinking
811-812	Repair, Maintenance, & Personal Services
813	Religious, Civic, Professional, Organizations
814	Private Households
920	Government & non NAICs

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TREDIS Software Group
2 Oliver St., 9th Fl,
Boston, MA 02109
Telephone 617.338.6775
Fax 617.338.1174
e-mail info@tredis.com
www.tredis.com