Benefit Cost Analysis of Northern Indiana Passenger Rail Project

March 2020

Prepared for:

NORTHERN INDIANA PASSENGER RAIL

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ACRONYMS

ADA	Americans with Disabilities Act
AIS	Abbreviated Injury Scale
BCA	Benefit Cost Analysis
B/C Ratio	Benefit–Cost Ratio
CBD	Central Business District
FTA	Federal Transit Administration
GDP	Gross Domestic Product
MAIS	Maximum Abbreviated Injury Scale
NIPRA	Northern Indiana Passenger Railroad Association
NPV	Net Present Value
NTD	National Transit Database
O&M	Operating and Maintenance
RTA	Regional Transportation Authority
RTAMS	Regional Transportation Authority Mapping and Statistics
SCC	Standard Cost Category
STOPS	Simplified Trips on Project Software
TEMS	Transportation Economics & Management Systems, Inc.
USDOT	United States Department of Transportation
VMT	Vehicle Miles Traveled
VOT	Value of Time

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I. INTRODUCTION

This report documents the Benefit Cost Analysis (BCA) that evaluates the benefits to society resulting from the Northern Indiana Passenger Rail Project. The BCA demonstrates the cost effectiveness of the Project measured in terms of a Benefit–Cost (B/C) ratio and Net Present Value (NPV). The quantified benefits, B/C ratios, and NPV for each Build Alternative and Sensitivity Testing are included as criteria for distinguishing between alternatives in the Project Evaluation Matrix.

I.1 Northern Indiana Passenger Rail Project

The Northern Indiana Passenger Rail Project includes the re-establishment of a passenger rail line through Northern Indiana. This project would utilize existing freight rail lines and improve infrastructure to accommodate passenger rail.

There are four alternatives proposed for the project, varying in maximum operating speed, daily frequency, and route termini.

Table 1: BCA Analysis Alternatives

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Route	Chicago to Lima	Chicago to Lima	Chicago to Lima	Chicago to Columbus
Speed	79 mph	79 mph	79 mph	110 mph
Frequency	2 daily round-trips	4 daily round-trips	4 daily round-trips	4 daily round-trips

The re-establishment of a passenger rail line would bring back a mode of transportation that the region currently lacks. The route would serve as a more cost-effective and productive travel option, as well as a safer alternative for the user and the environment, compared to highway travel.

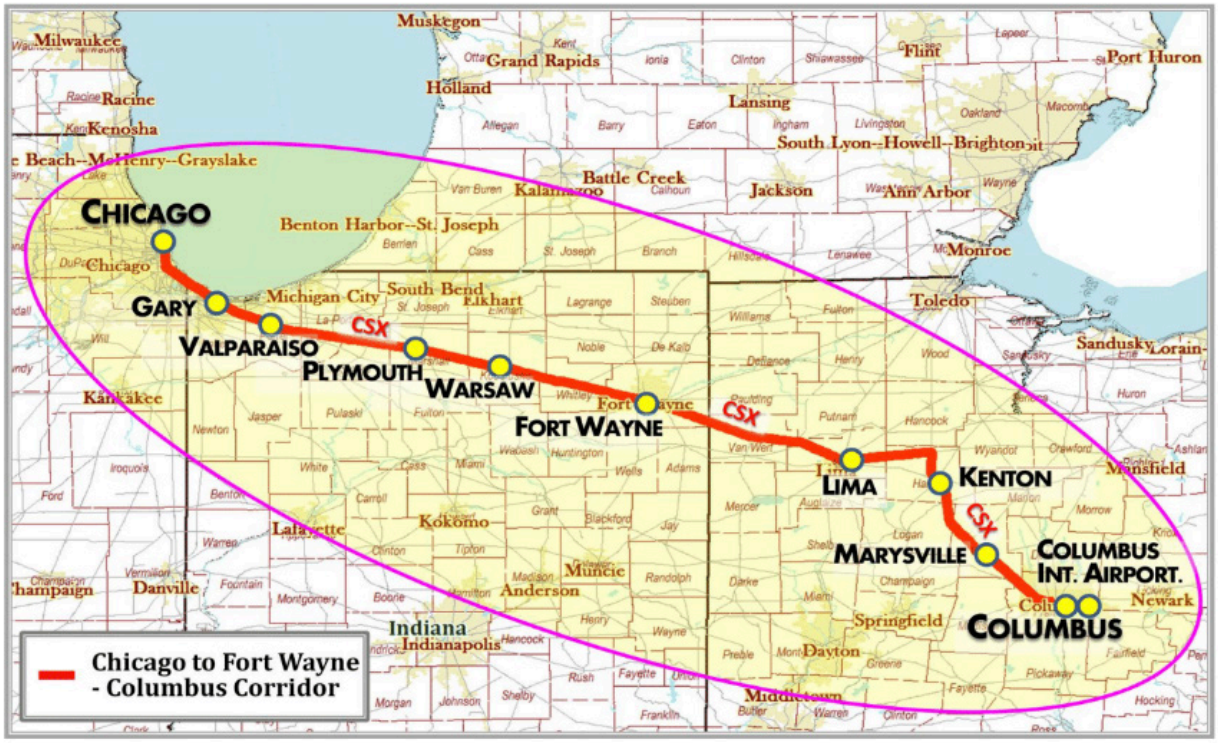
I.2 BCA Model Development

The BCA is based on ridership and travel time projections for rail users and travel times for users of the corridor completing their trips by auto.

A spreadsheet-based BCA model was constructed for the purposes of this analysis. The model utilizes various NIPRA statistics in addition to global parameters provided by the United States Department of Transportation (USDOT) specifically for the purposes of completing BCAs in support of federal grant applications[1].

1 U.S. Department of Transportation. Benefit-Cost Analysis Guidance for Discretionary Grant Programs, January 2020. Accessed at https://www.transportation.gov/sites/dot.gov/files/docs/mission/office-policy/transportation-policy/14091/benefit-cost-analysis-guidance-2020.pdf.

Figure 1: Project Location



Source: Northern Indiana Passenger Rail Association

I.3 Organization of BCA Memorandum

Section II describes the mechanisms that generate the benefits of the Project and the classes of benefits evaluated.

Section III describes the project-specific inputs to the BCA model.

Section IV describes the detailed methodology for computing Project benefits, including an illustration of the benefits calculated for an example year for the Project.

Section Source summarizes the BCA results and the resulting B/C Ratio.

Appendix A describes the global parameters used in the BCA model.

Appendix B provides detailed tabulations of annual benefits and costs for the overall Project.

II. PROJECT BENEFITS AND COSTS

II.1 Benefits of the Project

The following benefits were quantified for this analysis:

1. Passenger Travel Time Savings
2. Passenger Productivity Savings
3. Mode Shift Passenger Travel Cost Savings
4. Mode Crash Cost Savings
5. Mode Shift Emissions Damage Savings

The methodology for evaluating each of these benefits is discussed in Section IV.

Table 2: Project Matrix

Current Status / Baseline and Problem to be Addressed	This Project re-establishes a passenger rail line connecting Chicago, IL to Lima, OH (or Columbus, OH in Alternative 4) with intermediate stops.
Change to Baseline / Alternatives	Build Scenario includes the construction of one of four alternatives for the new passenger rail line
Type of Impacts	Reduced travel time, travel cost, and improved travel time productivity for rail users. Reduced crash costs and emissions damage resulting from auto to rail mode shift.
Affected Population	Long distance train travelers, regional intercity rail passengers, and highway travelers in these markets.
Economic Benefit	The BCA indicates that the Project will result in reduced passenger travel costs, avoided automobile trips and associated crash savings and emissions damage due to new rail ridership.
Summary of Results	Benefit/Cost ratio less than 1.00 indicates that the Project generates quantified benefits to society that do not exceed its costs for all alternatives.

II.2 Costs of the Project

Project costs for each Build Alternative are estimated in 2018 dollars and discounted at 7% for this analysis. For alternatives traveling at 79 mph, the Project is likely to not require additional signal costs. Should signal costs be required, the project cost for Alternatives 1 and 2 would increase by $56,957,700 and $66,277,700 respectively. The increase in project cost would lower the B/C Ratio by 0.01 for Alternative 1 and by 0.02 for Alternative 2.

The project costs used in this analysis are summarized in Table 3.

Additional costs such as incremental operating and maintenance (O&M) costs are considered "Other Costs" and are deducted from the total benefits for the benefit-cost ratio calculation.

Table 3: Project Costs (2018$)

Total Capital Cost	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Cost Estimate	$898,081,041	$978,449,393	$1,228,416,894	$1,862,866,679
Discounted (7%)	$561,843,270	$612,122,048	$768,502,767	$1,165,417,215

II.3 Residual Value

The residual value of the project is estimated based on an estimated 75 year useful life of all project elements and the prorated value at the end of the BCA period of analysis is added to the project benefits for calculating the B/C Ratio and NPV.

III. NIPRA INPUTS

III.1 Period of Analysis

Benefits were evaluated for a period of 30 years beginning with the opening of the Project in 2030 and ending in 2060 for all alternatives.

Table 4: Construction Project Schedule

Factor	All Alternatives
NIPR Construction Start	2025
NIPR Opening Year	2030

III.2 Base Year of Analysis

Per USDOT BCA guidance, this analysis was conducted in constant 2018 dollars. All values are discounted to 2020 at a 7% discount rate.

III.3 Train Ridership

To estimate the benefits associated with travel time savings and avoided travel cost, the projected ridership for each alternative was expressed as the annual number of passengers traveling in either direction between each station. The ridership projection for Alternatives 1, 2, and 3 were obtained from a 2018 Transportation Economics & Management Systems, Inc. (TEMS) passenger rail corridor study. The ridership projection for Alternative 4 was derived based on a 2012 TEMS passenger rail corridor feasibility study and business plan. These passenger estimates are summarized in Table 5.

Table 5: NIPR Ridership (2035)

Input	Alt 1[A]	Alt 2[A]	Alt 3[A]	Alt 4[B]	Units
ANNUAL PASSENGERS					
Chicago Union Station, IL-Gary Regional Airport, IN	338,000	514,000	753,000	797,772	*passengers/year*
Gary Regional Airport, IN-Valparaiso, IN	332,000	504,000	725,000	695,283	*passengers/year*
Valparaiso, IN-Plymouth, IN	317,000	483,000	693,000	659,217	*passengers/year*
Plymouth, IN-Warsaw, IN	297,000	454,000	649,000	631,370	*passengers/year*
Warsaw, IN-Fort Wayne, IN	259,000	397,000	566,000	592,109	*passengers/year*
Fort Wayne, IN-Lima, OH	119,000	185,000	266,000	473,185	*passengers/year*
Lima, IN-Kenton, OH	-	-	-	381,196	*passengers/year*
Kenton, OH-Marysville, OH	-	-	-	341,250	*passengers/year*
Marysville, OH-Hilliard, OH	-	-	-	304,728	*passengers/year*
Hilliard, OH-Columbus, OH	-	-	-	194,478	*passengers/year*

Source: A: TEMS, Chicago-Fort Wayne-Lima Passenger Rail Corridor Study: Sensitivity Analysis (Revised), June 2018. Appendix: 2035 Chicago-Fort Wayne-Lima Station-to-Station Volumes, Scenario 2 (With Existing Midwest Connectivity).

Source: B: Based on cumulative east-to-west station boardings from TEMS (2012), Exhibit 3-25 2030 Station Volumes, scaled to TEMS (2018) totals for Chicago-Lima segment. Appendix: 2035 Chicago-Fort Wayne-Lima Station Ons & Offs, Chicago-Lima totals.

To estimate the ridership for each year, a growth rate was applied, as summarized in Table 6.

Table 6: Ridership Growth Rate

Input	Alt 1[A]	Alt 2[A]	Alt 3[A]	Alt 4[B]
CUMULATIVE ANNUAL GROWTH RATE				
2025-2035	2.68%	2.71%	2.77%	2.77%
2035-2060	2.82%	2.93%	2.90%	2.90%

Source: A: TEMS, Chicago-Fort Wayne-Lima Passenger Rail Corridor Study: Sensitivity Analysis (Revised), June 2018. Growth rates based on passenger volume totals under "With Chicago Hub Connection" scenario as shown in Exhibits 1-1, 1-2, and 1-4

Source: B: Assumed to equal Chicago-Lima at 110mph with 4 round trips.

III.4 Trip Length

To estimate the benefits resulting from automobile to rail mode shift, the average trip length for each segment by travel mode was used, as shown in Table 7 and Table 8.

Table 7: Average Auto Trip Length

Factor	All Alternatives	Units
Chicago Union Station, IL-Gary Regional Airport, IN	29.40	*miles/vehicle*
Gary Regional Airport, IN-Valparaiso, IN	25.70	*miles/vehicle*
Valparaiso, IN-Plymouth, IN	38.80	*miles/vehicle*
Plymouth, IN-Warsaw, IN	27.10	*miles/vehicle*
Warsaw, IN-Fort Wayne, IN	41.00	*miles/vehicle*
Fort Wayne, IN-Lima, OH	69.00	*miles/vehicle*
Lima, IN-Kenton, OH	29.00	*miles/vehicle*
Kenton, OH-Marysville, OH	34.00	*miles/vehicle*
Marysville, OH-Hilliard, OH	19.00	*miles/vehicle*
Hilliard, OH-Columbus, OH	12.00	*miles/vehicle*

Source: Google Maps, itineraries to Chicago via US-30 and I-90.

Table 8: Average NIPR Trip Length

Factor	All Alternatives	Units
Chicago Union Station, IL-Gary Regional Airport, IN	23.00	*miles*
Gary Regional Airport, IN-Valparaiso, IN	21.30	*miles*
Valparaiso, IN-Plymouth, IN	40.40	*miles*
Plymouth, IN-Warsaw, IN	25.10	*miles*
Warsaw, IN-Fort Wayne, IN	38.90	*miles*
Fort Wayne, IN-Lima, OH	59.40	*miles*
Lima, IN-Kenton, OH	35.10	*miles*
Kenton, OH-Marysville, OH	32.00	*miles*
Marysville, OH-Hilliard, OH	19.30	*miles*
Hilliard, OH-Columbus, OH	9.20	*miles*

Source: TEMS, Northern Indiana/ Ohio Passenger Rail Corridor Feasibility Study and Business Plan, December 2012. Appendix 4: Train Schedules, based on mileposts by station.

III.5 Travel Times

To estimate the travel time savings associated with auto to rail mode shift, the average travel times for each segment by travel mode was used, as summarized in Table 9 and Table 10. Off-peak travel times were used to be conservative

Table 9: Average Auto Travel Time

Factor	All Alternatives	Units
Chicago Union Station, IL-Gary Regional Airport, IN	0.62	*hours/trip*
Gary Regional Airport, IN-Valparaiso, IN	0.52	*hours/trip*
Valparaiso, IN-Plymouth, IN	0.62	*hours/trip*
Plymouth, IN-Warsaw, IN	0.43	*hours/trip*
Warsaw, IN-Fort Wayne, IN	0.80	*hours/trip*
Fort Wayne, IN-Lima, OH	1.07	*hours/trip*
Lima, IN-Kenton, OH	0.45	*hours/trip*
Kenton, OH-Marysville, OH	0.58	*hours/trip*
Marysville, OH-Hilliard, OH	0.33	*hours/trip*
Hilliard, OH-Columbus, OH	0.15	*hours/trip*

Source: Google Maps, itineraries to Chicago via US-30 and I-90.

Table 10: Average NIPR Travel Time

Input	Alt 1[A]	Alt 2[A]	Alt 3[A]	Alt 4[B]	Units
AVERAGE BUILD TRAVEL TIME					
Chicago Union Station, IL-Gary Regional Airport, IN	0.51	0.51	0.42	0.42	*hours/trip*
Gary Regional Airport, IN-Valparaiso, IN	0.36	0.36	0.30	0.30	*hours/trip*
Valparaiso, IN-Plymouth, IN	0.62	0.62	0.46	0.46	*hours/trip*
Plymouth, IN-Warsaw, IN	0.43	0.43	0.29	0.29	*hours/trip*
Warsaw, IN-Fort Wayne, IN	0.63	0.63	0.45	0.45	*hours/trip*
Fort Wayne, IN-Lima, OH	0.90	0.90	0.66	0.66	*hours/trip*
Lima, IN-Kenton, OH	-	-	-	0.38	*hours/trip*
Kenton, OH-Marysville, OH	-	-	-	0.53	*hours/trip*
Marysville, OH-Hilliard, OH	-	-	-	0.32	*hours/trip*
Hilliard, OH-Columbus, OH	-	-	-	0.23	*hours/trip*

Source: A: TEMS, Chicago-Fort Wayne-Lima Passenger Rail Corridor Study, April 13, 2017. Exhibit 18 Chicago-Ft. Wayne-Lima Passenger Rail Service Scenarios.

Source: B: TEMS, Northern Indiana/Ohio Passenger Rail Corridor Feasibility Study and Business Plan, December 2012. Exhibit 5-4: Chicago to Columbus Running Times.

III.6 Business Travel

To estimate the passenger productivity benefits associated with mode shift, the share of rail users that are business travelers is considered, as shown in Table 11. A growth rate was applied to estimate the share of business travelers in intermediate years.

Table 11: Share of Business Travelers

Input	2020	2030	2040
Business Traveler Percentage	26.0%	27.1%	27.8%

Source: TEMS, Northern Indiana/ Ohio Passenger Rail Corridor Feasibility Study and Business Plan, December 2012. Exhibit 3-23 Rail Trip Purpose Forecast.

This analysis applies the average hourly salary of business workers, as shown in Table 12, as well as a productivity factor of 75%, reflecting an assumption that three quarters of time spent traveling on the train can be used for work or other productive purposes.

Table 12: Average Business Salary

Input	2020	Units
Average Business Salary	$62.10	*2018$/hour*

Source: OrthoWorx, Economic Impacts of Midwest High-Speed Rail, January 2011. Page 21.

III.7 Train Fare Costs

To estimate the passenger travel cost benefits associated with diverted trips, the cost of train tickets for passengers opting to ride a train was deducted from the benefit total. These values were calculated based on annual fare revenue, total ridership and segment length, as shown in Table 13.

Table 13: Average NIPR Fare

Input	Value	Units
NIPR Train Fare	$0.29	*2018$/passenger-mile*

Source: TEMS, Chicago-Fort Wayne-Lima Passenger Rail Corridor Study, April 13, 2017. Ratio of 2035 Chicago-Fort Wayne-Lima Revenue and 2035 Chicago-Fort Wayne-Lima Passenger Miles in Appendix, Scenario 2 "With Existing Midwest Connectivity.

III.8 Parking Costs

To estimate the parking cost savings realized by rail passengers who previously drove personal vehicles, this analysis assumes that all travelers will be parking in Chicago's Central Business District (CBD). The average parking cost in the CBD is prorated to represent the one-way trip cost for parking as shown in Table 14.

Table 14: Downtown Chicago Daily Parking Cost

	Input		2017	Units
CHICAGO CBD PARKING COSTS				
a	Average Downtown Daily Parking Cost		$30.00	*2018$/day*
b	Prorated One-way Parking Cost Factor		50%	
Prorated Parking Cost		a * b	**$15.37**	**2018$/day**

Source: Chicago Metropolitan Agency for Planning (CMAP) Parking Supply Management Strategies. September 2013. Accessed at: https://www.cmap.illinois.gov/about/2040/supporting-materials/process-archive/strategy-papers/parking/supply-management-strategies.

III.9 Locomotive Fuel Consumption

To estimate the emissions damage resulting from new rail service, the annual fuel consumption for each alternative was used, as summarized in Table 15. This analysis assumes that there is no change in locomotive fuel consumption over time.

Table 15: Locomotive Fuel Consumption

	Input		Alt 1	Alt 2 and 3	Alt 4	Units
a	Fuel Cost per Train-Mile[A]		$2.31	$2.31	$2.31	*2018$/train-mile*
b	Fuel Price[B]		$2.65	$2.65	$2.65	*2018$/gallon*
c	Locomotive Fuel Consumption per Train-Mile	a / b	0.87	0.87	0.87	*train-miles/gallon*
d	Annual Train-Miles		303,826	607,652	886,804	*train-miles/year*
Fuel Consumption		c * d	**348,545**	**697,090**	**1,017,329**	**gallons/year**

Source: A: NIPRA O&M Cost Model. 2018. Third Party Fuel and Power costs per train-mile

Source: B: U.S. Energy Information Administration. Short-Term Energy Outlook

IV. BENEFIT–COST ANALYSIS METHODOLOGY

IV.1 Passenger Travel Time Savings

Travel time cost savings for rail passengers are estimated based on expected ridership and the average time savings per trip between the Build and No-Build scenarios. Table 16 describes the methodology used to calculate the undiscounted benefit and shows the undiscounted benefit of each Build Alternative for the year of 2030 as an example. Similar calculations were made for each year between 2030 and 2059 to compute the overall discounted benefits summarized in the BCA results.

Table 16: NIPR Travel Time Benefit

	Input	Alt 1	Alt 2	Alt 3	Alt 4	Units
ANNUAL RAIL RIDERSHIP[A]						
a	Chicago Union Station, IL-Gary Regional Airport, IN	296,101	449,750	656,826	695,879	*trips/year*
b	Gary Regional Airport, IN-Valparaiso, IN	290,844	441,000	632,402	606,480	*trips/year*
c	Valparaiso, IN-Plymouth, IN	277,704	422,625	604,489	575,021	*trips/year*
d	Plymouth, IN-Warsaw, IN	260,183	397,250	566,109	550,730	*trips/year*
e	Warsaw, IN-Fort Wayne, IN	226,894	347,375	493,710	516,484	*trips/year*
f	Fort Wayne, IN-Lima, OH	104,248	161,875	232,026	412,749	*trips/year*
g	Lima, IN-Kenton, OH	--	--	--	332,509	*trips/year*
h	Kenton, OH-Marysville, OH	--	--	--	297,665	*trips/year*
i	Marysville, OH-Hilliard, OH	--	--	--	265,808	*trips/year*
j	Hilliard, OH-Columbus, OH	--	--	--	169,639	*trips/year*
NO-BUILD TRAVEL TIME[B]						
k	Chicago-Gary	0.62	0.62	0.62	0.62	*hours/trip*
l	Gary-Valparaiso	0.52	0.52	0.52	0.52	*hours/trip*
m	Valparaiso-Plymouth	0.62	0.62	0.62	0.62	*hours/trip*
n	Plymouth-Warsaw	0.43	0.43	0.43	0.43	*hours/trip*
o	Warsaw-Fort Wayne	0.80	0.80	0.80	0.80	*hours/trip*
p	Fort Wayne-Lima	1.07	1.07	1.07	1.07	*hours/trip*
q	Lima-Kenton	0.45	0.45	0.45	0.45	*hours/trip*
r	Kenton-Marysville	0.58	0.58	0.58	0.58	*hours/trip*
s	Marysville-Hilliard	0.33	0.33	0.33	0.33	*hours/trip*
t	Hilliard-Columbus	0.15	0.15	0.15	0.15	*hours/trip*

	Input		Alt 1	Alt 2	Alt 3	Alt 4	Units
BUILD TRAVEL TIME[C]							
u	Chicago-Gary		0.51	0.51	0.42	0.42	*hours/trip*
v	Gary-Valparaiso		0.36	0.36	0.30	0.30	*hours/trip*
w	Valparaiso-Plymouth		0.62	0.62	0.46	0.46	*hours/trip*
x	Plymouth-Warsaw		0.43	0.43	0.29	0.29	*hours/trip*
y	Warsaw-Fort Wayne		0.63	0.63	0.45	0.45	*hours/trip*
z	Fort Wayne-Lima		0.90	0.90	0.66	0.66	*hours/trip*
aa	Lima-Kenton		--	--	--	0.38	*hours/trip*
ab	Kenton-Marysville		--	--	--	0.53	*hours/trip*
ac	Marysville-Hilliard		--	--	--	0.32	*hours/trip*
ad	Hilliard-Columbus		--	--	--	0.23	*hours/trip*
AVERAGE TIME SAVINGS							
ae	Chicago-Gary	k - u	0.11	0.11	0.19	0.19	*hours/trip*
af	Gary-Valparaiso	l - v	0.15	0.15	0.22	0.22	*hours/trip*
ag	Valparaiso-Plymouth	m- w	0.00	0.00	0.16	0.16	*hours/trip*
ah	Plymouth-Warsaw	n- x	0.00	0.00	0.14	0.14	*hours/trip*
ai	Warsaw-Fort Wayne	o- y	0.17	0.17	0.35	0.35	*hours/trip*
aj	Fort Wayne-Lima	p- z	0.17	0.17	0.41	0.41	*hours/trip*
ak	Lima-Kenton	q- aa	--	--	--	0.07	*hours/trip*
al	Kenton-Marysville	r- ab	--	--	--	0.05	*hours/trip*
am	Marysville-Hilliard	s- ac	--	--	--	0.02	*hours/trip*
an	Hilliard-Columbus	t- ad	--	--	--	-0.08	*hours/trip*
ANNUAL TIME SAVINGS							
ao	Chicago-Gary	a * ae	31,749	48,223	126,804	134,343	*hours/year*
ap	Gary-Valparaiso	b * af	44,758	67,865	138,426	132,752	*hours/year*
aq	Valparaiso-Plymouth	c * ag	-463	-704	94,367	89,767	*hours/year*
ar	Plymouth-Warsaw	d * ah	795	1,214	78,469	76,337	*hours/year*
as	Warsaw-Fort Wayne	e * ai	37,627	57,606	173,758	181,774	*hours/year*
at	Fort Wayne-Lima	f * aj	17,780	27,609	95,066	169,112	*hours/year*
au	Lima-Kenton	g * ak	--	--	--	22,167	*hours/year*
av	Kenton-Marysville	h * al	--	--	--	14,883	*hours/year*
aw	Marysville-Hilliard	i * am	--	--	--	4,430	*hours/year*
ax	Hilliard-Columbus	j * an	--	--	--	-14,137	*hours/year*
ay	Total		132,245	201,813	706,891	811,429	*hours/year*
VALUE OF TIME[D]							
az	Intercity Personal Travel		$25.58	$25.58	$25.58	$25.58	*2018$/ person hour*

Input		Alt 1	Alt 2	Alt 3	Alt 4	Units
VALUE OF TRAVEL TIME SAVINGS BENEFIT						
All Riders	ay * az	**$3,382,891**	**$5,162,459**	**$18,082,579**	**$20,756,733**	**2018$/ year**

Source: A. TEMS 2018 Chicago-Fort Wayne-Lima Passenger Rail Corridor Study and cumulative east-to-west station boardings from TEMS (2012). See Table 5 and Table 6 on page 5

Source: B. Google Maps, itineraries to Chicago via US-30 and I-90. See Table 9 on page 7

Source: C. TEMS, Chicago-Fort Wayne-Lima Passenger Rail Corridor Study, April 13, 2017 and TEMS, Northern Indiana/ Ohio Passenger Rail Corridor Feasibility Study and Business Plan, December 2012. See Table 10 on page 7

Source: D. U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, January 2020. See Table A-2 on page 2

IV.2 Passenger Productivity Savings

Productivity savings for business travelers are estimated based on a productivity factor and average salary applied to the portion of annual time savings realized by business workers. Table 17 describes the methodology used to calculate the undiscounted benefit and shows the undiscounted benefit of each Build Alternative for the year of 2030 as an example. Similar calculations were made for each year between 2030 and 2059 to compute the overall discounted benefits summarized in the BCA results.

Table 17: NIPR Productivity Time Benefit

	Input	Alt 1	Alt 2	Alt 3	Alt 4	Units
ANNUAL TIME SAVINGS[A]						
a	Chicago-Gary	31,749	48,223	126,804	134,343	*hours/year*
b	Gary-Valparaiso	44,758	67,865	138,426	132,752	*hours/year*
c	Valparaiso-Plymouth	-463	-704	94,367	89,767	*hours/year*
d	Plymouth-Warsaw	795	1,214	78,469	76,337	*hours/year*
e	Warsaw-Fort Wayne	37,627	57,606	173,758	181,774	*hours/year*
f	Fort Wayne-Lima	17,780	27,609	95,066	169,112	*hours/year*
g	Lima-Kenton	--	--	--	22,167	*hours/year*
h	Kenton-Marysville	--	--	--	14,883	*hours/year*
i	Marysville-Hilliard	--	--	--	4,430	*hours/year*
j	Hilliard-Columbus	--	--	--	-14,137	*hours/year*
k	Total	132,245	201,813	706,891	867,871	*hours/year*

	Input		Alt 1	Alt 2	Alt 3	Alt 4	Units
BUSINESS TRAVEL[B]							
l	Business Traveler Percentage		27.10%	27.10%	27.10%	27.10%	*percent*
m	Business Productivity Factor		0.75	0.75	0.75	0.75	
n	Additional Productive Business Hours	*k * l * m*	26,879	41,018	143,675	164,923	*hours/year*
o	Average Business Salary		$76.74	$76.74	$76.74	$76.74	*2018$/year*
VALUE OF PRODUCTIVITY BENEFIT							
Business Productivity		*n * o*	**$2,062,581**	**$3,147,601**	**$11,025,121**	**$12,655,578**	**2018$/year**

Source: A. See Benefit 1 calculation on Table 16 on page 10

Source: B. TEMS, Northern Indiana/ Ohio Passenger Rail Corridor Feasibility Study and Business Plan, December 2012 and OrthoWorx, Economic Impacts of Midwest High-Speed Rail, January 2011. See Section III.6 on page 8

IV.3 Mode Shift Passenger Travel Cost Savings

The passenger travel cost savings resulting from mode shift are a combination of a VMT-driven operating cost savings and per trip parking cost savings, less the cost of train fare as estimated based on passenger miles traveled. Table 18 describes the methodology used to calculate the undiscounted benefit and shows the undiscounted benefit of each Build Alternative for the year of 2030 as an example. Similar calculations were made for each year between 2030 and 2059 to compute the overall discounted benefits summarized in the BCA results.

Table 18: NIPR Mode Shift Passenger Travel Cost Savings

	Input	Alt 1	Alt 2	Alt 3	Alt 4	Units
ANNUAL RAIL RIDERSHIP[A]						
a	Chicago-Gary	296,101	449,750	656,826	695,879	*trips/year*
b	Gary-Valparaiso	290,844	441,000	632,402	606,480	*trips/year*
c	Valparaiso-Plymouth	277,704	422,625	604,489	575,021	*trips/year*
d	Plymouth-Warsaw	260,183	397,250	566,109	550,730	*trips/year*
e	Warsaw-Fort Wayne	226,894	347,375	493,710	516,484	*trips/year*
f	Fort Wayne-Lima	104,248	161,875	232,026	412,749	*trips/year*
g	Lima-Kenton	--	--	--	332,509	*trips/year*
h	Kenton-Marysville	--	--	--	297,665	*trips/year*
i	Marysville-Hilliard	--	--	--	265,808	*trips/year*
j	Hilliard-Columbus	--	--	--	169,639	*trips/year*
VMT DIVERSION						
Vehicle Occupancy[B]						
k	Passenger Vehicles	1.67	1.67	1.67	1.67	*passengers/ vehicle*

	Input		Alt 1	Alt 2	Alt 3	Alt 4	Units
No Build Travel Distance[C]							
l	Chicago-Gary		29.40	29.40	29.40	29.40	*miles/vehicle*
m	Gary-Valparaiso		25.70	25.70	25.70	25.70	*miles/vehicle*
n	Valparaiso-Plymouth		38.80	38.80	38.80	38.80	*miles/vehicle*
o	Plymouth-Warsaw		27.10	27.10	27.10	27.10	*miles/vehicle*
p	Warsaw-Fort Wayne		41.00	41.00	41.00	41.00	*miles/vehicle*
q	Fort Wayne-Lima		69.00	69.00	69.00	69.00	*miles/vehicle*
r	Lima-Kenton		29.00	29.00	29.00	29.00	*miles/vehicle*
s	Kenton-Marysville		34.00	34.00	34.00	34.00	*miles/vehicle*
t	Marysville-Hilliard		19.00	19.00	19.00	19.00	*miles/vehicle*
u	Hilliard-Columbus		12.00	12.00	12.00	12.00	*miles/vehicle*
Annual VMT Diversion							
v	Chicago-Gary	a * l / k	5,212,791	7,917,754	11,563,277	12,250,805	*vehicle-miles/ year*
w	Gary-Valparaiso	b * m / k	4,475,870	6,786,647	9,732,172	9,333,255	*vehicle-miles/ year*
x	Valparaiso-Plymouth	c * n / k	6,452,043	9,819,072	14,044,413	13,359,771	*vehicle-miles/ year*
y	Plymouth-Warsaw	d * o / k	4,222,134	6,446,392	9,186,554	8,936,996	*vehicle-miles/ year*
z	Warsaw-Fort Wayne	e * p / k	5,570,445	8,528,368	12,121,013	12,680,137	*vehicle-miles/ year*
aa	Fort Wayne-Lima	f * q / k	4,307,272	6,688,249	9,586,705	17,053,695	*vehicle-miles/ year*
ab	Lima-Kenton	g * r / k	--	--	--	5,774,104	*vehicle-miles/ year*
ac	Kenton-Marysville	h * s / k	--	--	--	6,060,245	*vehicle-miles/ year*
ad	Marysville-Hilliard	i * t / k	--	--	--	3,024,161	*vehicle-miles/ year*
ae	Hilliard-Columbus	j * u / k	--	--	--	1,218,964	*vehicle-miles/ year*
af	*Total Miles*	*Sum of v:af*	30,240,555	46,186,482	66,234,134	89,692,133	*vehicle-miles/ year*
OPERATING COST							
ag	Light Duty Vehicles[D]		$0.51	$0.51	$0.51	$0.51	*2018$/vehi-cle-mile*
ah	*Total Operating Cost*	*af * ag*	$15,321,860	$23,401,118	$33,558,581	$45,443,951	*2018$/year*

	Input		Alt 1	Alt 2	Alt 3	Alt 4	Units
PARKING COST							
ai	Total Vehicle Trips		177,306	269,311	393,309	416,694	*vehicles/year*
aj	Average Parking Cost[E]		$15.37	$15.37	$15.37	$15.37	*2018$/vehicle*
ak	*Total Parking Cost*	*ai * aj*	$2,724,481	$4,138,239	$6,043,582	$6,402,921	*2018$/year*
TRAIN FARE							
Average Train Fare							
al	Train Fare[F]		$0.26	$0.26	$0.26	$0.26	*2018$/passenger mile*
Build Travel Distance[C]							
am	Chicago-Gary		23.00	23.00	23.00	23.00	*miles/trip*
an	Gary-Valparaiso		21.30	21.30	21.30	21.30	*miles/trip*
ao	Valparaiso-Plymouth		40.40	40.40	40.40	40.40	*miles/trip*
ap	Plymouth-Warsaw		25.10	25.10	25.10	25.10	*miles/trip*
aq	Warsaw-Fort Wayne		38.90	38.90	38.90	38.90	*miles/trip*
ar	Fort Wayne-Lima		59.40	59.40	59.40	59.40	*miles/trip*
as	Lima-Kenton		35.10	35.10	35.10	35.10	*miles/trip*
at	Kenton-Marysville		32.00	32.00	32.00	32.00	*miles/trip*
au	Marysville-Hilliard		19.30	19.30	19.30	19.30	*miles/trip*
av	Hilliard-Columbus		9.20	9.20	9.20	9.20	*miles/trip*
Passenger Distance Traveled							
aw	Chicago-Gary	a * am	6,810,316	10,344,250	15,106,989	16,005,218	*passenger miles/year*
ax	Gary-Valparaiso	b * an	6,194,987	9,393,300	13,470,159	12,918,024	*passenger miles/year*
ay	Valparaiso-Plymouth	c * ao	11,219,238	17,074,050	24,421,352	23,230,851	*passenger miles/year*
az	Plymouth-Warsaw	d * ap	6,530,597	9,970,975	14,209,328	13,823,323	*passenger miles/year*
ba	Warsaw-Fort Wayne	e * aq	8,826,166	13,512,888	19,205,302	20,091,212	*passenger miles/year*
bb	Fort Wayne-Lima	f * ar	6,192,359	9,615,375	13,782,347	24,517,282	*passenger miles/year*
bc	Lima-Kenton	g * as	--	--	--	11,671,056	*passenger miles/year*
bd	Kenton-Marysville	h * at	--	--	--	9,525,280	*passenger miles/year*
be	Marysville-Hilliard	i * au	--	--	--	5,130,092	*passenger miles/year*
bf	Hilliard-Columbus	j * av	--	--	--	1,560,680	*passenger miles/year*

Input			Alt 1	Alt 2	Alt 3	Alt 4	Units
bg	Total Passenger Miles	Sum aw:bf	45,773,665	69,910,838	100,195,477	138,473,019	passenger miles/year
bh	*Total Train Fare*	*al * bg*	*$12,084,433*	*$18,456,744*	*$26,452,012*	*$36,557,438*	*2018$/year*
Diversion Cost Savings							
bi	Operating Cost	ah	$15,321,860	$23,401,118	$33,558,581	$45,443,951	*2018$/year*
bj	Parking Cost	ak	$2,724,481	$4,138,239	$6,043,582	$6,402,921	*2018$/year*
bk	Less Train Fare	bh	$12,084,433	$18,456,744	$26,452,012	$36,557,438	*2018$/year*
Total Cost Savings		bi + bj + bk	**$5,961,908**	**$9,082,612**	**$13,150,152**	**$15,289,433**	**2018$/year**

Source: A. TEMS 2018 Chicago-Fort Wayne-Lima Passenger Rail Corridor Study and cumulative east-to-west station boardings from TEMS (2012). See Table 5 on page 5

Source: B. U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, January 2020. See Table A-3 on page 2

Source: C. Google Maps, itineraries to Chicago via US-30 and I-90 and TEMS, Northern Indiana/ Ohio Passenger Rail Corridor Feasibility Study and Business Plan, December 2012. See Table 7 and Table 8 on page 6

Source: D. U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, January 2020. See Table A-4 on page 3

Source: E. Chicago Metropolitan Agency for Planning (CMAP) Parking Supply Management Strategies. September 2013. See Table 14 on page 9

Source: F. TEMS, Chicago-Fort Wayne-Lima Passenger Rail Corridor Study, April 13, 2017. See Table 13 on page 8

IV.4 Mode Shift Crash Cost Savings

Crash cost savings resulting from auto to rail mode shift are estimated based on new ridership diverted from vehicles, average vehicle occupancy, average travel distance, rail crash statistics, highway crash statistics, and unit values of fatalities, injuries, and property damage. Trip diversion from vehicles vary for each Build Alternative. Table 19 describes the methodology used to calculate the undiscounted benefit and shows the undiscounted benefit of each Build Alternative for the year of 2030 as an example. Similar calculations were made for each year between 2030 and 2059 to compute the overall discounted benefits summarized in the BCA results.

Table 19: Mode Shift Crash Cost Benefit

	Input		Alt 1	Alt 2	Alt 3	Alt 4	Units
DIVERTED MILES[A]							
a	Total Auto Miles		30,240,555	46,186,482	66,234,134	89,692,133	*vehicle-miles/ year*
b	Total Rail Miles		45,773,665	69,910,838	100,195,477	138,473,019	*passenger-miles/ year*
CRASH RATES							
Rail Crashes[B]							
c	Fatality Rate		0.02	0.02	0.02	0.02	*persons/100M passenger-miles*
d	Injury Rate		3.24	3.24	3.24	3.24	*persons/100M passenger-miles*
Highway Crashes[C]							
e	Fatality Rate		1.16	1.16	1.16	1.16	*persons/100M vehicle-miles*
f	Injury Rate		85.48	85.48	85.48	85.48	*persons/100M vehicle-miles*
g	Crash Rate		403.91	403.91	403.91	403.91	*vehicles/100M vehicle-miles*
EXPECTED CRASHES							
Rail Crashes							
h	Fatalities	b * c / 100M	0.01	0.01	0.02	0.02	*persons/year*
i	Injuries	b * d / 100M	1.48	2.26	3.24	4.48	*persons/year*
Highway Crashes							
j	Fatalities	a * e / 100M	0.35	0.53	0.77	1.04	*persons/year*
k	Injuries	a * f / 100M	25.85	39.48	56.62	76.67	*persons/year*
l	Property Damage	a * g / 100M	122.14	186.55	267.53	362.28	*vehicles/year*
Reduced Crashes							
m	Fatalities	j- h	0.34	0.52	0.75	1.01	*persons/year*
n	Injuries	k- i	24.37	37.22	53.37	72.19	*persons/year*
o	Property Damage	l	122.14	186.55	267.53	362.28	*vehicles/year*

	Input		Alt 1	Alt 2	Alt 3	Alt 4	Units
MONETIZATION[D]							
p	Fatality		$9,600,000	$9,600,000	$9,600,000	$9,600,000	*2018$/person*
q	Injury		$174,030	$174,030	$174,030	$174,030	*2018$/person*
r	Property Damage		$4,400	$4,400	$4,400	$4,400	*2018$/vehicle*
VALUE OF BENEFIT							
s	Fatalities	m * p	$3,277,643	$5,005,953	$7,178,935	$9,716,715	*2018$/year*
t	Injuries	n * q	$4,240,813	$6,477,002	$9,288,745	$12,562,789	*2018$/year*
u	Property Damage	o * r	$537,437	$820,829	$1,177,117	$1,594,013	*2018$/year*
Total		s + t + u	**$8,055,893**	**$12,303,783**	**$17,644,796**	**$23,873,517**	**2018$/year**

Source: A. See Benefit 3 calculation on Table 18 on page 13

Source: B. U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, January 2020. See Table A-8 on page 5

Source: C. U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, January 2020. See Table A-9 on page 5

Source: D. U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, January 2020. See Table A-10 on page 6

IV.5 Mode Shift Emissions Damage Savings

Emissions damage cost savings resulting from auto to rail mode shift are estimated based on diverted automobile miles, train fuel consumption, average emissions rates, and emissions damage costs. Table 20 describes the methodology used to calculate the undiscounted benefit and shows the undiscounted benefit of each Build Alternative for the year of 2030 as an example. Similar calculations were made for each year between 2030 and 2059 to compute the overall discounted benefits summarized in the BCA results.

Table 20: Train Emissions Damage Benefit

	Input	Alt 1	Alt 2	Alt 3	Alt 4	Units
DIVERTED MILES[A]						
a	Total Auto Miles	30,240,555	46,186,482	66,234,134	89,692,133	*vehicle-miles/year*
FUEL CONSUMPTION[B]						
b	Total Gallons Consumed	348,545	697,090	697,090	1,017,329	*gallons/year*

	Input		Alt 1	Alt 2	Alt 3	Alt 4	Units
EMISSIONS RATES							
Emission Rates for Automobiles[C]							
c	Carbon Dioxide (CO_2)		239.5820	239.5820	239.5820	239.5820	*grams/vehicle-mile*
d	Volatile organic compounds (VOC)		0.0214	0.0214	0.0214	0.0214	*grams/vehicle-mile*
e	Nitrogen oxides (NO_x)		0.0569	0.0569	0.0569	0.0569	*grams/vehicle-mile*
f	Particulate matter ($PM_{2.5}$)		0.0009	0.0009	0.0009	0.0009	*grams/vehicle-mile*
g	Sulfur Oxides (SO_x)		0.0024	0.0024	0.0024	0.0024	*grams/vehicle-mile*
Emission Rates for Locomotives[D]							
h	Carbon Dioxide (CO_2)		10,160	10,160	10,160	10,160	*grams/gallon*
i	Volatile organic compounds (VOC)		1.3689	1.3689	1.3689	1.3689	*grams/gallon*
j	Nitrogen oxides (NO_x)		52.00	52.00	52.00	52.00	*grams/gallon*
k	Particulate matter ($PM_{2.5}$)		0.90	0.90	0.90	0.90	*grams/gallon*
Unit Conversion							
l	Grams to Short Tons		907,185	907,185	907,185	907,185	*grams/short ton*
REDUCED EMISSIONS							
Automobiles, less Locomotives							
m	Carbon Dioxide (CO_2)	[(a * c) - (b * h)] / l	4,082.82	4,390.52	9,684.98	12,293.58	*short tons/year*
n	Volatile organic compounds (VOC)	[(a * d) - (b * i)] / l	0.1877	0.0380	0.5111	0.5815	*short tons/year*
o	Nitrogen oxides (NO_x)	[(a * e) - (b * j)] / l	-18.0836	-37.0629	-35.8066	-52.6927	*short tons/year*
p	Particulate matter ($PM_{2.5}$)	[(a * f) - (b * k)] / l	-0.3165	-0.6468	-0.6273	-0.9223	*short tons/year*
q	Sulfur Oxides (SO_x)	a * g / l	0.0809	0.1235	0.1772	0.2399	*short tons/year*
UNIT VALUE OF EMISSIONS[E]							
r	Carbon Dioxide (CO_2)		$1	$1	$1	$1	*2018$/short ton*
s	Volatile organic compounds (VOC)		$2,100	$2,100	$2,100	$2,100	*2018$/short ton*
t	Nitrogen oxides (NO_x)		$8,600	$8,600	$8,600	$8,600	*2018$/short ton*
u	Particulate matter ($PM_{2.5}$)		$387,300	$387,300	$387,300	$387,300	*2018$/short ton*
v	Sulfur Oxides (SO_x)		$2,100	$2,100	$2,100	$2,100	*2018$/short ton*

	Input		Alt 1	Alt 2	Alt 3	Alt 4	Units
VALUE OF REDUCED EMISSIONS							
w	Carbon Dioxide (CO_2)	m * r	$4,083	$4,391	$9,685	$12,294	*2018$/year*
x	Volatile organic compounds (VOC)	n * s	$394	$80	$1,073	$1,221	*2018$/year*
y	Nitrogen oxides (NO_x)	o * t	-$155,519	-$318,741	-$307,937	-$453,158	*2018$/year*
z	Particulate matter ($PM_{2.5}$)	p * u	-$122,563	-$250,496	-$242,966	-$357,201	*2018$/year*
aa	Sulfur Oxides (SO_x)	q * v	$170	$259	$372	$504	*2018$/year*
Total Emissions Savings		w + x + y + z + aa	**-$273,435**	**-$564,508**	**-$539,772**	**-$796,340**	**2018$/year**

Source: A. See Benefit 3 calculation on Table 18 on page 13

Source: B. NIPRA O&M Cost Model. 2018 and U.S. Energy Information Administration. Short-Term Energy Outlook. See Table 15 on page 9

Source: C. U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, January 2020. See Table A-5 on page 3

Source: D. U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, January 2020. See Table A-6 on page 4

Source: E. U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, January 2020. See Table A-7 on page 4

V. BENEFIT–COST ANALYSIS RESULTS

V.1 Quantified Benefits

The BCA indicates that the Project will result in rail passenger travel time savings, rail passenger productivity savings, mode shift passenger travel cost savings, mode shift crash savings, and mode shift emissions damage savings. The Project produces a benefit/cost ratio lower than 1.00 for all Build Alternatives, indicating that the benefits to society do not exceed the Project's costs for all Alternatives. A summary of the discounted costs and benefits for each Build Alternative is shown in Table 21.

Appendix A provides detailed tabulations of annual benefits and costs for the Project under each Build Alternative.

Table 21: 7% Discounted Benefits and Costs for the Project (in millions)

Factor	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Passenger Travel Time Savings	$37.6	$58.0	$203.3	$233.4
Passenger Productivity Savings	$23.7	$36.6	$128.1	$147.1
Mode Shift Passenger Travel Cost Savings	$60.6	$93.2	$135.0	$158.3
Mode Shift Passenger Crash Cost Savings	$72.7	$112.0	$160.7	$217.5
Mode Shift Emissions Damage Savings	-$1.0	-$2.2	-$2.0	-$3.0
Total Benefits	$193.6	$297.7	$625.1	$753.2
Capital Cost	$510.9	$552.8	$768.5	$1,165.4
Other Costs	$113.1	$193.5	$233.0	$353.4
Residual Value	$32.7	$35.4	$49.2	$74.6
Net Benefits	$113.2	$139.6	$441.3	$474.4
B/C Ratio	0.22	0.25	0.57	0.41
Net Present Value	-$397.6	-$413.2	-$327.2	-$691.0

V.2 Sensitivity Testing

As a sensitivity test, this analysis considers the effect of corridor cost sharing to the Chicago to Columbus alternative to reflect the NIPRA project only carrying a portion of the cost associated with the shared corridor between Tolleston and Fort Wayne. The portion of the cost allocated to the project is based on the ridership share between Chicago and Columbus when compared to projected ridership on services from Chicago to Cleveland or Detroit. The improvements associated with the Project could potentially benefit other intercity passenger rail corridors further east, such as Toronto, New York City, and Washington, DC.

To test the impact of a shared corridor on the BCA results, a sensitivity scenario was developed that allocates the costs of the Tolleston (Gary, IN) to Fort Wayne segment to the Project based on the proportion of ridership on the Chicago-to-Columbus corridor if Chicago-to-Columbus, Chicago-to-Detroit, and Chicago-to-Cleveland services were in place. Ridership is based on corridor total results of the 2017 Midwest Regional Rail Planning Study conducted by the Federal Railroad Administration, which suggest that Chicago-to-Columbus services may carry less than 20 percent of the total passengers on the Chicago-to-Fort Wayne segment. The Project benefits do not exceed the costs under this sensitivity test, but the NPV is significantly improved. Further refinements to ridership and cost sharing assumptions may produce Project benefits that exceed the costs.

Table 22: 7% Discounted Benefits and Costs for the Sensitivity Test (in millions)

Factor	Alt 4	Sensitivity
Passenger Travel Time Savings	$233.4	$233.4
Passenger Productivity Savings	$147.1	$147.1
Mode Shift Passenger Travel Cost Savings	$158.3	$158.3
Mode Shift Passenger Crash Cost Savings	$217.5	$217.5
Mode Shift Emissions Damage Savings	-$3.0	-$3.0
Total Benefits	$753.2	$753.2
Capital Cost	$1,165.4	$737.5
Other Costs	$353.4	$353.4
Residual Value	$74.6	$47.2
Net Benefits	$474.4	$447.0
B/C Ratio	0.41	0.61
Net Present Value	-$691.0	-$290.4

V.3 Unquantified Benefits

Improved intercity rail services provide travelers with additional options that can affect many other sectors of the economy. Other Project benefits not quantified by this analysis include:

- Avoided congestion-related travel time savings associated with highway travel diverted to rail,
- Avoided tolls associated with highway travel diverted to rail,
- Travel time, travel cost, and emissions savings associated with mode shift from air travel to rail,
- Increased economic productivity, economic development, and property value increases from agglomeration associated with cities along the route being better connected by improved rail services,
- Avoided or deferred costs of capacity improvements to highways or airports associated with the additional capacity provided by intercity rail services,
- Potential benefits to local transit service that could connect to stations along the corridor,
- Potential benefits associated with other intercity passenger rail services that could share portions of the corridor, and
- Potential operating cost savings, including maintenance of way costs, associated with a shared use of the corridor.

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APPENDIX A
Model Inputs and Parameters

A-1 GDP Growth

To account for GDP growth during the analysis period, a GDP growth factor was applied to all costs as shown in Table A-1. Growth beyond the 10-year forecasts developed by the Congressional Budget Office was assumed to continue at the value of the final year of the forecast.

Table A-1: GDP Growth Factor

Factor	2018	2030	Units
Real GDP[A]	18641.30	23036.38	*billions of $*
Growth Factor	1.000	1.236	

Source: A. U.S. Congressional Budget Office 10-Year Economic Projections, August 2019. GDP. Accessed at https://www.cbo.gov/about/products/budget-economic-data#4.

A-2 Global Parameters

This BCA uses the following parameters based on values provided by the USDOT and other sources.

A-3 Passenger Value of Time

To estimate the benefits associated with travel time savings, a real Gross Domestic Product (GDP) growth rate was applied to USDOT-provided factors for Value of Time (VOT). VOT values are shown in Table A-2.

Table A-2: Value of Time Factor (2018 Dollars)

Trip Purpose / Vehicle Type	Value	Units
Intercity Personal Travel	$21.30	*/ person-hour*

Source: U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, January 2020. Table A-3: Value of Travel Time Savings. Accessed at https://www.transportation.gov/sites/dot.gov/files/docs/mission/office-policy/transportation-policy/14091/benefit-cost-analysis-guidance-2020.pdf

A-4 Average Vehicle Occupancy

To convert the cost per person to cost per vehicle or vice versa, USDOT-provided factors for Average Vehicle Occupancy were used, as summarized in Table A-3.

Table A-3: Average Vehicle Occupancy Factor

Vehicle Type	Value	Units
Passenger Vehicles	1.67	*persons/automobile*

Source: U.S. Department of Transportation, Benefit-Cost Analysis Guidance for Discretionary Grant Programs, January 2020. Table A-3: Value of Travel Time Savings. Accessed at https://www.transportation.gov/sites/dot.gov/files/docs/mission/office-policy/transportation-policy/14091/benefit-cost-analysis-guidance-2020.pdf

A-5 *Vehicle Operating Costs*

To estimate the travel operating cost benefits associated with fewer or shorter automobile trips, US-DOT-provided factors for Vehicle Operating Cost were used, as summarized in Table A-4.

Table A-4: Vehicle Operating Cost Factor (2018 dollars)

Vehicle Type	Value	Units
Light Duty Vehicles	$0.41	*/ VMT*

Source: U.S. Department of Transportation, Benefit Cost Analysis Guidance for Discretionary Grant Programs, January 2020. Table A-5: Vehicle Operating Costs. Accessed at https://www.transportation.gov/sites/dot.gov/files/docs/mission/office-policy/transportation-policy/14091/benefit-cost-analysis-guidance-2020.pdf

A-6 *Emissions Rates*

To estimate the emissions damage associated with changes in the length or frequency of automobile trips, emission rate factors derived from the California Air Resources Board EMissions FACtors (EMFAC) model were used for five pollutants associated with mobile sources. Using the approach applied in the Cal B/C Benefit-Cost Analysis model developed by the California Department of Transportation, emissions rates were aggregated for automobiles and trucks at different travel speeds based on different vehicle fleet compositions (2016 and 2036) to reflect the changing emissions profile under a range of driving conditions and as the fleet becomes greener over time. A growth rate was applied to estimate emissions rates for intermediate years.

Table A-5: Automobile Emission Rate Factors in grams per mile (2016 and 2036)

Year	Carbon Dioxide (CO_2)	Volatile Organic Compounds (VOCs)	Nitrogen Oxides (NO_x)	Particulate Matter ($PM_{2.5}$)	Sulfur Dioxide (SO_2)
Automobiles at 58 mph					
2016	340.33	0.0448	0.1651	0.0015	0.0034
2036	206.12	0.0156	0.036	0.0007	0.0021

Source: California Department of Transportation Life-Cycle Benefit-Cost Analysis Model, Cal-B/C V6.2 Emissions Tables. Accessed at https://dot.ca.gov/programs/transportation-planning/economics-data-management/transportation-economics.

To estimate the emissions damage associated with moving or idling locomotives, United States Environmental Protection Agency (EPA) emissions factors for locomotives were used. EPA provides factors for years 2006-2040. As a conservative estimate, the factors for 2040 were used for years after 2040.

Table A-6: Locomotive Emission Rate Factors in grams per gallon of fuel

Year	Carbon Dioxide (CO_2)	Volatile Organic Compounds (VOCs)	Nitrogen Oxides (NO_x)	Particulate Matter ($PM_{2.5}$)
Passenger/Commuter Locomotives				
2010	10,160	9.1	183	4.8
2020	10,160	3.3	93	2.1
2030	10,160	1.3	49	0.8
2040	10,160	0.5	23	0.3

Source: United States Environmental Protection Agency. 2009. Emissions Factors for Locomotives. Accessed at https://nepis.epa.gov/Exe/ZyPDF.cgi/P100500B.PDF?Dockey=P100500B.PDF

A-7 Emissions Costs

To estimate the benefits of avoided emissions, USDOT-provided factors for Emissions Cost were used, as summarized in Table A-7. The value of avoided carbon dioxide emissions increases over time per USDOT guidance.

Table A-7: BCA Emissions Cost Factors (2018 dollars)

Pollutant	Value	Units
Carbon Dioxide (CO_2)	$1- $2	*/ short ton*
Volatile Organic Compounds (VOCs)	$2,100	*/ short ton*
Nitrogen Oxides (NO_x)	$8,600	*/ short ton*
Particulate Matter ($PM_{2.5}$)	$387,300	*/ short ton*
Sulfur Dioxide (SO_2)	$50,100	*/ short ton*

Source: U.S. Department of Transportation. Benefit-Cost Analysis Guidance for Discretionary Grant Programs, January 2020. Table A-6: Damage Costs for Pollutant Emissions and Table A-7: Social Cost of Caron (SCC) per metric ton of CO2. Accessed at https://www.transportation.gov/sites/dot.gov/files/docs/mission/office-policy/transportation-policy/14091/benefit-cost-analysis-guidance-2020.pdf

A-8 Safety Data

To estimate the crash cost savings resulting from an automobile to rail mode shift, rail and highway crash data were used to develop fatality, injury, and crash rates as summarized in Table A-8 and Table A-9.

Table A-8: Rail Crash Rates

Factor			Value	Unit
a	Fatalities		7	*persons*
b	Injuries		1,274	*persons*
c	Passenger Miles		393.47	*100M passenger train-miles*
Fatality Rate		a / c	0.02	*persons/100M passenger-miles*
Injury Rate		b / c	3.24	*persons/100M passenger-miles*

Source: Bureau of Transportation Statistics Railroad Passenger Safety Data. Table 2-42 (2014-2018 Averages). Accessed at: https://www.bts.gov/content/railroad-passenger-safety-data

Table A-9: Highway Crash Rates

	Factor		Value	Unit
a	Total VMT		3,212,347.00	*MVMT/year*
b	Fatalities		37,133	*persons/year*
c	Injuries		2,746,000	*persons/year*
d	Vehicles Involved		12,975,000	*vehicles/year*
	Fatality Rate	b / a * 100	1.16	*persons/100M vehicle-miles*
	Injury Rate	c / a * 100	85.48	*persons/100M vehicle-miles*
	Property Damage Rate	d / a * 100	403.91	*vehicles/100M vehicle-miles*

Source: National Highway Traffic Safety Administration. 2019. Traffic Safety Facts. Accessed at: https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812696

A-9 Crash Costs

To estimate the benefits of avoided crashes, USDOT-provided factors for Value of Reduced Fatalities and Injuries were used, as summarized in Table A-10. A weighted average was calculated for injury crashes to convert Maximum Abbreviated Injury Scale (MAIS) categories 0 through 5 values to a single value based on probabilities of each crash severity level from the USDOT KABCO/Unknown–AIS Data Conversion Matrix, as shown in Table A-11.

Table A-10: BCA Value of Reduced Fatalities and Injuries (2018 dollars)

Factor	Value	Units
Fatality	$9,600,000	*/person*
Injury		
MAIS 0	$0	*/person*
MAIS 1	$28,800	*/person*
MAIS 2	$451,200	*/person*
MAIS 3	$1,008,000	*/person*
MAIS 4	$2,553,600	*/person*
MAIS 5	$5,692,800	*/person*
Property Damage	$4,400	*/vehicle*

Source: U.S. Department of Transportation. Benefit-Cost Analysis Guidance for Discretionary Grant Programs, January 2020. Table A-1: Value of Reduced Fatalities and Injuries and Table A-2: Property Damage Only (PDO) Crashes. Accessed at https://www.transportation.gov/sites/dot.gov/files/docs/mission/office-policy/transportation-policy/14091/benefit-cost-analysis-guidance-2020.pdf.

Table A-11: KABCO to AIS Conversion: Weighted Average (2018 Dollars)

Factor	O: Unknown Severity
Injury	
AIS 0	0.2154
AIS 1	0.6273
AIS 2	0.1040
AIS 3	0.0386
AIS 4	0.0044
AIS 5	0.0103
Weighted Average (*2018$/person*)	$174,030

Source: U.S. National Highway Traffic Safety Administration. Probabilities from KABCO/Unknown to AIS Data Conversion Matrix as provided in 2016 USDOT BCA Guidance, Table 4. Accessed at https://www.transportation.gov/sites/dot.gov/files/docs/Tiger_Benefit-Cost_Analysis_%28BCA%29_Resource_Guide_1.pdf.

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APPENDIX B

TABLE B-1: BCA SUMMARY ALTERNATIVE 1 - CHICAGO-LIMA 79MPH, 2 RT

Undiscounted Costs and Benefits								
Year	Calendar Year	Initial Construction Costs	Other Costs	Residual Value	Passenger Travel Time Savings	Passenger Productivity Savings	Mode Shift Passenger Travel Cost Savings	Mode Shift Crash Cost Savings
0	2020	$0	$0	$0	$0	$0	$0	$0
1	2021	$0	$0	$0	$0	$0	$0	$0
2	2022	$0	$0	$0	$0	$0	$0	$0
3	2023	$0	$0	$0	$0	$0	$0	$0
4	2024	$0	$0	$0	$0	$0	$0	$0
5	2025	$163,326,306	$0	$0	$0	$0	$0	$0
6	2026	$163,326,306	$0	$0	$0	$0	$0	$0
7	2027	$163,326,306	$0	$0	$0	$0	$0	$0
8	2028	$163,326,306	$0	$0	$0	$0	$0	$0
9	2029	$163,326,306	$0	$0	$0	$0	$0	$0
10	2030	$0	$15,924,775	$0	$3,382,891	$2,062,581	$5,961,908	$8,055,893
11	2031	$0	$15,997,377	$0	$3,533,878	$2,154,639	$6,179,480	$8,271,974
12	2032	$0	$16,070,311	$0	$3,691,603	$2,262,315	$6,405,461	$8,493,850
13	2033	$0	$16,143,577	$0	$3,856,367	$2,369,322	$6,640,191	$8,721,678
14	2034	$0	$16,217,177	$0	$4,028,486	$2,481,390	$6,884,026	$8,955,617
15	2035	$0	$16,291,113	$0	$4,208,287	$2,598,759	$7,137,335	$9,195,831
16	2036	$0	$16,373,664	$0	$4,396,112	$2,721,680	$7,400,503	$9,442,487
17	2037	$0	$16,456,633	$0	$4,604,692	$2,858,093	$7,694,603	$9,721,880
18	2038	$0	$16,540,023	$0	$4,816,685	$2,997,310	$7,990,215	$9,996,084
19	2039	$0	$16,623,835	$0	$5,038,437	$3,143,307	$8,297,783	$10,278,021
20	2040	$0	$16,708,071	$0	$5,270,399	$3,296,416	$8,617,810	$10,567,911
21	2041	$0	$16,790,643	$0	$5,513,040	$3,456,982	$8,950,823	$10,865,978
22	2042	$0	$16,873,622	$0	$5,766,852	$3,625,370	$9,297,369	$11,172,451
23	2043	$0	$16,957,012	$0	$6,032,348	$3,801,960	$9,658,021	$11,487,568
24	2044	$0	$17,040,814	$0	$6,310,068	$3,987,151	$10,033,377	$11,811,573
25	2045	$0	$17,125,030	$0	$6,600,574	$4,181,363	$10,424,059	$12,144,716
26	2046	$0	$17,246,249	$0	$6,904,454	$4,385,035	$10,830,718	$12,487,256
27	2047	$0	$17,368,327	$0	$7,222,324	$4,598,628	$11,254,033	$12,839,457
28	2048	$0	$17,491,269	$0	$7,554,828	$4,822,625	$11,694,713	$13,201,591
29	2049	$0	$17,615,081	$0	$7,902,641	$5,057,532	$12,153,496	$13,573,940
30	2050	$0	$17,739,769	$0	$8,266,466	$5,303,882	$12,631,156	$13,956,791
31	2051	$0	$17,865,340	$0	$8,647,041	$5,562,231	$13,128,498	$14,350,440
32	2052	$0	$17,991,800	$0	$9,045,137	$5,833,165	$13,646,361	$14,755,191
33	2053	$0	$18,119,155	$0	$9,461,561	$6,117,295	$14,185,626	$15,171,359
34	2054	$0	$18,247,411	$0	$9,897,156	$6,415,265	$14,747,207	$15,599,265
35	2055	$0	$18,376,576	$0	$10,352,806	$6,727,749	$15,332,062	$16,039,239
36	2056	$0	$18,506,654	$0	$10,829,433	$7,055,455	$15,941,189	$16,491,623
37	2057	$0	$18,637,654	$0	$11,328,003	$7,399,122	$16,575,631	$16,956,767
38	2058	$0	$18,769,580	$0	$11,849,526	$7,759,529	$17,236,476	$17,435,030
39	2059	$0	$18,902,441	$0	$12,395,060	$8,137,492	$17,924,860	$17,926,782
40	2060	$0	$0	$489,978,918	$0	$0	$0	$0
Total		**$816,631,530**	**$517,010,982**	**$489,978,918**	**$208,707,153**	**$133,173,645**	**$324,854,990**	**$369,968,241**

Undiscounted Costs and Benefits Con't				Discounted Costs and Benefits			
Year	Calendar Year	Mode Shift Emissions Damage Savings	Total Benefits less Other Costs	7% Discount Factor	7% PV Capital Costs	7% PV Residual Value	7% PV Total Benefits less Other Costs
0	2020	$0	$0	1.000	$0	$0	$0
1	2021	$0	$0	0.935	$0	$0	$0
2	2022	$0	$0	0.873	$0	$0	$0
3	2023	$0	$0	0.816	$0	$0	$0
4	2024	$0	$0	0.763	$0	$0	$0
5	2025	$0	$0	0.713	$116,449,399	$0	$0
6	2026	$0	$0	0.666	$108,831,214	$0	$0
7	2027	$0	$0	0.623	$101,711,415	$0	$0
8	2028	$0	$0	0.582	$95,057,397	$0	$0
9	2029	$0	$0	0.544	$88,838,689	$0	$0
10	2030	-$273,435	$3,265,064	0.508	$0	$0	$1,659,793
11	2031	-$249,506	$3,893,087	0.475	$0	$0	$1,849,577
12	2032	-$225,536	$4,557,381	0.444	$0	$0	$2,023,532
13	2033	-$213,104	$5,230,878	0.415	$0	$0	$2,170,628
14	2034	-$189,058	$5,943,284	0.388	$0	$0	$2,304,908
15	2035	-$179,857	$6,669,241	0.362	$0	$0	$2,417,240
16	2036	-$151,591	$7,435,526	0.339	$0	$0	$2,518,670
17	2037	-$142,292	$8,280,343	0.317	$0	$0	$2,621,345
18	2038	-$121,356	$9,138,915	0.296	$0	$0	$2,703,875
19	2039	-$115,358	$10,018,356	0.277	$0	$0	$2,770,159
20	2040	-$109,248	$10,935,217	0.258	$0	$0	$2,825,868
21	2041	-$91,622	$11,904,557	0.242	$0	$0	$2,875,106
22	2042	-$92,157	$12,896,262	0.226	$0	$0	$2,910,856
23	2043	-$92,668	$13,930,217	0.211	$0	$0	$2,938,536
24	2044	-$93,157	$15,008,198	0.197	$0	$0	$2,958,815
25	2045	-$93,625	$16,132,057	0.184	$0	$0	$2,972,318
26	2046	-$94,074	$17,267,140	0.172	$0	$0	$2,973,324
27	2047	-$94,503	$18,451,612	0.161	$0	$0	$2,969,425
28	2048	-$94,913	$19,687,576	0.150	$0	$0	$2,961,055
29	2049	-$95,306	$20,977,223	0.141	$0	$0	$2,948,618
30	2050	-$95,682	$22,322,844	0.131	$0	$0	$2,932,488
31	2051	-$96,042	$23,726,827	0.123	$0	$0	$2,913,014
32	2052	-$96,387	$25,191,668	0.115	$0	$0	$2,890,520
33	2053	-$96,717	$26,719,969	0.107	$0	$0	$2,865,308
34	2054	-$97,033	$28,314,449	0.100	$0	$0	$2,837,656
35	2055	-$97,336	$29,977,945	0.094	$0	$0	$2,807,822
36	2056	-$97,626	$31,713,420	0.088	$0	$0	$2,776,049
37	2057	-$97,903	$33,523,965	0.082	$0	$0	$2,742,557
38	2058	-$98,169	$35,412,811	0.076	$0	$0	$2,707,552
39	2059	-$98,423	$37,383,329	0.071	$0	$0	$2,671,226
40	2060	$0	$0	0.067	$0	$32,720,979	$0
Total		**-$3,783,685**	**$515,909,361**		**$510,888,114**	**$32,720,979**	**$80,517,839**

7% Discounted Benefit Summary	
Benefit Cost Ratio	**0.22**
Net Present Value	**-$397,649,296**

TABLE B-2: BCA SUMMARY ALTERNATIVE 2 - CHICAGO-LIMA 79MPH, 4 RT

Undiscounted Costs and Benefits								
Year	Calendar Year	Initial Construction Costs	Other Costs	Residual Value	Passenger Travel Time Savings	Passenger Productivity Savings	Mode Shift Passenger Travel Cost Savings	Mode Shift Crash Cost Savings
0	2020	$0	$0	$0	$0	$0	$0	$0
1	2021	$0	$0	$0	$0	$0	$0	$0
2	2022	$0	$0	$0	$0	$0	$0	$0
3	2023	$0	$0	$0	$0	$0	$0	$0
4	2024	$0	$0	$0	$0	$0	$0	$0
5	2025	$176,734,456	$0	$0	$0	$0	$0	$0
6	2026	$176,734,456	$0	$0	$0	$0	$0	$0
7	2027	$176,734,456	$0	$0	$0	$0	$0	$0
8	2028	$176,734,456	$0	$0	$0	$0	$0	$0
9	2029	$176,734,456	$0	$0	$0	$0	$0	$0
10	2030	$0	$27,337,533	$0	$5,162,459	$3,147,601	$9,082,612	$12,303,783
11	2031	$0	$27,462,168	$0	$5,394,150	$3,288,865	$9,416,522	$12,636,798
12	2032	$0	$27,587,370	$0	$5,636,239	$3,454,041	$9,763,421	$12,978,827
13	2033	$0	$27,713,144	$0	$5,889,193	$3,618,274	$10,123,840	$13,330,113
14	2034	$0	$27,839,491	$0	$6,153,500	$3,790,316	$10,498,331	$13,690,907
15	2035	$0	$27,843,829	$0	$6,429,669	$3,970,538	$10,887,466	$14,061,466
16	2036	$0	$27,984,920	$0	$6,718,232	$4,159,329	$11,291,846	$14,442,055
17	2037	$0	$28,126,726	$0	$7,050,129	$4,375,956	$11,762,787	$14,897,147
18	2038	$0	$28,269,250	$0	$7,382,464	$4,593,933	$12,227,822	$15,333,431
19	2039	$0	$28,412,497	$0	$7,730,464	$4,822,769	$12,712,157	$15,782,493
20	2040	$0	$28,525,365	$0	$8,094,869	$5,063,004	$13,216,628	$16,244,705
21	2041	$0	$28,666,337	$0	$8,476,451	$5,315,206	$13,742,103	$16,720,455
22	2042	$0	$28,808,007	$0	$8,876,020	$5,579,970	$14,289,492	$17,210,137
23	2043	$0	$28,950,376	$0	$9,294,425	$5,857,923	$14,859,744	$17,714,160
24	2044	$0	$29,093,449	$0	$9,732,553	$6,149,722	$15,453,851	$18,232,945
25	2045	$0	$29,206,901	$0	$10,191,333	$6,456,055	$16,072,848	$18,766,922
26	2046	$0	$29,413,642	$0	$10,671,740	$6,777,648	$16,717,818	$19,316,538
27	2047	$0	$29,621,846	$0	$11,174,793	$7,115,261	$17,389,890	$19,882,251
28	2048	$0	$29,831,525	$0	$11,701,559	$7,469,691	$18,090,246	$20,464,531
29	2049	$0	$30,042,687	$0	$12,253,156	$7,841,776	$18,820,121	$21,063,863
30	2050	$0	$30,129,532	$0	$12,830,755	$8,232,395	$19,580,801	$21,680,749
31	2051	$0	$30,469,507	$0	$13,435,581	$8,642,472	$20,373,636	$22,315,700
32	2052	$0	$30,685,186	$0	$14,068,918	$9,072,977	$21,200,031	$22,969,247
33	2053	$0	$30,902,391	$0	$14,732,110	$9,524,925	$22,061,457	$23,641,934
34	2054	$0	$31,121,133	$0	$15,426,563	$9,999,387	$22,959,450	$24,334,322
35	2055	$0	$31,341,424	$0	$16,153,753	$10,497,483	$23,895,617	$25,046,987
36	2056	$0	$31,563,275	$0	$16,915,221	$11,020,390	$24,871,634	$25,780,524
37	2057	$0	$31,786,695	$0	$17,712,584	$11,569,344	$25,889,255	$26,535,543
38	2058	$0	$32,011,698	$0	$18,547,533	$12,145,644	$26,950,311	$27,312,674
39	2059	$0	$32,238,292	$0	$19,421,841	$12,750,650	$28,056,719	$28,112,565
40	2060	$0	$0	$530,203,369	$0	$0	$0	$0
Total		**$883,672,282**	**$882,986,195**	**$530,203,369**	**$323,258,258**	**$206,303,545**	**$502,258,455**	**$572,803,774**

Undiscounted Costs and Benefits Con't				Discounted Costs and Benefits			
Year	Calendar Year	Mode Shift Emissions Damage Savings	Total Benefits less Other Costs	7% Discount Factor	7% PV Capital Costs	7% PV Residual Value	7% PV Total Benefits less Other Costs
0	2020	$0	$0	1.000	$0	$0	$0
1	2021	$0	$0	0.935	$0	$0	$0
2	2022	$0	$0	0.873	$0	$0	$0
3	2023	$0	$0	0.816	$0	$0	$0
4	2024	$0	$0	0.763	$0	$0	$0
5	2025	$0	$0	0.713	$126,009,225	$0	$0
6	2026	$0	$0	0.666	$117,765,631	$0	$0
7	2027	$0	$0	0.623	$110,061,337	$0	$0
8	2028	$0	$0	0.582	$102,861,063	$0	$0
9	2029	$0	$0	0.544	$96,131,834	$0	$0
10	2030	-$564,508	$1,794,415	0.508	$0	$0	$912,190
11	2031	-$516,188	$2,757,980	0.475	$0	$0	$1,310,296
12	2032	-$467,806	$3,777,352	0.444	$0	$0	$1,677,189
13	2033	-$442,518	$4,805,758	0.415	$0	$0	$1,994,219
14	2034	-$394,022	$5,899,540	0.388	$0	$0	$2,287,943
15	2035	-$375,233	$7,130,078	0.362	$0	$0	$2,584,268
16	2036	-$322,121	$8,304,421	0.339	$0	$0	$2,812,995
17	2037	-$303,120	$9,656,174	0.317	$0	$0	$3,056,897
18	2038	-$260,887	$11,007,512	0.296	$0	$0	$3,256,726
19	2039	-$248,545	$12,386,842	0.277	$0	$0	$3,425,065
20	2040	-$235,993	$13,857,848	0.258	$0	$0	$3,581,131
21	2041	-$200,423	$15,387,454	0.242	$0	$0	$3,716,272
22	2042	-$201,186	$16,946,427	0.226	$0	$0	$3,825,032
23	2043	-$201,915	$18,573,962	0.211	$0	$0	$3,918,119
24	2044	-$202,611	$20,273,010	0.197	$0	$0	$3,996,755
25	2045	-$203,277	$22,076,981	0.184	$0	$0	$4,067,666
26	2046	-$203,913	$23,866,190	0.172	$0	$0	$4,109,650
27	2047	-$204,520	$25,735,828	0.161	$0	$0	$4,141,676
28	2048	-$205,101	$27,689,402	0.150	$0	$0	$4,164,547
29	2049	-$205,655	$29,730,574	0.141	$0	$0	$4,179,013
30	2050	-$206,185	$31,988,984	0.131	$0	$0	$4,202,301
31	2051	-$206,690	$34,091,192	0.123	$0	$0	$4,185,478
32	2052	-$207,174	$36,418,814	0.115	$0	$0	$4,178,736
33	2053	-$207,635	$38,850,401	0.107	$0	$0	$4,166,111
34	2054	-$208,075	$41,390,514	0.100	$0	$0	$4,148,130
35	2055	-$208,495	$44,043,919	0.094	$0	$0	$4,125,283
36	2056	-$208,897	$46,815,597	0.088	$0	$0	$4,098,025
37	2057	-$209,280	$49,710,751	0.082	$0	$0	$4,066,779
38	2058	-$209,645	$52,734,820	0.076	$0	$0	$4,031,939
39	2059	-$209,993	$55,893,489	0.071	$0	$0	$3,993,870
40	2060	$0	$0	0.067	$0	$35,407,183	$0
Total		**-$8,041,610**	**$713,596,228**		**$552,829,089**	**$35,407,183**	**$104,214,301**

7% Discounted Benefit Summary	
Benefit Cost Ratio	**0.25**
Net Present Value	**-$413,207,606**

TABLE B-3: BCA SUMMARY ALTERNATIVE 3 - CHICAGO-LIMA 110MPH, 4 RT

Undiscounted Costs and Benefits								
Year	Calendar Year	Initial Construction Costs	Other Costs	Residual Value	Passenger Travel Time Savings	Passenger Productivity Savings	Mode Shift Passenger Travel Cost Savings	Mode Shift Crash Cost Savings
0	2020	$0	$0	$0	$0	$0	$0	$0
1	2021	$0	$0	$0	$0	$0	$0	$0
2	2022	$0	$0	$0	$0	$0	$0	$0
3	2023	$0	$0	$0	$0	$0	$0	$0
4	2024	$0	$0	$0	$0	$0	$0	$0
5	2025	$245,683,379	$0	$0	$0	$0	$0	$0
6	2026	$245,683,379	$0	$0	$0	$0	$0	$0
7	2027	$245,683,379	$0	$0	$0	$0	$0	$0
8	2028	$245,683,379	$0	$0	$0	$0	$0	$0
9	2029	$245,683,379	$0	$0	$0	$0	$0	$0
10	2030	$0	$32,819,668	$0	$18,082,579	$11,025,121	$13,150,152	$17,644,796
11	2031	$0	$32,969,297	$0	$18,905,900	$11,527,107	$13,641,167	$18,133,666
12	2032	$0	$33,119,607	$0	$19,766,707	$12,113,577	$14,151,553	$18,636,081
13	2033	$0	$33,270,603	$0	$20,666,708	$12,697,462	$14,682,111	$19,152,416
14	2034	$0	$33,422,287	$0	$21,607,687	$13,309,491	$15,233,674	$19,683,057
15	2035	$0	$33,498,595	$0	$22,591,510	$13,951,021	$15,807,110	$20,228,400
16	2036	$0	$33,668,340	$0	$23,620,127	$14,623,473	$16,403,325	$20,788,852
17	2037	$0	$33,838,945	$0	$24,758,323	$15,367,282	$17,066,517	$21,419,114
18	2038	$0	$34,010,415	$0	$25,918,462	$16,128,449	$17,735,293	$22,040,503
19	2039	$0	$34,182,753	$0	$27,132,962	$16,927,317	$18,431,608	$22,679,918
20	2040	$0	$34,409,745	$0	$28,404,372	$17,765,755	$19,156,642	$23,337,884
21	2041	$0	$34,579,799	$0	$29,735,359	$18,645,722	$19,911,629	$24,014,937
22	2042	$0	$34,750,692	$0	$31,128,713	$19,569,276	$20,697,854	$24,711,633
23	2043	$0	$34,922,431	$0	$32,587,358	$20,538,574	$21,516,661	$25,428,541
24	2044	$0	$35,095,018	$0	$34,114,353	$21,555,883	$22,369,454	$26,166,246
25	2045	$0	$35,320,895	$0	$35,712,901	$22,623,582	$23,257,698	$26,925,354
26	2046	$0	$35,570,914	$0	$37,386,354	$23,744,165	$24,182,923	$27,706,483
27	2047	$0	$35,822,703	$0	$39,138,223	$24,920,252	$25,146,728	$28,510,274
28	2048	$0	$36,076,274	$0	$40,972,181	$26,154,593	$26,150,782	$29,337,384
29	2049	$0	$36,331,640	$0	$42,892,077	$27,450,073	$27,196,828	$30,188,489
30	2050	$0	$36,564,986	$0	$44,901,935	$28,809,721	$28,286,688	$31,064,285
31	2051	$0	$36,847,808	$0	$47,005,973	$30,236,714	$29,422,262	$31,965,489
32	2052	$0	$37,108,635	$0	$49,208,603	$31,734,388	$30,605,539	$32,892,837
33	2053	$0	$37,371,309	$0	$51,514,445	$33,306,244	$31,838,594	$33,847,089
34	2054	$0	$37,635,842	$0	$53,928,335	$34,955,957	$33,123,595	$34,829,025
35	2055	$0	$37,902,247	$0	$56,455,336	$36,687,383	$34,462,806	$35,839,447
36	2056	$0	$38,170,538	$0	$59,100,749	$38,504,570	$35,858,594	$36,879,183
37	2057	$0	$38,440,729	$0	$61,870,122	$40,411,764	$37,313,430	$37,949,083
38	2058	$0	$38,712,831	$0	$64,769,263	$42,413,425	$38,829,897	$39,050,021
39	2059	$0	$38,986,860	$0	$67,804,254	$44,514,232	$40,410,694	$40,182,898
40	2060	$0	$0	$737,050,137	$0	$0	$0	$0
Total		**$1,228,416,894**	**$1,065,422,408**	**$737,050,137**	**$1,131,681,871**	**$722,212,575**	**$726,041,808**	**$821,233,385**

Undiscounted Costs and Benefits Con't				Discounted Costs and Benefits			
Year	Calendar Year	Mode Shift Emissions Damage Savings	Total Benefits less Other Costs	7% Discount Factor	7% PV Capital Costs	7% PV Residual Value	7% PV Total Benefits less Other Costs
0	2020	$0	$0	1.000	$0	$0	$0
1	2021	$0	$0	0.935	$0	$0	$0
2	2022	$0	$0	0.873	$0	$0	$0
3	2023	$0	$0	0.816	$0	$0	$0
4	2024	$0	$0	0.763	$0	$0	$0
5	2025	$0	$0	0.713	$175,168,854	$0	$0
6	2026	$0	$0	0.666	$163,709,209	$0	$0
7	2027	$0	$0	0.623	$152,999,261	$0	$0
8	2028	$0	$0	0.582	$142,989,963	$0	$0
9	2029	$0	$0	0.544	$133,635,480	$0	$0
10	2030	-$539,772	$26,543,206	0.508	$0	$0	$13,493,220
11	2031	-$492,026	$28,746,517	0.475	$0	$0	$13,657,263
12	2032	-$444,194	$31,104,118	0.444	$0	$0	$13,810,600
13	2033	-$419,432	$33,508,663	0.415	$0	$0	$13,904,904
14	2034	-$371,439	$36,040,183	0.388	$0	$0	$13,977,004
15	2035	-$353,132	$38,726,313	0.362	$0	$0	$14,036,198
16	2036	-$295,070	$41,472,367	0.339	$0	$0	$14,048,126
17	2037	-$276,532	$44,495,760	0.317	$0	$0	$14,086,218
18	2038	-$234,723	$47,577,568	0.296	$0	$0	$14,076,486
19	2039	-$222,785	$50,766,267	0.277	$0	$0	$14,037,296
20	2040	-$210,621	$54,044,287	0.258	$0	$0	$13,966,071
21	2041	-$175,421	$57,552,427	0.242	$0	$0	$13,899,664
22	2042	-$176,538	$61,180,245	0.226	$0	$0	$13,809,187
23	2043	-$177,607	$64,971,097	0.211	$0	$0	$13,705,450
24	2044	-$178,628	$68,932,292	0.197	$0	$0	$13,589,768
25	2045	-$179,604	$73,019,035	0.184	$0	$0	$13,453,697
26	2046	-$180,537	$77,268,474	0.172	$0	$0	$13,305,283
27	2047	-$181,429	$81,711,346	0.161	$0	$0	$13,149,837
28	2048	-$182,281	$86,356,385	0.150	$0	$0	$12,988,191
29	2049	-$183,096	$91,212,731	0.141	$0	$0	$12,821,118
30	2050	-$183,875	$96,313,768	0.131	$0	$0	$12,652,462
31	2051	-$184,619	$101,598,011	0.123	$0	$0	$12,473,493
32	2052	-$185,330	$107,147,402	0.115	$0	$0	$12,294,214
33	2053	-$186,010	$112,949,054	0.107	$0	$0	$12,112,058
34	2054	-$186,659	$119,014,410	0.100	$0	$0	$11,927,546
35	2055	-$187,280	$125,355,445	0.094	$0	$0	$11,741,159
36	2056	-$187,873	$131,984,684	0.088	$0	$0	$11,553,340
37	2057	-$188,439	$138,915,231	0.082	$0	$0	$11,364,494
38	2058	-$188,980	$146,160,796	0.076	$0	$0	$11,174,995
39	2059	-$189,496	$153,735,723	0.071	$0	$0	$10,985,187
40	2060	$0	$0	0.067	$0	$49,220,489	$0
Total		**-$7,343,425**	**$2,328,403,805**		**$768,502,767**	**$49,220,489**	**$392,094,530**

7% Discounted Benefit Summary	
Benefit Cost Ratio	**0.57**
Net Present Value	**-$327,187,747**

TABLE B-4: BCA SUMMARY ALTERNATIVE 4 - CHICAGO-COLUMBUS 110MPH, 4 RT

		Undiscounted Costs and Benefits						
Year	Calendar Year	Initial Construction Costs	Other Costs	Residual Value	Passenger Travel Time Savings	Passenger Productivity Savings	Mode Shift Passenger Travel Cost Savings	Mode Shift Crash Cost Savings
0	2020	$0	$0	$0	$0	$0	$0	$0
1	2021	$0	$0	$0	$0	$0	$0	$0
2	2022	$0	$0	$0	$0	$0	$0	$0
3	2023	$0	$0	$0	$0	$0	$0	$0
4	2024	$0	$0	$0	$0	$0	$0	$0
5	2025	$372,573,336	$0	$0	$0	$0	$0	$0
6	2026	$372,573,336	$0	$0	$0	$0	$0	$0
7	2027	$372,573,336	$0	$0	$0	$0	$0	$0
8	2028	$372,573,336	$0	$0	$0	$0	$0	$0
9	2029	$372,573,336	$0	$0	$0	$0	$0	$0
10	2030	$0	$49,770,291	$0	$20,756,733	$12,655,578	$15,289,433	$23,873,517
11	2031	$0	$49,997,199	$0	$21,701,811	$13,231,801	$15,871,447	$24,534,962
12	2032	$0	$50,225,142	$0	$22,689,919	$13,905,001	$16,476,798	$25,214,732
13	2033	$0	$50,454,123	$0	$23,723,017	$14,575,235	$17,106,462	$25,913,337
14	2034	$0	$50,684,149	$0	$24,803,154	$15,277,774	$17,761,456	$26,631,297
15	2035	$0	$50,799,869	$0	$25,932,470	$16,014,176	$18,442,839	$27,369,149
16	2036	$0	$51,057,283	$0	$27,113,205	$16,786,074	$19,151,720	$28,127,445
17	2037	$0	$51,316,002	$0	$28,419,724	$17,639,882	$19,939,784	$28,980,193
18	2038	$0	$51,576,032	$0	$29,751,430	$18,513,615	$20,735,412	$29,820,936
19	2039	$0	$51,837,379	$0	$31,145,537	$19,430,624	$21,564,297	$30,686,069
20	2040	$0	$52,181,607	$0	$32,604,971	$20,393,055	$22,427,881	$31,576,300
21	2041	$0	$52,439,489	$0	$34,132,791	$21,403,157	$23,327,670	$32,492,358
22	2042	$0	$52,698,646	$0	$35,732,202	$22,463,290	$24,265,237	$33,434,992
23	2043	$0	$52,959,083	$0	$37,406,560	$23,575,934	$25,242,225	$34,404,972
24	2044	$0	$53,220,807	$0	$39,159,376	$24,743,689	$26,260,350	$35,403,092
25	2045	$0	$53,563,346	$0	$40,994,326	$25,969,284	$27,321,405	$36,430,169
26	2046	$0	$53,942,494	$0	$42,915,259	$27,255,586	$28,427,263	$37,487,042
27	2047	$0	$54,324,326	$0	$44,926,204	$28,605,600	$29,579,881	$38,574,576
28	2048	$0	$54,708,861	$0	$47,031,378	$30,022,482	$30,781,303	$39,693,661
29	2049	$0	$55,096,118	$0	$49,235,199	$31,509,545	$32,033,665	$40,845,211
30	2050	$0	$55,449,981	$0	$51,542,286	$33,070,264	$33,339,199	$42,030,169
31	2051	$0	$55,878,875	$0	$53,957,481	$34,708,289	$34,700,236	$43,249,503
32	2052	$0	$56,274,413	$0	$56,485,848	$36,427,448	$36,119,212	$44,504,211
33	2053	$0	$56,672,752	$0	$59,132,691	$38,231,759	$37,598,674	$45,795,320
34	2054	$0	$57,073,910	$0	$61,903,560	$40,125,441	$39,141,281	$47,123,885
35	2055	$0	$57,477,908	$0	$64,804,269	$42,112,920	$40,749,813	$48,490,993
36	2056	$0	$57,884,765	$0	$67,840,900	$44,198,842	$42,427,174	$49,897,762
37	2057	$0	$58,294,503	$0	$71,019,823	$46,388,083	$44,176,400	$51,345,342
38	2058	$0	$58,707,141	$0	$74,347,706	$48,685,761	$46,000,662	$52,834,919
39	2059	$0	$59,122,699	$0	$77,831,529	$51,097,247	$47,903,277	$54,367,709
40	2060	$0	$0	$1,117,720,007	$0	$0	$0	$0
Total		**$1,862,866,679**	**$1,615,689,194**	**$1,117,720,007**	**$1,299,041,357**	**$829,017,437**	**$854,162,452**	**$1,111,133,822**

Undiscounted Costs and Benefits Con't				Discounted Costs and Benefits			
Year	Calendar Year	Mode Shift Emissions Damage Savings	Total Benefits less Other Costs	7% Discount Factor	7% PV Capital Costs	7% PV Residual Value	7% PV Total Benefits less Other Costs
0	2020	$0	$0	1.000	$0	$0	$0
1	2021	$0	$0	0.935	$0	$0	$0
2	2022	$0	$0	0.873	$0	$0	$0
3	2023	$0	$0	0.816	$0	$0	$0
4	2024	$0	$0	0.763	$0	$0	$0
5	2025	$0	$0	0.713	$265,639,639	$0	$0
6	2026	$0	$0	0.666	$248,261,345	$0	$0
7	2027	$0	$0	0.623	$232,019,949	$0	$0
8	2028	$0	$0	0.582	$216,841,074	$0	$0
9	2029	$0	$0	0.544	$202,655,209	$0	$0
10	2030	-$796,340	$22,008,629	0.508	$0	$0	$11,188,071
11	2031	-$726,448	$24,616,372	0.475	$0	$0	$11,695,061
12	2032	-$656,440	$27,404,869	0.444	$0	$0	$12,168,090
13	2033	-$620,108	$30,243,819	0.415	$0	$0	$12,550,110
14	2034	-$549,882	$33,239,649	0.388	$0	$0	$12,890,909
15	2035	-$522,988	$36,435,778	0.362	$0	$0	$13,206,003
16	2036	-$439,948	$39,681,213	0.339	$0	$0	$13,441,400
17	2037	-$412,758	$43,250,823	0.317	$0	$0	$13,692,103
18	2038	-$351,601	$46,893,759	0.296	$0	$0	$13,874,171
19	2039	-$334,045	$50,655,103	0.277	$0	$0	$14,006,558
20	2040	-$316,164	$54,504,435	0.258	$0	$0	$14,084,982
21	2041	-$264,670	$58,651,816	0.242	$0	$0	$14,165,181
22	2042	-$266,183	$62,930,892	0.226	$0	$0	$14,204,331
23	2043	-$267,630	$67,402,978	0.211	$0	$0	$14,218,448
24	2044	-$269,013	$72,076,687	0.197	$0	$0	$14,209,675
25	2045	-$270,334	$76,881,503	0.184	$0	$0	$14,165,354
26	2046	-$271,598	$81,871,057	0.172	$0	$0	$14,097,827
27	2047	-$272,805	$87,089,128	0.161	$0	$0	$14,015,285
28	2048	-$273,960	$92,546,003	0.150	$0	$0	$13,919,124
29	2049	-$275,063	$98,252,438	0.141	$0	$0	$13,810,639
30	2050	-$276,118	$104,255,819	0.131	$0	$0	$13,695,786
31	2051	-$277,126	$110,459,509	0.123	$0	$0	$13,561,446
32	2052	-$278,089	$116,984,217	0.115	$0	$0	$13,422,901
33	2053	-$279,009	$123,806,683	0.107	$0	$0	$13,276,372
34	2054	-$279,889	$130,940,368	0.100	$0	$0	$13,122,758
35	2055	-$280,729	$138,399,357	0.094	$0	$0	$12,962,891
36	2056	-$281,532	$146,198,381	0.088	$0	$0	$12,797,542
37	2057	-$282,299	$154,352,847	0.082	$0	$0	$12,627,427
38	2058	-$283,031	$162,878,877	0.076	$0	$0	$12,453,207
39	2059	-$283,730	$171,793,333	0.071	$0	$0	$12,275,494
40	2060	$0	$0	0.067	$0	$74,641,768	$0
Total		**-$10,959,530**	**$2,466,706,344**		**$1,165,417,215**	**$74,641,768**	**$399,799,146**

7% Discounted Benefit Summary	
Benefit Cost Ratio	**0.41**
Net Present Value	**-$690,976,301**

TABLE B-5: BCA SUMMARY SENSITIVITY - CHICAGO-LIMA 110MPH, 4 RT COST SHARING

		Undiscounted Costs and Benefits						
Year	Calendar Year	Initial Construction Costs	Other Costs	Residual Value	Passenger Travel Time Savings	Passenger Productivity Savings	Mode Shift Passenger Travel Cost Savings	Mode Shift Crash Cost Savings
0	2020	$0	$0	$0	$0	$0	$0	$0
1	2021	$0	$0	$0	$0	$0	$0	$0
2	2022	$0	$0	$0	$0	$0	$0	$0
3	2023	$0	$0	$0	$0	$0	$0	$0
4	2024	$0	$0	$0	$0	$0	$0	$0
5	2025	$235,763,133	$0	$0	$0	$0	$0	$0
6	2026	$235,763,133	$0	$0	$0	$0	$0	$0
7	2027	$235,763,133	$0	$0	$0	$0	$0	$0
8	2028	$235,763,133	$0	$0	$0	$0	$0	$0
9	2029	$235,763,133	$0	$0	$0	$0	$0	$0
10	2030	$0	$49,770,291	$0	$20,756,733	$12,655,578	$15,289,433	$23,873,517
11	2031	$0	$49,997,199	$0	$21,701,811	$13,231,801	$15,871,447	$24,534,962
12	2032	$0	$50,225,142	$0	$22,689,919	$13,905,001	$16,476,798	$25,214,732
13	2033	$0	$50,454,123	$0	$23,723,017	$14,575,235	$17,106,462	$25,913,337
14	2034	$0	$50,684,149	$0	$24,803,154	$15,277,774	$17,761,456	$26,631,297
15	2035	$0	$50,799,869	$0	$25,932,470	$16,014,176	$18,442,839	$27,369,149
16	2036	$0	$51,057,283	$0	$27,113,205	$16,786,074	$19,151,720	$28,127,445
17	2037	$0	$51,316,002	$0	$28,419,724	$17,639,882	$19,939,784	$28,980,193
18	2038	$0	$51,576,032	$0	$29,751,430	$18,513,615	$20,735,412	$29,820,936
19	2039	$0	$51,837,379	$0	$31,145,537	$19,430,624	$21,564,297	$30,686,069
20	2040	$0	$52,181,607	$0	$32,604,971	$20,393,055	$22,427,881	$31,576,300
21	2041	$0	$52,439,489	$0	$34,132,791	$21,403,157	$23,327,670	$32,492,358
22	2042	$0	$52,698,646	$0	$35,732,202	$22,463,290	$24,265,237	$33,434,992
23	2043	$0	$52,959,083	$0	$37,406,560	$23,575,934	$25,242,225	$34,404,972
24	2044	$0	$53,220,807	$0	$39,159,376	$24,743,689	$26,260,350	$35,403,092
25	2045	$0	$53,563,346	$0	$40,994,326	$25,969,284	$27,321,405	$36,430,169
26	2046	$0	$53,942,494	$0	$42,915,259	$27,255,586	$28,427,263	$37,487,042
27	2047	$0	$54,324,326	$0	$44,926,204	$28,605,600	$29,579,881	$38,574,576
28	2048	$0	$54,708,861	$0	$47,031,378	$30,022,482	$30,781,303	$39,693,661
29	2049	$0	$55,096,118	$0	$49,235,199	$31,509,545	$32,033,665	$40,845,211
30	2050	$0	$55,449,981	$0	$51,542,286	$33,070,264	$33,339,199	$42,030,169
31	2051	$0	$55,878,875	$0	$53,957,481	$34,708,289	$34,700,236	$43,249,503
32	2052	$0	$56,274,413	$0	$56,485,848	$36,427,448	$36,119,212	$44,504,211
33	2053	$0	$56,672,752	$0	$59,132,691	$38,231,759	$37,598,674	$45,795,320
34	2054	$0	$57,073,910	$0	$61,903,560	$40,125,441	$39,141,281	$47,123,885
35	2055	$0	$57,477,908	$0	$64,804,269	$42,112,920	$40,749,813	$48,490,993
36	2056	$0	$57,884,765	$0	$67,840,900	$44,198,842	$42,427,174	$49,897,762
37	2057	$0	$58,294,503	$0	$71,019,823	$46,388,083	$44,176,400	$51,345,342
38	2058	$0	$58,707,141	$0	$74,347,706	$48,685,761	$46,000,662	$52,834,919
39	2059	$0	$59,122,699	$0	$77,831,529	$51,097,247	$47,903,277	$54,367,709
40	2060	$0	$0	$707,289,398	$0	$0	$0	$0
Total		**$1,178,815,663**	**$1,615,689,194**	**$707,289,398**	**$1,299,041,357**	**$829,017,437**	**$854,162,452**	**$1,111,133,822**

Undiscounted Costs and Benefits Con't				Discounted Costs and Benefits			
Year	Calendar Year	Mode Shift Emissions Damage Savings	Total Benefits less Other Costs	7% Discount Factor	7% PV Capital Costs	7% PV Residual Value	7% PV Total Benefits less Other Costs
0	2020	$0	$0	1.000	$0	$0	$0
1	2021	$0	$0	0.935	$0	$0	$0
2	2022	$0	$0	0.873	$0	$0	$0
3	2023	$0	$0	0.816	$0	$0	$0
4	2024	$0	$0	0.763	$0	$0	$0
5	2025	$0	$0	0.713	$168,095,855	$0	$0
6	2026	$0	$0	0.666	$157,098,930	$0	$0
7	2027	$0	$0	0.623	$146,821,430	$0	$0
8	2028	$0	$0	0.582	$137,216,290	$0	$0
9	2029	$0	$0	0.544	$128,239,523	$0	$0
10	2030	-$796,340	$22,008,629	0.508	$0	$0	$11,188,071
11	2031	-$726,448	$24,616,372	0.475	$0	$0	$11,695,061
12	2032	-$656,440	$27,404,869	0.444	$0	$0	$12,168,090
13	2033	-$620,108	$30,243,819	0.415	$0	$0	$12,550,110
14	2034	-$549,882	$33,239,649	0.388	$0	$0	$12,890,909
15	2035	-$522,988	$36,435,778	0.362	$0	$0	$13,206,003
16	2036	-$439,948	$39,681,213	0.339	$0	$0	$13,441,400
17	2037	-$412,758	$43,250,823	0.317	$0	$0	$13,692,103
18	2038	-$351,601	$46,893,759	0.296	$0	$0	$13,874,171
19	2039	-$334,045	$50,655,103	0.277	$0	$0	$14,006,558
20	2040	-$316,164	$54,504,435	0.258	$0	$0	$14,084,982
21	2041	-$264,670	$58,651,816	0.242	$0	$0	$14,165,181
22	2042	-$266,183	$62,930,892	0.226	$0	$0	$14,204,331
23	2043	-$267,630	$67,402,978	0.211	$0	$0	$14,218,448
24	2044	-$269,013	$72,076,687	0.197	$0	$0	$14,209,675
25	2045	-$270,334	$76,881,503	0.184	$0	$0	$14,165,354
26	2046	-$271,598	$81,871,057	0.172	$0	$0	$14,097,827
27	2047	-$272,805	$87,089,128	0.161	$0	$0	$14,015,285
28	2048	-$273,960	$92,546,003	0.150	$0	$0	$13,919,124
29	2049	-$275,063	$98,252,438	0.141	$0	$0	$13,810,639
30	2050	-$276,118	$104,255,819	0.131	$0	$0	$13,695,786
31	2051	-$277,126	$110,459,509	0.123	$0	$0	$13,561,446
32	2052	-$278,089	$116,984,217	0.115	$0	$0	$13,422,901
33	2053	-$279,009	$123,806,683	0.107	$0	$0	$13,276,372
34	2054	-$279,889	$130,940,368	0.100	$0	$0	$13,122,758
35	2055	-$280,729	$138,399,357	0.094	$0	$0	$12,962,891
36	2056	-$281,532	$146,198,381	0.088	$0	$0	$12,797,542
37	2057	-$282,299	$154,352,847	0.082	$0	$0	$12,627,427
38	2058	-$283,031	$162,878,877	0.076	$0	$0	$12,453,207
39	2059	-$283,730	$171,793,333	0.071	$0	$0	$12,275,494
40	2060	$0	$0	0.067	$0	$47,233,055	$0
Total		**-$10,959,530**	**$2,466,706,344**		**$737,472,028**	**$47,233,055**	**$399,799,146**

7% Discounted Benefit Summary	
Benefit Cost Ratio	**0.61**
Net Present Value	**-$290,439,827**