Benefit Cost Analysis

Introduction

This appendix describes the method used for estimating benefits and life cycle costs of the I-69 Corridor Project. This analysis emphasizes the importance and full benefits of the project. In conducting the benefit-cost analysis, CS followed Federal guidance regarding evaluation criteria, discount and monetization rates, and evaluation methods prescribed in the 2016 TIGER and FASTLANE Guidance and supporting documents.

The primary benefits of the Project are:

- Improved the condition of the corridor by lessening pavement maintenance
- Reduced travel time for passengers cars and trucks
- Reduced vehicle operating costs (fuel and non-fuel costs)
- Reduced air emissions generated by motor vehicles
- Greater safety for users of motorized and non-motorized transportation modes in the vicinity of the project

Consistent with USDOT grant methodology and guidance, the benefits resulting from the I-69 Corridor Project (see Table 1) are broken down into the following major categories: a) State of Good Repair, b) Economic Competitiveness, c) Environmental Sustainability, and d) Safety. The benefits of the I-69 Corridor Project are calculated in 2015 dollars over a time horizon of 20 years, starting in 2020 and ceasing in 2040.

Table 1 Direct Benefits Resulting from the I-69 Corridor Project

Benefit Category	Metrics
A. State of Good Repair	Pavement Maintenance Costs
B. Economic Competitiveness	Travel Time Costs Vehicle Operating Costs (VOC) Logistics Cost Savings
C. Environmental Sustainability	Social Cost of Carbon (SCC) Emissions Non-Carbon Emissions Costs
D. Safety	Traffic Accident Costs

Travel Patterns

The estimation of the benefits involved establishing the Baseline and Build Scenario and calculating the differences between the Build and the Baseline in the benchmark years. The project team prepared and analyzed the following four model scenarios using the Arkansas travel demand model (TDM):

- 2020 No Build Baseline
- 2040 No Build Baseline
- 2020 Build –I-69 Corridor Project
- 2040 Build –I-69 Corridor Project
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The model outputs for each of the study scenarios used in the estimation of the benefits included the following:

- Daily vehicle-miles traveled (VMT) by vehicle type (passenger cars and trucks), trip purpose (commute, business and leisure trips), and time period (a.m. peak period, mid-day, p.m. peak period, and night) in 2020 and 2040.
- Daily vehicle-hours traveled (VHT) by vehicle type (passenger cars and trucks), trip purpose (commute, business and leisure trips), and time period (a.m. peak period, mid-day, p.m. peak period, and night) in 2020 and 2040.

The project completion date was assumed to be 2020. Aa straight-line growth pattern was assumed for VMT and VHT from 2020 to 2040 for the No-Build scenario and Build scenario. In this way the intermittent years during the 20-year study period (2020 to 2040) have been estimated. The focus of the travel efficiency portion of the benefit-cost analysis is the difference between the build and no-build scenarios in terms of a reduction in VMT and/or VHT.

Daily VMT and VHT accruing to commute and business trips were annualized by assuming 260 working days a year (i.e., 52 weeks). Daily VMT and VHT for leisure and truck trips were annualized by multiplying daily VMT and VHT by 365 days.

Table 2 provides traffic forecasts for vehicle miles traveled (VMT) and vehicle hours traveled (VHT) in 2040. As shown in the table, passenger cars and trucks would benefit from the added capacity provided by the project.

Table 2 Daily and Annual Changes in Traffic in 2040

	Daily		Annual	
	Auto	Truck	Auto	Truck
VMT	(52,996.97)	(74,843)	(19,343,893)	(27,317,687)
VHT	(184.15)	(1,200)	(67,214)	(437,897)

Source: Output of the model scenarios using the Arkansas TDM

State of Good Repair

The expected reduction in VMT will lead to a reduction in pavement wear and tear over the 20-year analysis period.

The method to assess highway system state of good repair (SOGR) benefits involves estimation of the marginal external cost associated with pavement maintenance by vehicle type and highway functional class. This analysis uses the average external marginal costs for urban highways provided by the Federal Highway Administration (FHWA) (see Table 3) which represent the additional spending (or saving) in all costs of maintaining pavements, including resurfacing and reconstruction, resulting from a unit increase/decrease in VMT borne by public agencies responsible for highway maintenance. The marginal pavement cost is multiplied by the annual changes in VMT over the 20-year analysis period.

In addition to the decreased wear and tear caused by the reduction in miles traveled, the project has the benefit of causing significant operations and maintenance costs to be foregone. The Arkansas State Highway and Transportation Department estimates these foregone expenses to come to $350,078,151 over the period from 2020 through 2040. Table 4 summarizes the SOGR benefits/disbenefits.

Table 3 Marginal External Pavement Cost for Urban Highways

Vehicle Class	Urban Highways (Average)	Urban Highways (Average)
	in 2000$	in 2015$
Passenger Cars	0.001	0.0014
Trucks	0.257	0.354

Addendum to the 1997 Federal Highway Cost Allocation Study Final Report, 2000. Table 13
Notes:
1. Marginal pavement cost was inflated from 2000 to 2015 dollars based on the Consumer Price Index (CPI)
2. Truck costs were calculated as an average of 60 kip 5-axle combo/urban interstate and 80 kip 5-axle combo/urban interstate.

Table 4. Sate of Good Repair Cost Benefits/Disbenefits

Year	Calendar Year	State of Good Repair Savings	PV of SOGR Savings (3%) [C/(1+3%)^A]	PV of SOGR Savings (7%) [C/(1+7%)^A]
0	2016	$0	$0	$0
1	2017	$0	$0	$0
2	2018	$0	$0	$0
3	2019	$0	$0	$0
4	2020	$2,312,482	$2,054,610	$1,764,181
5	2021	$2,511,274	$2,166,247	$1,790,504
6	2022	$2,710,066	$2,269,638	$1,805,832
7	2023	$2,908,859	$2,365,168	$1,811,491
8	2024	$3,107,651	$2,453,209	$1,808,681
9	2025	$3,306,444	$2,534,114	$1,798,486
10	2026	$3,505,236	$2,608,225	$1,781,884
11	2027	$3,704,028	$2,675,869	$1,759,757
12	2028	$3,902,821	$2,737,360	$1,732,899
13	2029	$4,101,613	$2,792,999	$1,702,024
14	2030	$4,300,405	$2,843,075	$1,667,771
15	2031	$4,499,198	$2,887,864	$1,630,716
16	2032	$4,697,990	$2,927,632	$1,591,372
17	2033	$4,896,782	$2,962,634	$1,550,196
18	2034	$5,095,575	$2,993,113	$1,507,597
19	2035	$5,294,367	$3,019,304	$1,463,937
20	2036	$5,493,159	$3,041,429	$1,419,537
21	2037	$5,691,952	$3,059,705	$1,374,681
22	2038	$5,890,744	$3,074,335	$1,329,619
23	2039	$6,089,537	$3,085,518	$1,284,569
24	2040	$6,288,329	$3,093,441	$1,239,723
	Total State of Good Repair Savings	**$90,308,512**	**$57,645,487**	**$33,815,456**

Note Positive values represent savings and negative values represent losses

Travel Time Cost Benefits/Disbenefits

The expected reduction in VMT along the corridor will result in higher travel speeds and reduced travel time for highway users. In contrast, increased VMT will result in lower travel speeds and added travel time for highway users.

Annual changes in VHT by trip purpose over the 20-year analysis period are multiplied by the corresponding Average Vehicle Occupancy (AVO) and Value of Time (VOT), presented inn Table 5. Travel time cost benefits/disbenefits resulting from the project are summarized in Table 6. The cost of time for leisure trips is assumed to only be opportunity cost and is therefor given no economic value. Time commuting is given 50% of the full value of time.

Table 5. Average Vehicle Occupancy and Value of Time by Vehicle Type/Trip Purpose

Trip Purpose	Average Vehicle Occupancy (AVO)	Value of Time (VOT) in 2015$
Auto - Leisure	2.0	$0
Auto -Commute	1.2	$9.75
Auto - Business	1.5	$19.49
Truck	1	$26.63

Source of AVO: Estimated based on the occupancy rates provided by the Arkansas Travel Demand Model
Source of VOT: The *2016 TIGER Benefit-Cost Analysis (BCA) Resource Guide*. Available at https://www.transportation.gov/sites/dot.gov/files/docs/BCA%20Resource%20Guide%202516.pdf

Table 6. Travel Time Cost Benefits/Disbenefits

Calendar Year	Value of Time Savings	PV of Value of Time Savings (3%) [C/(1+3%)^A]	PV of Value of Time Savings (7%) [C/(1+7%)^A]
2020	$3,228,831	$2,868,774	$2,463,259
2021	$3,506,599	$3,024,823	$2,500,157
2022	$3,784,368	$3,169,349	$2,521,684
2023	$4,062,137	$3,302,889	$2,529,695
2024	$4,339,906	$3,425,962	$2,525,865
2025	$4,617,675	$3,539,063	$2,511,709
2026	$4,895,444	$3,642,670	$2,488,595
2027	$5,173,213	$3,737,239	$2,457,756
2028	$5,450,981	$3,823,209	$2,420,301
2029	$5,728,750	$3,901,000	$2,377,228
2030	$6,006,519	$3,971,017	$2,329,432
2031	$6,284,288	$4,033,645	$2,277,715
2032	$6,562,057	$4,089,257	$2,222,796
2033	$6,839,826	$4,138,207	$2,165,314
2034	$7,117,595	$4,180,837	$2,105,839
2035	$7,395,364	$4,217,473	$2,044,880
2036	$7,673,132	$4,248,427	$1,982,883
2037	$7,950,901	$4,274,001	$1,920,247
2038	$8,228,670	$4,294,481	$1,857,319
2039	$8,506,439	$4,310,142	$1,794,407
2040	$8,784,208	$4,321,248	$1,731,777
Total Value of Time Savings	**$126,136,903**	**$80,513,714**	**$47,228,858**

Note: Positive values represent savings and negative values represent losses

Vehicle Operating Costs Benefits/Disbenefits

The reduction in VMT also generates savings in the cost associated with the operation and maintenance of passenger cars and trucks. In contrast, increased VMT would lead to increased vehicle operating costs (VOC). VOC include fuel and non-fuel costs. The non-fuel component is comprised of all the necessary replacement items on the vehicle and regular maintenance (e.g., oil and fluid changes, tire rotations, tire replacements, and wiper replacement) as well as truck/trailer lease or purchase payments, permits and licenses, and other related costs to owners of commercial vehicles.

The method to assess VOC benefits/disbenefits involves estimation of the VOC per vehicle type. Average per-mile VOC for passenger vehicles is estimated based on the VOC for three size categories of sedans (i.e., small, medium and large sedans), four wheel-drive sport utility vehicles (SUV) and minivans provided by the American Automobile Association (AAA) (see Table 7). This analysis uses the average auto VOC resulting from 15,000 miles traveled per year. Average per-mile VOC for trucks is estimated using published analyses of the operational costs for trucking based on information provided directly by motor carriers to the American Transportation Research Institute (ATRI) (see Table 8). The VOC for autos and trucks are inflated from 2014 to 2015 dollars using the Consumer Price Index (CPI).

Table 7. Average Marginal Vehicle Operating Cost for Passenger Vehicles

Auto Type	VOC (in cents/mile) in 2014		
	Miles per Year		
	10,000	15,000	20,000
Small Sedan	58.2	44.9	38.0
Medium Sedan	75.9	58.1	49.0
Large Sedan	93.3	71.0	59.5
Sedan (Composite Average)	75.8	58.0	48.8
4WD Sport Utility Vehicle	92.6	70.8	59.7
Minivan	81.2	62.5	52.9
Average =	**83.2**	**63.8**	53.8

Source: Your Driving Costs, 2015 Edition (AAA)
Notes: (1) VOC per mile derived from a popular model of each type listed assuming ownership of more than 5 years or 75,000 miles before replacement. (2) VOC per mile includes costs for fuel, maintenance, tires, full-coverage insurance, fees (license, registration and taxes), depreciation, and financing.

Table 8. Average Marginal Vehicle Operating Cost for Trucks for the Southeast Region ($/mile)

Operating Cost	VOC (in $/mile) in 2015 Dollars
Truck/Trailer Lease or Purchase Payments	$0.21
Repair & Maintenance	$0.19
Truck Insurance Premiums	$0.06
Permits and Licenses	$0.009
Tires	$0.04
Total =	**$0.51**

Source: An Analysis of the Operational Costs of Trucking: 2015 Update (ATRI, September 2015), Table 15, p. 27.

Fuel operating cost are calculated by multiplying the price of fuel per gallon by the average fuel efficiency, to come up with a fuel cost per mile. This is then applied to the change in vehicle miles traveled to produce the change in fuel cost. Fuel prices ($2.26 per gallon for gasoline, all grades and $2.58 for diesel, all types) were taken from the US Energy Information Administration, using the 2015 annual average for the Gulf Coast. Fuel efficiency numbers (autos: 0.05 gallons per mile and trucks: 0.159 gallons per mile)are taken from the Environmental Protection Agency, and The Department of Energy.

VOC benefits/disbenefits are estimated by multiplying the average marginal VOC by vehicle type by its corresponding annual changes in VMT over the 20-year analysis period. The results from this estimation are shown in Table 9.

Table 9. Vehicle Operating Cost Benefits/Disbenefits

Calendar Year	Non-Fuel VOC Savings	Fuel VOC Savings	Total Vehicle Operating Cost Savings	PV of VOC Savings (3%) [C/(1+3%)^A]	PV of VOC Savings (7%) [C/(1+7%)^A]
2020	$3,646,749	$3,255,990	$6,902,739	$6,132,994	$5,266,067
2021	$3,964,030	$3,542,782	$7,506,811	$6,475,441	$5,352,253
2022	$4,281,310	$3,829,573	$8,110,884	$6,792,737	$5,404,624
2023	$4,598,591	$4,116,365	$8,714,956	$7,086,057	$5,427,237
2024	$4,915,872	$4,403,156	$9,319,028	$7,356,527	$5,423,759
2025	$5,233,153	$4,689,948	$9,923,101	$7,605,230	$5,397,509
2026	$5,550,434	$4,976,739	$10,527,173	$7,833,205	$5,351,481
2027	$5,867,714	$5,263,531	$11,131,245	$8,041,448	$5,288,374
2028	$6,184,995	$5,550,322	$11,735,317	$8,230,916	$5,210,621
2029	$6,502,276	$5,837,114	$12,339,390	$8,402,524	$5,120,408
2030	$6,819,557	$6,123,905	$12,943,462	$8,557,153	$5,019,698
2031	$7,136,838	$6,410,697	$13,547,534	$8,695,647	$4,910,250
2032	$7,454,118	$6,697,488	$14,151,607	$8,818,813	$4,793,639
2033	$7,771,399	$6,984,280	$14,755,679	$8,927,428	$4,671,270
2034	$8,088,680	$7,271,071	$15,359,751	$9,022,235	$4,544,396
2035	$8,405,961	$7,557,863	$15,963,823	$9,103,945	$4,414,130
2036	$8,723,242	$7,844,654	$16,567,896	$9,173,242	$4,281,459
2037	$9,040,522	$8,131,446	$17,171,968	$9,230,779	$4,147,255
2038	$9,357,803	$8,418,237	$17,776,040	$9,277,182	$4,012,286
2039	$9,675,084	$8,705,029	$18,380,113	$9,313,051	$3,877,227
2040	$9,992,365	$8,991,820	$18,984,185	$9,338,961	$3,742,668
Total VOC Savings	**$143,210,692**	**$128,602,010**	**$271,812,701**	**$173,415,518**	**$101,656,612**

Note: Positive values represent savings and negative values represent losses.

Emission Cost Benefits/Disbenefits

This category of project benefits (disbenefits) captures the savings (or additional expenditures) in emission damage costs resulting from reduced (increased) VMT under the Build Scenario (compared to the No Build).

This analysis applies the running emission rates pertain to Carbon Dioxide (CO_2), Volatile Organic Compound (VOC), Nitrogen Oxides (NOx), Particular Matter (PM) and Sulfur Dioxide (SOx) for passenger cars and trucks on urban restricted access roads estimated by Cambridge Systematics (CS) using data from the Environmental Protection Agency, and The Department of Energy.

The emissions rates (in grams per mile) of non-carbon emissions (VOC, NOx, PM and SOx) are multiplied by the annual changes in VMT resulting from the implementation of the I-69 Corridor Project, converted to metric tons and then, multiplied by the emission cost metric ton depicted in Table 10. The CO_2 emissions rates (in grams per mile) are multiplied by the annual changes in VMT resulting from the implementation of the Project, converted to metric tons and then, multiplied by the emission cost per metric ton depicted in Table 11. It should be noted that the social cost of carbon (SCC) dioxide emissions increases annually and values for these emissions are to be discounted at a value of 3 percent rather than the 7 percent recommendation for all other non-carbon benefits or costs. The expected emission cost benefits/disbenefits are shown in Table 12.

Table 10. Emission Damage Costs

Emission Type	Emission Damage Cost ($/metric ton) in 2015$
	gram/mile
VOCs	$2,032
NOx	$8,010
PM	$366,414
SOx	$47,341

Source: 2016 TIGER Benefit-Cost Analysis (BCA) Resource Guide; Corporate Average Fuel Economy for MY2017-MY2025 Passenger Cars and Light Trucks (August 2012), page 922, Table VIII-16, "Economic Values Used for Benefits Computations (2010 dollars)."
Note: The 2016 Benefit-Cost Analysis (BCA) Resource Guide converts the emission damage cost value into 2015 dollars.

Table 21. Social Cost of Carbon (3%)

Year	3% SCC ($/metric tons) in 2015$
2025	$47
2021	$47
2022	$48
2023	$50
2024	$51
2025	$52
2026	$53
2027	$54
2028	$55
2029	$55
2030	$56
2031	$58
2032	$59
2033	$60
2034	$61
2035	$62
2036	$63
2037	$64
2038	$65
2039	$67
2045	$68

Source: 2016 TIGER Benefit-Cost Analysis (BCA) Resource Guide; Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis under Executive Order 12866 (May 2013; revised July 2015), page 17, Table A1 "Annual SCC Values: 2010-2050 (2007$/metric ton CO_2).

Note: The 2016 Benefit-Cost Analysis (BCA) Resource Guide converts the social cost of carbon (SCC) into 2015 dollars.

Table 12. Emissions Cost Benefits/Disbenefits

Calendar Year	Emissions Reduction Savings	PV of Emissions Reduction Savings (3%) [C/(1+3%)^A]	PV of Emissions Reduction Savings (7%) [C/(1+7%)^A]
2020	$2,197,710	$1,952,637	$1,676,622
2021	$2,388,753	$2,060,559	$1,703,148
2022	$2,594,920	$2,173,204	$1,729,105
2023	$2,819,608	$2,292,599	$1,755,910
2024	$3,031,437	$2,393,044	$1,764,324
2025	$3,245,531	$2,487,429	$1,765,354
2026	$3,461,891	$2,575,972	$1,759,850
2027	$3,680,515	$2,658,882	$1,748,586
2028	$3,901,404	$2,736,366	$1,732,270
2029	$4,101,508	$2,792,927	$1,701,980
2030	$4,325,794	$2,859,860	$1,677,618
2031	$4,577,662	$2,938,227	$1,659,156
2032	$4,807,612	$2,995,945	$1,628,504
2033	$5,039,826	$3,049,178	$1,595,480
2034	$5,274,306	$3,098,099	$1,560,477
2035	$5,511,050	$3,142,875	$1,523,851
2036	$5,750,060	$3,183,669	$1,485,925
2037	$5,991,334	$3,220,637	$1,446,986
2038	$6,234,874	$3,253,934	$1,407,293
2039	$6,515,054	$3,301,124	$1,374,330
2040	$6,764,256	$3,327,566	$1,333,550
Total Emissions Reduction Savings	**$92,215,103**	**$58,494,733**	**$34,030,317**

Note: Positive values represent savings and positive values represent losses..

Traffic Safety Benefits/Disbenefits

The reduction (or increase) of traffic accidents depends on the reduction (or increase) of vehicle-miles traveled by passenger cars and trucks under the Build Scenario (compared to the No Build). The method to assess safety benefits/disbenefits resulting from the implementation of the I-69 Corridor involves applying the regional fatality, injury and property damage only (PDO) crash rates to the annual changes in VMT and then, estimating the dollar value by using comprehensive cost of motor vehicle crashes by injury level.

This analysis uses the average fatality, injury and PDO crash rates in the state of Arkansas, estimated based on the reported crash statistics for 2013 (see Table 13), and the average monetized value of fatalities, injuries and PDO crashes prescribed in the 2016 Benefit-Cost Analysis (BCA) Resource Guide (see Table 14). The results from this estimation are shown in Table 15.

Table 13. Traffic Fatality and Injury Rates in Arkansas, 2013

	Count	Rate per 1 Million VMT
Million VMT	340.24	
Fatal Crashes	461	1.35
Injury Crashes	17,336	50.95
PDO Crashes	40,652	119.48

Crash counts: Arkansas State Police, Highway Safety Office, "Arkansas 2013 Traffic Crash Statistic"

Arkansas VMT: US Department of Transportation, Federal Highway Administration, "Highway Statistics, 2013", Table VM-2

Table 14. Average Comprehensive Cost of Motor Vehicle Crashes

Average Monetized Value of Accidents	**Value (in 2015$)**	**Unit**
- Fatal Accident Cost	$9,600,000	$/crash
- Accident Cost (Injured Severity Unknown)	$174,030	$/crash
- Property Damage Only (PDO) Crash Cost	$4,198	$/crash

Source of Fatal Accident Cost: 2016 TIGER Benefit-Cost Analysis (BCA) Resource Guide supplement to the 2016 Benefit-Cost Analysis Guidance for Grant Applicants. *Guidance on Treatment of the Economic Value of a Statistical Life in U.S. Department of Transportation Analyses* (2016).

Source of Injury Accident Cost: estimated based on the KABCO/Unknown - AIS Data Conversion Matrix developed by the NHTSA (July 2011) and provided in the 2016 TIGER Benefit-Cost Analysis (BCA) Resource Guide, page 13 of 20.

Source of PDO Crash Cost: The Economic and Societal Impact of Motor Vehicle Crashes, 2010

Table 15. Traffic Accident Cost Benefits/Disbenefits

Calendar Year	Crash Reduction Savings	PV of Crash Reduction Savings (3%) [C/(1+3%)^A]	PV of Crash Reduction Savings (7%) [C/(1+7%)^A]
2020	$2,639,864	$2,345,485	$2,013,940
2021	$2,880,710	$2,484,926	$2,053,907
2022	$3,121,556	$2,614,254	$2,080,025
2023	$3,362,402	$2,733,941	$2,093,935
2024	$3,603,249	$2,844,438	$2,097,124
2025	$3,844,095	$2,946,179	$2,090,933
2026	$4,084,941	$3,039,580	$2,076,577
2027	$4,325,787	$3,125,041	$2,055,150
2028	$4,566,633	$3,202,945	$2,027,640
2029	$4,807,479	$3,273,660	$1,994,933
2030	$5,048,326	$3,337,538	$1,957,828
2031	$5,289,172	$3,394,918	$1,917,039
2032	$5,530,018	$3,446,124	$1,873,208
2033	$5,770,864	$3,491,468	$1,826,908
2034	$6,011,710	$3,531,246	$1,778,648
2035	$6,252,556	$3,565,746	$1,728,884
2036	$6,493,403	$3,595,240	$1,678,019
2037	$6,734,249	$3,619,991	$1,626,409
2038	$6,975,095	$3,640,250	$1,574,371
2039	$7,215,941	$3,656,258	$1,522,180
2040	$7,456,787	$3,668,245	$1,470,080
Total Crash Reduction Savings	**$106,014,838**	**$67,557,470**	**$39,537,737**

Note: Positive values represent savings and negative values represent losses

Total Monetized Benefits

Table 16 summarizes the monetized benefits (undiscounted and discounted) for each benefit category.

Table 16. Total Monetized Benefits by Benefit Category

Benefits	2015$	PV @ 7%	PV @ 3%
Reduction in Value of Time Costs	$ 126,136,903	$ 47,228,858	$ 80,513,714
Reduction in Non-Fuel Vehicle Operating Costs	$ 143,210,692	$ 53,581,084	$ 91,382,918
Reduction in Fuel Vehicle Operating Costs	$ 128,602,010	$ 48,075,528	$ 82,032,600
Reduction in Safety Costs	$ 106,014,838	$ 39,537,737	$ 67,557,470
Reduction in Emissions Costs	$ 92,215,103	$ 34,030,317	$ 58,494,733
Reduction in Logistics Costs	$ 129,262	$ 48,468	$ 82,557
Reduction in Repair Costs	$ 90,308,512	$ 33,815,456	$ 57,645,487
Total Benefits	**$ 686,617,320**	**$ 256,317,447**	**$ 437,709,480**

Project Life Cycle Cost Analysis

The cost of the I-69 Project consist of capital expenditures, including design, land acquisition and construction, as well as operation and maintenance (O&M). The Arkansas State Highway and Transportation Department (AHTD) provided capital cost estimates (in 2015 dollars). The project is expected to require $650 million (in 2015 dollars) in capital expenditures, over four years with expected completion in 2021.

The cost of average cost maintenance for Arkansas (based on FHWA Highway Statistics) is around $3,614 per lane-mile annually. This analysis uses this value to estimate the annual O&M cost of net increase of 89 lane miles. Annual O&M expenditures are estimated assuming O&M costs start in 2022.

Table 17 presents the life cycle cost of the project.

Table 17. I-69 Corridor Project - Life Cycle Cost Analysis

Calendar Year	Initial Capital Cost	Operations & Maintenance Costs	Total Life Cycle Costs	PV of Life Cycle Costs (3%) [E/(1+3%)^A]	PV of Life Cycle Costs (7%) [E/(1+7%)^A]
2016	$0	$0	$0	$0	$0
2017	$0	$0	$0	$0	$0
2018	$33,875,000	$0	$33,875,000	$31,930,436	$29,587,737
2019	$33,875,000	$0	$33,875,000	$31,000,424	$27,652,091
2020	$33,875,000	$0	$33,875,000	$30,097,499	$25,843,075
2021	$33,875,000	$0	$33,875,000	$29,220,873	$24,152,407
2022	$0	$1,362,586	$1,362,586	$1,141,144	$907,949
2023	$0	$1,362,586	$1,362,586	$1,107,907	$848,550
2024	$0	$1,362,586	$1,362,586	$1,075,638	$793,038
2025	$0	$1,362,586	$1,362,586	$1,044,309	$741,157
2026	$0	$1,362,586	$1,362,586	$1,013,892	$692,670
2027	$0	$1,362,586	$1,362,586	$984,361	$647,355
2028	$0	$1,362,586	$1,362,586	$955,690	$605,005
2029	$0	$1,362,586	$1,362,586	$927,855	$565,425
2030	$0	$1,362,586	$1,362,586	$900,830	$528,434
2031	$0	$1,362,586	$1,362,586	$874,592	$493,864
2032	$0	$1,362,586	$1,362,586	$849,119	$461,555
2033	$0	$1,362,586	$1,362,586	$824,387	$431,360
2034	$0	$1,362,586	$1,362,586	$800,376	$403,140
2035	$0	$1,362,586	$1,362,586	$777,064	$376,766
2036	$0	$1,362,586	$1,362,586	$754,431	$352,118
2037	$0	$1,362,586	$1,362,586	$732,457	$329,082
2038	$0	$1,362,586	$1,362,586	$711,123	$307,554
2039	$0	$1,362,586	$1,362,586	$690,411	$287,433
2040	$0	$1,362,586	$1,362,586	$670,302	$268,629
Total State of Good Repair Savings	**$135,500,000**	**$25,889,136**	**$161,389,136**	**$139,085,121**	**$117,276,393**

Benefit-Cost Analysis Findings

Table 18 summaries the BCA findings. Annual costs and benefits are computed over the lifecycle of the project (20 years). As stated earlier, construction is expected to be completed by the end of 2021 and benefits to be accrued during the full operation of the project. The project has a benefit-cost ratio of 3.1 at a real discount rate of 3 percent and 2.2 at a real discount rate of 7 percent. The Net Present Value (NPV) of the project is $298 million at 3 percent and $139 million at 7 percent over the assumed 20-year project life, from 2020 to 2040. These findings demonstrate that there are significant long-term economic benefits associated with the Project, and is regionally an important project.

Table 18. Summary of Benefit-Cost Analysis of I-69 Corridor Project

Benefits	**2015$**	**PV @ 7%**	**PV @ 3%**
Reduction in Value of Time Costs	$ 126,136,903	$ 47,228,858	$ 80,513,714
Reduction in Non-Fuel Vehicle Operating Costs	$ 143,210,692	$ 53,581,084	$ 91,382,918
Reduction in Fuel Vehicle Operating Costs	$ 128,602,010	$ 48,075,528	$ 82,032,600
Reduction in Safety Costs	$ 106,014,838	$ 39,537,737	$ 67,557,470
Reduction in Emissions Costs	$ 92,215,103	$ 34,030,317	$ 58,494,733
Reduction in Logistics Costs	$ 129,262	$ 48,468	$ 82,557
Reduction in Repair Costs	$ 90,308,512	$ 33,815,456	$ 57,645,487
Total Benefits	$ 686,617,320	$ 256,317,447	$ 437,709,480
Costs			
Construction Costs	$ 135,500,000	$ 107,235,310	$ 122,249,231
Maintenance and Operations Costs	$ 25,889,136	$ 10,041,083	$ 16,835,889
Total Costs	$ 161,389,136	$ 117,276,393	$ 139,085,121
Net Benefits	$ 525,228,184	$ 139,041,054	$ 298,624,359
Benefit-Cost Ratio	**4.3**	**2.2**	**3.1**

Economic Impact Analysis

The transportation costs savings and increased public expenditures are expected to have a positive impact on the regional and state economies in terms of increases in the number of jobs, income and overall gross state product.

The expenditure of public sector dollars is expected to create short-term jobs in the development and construction phases and maintenance of the I-69 Corridor Project (see Table 19). The benefit of increase in the job-years as a result of the Project during development and construction was computed as a product of the undiscounted project cost and the value on government dollars spent to create a single job-year (i.e., $76,900 in 2015$). It is projected that the construction spending on the project will support 1,762 job-years.

In terms of long-term impacts, the "out-of-pocket" travel time changes for business trips and truck trips and the vehicle operating costs changes for all trips were entered in a regional IMPLAN economic model. The model estimates the direct, indirect and induced impacts arising from changes in regional transportation costs. The results of this analysis are displayed in Table 20. It is estimated that the improvements in the I-69 corridor will support significant long-term economic impacts, averaging 125 jobs, $6 million in income and $18 million in GSP annually. These benefits are not counted in the B/C calculation.

Table 19. Construction Spending Job Creation Benefits

Job Creation	Value
Increase in Short-Term Job-Years due to Project during Development and Construction	1,762 Job-Years

Table 20. Long-term Economic Impact, Average Annual Impacts

	Employment	**Labor Income**	**Output**
Total Impact	**125**	**$6**	**$18**

Source: CS calculations using IMPLAN