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16. Abstract

This report highlights the benefits and return on investment of transportation funding in Texas. In total, over the next decade, Texans will invest $131 billion in statewide infrastructure with a total economic benefit of an estimated $373 billion.

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THE BENEFITS OF TRANSPORTATION INVESTMENT IN TEXAS

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Report 0-6806-TTI-BS2
Project 0-6806-TTI
Project Title: The Benefits of Transportation Investment in Texas

Performed in cooperation with the
Texas Department of Transportation
and the
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DISCLAIMER

This research was performed in cooperation with the Texas Department of Transportation (TxDOT) and the Federal Highway Administration (FHWA). The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official view or policies of the FHWA or TxDOT. This report does not constitute a standard, specification, or regulation.

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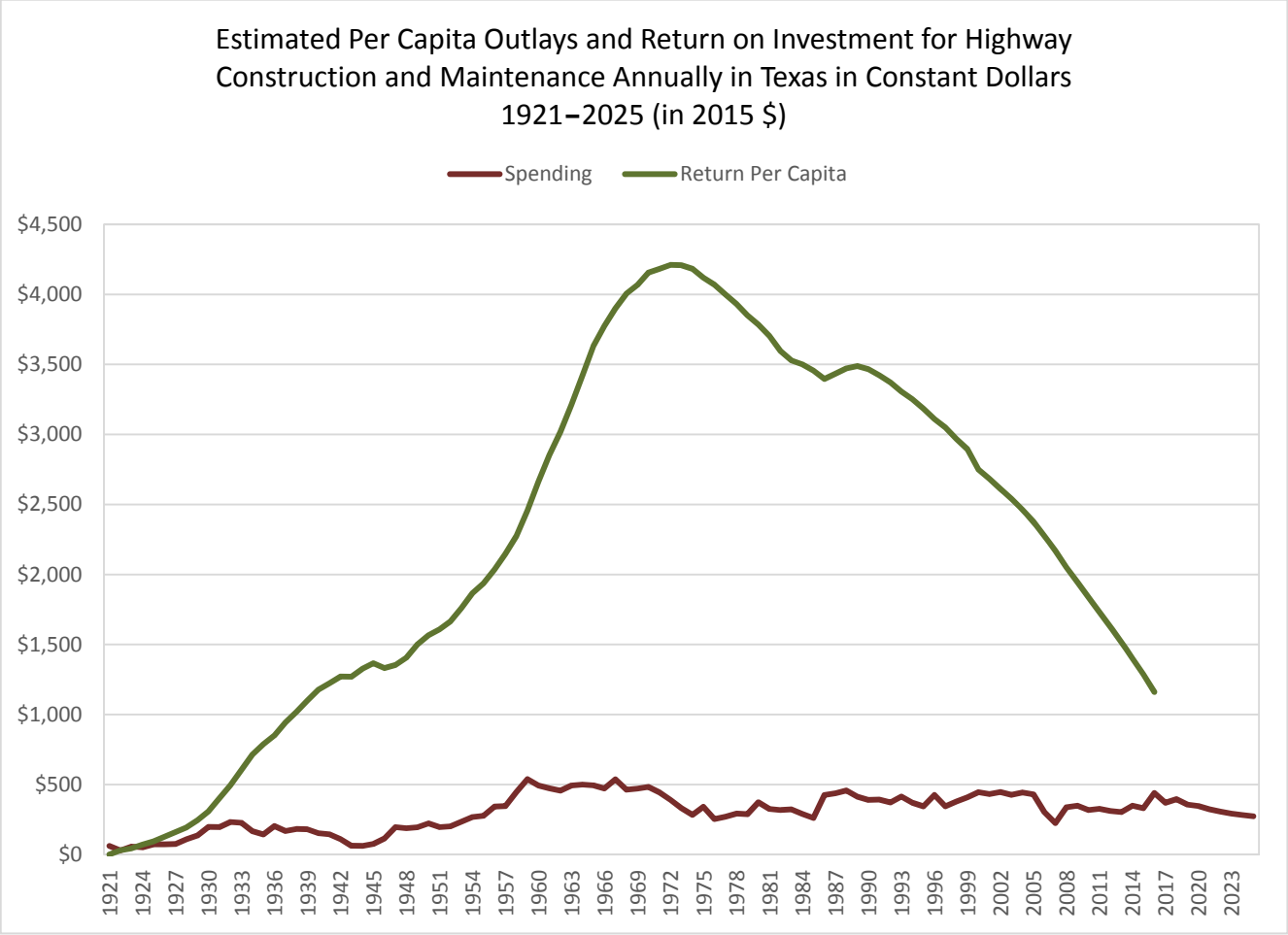
THE BENEFITS OF TRANSPORTATION INVESTMENT IN TEXAS

- Since 1921, Texans have invested $151 billion in roadway construction and maintenance on the state system, over $514 billion in 2015 dollars.[1,2,3]

- It is estimated the $514 billion investment in roadway construction and maintenance has returned approximately $3.2 trillion in benefit to the State.[4] It should be noted, however, that this calculation implies that absent the investment that has been made, commerce in the 21st century could be somehow conducted with what, in effect, would be an early 20th century roadway network. In fact, it could not. In reality, the Texas economy would be markedly smaller with far fewer jobs, income, and opportunity without the transportation investment that has occurred.

- The chart below shows historical and projected investment and return on highway construction and maintenance in Texas when expenditures are adjusted for both construction inflation and population growth. The chart indicates the rapid increase in per capita expenditures resulting from the construction of the interstate system in the 1960s and the impact of the state motor fuels tax increases in the late 1980s and early 1990s. The spike in planned expenditures in 2016 and beyond is shown as is the gradual decline in per capita expenditures due to continued population growth and construction inflation.[5]

[1] Nominal investment was converted to constant dollar investment using construction cost indices developed by the Federal Highway Administration for the years 1921 through 1997. For the period 1998 through 2015, the Texas Highway Cost Index was used.
[2] In nominal dollars. Source: Highway Statistics, Federal Highway Administration and Texas Department of Transportation Cash Flow Forecasts.
[3] Includes construction, maintenance, engineering, and right-of-way costs.
[4] Calculated using methodology employed by Nadiri and Mamuneas. *Contribution of Highway Capital to Industry and National Productivity Growth*. Federal Highway Administration, Office of Policy Development, Work Order Number BAT-94-008.
[5] For the period 2016 through 2025, a 3 percent annual construction inflation rate was assumed.



Sources: Federal Highway Administration Highway Statistics publications, Texas Department of Transportation Cash Flow Forecast, Texas A&M Transportation Institute.

- For the period 2010 to 2015, Texans invested $40 billion in state roadway infrastructure. As a result of the investment made, the total economic benefit is estimated to be $115 billion for the period 2010 to 2015.[6]

- Benefits that occur as a result of infrastructure investment manifest themselves in many ways. The following table provides an estimate of benefits by type as a result of infrastructure investment from 2010 to 2015.

[6] Benefits were estimated using TREDIS model methodologies on a sample of 137 project benefit/cost analysis performed for TxDOT over the past year. These sample projects were segregated into rural and urban projects and then multiplier values were calculated for sample.

Total Investment	**$40.4**	**billion**

BENEFITS	Amount	
Vehicle Operating Cost Savings	$1.4	billion
Business Time and Reliability Savings	$2.9	billion
Personal Time and Reliability Savings	$3.0	billion
Safety Benefits	$4.9	billion
Logistics/Freight Cost Savings	$0.8	billion
Environmental Benefits	$0.0	billion
Business Output	$70.2	billion
Positive Economic Effect of Wage Income	$31.8	billion
Total Benefits	**$115.0**	**billion**

- In total, over the next decade, Texans will invest $131 billion in statewide infrastructure with a total economic benefit of an estimated $373 billion.[7]

- The following table provides an estimate of benefits by type due to infrastructure investment that will occur from 2016 to 2025 as a result of the additional revenue provided by the legislature in 2015.

Total Investment	**$131.0**	**billion**

BENEFITS	Amount	
Vehicle Operating Cost Savings	$4.5	billion
Business Time and Reliability Savings	$9.4	billion
Personal Time and Reliability Savings	$9.6	billion
Safety Benefits	$15.8	billion
Logistics/Freight Cost Savings	$2.7	billion
Environmental Benefits	$0.1	billion
Business Output	$227.9	billion
Positive Economic Effect of Wage Income	$103.2	billion
Total Benefits	**$373.1**	**billion**

- It is estimated that Texans will invest over $39 billion for the period 2016 through 2025 from revenue and recapture measures passed during the 2015 Legislative session.[8] The estimated economic impact of the increased investment is $111 billion. (Note: The $39 billion in incremental investment is included in the $131 billion investment in the preceding table.)

[7] Investment amount includes traditional spending from Fund 006, bond proceeds, Mobility Fund bond proceeds, new revenues, and recapture savings.
[8] Includes estimated revenue from Proposition 1 and Proposition 7 plus revenue recapture savings. Data provided by TxDOT.

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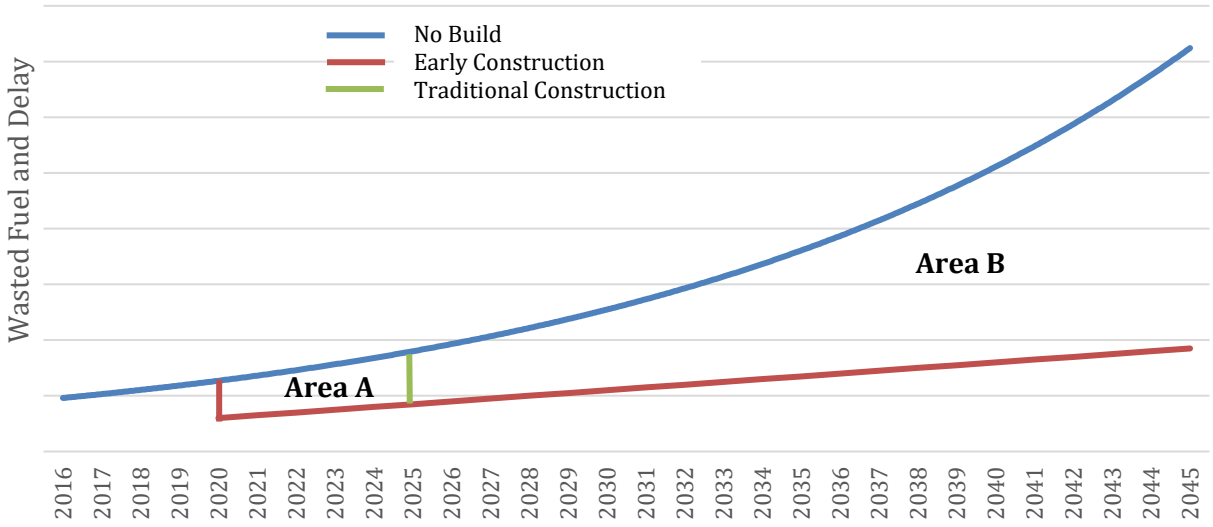
Benefit Cost Analysis of Early Letting with Debt Finance

This document provides a response to the question posed by Commissioner Austin comparing the benefits and costs of constructing roadway projects early with debt financing as opposed to delaying construction to the programmed letting date. The Texas A&M Transportation Institute (TTI) began by selecting a representative sample of projects from around the state. Projects that add additional capacity to the major metropolitan areas of Dallas- Fort Worth, Houston, San Antonio, and El Paso were selected as well as additional capacity projects from the urban areas of Laredo, Abilene, and Sherman.

A benefit- cost analysis was conducted for each project by assuming a shovel-ready start date of 2016 along with current traffic and congestion levels. Each project assumed a four year construction period and a 30 year life cycle. The benefits captured in the analysis were those that would accumulate between the early start of operations and the programmed start of operations (see Area A below).



The benefits calculated include vehicle operating cost savings, both business and personal time savings, safety, logistics cost savings, environmental benefits, increased business efficiencies, business profits, aggregate economic activity economy wide, and the construction cost inflation saved. These benefits were offset by the cost of the funds produced by financing the project. The cost of funds estimated include the estimated bond issuance cost and interest accumulated on a 20 year bond.

The following pages analyze the two alternatives for 10 selected projects. Also included is a graph that shows the cost of funds compared to the cost of construction utilizing the current estimated borrowing cost and construction inflation costs.

San Antonio District

I-35 from I-410 N to the Guadalupe/ Bexar County Line	
Project Cost (2016 $ mil)	$618
Analysis Start Year	2016
Scheduled Start Year	2020
Benefits and Costs	**Present Value (2016 $ mil)**
Issuance Cost (2%)	$12
Interest (4%)	$297
Total Cost of Funds	***$309***
Vehicle Operating Cost Savings	$8
Business Time and Reliability Cost Savings	$5
Personal Time and Reliability Cost Savings	$4
Safety Benefits	$22
Logistics/Freight Cost Savings	$2
Environmental Benefits	Minimal
Increased Business Efficiencies	$742
Business Profit/ Income	$48
Aggregate Economic Activity Economy Wide	$113
Construction Cost Inflation Saved	$85
Total Benefits of Early Letting	***$1,029***
Total Benefits Less Cost of Funds	***$720***
Benefit/Cost Ratio	***3.3***

Notes[1]:

1. Vehicle operating costs include, but are not limited to: fuel, purchase payments, insurance premiums, tires, and repairs.
2. Business time and reliability cost savings are the business cost of labor for professional drivers and paid crew as well as the cost of lost scheduling time due to unreliable travel conditions.
3. Personal time and reliability cost savings are the user valuation of the average passenger's time and the value of lost scheduling time due to unreliable travel conditions.
4. Logistics/freight savings represent the time and shipping cost savings to industries that produce or consume the freight goods on the trucks accounted for in the project.
5. Environmental factors include the cost savings of air pollution and greenhouse gasses per VMT.
6. Increased business efficiencies assumes an 8% rate of return.
7. Median business profit/income is assumed to be 6.5%.
8. Aggregate economic activity economy wide assumes a 5.7% savings rate.
9. A minimum 1.0 mph speed improvement is assumed for all speed improvements less than 1.0 mph.
10. Accident rates (fatalities, personal injury, and property damage) per 100m VMT were reduced by 10 percent.
11. Cost of Funds assumes a 20 year bond with a 4% interest rate and a 2% issuance cost.

[1] TREDIS® Data Sources and Default Values, Version 4.0

Fort Worth District

I-820 from I-20 to Meadowbrook Dr.	
Project Cost (2016 $ mil)	$416
Analysis Start Year	2016
Scheduled Start Year	2023
Benefits and Costs	**Present Value (2016 $ mil)**
Issuance Cost (2%)	$8
Interest (4%)	$200
Total Cost of Funds	***$208***
Vehicle Operating Cost Savings	$5
Business Time and Reliability Cost Savings	$4
Personal Time and Reliability Cost Savings	$4
Safety Benefits	$20
Logistics/Freight Cost Savings	$1
Environmental Benefits	Minimal
Increased Business Efficiencies	$1,198
Business Profit/ Income	$78
Aggregate Economic Activity Economy Wide	$182
Construction Cost Inflation Saved	$103
Total Benefits of Early Letting	***$1,595***
Total Benefits Less Cost of Funds	***$1,387***
Benefit/Cost Ratio	***7.7***

Notes[1]:

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3. Personal time and reliability cost savings are the user valuation of the average passenger's time and the value of lost scheduling time due to unreliable travel conditions.
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5. Environmental factors include the cost savings of air pollution and greenhouse gasses per VMT.
6. Increased business efficiencies assumes an 8% rate of return.
7. Median business profit/income is assumed to be 6.5%.
8. Aggregate economic activity economy wide assumes a 5.7% savings rate.
9. A minimum 1.0 mph speed improvement is assumed for all speed improvements less than 1.0 mph.
10. Accident rates (fatalities, personal injury, and property damage) per 100m VMT were reduced by 10 percent.
11. Cost of Funds assumes a 20 year bond with a 4% interest rate and a 2% issuance cost.

[1] TREDIS® Data Sources and Default Values, Version 4.0

Houston District

I-610 from I-69 to I-10 W	
Project Cost (2016 $ mil)	$310
Analysis Start Year	2016
Scheduled Start Year	2021
Benefits and Costs	**Present Value (2016 $ mil)**
Issuance Cost (2%)	$6
Interest (4%)	$149
Total Cost of Funds	***$155***
Vehicle Operating Cost Savings	$22
Business Time and Reliability Cost Savings	$13
Personal Time and Reliability Cost Savings	$15
Safety Benefits	$19
Logistics/Freight Cost Savings	$3
Environmental Benefits	Minimal
Increased Business Efficiencies	$521
Business Profit/ Income	$34
Aggregate Economic Activity Economy Wide	$79
Construction Cost Inflation Saved	$55
Total Benefits of Early Letting	***$761***
Total Benefits Less Cost of Funds	***$606***
Benefit/Cost Ratio	***4.9***

Notes[1]:

1. Vehicle operating costs include, but are not limited to: fuel, purchase payments, insurance premiums, tires, and repairs.
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3. Personal time and reliability cost savings are the user valuation of the average passenger's time and the value of lost scheduling time due to unreliable travel conditions.
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5. Environmental factors include the cost savings of air pollution and greenhouse gasses per VMT.
6. Increased business efficiencies assumes an 8% rate of return.
7. Median business profit/income is assumed to be 6.5%.
8. Aggregate economic activity economy wide assumes a 5.7% savings rate.
9. A minimum 1.0 mph speed improvement is assumed for all speed improvements less than 1.0 mph.
10. Accident rates (fatalities, personal injury, and property damage) per 100m VMT were reduced by 10 percent.
11. Cost of Funds assumes a 20 year bond with a 4% interest rate and a 2% issuance cost.

[1] TREDIS® Data Sources and Default Values, Version 4.0

Houston District

I-69 from I-45 to SH 288	
Project Cost (2016 $ mil)	$174
Analysis Start Year	2016
Scheduled Start Year	2021
Benefits and Costs	**Present Value (2016 $ mil)**
Issuance Cost (2%)	$3
Interest (4%)	$83
Total Cost of Funds	***$86***
Vehicle Operating Cost Savings	$1
Business Time and Reliability Cost Savings	$1
Personal Time and Reliability Cost Savings	$1
Safety Benefits	$4
Logistics/Freight Cost Savings	Minimal
Environmental Benefits	Minimal
Increased Business Efficiencies	$292
Business Profit/ Income	$19
Aggregate Economic Activity Economy Wide	$44
Construction Cost Inflation Saved	$31
Total Benefits of Early Letting	***$393***
Total Benefits Less Cost of Funds	***$307***
Benefit/Cost Ratio	***4.6***

Notes[1]:

1. Vehicle operating costs include, but are not limited to: fuel, purchase payments, insurance premiums, tires, and repairs.
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3. Personal time and reliability cost savings are the user valuation of the average passenger's time and the value of lost scheduling time due to unreliable travel conditions.
4. Logistics/freight savings represent the time and shipping cost savings to industries that produce or consume the freight goods on the trucks accounted for in the project.
5. Environmental factors include the cost savings of air pollution and greenhouse gasses per VMT.
6. Increased business efficiencies assumes an 8% rate of return.
7. Median business profit/income is assumed to be 6.5%.
8. Aggregate economic activity economy wide assumes a 5.7% savings rate.
9. A minimum 1.0 mph speed improvement is assumed for all speed improvements less than 1.0 mph.
10. Accident rates (fatalities, personal injury, and property damage) per 100m VMT were reduced by 10 percent.
11. Cost of Funds assumes a 20 year bond with a 4% interest rate and a 2% issuance cost.

[1] TREDIS® Data Sources and Default Values, Version 4.0

Austin District

I-35 from US 183 to Riverside Dr.	
Project Cost (2016 $ mil)	$576
Analysis Start Year	2016
Scheduled Start Year	2021
Benefits and Costs	**Present Value (2016 $ mil)**
Issuance Cost (2%)	$12
Interest (4%)	$277
Total Cost of Funds	***$289***
Vehicle Operating Cost Savings	$15
Business Time and Reliability Cost Savings	$10
Personal Time and Reliability Cost Savings	$10
Safety Benefits	$29
Logistics/Freight Cost Savings	$3
Environmental Benefits	Minimal
Increased Business Efficiencies	$968
Business Profit/ Income	$63
Aggregate Economic Activity Economy Wide	$147
Construction Cost Inflation Saved	$102
Total Benefits of Early Letting	***$1,347***
Total Benefits Less Cost of Funds	***$1,058***
Benefit/Cost Ratio	***4.7***

Notes[1]:

1. Vehicle operating costs include, but are not limited to: fuel, purchase payments, insurance premiums, tires, and repairs.
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3. Personal time and reliability cost savings are the user valuation of the average passenger's time and the value of lost scheduling time due to unreliable travel conditions.
4. Logistics/freight savings represent the time and shipping cost savings to industries that produce or consume the freight goods on the trucks accounted for in the project.
5. Environmental factors include the cost savings of air pollution and greenhouse gasses per VMT.
6. Increased business efficiencies assumes an 8% rate of return.
7. Median business profit/income is assumed to be 6.5%.
8. Aggregate economic activity economy wide assumes a 5.7% savings rate.
9. A minimum 1.0 mph speed improvement is assumed for all speed improvements less than 1.0 mph.
10. Accident rates (fatalities, personal injury, and property damage) per 100m VMT were reduced by 10 percent.
11. Cost of Funds assumes a 20 year bond with a 4% interest rate and a 2% issuance cost.

[1] TREDIS® Data Sources and Default Values, Version 4.0

Dallas District

FM 664 from US 287 in Waxahachie to Westmoreland Dr.	
Project Cost (2016 $ mil)	$237
Analysis Start Year	2016
Scheduled Start Year	2024
Benefits and Costs	**Present Value (2016 $ mil)**
Issuance Cost (2%)	$5
Interest (4%)	$114
Total Cost of Funds	***$119***
Vehicle Operating Cost Savings	Minimal
Business Time and Reliability Cost Savings	$1
Personal Time and Reliability Cost Savings	$1
Safety Benefits	$3
Logistics/Freight Cost Savings	Minimal
Environmental Benefits	Minimal
Increased Business Efficiencies	$853
Business Profit/ Income	$55
Aggregate Economic Activity Economy Wide	$130
Construction Cost Inflation Saved	$66
Total Benefits of Early Letting	***$1,109***
Total Benefits Less Cost of Funds	***$990***
Benefit/Cost Ratio	***9.3***

Notes[1]:

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5. Environmental factors include the cost savings of air pollution and greenhouse gasses per VMT.
6. Increased business efficiencies assumes an 8% rate of return.
7. Median business profit/income is assumed to be 6.5%.
8. Aggregate economic activity economy wide assumes a 5.7% savings rate.
9. A minimum 1.0 mph speed improvement is assumed for all speed improvements less than 1.0 mph.
10. Accident rates (fatalities, personal injury, and property damage) per 100m VMT were reduced by 10 percent.
11. Cost of Funds assumes a 20 year bond with a 4% interest rate and a 2% issuance cost.

[1] TREDIS® Data Sources and Default Values, Version 4.0

El Paso District

US 62 from West of Global Reach to West of Loop 375	
Project Cost (2016 $ mil)	$193
Analysis Start Year	2016
Scheduled Start Year	2019
Benefits and Costs	**Present Value (2016 $ mil)**
Issuance Cost (2%)	$4
Interest (4%)	$93
Total Cost of Funds	***$97***
Vehicle Operating Cost Savings	Minimal
Business Time and Reliability Cost Savings	$1
Personal Time and Reliability Cost Savings	$1
Safety Benefits	$2
Logistics/Freight Cost Savings	Minimal
Environmental Benefits	Minimal
Increased Business Efficiencies	$154
Business Profit/ Income	$10
Aggregate Economic Activity Economy Wide	$23
Construction Cost Inflation Saved	$20
Total Benefits of Early Letting	***$211***
Total Benefits Less Cost of Funds	***$114***
Benefit/Cost Ratio	***2.2***

Notes[1]:

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4. Logistics/freight savings represent the time and shipping cost savings to industries that produce or consume the freight goods on the trucks accounted for in the project.
5. Environmental factors include the cost savings of air pollution and greenhouse gasses per VMT.
6. Increased business efficiencies assumes an 8% rate of return.
7. Median business profit/income is assumed to be 6.5%.
8. Aggregate economic activity economy wide assumes a 5.7% savings rate.
9. A minimum 1.0 mph speed improvement is assumed for all speed improvements less than 1.0 mph.
10. Accident rates (fatalities, personal injury, and property damage) per 100m VMT were reduced by 10 percent.
11. Cost of Funds assumes a 20 year bond with a 4% interest rate and a 2% issuance cost.

[1] TREDIS® Data Sources and Default Values, Version 4.0

Laredo District

I-35 from South of Uniroyal to North of US 83	
Project Cost (2016 $ mil)	$84
Analysis Start Year	2016
Scheduled Start Year	2021
Benefits and Costs	**Present Value (2016 $ mil)**
Issuance Cost (2%)	$2
Interest (4%)	$40
Total Cost of Funds	***$42***
Vehicle Operating Cost Savings	Minimal
Business Time and Reliability Cost Savings	$1
Personal Time and Reliability Cost Savings	$1
Safety Benefits	$5
Logistics/Freight Cost Savings	$1
Environmental Benefits	Minimal
Increased Business Efficiencies	$141
Business Profit/ Income	$9
Aggregate Economic Activity Economy Wide	$21
Construction Cost Inflation Saved	$15
Total Benefits of Early Letting	***$194***
Total Benefits Less Cost of Funds	***$152***
Benefit/Cost Ratio	***4.6***

Notes[1]:

1. Vehicle operating costs include, but are not limited to: fuel, purchase payments, insurance premiums, tires, and repairs.
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4. Logistics/freight savings represent the time and shipping cost savings to industries that produce or consume the freight goods on the trucks accounted for in the project.
5. Environmental factors include the cost savings of air pollution and greenhouse gasses per VMT.
6. Increased business efficiencies assumes an 8% rate of return.
7. Median business profit/income is assumed to be 6.5%.
8. Aggregate economic activity economy wide assumes a 5.7% savings rate.
9. A minimum 1.0 mph speed improvement is assumed for all speed improvements less than 1.0 mph.
10. Accident rates (fatalities, personal injury, and property damage) per 100m VMT were reduced by 10 percent.
11. Cost of Funds assumes a 20 year bond with a 4% interest rate and a 2% issuance cost.

[1] TREDIS® Data Sources and Default Values, Version 4.0

Paris District

US 75 from South of Center St. in Sherman to Travis St.	
Project Cost (2016 $ mil)	$75
Analysis Start Year	2016
Scheduled Start Year	2029
Benefits and Costs	**Present Value (2016 $ mil)**
Issuance Cost (2%)	$2
Interest (4%)	$36
Total Cost of Funds	***$38***
Vehicle Operating Cost Savings	Minimal
Business Time and Reliability Cost Savings	$1
Personal Time and Reliability Cost Savings	$1
Safety Benefits	$4
Logistics/Freight Cost Savings	Minimal
Environmental Benefits	Minimal
Increased Business Efficiencies	$630
Business Profit/ Income	$41
Aggregate Economic Activity Economy Wide	$96
Construction Cost Inflation Saved	$33
Total Benefits of Early Letting	***$806***
Total Benefits Less Cost of Funds	***$768***
Benefit/Cost Ratio	***21.2***

Notes[1]:

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11. Cost of Funds assumes a 20 year bond with a 4% interest rate and a 2% issuance cost.

[1] TREDIS® Data Sources and Default Values, Version 4.0

Abilene District

I-20 from Abilene West City Limits to Catclaw Creek	
Project Cost (2016 $ mil)	$35
Analysis Start Year	2016
Scheduled Start Year	2030
Benefits and Costs	**Present Value (2016 $ mil)**
Issuance Cost (2%)	$1
Interest (4%)	$17
Total Cost of Funds	***$18***
Vehicle Operating Cost Savings	Minimal
Business Time and Reliability Cost Savings	$2
Personal Time and Reliability Cost Savings	$1
Safety Benefits	$8
Logistics/Freight Cost Savings	$2
Environmental Benefits	Minimal
Increased Business Efficiencies	$336
Business Profit/ Income	$22
Aggregate Economic Activity Economy Wide	$51
Construction Cost Inflation Saved	$17
Total Benefits of Early Letting	***$440***
Total Benefits Less Cost of Funds	***$422***
Benefit/Cost Ratio	***24.8***

Notes[1]:

1. Vehicle operating costs include, but are not limited to: fuel, purchase payments, insurance premiums, tires, and repairs.
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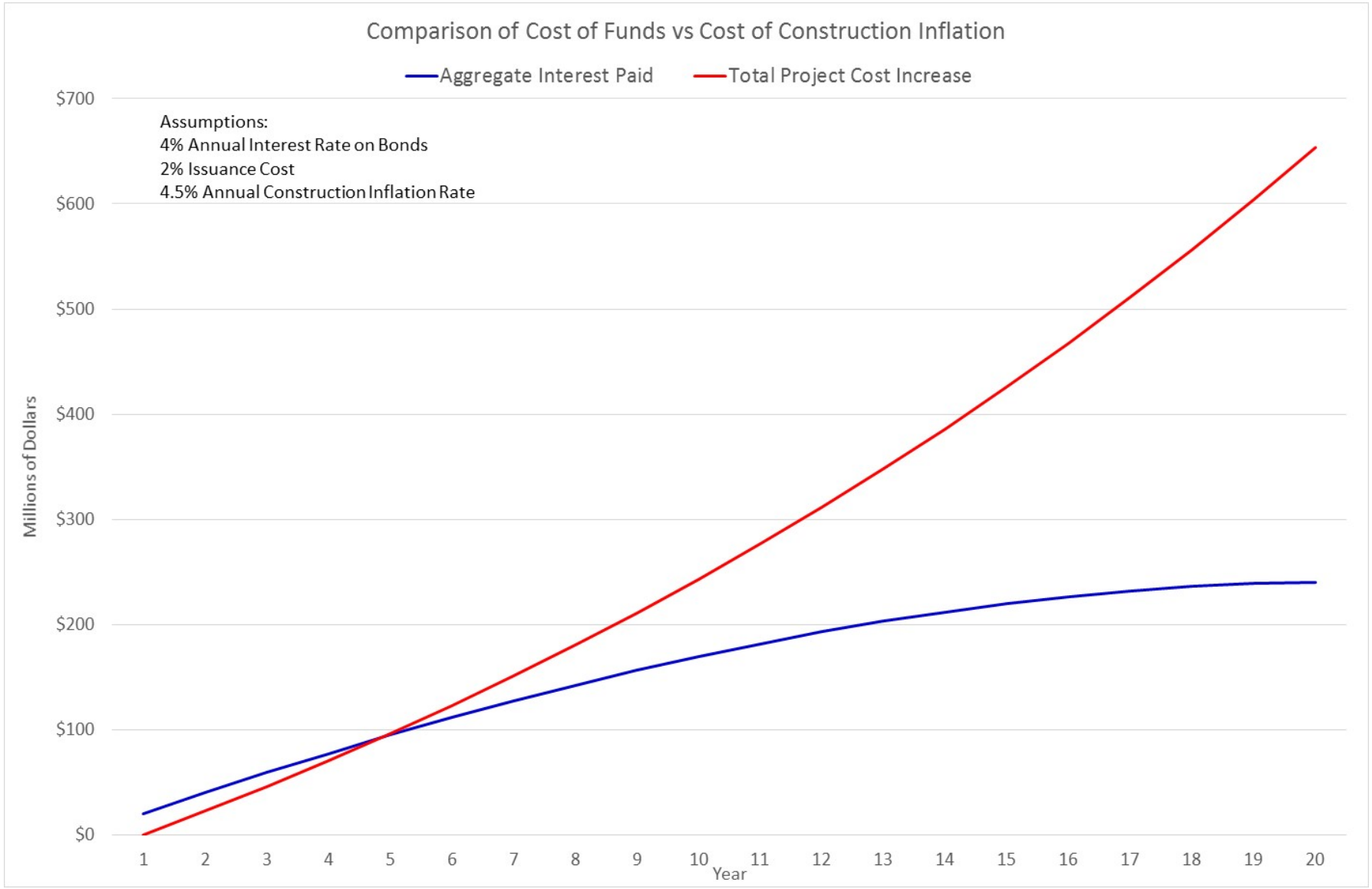
10. Accident rates (fatalities, personal injury, and property damage) per 100m VMT were reduced by 10 percent.
11. Cost of Funds assumes a 20 year bond with a 4% interest rate and a 2% issuance cost.

[1] TREDIS® Data Sources and Default Values, Version 4.0


Comparison of Cost of Funds vs Cost of Construction Inflation
Aggregate Interest Paid
Total Project Cost Increase
Assumptions:
4% Annual Interest Rate on Bonds
2% Issuance Cost
4.5% Annual Construction Inflation Rate
Millions of Dollars
$700
$600
$500
$400
$300
$200
$100
$0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Year