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16. Abstract

This report evaluated transportation improvement alternatives for the US 59 Southwest Freeway corridor from the full-cost, life-cycle approach perspective. The alternatives involve hypothetical facility improvements as well as vehicle occupancy improvements. Our findings suggest that the current facility will not be able to service the projected peak-hour traffic demand; and after running MODECOST — a computer model based on the full-cost analysis concept — we observed that travelers bore a significant amount of external costs, including congestion costs and air pollution costs. The annual life-cycle cost savings from the reduction of external costs and users/agency costs can more than offset the cost of initial investment for expansion of the current facility.

The case study conducted in this report shows that, in many cases, external costs and user/agency costs are more relevant than the initial investment in the facility. Expanding the current facility to add general purpose lanes or HOV lanes to accommodate ride-sharing and special transit service reduces the external costs and user/agency costs, which in turn reduces the system life-cycle costs of the facility.

The study also shows that full life-cycle cost analysis is a very effective tool for comparing the costs of transportation investment alternatives and for enhancing qualitative assessments and planning/engineering judgment. The actual value calculated by the full-cost analysis sometimes can be used as an assessment indicator by policy makers and transportation professionals.

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US 59 HARRIS COUNTY/FORT BEND COUNTY: A CASE STUDY APPLICATION OF A FULL-COST MODEL FOR EVALUATING URBAN PASSENGER TRANSPORTATION

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Research Report Number 1356-5

Research Project 0-1356
Development of an Urban Transportation Investment Model

conducted for the

Texas Department of Transportation

in cooperation with the

U.S. Department of Transportation
Federal Highway Administration

by the

CENTER FOR TRANSPORTATION RESEARCH
Bureau of Engineering Research
THE UNIVERSITY OF TEXAS AT AUSTIN

August 1996

IMPLEMENTATION RECOMMENDATIONS

This report, one of the six case studies assessing the full cost of urban passenger transportation alternatives, evaluates transportation improvement alternatives for the US 59 Southwest Freeway corridor in Harris and Fort Bend Counties in Texas. Given its effectiveness for valuing transportation investment alternatives, full-cost analysis represents a critical element in multimodal transportation investment planning. In terms of implementation, the findings in this report suggest that full-cost analysis is capable of enhancing TxDOT's qualitative assessments and planning/engineering judgment. Thus, the implementation recommendation is the application of MODECOST as a way of analyzing the full costs of urban transportation improvement alternatives in Texas.

Prepared in cooperation with the Texas Department of Transportation and the U.S. Department of Transportation, Federal Highway Administration.

REPORTS FOR THIS PROJECT

1356-1, "Full-Cost Analysis of Urban Passenger Transportation," by Jiefeng Qin, Karen M. Smith, Michael T. Martello, Mark A. Euritt, and José Weissmann. This report examines methods for evaluating and comparing urban passenger transportation projects regardless of mode. After identifying the full-cost approach as an effective tool for undertaking such comparisons, this report describes MODECOST, a full-cost evaluation model developed by the Center for Transportation Research (CTR) of The University of Texas at Austin.

1356-2, "Development of a Multimodal Full-Cost Model — MODECOST," by Jiefeng Qin, José Weissmann, Michael T. Martello, and Mark A. Euritt. This report summarizes the development of MODECOST, a multimodal full-cost model. First, various cost categories for three modes of a passenger transportation system — auto, bus, and light rail — are identified. This is followed by a discussion of procedures used for annualizing the life-cycle costs of each component of a transportation system. The report also summarizes the unit cost data found in the literature and data received from officials at the Texas Department of Transportation as well as from staff of other public agencies around the country.

1356-3, "Full-Cost Analysis of the Katy Freeway Corridor," by Jiefeng Qin, Michael T. Martello, José Weissmann, and Mark A. Euritt. Using a full-cost approach, this report evaluated the different transportation improvement alternatives (developed by Parsons Brinckerhoff Quade & Douglas, Inc.) available for the IH-10 Katy Freeway corridor. Through MODECOST — a computer model based on the full-cost analysis concept — we found that the current facility cannot meet future traffic demands.

1356-4, "The Houston-Harte of San Angelo: A Case Study Application of a Full-Cost Model for Evaluating Urban Passenger Transportation," by Karen M. Smith, Jiefeng Qin, José Weissmann, Mark A. Euritt, and Michael T. Martello. This report evaluates the full costs of transportation alternatives on the Houston-Harte corridor in San Angelo, Texas. The alternatives examined are those considered by the San Angelo District of the Texas Department of Transportation, which include: (1) the continuation of the existing frontage lanes-only configuration and (2) the construction of the mainlanes for completion of the facility. The results of MODECOST — a computer model developed by a Center for Transportation Research (CTR) team — indicate that the addition of mainlanes to the Houston-Harte corridor is both feasible and cost effective.

1356-5, "US 59 Harris County/Fort Bend County: A Case Study Application Of A Full-Cost Model For Evaluating Urban Passenger Transportation," by Michael T. Martello, Jiefeng Qin, José Weissmann, and Mark A. Euritt. This report evaluated transportation improvement alternatives for the US 59 Southwest Freeway corridor from the full-cost, life-cycle approach perspective. The alternatives involve hypothetical facility improvements as well as vehicle occupancy improvements. Our findings suggest that the current facility will not be able to service the projected peak-hour traffic demand; and after running MODECOST — a computer model based on the full-cost analysis concept — we observed that travelers bore a significant amount of external costs, including congestion costs and air pollution costs.

1356-6, "Application of Full Cost of Urban Passenger Transportation Case Study: Northeast (Ih-35) Corridor," by Jiefeng Qin, Michael T. Martello, José Weissmann, and Mark A. Euritt. Using a full-cost approach, we evaluated the different transportation improvement alternatives (developed by Rust Lichliter/Jameson) available for the Northeast (IH-35) corridor in San Antonio, Texas. Through MODECOST — a computer model based on the full-cost analysis concept — we found that the current facility cannot meet future traffic demands.

1356-7, "Full-Cost Evaluation of the Northeast Transit Terminal in El Paso, Texas," by Michael T. Martello, Jiefeng Qin, José Weissmann, and Mark A. Euritt. This report presents the results of an evaluation of the cost effectiveness of the Northeast Transit Terminal, an existing Sun Metro bus transit terminal located 23 km north of downtown El Paso, Texas. The evaluation of the transit terminal's cost effectiveness was conducted from a full-cost perspective and consisted of hypothesizing the amount of existing bus ridership that is attributable to the presence of the transit terminal. MODECOST, a computer model developed through this project, was used for the analysis.

1356-8F, "Development of an Urban Transportation Investment Model: Executive Summary," by Michael T. Martello, José Weissmann, Mark A. Euritt, and Jiefeng Qin. This final report summarizes the objectives of the project and provides recommendations for implementation.

DISCLAIMERS

Mark A. Euritt
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TABLE OF CONTENTS

IMPLEMENTATION RECOMMENDATIONS iii
REPORTS FOR THIS PROJECT iii
SUMMARY ix

CHAPTER 1. INTRODUCTION 1
1.1 The Concept of Full-Cost Analysis 1
1.2 A Brief Review of the MODECOST Model 2
1.3 Scope of the Report 2

CHAPTER 2. BACKGROUND 3
2.1 Introduction 3
2.2 Project Analysis Scenarios 3

CHAPTER 3. DESCRIPTION OF INPUT DATA 7
3.1 Person-Trip Demand 7
3.2 Freight Truck Demand 8
3.3 Mode Split and Vehicle Occupancy 10
3.4 Vehicle Traffic Distribution in Peak and Non-Peak Periods 10
3.5 Value of Time 12
3.6 Facility Cost Data 12
3.7 Emission Value Data 12
3.8 Transit Agency Data 12
3.9 Capital and Operating Data for Personal Vehicle 12

CHAPTER 4. RESULTS OF BASE CASE 15

CHAPTER 5. ANALYSIS OF ALTERNATIVES 21

CHAPTER 6. COMPARISON OF ALTERNATIVES 53

CHAPTER 7. CONCLUSION 57

REFERENCES 59

APPENDIX A. INPUT AND OUTPUT DATA OF MODECOST SAMPLE SCENARIO 2.2 61

SUMMARY

This report evaluated transportation improvement alternatives for the US 59 Southwest Freeway corridor from the full-cost, life-cycle approach perspective. The alternatives involve hypothetical facility improvements as well as vehicle occupancy improvements. Our findings suggest that the current facility will not be able to service the projected peak-hour traffic demand; and after running MODECOST — a computer model based on the full-cost analysis concept — we observed that travelers bore a significant amount of external costs, including congestion costs and air pollution costs. The annual life-cycle cost savings from the reduction of external costs and users/agency costs can more than offset the cost of initial investment for expansion of the current facility.

The case study conducted in this report shows that, in many cases, external costs and user/agency costs are more relevant than the initial investment in the facility. Expanding the current facility to add general purpose lanes or HOV lanes to accommodate ride-sharing and special transit service reduces the external costs and user/agency costs, which in turn reduces the system life-cycle cost of the facility.

The study also shows that full life-cycle cost analysis is a very effective tool for comparing the costs of transportation investment alternatives and for enhancing qualitative assessments and planning/engineering judgment. The actual value calculated by the full-cost analysis sometimes can be used as an assessment indicator by policy makers and transportation professionals.

CHAPTER 1. INTRODUCTION

1.1 THE CONCEPT OF FULL-COST ANALYSIS

Within Texas, a vast, 467,000-km transportation network has been developed to address the mobility and accessibility needs of state travelers (Ref 10). Today, more than 70 percent of local travel occurs between Texas cities having populations of over 200,000 (Ref 11), with most of these trips made by travelers using personal vehicles. The dependence on personal vehicles has created new problems for transportation professionals, environmentalists, and the public. These problems include congestion in many major metropolitan areas, air pollution and global weather change, noise, accidents, and high energy use. The Federal Highway Administration (FHWA) reported that 25 percent of Texas' urban Interstate highways exceeds 95 percent of capacity, and that 43 percent are operating at over 80 percent of their carrying capacity.

In Houston, one of the largest cities in the nation, these congestion problems have led to the city being classified as a non-attainment area. Thus, the main purpose of this report is to assist policymakers in evaluating investment alternatives for the improvement of transportation within Houston, and specifically along the US 59 Southwest Freeway, one of its major corridors.

Prior to 1990, transportation policy focused primarily on the development of the Interstate system. And for such development, cost evaluations of transportation alternatives in the urban environment typically considered initial capital investments only. However, the passage of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) and the Clean Air Act Amendments of 1990 (CAAA) prompted a more comprehensive approach to evaluating transportation options. That is, ISTEA and CAAA shifted traditional planning and decisionmaking to a multimodal transportation perspective, one that examines highway, transit, and rail issues in combination. In this approach, the transportation planning process looks at the problem from the perspective of an integrated system, emphasizing efficient and productive transfer of people and goods. Within this scheme, costs, including indirect social and environmental costs, are to be fully accounted for in comparing modes and management strategies to identify the most cost-effective options.

Transportation full-cost analysis is the first step in developing a multimodal transportation investment plan. Full-cost analysis takes into account not only infrastructure costs, but also user and external costs; in this way, it is capable of enhancing transportation planning significantly. Focus on any singular cost may result in an inefficient system and can lead to reduced long-term economic investment. The full-cost approach provides a stronger platform from which to evaluate — without modal bias — transportation investment options. It identifies least-cost alternatives and promotes efficient use of the system.

1.2 A BRIEF REVIEW OF THE MODECOST MODEL

Previous reports (Refs 8, 9) reviewed the literature and current practice of full-cost transportation system planning. In this project, the Center for Transportation Research (CTR) of

The University of Texas at Austin investigated the full-cost analysis approach for evaluating transportation decisions. As a result of this research effort, the computer model, MODECOST, was developed. MODECOST has the ability to assist Metropolitan Planning Organizations (MPOs) and regional and municipal authorities in comparing multimodal transportation alternatives by accounting for the full cost of each mode. MODECOST incorporates many aspects of modal costs that have not traditionally been accounted for, such as air pollution cost, accident cost, and personal vehicle user cost — costs not usually included in decision matrices for transportation investment. By taking costs such as these into account, MODECOST is estimating the direct and indirect costs from the perspective of how much society (or the taxpayer) is paying for that mode of transportation.

In summary, MODECOST allows the transportation planner to compare the full cost of three major urban transportation modes — auto, bus, and rail — along a particular corridor. It is based on the full-cost and life-cycle-cost concepts discussed in previous reports (Refs 8, 9). MODECOST is an easy-to-operate, interactive and menu-driven software program that compares transportation alternatives. The software can be run on any IBM-PC or compatible computer using Microsoft Windows (Ref 5).

1.3 SCOPE OF THE REPORT

This report summarizes cost estimates and comparisons for six transportation alternatives for the US 59 Southwest Freeway extending from Rosenberg in Fort Bend County to Houston in Harris County. Cost comparisons among alternatives are useful for policy purposes, insofar as they help determine under what circumstances one alternative is more efficient than another in terms of the resources it uses to provide a given service.

This chapter reviewed the background of full-cost analysis and outlined the report. Chapter 2 is concerned with the background and development of the six alternatives assessed for US 59. Chapter 3 describes the data inputs and assumptions made in the analysis. Chapter 4 and Chapter 5 build upon the calculations of MODECOST to present the full cost of urban passenger transportation for different investment alternatives. Specifically, Chapter 4 presents the results for the base case, dubbed "No Build," which serves as the basis for comparison. Chapter 5 then describes the results for other investment alternatives, which may result in overall full-cost savings. Chapter 6 compares the transportation scenarios assessed in this case study. Chapter 7 then summarizes the findings of this report.

CHAPTER 2. BACKGROUND

2.1 INTRODUCTION

The Houston-Galveston Area Council (H-GAC) recently submitted a request for proposals (RFP) for the development of a mobility plan for Fort Bend County. The proposed objective of the mobility plan is to develop a countywide plan, including both thoroughfare and public transit elements (Ref 1). The RFP called for the evaluation of the costs and benefits of each mobility strategy proposed. In this study, our analysis will address transportation cost issues not typically found in mobility studies.

Fort Bend County is adjacent to Harris County and is a part of the eight-county Houston-Galveston Transportation Management Area, as described in *Vision 2020 — Fort Bend County Mobility Assessment* (Ref 4). Its population is expected to double from 257,000 in 1995 to 525,000 by the year 2020. Employment is expected to grow within the county as well. County vehicle miles traveled (VMT) is expected to increase to 11,700,000 by 2020, up from 4,700,000 VMT in 1990.

An important transportation planning issue for Fort Bend County is maintaining and improving links from the county to major employment centers in the Houston-Galveston area (Ref 1). US 59 is considered a key transportation facility linking Fort Bend County with the Houston-Galveston area, from State Highway 36 Bypass in Rosenberg extending to the northeast into Harris County, connecting with Loop 610 West in Houston. Figure 2.1 shows Fort Bend County, as well as a part of Harris County, and highlights the US 59 study corridor.

2.2 PROJECT ANALYSIS SCENARIOS

Owing to varying existing roadway geometric characteristics and traffic volume levels, the 46-km (28.5-mile) US 59 corridor under study from Loop 610 West in Harris County to State Highway 36 Bypass in Fort Bend County is divided into thirteen segments. They are:

- Seg 1: Loop 610 to Westpark
- Seg 2: Westpark to Beechnut
- Seg 3: Beechnut to S.W. Plaza
- Seg 4: S.W. Plaza to Fort Bend County Line
- Seg 5: Fort Bend County Line to Ref Mrk 528 + 0.800
- Seg 6: Ref Mrk 528 + 0.800 to Kirkland
- Seg 7: Kirkland to US 90A
- Seg 8: US 90A to Ref Mrk 530+0.500
- Seg 9: Ref Mrk 530+0.500 to Ref Mrk 530+1.008
- Seg 10: Ref Mrk 530+1.008 to Ref Mrk 532+0.365
- Seg 11: Ref Mrk 532+0.365 to Brazos River
- Seg 12: Brazos River to FM 2218
- Seg 13: FM 2218 to State Hwy 36 Bypass

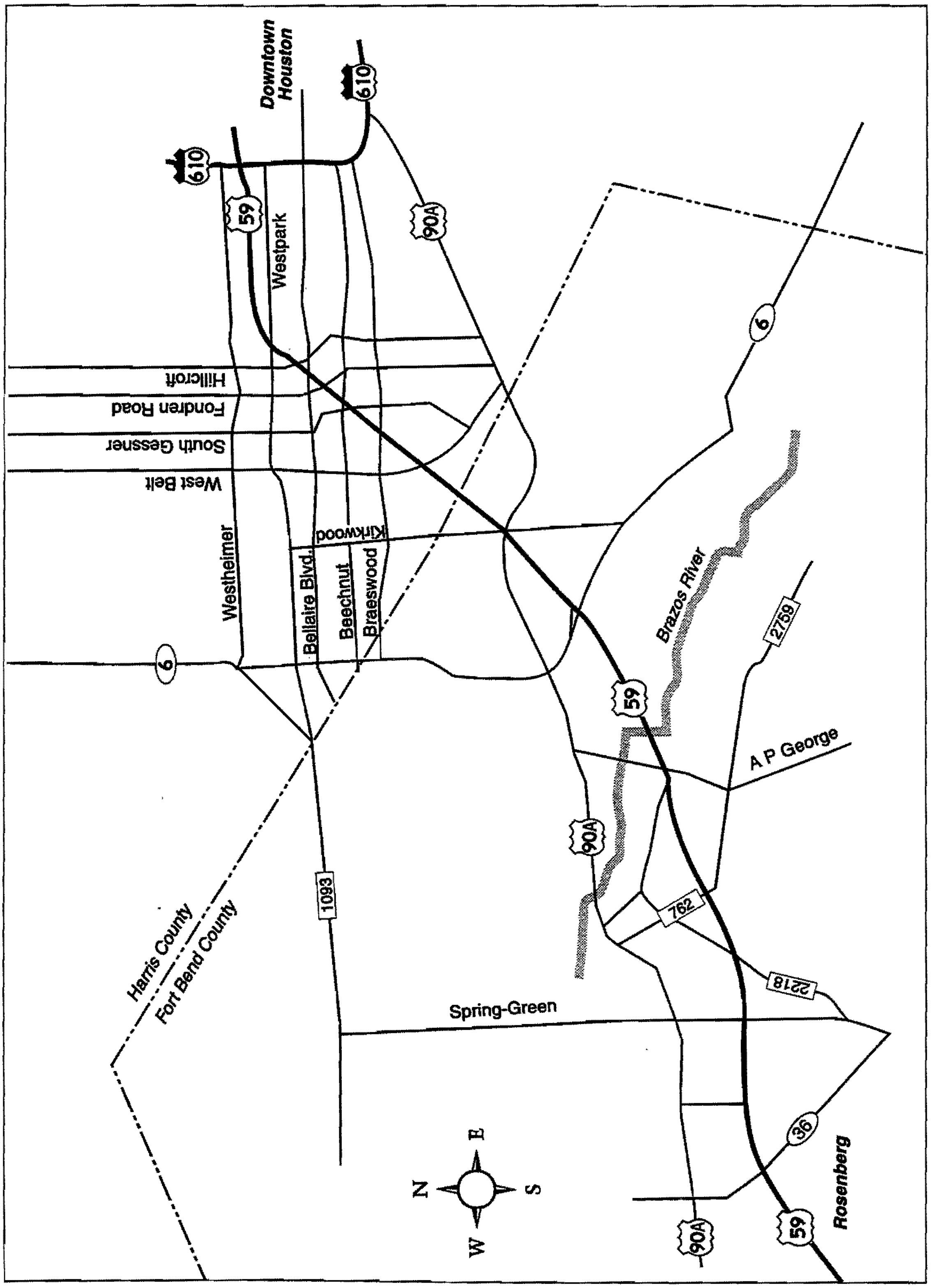

Figure 2.1 US 59 corridor

US 59 TRANSPORTATION FACILITY ALTERNATIVES

The Vision 2020 Fort Bend County Mobility Assessment summarizes the officially proposed Transportation Improvement Program (TIP) projects for FY 1994 – FY 1998 in Fort Bend County (other proposed transportation improvements are also included). *The Vision 2020 Mobility Assessment* serves as the starting point for proposed transportation improvements that are analyzed in this study. Given the absence of other data, the following Transportation Facility Alternatives (TFAs) are proposed. The facility improvements, such as additional highway capacity and HOV lanes, are assumed to be in place throughout the entire study period (year 2000 through year 2040).

TFA 1: No Investment

This alternative does not provide for any transportation facility improvements.

TFA 2: HOV Facility Investment

This alternative calls for an HOV facility to extend from Segment 1 through Segment 11 for a distance of about 26 km (over 16 miles). The HOV facility is a two-lane facility running along the existing US 59 corridor and designated for two modes: buses and carpools/vanpools. Three additional park-and-ride lots and two transit centers are assumed to be constructed along the corridor. Currently, six park-and-ride lots are estimated to be servicing the study corridor.[1]

The reader should note that the current version of MODECOST distributes the costs of park-and-ride lots and transit centers on an areawide basis — *not* directly to the specific corridor under study. In other words, the transit agency's total cost for providing services in the specific study corridor being analyzed will include only a portion of the total cost of the park-and-ride lots and transit centers.

TFA 3: General Purpose Facility Investment

This alternative calls for the addition of one lane of highway capacity in each direction from Segment 1 through Segment 11 for a distance of about 26 km (over 16 miles) without an HOV facility (except for the existing one-lane reversible HOV facility located in the first four segments of the project).

The study scenarios being evaluated are dependent not only upon various transportation facility improvements as described above, but also upon varying travel behavior characteristics, such as mode split and vehicle occupancy. Given the lack of data available on US 59, the following Travel Behavior Alternatives (TBAs) are proposed as mode split and vehicle occupancy alternatives. We assume that TBA 1 represents existing conditions and that the mode splits are constant throughout the entire study period. Also, we classify carpools as a separate mode.

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[1] Phone conversation with Surrinder Marwah at H-GAC; 3/14/96.

US 59 TRAVEL BEHAVIOR ALTERNATIVES

Passenger Vehicle Classification and Occupancies:

- TBA 1: 93.74% SOV (1.0), 6.00% Carpool (2.2), 0.26% Bus (11)
- TBA 2: 87.48% SOV (1.0), 12.00% Carpool (2.2), 0.52% Bus (22)

TBA 1 results in an overall passenger vehicle occupancy of 1.10, while the second travel behavior alternative results in an overall passenger vehicle occupancy of 1.25 (an increase of 14 percent). The following matrix of transportation facility alternatives and mode split alternatives summarizes the six scenarios that are evaluated in this study.

Table 2.1. US 59 case study scenarios

TRANSPORTATION FACILITY ALTERNATIVES	TRAVEL BEHAVIOR ALTERNATIVES	
	TBA 1	TBA 2
TFA 1	Scenario 1.1	Scenario 1.2
TFA 2	Scenario 2.1	Scenario 2.2
TFA 3	Scenario 3.1	Scenario 3.2

Scenario 1.1 represents the existing-conditions scenario, one that is somewhat hypothetical given the lack of existing data. The remaining scenarios thus represent facility and/or mode split improvements to the existing conditions.

Scenario 1.2 represents the no-build alternative, one where the share of buses and carpools in the vehicle stream doubles, increasing from 0.26 percent to 0.52 percent for buses and from 6 percent to 12 percent for carpools. Bus occupancy also doubles from 11 passengers per vehicle to 22 passengers per vehicle.

Scenario 2.1 represents an "HOV Build" scenario, one in which there is no increase in the existing number of higher occupant vehicles in the traffic stream. Scenario 2.2 represents an "HOV-Build" scenario, which is accompanied by an increase in the share of higher-occupant vehicles using the freeway.

Scenario 3.1 represents a "General Purpose Build" scenario that has no increase in the overall passenger vehicle occupancy, while Scenario 3.2 represents the "General Purpose Build" scenario, in which the overall passenger vehicle occupancy increases to 1.25 (from 1.10).

CHAPTER 3. DESCRIPTION OF INPUT DATA

3.1 PERSON TRIP DEMAND

Average annual daily traffic (AADT) volumes, growth rates, percent trucks, directional factors (D), and K-factors have been provided by TxDOT via the "TRM" system. Table 3.1 summarizes the data received from TxDOT.

Table 3.1 Existing traffic data

US 59 SEGMENT	1994 AADT	Annual Growth Rate	Percent Trucks	Peak Period Direction Factor (D)	Peak Hour Factor (K)[1]
1	237,560	1.70%	6.9%	53%	7.2%
2	204,490	3.53%	7.1%	53%	7.2%
3	112,350	1.70%	8.2%	53%	7.2%
4	105,950	3.06%	8.3%	53%	7.2%
5	105,950	3.06%	8.3%	53%	7.2%
6	74,520	2.96%	9.4%	64%	11.7%
7	74,520	2.96%	9.4%	64%	11.7%
8	91,690	2.51%	8.7%	64%	11.7%
9	91,690	2.51%	8.7%	64%	11.7%
10	82,340	3.04%	9.1%	64%	11.7%
11	65,000	2.63%	12.8%	64%	11.7%
12*	36,600	2.38%	14.5%	64%	11.7%
13**	16,650	3.02%	18.2%	64%	11.7%

*Average of two different traffic volume levels
**Average of three different traffic volume levels

Using these and other assumed data, we converted the AADT to person trips for each segment, as summarized in Table 3.2. We estimate that weekday person trips are 112 percent of the AADT and that weekend person trips are 70 percent of the AADT. This estimation is based upon weekday and weekend person-trip demand data on the Katy Freeway (Ref 2). We also assume that the overall daily directional split is 50 percent in each direction.

3.2 FREIGHT TRUCK DEMAND

Percent trucks for each segment was provided by TxDOT. Table 3.3 summarizes the truck data received. We assume that the percent truck data received apply to the annual average daily traffic (AADT), and that weekday truck volumes are 120 percent of the AADT, while weekend truck traffic is 51 percent of the AADT. Our estimation of the classification of these trucks (Table

[1] Represents 30th highest hour of the year based on phone conversation with TxDOT staff working under Mark Hodges, TPP-Traffic Analysis.

3.4) is based upon data obtained from an annual classification study conducted west of the Harris County line (Sta: MS-1200) on the Katy Freeway (Ref 2).

Table 3.2 US 59 corridor —Year 2000 person trips

US 59 SEGMENT	Weekday	Weekend
1	300,932	188,083
2	287,677	179,798
3	140,334	87,709
4	143,163	89,477
5	143,163	89,477
6	98,908	61,818
7	98,908	61,818
8	119,457	74,660
9	119,457	74,660
10	110,162	68,851
11	81,451	50,907
12*	44,356	27,723
13**	19,951	12,470

*Average of two segments
**Average of three segments

Table 3.3 US 59 corridor — 2000 freight truck trips

US 59 SEGMENT	Weekday	Weekend
1	21,764	9,250
2	21,454	9,118
3	12,232	5,199
4	12,644	5,374
5	12,644	5,374
6	10,014	4,256
7	10,014	4,256
8	11,108	4,721
9	11,108	4,721
10	10,761	4,574
11	11,667	4,958
12*	7,348	3,123
13**	4,321	1,836

*Average of two different traffic volume levels
**Average of three different traffic volume levels

Table 3.4 Freight truck mix

Truck Category	Percent
2-axle Single Unit	18.0
3/4-axle Single Unit	4.6
3/4-axle Semi-Trailer	4.6
5-axle Semi-Trailer	66.6
6-axle Semi Trailer	3.3
5-axle Trailer	2.3
6-axle Trailer	0.6

3.3 MODE SPLIT AND VEHICLE OCCUPANCY

No person-trip mode split or vehicle occupancy data were available or collected for the US 59 corridor. Therefore, we have made the following assumptions and estimations concerning these existing travel characteristics. From the Katy Freeway case study (Ref 2), passenger vehicle classification data at Manual Count Station (MS-1200) indicate that buses represent 0.26 percent of the passenger vehicle stream. Further, the existing bus occupancy is estimated to be 11 (Ref 3)[2] and the existing vehicle occupancy of carpoolers is estimated to be 2.2 (Ref 4).

Working backwards from this information, and assuming that the existing overall passenger vehicle occupancy (including bus traffic) is 1.1, the US 59 passenger vehicle classification is estimated to be 93.74 percent single occupant vehicle, 6 percent carpool (at 2.2 persons per vehicle), and 0.26 percent bus (at 11 persons per vehicle).

Total daily person-trips on each segment of US 59 are then calculated from the information described above. Person-trip mode splits, which are required for input into MODECOST, are then estimated using the following procedure. First, a capacity restraint is imposed on the HOV facility, assuming it to be utilized up to its capacity (1,800 vehicles per hour per lane). Buses are given priority to be allocated onto the HOV lane. Next, any remaining HOV lane capacity is assumed to be utilized by carpools. Any carpools (or buses) that cannot be accommodated by the HOV lane capacity are assigned to the general purpose lanes. No capacity restraint is assumed for the general purpose lanes.

The percent "Bus-HOV" and "Auto-HOV" person-trips of the total person-trips are then calculated. This is the person-trip mode split for these two modes and is input into MODECOST. The "Auto-Main" person-trip mode split is then calculated by considering the number of single-occupant vehicles in the traffic stream. Finally, the "Bus-Main" person-trip mode split is calculated by considering the number of buses not assigned to the HOV lane and its estimated average occupancy.

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[2] 1992 Houston METRO total annual passenger miles divided by annual vehicle miles.

These calculations, required because only ADT data were available on the US 59 corridor, result in non-uniform person-trip mode splits over the life cycle of the study (40 years). While MODECOST does allow for varying mode splits over the study life, mode split data for only one year were input and assumed to be constant over the study life-cycle period. Person-trip mode split data for the year 2020 were input for the entire study period, which begins in the year 2000 and ends in the year 2040.

3.4 VEHICLE TRAFFIC DISTRIBUTION IN PEAK AND NON-PEAK PERIODS

TxDOT provided directional and peak factors for average annual daily traffic (AADT). These factors are used to estimate AM and PM peak-hour directional vehicle trips for an average day (assumed to be an average weekday). The remaining 22 hours of non-peak hour traffic is assumed to be 14 hours of the "daytime" period and 8 hours of "nighttime" period, as designated in MODECOST. The percent share of total vehicle trips of the night period (10 PM - 6 AM) is assumed to be 3.0 percent. The remaining non-peak vehicle trips are assumed to occur during the daytime period. For a given segment, the total daily inbound vehicle trips are assumed to equal the total daily outbound person-trips. Table 3.4 summarizes the weekday diurnal trip distributions. As shown in Table 3.5, weekends are assumed to not have peak-hour periods.

Assumptions concerning the vehicle traffic distributions on HOV facilities were made (see the sample US 59 input data provided in Appendix A). In general, it was assumed that the hourly vehicle traffic distribution on the HOV facility would reflect larger portions of traffic traveling during peak hours on the HOV facility than for traffic on the general purpose lanes.

Table 3.4 Weekday diurnal distribution of vehicle traffic — General purpose lanes

US 59 Segment	AM Peak (1 hour)		PM Peak (1 hour)		Day (14 hour)		Night (8 hour)		
	In	Out	In	Out	In	Out	In	Out	Total
1	3.8	3.4	3.4	3.8	39.8	39.8	3.0	3.0	100.0
2	3.8	3.4	3.4	3.8	39.8	39.8	3.0	3.0	100.0
3	3.8	3.4	3.4	3.8	39.8	39.8	3.0	3.0	100.0
4	3.8	3.4	3.4	3.8	39.8	39.8	3.0	3.0	100.0
5	7.5	4.2	4.2	7.5	35.3	35.3	3.0	3.0	100.0
6	7.5	4.2	4.2	7.5	35.3	35.3	3.0	3.0	100.0
7	7.5	4.2	4.2	7.5	35.3	35.3	3.0	3.0	100.0
8	7.5	4.2	4.2	7.5	35.3	35.3	3.0	3.0	100.0
9	7.5	4.2	4.2	7.5	35.3	35.3	3.0	3.0	100.0
10	7.5	4.2	4.2	7.5	35.3	35.3	3.0	3.0	100.0
11	7.5	4.2	4.2	7.5	35.3	35.3	3.0	3.0	100.0
12	7.5	4.2	4.2	7.5	35.3	35.3	3.0	3.0	100.0
13	7.5	4.2	4.2	7.5	35.3	35.3	3.0	3.0	100.0

Table 3.5 Weekend diurnal distribution of vehicle traffic — General purpose lanes

US 59 Segment	AM Peak (1 hour)		PM Peak (1 hour)		Day (14 hour)		Night (8 hour)		
	In	Out	In	Out	In	Out	In	Out	Total
1	0.0	0.0	0.0	0.0	47.0	47.0	3.0	3.0	100.0
2	0.0	0.0	0.0	0.0	47.0	47.0	3.0	3.0	100.0
3	0.0	0.0	0.0	0.0	47.0	47.0	3.0	3.0	100.0
4	0.0	0.0	0.0	0.0	47.0	47.0	3.0	3.0	100.0
5	0.0	0.0	0.0	0.0	47.0	47.0	3.0	3.0	100.0
6	0.0	0.0	0.0	0.0	47.0	47.0	3.0	3.0	100.0
7	0.0	0.0	0.0	0.0	47.0	47.0	3.0	3.0	100.0
8	0.0	0.0	0.0	0.0	47.0	47.0	3.0	3.0	100.0
9	0.0	0.0	0.0	0.0	47.0	47.0	3.0	3.0	100.0
10	0.0	0.0	0.0	0.0	47.0	47.0	3.0	3.0	100.0
11	0.0	0.0	0.0	0.0	47.0	47.0	3.0	3.0	100.0
12	0.0	0.0	0.0	0.0	47.0	47.0	3.0	3.0	100.0
13	0.0	0.0	0.0	0.0	47.0	47.0	3.0	3.0	100.0

3.5 VALUE OF TIME

Although the inclusion of travel time costs in the analysis makes the results more meaningful, it also introduces questions about some of the assumptions. Passenger travel-time values are very difficult to measure, and various studies have disagreed regarding the appropriate estimate for the value of travel time. Furthermore, some planners are skeptical of a single assumed value for travel time. However, from the perspective of alternative comparisons, the single value method is adequate. In this analysis we assume a value of $5.00 per passenger per hour for travel-time. The value equals to one-third of the average wage rate (Ref 5), which is assumed to be $15.00 per passenger per hour.

3.6 FACILITY COST DATA

Most data on facility unit costs have been obtained from the General Guidelines for Estimates provided by the Texas Department of Transportation. Because we assume the existing right-of-way is large enough to accommodate either the expansion of the existing facility or the addition of a new facility, the purchase of right-of-way is not included in this study.

3.7 EMISSION VALUE DATA

The emission values, which are based primarily on damage value estimates of stationary source emissions, are found in the literature (Ref 6). In the Houston metropolitan area, the values are \$6,890 per ton for nitrogen oxides (NO_X), \$3,540 per ton for hydrocarbons (HC), \$5,190 per ton for soot-like particulate (PM10), \$2,910 per ton for sulfur oxides (SO_X), and \$2,000 per ton for carbon monoxide (CO).

3.8 TRANSIT AGENCY DATA

Transit cost data from Houston Metro are used in this analysis. The bus fleet running on the Katy Freeway consists of the Low-Floor 12.2-m (40-foot) New Flyer, which has an initial capital cost of \$257,000 per bus and a life of 12 years.[3]

There are a total of 39 park-and-ride lots and 42 transit centers constructed or under construction in Houston. The average cost of a park-and-ride lot is \$3,900,000, while the cost of a transit center is \$4,900,000.[4] These costs were used in the analysis.

3.9 CAPITAL AND OPERATING DATA FOR PERSONAL VEHICLES

The cost of owning and operating a motor vehicle is of major significance. The data listed in Table 3-6 trace selected vehicles in personal use and their costs over a 12-year lifetime by FHWA (Ref 7). The costs were based on operation of typical vehicles.

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[3] Based on the data provided by Bill Peterson, Houston METRO.

[4] Based on the data sent by Katherine F. Turnbull, Texas Transportation Institute.

Table 3.6 Auto capital and operating data

Cost Category	Cost
Average Vehicle Price ($/vehicle)	13,534
Average Pickup and Van Price ($/vehicle)	15,813
Percent being Financed	75%
Loan Period (year)	5
Loan Rate	10.0%
Salvage Value ($/vehicle)	1,000
Vehicle Life (year)	12
Average Annual Driven Miles (mile)	10,700
Annual Scheduled Maintenance ($/vehicle)	232
Annual Unscheduled Maintenance ($/vehicle)	195
Annual Oil Change ($/vehicle)	59
Annual Tire Change ($/vehicle)	97
Annual Insurance ($/vehicle)	600
Annual Parking ($/vehicle)	360
Enhanced I/M ($/vehicle)	55
Average Gasoline Price without Taxes ($/gallon)	0.70

Source: *Cost of Owning & Operating Automobiles, Vans & Light Trucks 1991*. U.S. Department of Transportation, Washington, D.C., 1992.

CHAPTER 4. RESULTS OF BASE CASE

SCENARIO 1.1

Scenario 1.1 represents existing facility and mode-split conditions on US 59 within the study limits. Figure 4.1[1] depicts the existing number of lanes on US 59 for each segment of US 59 analyzed (as well as the length of each segment). Segment boundaries were established based upon varying capacity and traffic volumes.

Figure 4.2 summarizes the systemwide life-cycle annual cost findings for this scenario. Total agency cost, including highway and transit, is $39.0 million, or 0.7 percent of the total system annual cost. The auto-user cost, which includes the cost of purchasing and operating an automobile, is $451.8 million, or 7.7 percent of the total system annual cost. The reader should be aware that MODECOST assumes that transit riders do not incur automobile ownership and operation costs and therefore do not contribute to the total system annual cost for auto users.

Total external costs are estimated to be $5.376 billion, or 91.6 percent of the total system annual cost. External costs include monetary estimates of travel time under recurring congestion, air pollution, accidents, incident delay, and other external costs. Table 4.1 summarizes the input data for the figures presented in this section.

Figure 4.3 depicts the systemwide annual life-cycle costs for Scenario 1.1 in more detail by disaggregating the main external cost categories. The estimate of travel time and its monetary value in this analysis results in a travel time cost accounting for 79.1 percent of the total system cost. For comparison purposes, Figure 4.4 and Figure 4.5 present the results of the analysis minus the system travel time cost estimate and without the air pollution cost estimate.

As shown, the cost of owning and operating an auto becomes the predominant system cost component when these two external costs (travel time and air pollution) are ignored in the analysis.

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[1] Source of number of lanes data: Surinder Marwaha, H-GAC, phone conversation on April 22, 1996.

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Sec #13	St. Hwy 36 Bypass	FM 2218	GP = 2	(4.6 mi) 7.4 km	GP = 2	
Sec #12	FM 2218	Brazos River	GP = 2	(7.5 mi) 12.1 km	GP = 2	
Sec #11	Brazos River		GP = 2	(3.6 mi) 5.8 km	GP = 2	
Sec #10			GP = 2	(1.3 mi) 2.1 km	GP = 2	
Sec #9			GP = 2	(0.5mi) 0.8 km	GP = 2	
Sec #8		US 90A	GP = 2	(0.6 mi) 1.0 km	GP = 2	
Sec #7	US 90A	Kirkland	GP = 2	(0.4 mi) 0.6 km	GP = 2	
Sec #6	Kirkland		GP = 3	(0.7 mi) 1.1 km	GP = 3	
Sec #5		Harris County/ Fort Bend County Line	GP = 3	(0.8mi) 1.3 km	GP = 3	
Sec #4	Harris County/ Fort Bend County Line	S. W. Plaza	GP = 5	(1.6mi) 2.6 km	GP = 5	HOV=1(R)
Sec #3	S. W. Plaza	Beechnut	GP = 5	(2.4mi) 3.9 km	GP = 5	HOV=1(R)
Sec #2	Beechnut	Westpark	GP = 5	(3.0 mi) 4.8 km	GP = 5	HOV=1(R)
Sec #1	Westpark	Loop 610 West	GP = 6	(1.5 mi) 2.4 km	GP = 6	HOV=1(R)

GP = General Purpose Through Lanes

HOV = HOV Lanes (R=Reversible)

Total = (28.5 miles)
46 km

Figure 4.1 Scenario 1.1 and 1.2

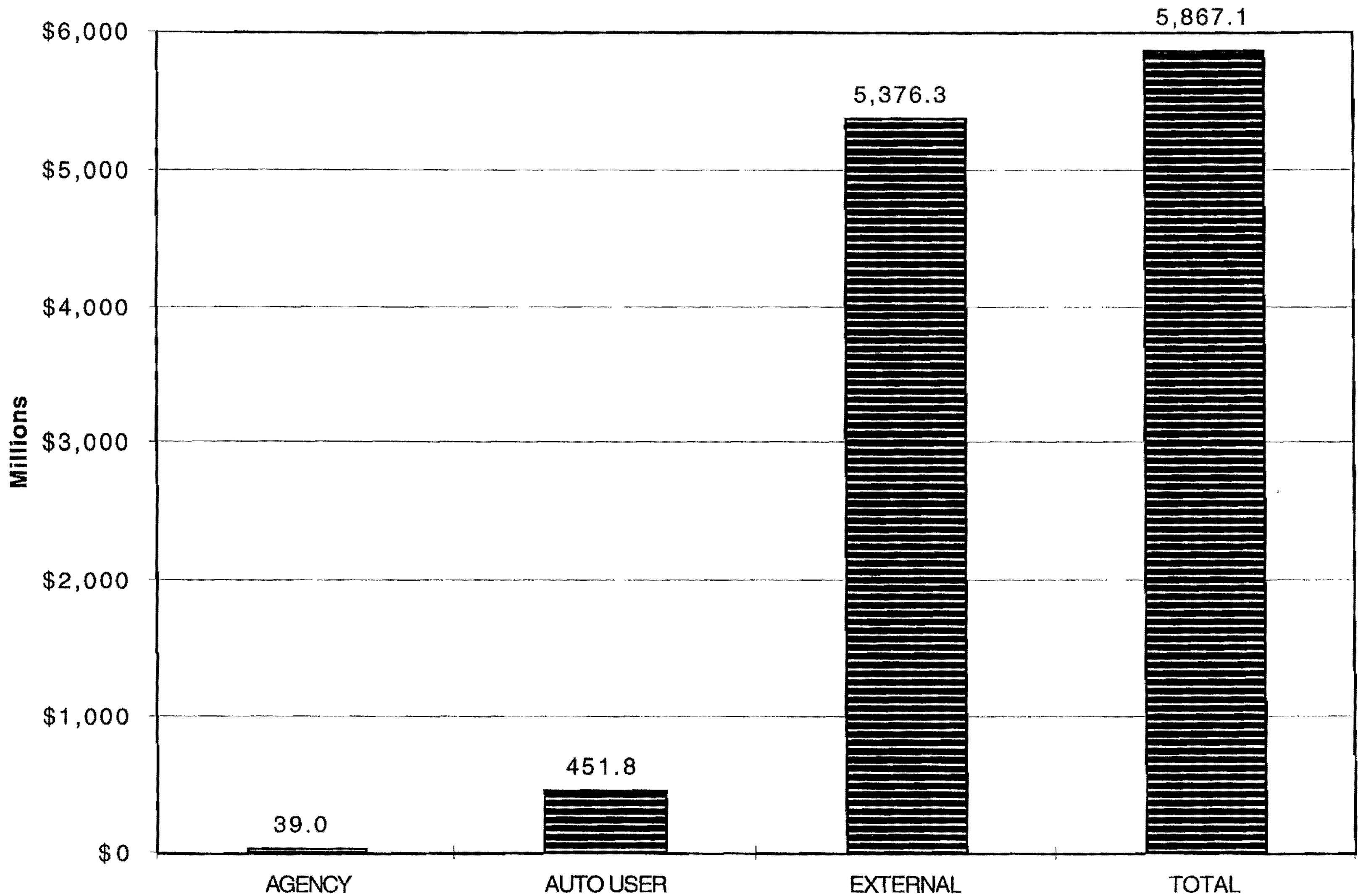

Figure 4.2 US 59 case study — Scenario 1.1 life-cycle annual costs

Table 4.1 Scenario 1.1 cost summary (millions of dollars) — General purpose plus HOV

	No. of Lanes	12	10	10	10	6	6	4	4	4	4	4	4	4		
	Length (mi)	1.5	2.96	2.36	1.60	0.80	0.70	0.40	0.59	0.51	1.34	3.55	7.50	4.57	CORRIDOR	CORRIDOR
	Segment #	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	TOTAL	TOTAL
	AGENCY	**3.38**	**7.67**	**4.27**	**4.16**	**0.90**	**1.11**	**0.36**	**0.56**	**0.49**	**1.71**	**4.69**	**6.51**	**3.23**	**$39.04**	0.67%
	Highway Facility	2.00	4.48	3.25	3.35	0.49	0.87	0.22	0.33	0.28	1.18	3.72	5.42	2.91	$28.51	0.49%
	Transit Agency	1.38	3.19	1.01	0.81	0.41	0.24	0.14	0.24	0.20	0.52	0.98	1.09	0.32	$10.53	0.18%
	AUTO USER	59.64	137.85	43.72	35.01	17.22	10.29	5.88	9.97	8.62	22.14	41.44	46.39	13.65	**$451.82**	7.70%
ANNUAL	**EXTERNAL**	**128.72**	**3,869.01**	**32.48**	**53.86**	**244.45**	**29.89**	**68.97**	**141.90**	**122.66**	**386.14**	**229.66**	**55.99**	**12.53**	**$5,376.25**	91.63%
COST	Travel Time	94.08	3,405.16	12.31	34.99	213.94	22.97	59.99	124.25	107.40	339.90	190.71	30.06	4.58	$4,640.33	79.09%
	Air Pollution	15.84	420.38	6.20	7.67	24.91	3.54	7.05	14.40	12.44	38.98	24.84	9.82	3.01	$589.07	10.04%
	Incident Delay	6.17	14.26	4.59	3.68	1.84	1.11	0.64	1.07	0.92	2.38	4.64	5.29	1.62	$48.21	0.82%
	Accident	1.63	3.77	1.21	0.97	0.48	0.29	0.17	0.28	0.24	0.62	1.21	1.39	0.43	$12.68	0.22%
	Other External	11.00	25.42	8.18	6.56	3.28	1.98	1.13	1.91	1.65	4.25	8.27	9.44	2.89	$85.96	1.47%
	TOTAL	**191.75**	**4,014.53**	**80.47**	**93.04**	**262.57**	**41.29**	**75.21**	**152.43**	**131.76**	**409.98**	**275.79**	**108.89**	**29.41**	**$5,867.12**	**100%**
INITIAL INVESTMENT	Highway	13.63	29.74	21.80	20.92	3.76	6.96	1.73	2.56	2.22	9.52	30.13	43.15	23.00	**$209.11**	

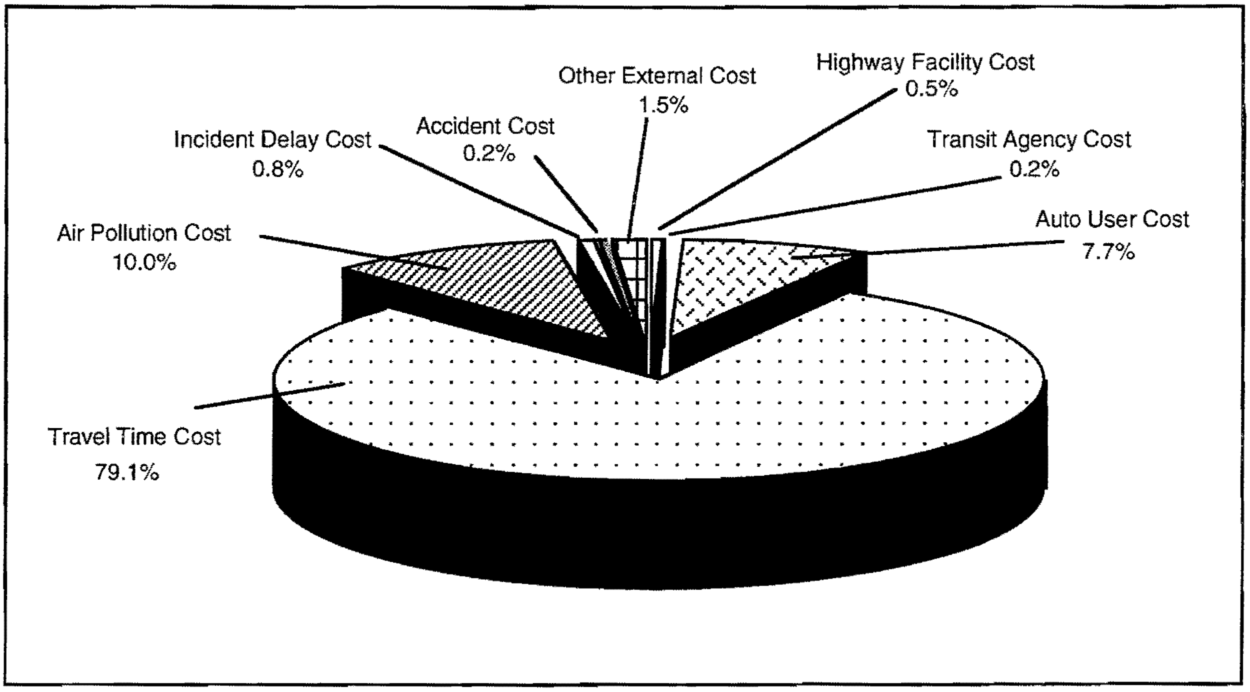

Figure 4.3 Annual shares of system cost — Scenario 1.1

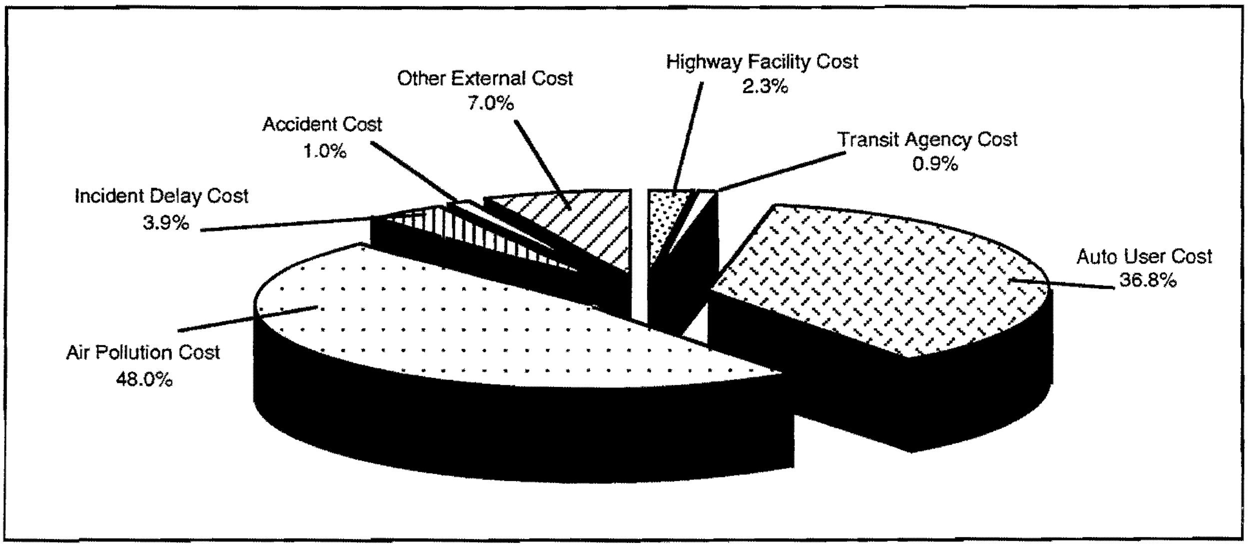

Figure 4.4 Annual shares of system cost — Scenario 1.1 without travel time cost

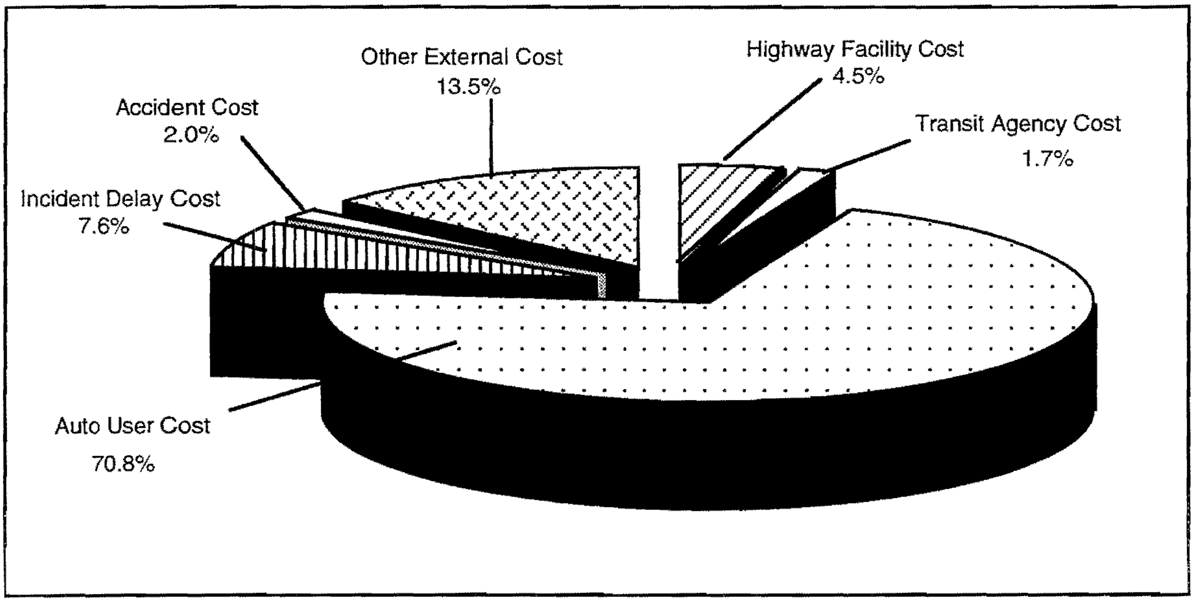

Figure 4.5 Annual shares of system cost — Scenario 1.1 without travel time and air pollution costs

CHAPTER 5. ANALYSIS OF ALTERNATIVES

The previous chapter presented the results of the base case (existing conditions) scenario (Scenario 1.1). This chapter presents the results of the five alternative facility and mode split scenarios assessed.

SCENARIO 1.2

Scenario 1.2 represents the existing facility attributes, but with an "improved" mode split on US 59, which results in the average passenger vehicle occupancy increasing to 1.25 on the general purpose lanes (from an occupancy of 1.1).

Figure 5.1 summarizes the systemwide life-cycle annual cost findings for this scenario. Total agency cost, including highway and transit, is $46.9 million, or 1.2 percent of the total system annual cost. The auto-user cost, which includes the cost of purchasing and operating an automobile, is $381.2 million, or 10.1 percent of the total system annual cost. The reader should be aware that MODECOST assumes that transit riders do not incur automobile ownership and operation costs and therefore do not contribute to the total system annual cost for auto users.

Total external costs are estimated to be $3.349 billion, or 88.7 percent of the total system annual cost. External costs include monetary estimates of travel time under recurring congestion, air pollution, accidents, incident delay, and other external costs. Table 5.1 summarizes the input data for the figures presented in this section.

Figure 5.2 depicts the systemwide annual life-cycle costs for Scenario 1.2 in more detail by disaggregating the main external cost categories. The estimate of travel time and its monetary value in this analysis results in travel time costs accounting for 76.1 percent of the total system cost. For comparison purposes, Figure 5.3 and Figure 5.4 present the results of the analysis minus the system travel time cost estimate (and without the air pollution cost estimate).

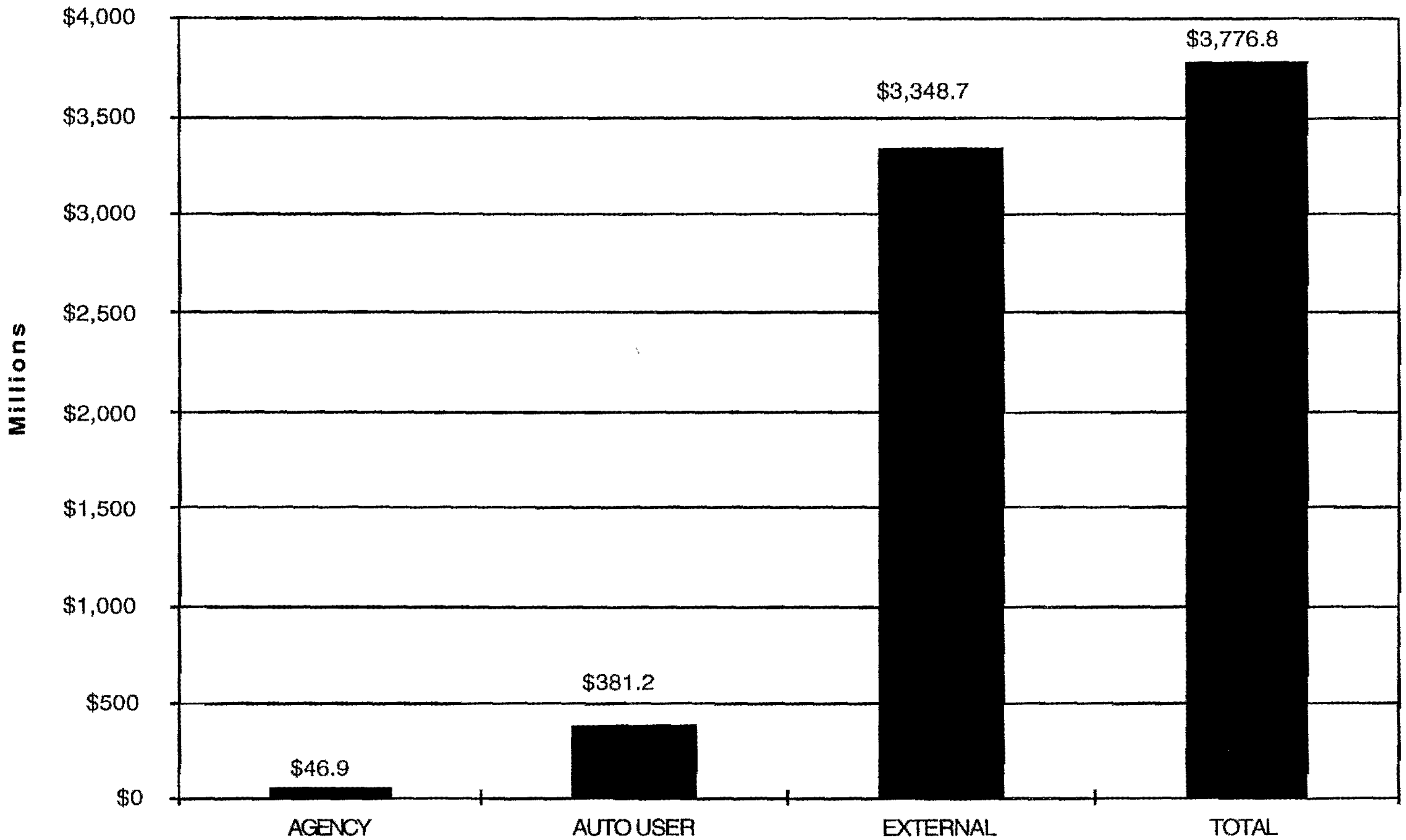

Figure 5.1 US 59 case study — Scenario 1.2 life-cycle annual costs

Table 5.1 Scenario 1.2 cost summary (millions of dollars) — General purpose plus HOV

	No. of Lanes	12	10	10	10	6	6	4	4	4	4	4	4	4		
	Length (mi)	1.5	2.96	2.36	1.60	0.80	0.70	0.40	0.59	0.51	1.34	3.55	7.50	4.57	**CORRIDOR**	**CORRIDOR**
	Segment #	**1a**	**1**	**2**	**3a**	**3b**	**4a**	**4b**	**5**	**6**	**7**	**8**	**9**	**10**	TOTAL	TOTAL
	AGENCY	**4.41**	**10.05**	**5.02**	**4.78**	**1.20**	**1.29**	**0.46**	**0.74**	**0.64**	**2.09**	**5.42**	**7.32**	**3.47**	**$46.89**	1.24%
	Highway	1.99	4.47	3.24	3.34	0.49	0.87	0.22	0.33	0.28	1.18	3.71	5.41	2.91	$28.44	**0.75%**
	Transit	2.42	5.58	1.77	1.43	0.71	0.42	0.24	0.41	0.36	0.91	1.71	1.91	0.56	$18.45	**0.49%**
	AUTO USER	51.26	117.84	37.68	30.24	14.14	8.45	4.83	8.19	7.08	18.18	34.03	38.10	11.21	**$381.23**	**10.09%**
ANNUAL	**EXTERNAL**	**68.44**	**2,455.02**	**33.23**	**32.14**	**133.28**	**18.25**	**39.57**	**77.82**	**67.27**	**226.83**	**135.96**	**48.51**	**12.38**	**$3,348.69**	**88.66%**
COST	Travel Time	42.24	2,174.23	13.94	16.42	116.08	12.87	34.16	67.82	58.63	200.09	108.48	24.72	4.86	$2,874.54	**76.11%**
	Air Pollution	8.07	238.91	5.81	4.91	11.81	2.12	3.55	6.87	5.94	19.77	13.88	8.27	2.75	$332.66	**8.81%**
	Incident Delay	6.17	14.26	4.59	3.68	1.84	1.11	0.64	1.07	0.92	2.38	4.64	5.29	1.62	$48.21	**1.28%**
	Accident	1.42	3.27	1.06	0.85	0.40	0.24	0.14	0.23	0.20	0.52	1.02	1.17	0.36	$10.89	**0.29%**
	Other	10.54	24.34	7.84	6.28	3.14	1.90	1.09	1.83	1.58	4.07	7.94	9.07	2.78	$82.39	**2.18%**
															$0.00	
	TOTAL	**124.11**	**2,582.90**	**75.93**	**67.15**	**148.62**	**27.99**	**44.86**	**86.74**	**74.98**	**247.11**	**175.41**	**93.94**	**27.06**	**$3,776.81**	**100%**
INITIAL INVESTMENT	Highway	13.57	29.64	21.73	20.87	3.74	6.94	1.73	2.56	2.21	9.50	30.08	43.05	22.95	**$208.55**	

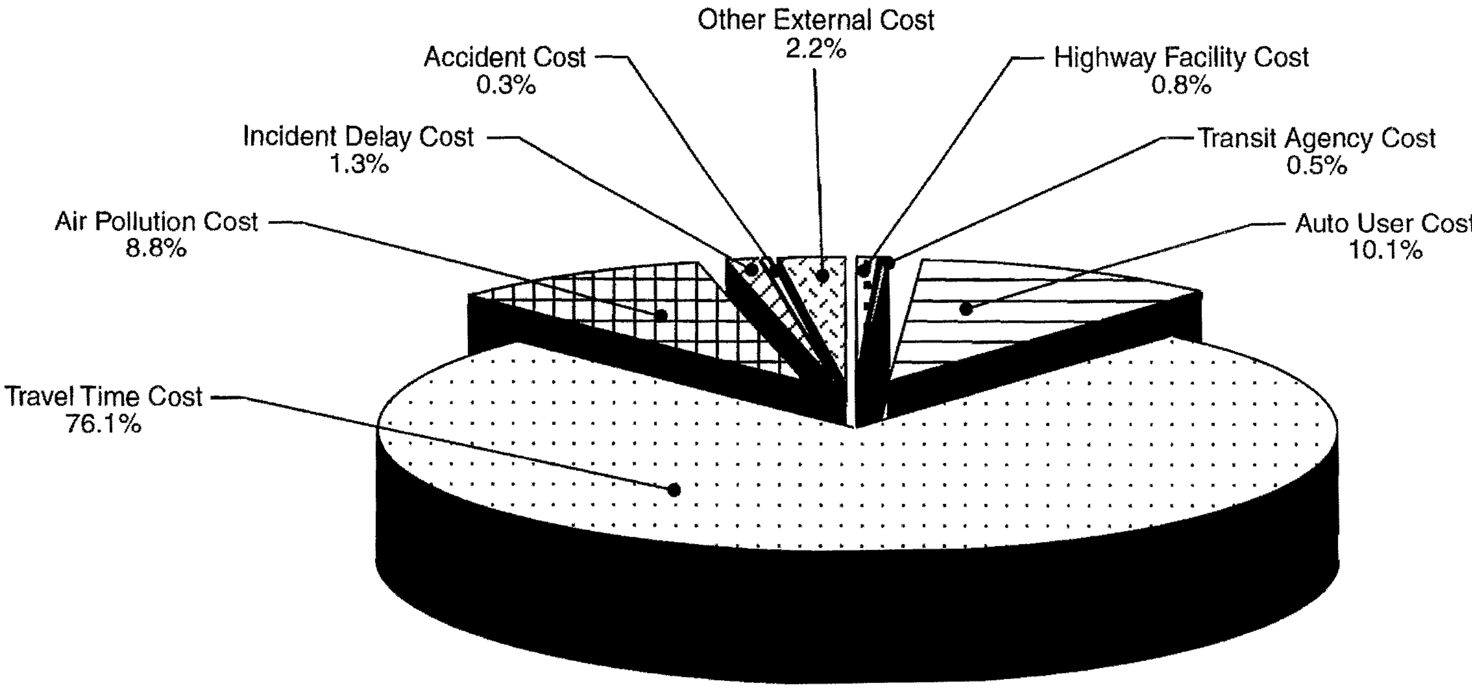

Figure 5.2 Annual shares of system cost — Scenario 1.2

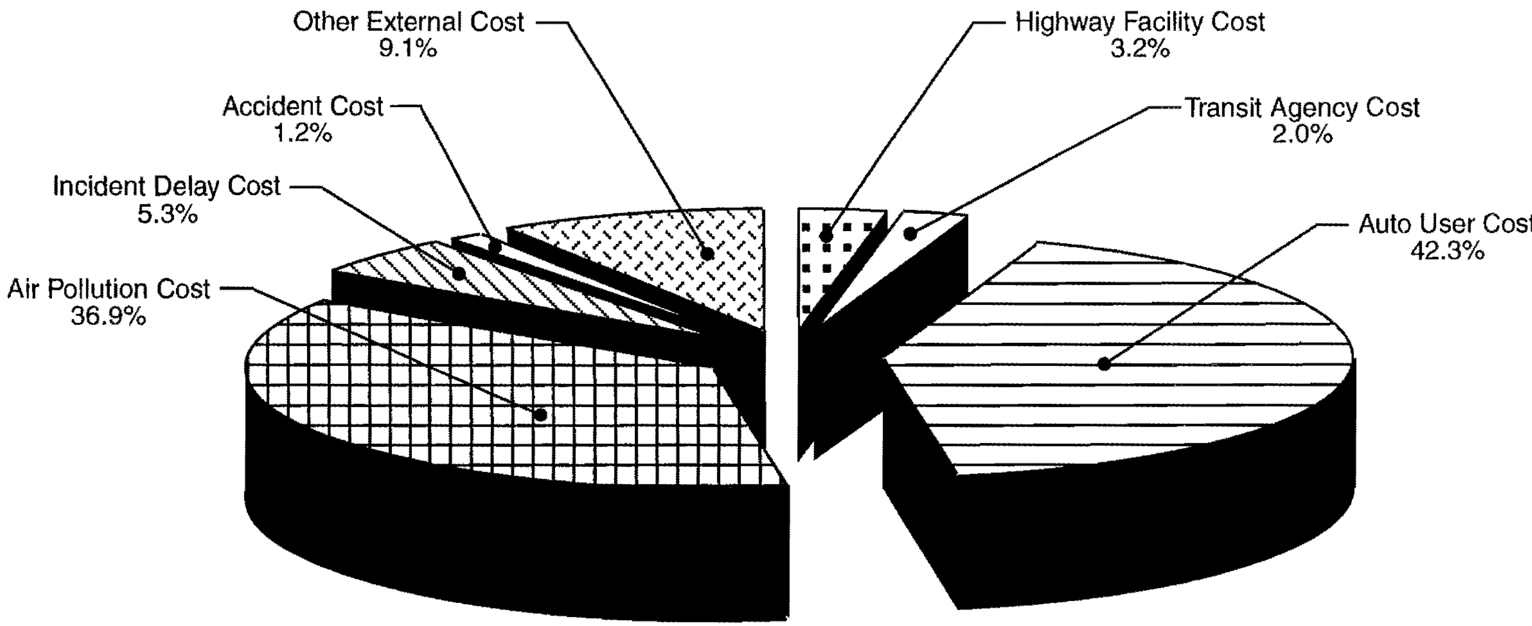

Figure 5.3 Annual shares of system cost — Scenario 1.2 without travel time cost

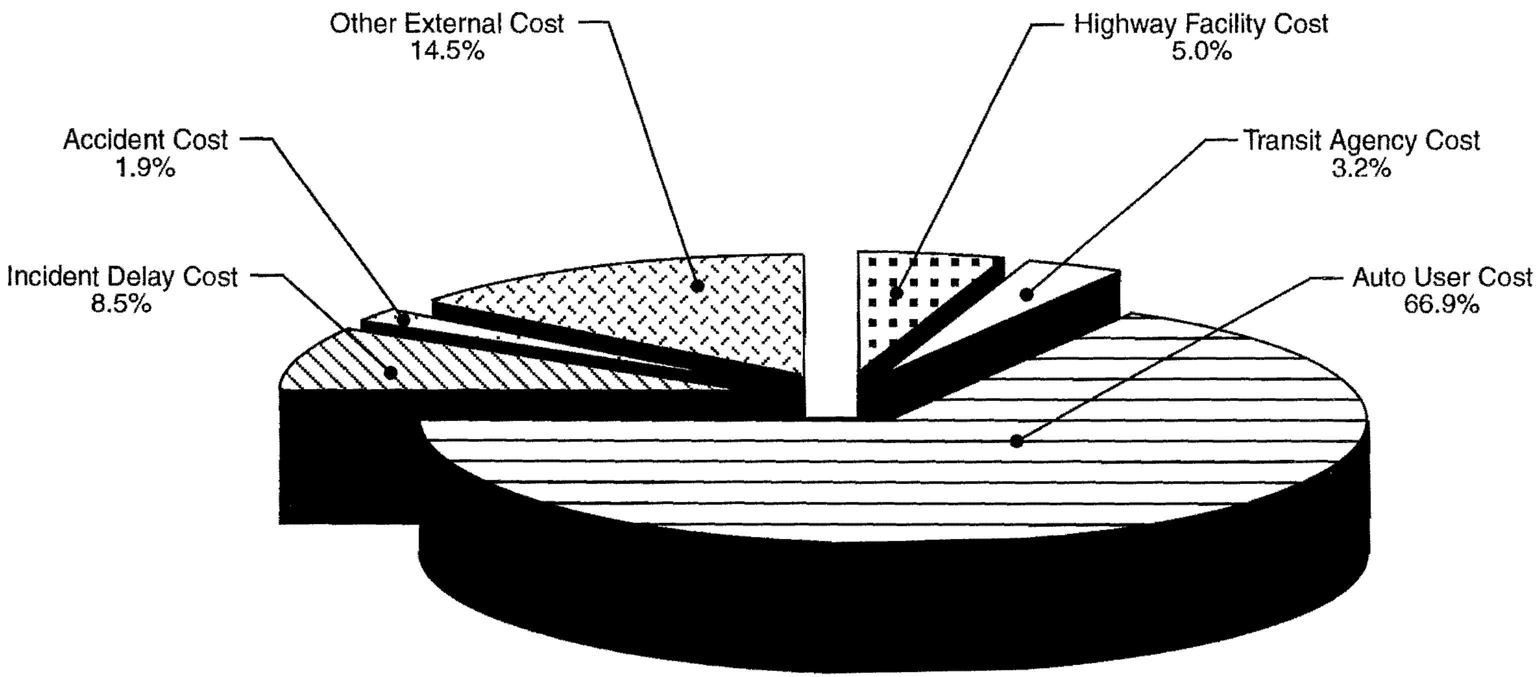

Figure 5.4 Annual shares of system cost — Scenario 1.2 without travel time and air pollution cost

SCENARIO 2.1

Scenario 2.1 represents an "HOV Build" scenario along US 59, but under existing mode split conditions. Figure 5.5 depicts the number of lanes, both general purpose and HOV, that are used in the analysis of this scenario. Under Scenario 2.1, the existing 13.7-km (8.5-mile) one-lane reversible HOV lane is assumed to be replaced with a 26.4-km (16.4-mile) two-lane HOV facility.

Figure 5.6 summarizes the systemwide life-cycle annual cost findings for this scenario. Total agency cost, including highway and transit, is $42.1 million, or 0.8 percent of the total system annual cost. The auto user cost, which includes the cost of purchasing and operating an automobile, is $456.5 million, or 8.3 percent of the total system annual cost. The reader should be aware that MODECOST assumes that transit riders do not incur automobile ownership and operation costs and therefore do not contribute to the total system annual cost for auto users.

Total external costs are estimated to be $4.98 billion, or 90.9 percent of the total system annual cost. External costs include monetary estimates of travel time under recurring congestion, air pollution, accidents, incident delay, and other external costs. Table 5.2 summarizes the input data for the figures presented in this section.

Figure 5.7 depicts the systemwide annual life-cycle costs for Scenario 2.1 in more detail by disaggregating the main external cost categories. The estimate of travel time and its monetary value in this analysis results in a travel time cost accounting for 77.9 percent of the total system cost. For comparison purposes, Figure 5.8 and Figure 5.9 present the results of the analysis minus the system travel time cost estimate (and without the air pollution cost estimate).

DOWNTOWN ROSENBERG — DOWNTOWN HOUSTON

St. Hwy 36 Bypass | FM 2218 | Brazos River | US 90A | Kirkland | Harris County/ Fort Bend County Line | S. W. Plaza | Beechnut | West park | Loop 610 West

Sec #13	Sec #12	Sec #11	Sec #10	Sec #9	Sec #8	Sec #7	Sec #6	Sec #5	Sec #4	Sec #3	Sec #2	Sec #1
		HOV=1	HOV=1	HOV=1	HOV=1	HOV=1	HOV=1	HOV=1	HOV=1	HOV=1	HOV=1	HOV=1
GP = 2	GP = 2	GP = 2	GP = 2	GP = 2	GP = 2	GP = 2	GP = 3	GP = 3	GP = 5	GP = 5	GP = 5	GP = 6
(4.6 mi)	(7.5 mi)	(3.6 mi)	(1.3 mi)	(0.5mi)	(0.6 mi)	(0.4 mi)	(0.7 mi)	(0.8mi)	(1.6mi)	(2.4mi)	(3.0 mi)	(1.5 mi)
7.4 km	12.1 km	5.8 km	2.1 km	0.8 km	1.0 km	0.6 km	1.1 km	1.3 km	2.6 km	3.9 km	4.8 km	2.4 km
GP = 2	GP = 2	GP = 2	GP = 2	GP = 2	GP = 2	GP = 2	GP = 3	GP = 3	GP = 5	GP = 5	GP = 5	GP = 6
		HOV=1	HOV=1	HOV=1	HOV=1	HOV=1	HOV=1	HOV=1	HOV=1	HOV=1	HOV=1	HOV=1

GP = General Purpose Through Lanes

HOV = HOV Lanes (R=Reversible)

Total = (28.5 miles)
46 km

Figure 5.5 Scenario 2.1 & 2.2

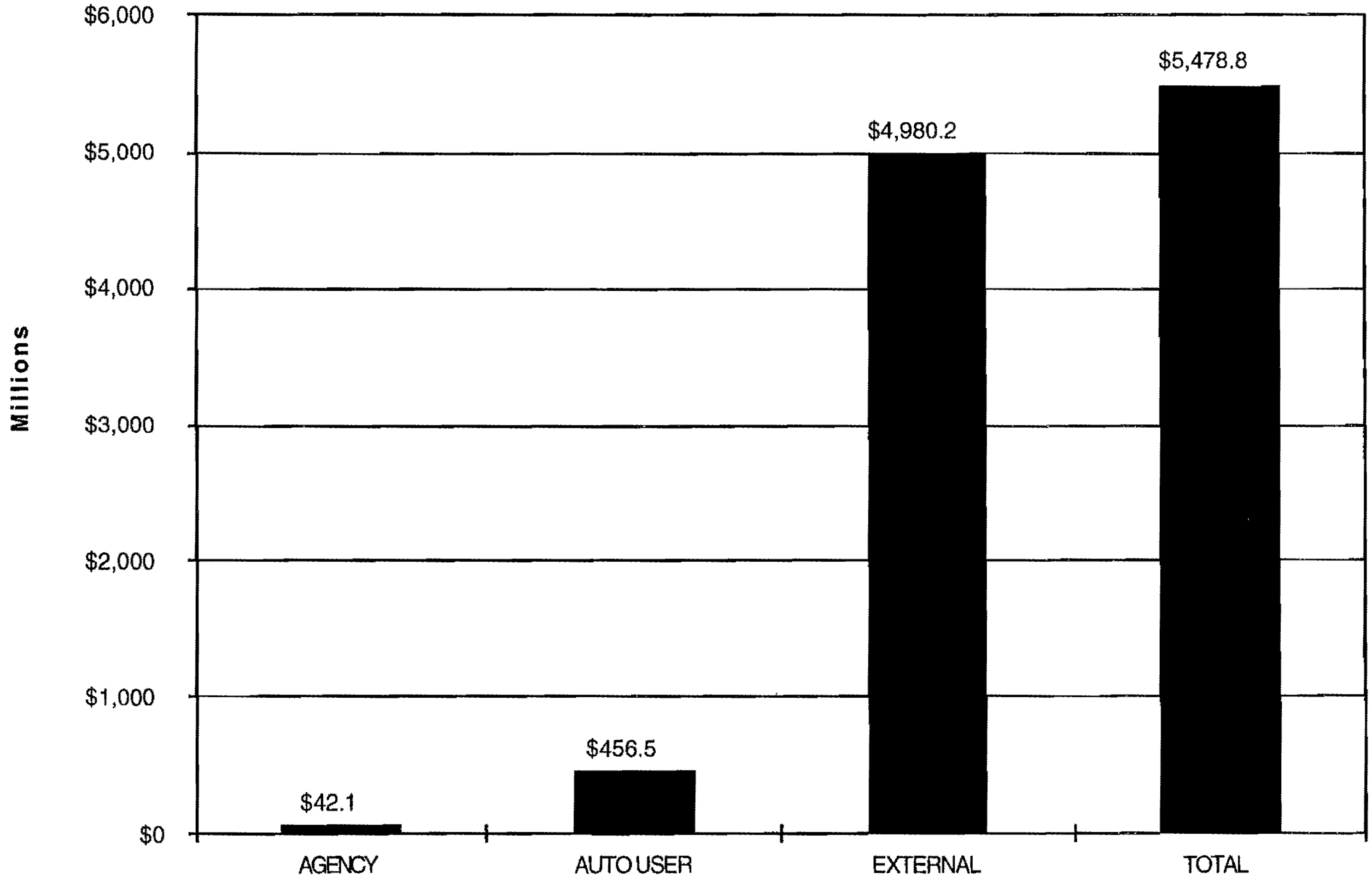

Figure 5.6 U.S. 59 case study — Scenario 2.1 life-cycle annual costs

Table 5.2 Scenario 2.1 cost summary (millions of dollars) — General purpose plus HOV

	No. of Lanes	12	10	10	10	6	6	4	4	4	4	4	4	4		
	Length (mi)	1.5	2.96	2.36	1.60	0.80	0.70	0.40	0.59	0.51	1.34	3.55	7.50	4.57	CORRIDOR	CORRIDOR
	Segment #	**1a**	**1**	**2**	**3a**	**3b**	**4a**	**4b**	**5**	**6**	**7**	**8**	**9**	**10**	TOTAL	TOTAL
	AGENCY	**3.49**	**7.88**	**4.41**	**4.26**	**1.00**	**1.45**	**0.41**	**0.63**	**0.65**	**2.12**	**6.13**	**6.53**	**3.24**	**$42.11**	**0.77%**
	Highway	2.09	4.66	3.39	3.44	0.59	1.20	0.27	0.40	0.34	1.59	5.14	5.42	2.91	$31.45	0.57%
	Transit	1.40	3.22	1.03	0.82	0.41	0.25	0.14	0.24	0.21	0.53	0.99	1.11	0.33	$10.66	0.19%
	AUTO USER	60.22	138.22	44.12	35.33	17.67	10.56	6.03	10.23	8.84	22.72	42.52	46.39	13.65	**$456.50**	8.33%
ANNUAL	**EXTERNAL**	**125.92**	**3,732.49**	**32.53**	**52.74**	**191.28**	**24.47**	**54.60**	**110.86**	**95.83**	**306.22**	**184.76**	**55.99**	**12.53**	**$4,980.22**	**90.90%**
COST	Travel Time	91.29	3,276.53	12.28	33.87	164.14	17.85	46.50	95.18	82.28	264.83	148.45	30.06	4.58	$4,267.85	77.90%
	Air Pollution	15.81	412.48	6.26	7.66	21.54	3.23	6.17	12.42	10.74	34.11	22.16	9.82	3.01	$565.40	10.32%
	Incident Delay	6.17	14.26	4.59	3.68	1.84	1.11	0.64	1.07	0.92	2.38	4.64	5.29	1.62	$48.21	0.88%
	Accident	1.64	3.78	1.22	0.98	0.49	0.30	0.17	0.28	0.25	0.64	1.24	1.39	0.43	$12.80	0.23%
	Other	11.00	25.42	8.18	6.56	3.28	1.98	1.13	1.91	1.65	4.25	8.27	9.44	2.89	$85.96	1.57%
	TOTAL	**189.63**	**3,878.58**	**81.06**	**92.34**	**209.95**	**36.48**	**61.04**	**121.73**	**105.22**	**331.06**	**233.41**	**108.91**	**29.41**	**$5,478.82**	**100%**
INITIAL INVEST.	Highway	14.79	32.02	23.61	22.14	4.99	8.03	2.35	3.47	3.00	11.58	35.57	43.15	23.00	**$227.71**	

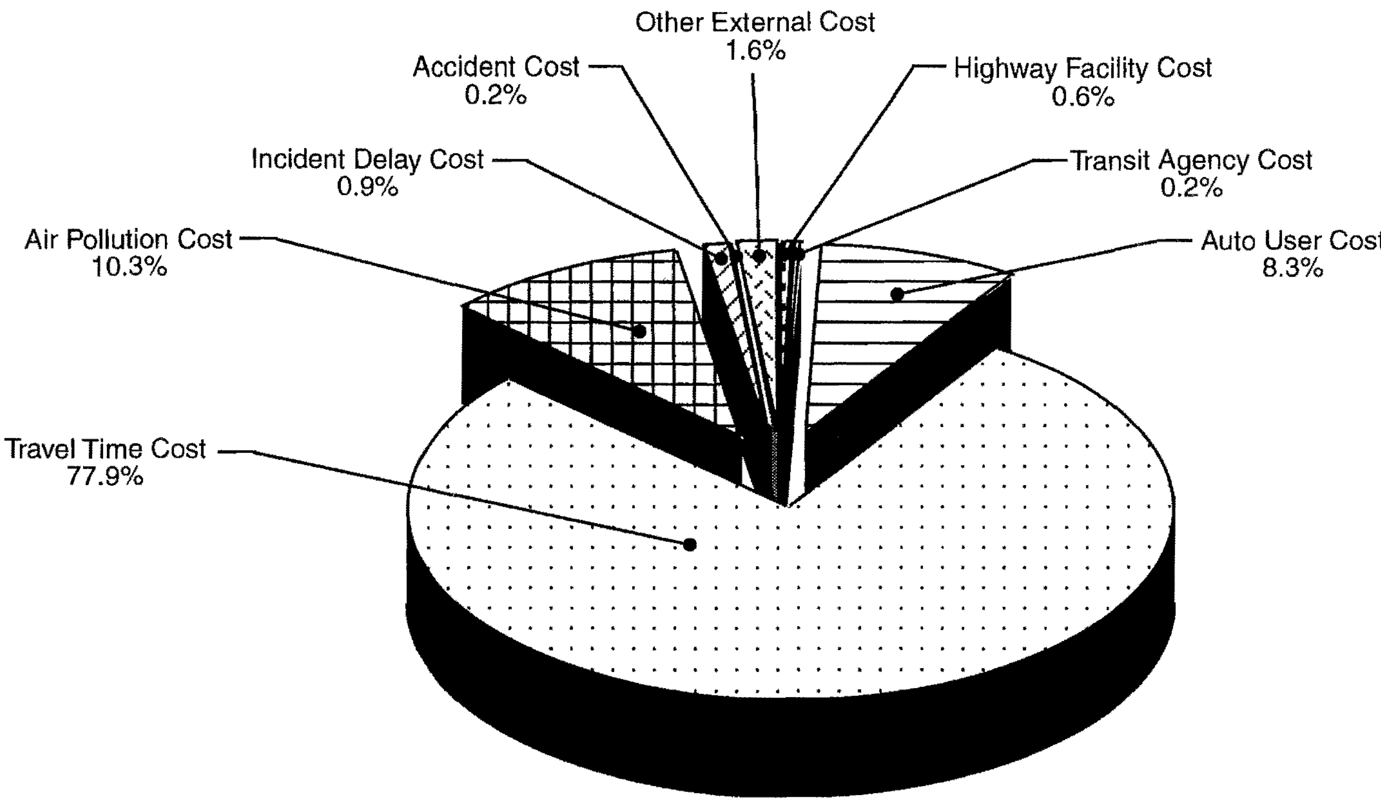

Figure 5.7 Annual shares of system cost — Scenario 2.1

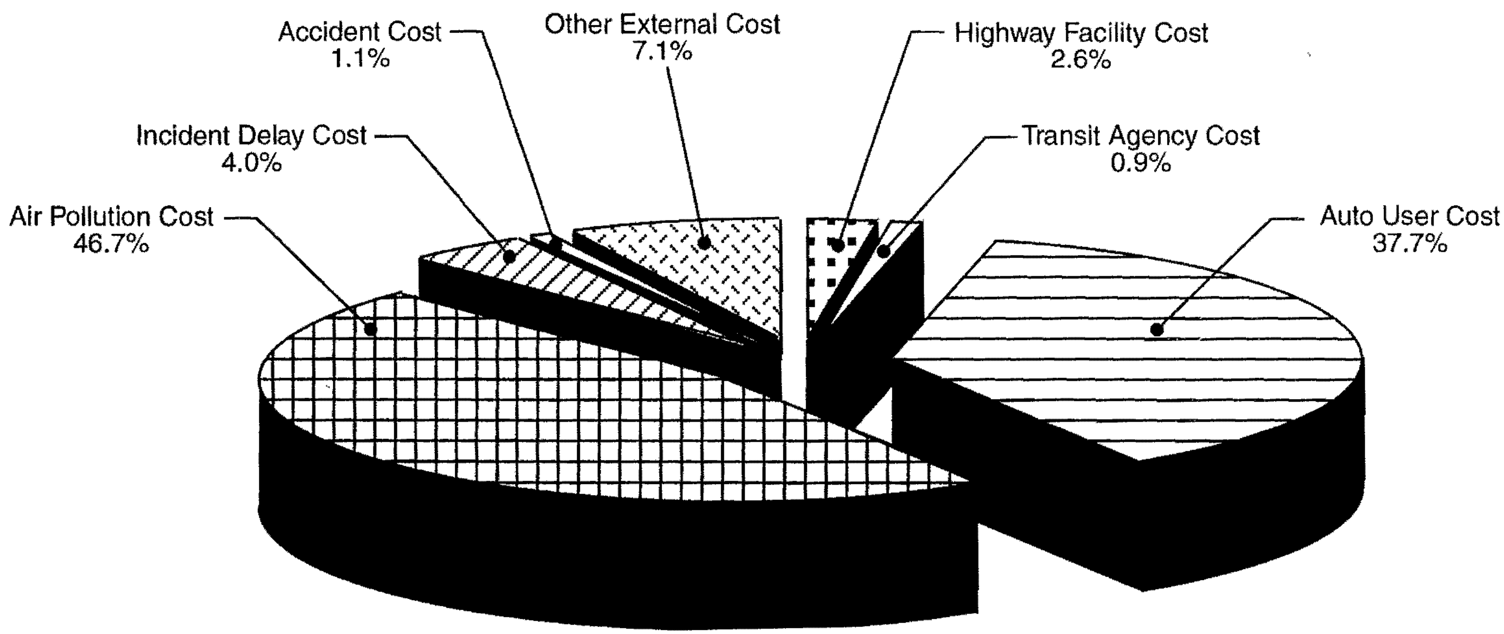

Figure 5.8 Annual shares of system cost — Scenario 1.2 without travel time cost

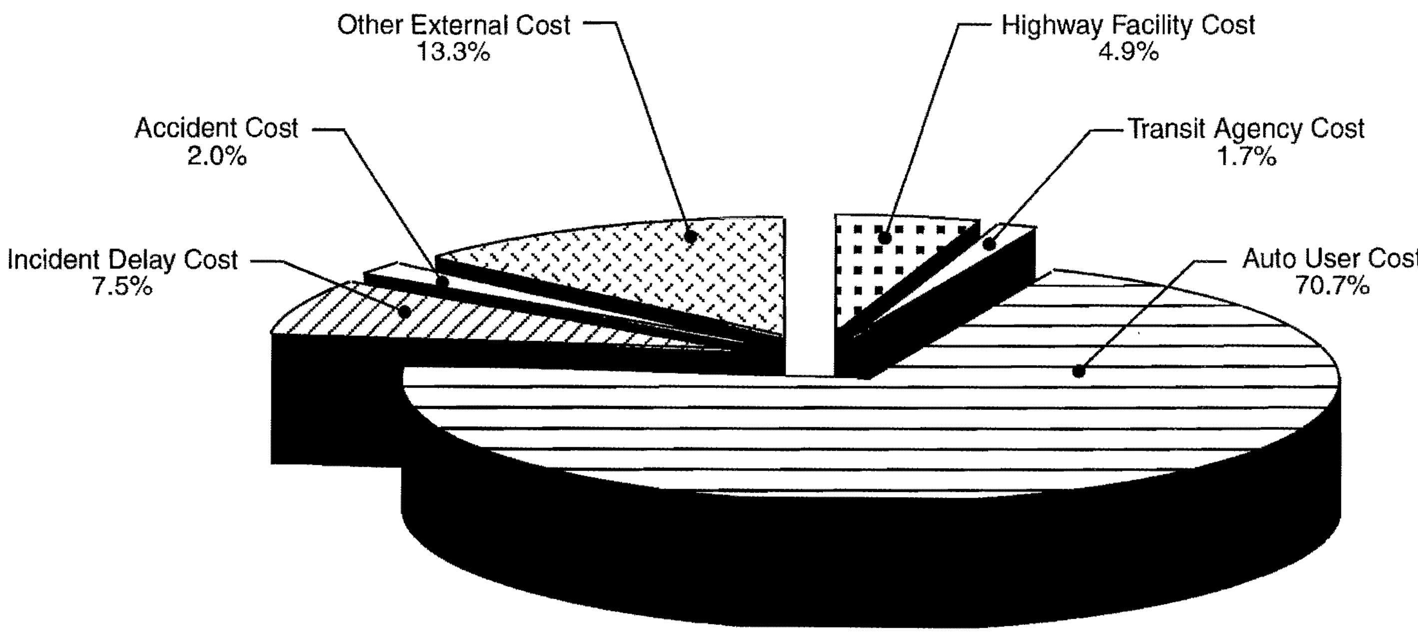

Figure 5.9 Annual shares of system cost — Scenario 1.2 without travel time and air pollution cost

SCENARIO 2.2

Scenario 2.2 represents the "HOV Build" scenario on US 59, along with an assumed increase in the number of higher-occupant vehicles in the traffic stream.

Figure 5.10 summarizes the systemwide life-cycle annual cost findings for this scenario. Total agency cost, including highway and transit, is $50.0 million, or 1.8 percent of the total system annual cost. The auto user cost, which includes the cost of purchasing and operating an automobile, is $381.9 million[1], or 13.4 percent of the total system annual cost. The reader should be aware that MODECOST assumes that transit riders do not incur automobile ownership and operation costs and therefore do not contribute to the total system annual cost for auto users.

Total external costs are estimated to be $2.414 billion, or 84.8 percent of the total system annual cost. External costs include monetary estimates of travel time under recurring congestion, air pollution, accidents, incident delay, and other external costs. Table 5.3 summarizes the input data for the figures presented in this section.

Figure 5.11 depicts the systemwide annual life-cycle costs for Scenario 2.2 in more detail by disaggregating the main external cost categories. The estimate of travel time and its monetary value in this analysis results in a travel time cost accounting for 70.6 percent of the total system cost. For comparison purposes, Figure 5.12 and Figure 5.13 present the results of the analysis minus the system travel time cost estimate (and without the air pollution cost estimate).

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[1] Due to round-off error with mode-split and occupancy input data, MODECOST's estimate of the annual number of vehicles on a given segment can differ from the actual number. This can significantly affect travel time estimates when the demand on the facility is near or over capacity. In order to correct for this problem in Scenario 2.2, the auto-main average vehicle occupancy was adjusted until the auto user cost was approximately equal to the auto user cost in Scenario 1.2 and Scenario 3.2. All three of these scenarios should have the same number of total vehicles because all three begin with the same ADT and vehicle classification data.

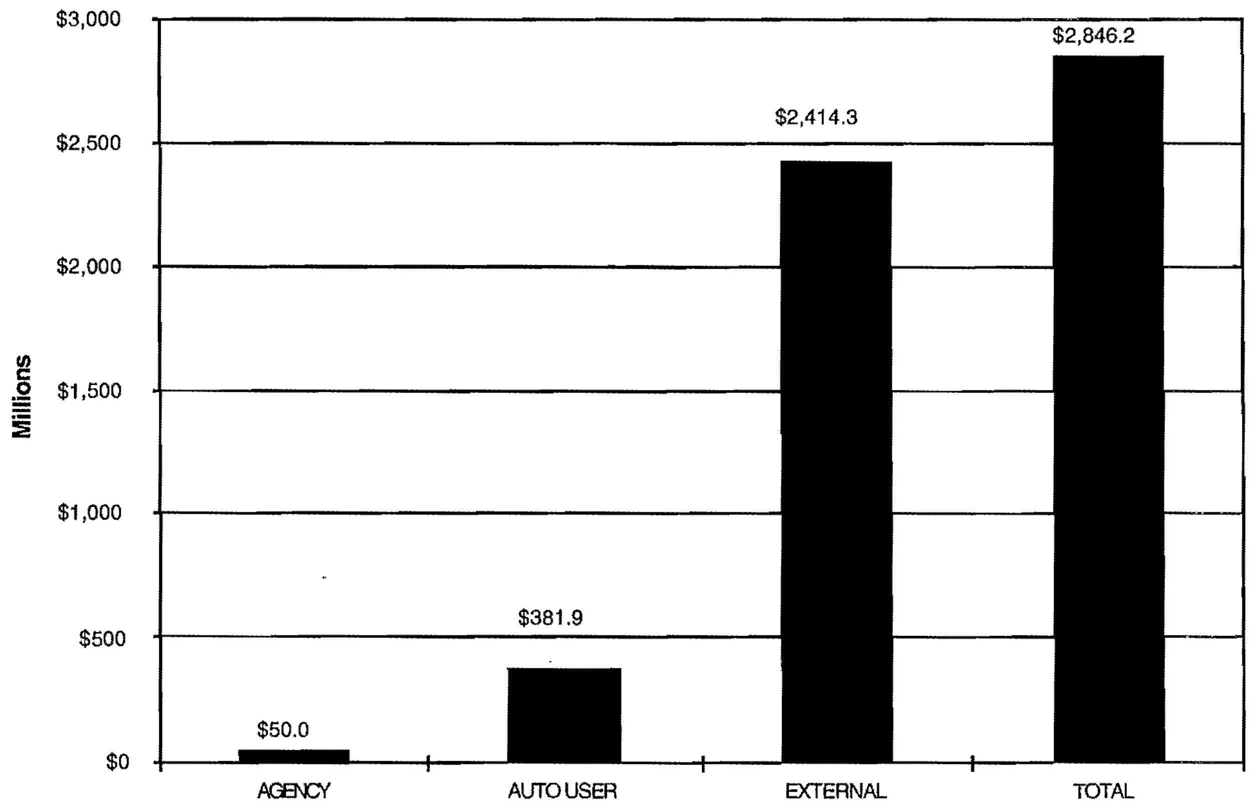

Figure 5.10 US 59 case study — Scenario 2.2 life-cycle annual cost

Table 5.3 Scenario 2.2 cost summary (millions of dollars) — General purpose plus HOV

	No. of Lanes	12	10	10	10	6	6	4	4	4	4	4	4	4		
	Length (mi)	1.5	2.96	2.36	1.60	0.80	0.70	0.40	0.59	0.51	1.34	3.55	7.50	4.57	CORRIDOR	CORRIDOR
	Segment #	**1a**	**1**	**2**	**3a**	**3b**	**4a**	**4b**	**5**	**6**	**7**	**8**	**9**	**10**	**TOTAL**	**TOTAL**
	AGENCY	**4.53**	**10.29**	**5.18**	**4.87**	**1.30**	**1.63**	**0.51**	**0.81**	**0.70**	**2.52**	**6.87**	**7.34**	**3.47**	**$50.03**	**1.76%**
	Highway	2.08	4.64	3.38	3.44	0.59	1.20	0.27	0.40	0.34	1.59	5.14	5.41	2.91	$31.38	1.10%
	Transit	2.45	5.64	1.80	1.44	0.72	0.43	0.25	0.42	0.36	0.92	1.73	1.94	0.57	$18.66	0.66%
	AUTO USER	49.16	113.92	38.22	30.01	15.00	9.15	5.23	8.86	7.66	19.68	36.83	37.21	10.94	**$381.86**	13.42%
ANNUAL	**EXTERNAL**	**49.09**	**1,779.51**	**33.33**	**30.04**	**82.77**	**14.16**	**26.14**	**50.39**	**43.55**	**148.18**	**97.07**	**47.73**	**12.32**	**$2,414.27**	**84.83%**
COST	Travel Time	24.20	1,557.10	13.92	14.45	68.17	8.87	21.28	41.56	35.92	124.68	70.88	24.10	4.84	$2,009.97	70.62%
	Air Pollution	6.82	180.63	5.92	4.79	9.19	2.02	3.00	5.68	4.91	16.48	12.52	8.12	2.72	$262.79	9.23%
	Incident Delay	6.17	14.26	4.59	3.68	1.84	1.11	0.64	1.07	0.92	2.38	4.64	5.29	1.62	$48.21	1.69%
	Accident	1.36	3.17	1.07	0.84	0.42	0.26	0.15	0.25	0.22	0.56	1.10	1.15	0.36	$10.91	0.38%
	Other	10.54	24.34	7.84	6.28	3.14	1.90	1.09	1.83	1.58	4.07	7.94	9.07	2.78	$82.40	2.90%
	TOTAL	**102.77**	**1,903.71**	**76.72**	**64.92**	**99.07**	**24.94**	**31.88**	**60.06**	**51.91**	**170.37**	**140.77**	**92.28**	**26.74**	**$2,846.16**	**100%**
INITIAL INVEST.	Highway	14.72	31.92	23.55	22.10	4.98	8.03	2.35	3.47	3.00	11.58	35.56	43.03	22.94	**$227.24**	

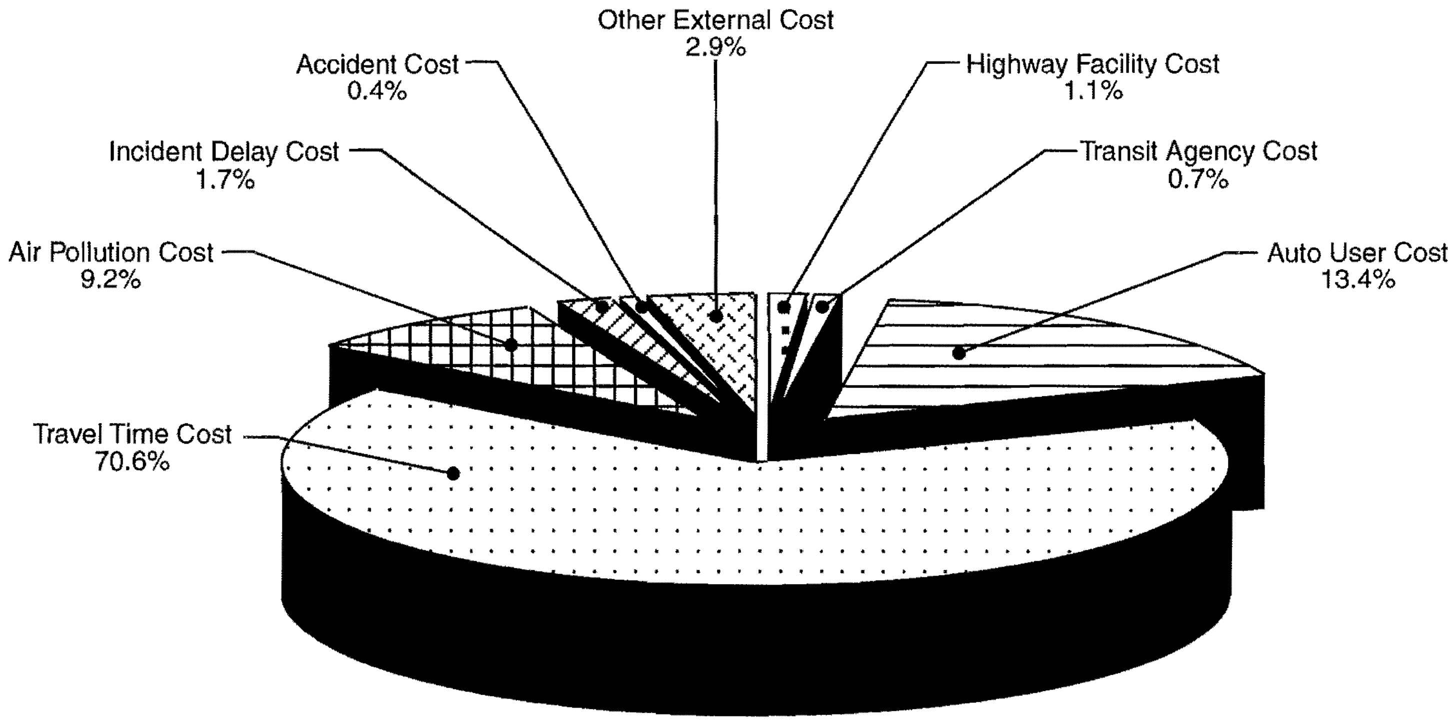

Figure 5.11 Annual shares of system cost — Scenario 2.2

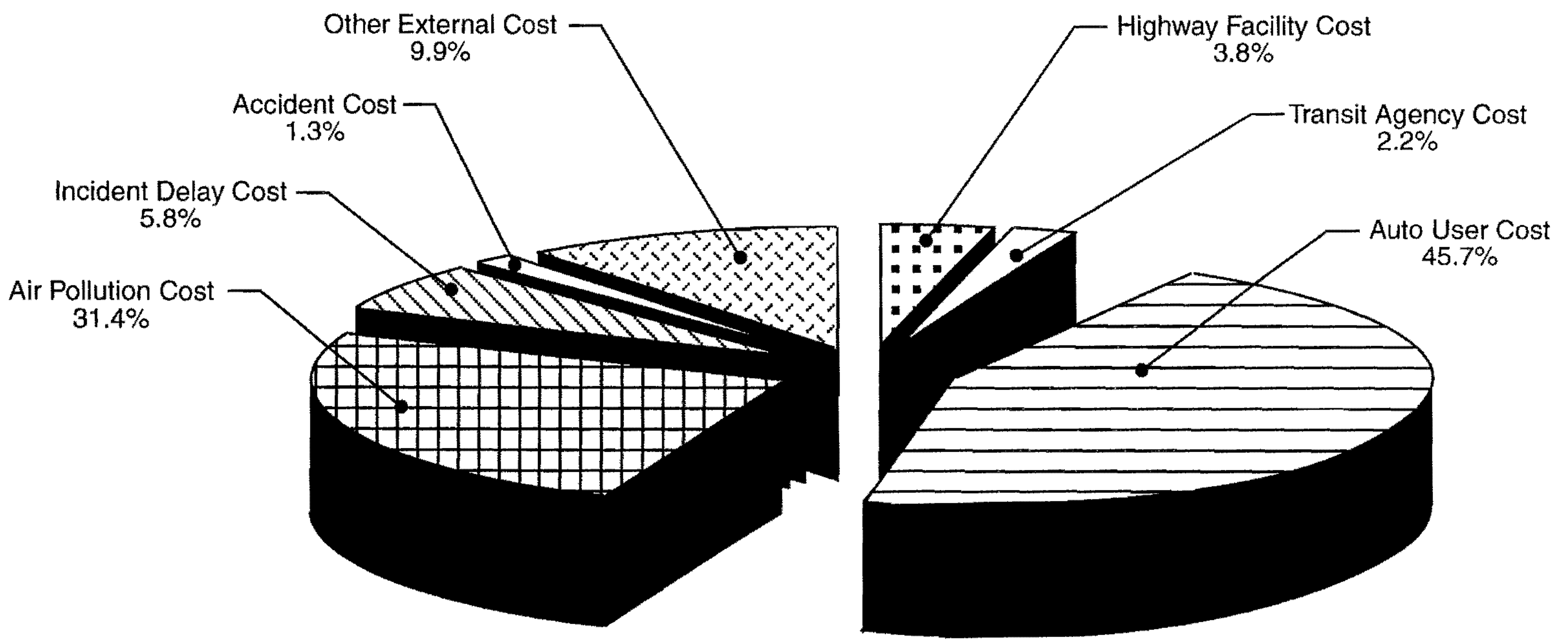

Figure 5.12 Annual shares of system cost — Scenario 2.2 without travel time cost

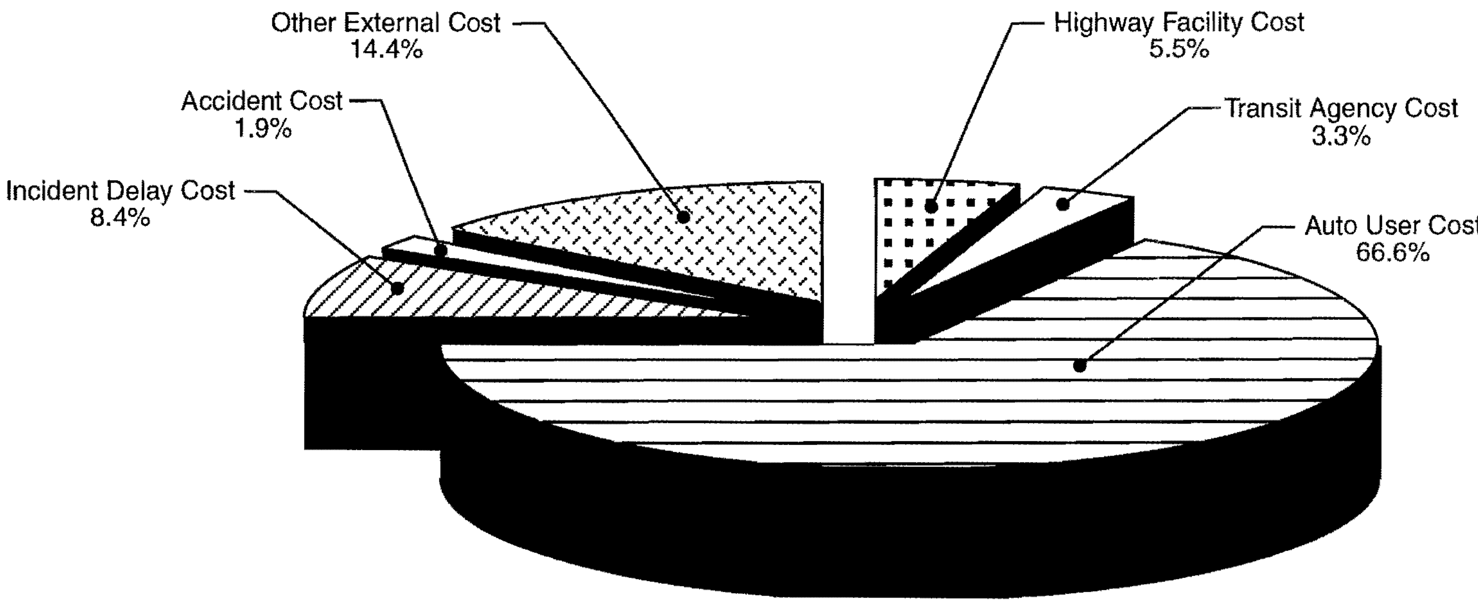

Figure 5.13 Annual shares of system cost — Scenario 2.2 without travel time and air pollution cost

SCENARIO 3.1

Scenario 3.1 represents a "General Purpose Lane Build" scenario along US 59 under existing mode split conditions. Figure 5.14 depicts the number of lanes, both general purpose and HOV, that are used in the analysis of this scenario. Under Scenario 3.1, 26.4 km (16.4 miles) of the existing general purpose facility have one lane of capacity added in each direction up to a maximum of six lanes. Therefore, no lanes were added to Segment 1, which has six general purpose through lanes already in each direction, and no lanes were added to Segment 12 and Segment 13 (which are outside the 26.4-km limit of this scenario).

Figure 5.15 summarizes the systemwide life-cycle annual cost findings for this scenario. Total agency cost, including highway and transit, is $39.9 million, or 1.2 percent of the total system annual cost. The auto user cost, which includes the cost of purchasing and operating an automobile, is $451.8 million, or 13.3 percent of the total system annual cost. The reader should be aware that MODECOST assumes that transit riders do not incur automobile ownership and operation costs and therefore do not contribute to the total system annual cost for auto users.

Total external costs are estimated to be $2.897 billion, or 90.9 percent of the total system annual cost. External costs include monetary estimates of travel time under recurring congestion, air pollution, accidents, incident delay, and other external costs. Table 5.4 summarizes the input data for the figures presented in this section.

Figure 5.16 depicts the systemwide annual life-cycle costs for Scenario 3.1 in more detail by disaggregating the main external cost categories. The estimate of travel time and its monetary value in this analysis results in travel time costs accounting for 71.4 percent of the total system cost. For comparison purposes, Figure 5.17 and Figure 5.18 present the results of the analysis minus the system travel time cost estimate (and without the air pollution cost estimate).

DOWNTOWN ROSENBERG — DOWNTOWN HOUSTON

	Sec #13	Sec #12	Sec #11	Sec #10	Sec #9	Sec #8	Sec #7	Sec #6	Sec #5	Sec #4	Sec #3	Sec #2	Sec #1
From	St. Hwy 36 Bypass	FM 2218	Brazos River				US 90A	Kirkland		Harris County/ Fort Bend County Line	S. W. Plaza	Beechnut	Westpark
To	FM 2218	Brazos River				US 90A	Kirkland		Harris County/ Fort Bend County Line	S. W. Plaza	Beechnut	Westpark	Loop 610 West
Upper	GP = 2	GP = 2	GP = 3	GP = 3	GP = 3	GP = 3	GP = 3	GP = 4	GP = 4	GP = 6	GP = 6	GP = 6	GP = 6
Length	(4.6 mi) 7.4 km	(7.5 mi) 12.1 km	(3.6 mi) 5.8 km	(1.3 mi) 2.1 km	(0.5mi) 0.8 km	(0.6 mi) 1.0 km	(0.4 mi) 0.6 km	(0.7 mi) 1.1 km	(0.8mi) 1.3 km	(1.6mi) 2.6 km	(2.4mi) 3.9 km	(3.0 mi) 4.8 km	(1.5 mi) 2.4 km
Lower	GP = 2	GP = 2	GP = 3	GP = 3	GP = 3	GP = 3	GP = 3	GP = 4	GP = 4	GP = 6	GP = 6	GP = 6	GP = 6
HOV										HOV=1(R)	HOV=1(R)	HOV=1(R)	HOV=1(R)

GP = General Purpose Through Lanes

HOV = HOV Lanes (R=Reversible)

Total = (28.5 miles) 46 km

Figure 5.14 Scenario 3.1 & 3.2

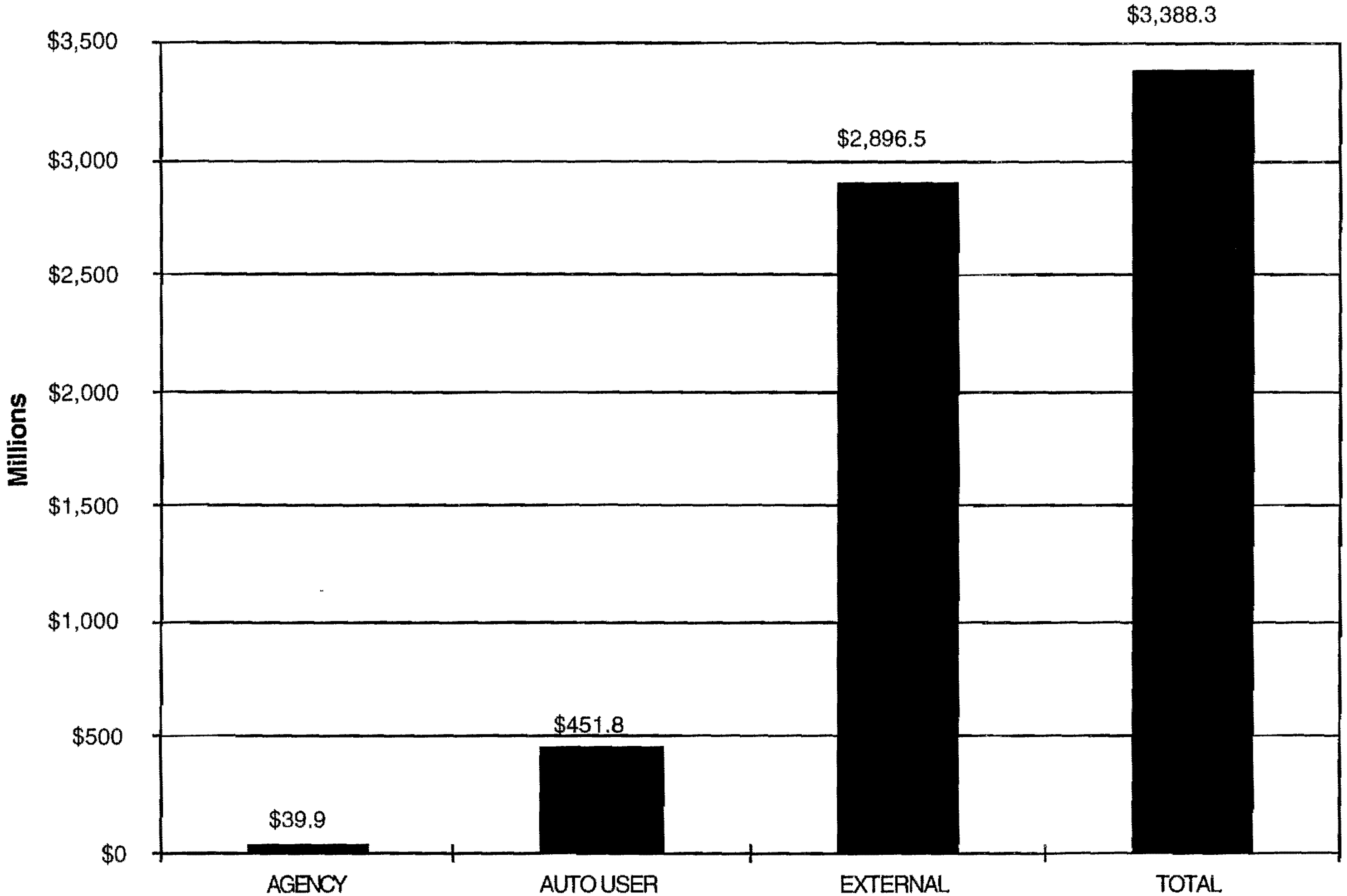

Figure 5.15 US 59 case study — Scenario 3.1 life-cycle annual costs

Table 5.4 Scenario 3.1 cost summary (millions of dollars) — General purpose plus HOV

	No. of Lanes	12	10	10	10	6	6	4	4	4	4	4	4	4		
	Length (mi)	1.5	2.96	2.36	1.60	0.80	0.70	0.40	0.59	0.51	1.34	3.55	7.50	4.57	CORRIDOR	CORRIDOR
	Segment #	**1a**	**1**	**2**	**3a**	**3b**	**4a**	**4b**	**5**	**6**	**7**	**8**	**9**	**10**	TOTAL	TOTAL
	AGENCY	**3.38**	**7.86**	**4.40**	**4.26**	**0.95**	**1.15**	**0.38**	**0.60**	**0.52**	**1.78**	**4.89**	**6.51**	3.23	**$39.92**	1.18%
	Highway	2.00	4.67	3.39	3.44	0.54	0.91	0.24	0.36	0.31	1.26	3.92	5.42	2.91	$29.38	0.87%
	Transit	1.38	3.19	1.01	0.81	0.41	0.24	0.14	0.24	0.20	0.52	0.98	1.09	0.32	$10.53	0.31%
	AUTO USER	59.64	137.85	43.72	35.01	17.22	10.29	5.88	9.97	8.62	22.14	41.44	46.39	13.65	**$451.82**	**13.33%**
ANNUAL	**EXTERNAL**	**128.72**	**2,297.52**	**32.57**	**29.98**	**82.61**	**13.57**	**17.08**	**32.61**	**28.19**	**99.00**	**88.15**	**55.99**	**12.53**	**$2,896.51**	**85.49%**
COST	Travel Time	94.08	2,003.38	12.10	13.42	68.00	8.15	13.13	25.64	22.16	80.83	42.29	30.06	4.58	$2,417.81	71.36%
	Air Pollution	15.84	250.68	6.49	5.35	9.02	2.04	2.02	3.72	3.21	10.91	9.74	9.82	3.01	$331.85	9.79%
	Incident Delay	6.17	14.26	4.59	3.68	1.84	1.11	0.64	1.07	0.92	2.38	4.64	5.29	1.62	$48.21	1.42%
	Accident	1.63	3.77	1.21	0.97	0.48	0.29	0.17	0.28	0.24	0.62	1.21	1.39	0.43	$12.68	0.37%
	Other	11.00	25.42	8.18	6.56	3.28	1.98	1.13	1.91	1.65	4.25	8.27	9.44	2.89	$85.96	2.54%
	TOTAL	**191.75**	**2,443.23**	**80.89**	**89.25**	**100.78**	**25.01**	**23.35**	**43.17**	**37.32**	**122.92**	**112.48**	**108.89**	**29.41**	**$3,388.25**	**100%**
INITIAL INVEST.	Highway	13.63	30.80	22.57	21.44	4.02	7.18	1.86	2.75	2.38	9.95	31.22	43.15	23.00	**$213.97**	

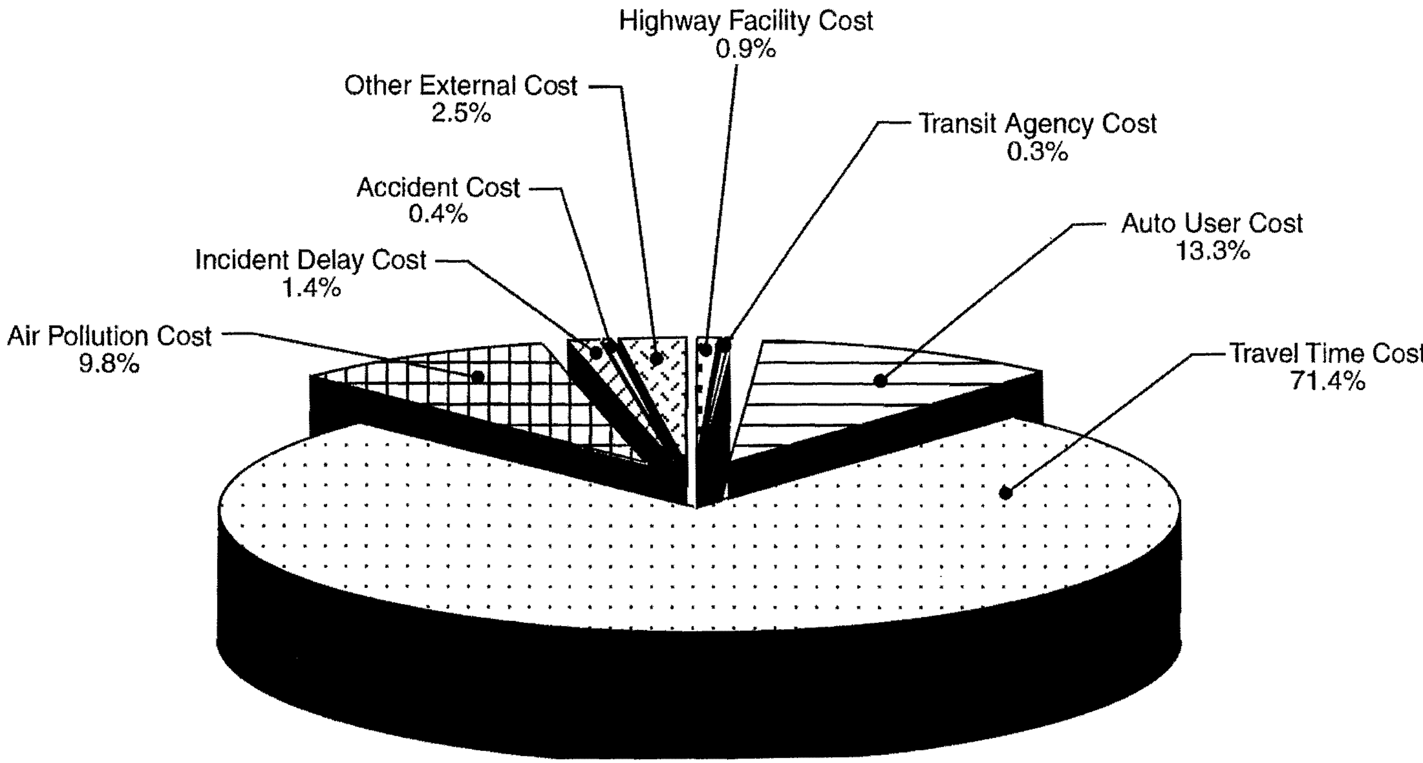

Figure 5.16 Annual shares of system cost — Scenario 3.1

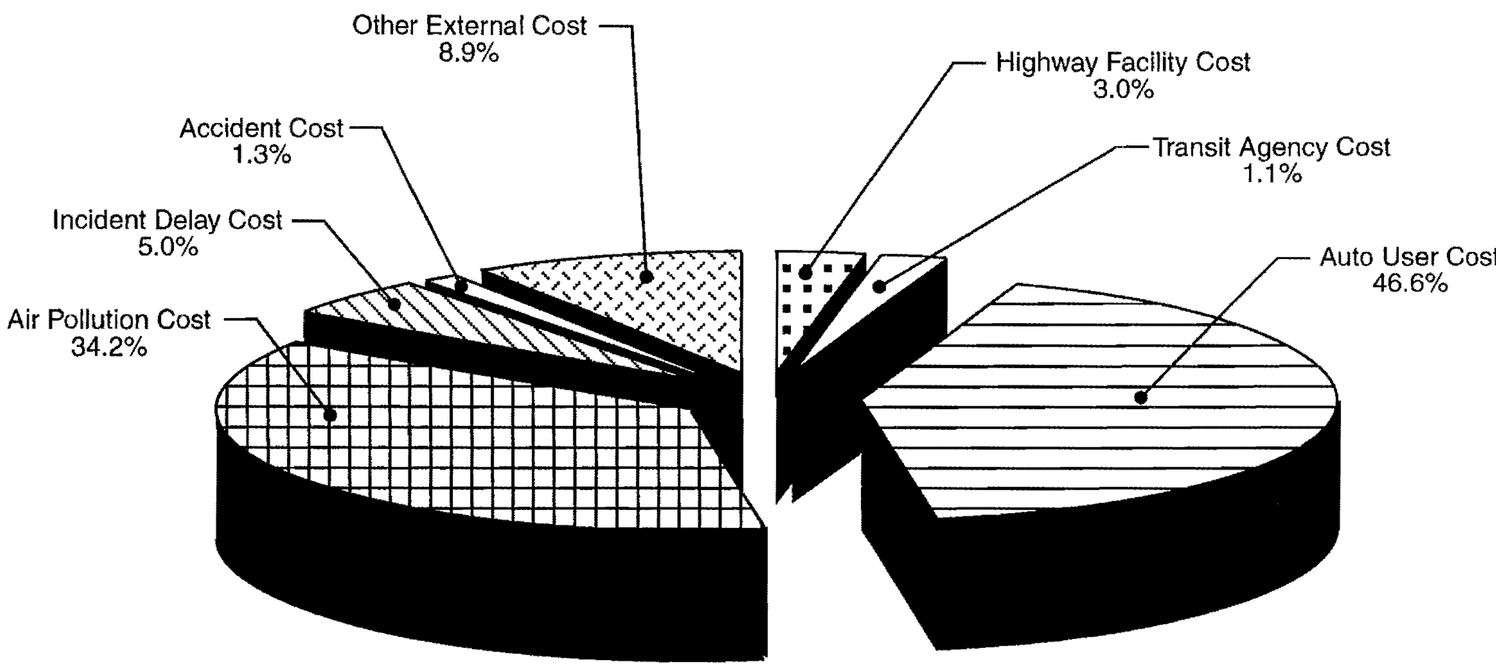

Figure 5.17 Annual shares of system cost — Scenario 3.1 without travel time cost

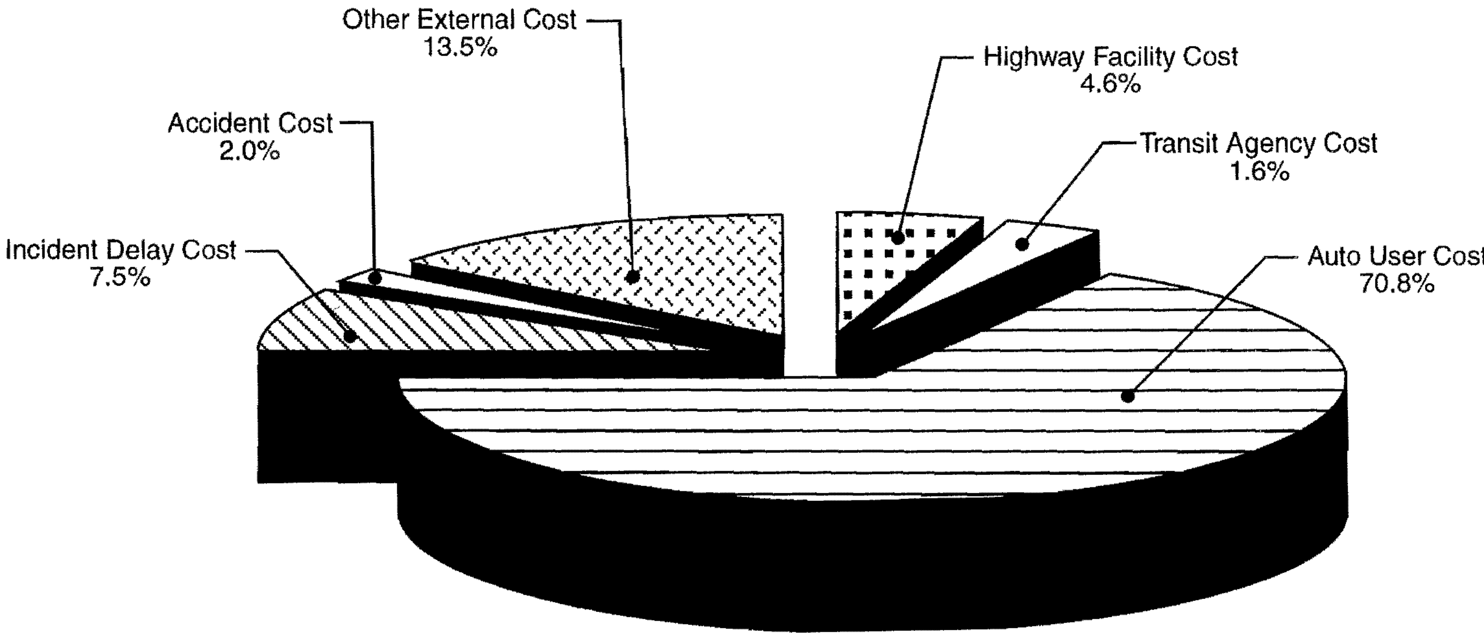

Figure 5.18 Annual shares of system cost — Scenario 3.1 without travel time and air pollution cost

SCENARIO 3.2

Scenario 3.2 represents a "General Purpose Lane Build" scenario on US 59, along with an assumed increase in the number of higher-occupant vehicles in the traffic stream.

Figure 5.19 summarizes the systemwide life-cycle annual cost findings for this scenario. Total agency cost, including highway and transit, is $47.7 million, or 2.1 percent of the total system annual cost. The auto user cost, which includes the cost of purchasing and operating an automobile, is $381.2 million, or 16.7 percent of the total system annual cost. The reader should be aware that MODECOST assumes that transit riders do not incur automobile ownership and operation costs and therefore do not contribute to the total system annual cost for auto users.

Total external costs are estimated to be $1.859 billion, or 81.2 percent of the total system annual cost. External costs include monetary estimates of travel time under recurring congestion, air pollution, accidents, incident delay, and other external costs. Table 5.5 summarizes the input data for the figures presented in this section.

Figure 5.20 depicts the systemwide annual life-cycle costs for Scenario 3.2 in more detail by disaggregating the main external cost categories. The estimate of travel time and its monetary value in this analysis results in travel time costs accounting for 66.5 percent of the total system cost. For comparison purposes, Figure 5.21 and Figure 5.22 present the results of the analysis minus the system travel time cost estimate (and without the air pollution cost estimate).

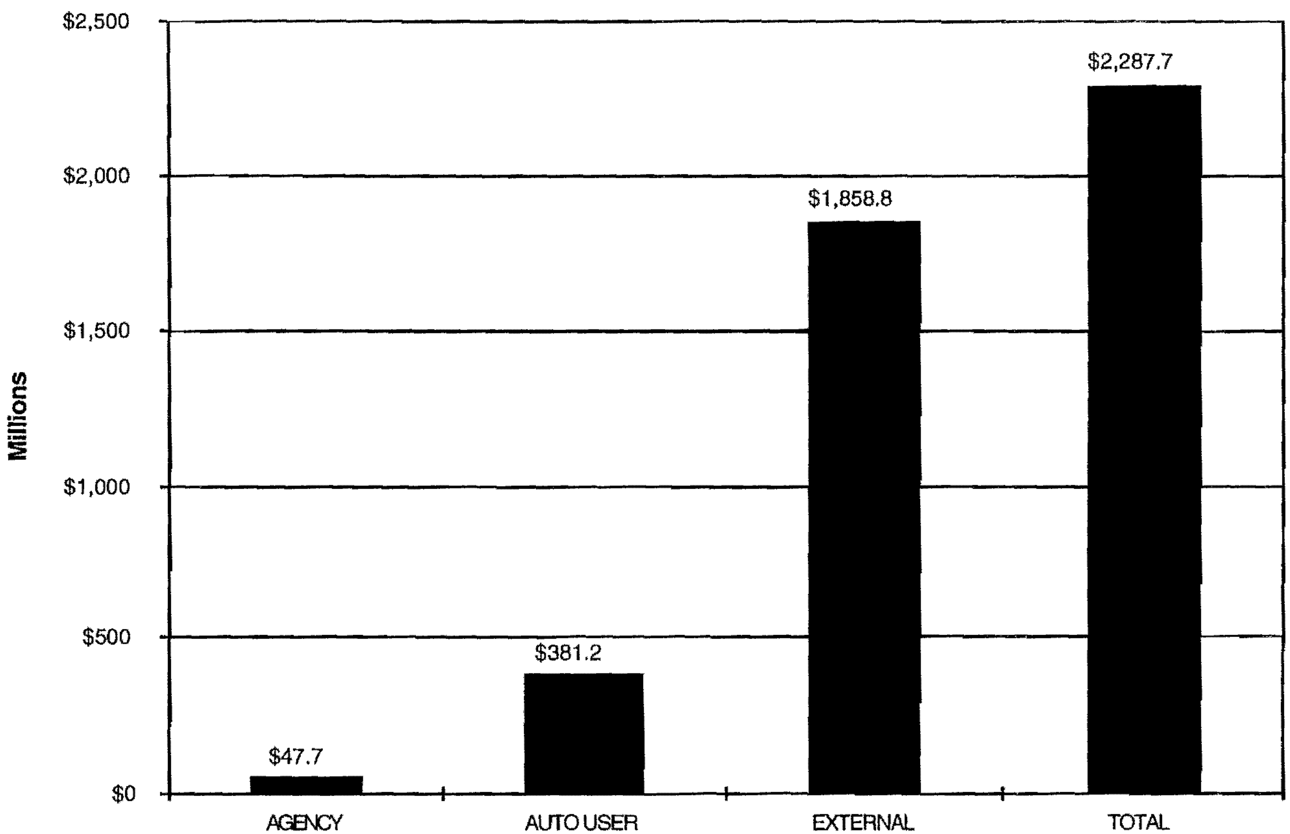

Figure 5.19 US 59 case study — Scenario 3.2 life-cycle annual costs

Table 5.5 Scenario 3.2 cost summary (millions of dollars) — General purpose plus HOV

	No. of Lanes	12	10	10	10	6	6	4	4	4	4	4	4	4		
	Length (mi)	1.5	2.96	2.36	1.60	0.80	0.70	0.40	0.59	0.51	1.34	3.55	7.50	4.57	CORRIDOR	CORRIDOR
	Segment #	**1a**	**1**	**2**	**3a**	**3b**	**4a**	**4b**	**5**	**6**	**7**	**8**	**9**	**10**	TOTAL	TOTAL
	AGENCY	**4.41**	**10.23**	**5.15**	**4.87**	**1.25**	**1.33**	**0.49**	**0.77**	**0.67**	**2.17**	**5.62**	**7.32**	**3.47**	**$47.75**	**2.09%**
	Highway	1.99	4.66	3.38	3.44	0.54	0.91	0.24	0.36	0.31	1.26	3.91	5.41	2.91	$29.30	1.28%
	Transit	2.42	5.58	1.77	1.43	0.71	0.42	0.24	0.41	0.36	0.91	1.71	1.91	0.56	$18.45	0.81%
	AUTO USER	51.26	117.84	37.68	30.24	14.14	8.45	4.83	8.19	7.08	18.18	34.03	38.10	11.21	**$381.23**	**16.66%**
ANNUAL	**EXTERNAL**	**68.44**	**1,457.67**	**33.31**	**27.97**	**41.87**	**11.24**	**10.43**	**19.62**	**16.96**	**57.21**	**53.14**	**48.51**	**12.38**	**$1,858.77**	**81.25%**
COST	Travel Time	42.24	1,275.52	13.81	12.49	32.14	6.37	7.36	14.34	12.39	44.28	31.89	24.72	4.86	$1,522.42	66.55%
	Air Pollution	8.07	140.28	6.02	4.67	4.36	1.62	1.21	2.15	1.86	5.95	7.65	8.27	2.75	$194.86	8.52%
	Incident Delay	6.17	14.26	4.59	3.68	1.84	1.11	0.64	1.07	0.92	2.38	4.64	5.29	1.62	$48.21	2.11%
	Accident	1.42	3.27	1.06	0.85	0.40	0.24	0.14	0.23	0.20	0.52	1.02	1.17	0.36	$10.89	0.48%
	Other	10.54	24.34	7.84	6.28	3.14	1.90	1.09	1.83	1.58	4.07	7.94	9.07	2.78	$82.39	3.60%
															$0.00	
	TOTAL	**124.11**	**1,585.74**	**76.14**	**63.08**	**57.26**	**21.03**	**15.74**	**28.58**	**24.70**	**77.57**	**92.79**	**93.94**	**27.06**	**$2,287.74**	**100%**
INITIAL INVEST.	Highway	13.57	30.68	22.48	21.38	4.00	7.16	1.85	2.74	2.37	9.92	31.15	43.05	22.95	$213.30	

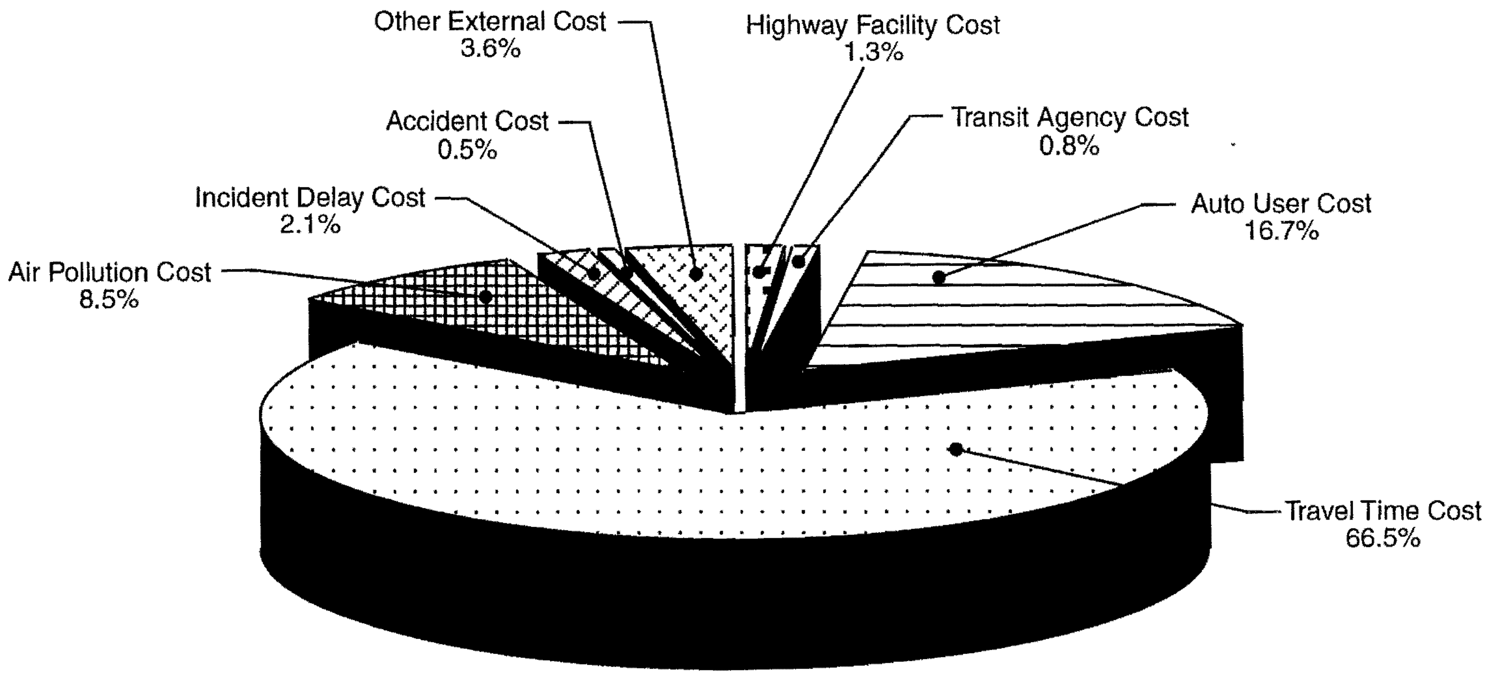

Figure 5.20 Annual shares of system cost — Scenario 3.2

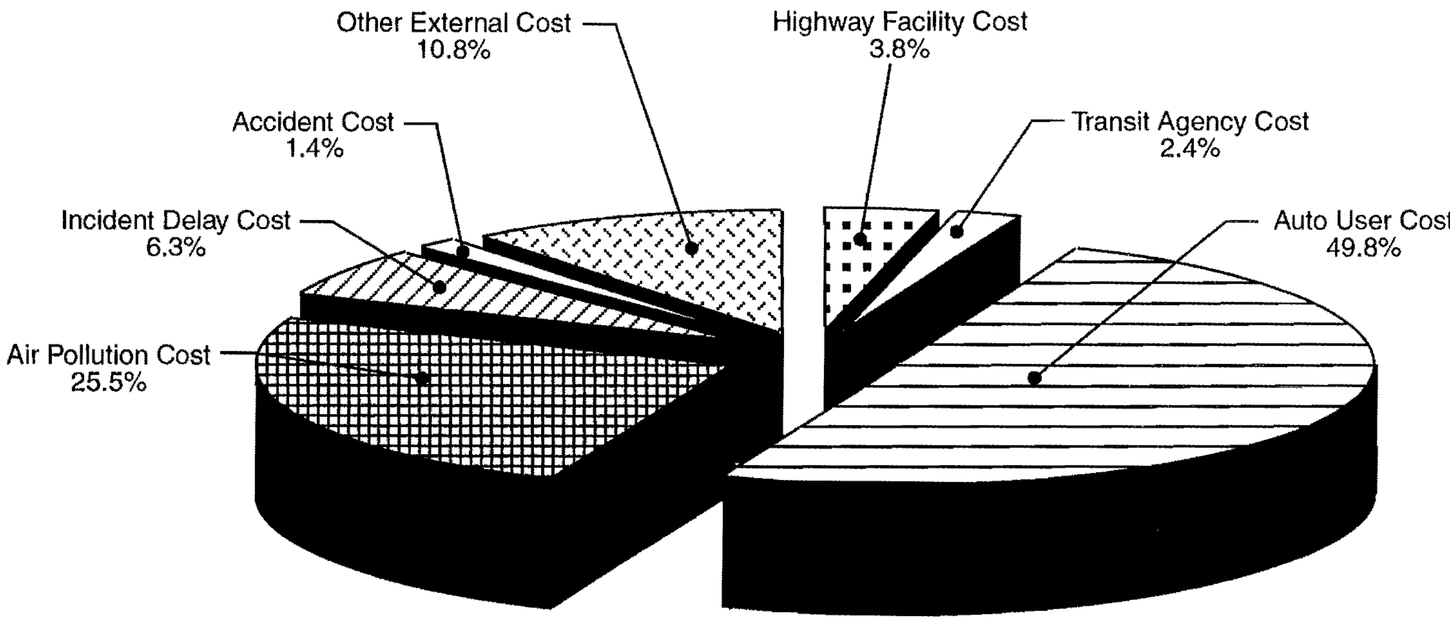

Figure 5.21 Annual shares of system cost — Scenario 3.2 without travel time cost

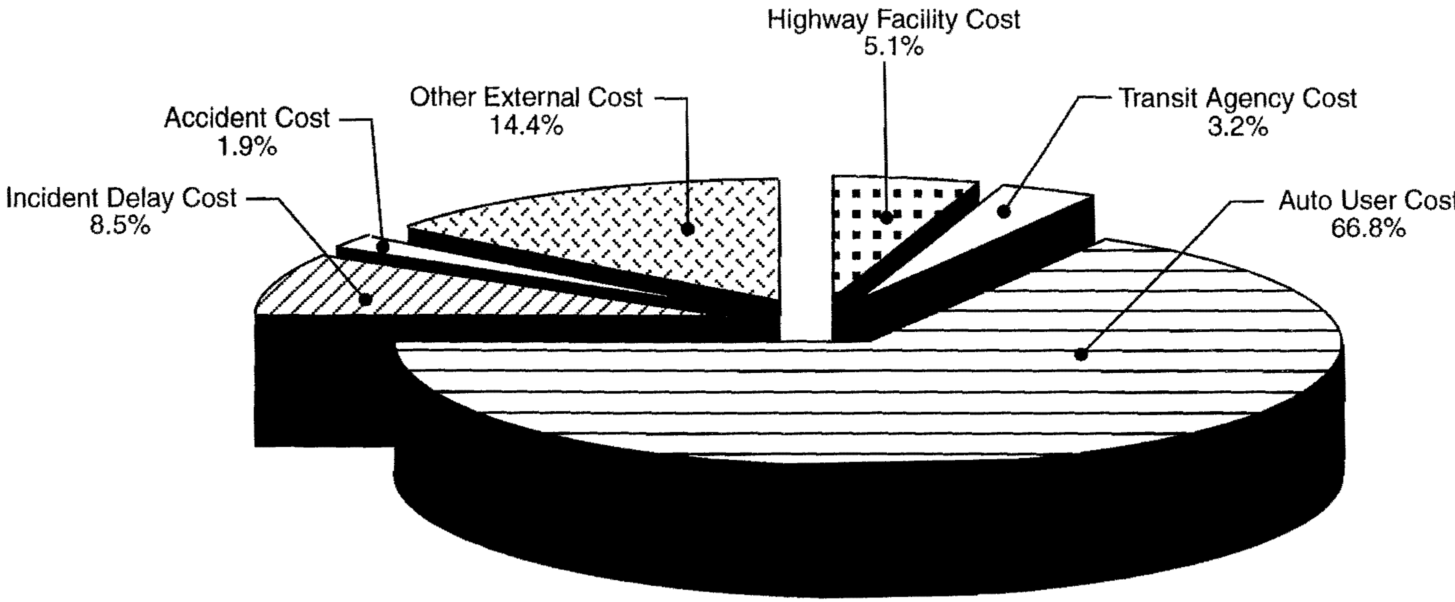

Figure 5.22 Annual shares of system cost — Scenario 3.2 without travel time and air pollution cost

CHAPTER 6. COMPARISON OF ALTERNATIVES

In this chapter, we compare the results of the six scenarios analyzed. Two methods of comparison will be employed. In the first method, the results will be compared for a single Transportation Facility Alternative (TFA) between the two mode splits, or Transportation Behavior Alternatives (TBAs), that are assessed for each TFA. For example, the results of Scenario 1.1 will be compared with the results of Scenario 1.2; Scenario 2.1 will be compared with Scenario 2.2; and Scenario 3.1 will be compared with Scenario 3.2. Thus, the impacts of higher-occupant vehicles within a given roadway capacity alternative (no-build, HOV build, general purpose build) are assessed.

In the second method, the results will be compared among TFAs for each of the two mode split alternatives, or TBAs. In other words, the results from Scenario 1.1, Scenario 2.1, and Scenario 3.1 will be compared, as will the results of Scenario 1.2, Scenario 2.2, and Scenario 3.2. Thus, the impacts of build (or no-build) alternatives are compared for a given mode split.

COMPARISON OF INDIVIDUAL FACILITY ALTERNATIVES UNDER VARYING TRANSIT AND RIDESHARING CONDITIONS

Scenario 1.1 vs Scenario 1.2

Referring to Figure 4.2 and Figure 5.1, the results of assuming a larger proportion of higher occupant vehicles in the traffic stream under Scenario 1.2 yield outcomes that are to be expected. Systemwide agency costs increase in Scenario 1.2 owing to the need for additional buses and to the need for additional park-and-ride lots and transit centers.

As a corollary to the increase in transit agency costs, the systemwide auto user cost decreases under Scenario 1.2 owing to MODECOST's assumption that bus riders do not incur any cost for owning and operating an auto. Finally, system external costs are significantly reduced under Scenario 1.2, owing to a larger proportion of higher occupant vehicles in the traffic stream, which reduces such external costs as travel time and air pollution.

The same general conclusions can be drawn when comparing Scenario 2.1 with Scenario 2.2 and when comparing Scenario 3.1 with Scenario 3.2. Accordingly, these scenarios will not be discussed.

COMPARISON OF FACILITY ALTERNATIVES UNDER TRAVEL BEHAVIOR ALTERNATIVE #1

Scenario 1.1 vs Scenario 2.1 vs Scenario 3.1

Under these scenarios, the facility improvements change while the proportion of high-occupancy vehicles in the traffic stream remains constant at what is estimated to be existing mode splits and occupancies. We would expect that the estimate of the total life-cycle system cost under

Scenario 3.1 would be less than that for Scenario 1.1, given the additional capacity added to the general purpose lanes in Scenario 3.1.

The results obtained under Scenario 2.1 are less predictable. While two lanes of capacity are added in Scenario 2.1 (as in Scenario 3.1), the use of the lanes added in Scenario 2.1 is restricted to high-occupant vehicles (carpools and buses). The estimated existing mode splits on US 59 might not be adequate to make full use of the HOV lanes and, consequently, may leave unused capacity on the HOV lanes, resulting in external cost reductions smaller than would occur if the HOV lanes were used to a fuller extent.

Actual inspection of the results (refer to Figure 4.2, Figure 5.6, and Figure 5.15) verifies these expectations. The total system life-cycle cost under Scenario 3.1 is approximately 42 percent less than that for existing conditions, as estimated under Scenario 1.1. Scenario 2.1 results are less significant, with the total system life-cycle cost reduction (relative to Scenario 1.1) being about 7 percent. This is due to the fact that the estimated existing mode splits and occupancies may not be adequate to make full use of the available HOV facility capacity.

The limited effects on the total system life-cycle cost of Scenario 2.1 can also be attributed to a second issue, namely, that mode splits for the year 2020 have been input into the model for the entire life-cycle period (year 2000 to year 2040). This has the effect of not assigning as much traffic to the HOV facility as HOV capacity would allow because, as total traffic volumes increase owing to estimated growth rates, the percentage of this total traffic that can "fit" into the HOV facility becomes smaller.

Thus, in the years preceding 2020, the percentage of the total traffic assigned to the HOV facility could have been higher than the percentage used for the year 2020, assuming that the HOV facility would be filled to capacity. By utilizing the lower 2020 percentage for the preceding years, we are in effect assuming that the "demand" for the HOV facility is less than capacity up to the year 2020.

One anomaly in the results is the slight increase in the system auto-user cost under Scenario 2.1 (about 1 percent greater) relative to Scenario 1.1 or Scenario 3.1. This apparent increase should be disregarded. It is due to a round-off error of the average vehicle occupancy input for the general purpose lanes, as well as to using the weekday's average auto occupancy on the general purpose lanes for the weekend.

COMPARISON OF FACILITY ALTERNATIVES UNDER TRAVEL BEHAVIOR ALTERNATIVE #2

Scenario 1.2 vs Scenario 2.2 vs Scenario 3.2

A similar comparison of these scenarios and those discussed in the previous section can be made (refer to Figure 5.1, Figure 5.10, and Figure 5.19). Scenario 3.2 (the "General Purpose Lane Build" scenario) offers the largest reduction in total system life-cycle cost from Scenario 1.2, with a 39 percent reduction. As in the Scenario 3.1 and Scenario 1.1 comparison, the reduction is attributable to a reduction in external costs, specifically travel time and air pollution costs.

Scenario 2.2 (the "HOV Build" scenario) offers a 25 percent reduction in the total life-cycle system cost from Scenario 1.2, the "No-Build" scenario. As explained in the previous section, there are several issues involved in the analysis of the "HOV Build" scenario that potentially restrict its effectiveness.

CHAPTER 7. CONCLUSIONS

While the results obtained from the system life-cycle cost analysis are not necessarily surprising, they are nonetheless interesting. Adding HOV lanes or general purpose lanes to an existing highway does increase the annual life-cycle cost for construction, rehabilitation, and operation and maintenance of the roadway facility.

The "HOV Build" scenario is predicted to increase highway agency life-cycle costs by about 8 percent (about $3 million annually for this corridor), while the "General Purpose Lane Build" scenario is predicted to increase the agency life-cycle costs by about 2 percent (about $1 million annually for this corridor). The implication is that adding lanes, even when not considering ROW costs, requires a significant amount of public funds. When additional transit agency costs are incurred (Travel Behavior Alternative 2), owing to the need to provide additional buses, park-and-ride lots, and transit centers, there is a further increase in required public funds.

However, consideration of total system life-cycle costs, which include private vehicle expenses as well as costs for such externalities as travel time and air pollution, yields a different result. The total annual system life-cycle cost for the "HOV Build" scenario in this corridor is estimated to be about 7 percent *less* than the "No-Build" scenario under existing transit and ridesharing conditions (or about $390 million annually for this corridor). Under conditions of greater transit use and more ridesharing, the "HOV Build" scenario is estimated to have an annual system life-cycle cost about 25 percent *less than* the "No-Build" scenario (or about $930 million annually for this corridor).

Under the "General Purpose Build" scenario, the total system annual life-cycle cost savings are estimated to be even greater. Under existing transit and ridesharing conditions, this scenario is estimated to cost about 40 percent *less* than the "No-Build" scenario (or about $2.5 billion annually for this corridor). Under conditions of greater transit use and more ridesharing, the general purpose lane scenario is estimated to have a system annual life-cycle cost about 40 percent *less* than the "No-Build" scenario (or about $1.5 billion annually for this corridor).

The "General Purpose Build" scenario is more effective at reducing costs of travel time and air pollution, owing to the underutilization of the HOV lanes in the "HOV Build" scenario for reasons described earlier in the report.

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APPENDIX A

INPUT AND OUTPUT DATA OF MODECOST SAMPLE SCENARIO 2.2

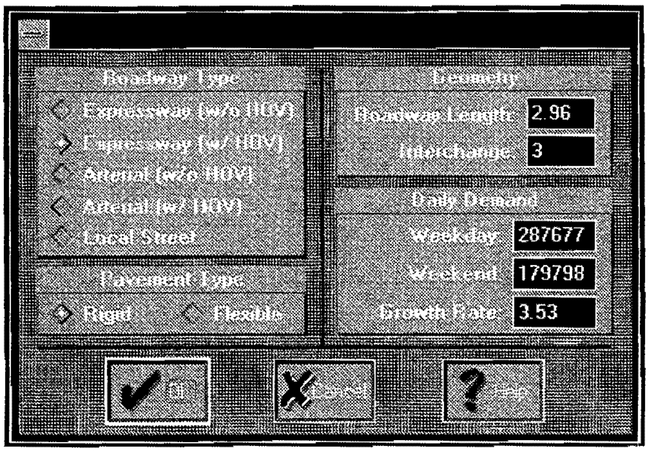

Figure A-1. Input Dialog Box 1 -- Geometry and Demand Data

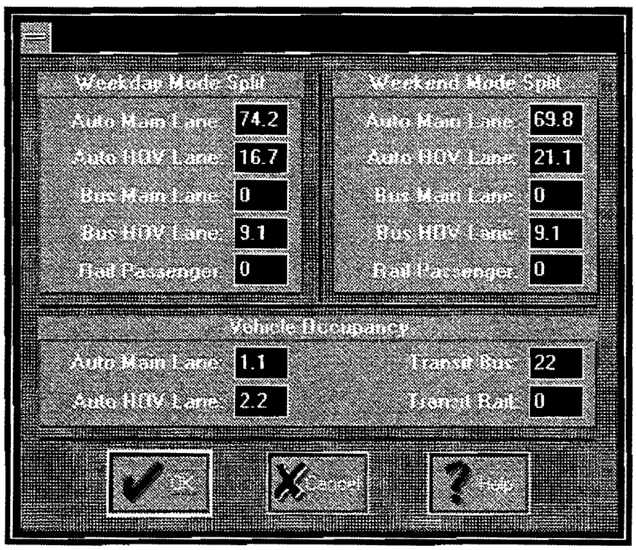

Figure A-2. Input Dialog Box 2 -- Mode Split and Occupancy Data

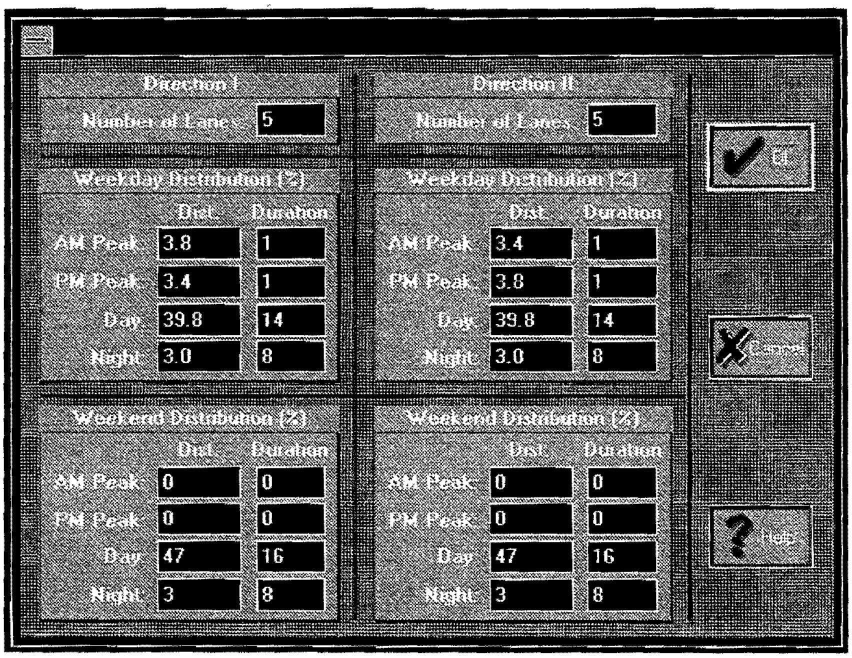

Figure A-3. Input Dialog Box 3 -- Regular Lane Traffic Data

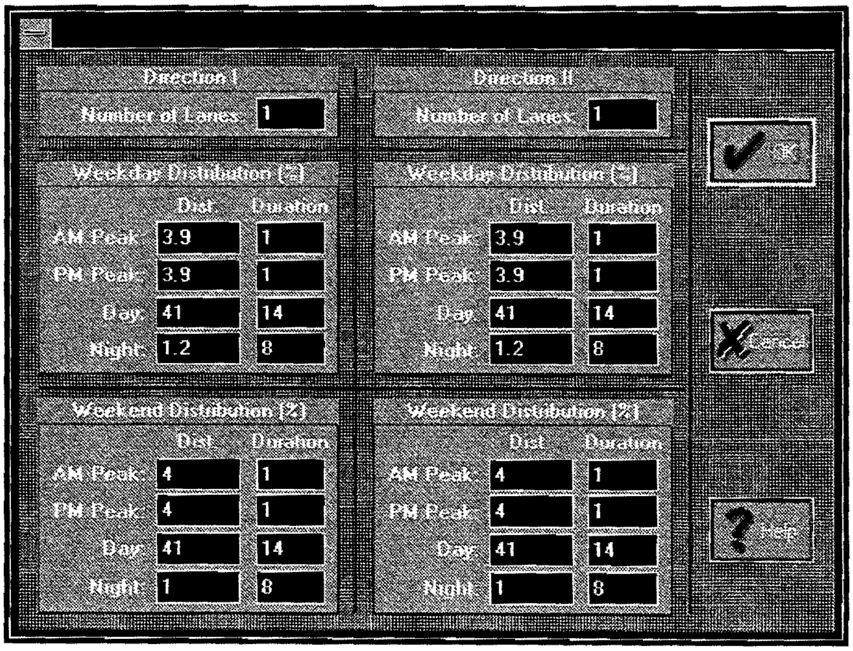

Figure A-4. Input Dialog Box 4 -- HOV Lane Traffic Data

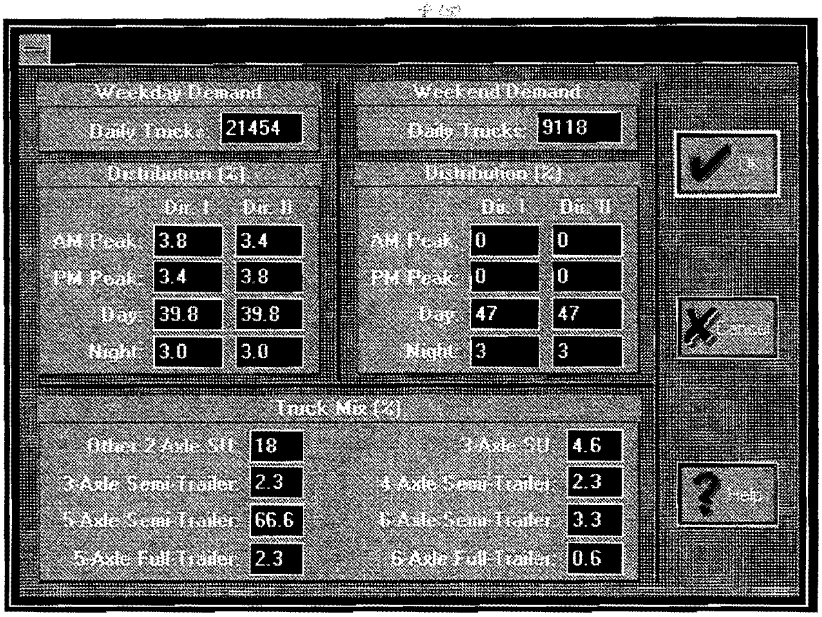

Figure A-5. Input Dialog Box 5 -- Truck Demand Data

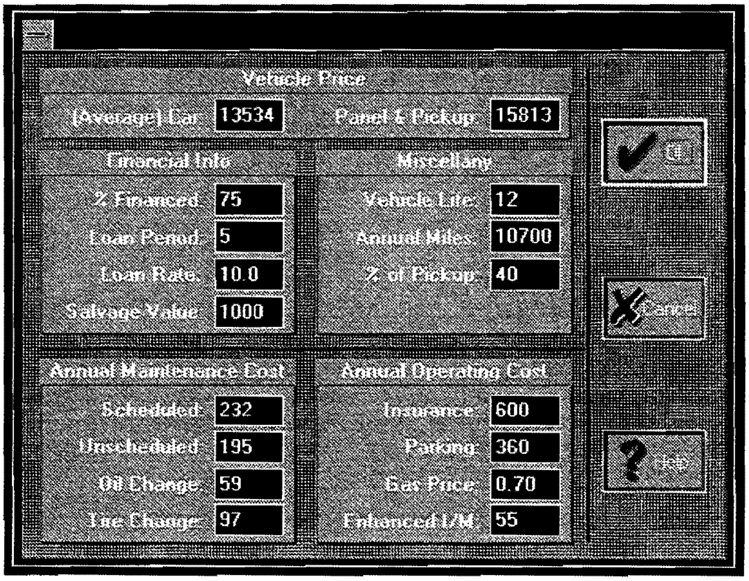

Figure A-6. Input Dialog Box 6 -- Auto Unit Cost Data

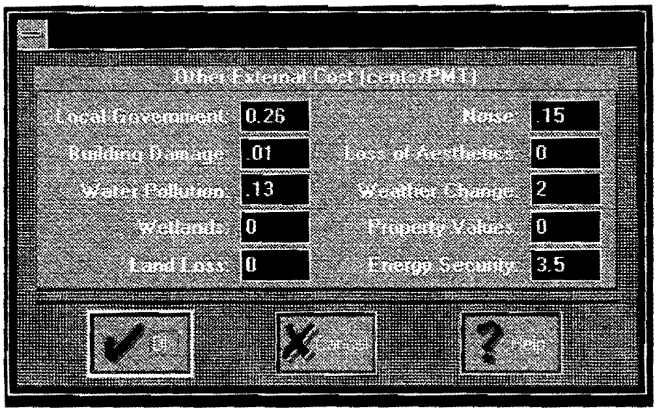

Figure A-7. Input Dialog Box 7 -- Auto Unit Cost Data (cont.)

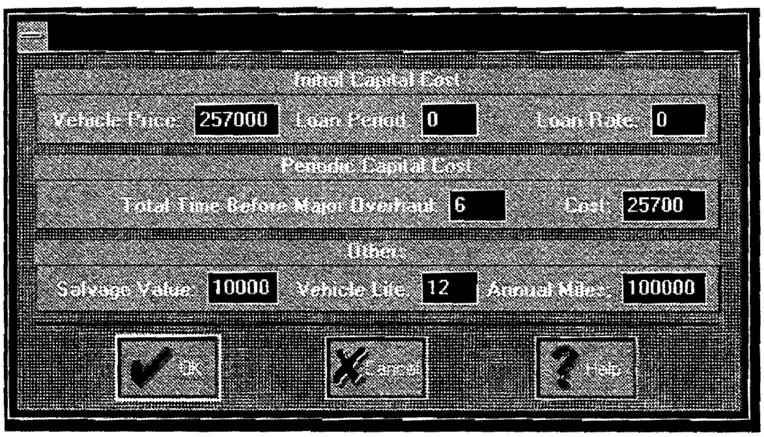

Figure A-8. Input Dialog Box 8 -- Bus Unit Cost Data

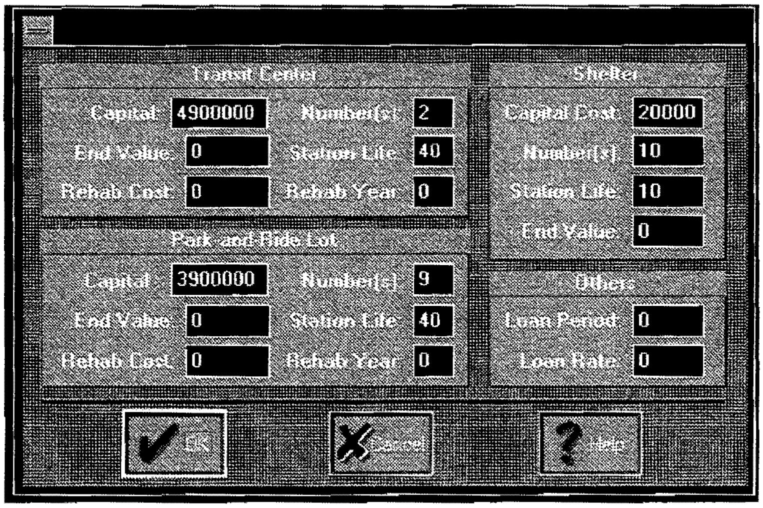

Figure A-9. Input Dialog Box 9 -- Bus Station Data

INPUT (C:\MODECOST\US59\SC2.2M3\SC22SEG1.OUT)

1. Roadway Facility & Demand Data

Roadway Type: Expressway with HOV Lanes
Pavement Type: Rigid
Section Length: 2.96 Miles
No. of Intersections/Interchanges: 3
Weekday (Daily) Person-Trips: 287677
Weekend (Daily) Person-Trips: 179798
Demand Growth Rate: 3.53 %

2. Mode Split & Vehicle Occupancy

	Weekday(Weekend)					Occupancy			
Yr	Auto	AutoHOV	Bus	BusHOV	Rail	SOV	HOV	Bus	Rail
1	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
2	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
3	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
4	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
5	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
6	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
7	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
8	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
9	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
10	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
11	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
12	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
13	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
14	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
15	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
16	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
17	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
18	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
19	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
20	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
21	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
22	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
23	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
24	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
25	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
26	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
27	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
28	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
29	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
30	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
31	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
32	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
33	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
34	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
35	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
36	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
37	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
38	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
39	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0
40	74.2(69.8)	16.7(21.1)	0.0(0.0)	9.1(9.1)	0.0(0.0)	1.1	2.2	22.0	0.0

3. Different Period Traffic Distribution/Duration

Main Lane

	Weekday		Weekend	
	Dir 1(5 Ln)	Dir 2(5 Ln)	Dir 1(5 Ln)	Dir 2(5 Ln)
AM Peak	3.8/ 1.0	3.4/ 1.0	0.0/ 0.0	0.0/ 0.0
PM Peak	3.4/ 1.0	3.8/ 1.0	0.0/ 0.0	0.0/ 0.0
Day	39.8/ 14.0	39.8/ 14.0	47.0/ 16.0	47.0/ 16.0
Night	3.0/ 8.0	3.0/ 8.0	3.0/ 8.0	3.0/ 8.0

HOV Lane

	Weekday		Weekend	
	Dir 1(1 Ln)	Dir 2(1 Ln)	Dir 1(1 Ln)	Dir 2(1 Ln)
AM Peak	3.9/ 1.0	3.9/ 1.0	4.0/ 1.0	4.0/ 1.0
PM Peak	3.9/ 1.0	3.9/ 1.0	4.0/ 1.0	4.0/ 1.0
Day	41.0/ 14.0	41.0/ 14.0	41.0/ 14.0	41.0/ 14.0
Night	1.2/ 8.0	1.2/ 8.0	1.0/ 8.0	1.0/ 8.0

3. Truck Demand, Distribution, and Mix

	Weekday		Weekend	
Daily Demand:	21454		9118	
	Direction 1	Direction 2	Direction 1	Direction 2
AM Peak	3.8	3.4	0.0	0.0
PM Peak	3.4	3.8	0.0	0.0
Day	39.8	39.8	47.0	47.0
Night	3.0	3.0	3.0	3.0

Other 2-Axle Single Unit: 18.0%
3-Axle Single Unit: 4.6%
3-Axle Semi-Trailer: 2.3%
4-Axle Semi-Trailer: 2.3%
5-Axle Semi-Trailer: 66.6%
6-Axle Semi-Trailer: 3.3%
5-Axle Full-Trailer: 2.3%
6-Axle Full-Trailer: 0.6%

4. Auto Capital & Operating Data

Average Car Price: $ 13,534
Average Pick-up and Van Price: $ 15,813
Percent being Financed: 75.00 %
Loan Period: 5.0 Year
Loan Rate: 10.00 %
Salvage Value at End: $ 1,000
Vehicle Life: 12.0 Year
Average Annual Driven Miles: 10,700 Miles
Percent of Pick-ups and Vans: 40.00 %
Annual Scheduled Maintenance: $ 232
Annual Unxcheduled Maintenance: $ 195
Annual Oil Change: $ 59
Annual Tire Change: $ 97
Annual Insurance: $ 600
Annual Parking: $ 360
Fuel Price: $ 0.70 per Gallon
Enahanced I/M: $ 55

5. Bus Vehicle Data

Vehicle Purchase Price: $ 257,000 per Vehicle
Loan Period: 0.0 Year
Loan Rate: 0.00 %
Vehicle Life: 12.0 Year
Vehicle Salvage Value at End: $ 10,000 per Vehicle
Average Annual Driven Miles: $ 100,000 per Vehicle
Total Time Before Overhaul: 6.0 Year
Overhaul Cost: $ 25,700 per Vehicle

6. Bus Station Data

Transit Center Cost: $ 4,900,000 per Station
No. of Transit Center: 2 Station(s)
Transit Center Life: 40.0 Year
Transit Center Salvage Value: $ 0 per Station
Transit Center Rehabilitation Year: 0.0 Year
Transit Center Rehabilitation Cost: $ 0 per Station
Parking Ride Lot Cost: $ 3,900,000 per Station
No. of Parking Ride Lot: 9 Station(s)
Parking Ride Lot Life: 40.0 Year
Parking Ride Lot Salvage Value: $ 0 per Station
Parking Ride Lot Rehabilitation Year: 0.0 Year
Parking Ride Lot Rehabilitation Cost: $ 0 per Station
Shelter Cost: $ 20,000 per Station
No. of Shelter: 10 Station(s)
Shelter Life: 10.0 Year
Shelter Lot Salvage Value: $ 0 per Station
Loan Period: 0.0 Year
Loan Rate: 0.00 %

7. Bus Operating Data

Average Passenger Trip Length: 10.0 Miles
Station Spacing: 1.0 Miles
Bus Headway: 10.0 Minutes
Operating and Maintenance Cost: $ 158,500,000
Administration Cost: $ 0
User Time from Origin to Station: 10.0 Minutes
User Time from Station to Destination: 10.0 Minutes

8. Rail Car Data
Car Purchase Price: $ 0 per Vehicle
Loan Period: 0.0 Year
Loan Rate: 0.00 %
Vehicle Life: 0.0 Year
Car Salvage Value at End: $ 0 per Vehicle
Total Time Before Major Overhaul: 0.0 Year
Major Overhaul Cost: $ 0 per Vehicle
Total Time Before 1st Manor Overhaul: 0.0 Year
1st Manor Overhaul Cost: $ 0 per Vehicle
Total Time Before 2nd Manor Overhaul: 0.0 Year
2nd Manor Overhaul Cost: $ 0 per Vehicle
Total Time Before 3rd Manor Overhaul: 0.0 Year
3rd Manor Overhaul Cost: $ 0 per Vehicle

9. Rail Guideway Data

Guideway Length: $ 0 Miles
Guideway Unit Price: $ 0 per Mile
Loan Period: 0.0 Year
Loan Rate: 0.00 %
Guideway Life: 0.0 Year
Guideway Salvage Value at End: $ 0
Total Time Before 1st Rehabilitation: 0.0 Year
1st Rehabilitation Cost: $ 0
Total Time Before 2nd Rehabilitation: 0.0 Year
2nd Rehabilitation Cost: $ 0
Total Time Before 3rd Rehabilitation: 0.0 Year
3rd Rehabilitation Cost: $ 0

10. Rail Station Data

Station Price: $ 0 per Station
Loan Period: 0.0 Year
Loan Rate: 0.00 %
Station Life: 0.0 Year
Station Salvage Value at End: $ 0 per Station
Total Time Before 1st Rehabilitation: 0.0 Year
1st Rehabilitation Cost: $ 0 per Station
Total Time Before 2nd Rehabilitation: 0.0 Year
2nd Rehabilitation Cost: $ 0 per Station
Total Time Before 3rd Rehabilitation: 0.0 Year
3rd Rehabilitation Cost: $ 0 per Station

11. Rail Yards & Shops Data

Yards & Shops Cost: $ 0
Loan Period: 0.0 Year
Loan Rate: 0.00 %
Yards & Shops Life: 0.0 Year
Yards & Shops Salvage Value at End: $ 0

12. Rail Right-of-Way Data

Right-of-Way Cost: $ 0
Loan Period: 0.0 Year
Loan Rate: 0.00 %
Right-of-Way Life: 0.0 Year
Right-of-Way Salvage Value at End: $ 0

13. Rail Other Facility Data

System Cost: $ 0 per Mile
Soft Cost: $ 0 per Mile
Special Cost: $ 0 per Mile

14. Rail Operating Data

Round Trip System Length: 0.0 Miles
Station Spacing: 0.0 Miles
Peak Hour Train Headway: 0.0 Minutes
Number of Cars per Train: 0 Vehicles per Train
Total Number of Backup Cars: 0
Annual VMT: 0
Acceleration/Deceleration Rate: 0.00 m/s/s
Maximum Velocity: 0.0 Km/Hr
Average Passenger Trip Length: 0.0 Miles
Standing Time at Station: 0.0 Minutes
Energy Consumption: 0.00 VMT per KWH
Operating and Maintenance Cost: $ 0
Administration Cost: $ 0
User Time from Origin to Station: 0.0 Minutes
User Time from Station to Destination: 0.0 Minutes

15. Auto Other External Cost Data (in $/PMT)

Local Government: $ 0.0026
Noise: $ 0.0015
Building Damage: $ 0.0001
Aesthetics: $ 0.0000
Water Pollution: $ 0.0013
Weather Change: $ 0.0200
Wetland: $ 0.0000
Property Value: $ 0.0000
Land Loss: $ 0.0000
Energy Security: $ 0.0350

16. Rail Other External Cost Data (in $/PMT)

Local Government: $ 0.0000
Noise: $ 0.0000
Building Damage: $ 0.0000
Aesthetics: $ 0.0000
Water Pollution: $ 0.0000
Weather Change: $ 0.0000
Wetland: $ 0.0000
Property Value: $ 0.0000
Land Loss: $ 0.0000
Energy Security: $ 0.0000

Rail Electricity Generation Source:
Coal: 0.00%
Natural Gas: 0.00%
Nuclear: 0.00%
Hydro: 0.00%

17. Other Data

Population Density: 1,760 Persons/sq. mi.
Discount Rate: 10.00%
Areawide Total VMT by Vehicles: 31,761,000,448
Percent of Areawide VMT on Expressway: 42.00%
Percent of Areawide VMT by Bus: 0.17 %
Value of Time (Private): $ 5.00 per Hour
Value of Time (Commercial): $ 5.00 per Hour
Percentage of Private Vehicles: 100.00%
Pollutant Damage Value:
CO: $ 2.00 per Kg
HC: $ 3.54 per Kg
NOx: $ 6.89 per Kg
SOx: $ 2.91 per Kg
PM: $ 5.19 per Kg
Truck Equivalent Factor: 1.70 Passenger Vehicles
Bus Equivalent Factor: 1.50 Passenger Vehicles
Weather Condition:
Rain Fall: Above Average
Snow Fall: Below Average

OUTPUT (C:\MODECOST\US59\SC2.2M3\SC22SEG1.OUT)

1. Auto and/or Bus

Roadway Section (Main Lane):

Annual Cost (in $/yr) by Modes

Mode	Auto & Pickup	Bus	Truck	Total
Facility Cost	2,003,803	0	1,523,410	3,527,213
Travel Time Cost	1,375,344,512	0	136,891,344	1,512,235,776
Air Pollution Cost	169,331,024	0	8,795,486	178,126,512
Incident Delay Cost	9,774,596	0	930,182	10,704,778
Accident Cost	2,585,112	0	270,608	2,855,720
Other External Cost	17,717,736	0	1,686,076	19,403,810
User/Agency Cost	101,715,224	0	0	101,715,224

Highway Facility Cost

	Annual Cost ($/yr)	Initial Lump-Sum ($)
Right-of-way	0	0
Cost of Preparing Roadway-Bed	133,328	1,303,821
Shoulder, Sewer, Signage, Lighting	1,119,945	10,952,000
Cost of Interchange/Intersection	1,135,080	11,100,000
Pavement Cost	396,011	3,872,616
Rehabilitation Cost	78,737	-
Annual Maintenance Cost	177,600	-
Cost of Administration, Safety, etc.	486,512	-

Travel Time Cost (in $/yr) of Different Periods (Unit Cost: $/PMT)

Period (Direction)	Auto & Pickup	Bus	Truck
Weekday AM Peak (1)	11,257,248 (0.847)	0 (0.000)	1,131,440 (0.847)
Weekday PM Peak (1)	7,625,622 (0.641)	0 (0.000)	766,434 (0.641)
Weekday Day (1)	644,149,504 (4.629)	0 (0.000)	64,741,968 (4.629)
Weekday Night (1)	561,687 (0.054)	0 (0.000)	56,454 (0.054)
Weekend AM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (1)	23,946,488 (0.614)	0 (0.000)	1,739,807 (0.614)
Weekend Night (1)	131,688 (0.053)	0 (0.000)	9,568 (0.053)
Weekday AM Peak (2)	7,625,622 (0.641)	0 (0.000)	766,434 (0.641)
Weekday PM Peak (2)	11,257,248 (0.847)	0 (0.000)	1,131,440 (0.847)
Weekday Day (2)	644,149,504 (4.629)	0 (0.000)	64,741,968 (4.629)
Weekday Night (2)	561,687 (0.054)	0 (0.000)	56,454 (0.054)
Weekend AM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (2)	23,946,488 (0.614)	0 (0.000)	1,739,807 (0.614)
Weekend Night (2)	131,688 (0.053)	0 (0.000)	9,568 (0.053)

Pollution Cost (in $/yr) of Different Periods (Unit Cost: $/PMT)

Period (Direction)	Auto & Pickup	Bus	Truck
Weekday AM Peak (1)	1,413,316 (0.106)	0 (0.000)	215,440 (0.161)
Weekday PM Peak (1)	985,514 (0.083)	0 (0.000)	173,302 (0.145)
Weekday Day (1)	78,462,808 (0.564)	0 (0.000)	3,515,621 (0.251)
Weekday Night (1)	317,678 (0.030)	0 (0.000)	122,904 (0.117)
Weekend AM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (1)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (1)	3,407,480 (0.087)	0 (0.000)	348,913 (0.123)
Weekend Night (1)	78,715 (0.032)	0 (0.000)	21,563 (0.119)
Weekday AM Peak (2)	985,514 (0.083)	0 (0.000)	173,302 (0.145)
Weekday PM Peak (2)	1,413,316 (0.106)	0 (0.000)	215,440 (0.161)
Weekday Day (2)	78,462,808 (0.564)	0 (0.000)	3,515,621 (0.251)
Weekday Night (2)	317,678 (0.030)	0 (0.000)	122,904 (0.117)
Weekend AM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend PM Peak (2)	0 (0.000)	0 (0.000)	0 (0.000)
Weekend Day (2)	3,407,480 (0.087)	0 (0.000)	348,913 (0.123)
Weekend Night (2)	78,715 (0.032)	0 (0.000)	21,563 (0.119)

Roadway Section (HOV Lane):

Annual Cost (in $/yr) by Modes

Mode	Auto & Pickup	Bus	Truck	Total
Facility Cost	1,073,648	42,513	0	1,116,161
Travel Time Cost	24,265,390	20,600,270	0	44,865,660
Air Pollution Cost	2,246,435	260,735	0	2,507,170
Incident Delay Cost	2,344,780	1,213,271	0	3,558,051
Accident Cost	310,065	0	0	310,065
Other External Cost	4,250,221	690,662	0	4,940,882
User/Agency Cost	12,199,984	5,642,548	0	17,842,532

Highway Facility Cost

	Annual Cost ($/yr)	Initial Lump-Sum ($)
Right-of-way	0	0
Cost of Preparing Roadway-Bed	423,763	4,144,000
Shoulder, Sewer, Signage, Lighting	0	0
Cost of Interchange/Intersection	1,135,080	11,100,000
Pavement Cost	55,763	545,307
Rehabilitation Cost	15,747	-
Annual Maintenance Cost	35,520	-
Cost of Administration, Safety, etc.	266,540	-

Travel Time Cost (in $/yr) of Different Periods (Unit Cost: $/PMT)

Period (Direction)	Auto & Pickup	Bus	Truck
Weekday AM Peak (1)	485,161 (0.158)	500,195 (0.299)	0 (0.000)
Weekday PM Peak (1)	485,161 (0.158)	500,195 (0.299)	0 (0.000)
Weekday Day (1)	10,253,862 (0.318)	8,066,626 (0.459)	0 (0.000)
Weekday Night (1)	49,440 (0.052)	99,502 (0.193)	0 (0.000)
Weekend AM Peak (1)	91,152 (0.091)	100,361 (0.232)	0 (0.000)
Weekend PM Peak (1)	91,152 (0.091)	100,361 (0.232)	0 (0.000)
Weekend Day (1)	663,654 (0.064)	911,978 (0.206)	0 (0.000)
Weekend Night (1)	13,113 (0.052)	20,918 (0.193)	0 (0.000)
Weekday AM Peak (2)	485,161 (0.158)	500,195 (0.299)	0 (0.000)
Weekday PM Peak (2)	485,161 (0.158)	500,195 (0.299)	0 (0.000)
Weekday Day (2)	10,253,862 (0.318)	8,066,626 (0.459)	0 (0.000)
Weekday Night (2)	49,440 (0.052)	99,502 (0.193)	0 (0.000)
Weekend AM Peak (2)	91,152 (0.091)	100,361 (0.232)	0 (0.000)
Weekend PM Peak (2)	91,152 (0.091)	100,361 (0.232)	0 (0.000)
Weekend Day (2)	663,654 (0.064)	911,978 (0.206)	0 (0.000)
Weekend Night (2)	13,113 (0.052)	20,918 (0.193)	0 (0.000)

Pollution Cost (in $/yr) of Different Periods (Unit Cost: $/PMT)

Period (Direction)	Auto & Pickup	Bus	Truck
Weekday AM Peak (1)	47,725 (0.016)	8,310 (0.005)	0 (0.000)
Weekday PM Peak (1)	47,725 (0.016)	8,310 (0.005)	0 (0.000)
Weekday Day (1)	852,818 (0.026)	86,891 (0.005)	0 (0.000)
Weekday Night (1)	15,441 (0.016)	2,275 (0.004)	0 (0.000)
Weekend AM Peak (1)	12,802 (0.013)	2,031 (0.005)	0 (0.000)
Weekend PM Peak (1)	12,802 (0.013)	2,031 (0.005)	0 (0.000)
Weekend Day (1)	129,774 (0.013)	20,041 (0.005)	0 (0.000)
Weekend Night (1)	4,132 (0.016)	478 (0.004)	0 (0.000)
Weekday AM Peak (2)	47,725 (0.016)	8,310 (0.005)	0 (0.000)
Weekday PM Peak (2)	47,725 (0.016)	8,310 (0.005)	0 (0.000)
Weekday Day (2)	852,818 (0.026)	86,891 (0.005)	0 (0.000)
Weekday Night (2)	15,441 (0.016)	2,275 (0.004)	0 (0.000)
Weekend AM Peak (2)	12,802 (0.013)	2,031 (0.005)	0 (0.000)
Weekend PM Peak (2)	12,802 (0.013)	2,031 (0.005)	0 (0.000)
Weekend Day (2)	129,774 (0.013)	20,041 (0.005)	0 (0.000)
Weekend Night (2)	4,132 (0.016)	478 (0.004)	0 (0.000)

Cost (million $) by year and by categories: Bus HOV Lane

Year	Facility	Time	Air Pollut	Inci Delay	Accident	External	User/Age
1	0.043	7.343	0.167	0.842	0.000	0.479	3.917
2	0.043	7.609	0.172	0.872	0.000	0.496	4.055
3	0.043	7.884	0.179	0.903	0.000	0.514	4.198
4	0.043	8.170	0.185	0.935	0.000	0.532	4.346
5	0.043	8.466	0.192	0.968	0.000	0.551	4.500
6	0.043	8.774	0.199	1.002	0.000	0.570	4.659
7	0.043	9.093	0.206	1.037	0.000	0.590	4.823
8	0.043	9.425	0.213	1.074	0.000	0.611	4.993
9	0.043	9.769	0.221	1.112	0.000	0.633	5.170
10	0.043	10.126	0.229	1.151	0.000	0.655	5.352
11	0.043	10.497	0.237	1.191	0.000	0.678	5.541
12	0.043	10.882	0.245	1.233	0.000	0.702	5.737
13	0.043	11.283	0.254	1.277	0.000	0.727	5.939
14	0.043	11.699	0.264	1.322	0.000	0.753	6.149
15	0.043	12.132	0.273	1.369	0.000	0.779	6.366
16	0.043	12.581	0.283	1.417	0.000	0.807	6.590
17	0.043	13.049	0.293	1.467	0.000	0.835	6.823
18	0.043	13.536	0.304	1.519	0.000	0.865	7.064
19	0.043	14.043	0.315	1.573	0.000	0.895	7.313
20	0.043	14.572	0.327	1.628	0.000	0.927	7.571
21	0.043	15.122	0.338	1.685	0.000	0.959	7.839
22	0.043	15.696	0.351	1.745	0.000	0.993	8.115
23	0.043	16.296	0.364	1.807	0.000	1.028	8.402
24	0.043	17.669	0.385	1.870	0.000	1.065	8.698
25	0.043	18.987	0.403	1.936	0.000	1.102	9.006
26	0.043	20.404	0.422	2.005	0.000	1.141	9.323
27	0.043	21.928	0.441	2.076	0.000	1.181	9.653
28	0.043	23.565	0.461	2.149	0.000	1.223	9.993
29	0.043	25.327	0.480	2.225	0.000	1.266	10.346
30	0.043	27.358	0.502	2.303	0.000	1.311	10.711
31	0.043	29.603	0.525	2.384	0.000	1.357	11.089
32	0.043	58.022	0.705	2.469	0.000	1.405	11.481
33	0.043	124.258	0.854	2.556	0.000	1.455	11.886
34	0.043	197.444	0.965	2.646	0.000	1.506	12.306
35	0.043	278.157	1.073	2.739	0.000	1.559	12.740
36	0.043	367.018	1.187	2.836	0.000	1.614	13.190
37	0.043	464.697	1.307	2.936	0.000	1.671	13.655
38	0.043	571.912	1.435	3.040	0.000	1.730	14.137
39	0.043	692.757	1.601	3.147	0.000	1.792	14.636
40	0.043	841.537	1.803	3.258	0.000	1.855	15.153

Cost (million $) by year and by categories: Bus Main Lane

Year	Facility	Time	Air Pollut	Inci Delay	Accident	External	User/Age
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.000	0.000	0.000	0.000	0.000	0.000	0.000
31	0.000	0.000	0.000	0.000	0.000	0.000	0.000
32	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36	0.000	0.000	0.000	0.000	0.000	0.000	0.000
37	0.000	0.000	0.000	0.000	0.000	0.000	0.000
38	0.000	0.000	0.000	0.000	0.000	0.000	0.000
39	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Cost (million $) by year and by categories: Auto HOV Lane

Year	Facility	Time	Air Pollut	Inci Delay	Accident	External	User/Age
1	1.074	4.030	0.945	1.628	0.215	2.950	8.468
2	1.074	4.184	0.969	1.685	0.223	3.054	8.767
3	1.074	4.345	0.994	1.745	0.231	3.162	9.077
4	1.074	4.512	1.019	1.806	0.239	3.274	9.397
5	1.074	4.687	1.045	1.870	0.247	3.389	9.729
6	1.074	4.869	1.070	1.936	0.256	3.509	10.072
7	1.074	5.059	1.096	2.004	0.265	3.633	10.428
8	1.074	5.258	1.122	2.075	0.274	3.761	10.796
9	1.074	5.465	1.148	2.148	0.284	3.894	11.177
10	1.074	5.681	1.174	2.224	0.294	4.031	11.572
11	1.074	5.908	1.200	2.303	0.304	4.174	11.980
12	1.074	6.145	1.226	2.384	0.315	4.321	12.403
13	1.074	6.393	1.252	2.468	0.326	4.474	12.841
14	1.074	6.652	1.277	2.555	0.338	4.631	13.294
15	1.074	6.925	1.303	2.645	0.350	4.795	13.764
16	1.074	7.210	1.328	2.739	0.362	4.964	14.249
17	1.074	7.510	1.353	2.835	0.375	5.139	14.752
18	1.074	7.825	1.378	2.935	0.388	5.321	15.273
19	1.074	8.157	1.402	3.039	0.402	5.509	15.812
20	1.074	8.507	1.426	3.146	0.416	5.703	16.370
21	1.074	8.876	1.450	3.257	0.431	5.904	16.948
22	1.074	9.266	1.473	3.372	0.446	6.113	17.547
23	1.074	9.679	1.495	3.491	0.462	6.329	18.166
24	1.074	11.488	1.607	3.615	0.478	6.552	18.807
25	1.074	13.172	1.725	3.742	0.495	6.783	19.471
26	1.074	15.011	1.833	3.874	0.512	7.023	20.159
27	1.074	17.019	1.942	4.011	0.530	7.271	20.870
28	1.074	19.210	2.058	4.153	0.549	7.527	21.607
29	1.074	21.600	2.181	4.299	0.569	7.793	22.370
30	1.074	24.521	2.328	4.451	0.589	8.068	23.159
31	1.074	27.837	2.517	4.608	0.609	8.353	23.977
32	1.074	79.168	5.604	4.771	0.631	8.648	24.823
33	1.074	199.876	12.395	4.939	0.653	8.953	25.699
34	1.074	333.319	20.254	5.114	0.676	9.269	26.607
35	1.074	480.553	29.032	5.294	0.700	9.596	27.546
36	1.074	642.722	38.748	5.481	0.725	9.935	28.518
37	1.074	821.050	49.460	5.675	0.750	10.286	29.525
38	1.074	1016.859	61.238	5.875	0.777	10.649	30.567
39	1.074	1239.264	74.690	6.082	0.804	11.025	31.646
40	1.074	1521.035	91.454	6.297	0.833	11.414	32.763

Cost (million $) by year and by categories: Auto Main Lane

Year	Facility	Time	Air Pollut	Inci Delay	Accident	External	User/Age
1	2.004	18.044	6.483	6.785	1.794	12.299	70.604
2	2.004	18.809	6.603	7.024	1.858	12.733	73.096
3	2.004	19.616	6.723	7.272	1.923	13.182	75.677
4	2.004	20.467	6.841	7.529	1.991	13.647	78.348
5	2.004	22.320	7.044	7.795	2.062	14.129	81.114
6	2.004	24.598	7.398	8.070	2.134	14.628	83.977
7	2.004	27.071	7.717	8.355	2.210	15.144	86.942
8	2.004	29.758	8.029	8.650	2.288	15.679	90.011
9	2.004	34.667	8.627	8.955	2.368	16.232	93.188
10	2.004	39.268	9.174	9.271	2.452	16.805	96.477
11	2.004	44.290	9.733	9.599	2.539	17.399	99.883
12	2.004	49.771	10.325	9.937	2.628	18.013	103.409
13	2.004	55.753	10.964	10.288	2.721	18.649	107.059
14	2.004	279.287	36.703	10.651	2.817	19.307	110.839
15	2.004	563.753	69.627	11.027	2.916	19.988	114.751
16	2.004	877.991	106.930	11.417	3.019	20.694	118.802
17	2.004	1224.472	148.395	11.820	3.126	21.425	122.996
18	2.004	1605.849	194.200	12.237	3.236	22.181	127.337
19	2.004	2024.986	244.634	12.669	3.351	22.964	131.832
20	2.004	2484.961	300.044	13.116	3.469	23.774	136.486
21	2.004	2989.088	360.816	13.579	3.591	24.614	141.304
22	2.004	3540.931	427.373	14.058	3.718	25.483	146.292
23	2.004	4144.322	500.174	14.555	3.849	26.382	151.456
24	2.004	4803.389	579.715	15.068	3.985	27.313	156.802
25	2.004	5522.571	666.529	15.600	4.126	28.278	162.338
26	2.004	6306.630	761.191	16.151	4.271	29.276	168.068
27	2.004	7160.703	864.322	16.721	4.422	30.309	174.001
28	2.004	8090.298	976.586	17.311	4.578	31.379	180.143
29	2.004	9127.757	1102.216	17.922	4.740	32.487	186.502
30	2.004	10369.736	1250.936	18.555	4.907	33.634	193.086
31	2.004	11721.640	1413.820	19.210	5.081	34.821	199.902
32	2.004	13192.095	1591.285	19.888	5.260	36.050	206.958
33	2.004	14790.383	1784.303	20.590	5.446	37.323	214.264
34	2.004	16526.449	1994.029	21.317	5.638	38.640	221.827
35	2.004	18411.027	2221.743	22.070	5.837	40.004	229.658
36	2.004	20455.615	2468.826	22.849	6.043	41.416	237.765
37	2.004	22672.578	2736.769	23.655	6.256	42.878	246.158
38	2.004	25075.209	3027.177	24.490	6.477	44.392	254.847
39	2.004	27677.756	3341.772	25.355	6.706	45.959	263.843
40	2.004	30495.572	3682.410	26.250	6.942	47.581	273.157

Cost (million $) by year and by categories: Rail

Year	Facility	Time	Air Pollut	Inci Delay	Accident	External	User/Age
1	0.000	0.000	0.000	0.000	0.000	0.000	0.000
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
4	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	0.000	0.000	0.000	0.000	0.000	0.000	0.000
12	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	0.000	0.000	0.000	0.000	0.000	0.000	0.000
14	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000
17	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	0.000	0.000	0.000	0.000	0.000	0.000	0.000
19	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	0.000	0.000	0.000	0.000	0.000	0.000	0.000
23	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	0.000	0.000	0.000	0.000	0.000	0.000	0.000
31	0.000	0.000	0.000	0.000	0.000	0.000	0.000
32	0.000	0.000	0.000	0.000	0.000	0.000	0.000
33	0.000	0.000	0.000	0.000	0.000	0.000	0.000
34	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35	0.000	0.000	0.000	0.000	0.000	0.000	0.000
36	0.000	0.000	0.000	0.000	0.000	0.000	0.000
37	0.000	0.000	0.000	0.000	0.000	0.000	0.000
38	0.000	0.000	0.000	0.000	0.000	0.000	0.000
39	0.000	0.000	0.000	0.000	0.000	0.000	0.000
40	0.000	0.000	0.000	0.000	0.000	0.000	0.000