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Addendum to the 1997 Federal Highway Cost Allocation Study Final Report

U.S. Department of Transportation
Federal Highway Administration

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Introduction

When the 1997 Federal Highway Cost Allocation Study (HCAS) was sent to Congress in August 1997, estimates of air pollution-related costs of highway use were not included. Research by the Environmental Protection Agency (EPA) on social costs associated with air pollution was being completed and the Department of Transportation wanted estimates of air pollution costs attributable to highway use by motor vehicles to reflect the new EPA research. This addendum to the 1997 Federal HCAS presents estimates of air pollution-related costs of highway use and summarizes how these costs relate to other costs analyzed in the 1997 Federal HCAS. In this addendum, as in the 1997 HCAS report, costs of air pollution, congestion, and other impacts of highway use not borne by transportation agencies represent social and economic costs incurred by affected individuals, not engineering costs to comply with standards or to mitigate adverse impacts as the term "costs" is often used in the environmental literature.

Two changes relevant for highway cost allocation have occurred since the 1997 Federal HCAS was submitted to Congress. First, proceeds of 4.3 cents per gallon of motor fuel tax that had been dedicated for deficit reduction by the Omnibus Budget Reconciliation Act of 1993 (P.L. 103-66) were directed to the Federal Highway Trust Fund beginning October 1, 1997 by the Taxpayer Relief Act of 1997 (P.L. 105-34). This not only increased total highway user revenues available for highway and related improvements, but it also changed the relative shares of Federal user fees paid by different vehicle classes. Ratios of user fee payments to highway cost responsibility for different vehicles (so-called equity ratios) were affected by this change.

The second change was passage of the Transportation Equity Act for the 21st Century (TEA-21) (P.L. 105-178). While this watershed legislation builds upon initiatives established in the Intermodal Surface Transportation Assistance Act of 1991 (ISTEA) (P.L. 102-240), it significantly increases overall surface transportation funding levels and has new initiatives to meet challenges of improving safety, enhancing the natural and human environment, and advancing America's economic growth and competitiveness. Changes in authorization levels for different program areas have affected the relative cost responsibility of different vehicle classes and ratios of user fee payments to cost responsibility for different vehicles. These changes are analyzed in this report.

For ease of comparison, this report is organized similarly to the Summary Report of the 1997 Federal HCAS. The analysis year continues to be 2000, and the same vehicle classes, vehicle miles of travel, and other vehicle characteristics are used. This not only facilitates comparison with the earlier report, but is essential if results are to be directly useful for the Department's Comprehensive Truck Size and Weight (TS&W) Study which uses travel characteristics developed for the 1997 Federal HCAS in its base case.

Summary of Findings

Total social costs of air pollution associated with motor vehicle use are estimated to range from $30 billion to $349 billion per year.[1] Most of those costs are associated with premature death and illness caused by particulate matter, including both direct particulate emissions and the secondary formation of particulates from other emissions. The wide range of air pollution cost estimates is indicative of the many uncertainties surrounding costs of motor-vehicle-related air pollution.

The 1997 HCAS discussed four main costs of highway use not borne directly by transportation agencies -- crash costs, air pollution, congestion, and noise. Based on mid-range estimates, crash costs are the largest of those costs, accounting for about 75 percent of total costs for those four impacts. Congestion costs represent the next highest cost (14%), followed by air pollution (9%) and finally noise (1%). Most crash and congestion costs are borne directly by motorists, but impacts of air pollution and noise are not directly tied to an individual's use of the highway.

As noted above, the Omnibus Budget Reconciliation Act of 1993 imposed a 4.3 cents per gallon tax on transportation fuels to be used for deficit reduction. Proceeds of this tax were not considered to be highway user fees – they were deposited in the General Fund rather than the Highway Trust Fund, and were not available to finance highway, transit, or other transportation improvements. Since proceeds of the 4.3 cents per gallon deficit reduction tax were not highway user fees, they were not included in the 1997 Federal Highway Cost Allocation Study.

The Taxpayer Relief Act of 1997 directed that proceeds of the 4.3 cents per gallon tax on highway motor fuels that had been dedicated for deficit reduction should be deposited in the Highway Trust Fund beginning October 1, 1997 and be available for transportation purposes. This made the 4.3 cents per gallon tax a highway user fee which should be included with other fuel tax revenues in highway cost allocation. The change affects the relative equity of the Federal highway user fee structure. The share of total Federal highway user revenues paid by heavy trucks declines, thereby reducing the share of highway cost responsibility that heavy trucks pay through user fees.

In the 1997 HCAS combination trucks were found, on average, to pay 90 percent of their Federal highway cost responsibility through user fees, but with changes in the fuel tax they now pay only 80 percent of their cost responsibility. The heaviest combinations, those over 80,000 pounds, pay only half of their cost responsibility.

Programmatic changes enacted in the recent TEA-21 are anticipated to have virtually no effect on user fee equity.

The Department plans to update the 1997 HCAS before the next surface transportation reauthorization. Potential options to improve overall user fee equity will be examined in greater depth in that study.

Vehicle Travel Characteristics and Population by Different Vehicle Classes

Table 1 shows total 2000 vehicle miles of travel (VMT) by different groups of vehicles. Travel for single unit and combination truck classes is broken down by registered weight groups. Passenger vehicles account for about 93 percent of total VMT in the United States. Single unit trucks and combination trucks account for 3 and 4 percent of total travel, respectively. Over two-thirds of single unit truck travel is by vehicles registered below 25,000 pounds while among combination vehicles, 75 percent of travel is by vehicles registered between 75,000 and 80,000 pounds.

In Chapter II of the main 1997 HCAS report, VMT, operating weight, and registered weight distributions for 20 different vehicle classes were presented. Vehicle classes include automobiles, pickups and vans, buses, three types of single unit trucks, six types of single trailer combinations, three types of truck-trailer combinations, four types of twin-trailer combinations, and a triple trailer combination. Truck travel and operating weight distributions on each of 12 highway functional classes are also estimated for each vehicle configuration. Data needs of the Department's Comprehensive TS&W Study were important considerations in selecting configurations to be included in the 1997 Federal HCAS.

Figure 1 shows VMT for different vehicle classes in rural and urban areas. Almost

Table 1. Total 2000 Travel and Number of Vehicles by Class and Registered Weights				
Vehicle Class/ Registered Weight	**Vehicle Miles of Travel (millions)**		**Number of Vehicles**	
Passenger Vehicles	**Total**	**Percent**	**Total**	**Percent**
Autos	1,818,461	67.5%	167,697,897	70.0%
Pickups/Vans	669,198	24.8%	63,259,330	26.4%
Buses	7,397	0.2%	754,509	0.3%
Total	2,495,056	92.6%	231,711,736	96.7%
Single Unit Trucks				
<25,000 pounds	56,451	2.1%	4,126,241	1.7%
25,001 - 50,000 pounds	18,631	0.7%	1,352,441	0.6%
>50,000 pounds	8,018	0.3%	491,745	0.2%
Total	83,100	3.1%	5,970,431	2.5%
Combination Trucks				
≤50,000 pounds	6,744	0.3%	253,022	0.1%
50,001 - 70,000 pounds	16,685	0.4%	225,347	0.1%
70,001 - 75,000 pounds	5,926	0.2%	94,509	0.0%
75,001 - 80,000 pounds	86,176	3.2%	1,295,973	0.5%
80,001 - 100,000 pounds	3,879	0.1%	64,365	0.0%
>100,001 pounds	2,279	0.1%	37,788	0.0%
Total	115,689	4.3%	1,971,004	0.8%
Total Trucks	198,789	7.4%	7,941,435	3.3%
Total All Vehicles	2,693,845	100.0%	239,653,170	100.0%

Source: FHWA projections based on State-reported data, the Truck Inventory and Use Survey, and other sources.

two-thirds of total automobile travel is in urban areas, a much higher percentage than for other vehicle classes. Over half of the annual travel by pickups, vans, buses, and single unit trucks is in urban areas, but only 40 percent of combination truck travel is in urban areas.

Federal-aid Highway Program Costs

The distribution of Federal obligations by improvement type and highway functional class has a strong influence on the relative cost responsibility of different vehicle classes. Estimates of the 2000 distribution of Highway Trust Fund (HTF) obligations by improvement type in the 1997 HCAS were based on the actual distribution of obligations during the 1993 to 1995 base period. For analysis purposes total 2000 obligations were assumed to equal total revenues to the HTF in Calendar Year 2000 which were estimated to be $27,174 million including $3,380 million for the Mass Transit Account (MTA) of the HTF.

As noted above two laws passed since the 1997 HCAS have affected the level and distribution of Federal obligations for highway-related purposes. First, the Taxpayer Relief Act of 1997 transferred proceeds of 4.3 cents per gallon of Federal motor fuel taxes that had been dedicated for deficit reduction to the HTF, thereby increasing overall funds available for highway-related purposes. Second, TEA-21 reauthorized surface transportation programs for six years, raising most program levels with some changes in the distribution of funds among the various programs. TEA-21 also guarantees that highway and transit program funding will be aligned with actual and projected HTF receipts. The most recent estimate of calendar year 2000 HTF receipts, including proceeds of the 4.3

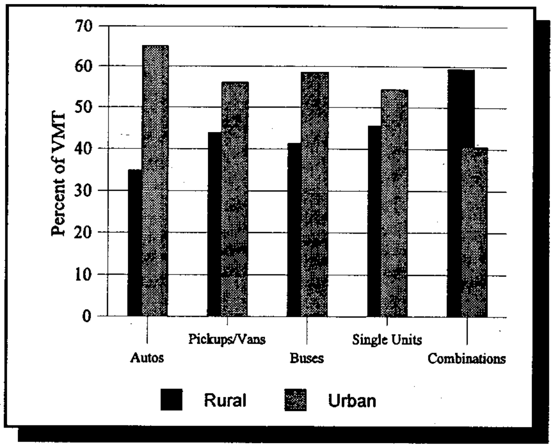

Figure 1. Distribution of VMT in Rural and Urban Areas

cents per gallon that previously had been dedicated for deficit reduction, is $33,233 million.

Table 2 compares the relative authorizations for major program areas under TEA-21 with those under ISTEA. In most cases the distribution of funds is quite similar. One notable exception is the elimination of a separate Interstate Construction program in TEA-21. All remaining work to complete the Interstate System was fully funded under prior legislation. Certain improvements to the Interstate System are eligible under the Interstate Maintenance program and Interstate System lane additions are eligible from National Highway System funds. Translating changes in authorization levels for different programs into changes in the distribution of obligations by improvement type and highway functional class is difficult. TEA-21, like ISTEA, provides States considerable flexibility to shift funds among program categories. In this analysis, the distribution of funds by improvement type for each program area in 2000 is assumed to be the same as the distribution for that program area in 1997.

Table 2. Comparison of TEA-21 and Major ISTEA Program Authorizations

Program Area	TEA-21	ISTEA
Interstate Maintenance	13.8%	13.8%
Interstate Construction	0	5.9
National Highway System	16.5	17.1
Bridge	11.8	13.1
Surface Transportation Program	19.2	19.4

Source: FHWA

Table 3 compares 2000 Federal obligations by improvement type estimated for the 1997 HCAS with revised estimates based on the TEA-21 program composition. Assuming that funds from each program area are spent in the same manner as they were in 1997, the TEA-21 program composition would be expected to have slightly more capacity expansion, and slightly less system preservation than was estimated for the 1997 HCAS based on the overall 1993-1995 distribution of obligations by improvement type.

Again, for analysis purposes, the distribution of obligations by highway functional class is assumed to be the same in 2000 as in the 1993-1995 base period. Two-thirds of Federal obligations are on urban highways and one-third on rural highways. In both urban and rural areas more Federal monies are obligated for improvements on higher order highway systems (Interstate and other principal arterial highways) than on lower order systems.

The distribution of program expenditures by highway type can significantly influence the relative cost responsibilities of different vehicle classes. The distribution of travel on different types of highways varies substantially by vehicle class, and other physical and operational characteristics of highways that can affect cost responsibility also vary by highway type.

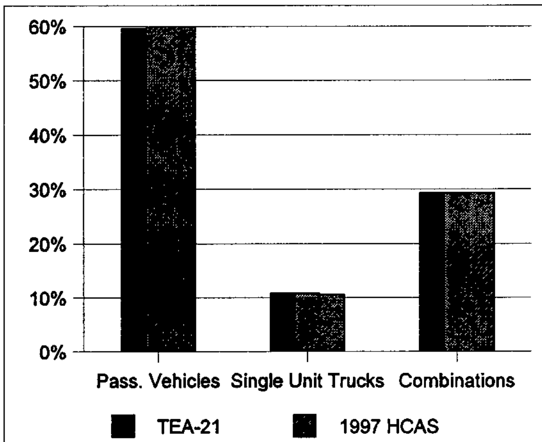

Figure 2. Shares of Highway Cost Responsibility Under TEA-21 Program Structure Compared to 1997 HCAS Shares

Source: FHWA estimates

Allocation of 2000 Federal Highway Program Costs

In this analysis, procedures for allocating various highway improvement costs among vehicle classes are the same as used in the 1997 HCAS. Table 4 summarizes the cost responsibility of different vehicles for anticipated obligations under the TEA-21 program structure, assuming that funds for each program element under TEA-21 are obligated in the same way they were obligated under ISTEA.

Figure 2 compares shares of cost responsibility under the TEA-21 program structure with cost responsibility estimated in the 1997 HCAS based upon the distribution of program costs during the 1994-1995 period. The small differences in program structure between TEA-21 and ISTEA are not large enough to substantially affect the relative cost responsibilities of different vehicle classes. Passenger vehicles have a slightly higher share of cost responsibility under TEA-21 while combinations have a slightly lower share.

Highway User Fee Payments

Highway user charges are fees upon owners and operators of motor vehicles for their use of public highways.

Table 3. 2000 Distribution of Federal Highway Program Costs Estimated in 1997 HCAS and Under TEA-21 ($ Millions)

Category	Improvement Type	1997 HCAS		TEA-21	
		Amount	Percent	Amount	Percent
New Capacity	New Construction	$2,941	10.8%	$2,879	8.7%
	Reconstruction - Added Lanes	$937	3.4%	$2,864	8.6%
	Major Widening	$1,836	6.8%	$2,007	6.0%
	Total	$5,713	21.0%	$7,750	23.3%
System Preservation	3R Preservation	$7,250	26.7%	$7,934	23.9%
	Minor Widening	$484	1.8%	$651	2.0%
	Bridge Replacement	$2,114	7.8%	$2,480	7.5%
	Major Bridge Rehabilitation	$1,198	4.4%	$1,110	3.3%
	Minor Bridge Rehabilitation	$445	1.6%	$643	1.9%
	Total	$11,490	42.3%	$12,819	38.6%
System Enhancement	Safety/TSM	$2,542	9.4%	$3,112	9.4%
	Environmentally-Related	$530	2.0%	$1,064	3.2%
	Other Projects	$1,113	4.1%	$590	1.8%
	Total	$4,184	15.4%	$4,766	14.3%
MTA		$3,380	12.4%	$4,597	13.8%
Other		$2,407	8.9%	$3,302	9.9%
Total		$27,175	100.0%	$33,233	100.0%

Source: FHWA based on obligation data in its Fiscal Management Information System

Table 4. 2000 Federal Cost Responsibility by Vehicle Class Under TEA-21 Program Structure ($ Millions)			
Vehicle Class/ Registered Weight	Total Program Costs	Cents per Mile	Shares of Total
Autos	$14,501	0.80	43.6%
Pickups/Vans	$5,103	0.76	15.4%
Buses	$237	3.20	0.7%
All Passenger Vehicles	$19,841	0.80	59.7%
Single Unit Trucks			
≤25,000 pounds	$1,245	2.20	3.7%
25,001 - 50,000 pounds	$1,049	5.46	3.2%
>50,000 pounds	$1,344	18.12	4.0%
All Single Units	$3,638	4.38	10.9%
Combination Trucks			
≤50,000 pounds	$231	3.43	0.7%
50,001 - 70,000 pounds	$557	5.21	1.7%
70,001 - 75,000 pounds	$452	7.62	1.4%
75,001 - 80,000 pounds	$7,458	8.65	22.4%
80,001 - 100,000 pounds	$594	15.32	1.8%
>100,001 pounds	$462	20.28	1.4%
All Combinations	$9,754	8.43	29.4%
All Trucks	$13,392	6.74	40.3%
All Revenues	$33,233	1.23	100.0%

Source: FHWA estimates

Historically, the primary purpose for imposing highway user fees at both the Federal and State levels has been to raise revenues to finance highway improvement programs. This direct relationship between highway user fees and highway program funding is highlighted by the fact that the Federal Government and many States deposit large parts of their highway user fees in dedicated highway or transportation trust funds rather than in the general fund. The linkage between highway user fees and highway program financing is central to HCASs which seek to determine whether fees paid by each vehicle class cover costs occasioned by those vehicles.

Current Federal highway user fees and rates are shown in Table 5. Federal highway user taxes include taxes on various highway fuels, an excise tax on the sale of heavy trucks, a tax on tires weighing over 40 pounds, and a heavy vehicle use tax (HVUT) on trucks with registered weights over 55,000 pounds. Each of these taxes has been in place for many years, although rates and the specific equipment that is taxed have changed from time to time.

Federal User Fee Payments by Vehicle Class

When the 1997 HCAS was conducted, 4.3 cents per gallon of Federal fuel tax was dedicated for deficit reduction and was not considered a highway user fee. Proceeds of the 4.3 cents per gallon are now deposited in the HTF to be used for purposes eligible under TEA-21, and are now considered highway user fees. This change affects the relative shares of highway user fees paid by different vehicle classes. Table 6 shows Federal highway user revenues (HURs) projected to be paid by different vehicle classes in 2000 under the current user fee structure. Passenger vehicles, which account for 93 percent of total highway travel, pay 68 percent of total Federal highway user fees. Combination trucks, on the other hand, pay 23 percent of total highway user fees even though they travel less than 5 percent of total mileage. Among the truck classes, user fees vary substantially by vehicle weight. Single unit trucks registered at 50,000 pounds or more pay 2.2 times as much per mile in Federal user fees as single unit trucks registered at 25,000 pounds or less. User fees paid by combination trucks do not vary as much with weight as for single unit trucks, but the variation is still substantial. Figure 3 summarizes the average Federal user fees paid per mile of travel by different vehicle classes.

Figure 4 compares shares of Federal highway user fees paid by passenger vehicles, single unit trucks, and combination trucks under the current user fee structure with shares estimated in the 1997 HCAS when proceeds of the 4.3 cents per gallon were dedicated for deficit reduction and not considered highway user fees. The share of Federal user fees estimated to be contributed by

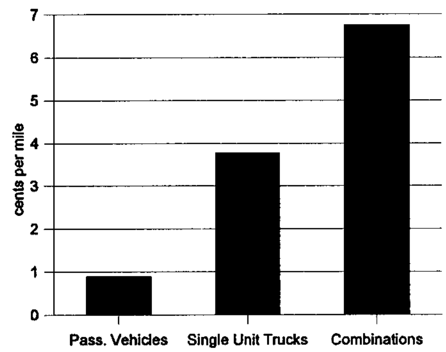

Figure 3. Federal User Fees Paid Per Mile of Travel by Vehicle Class

Source: FHWA estimates

passenger vehicles in 2000 has increased by almost 4 percentage points while the share of total user fees paid by combination vehicles decreased by almost the same amount. This difference arises because combination vehicles also pay other Federal user charges that have not changed since 1997 except for a minor technical change in the taxation of tires on new vehicles. The higher fuel taxes thus have a relatively smaller effect on total user fees paid by combination vehicles than they have on total fees paid by passenger vehicles.

2000 Federal Highway User Fee Equity Ratios

The equity of highway user charges typically is measured in HCASs as the ratio of the shares of revenues contributed by each vehicle class to the shares of highway costs that vehicle class occasions. This ratio is often called a revenue/cost ratio or an "equity ratio." As discussed in the 1997 HCAS, highway agency costs are different from the economic costs associated with the operation of different vehicle classes. Analyses of economic costs occasioned by each vehicle class, which include environmental, safety, and delay costs imposed on others as well as pavement, bridge, and other infrastructure costs, are important in considering the economic efficiency of highway user fees. However, HCASs traditionally have focused primarily on the equity of highway user fees as measured by the extent to which each vehicle class pays the share of highway agency costs for which it is responsible. Agency costs considered in HCASs do not reflect what transportation agencies should spend in various areas, but are estimates of how obligations actually are being distributed. The Department's Surface Transportation Conditions and Performance report provides overall estimates of investment requirements to meet system performance and condition objectives, although it does not suggest how much of those costs should be borne by Federal, State, and local transportation agencies.

Table 7 shows estimated Federal equity ratios in 2000 under the current highway user charge structure and the TEA-21 program structure.

Table 5. Current Federal Highway User Tax Rates

Current Tax	Tax Rate Under Current Law
Fuel	
Gasoline	18.3 cents per gallon [1]
Diesel	24.3 cents per gallon [1]
Alternative Fuels	0 - 18.3 cents per gallon [1]
Vehicle Excise Tax	
Heavy Trucks >33,000 pounds, trailers > 26,000 pounds GVW	12 percent of retail sales for new vehicles (trucks, tractors, or trailers)
Tire Tax	
41 to 70 pounds	15 cents per pound over 40 pounds
71 to 90 pounds	$4.50 plus 30 cents per pound over 70 pounds
Over 90 pounds	$10.50 plus 50 cents per pound over 90 pounds
HVUT	
Annual tax on vehicles 55,000 pounds gross weight or more	$100 plus $22 per 1,000 pounds over 55,000 with an annual cap of $550

[1] excludes 0.1 ¢ per gallon to Leaking Underground Storage Tank Fund

Source: FHWA

Equity ratios estimated in the 1997 HCAS are shown for comparison. As a class, automobiles continue to pay about the same share of Federal highway user fees as their share of highway costs, and pickups and vans continue to pay substantially more than their share of highway costs. Differences in equity ratios between automobiles and other passenger vehicles are primarily attributable to the automobiles' better fuel economy (higher miles per gallon) which means they pay less fuel tax per mile of travel than pickups and vans.

User fee equity for single unit and combination trucks is highly dependent on the weight of the vehicles. As a class single units continue to pay about 90 percent of their Federal highway cost responsibility under the new user fee and TEA-21 program structure. In the 1997 HCAS combination trucks as a group were estimated to pay 90 percent of their highway cost responsibility in 2000, but under the new user fee and program structure, combinations will pay only about 80 percent of their cost responsibility. This reduction in the equity ratio for combination trucks primarily arises because combination trucks will pay a smaller share of Federal user fees under the new user fee structure than they did under the former fee structure while their share of cost responsibility remains virtually the same. For both single unit and combination trucks, there continue to be large differences in equity ratios for vehicles in different weight groups.

Other Highway-Related Costs

The 1997 HCAS included extensive discussions of highway-related costs that are not borne by transportation agencies, but by motorists or society at large. These costs include environmental, safety, congestion, and other costs associated with highway use. While transportation agencies do not bear these costs directly, their concern about such costs is evidenced by a broad range of regulatory and programmatic initiatives to reduce crashes, emissions, and other consequences of highway use that create costs for society. Significant progress has been made in reducing many of these social costs of highway use, but substantial costs remain. As discussed in the 1997 HCAS, crashes, congestion, air pollution, and noise are generally acknowledged to be the most significant social costs that can be quantified.

As noted in the Introduction to this Addendum, the 1997 HCAS did not include estimates of air pollution costs. Work on a major EPA study on Benefits and Costs of the Clean Air Act was still underway which was relevant to estimates of air pollution costs associated with motor vehicle use. The Department postponed estimating highway-related air pollution costs until that work was completed and the same methods could be used for the Department's highway cost allocation study.

Table 6. 2000 Federal User Fee Payments by Vehicle Class Under the Current Federal User Charge Structure ($ Millions)

Vehicle Class/ Registered Weight	Total User Fee Payments	Cents per Mile	Shares of Total
Autos	$14,819	0.81	44.6%
Pickups/Vans	$7,416	1.11	22.3%
Buses	$50	0.67	0.1%
All Passenger Vehicles	$22,285	0.89	67.1%
Single Unit Trucks			
≤25,000 pounds	$1,853	3.28	5.6%
25,001 - 50,000 pounds	$746	3.88	2.2%
>50,000 pounds	$543	7.32	1.6%
All Single Units	$3,142	3.78	9.5%
Combination Trucks			
≤50,000 pounds	$332	4.92	1.0%
50,001 - 70,000 pounds	$561	5.25	1.6%
70,001 - 75,000 pounds	$402	6.78	1.2%
75,001 - 80,000 pounds	$6,006	6.97	18.1%
80,001 - 100,000 pounds	$300	7.74	0.9%
>100,001 pounds	$205	9.01	0.6%
All Combinations	$7,806	6.75	23.5%
All Trucks	$10,948	5.51	32.9%
All Revenues	$33,233	1.23	100.0%

Source: FHWA estimates

Table 7. Ratios of 2000 Federal User Charges to Allocated Costs by Vehicle Class		
Vehicle Class/Registered Weight	**1997 HCAS Ratios**	**Updated Ratios**
Autos	1.0	1.0
Pickups/Vans	1.4	1.5
Buses	0.1	0.2
Passenger Vehicles	1.1	1.1
Single Unit Trucks		
≤25,000 pounds	1.5	1.5
25,001 - 50,000 pounds	0.7	0.7
> 50,001 pounds	0.5	0.4
Total Single Unit	0.9	0.9
Combination Trucks		
≤50,000 pounds	1.6	1.4
50,001 - 70,000 pounds	1.1	1.0
70,001 - 75,000 pounds	1.0	0.9
75,001 - 80,000 pounds	0.9	0.8
80,001 - 100,000 pounds	0.6	0.5
>100,001 pounds	0.5	0.4
Total Combinations	0.9	0.8
Total All Vehicles	1.0	1.0

Source: FHWA estimates

One point emphasized in the 1997 HCAS is the uncertainty surrounding estimates of most social costs of highway use. Differences between high and low cost estimates may vary by one or more orders of magnitude. Many factors contribute to this uncertainty including (1) the difficulty in isolating effects of highway-related factors from other factors that contribute to health and other social costs; (2) the site-specific nature of many social costs of highways; and (3) uncertainties in valuing costs of premature deaths attributable to highway crashes and motor vehicle emissions.

Highway-Related Air Pollution Costs

Motor vehicles produce emissions that in sufficient pollutant concentrations can cause a variety of health and other impacts including shortness of breath, respiratory and other disease, death, structural deterioration, crop damage, and decreased visibility. Since 1970, the Federal Clean Air Act (CAA) and 1977 and 1990 Clean Air Act Amendments (CAAA) have provided a framework for nationwide efforts to reduce motor vehicle and other sources of air pollution. Important provisions of those laws include establishment of National Ambient Air Quality Standards for key pollutants, requirements that States develop implementation plans for attaining those standards, and limits on allowable motor vehicle tailpipe emissions. The ISTEA and TEA-21 complement the CAA by providing funding to implement balanced transportation programs that will reduce emissions.

In 1997, EPA developed a report, The Benefits and Costs of the Clean Air Act, 1970 - 1990. This report reflects EPA's findings and not necessarily those of other agencies in the Administration. Other agency's concerns included, among other things, the methods used to estimate the number of premature deaths and illnesses avoided due to the CAA, and the methods used to value non-health related benefits. Part of these concerns arise from the no-control baseline EPA uses to estimate reductions that have been achieved in emissions since passage of the CAA. Mindful of other agencies concerns, this Addendum uses EPA's estimates as an illustrative bounding case example of the impact of motor vehicle emissions.

Table 8, based on data in EPA's 1998 report, shows the estimated contribution of on-highway motor vehicles to total emissions for key air pollutants in 1990. The EPA estimates that in 1990 motor vehicles accounted for only 2 percent of total sulfur dioxide emissions and 11 percent of total suspended particulate emissions. Conversely, motor vehicles accounted for 70 percent of total carbon monoxide and 2/3 of lead emissions.

Despite the progress that has been made to date in reducing harmful motor vehicle emissions, air pollution remains a concern in many parts of the country. In its report, The Benefits and Costs of the Clean Air Act, 1970 - 1990, EPA estimates the economic benefits of air pollution reductions achieved under the CAA. Methods used by EPA in its 1998 study are the primary bases of air pollution cost estimates in this report. As noted in the Introduction, costs of air pollution estimated in this Addendum are social and economic costs of air pollution, not the engineering costs to comply with standards or to mitigate adverse impacts as the term "costs" is often used in the environmental literature.

Table 9 shows estimates of economic costs associated with highway-related air pollution based upon data and methods used by EPA in its study. Almost all costs are attributable to mortality, chronic bronchitis, and other respiratory and heart diseases caused by inhalation of particulate matter, but some costs also arise from ozone, sulfur dioxide, nitrogen dioxide, and carbon monoxide. Other effects of air pollution including infant mortality, changes in pulmonary function, lung inflammation, and reduced crop yields are known to arise from air pollution but are not included in these costs because researchers have not yet quantified those effects. Future research should allow a more complete accounting of air pollution costs arising from motor vehicles and other sources.

Table 8. Major Highway-Related Air Pollutants

Pollutant	Percent of Total 1990 Emissions from Highway Motor Vehicles
Total Suspended Particulates	11.1%
Sulfur Dioxide	2.4%
Nitrous Oxides	36.0%
Volatile Organic Compounds	37.1%
Carbon Monoxide	70.4%

Source: The Benefits and Costs of the Clean Air Act, Tables B-16 to B-20.

Even costs quantified in Table 9 are highly uncertain due to data and methodological limitations and should be viewed as indicative only of the order of magnitude of costs. Chemical processes that transform emissions into ozone, particulate matter, and other pollutants are very complex, as is the transport of pollutants from their source to where they ultimately affect human health. Sources of some pollutant types are not well understood, nor are some aspects of the health impacts due to motor vehicle emissions. Scientific data on relationships between air pollution and premature death also are weak in many cases. This Addendum does not fully discuss these limitations and uncertainties. Technical reports by Systems Applications International[2] and Abt Associates,[3] from which air pollution cost estimates shown in Table 9 and subsequent tables are derived, discuss many of those factors and indicate areas where further research is needed. They also discuss the various empirical studies that have attempted to estimate economic costs for different pollutants and issues involved in extrapolating results of those case-specific studies to nationwide cost estimates.

There is considerable debate about valuing economic costs of premature deaths associated with air pollution. This debate is important because costs associated with premature deaths from particulate matter account for over three-quarters of total air pollution-related costs.

In policy and regulatory analyses, EPA uses a value of $4.8 million to represent the cost of a premature death. This value is the mean of estimates from 26 studies dating back to the mid 1970s that have attempted to place a value on the cost of premature deaths. Estimates from those studies range from $0.6 million to $13.5 million, reflecting the large uncertainties in trying to estimate the public's willingness to pay to avoid premature death.

The Department of Transportation has adopted a value of $2.7 million per premature death, based on a comprehensive 1991 study by the Urban Institute. While that study focused on the costs of premature deaths associated with highway crashes, it drew upon many of the same studies that EPA used, and the results apply to premature deaths attributable to factors other than highway crashes. Both DOT and EPA have devoted significant efforts in developing these cost estimates, and while their costs differ somewhat, they fall within a much broader range of costs that have been estimated by others.

The EPA's study, The Benefits and Costs of the Clean Air Act, notes that the Science Advisory Board charged with reviewing the study recommended comparing cost estimates based upon EPA's traditional value of life estimates with costs using an alternative approach for valuing costs of air pollution-related deaths. That approach explicitly considers the number of years by which lives may be shortened as a result of exposure to air pollution. Under this life-years lost approach, costs of premature death are estimated to be about 55 percent of EPA's value of $4.8 million per premature death. This translates into an average value of about $2.6 million per premature death, which coincidentally, is very close to the value DOT uses for the cost of premature deaths. The EPA has additional research underway in this area.

Figure 5 compares total motor vehicle-related air pollution costs estimated using DOT's cost

Table 9. Estimated Economic Costs of Motor Vehicle-Related Air Pollution in 2000 [1]

Pollutant	Impact	Costs of Rural Motor Vehicle Travel $1990 (millions)	Costs of Urban Motor Vehicle Travel $1990 (millions)	Costs of All Motor Vehicle Travel $1990 (millions)
Particulate Matter	Mortality[2]	12,695	21,558	31,162
Particulate Matter	Non-fatal Illness	3,683	6,232	9,183
Sulfur dioxide, nitrogen dioxide, carbon monoxide	Non-fatal Illness	0	51	51
Ozone	Non-fatal Illness	28	16	47 [3]
Total		16,406	27,857	40,443 [4]

[1]Costs for "criteria" pollutants only (does not include toxic pollutant costs). Excludes certain health-related costs and costs of reduced visibility, crop damage, and material damage not quantified by EPA.
[2]Mortality costs based on DOT's $2.7 million estimated cost of a premature death.
[3] Does not include ozone mortality costs, which are highly uncertain.
[4] Comparable estimate using EPA's value of life is $64,681.

Source: Abt Associates, 1998, pages 9-11.

of premature death with costs estimated using EPA's value. As noted above, preliminary estimates using an alternative life-years lost approach would be slightly less than costs using the DOT cost estimates, but more work needs to be done to develop a consensus on the advisability and applicability of a life-years approach to valuing costs of premature death associated with air pollution and to refine those cost estimates. It is also important to note that data and methods used by EPA that were the basis for these cost estimates continue to be improved.

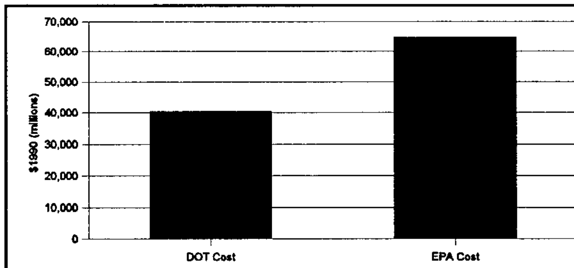

Figure 5. Comparison of Social Costs of Highway Related Air Pollution in 2000 Based on DOT and EPA Costs of Premature Death

Source: Abt Associates for EPA and FHWA.

Air pollution costs attributable to motor vehicles were estimated by comparing levels of air pollution when all sources of pollution were present with air pollution when motor vehicle emissions were eliminated. Costs attributable to rural motor vehicle travel were estimated by eliminating all urban motor vehicle travel, and urban costs were estimated by eliminating rural travel. These methods were necessary to eliminate interactions between emissions in rural and urban areas that would make it impossible to estimate whether there are significant differences in costs associated with travel in rural and urban areas.

About two-thirds of motor vehicle-related air pollution costs are attributable to urban travel and one-third to rural travel. As can be seen in Table 9, the sum of these costs for urban and rural travel individually is slightly greater than costs for all motor vehicle travel. This is explained by regional transport of both precursor emissions and air pollutants and the complex chemistry leading to the production of ozone and particulate matter.

Figure 6 shows overall average air pollution costs per mile of travel in rural and urban areas. Average costs for rural travel are about 1.5 cents per mile compared to 1.75 cents per mile for urban travel. Average costs for all motor vehicle travel are about 1.5 cents per mile. Costs for all travel are lower than would be expected based on costs for urban and rural travel alone because, as noted above, total costs for all motor vehicle travel are less than the sum of costs of rural and urban travel when those costs are estimated individually.

The average costs shown in Figure 6 mask large differences in highway-related air pollution costs in various parts of the country. They also do not reflect differences in costs associated with travel by different vehicle classes.

While the uncertainty of cost estimates was emphasized in technical reports submitted by consultants for this study, no explicit range of high, medium, and low estimates of motor

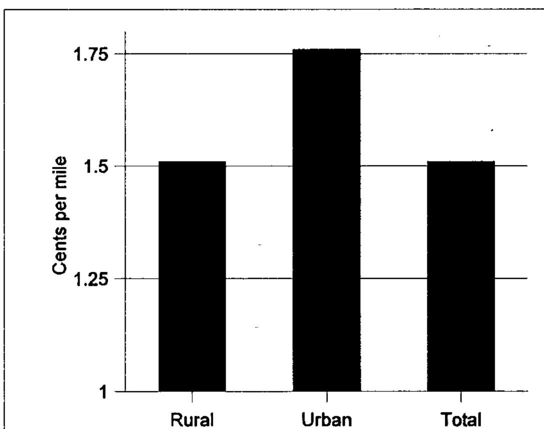

Figure 6. Average Air Pollution Costs per Mile in Rural and Urban Areas

Source: FHWA estimates based on SAI and Abt Associates data.

Table 10. 2000 High, Mid-Range, and Low Estimates for Social Costs of Motor Vehicle Use ($ Millions)			
	High	Mid-Range	Low
Congestion	$181,635	$61,761	$16,352
Crash Costs	$839,463	$339,886	$120,580
Air Pollution	$349,100	$40,443	$30,300
Noise	$11,446	$4,336	$1,214
Total	$1,533,344	$446,319	$170,246

Source: McCubbin and Delucchi, Cambridge Systematics and Abt Associates.

vehicle-related air pollution costs was developed. A recent study of air pollution costs attributable to motor vehicles by Mark Delucchi and Donald McCubbin estimated that costs range from 0.9 to 14 cents per mile.[4] This is a wide range, but it is consistent with ranges estimated for other social costs of highway use.

A major source of variation in estimates of air pollution costs attributable to motor vehicles is whether or not road dust is included. The EPA does not classify road dust as a pollutant attributable to motor vehicles, but others have included road dust in cost estimates.

Table 10 shows high, medium, and low estimates of the costs of air pollution attributable to motor vehicle use along with the costs of crashes, congestion, and noise that were included in the 1997 HCAS. The mid-range air pollution cost estimate is taken from costs shown in Table 9. The EPA did not develop ranges of motor-vehicle-related air pollution costs; high and low cost estimates shown in Table 10 are taken from McCubbin and Delucchi's estimates of total social costs of motor vehicle use. None of the air pollution cost estimates include costs associated with road dust stirred up by the passage of motor vehicles.

Crash costs represent the largest social cost of motor vehicle use shown in Table 10 across all cost ranges. The high estimate of air pollution costs ranks second among high cost estimates, but mid-range estimates of congestion costs are 50 percent higher than corresponding estimates of air pollution costs.

For each of the impact areas shown in Table 10 the "mid-range" estimate is closer to the low than to the high estimate. This is another reflection of uncertainties surrounding economic costs of highway use. The high cost estimates often include costs which some analysts do not believe should be attributed to highway use, costs that are difficult to quantify, or costs for which only limited evidence exists. Also, the high range costs generally include the highest values that have been estimated for key cost components from among the various studies that have been done whereas mid-range costs typically use values that approximately reflect mean values estimated in other studies. Mid-range cost estimates rely on the soundest evidence available to date for each impact area, but are subject to change over time as new research results become available.

Figure 7 compares highway agency costs with social costs of highway use. Social costs are broken into costs borne by highway users (congestion costs and most crash costs) and costs borne by non-users (air pollution, noise, and a small share of crash costs). While most social costs of highways included in Figure 7 are borne by highway users, the $90 billion borne by society in general is significant.

Air Pollution Costs Attributable to Different Vehicle Classes

Table 11 shows percentages of different types of emissions attributable to the vehicle classes included in EPA models. These vehicle classes do not correspond well with vehicle classes used by the Department for highway cost allocation and truck size and weight analyses. In particular, most of the trucks with three or more axles are all grouped in the EPA class of heavy duty diesel vehicles. Thus, it is difficult to directly use the EPA models to estimate air pollution costs attributable to the different highway cost allocation study vehicle classes.

Except for PM_{10} and $PM_{2.5}$, automobiles account for the largest share of various motor vehicle emissions. Because of the complex chemical processes by which emissions are transformed into particulate matter, ozone, and other secondary pollutants, and variations in the transport of pollutants in different regions of the country, relative emissions attributable to different vehicle classes cannot be directly translated into relative air pollution costs without detailed air quality modeling that was beyond the scope of this project. For instance, while heavy trucks account for a large share of particulate emissions, they account for a smaller share of costs because significant portions of particulate matter are formed through chemical reactions involving other compounds emitted predominantly by light trucks and passenger vehicles.

Four vehicle classes are responsible for 99 percent of all emissions: automobiles; pickups, vans, and sport utility vehicles; heavy duty gas vehicles; and heavy duty diesel vehicles. Other vehicle classes have much less VMT, and thus their total emissions are lower, although emissions per mile of travel would be comparable. The emissions modeling approach used in this study did not differentiate emissions more finely than the eight vehicle classes shown in Table 11. While the relative emissions shown in Table 11 do not directly correspond to the relative contribution to pollution and pollution-related costs for different vehicle classes, they do indicate the relative order of magnitude of the contribution by different vehicle classes. Further work is underway to improve estimates of emissions by different vehicle classes under a variety of operating conditions. This work should improve the ability to estimate the relative contribution to air pollution costs by different vehicle classes

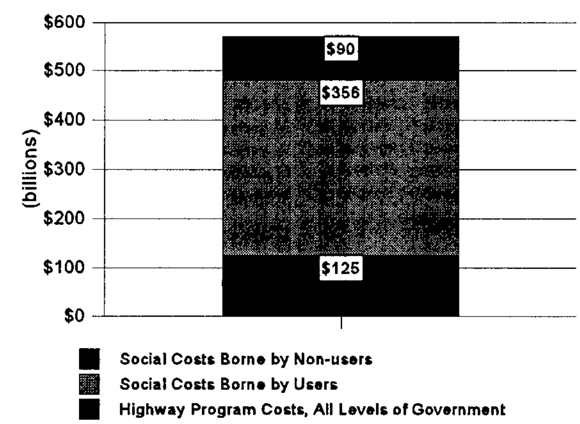

Figure 7. Total 2000 Highway Program Costs and Social Costs Borne by Users and Non-Users

Source: FHWA estimates.

Table 12 uses the percentages from Table 11 to estimate total costs attributable to the four EPA vehicle classes that account for the majority of costs along with the average costs per mile of travel for each vehicle class. Costs are estimated by taking proportions of total precursor emissions for each vehicle class, based upon the Group 3 set of emissions shown in Table 11, and multiplying by total air pollution costs. Costs per mile are estimated by dividing total costs for each vehicle class by the VMT for that class. Passenger vehicles (automobiles, pickups and vans) account for about three-quarters of total estimated costs. Costs per mile for pickups and vans are closer to those of trucks than they are to costs per mile for automobiles because pickups and vans are not subject to the same tailpipe emissions standards as automobiles and because they get poorer fuel economy than automobiles.

Marginal Costs of Highway Use

Marginal costs of highway use reflect changes in total costs associated with an additional increment of travel. Marginal costs include

Table 11. Distribution of Various Emissions by Vehicle Class									
	LD Gas Vehicles	**LD Gas Trucks 1**	**LD Gas Trucks 2**	**HD Gas Vehicles**	**LD Diesel Vehicles**	**LD Diesel Trucks**	**HD Diesel Vehicles**	**Motor-cycles**	**Total**
SOA	51%	15%	10%	5%	0%	0%	17%	1%	99%
SOx	45%	15%	8%	3%	0%	0%	29%	0%	100%
NOx	42%	29%	0%	4%	0%	0%	25%	0%	100%
VOC	60%	30%	0%	5%	0%	0%	5%	0%	100%
PM10	26%	7%	4%	3%	0%	0%	59%	0%	99%
PM, coarse	47%	12%	7%	4%	0%	0%	29%	0%	99%
PM2.5	19%	6%	3%	3%	0%	0%	68%	0%	99%
Group 1	50%	29%	0%	4%	0%	0%	16%	0%	99%
Group 2	50%	28%	0%	4%	0%	0%	17%	0%	100%
Group 3	50%	28%	1%	4%	0%	0%	17%	0%	100%
LD Gas Vehicle – gas-powered automobile									
LD Gas Truck 1 – gas-powered trucks weighing 6,000 pounds or less (pickups, vans, etc.)									
LD Gas Truck 2 – gas powered trucks weighing between 6,001 and 8,500 pounds									
HD Gas Vehicles – gas powered trucks and buses weighing more than 8,500 pounds									
LD Diesel Vehicle – Diesel-powered automobiles									
LD Diesel Trucks – diesel-powered trucks weighing 8,500 pounds or less									
HD Diesel Vehicles – diesel-powered vehicles weighing more than 8,500									
SOA - secondary organic aerosols									
SOx – sulfur dioxide									
NOx – nitrogen oxide									
VOC – Volatile organic compounds									
PM10 – directly emitted particulate matter less than 10 microns									
PM, coarse – directly emitted particulate matter between 10 and 2.5 microns									
PM2.5 – directly emitted particulate matter less than 2.5 microns									
Group 1 – VOC and NOX, the primary precursor emissions for ozone									
Group 2 – Group 1 plus PM2.5, SOx, and SOA, precursors for both ozone and PM formation									
Group 3 – Group 2 plus ammonia, a precursor for both ozone and PM formation									

Source: Abt Associates for FHWA and EPA

incremental costs to the highway user (e.g., added vehicle operating cost and travel time), costs to public agencies (added use-related rehabilitation and maintenance costs), and external costs such as air pollution and congestion costs imposed on others. Many marginal costs vary by either location of travel or time-of-day. For instance, incremental pavement deterioration associated with an extra mile of travel by particular vehicle classes depends on the design and condition of the pavement upon which they travel, temperature, and other local characteristics. Congestion costs associated with an additional mile of travel on low-volume rural Interstate highways are negligible, but costs on urban Interstate highways may be high, particularly during peak periods when traffic volumes are greatest.

Table 12. Air Pollution Costs Attributable to Different Vehicle Classes		
Vehicle Class	**Total Estimated Cost ($1990 millions)**	**Cents Per Mile of Travel**
Automobiles	$20,343	1.1
Pickups, Vans	$11,324	2.6
Gasoline Vehicles > 8,500 pounds	$1,699	3.0
Diesel Vehicles > 8,500 pounds	$6,794	3.9

Source: FHWA estimates based on Abt Associates data

Pavement costs represent the contribution of a mile of travel by different vehicles to pavement deterioration and the costs of repairing the damage. Congestion costs reflect the value of added travel time due to additional small increments of traffic. Crash costs include medical costs, property damage, lost productivity, pain and suffering, and other costs associated with highway crashes. Air pollution costs are measured in terms of the cost of premature death, illness, and other effects of various highway-related emissions. Noise costs reflect changes in the value of adjacent properties caused by motor vehicle-related noise.

With the exception of their own travel time, vehicle operating costs, and perhaps risks of having a crash, highway users normally do not consider many of these marginal costs when deciding whether to make a trip. In general, economic efficiency would be enhanced if users had to pay those marginal costs they do not consider in trip-making decisions.

Since many marginal costs vary according to when or where a trip is made, charges based on average costs will not necessarily promote improved economic efficiency. To achieve the greatest degree of efficiency, fees reflecting the marginal costs of trips made in various locations at various times of the day should be charged. Then, only trips whose benefits equal or exceed the full cost of the trip would be made.

Table 13 shows estimates of marginal pavement, congestion, crash, air pollution, and noise costs in 2000 for selected vehicles operating under different conditions. Costs reflect typical or average conditions; in certain locations, costs could be expected to vary from values shown. The relative costs of pavement damage, congestion, crashes, air pollution, and noise for different vehicle classes operating in rural and urban areas are as important as the individual costs themselves.

Marginal air pollution costs are particularly difficult to estimate because they are influenced by other sources of pollution in an area, climatic and atmospheric conditions, the complex chemistry of secondary pollutant formation, and other factors that vary over time and location. Not only do emissions per mile of travel vary depending on local conditions, but more importantly, contributions of those emissions to changes in pollutant concentrations and to health and other air pollution-related costs vary widely.

Marginal air pollution costs were estimated for this study by first estimating differences in air pollution concentrations with and without highway traffic. Costs of the air pollution attributable to motor vehicle use were then estimated based on marginal costs of changes in pollutant concentrations estimated in other recent studies and used by EPA in its study, The Benefits and Costs of the Clean Air Act, 1970 - 1990. Finally, per-mile costs were estimated by dividing total costs by VMT. While strictly speaking these are average rather than marginal costs with respect to VMT, they are derived from estimates of the marginal costs of changes in air pollution concentrations. Furthermore changes in air pollution concentrations with and without motor vehicle emissions were less than 10 percent at most locations where changes were

Table 13. 2000 Pavement, Congestion, Crash, Air Pollution, and Noise Costs for Illustrative Vehicles Under Specific Conditions						
	Cents per Mile					
Vehicle Class/Highway Class	Pavement	Congestion	Crash	Air Pollution	Noise	Total
Autos/Rural Interstate	0	0.78	0.98	1.14	0.01	2.91
Autos/Urban Interstate	0.1	7.70	1.19	1.33	0.09	10.41
40 kip 4-axle S.U. Truck/Rural Interstate	1.0	2.45	0.47	3.85	0.09	7.86
40 kip 4-axle S.U. Truck/Urban Interstate	3.1	24.48	0.86	4.49	1.50	34.43
60 kip 4-axle S.U. Truck/Rural Interstate	5.6	3.27	0.47	3.85	0.11	13.3
60 kip 4-axle S.U. Truck/Urban Interstate	18.1	32.64	0.86	4.49	1.68	57.77
60 kip 5-axle Comb/Rural Interstate	3.3	1.88	0.88	3.85	0.17	10.08
60 kip 5-axle Comb/Urban Interstate	10.5	18.39	1.15	4.49	2.75	37.28
80 kip 5-axle Comb/Rural Interstate	12.7	2.23	0.88	3.85	0.19	19.85
80 kip 5-axle Comb/Urban Interstate	40.9	20.06	1.15	4.49	3.04	69.64

NOTE: S.U. = Single Unit, Comb. = Combination; Air pollution costs are averages of costs of travel on all rural and urban highway classes, not just Interstate. Available data do not allow differences in air pollution costs for heavy truck classes to be distinguished.

Source: FHWA estimates based on Cambridge Systematics and Abt Associates data.

estimated. Since resource constraints did not allow direct estimation of marginal air pollution costs of motor vehicle use, the average cost estimates are used to approximate marginal costs.

Separate estimates were made of costs of rural and urban travel but those estimates do not show the large variations that occur in specific rural or urban locations. No separate estimates were made for travel on different highway functional classes. Costs for different vehicle classes are estimated simply on the basis of relative emissions. Considerable work remains to improve estimates of marginal air pollution costs by different vehicle classes.

While marginal pavement, safety, congestion, and noise costs more closely represent true marginal costs than do marginal air pollution costs, they all represent average or typical marginal costs estimated for a broad cross section of Interstate highways. Costs at specific locations could vary considerably from costs shown, especially for noise costs which, like air pollution costs, are subject to many external factors.

Variations in marginal costs among vehicles and locations are not uniform; they are highly dependent on the type of cost being considered. Pavement, congestion, air pollution, and noise costs are higher in urban areas than rural areas, but marginal crash costs are higher in rural areas, reflecting the higher fatality rates for travel in rural areas. Cost differences among vehicle classes also vary widely. The 80,000 pound 5-axle combination truck operating in urban areas, has marginal costs many times greater than those of autos operating in rural areas, but marginal costs for 60,000 pound combination trucks operating in rural areas are less than marginal costs of automobiles operating on congested urban Interstate highways.

Figure 8 shows high and low ranges of air pollution, noise, congestion, and crash cost estimates along with best estimates (middle range) of those costs based upon the best research in each area. The large uncertainty surrounding these estimates suggests that caution should be exercised in making decisions that could significantly influence either user costs or highway investment based upon these social costs.

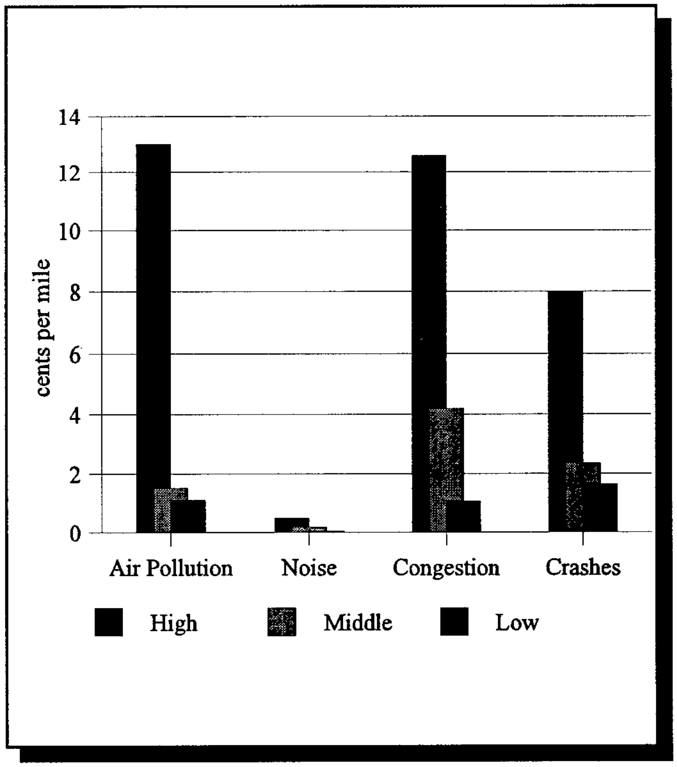

Figure 8. 2000 Estimated Ranges of Marginal Costs of Highway Travel

Highway marginal costs cannot directly be separated into Federal and non-Federal costs. Costs result from travel on all highways and to one extent or another affect all segments of society and all geographic areas. All units of government working together have joint responsibilities to take appropriate steps to reduce these costs. These steps may include mitigating costs through regulatory means, making investment decisions that contribute toward reducing highway marginal costs, or using pricing mechanisms to more nearly reflect marginal costs in the prices that motorists pay for highway transportation.

While highway marginal costs cannot be assigned to one level of government or another, there is an interest in how close current Federal user fees are to efficient fees. To compare cost allocations based on efficiency criteria with Federal user fee payments by different vehicles, marginal costs must be distributed among different levels of government. The 1982 Federal HCAS distributed marginal costs in proportion to the shares of total highway user revenues produced at each level of government on the grounds that this would leave the relative roles of each level of government for financing and charging for highways unchanged. The same approach is used in this study.

Table 14 compares the estimated Federal shares of marginal costs from Table 13 to Federal highway cost responsibility estimated in the equity analysis and to Federal user fees paid by different vehicle classes. Comparing Federal user fees with the Federal share of marginal costs reflects the efficiency of the user fee structure while comparing user fees to program cost responsibility is a measure of equity. Marginal costs and program costs are estimated by different methods for completely different purposes and cannot be added together.

Federal program costs are greater than the estimated Federal share of marginal costs for rural travel by heavy single unit trucks and combinations, but less than marginal costs for automobiles and light single unit trucks. Marginal costs of congestion, noise, and safety

Vehicle Class/Highway Class	Marginal Costs	Federal Program Costs	Federal User Fees
Autos/Rural Interstate	0.9	0.4	0.8
Autos/Urban Interstate	3.1	1.8	0.8
40 kip 4-axle S.U. Truck/Rural Interstate	2.4	2.1	12.4
40 kip 4-axle S.U. Truck/Urban Interstate	10.3	4.6	12.4
60 kip 4-axle S.U. Truck/Rural Interstate	4.0	8.6	14.0
60 kip 4-axle S.U. Truck/Urban Interstate	17.3	15.3	14.0
60 kip 5-axle Comb*/Rural Interstate	3.0	3.3	6.9
60 kip 5-axle Comb*/Urban Interstate	11.2	8.1	6.9
80 kip 5-axle Comb*/Rural Interstate	5.9	9.5	7.4
80 kip 5-axle Comb*/Urban Interstate	20.9	21.2	7.4

Table 14. 2000 Comparison of Assumed Federal Share of Marginal Highway Costs to Federal Agency Costs and Federal User Fees
(cents per mile)

Source: FHWA estimates

are relatively low in rural areas, and overall agency cost responsibility in rural areas exceeds marginal costs for all but the lightest vehicle classes. In urban areas the opposite is true. Not only are costs of congestion, air pollution, and noise higher in urban than rural areas, but marginal pavement costs also are higher, reflecting among other things the higher construction costs in urban areas and the delay incurred by users when pavements are being rehabilitated. Federal user fees per mile of travel exceed marginal costs of rural travel for all vehicle classes except automobiles. Marginal costs of urban travel exceed Federal user fees per mile for all vehicle classes except the light single unit truck.

There currently are no Federal, State, or local user fees imposed that directly reflect congestion, air pollution, noise, or other external costs of highway use. There is interest, however, among some State and local agencies in exploring the feasibility of variable or time-of-day pricing to help manage highway travel in certain corridors. For instance on State Route 91 in California, four additional lanes were constructed with private funds on which tolls are charged that vary by time of day. A project is underway in San Diego under the Value Pricing Pilot Program that has tolls which vary according to the level of congestion.

Fees on "gross emitters," the most polluting of vehicles that are responsible for large percentages of total pollutants, have been suggested as a way to charge the worst polluters for air pollution costs they impose, and general increases in fuel taxes have also been suggested to address air pollution costs. A gross emitter tax could directly reflect air pollution costs, but questions of equity and other implementation issues have prevented such a tax from being implemented to date. General fuel tax increases implemented at the local level would not be as sensitive to factors affecting air pollution as the gross emitter tax, but could reflect regional differences in air pollution costs.

While there are opportunities at the local level to develop user fees that could reflect congestion, air pollution, and other external costs, implementing charges that could reflect the locational and temporal variability or most such costs would be difficult.

Summary and Conclusions

Since the 1997 HCAS was completed, several changes affecting conclusions about the equity and economic efficiency of Federal highway user fees have occurred. First and most importantly, proceeds of 4.3 cents per gallon of Federal fuel taxes have been shifted from the General Fund where they were dedicated to deficit reduction to the Highway Trust Fund where they may be used for highway-related purposes under the new TEA-21 legislation. Second, TEA-21 significantly increased total authorizations for highway, transit and related purposes and shifted the distribution of funding among different program areas. Third, additional information has been developed concerning air pollution-related costs of highway use which fills a large gap in estimates of social and marginal costs of highway travel.

From an equity perspective, the most significant change is an increased spread in ratios of user fee payments to highway cost responsibility between lighter vehicles and heavier vehicles. Table 7 showed that equity ratios for the heaviest single unit trucks and all the weight groups of combination trucks went down. Now only the very lightest combination trucks pay their share of Federal highway cost responsibility. The most common combination vehicles, those registered at weights between 75,000 and 80,000 pounds, now pay only 80 percent of their share of Federal highway costs and combinations registered between 80,000 and 100,000 pounds pay only half their share of Federal highway costs. Any future increase in Federal fuel taxes without corresponding increases in taxes on the heaviest trucks will further exacerbate the underpayment of Federal user fees by heavy trucks.

Changes in program composition and funding levels between ISTEA and TEA-21 did not have a large effect on the relative cost responsibility of different vehicle classes. Much larger changes in relative program funding levels would be required to substantially affect cost responsibility, and the flexibility for States to shift funds from one program to another would temper even large changes in program composition.

Economic costs of motor vehicle-related air pollution remain large, even though substantial progress has been made in abating emissions through a variety of initiatives. While average air pollution costs per mile of travel in rural areas are not much lower than average costs of urban travel - 1.5 cents per mile in rural areas compared to 1.75 cents per mile in urban areas - care must be exercised in interpreting these results because they mask real differences in air pollution-related costs of motor vehicle use in different areas. Air pollution costs of travel in very rural areas away from population centers would be lower than the average rural costs shown in this report, and likewise, costs of travel in urban areas with the highest ambient air pollution levels would be higher than average costs of urban travel shown in this report. Air pollution is one of the most difficult social costs of highway use to evaluate from a policy perspective because effects vary geographically and spill over to other areas in ways that vary from region to region. More research will be needed to further refine estimates of marginal air pollution costs in various locations.

The Department plans to update the 1997 HCAS before the next surface transportation reauthorization. Potential options to improve overall user fee equity will be examined in greater depth in that study and additional research to improve estimates of air pollution and other social costs of highway travel will be conducted.

Footnotes

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