Healthy Returns:
The Economic Effects of Surface Transportation and Motor Fuel Taxes

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I. Introduction

The prosperity, wealth and free movement that Americans enjoy could hardly exist without our extensive network of public highways, roads, and bus and rail systems. Nor could the markets that make up the U.S. economy operate efficiently — or operate at all in their present form — without the surface transportation systems that link businesses to their suppliers and customers, and give every person access to goods, services and jobs. This vast transportation network also brings an array of other goods and services — education, health care, recreation, government services and more — within the reach of every American.

This study examines the economic and social costs benefits, as well as costs, of our surface transportation system. While estimates vary depending on assumptions, we find under base-case assumptions that the current use of public highways and public transit produces about $700 billion a year in net economic benefits for Americans. Based on new estimates developed for this study, our highway and transit investments produce about $260 billion a year in benefits for U.S. businesses, principally in lower costs and higher productivity. These investments also generate about $440 billion a year in benefits to individual Americans in the value of the time they save commuting to work and the higher income they can earn by working further from home.

Americans spend about $150 billion a year in taxes and other fees to build, operate and maintain the networks generating these benefits. Federal, state and local motor-fuel taxes are the largest single source of funds, although the $61 billion raised by these fuel taxes covers less than 40 percent of public spending for surface transportation. Federal fuel taxes, which produce most of the federal revenues used for highways and transit, also leverage significant additional spending by states and localities through federal highway and public-transit grants.

Relying on fuel taxes to support highways and transit is sound economics. Most forms of taxation raise the relative price of the goods or activities being taxed, interfering with the market's ability to allocate resources according to actual costs, and so reduce the economy's overall efficiency. Fuel taxes, however, function largely as user fees and

[1] This study was commissioned and sponsored by the American Public Transportation Association

externality taxes; and these taxes, when set at the proper level, can make the economy *more* efficient.

A user fee will not distort relative prices if it accurately reflects the actual cost of providing a public good to those who use it and benefit from it. Similarly, an externality tax can improve the economy's efficiency if it accurately reflects costs that arise in the production or use of a good but are not included in its market price, such as pollution and congestion. In the case of motor vehicles, these indirect or externality costs are substantial.

While these calculations again depend on a number of assumptions, we show that the pollution and congestion produced by driving cost Americans about $107 billion a year — about $40 billion in health costs associated with automobile pollution, and about $67 billion in time and other costs associated with traffic congestion.

Current motor fuel taxes generally approximate both a classical user fee and externality tax. While a direct charge for each mile driven might be the theoretically-ideal user fee, the fuel taxes used to build, maintain and operate the nation's highways and roads fall on the drivers who use these public goods, and thus approximate a classic user fee. As externality taxes, motor fuel taxes are paid by drivers whose travel produces pollution and congestion costs not otherwise included in the market price of fuel or automobiles.

Therefore, fuel taxes at their current level — or higher — need not slow the economy, especially if the measure of economic growth correctly accounts for all of the costs of transportation. As a user fee, fuel taxes do not reduce economic efficiency by interfering with relative prices, as most other taxes do. As an externality tax, fuel taxes can enable prices to reflect actual costs more closely, enhancing economic efficiency. Therefore, fuel taxes can actually enhance output or growth, correctly measured, by increasing the economy's efficiency, not even including the large contributions to growth from the use of the highway and transit systems funded by these taxes.

Greater reliance on fuel taxes and less reliance on other forms of taxation to finance surface transportation could make sound economic sense. Considered as a user fee, fuel taxes provide just 40 percent of the public resources directed to all surface transportation, and barely half of the resources used to build, maintain and operate highways and roads. Combined with other user fees, such as transit fares and highway tolls, motor fuel taxes cover 60 percent of public spending on surface transportation. To cover all public spending on surface transportation, motor fuel taxes, combined with other existing user fees, would have to increase from their current level of 36.9-cents per gallon to 75-cents per gallon.

Similarly, while estimates vary, fuel taxes incorporate just 55 percent of the externality costs associated with the pollution and congestion caused by driving. In order to incorporate into fuel prices the health costs of automobile pollution and the economic losses attributable to automobile congestion, motor fuel taxes would have to increase, again, from 36.9-cents per gallon to about 75-cents per gallon. Compared to the total costs associated with surface transportation — both the direct costs and the externality costs — fuel prices including current taxes may well be too low.

Adjusted for inflation, the real level of fuel taxes has been declining while the real costs to maintain, upgrade and, where necessary, expand surface transportation systems have been rising. The real level of the tax and the facilities it supports could be maintained by indexing it to inflation. If the level of the federal gas tax had been adjusted for inflation since 1993, when it was last raised, to 18.4-cents per gallon, its level today would be 23.5-cents per gallon.

Higher taxes on fuels could have negative economic effects as well. When fuel prices rise, households and businesses have less to spend for other purposes, potentially dampening personal consumption and business investment. Much of this potential adverse impact could be offset if an increase in fuel taxes were matched by reductions in other forms of tax currently used to help finance surface transportation, especially since fuel taxes do not involve the adverse efficiency effects of other taxes. Moreover, when higher fuel taxes support additional sound investments in surface transportation, the net economic effect is positive.

Motor fuel taxes also are a particularly appropriate way to finance public transportation. As a matter of equity, it is fitting that drivers provide part of the financing for public transit, since transit users pay the non-fuel taxes (and bond issues) that provide the other half of highway funding. Transit riders, along with drivers, also bear some of the health-care costs created by automobile pollution and subsidize services that benefit drivers, such as "free" parking.

Public transportation also decreases the direct and indirect costs associated with highways and roads. The use of public transit lessens the carrying load on roadways, reducing expenditures on highway construction and maintenance. The use of public transit also directly reduces the health-related costs of surface transportation linked to pollution, ultimately reducing the incidence of illness and even saving lives. Using fuel taxes to finance public transportation, which directly reduces such health costs, makes the motor fuel tax a true externality tax.

For every passenger mile traveled, public transit produces only a fraction of the pollutants of private vehicles: 5 percent of the volatile organic compounds, 6 percent of the nitrogen oxides, less than 5 percent of the carbon monoxide, 55 percent fewer large particulates, and 27 percent fewer small particulates. The most dangerous and costly emissions are the small particulates, and in this respect public rail systems are the most health-friendly form of surface transportation. Electrically-powered rail systems emit barely *one-tenth of one percent* of the dangerous small particulates emitted by automobiles and light trucks.

Public transportation also directly lessens traffic congestion and its associated costs, as we show in Section VI. *Our estimates suggest that the use of public transit in*

33 major metropolitan areas saves nearly $15 billion a year in congestion-related costs — savings equal to more than 2.5 times all the fuel taxes used to support public transit, and nearly half of all public funds spent on public transportation. These congestion-related savings vary from community to community — ranging from more than $6 billion a year in the New York City area, and over $2 billion a year in Los Angeles, to $630 million a year in the Boston area, $205 million in the Houston region, and $120 million in Minneapolis-Saint Paul (see Table 12, below).

Finally, it is notable that our analyses of surface transportation and motor fuel taxes rely on assumptions that clearly understate the benefits of both. For example, the estimate that surface transportation produces $260 billion a year in benefits to businesses is based on a more conservative rate of return on public infrastructure than used in most other analyses. Similarly, our finding that highways and public transit produce $440 billion in annual economic benefits to individuals covers only the value of the time that people save commuting to work and their expanded access to jobs, and not the value of people's access to medical care, education, and other destinations.

Our study also may well *understate* the benefits of public transportation. For example, the official government data used to estimate the pollution emitted by transit vehicles do not fully account for the recent modernizations of bus fleets, which have sharply cut their emissions. In addition, the congestion-related savings from public transit used here cover 33 major metropolitan areas, excluding scores of smaller communities with significant traffic congestion and highly-developed public-transit systems. Furthermore, as noted earlier, our analysis of negative externalities linked to highways did not consider the substantial costs of externalities other than pollution and congestion, such as accidents and crime associated with automobile use. Finally, in assessing the relative efficiency of public transportation, we do not include certain costs associated only with private driving, such as the value of free parking and the personal expenditures entailed in owning and operating a personal automobile.

Even using all these conservative assumptions, highways and public transportation clearly produce enormous net benefits for virtually every person and business in the United States, and motor fuel taxes are the most equitable and economically-efficient means available to raise the funds for these systems. Our commitment to surface transportation and the taxes used to support much of it should be sustained and enhanced.

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II. The Economic Benefits of Highways and Public Transportation

The public roadways and mass transit systems that make up the country's surface transportation network contribute to the country's economic growth, productivity and overall welfare in numerous ways. For everyone but the most intrepid walkers, virtually every activity that occurs outside the home — from work and school to medical care and recreation — depends on the use of surface transportation. Virtually everything used and enjoyed by individuals inside their homes and by businesses in their workplaces — from food and furniture to medicine and security — similarly depends on highways and public transportation. The funds used to build, maintain and operate the nation's highways, roads and public bus and train systems, therefore, are investments in our rising living standards and improving quality of life.

Economists have studied the impact of public investment on business for more than two decades, and consistently have found that surface transportation systems in the United States and other developed nations increase an economy's overall output, reduce prices, and raise profits.[2] These infrastructure investments lower costs, which helps to increase productivity thus raising the rate of return on private investment, which in turn increases investment and further boosts productivity.

Most studies further indicate that while the yields from particular investments, public and private, range from very small to very large, public infrastructure as a whole has produced higher economic returns than overall private investment. A major study conducted for the Federal Highway Administration, for example, found that from 1960 to 1991, the average net return on highway capital — the benefits generated for American business — ranged from 54 percent in the 1960s to 16 percent for the 1980s, averaging 32 percent over the entire period, as compared to an average 17 percent return for private capital.[3]

Economists do not agree on the precise extent of these benefits, and their results vary substantially based on how they measure returns and the time period they cover. There is no consensus about the precise strength of these economic effects, but we have adopted a conservative approach to establish the *minimum* benefits of surface-transportation investments. Specifically, we apply the lowest yield for any decade as calculated by the Federal Highway Administration — a 16 percent net social rate of return found for the highway system in the 1980s — to the capital stock of surface transportation.

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[2] For a survey of these studies, see M. Ishaq Nadiri and Theofanis Mamuneas, "Contributions of Highway Capital to Output and Productivity Growth in the U,.S. Economy and Industries," Federal Highway Administration Office of Policy Development, Department of Transportation, September 1998.
[3] *Ibid.*

The Capital Stock in Surface Transportation

Our analysis begins with estimates of the current-cost net-capital stock of the various parts of the system. The current-cost net-capital stock represents the market value of the assets that comprise the system, which equals the present value of the expected future services derived from these assets. The Bureau of Economic Analysis (BEA) has calculated the current-cost net-capital stock of many government fixed assets. The BEA has found that the current value of U.S. highways, roads and streets comes to nearly $1,478.9 billion, with federal highway assets accounting for a little more than $24 billion, and state and local highway and streets accounting for more than $1,454 billion.[4]

The BEA has not calculated the value of public transportation capital, so we have constructed estimates (Table 2, below) using the following method. We start with the basic elements of capital spending by transit authorities: Rolling stock (buses, railroad engines and passenger cars); investments in equipment and structural facilities (industrial equipment, information technologies, office buildings, industrial buildings and railroad structures); and other capital spending (vehicles, structures, and equipment). Next, we identified corresponding assets from private business investment. Then we calculated the ratio of annual business capital spending on each of these asset classes and its current-cost net-capital stock, determined by the BEA. Finally, we applied these ratios to transit system capital spending for each asset class in 2000, in order to derive our estimates of their current-cost net-capital stock.

Using this method, we estimate that the current-cost net-capital stock of all public transportation systems in 2000 came to more than $164 billion: over $24 billion for public bus systems and nearly $140 billion for public rail systems (See Table 1).[5]

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[4] Bureau of Economic Analysis, *Standard Fixed Assets Tables,* Table 7.1, "Current Cost Net Stock of Government Fixed Assets."

[5] Data: Capital spending, transit: American Public Transportation Association; Private sector capital stock: Bureau of Economic Analysis, *Standard Fixed Asset Tables*, *op. cit.,* Table 2.1*;* Business Investment: Bureau of Economic Analysis, *National Income and Product Accounts*, Gross Domestic Product.

Table 1. Current-Cost Net-Capital Stock, Public Bus and Rail Systems, 2000

Asset	Investment ($ billions)	Ratio, Investment to Capital Stock[6]	Net Capital Stock ($ billions)
Rolling Stock	**$3.139**		**$23.561**
Bus Systems	*$2.040*	*0.2740*	*$7.444*
Rail	*$1.099*	*0.0682*	*$16.117*
Facilities: Equipment/ Structures	**$5.406**		**$131.163**
Bus Systems	*$1.120*	*0.3185/0.1163/0.0495*	*$11.920*
Rail	*$4.286*	*0.3185/0.1163/0.0139*	*$119.243*
Other: Vehicles/ Structures/Equipment	**$1.043**		**$9.438**
Bus Systems	*$0.547*	*0.3185/0.2631/0.0495*	*$4.949*
Rail	*$0.496*	*0.3185/0.2631/0.0495*	*$4.489*
Total Bus Systems	**$3.707**		**$24.313**
Total Rail	**$5.881**		**$139.849**
TOTAL	**$9.587**		**$164.162**

Adding the value of the capital stock of the public transit and highway systems, we find that the total net capital stock of surface transportation comes to about $1,643 billion (Table 2). Applying the Federal Highway Administration calculation of a 16 percent return on highway infrastructure in the 1980s, we find that the use of surface transportation in 2000 produced direct economic benefits to U.S. businesses totaling nearly $263 billion.

Table 2. Economic Benefits of Surface Transportation for U.S. Business, 2000

Capital Asset	Net Capital Stock (billions)	Economic Benefits (billions)
Roadways	$1,478.9	$236.6
Public Transit Systems	$164.2	$26.3
Total	$1,643.1	$262.9

This estimate of economic benefits covers those derived directly by businesses and does not cover "consumer benefits," including the benefits Americans derive from using highways and public transportation to commute to and from work or school, receive medical care, go shopping, and so on. There are no reliable economic analyses of the precise extent of these benefits, but we can calculate the likely magnitude of those benefits in the case of people's daily commute to and from work.

It could be argued that the benefits of surface transportation related to commuting approximate a significant share of all the income that people earn from working, since

[6] The ratios of investment to net capital stock in facilities: information technologies, 0.3185; industrial equipment, 0.1163; buildings, 0.0495; railroad structures, 0.0139. The ratios of investment to net capital stock in other investments: information technologies, 0.3175; automobiles, 0.2631; buildings, 0.0495.

earning that income usually depends on their ability to get to and from their workplaces. We begin with the much more conservative assumption that the use of highways, roads and public transit to travel to and from work is worth one hour per day for an average American, in the time directly saved in this travel and the additional earnings from the ability to work farther away from home. We then draw on three pieces of data. First, in 1999, 103.5 million Americans drove to and from work, and another 5.8 million commuted to work using public transportation.[7] Second, Americans earn on average $16.23 per hour. Third, Americans work on average 250 days per year.[8]

On this basis, we estimate that Americans derive more than $443 billion in consumer benefits from using surface transportation to commute to and from work — nearly $420 billion in benefits from using highways and roads to commute and $23.5 billion from using public transportation.

Table 3. Economic Benefits of Surface Transportation to Commuters, 2000

	Number	Earnings	Hours	Value (billions)
Automobile Commuters	103,466,000	$16.23/hour	250	**$419. 8**
Transit Commuters	5,779,000	$16.23/hour	250	**$23.5**
TOTAL	109,245,000	$16.23/hour	250	**$443.3**

Taken together, American businesses and commuters derive a minimum of $706 billion in direct economic benefits from our investments in highways, roads and public transportation.

Table 4. Total Economic Benefits of Surface Transportation, 2000, $ billions

	Highways	Public Transportation	Total
Business	$236.6	$26.3	$262.9
Commuters	$419.8	$23.5	$443.3
Total	**$656.4**	**$52.8**	**$706.2**

These findings are based on conservative assumptions and therefore provide what should be considered the minimum, net economic benefits derived from roads and public transportation. For example, the estimates rely on a lower rate of return on infrastructure than found by many studies, and assume a minimal amount of time saved by commuters using surface transportation. Surface transportation also provides many other benefits that produce direct economic returns, including access to education, health care and recreation. It is certain, therefore, that the total economic benefits produced by public transportation and roadways exceed our estimated $706 billion.

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[7] *National Transportation Statistics, 2001*, Bureau of Transportation Statistics, Department of Transportation, Table 1-31.

[8] *National Compensation Survey: Occupational Wages in the United States*, Bureau of Labor Statistics, Department of Labor, August 2002, Table 1.

III. The Direct Costs of the Surface Transportation System

Highways and public transportation involve substantial costs as well as benefits. The direct costs include the taxes, fares, tolls, and other receipts that support the capital outlays and operating expenses for highways, roads and public transit systems. The indirect costs include major "negative externalities," including pollution, congestion, and accidents. We will first examine the direct costs, focusing on the taxes that provide most of the resources used to build, operate and maintain America's roadways and public transportation systems.

Government Spending on Highways and Public Transportation

In 2000, government at all levels spent $153 billion on surface transportation, including $122.7 billion on federal, state and local highways and roads, and $30.3 billion on public transportation.[9] We avoid double counting by classifying federal grants to states and localities as federal spending only and attributing transfers between state and local governments to the originating level of government. We also exclude funds used to refinance bond issues, retained in the Highway Trust Fund or held in state reserves.

Table 5. Spending on Surface Transportation, All Levels of Government, 2000

	Amount	Share
Highways	**$122.7 billion**	**80.2%**
Capital Outlays	($61.3 billion)	(40.1%)
Operating Expenses	($30.6 billion)	(20.0%)
Other	($30.7 billion)	(20.1%)
Public Transportation	**$30.3 billion**	**19.8%**
Capital Outlays	($9.0 billion)	(5.9%)
Operating Expenses	($21.3 billion)	(13.9%)
TOTAL	**$153.0 billion**	**100.0%**

The largest shares of government spending for surface transportation occur at the state level. State support for highways accounts for more than 41 percent of all spending for surface transportation, while federal highway spending accounts for nearly 18 percent and local highway spending accounts for another 21 percent. State and local support for

[9] *Highway Statistics 2001*, Federal Highway Administration, Department of Transportation, Table HF-2, Table MT-2A, Table MT-2B.

public transit makes up another 16 percent of surface transportation spending, while federal support for transit accounts for another 3 percent.

Table 6. Spending on Surface Transportation by Level of Government, 2000

	Amount	Share
Federal Spending	**$32.7 billion**	**21.2%**
Grants – Highways	($25.8 billion)	(16.7%)
Federal Highways, Other	($1.7 billion)	(1.1%)
Grants – Transit	($5.3 billion)	(3.4%)
State Spending – Highways	**$63.9 billion**	**41.4%**
Local Spending – Highways	**$32.6 billion**	**21.1%**
State/Local – Transit	**$25.1 billion**	**16.3%**
Total	**$154.3 billion**	**100.0%**

The federal government spent $27.5 billion on highways in 2000, including $25.8 billion in grants to states and localities, $329 million in capital outlays for federal highways, $163 million in maintenance for federal highways, and $1.2 billion for administration and other costs. [10] The federal government also distributed $5.25 billion for public transit — $4.3 billion for capital outlays and $981 million for maintenance.

State governments spent $89.8 billion for highways in 2000, including federal grants.[11] Setting aside those grants, as well as $1.5 billion in payments from local governments and money used to refund maturing bonds, the states spent $63.9 billion of their own funds on highways.[12] (This total includes $11.0 billion in grants to local governments for highways). Local governments disbursed $47.1 billion for highways, including federal grants, the $11.0 billion in payments from state governments, and money used to refinance bonds.[13] Setting aside those grants, payments and refinancing costs, local governments spent $32.6 billion of their own funds on highways in 2000.[14] Finally, state and local governments spent $30.3 billion on public transportation systems, including $5.25 billion from federal grants and $25.05 billion of their own funds.[15]

Sources of Funding for Surface Transportation

Funding for highways and public transportation comes from many sources, including fuel taxes, property and income taxes, tolls, fares, other operator receipts, and bond issues. Motor fuel taxes are the largest single source of this funding. Governments at all levels collected $161.7 billion for surface transportation in 2000, of which $60.2 billion or more than 37 percent came from fuel taxes. Fuel taxes accounted for more than

[10] *Highway Statistics 2001, op. cit.*, Table FA-21, Table MT-2A, Table MT-2B.
[11] *Highway Statistics 2001, op cit.*, Table SF-2 and Table SF-21.
[12] *Ibid.*
[13] *Highway Statistics 2001, op cit.*, Table LGF-21.
[14] *Highway Statistics 2001, op cit.*, Table LGF-2, Table LGF-21.
[15] *Highway Statistics 2001, op cit.*, Table MT-2A, Table MT-2B.

42 percent of the resources raised for highways, and about 15 percent of the resources raised for public transportation. (The funds raised for surface transportation exceed spending on surface transportation, because some of the revenues are retained in the Highway Trust Fund or state reserves).

Table 7. Fuel Taxes and Other Sources of Revenues, As a Share of Total Receipts for Surface Transportation, 2000

	Amount ($ billions)	Share of Total Receipts
Highways	**$131.37**	**81.3%**
Federal Fuel Taxes	$25.13	15.5%
Other Federal Highway Taxes	$4.59	2.8%
Other Federal Revenues	$1.35	0.8%
State Fuel Taxes	$28.71	17.8%
Other State Highway Taxes and Tolls	$20.27	12.5%
Other State Receipts	$17.45	10.8%
Local Fuel and Vehicle Taxes	$1.84	1.1%
Other Local Receipts	$32.03	19.8%
Transit	**$30.31**	**18.7%**
Federal Fuel Taxes[16]	$4.11	2.5%
Other Federal Revenues	$1.14	0.7%
State Fuel Taxes	$0.42	0.3%
Other States Receipts	$4.94	3.1%
Local Receipts	$8.55	5.3%
Fares and Operator Receipts	$11.15	6.9%
All Fuel Taxes	**$60.21**	**37.2%**
All Other Receipts	**$101.47**	**62.8%**
TOTAL	**$161.68**	**100.0%**

The role of fuel taxes in surface transportation is greater than these data suggest. Fuel taxes are the main source of funds for federal highway and public-transit grants, which leverage significant additional transportation spending at the state and local levels.

The federal government collected $36.4 billion for surface transportation in 2000, with $29.2 billion or more than 80 percent coming from fuel taxes. Of this $36.4 billion, $31.1 billion went to highways, with $25.1 billion or about 81 percent coming from fuel taxes; and $5.25 billion went to public transportation, of which nearly 80 percent came from fuel taxes.[17] The difference between federal transportation receipts of $36.4 billion and spending of $32.3 billion, $4.1 billion, was retained in the Highway Trust Fund.

[16] The Federal Transit Administration provided $5.14 billion for public transit in 2000, of which 80 percent or $4.11 billion came from federal fuel taxes; the remaining 20 percent or $1.03 billion, came from general revenues, as did an additional $0.11 billion (totaling $1.14 billion from "Other Federal Revenues.")

[17] *Highway Statistics, 2001*, op. cit., Table FE-9.

Table 8. Federal Sources of Funding for Highways, 2000[18]

	Amount (billions)	Share
Highway User Fees	**$29.72**	**95.6%**
Motor Fuel Taxes	($25.13)	(80.8%)
Motor Vehicle and Tire Taxes	($4.59)	(14.8%)
General Appropriations	**$1.20**	**3.9%**
Other Federal Receipts	**$0.15**	**0.5%**
TOTAL	**$31.09**	**100.0%**

Table 9. Federal Sources of Funding for Public Transportation, 2000[19]

	Amount ($ billions)	Share
Motor Fuel Taxes	**$4.11**	**78.3%**
Other Appropriations	**$1.14**	**21.7%**
Total	**$5.25**	**100.0%**

The states raised $66.4 billion for highways in 2000, excluding transfers from federal and local governments, refunding highway bonds, and reserves from previous years. Of that total, $28.7 billion or more than 43 percent came from state fuel taxes.[20] The other major sources of state highway revenues were taxes on motor vehicles, tolls, other state taxes, general appropriations, and new bond issues.[21]

Table 10. State Sources of Funding for Highways, 2000

	Amount (billions)	Share
Highway User Fees	**$48.98**	**73.7%**
State Fuel Taxes	($28.71)	(43.2%)
State Motor Vehicle Taxes	($15.53)	(23.4%)
Tolls	($4.74)	(7.1%)
Other States Taxes	**$2.40**	**3.6%**
General Appropriations	**$4.14**	**6.2%**
Bond Issues	**$8.18**	**12.3%**
Other	**$2.73**	**4.1%**
TOTAL	**$66.43**	**100.0%**

At the local level, governments raised $33.9 billion for highways, excluding once again $13.0 billion in transfers from federal and state governments and monies raised by refunding maturing highway bonds. Of that total, just $1.8 billion, or barely 5 percent,

[18] *Highway Statistics 2001*, Federal Highway Administration, Department of Transportation, Table FA-5.
[19] *Ibid.*, Table MT-2A, Table MT-2B.
[20] *Highway Statistics 2001, op cit.*, Table SF-1.
[21] *Ibid.*

came from local fuel and motor vehicle taxes.[22] (Attributing the appropriate shares of these transfers to state and federal fuel taxes, localities derived $9.1 billion from fuel taxes or nearly 20 percent.) Major sources of local funding for roadways include general appropriations, property taxes, other local taxes, proceeds from local bonds, and tolls.[23]

Table 11. Local Sources of Funding for Highways, 2000

	Amount ($ billions)	**Share**
Local User Fees	**$2.83**	**8.4%**
Fuel and Motor Vehicle Taxes	$1.84	(5.4%)
Tolls	$0.99	(2.9%)
Local appropriations	**$14.04**	**41.5%**
Property Taxes	**$6.12**	**18.1%**
Other Taxes and Miscellaneous	**$7.76**	**22.9%**
Bond Issues	**$3.12**	**9.2%**
TOTAL	**$33.87**	**100%**

Sources of Funding for Public Transportation

Transit operators in 2000 collected and spent $30.3 billion from federal, state and local sources, with fuel taxes accounting for 13.6 percent of the total.[24] Motor fuel taxes are especially important in funding capital costs: Federal and state fuel taxes accounted for nearly 40 percent of capital outlays, compared to 5 percent of operating expenses. The other major sources of funding for public transportation are user fees: Passenger fares contribute more than 25 percent of all public-transportation funding and other operator receipts provide another 11 percent. In addition, direct local appropriations cover nearly 23 percent of capital outlays and more than 30 percent of operating expenses.

Table 12. Sources and Use of Funding for Public Transportation, 2000[25]

Source	**Capital Outlays ($ billions)**		**Operating Expenses ($ billions)**		**Total ($ billions)**	
	Amount	**Share**	**Amount**	**Share**	**Amount**	**Share**
Federal Fuel Tax	$3.39	37.5%	$0.72	3.4%	$4.11	13.6%
Passenger Fares	--	--	$7.77	36.5%	$7.77	25.6%
Operator Receipts	$1.77	19.6%	$1.61	7.6%	$3.38	11.2%
Other Fed. Funds	$0.87	9.6%	$0.26	1.2%	$1.13	3,7%
State Fuel Taxes	$0.08	0.9%	$0.35	1.6%	$0.42	1.4%
Other State Taxes	$0.25	0.3%	$1.65	7.8%	$1.90	6.3%
State Funds	$0.63	7.0%	$2.42	11.4%	$3.04	10.0%
Local Funds	$2.04	22.6%	$6.51	30.6%	$8.55	28.2%
TOTAL	$9.03	100.0%	$21.29	100.0%	$30.31	100.0%

[22] *Highway Statistics 2001, op cit.*, Table LGF-1.
[23] *Highway Statistics 2001, op cit.*, Table LGF-21.
[24] *Highway Statistics 2001, op cit.*, Table MT-2A, Table MT-2B.
[25] *Ibid.*

There are important differences in the costs covered by the financing of highways and of public transportation. Most notably, the costs of public transit covered by taxes, fares, and so forth, include the fuel used by buses and trains, while the fuel and other expenses associated with the use of highways are not included in the calculations of highway costs. In this sense, the financing burden associated with public transportation, relative to private vehicles traveling on highways and roads, is somewhat overstated.

User Fees and Public Spending on Surface Transportation

The data above demonstrate that user fees account for the majority of public costs associated with surface transportation. In 2000, motor fuel taxes generated about $60 billion or 39 percent of the $154.3 billion in total public expenditures on highways, roads and public transit. In addition, states also collected $21.4 billion in non-fuel highway user fees (mainly motor vehicle taxes and tolls), and localities collected $11.15 billion in user fees from public transportation (fares and other operator receipts). User fees connected to highway and transit use, therefore, provide nearly $937 billion or 60 percent of total public spending on highways, roads and public transportation.

The surface transportation system could be financed entirely by user fees if, in addition to the existing non-fuel transportation-user-fees, the fuel tax rose from 36.9-cents per gallon to 74.6-cents per gallon.

* * *

IV. The Economic Case for Using Fuel Taxes to Fund Surface Transportation

Financing public policies and public goods, to the extent possible, should be efficient, equitable, and promote social welfare. As noted earlier, motor fuel taxes provide about 37 percent of all surface-transportation revenues collected by government at all levels; since some of these revenues are held in reserve every year, fuel taxes cover 39 percent of direct government spending on surface transportation.[26] This reliance on fuel taxes is economically sound because motor fuel taxes harness, albeit imperfectly, the efficiency-enhancing properties of user fees and externality charges.

Motor Fuel Taxes and Economic Efficiency

For reasons we will discuss below, it is broadly accepted that taxes are necessary and appropriate to finance the nation's highways and public transportation systems. Like education and national security, the surface-transportation system produces "spillover" benefits or positive externalities, principally in the form of higher growth and productivity. The positive externalities go beyond those enjoyed directly by the people and businesses using the highways. For example, a new highway may increase customer traffic for firms located on the roadway and raise property values for people living nearby, but businesses and persons located some distance from the highway may also benefit. More generally, well planned and maintained highways can support productivity advances not directly related to the transport of goods, services and people. For example, an efficient surface transportation system enables businesses to reduce their inventories, which in turn has given rise to "just in time" inventory practices and other managerial innovations that increase productivity and profits beyond the direct benefits of the already-efficient transportation of goods and services.

Left to the private market, goods and services that produce spillover benefits are usually characterized by under-investment, because some of the benefits do not accrue to the investors. If education were left solely to the private market, for example, there is no doubt that the overall level of education, and the consequent level of economic and social welfare, would be much less than it is today. Similarly, it is rarely, if ever, disputed that if our highways, bus and rail systems were all privately owned and financed, our surface-transportation system would be far less extensive and the U.S. economy would be smaller and less productive. Surface transportation, like education, is a classic public good, and economic efficiency and public welfare require its extensive public funding.

Almost all taxes, however, impose costs on both the economy as a whole and on individual taxpayers. A tax on the price of certain goods or activities dampens the

[26] See Table 8 and Table 7, respectively.

demand for them and, as a result, reduces the relative price of other substitute goods and activities, thus spurring their demand. A tax on apples, for example, will tend to reduce apple sales and increase sales of other fruits and foods that people consider generally equivalent to apples. More generally, a tax on consumption tends to reduce the relative price of saving, thereby decreasing consumption and encouraging saving. And a tax on labor tends to raise the relative price of work effort, encouraging relatively more consumption of leisure. By affecting relative prices, taxes interfere with the market's ability to allocate resources according to their actual costs, which results in a reduction in the economy's overall efficiency.

The Relative Advantages of User Fees and Externality Taxes

User fees and externality taxes, however, invert the economic implications of most other types of taxes. In fact, if user fees and externality taxes are set at the proper level, they can even make the economy *more* efficient. A user fee is a tax on the use of a public good, focusing the cost on those who benefit from the good or service supported by the fee. If a user fee is set at a level that reflects the actual direct costs of providing the good to the user, it need not distort the relative price of the good or service taxed.

Much as public goods produce positive externalities or benefits that accrue to people or firms not directly involved in the financing or use of them, the production or use of other goods and services may entail "negative externalities," or costs imposed on people or firms not directly involved in their production or use. Pollution and its health-care costs are classic examples of "negative externalities," when the production or use of industrial goods, in effect, uses our air and water to dispose of waste products without paying for it. The economic problem with pollution and other negative externalities is that some of the costs of producing these goods and services are not captured in their prices. Much like most taxes, negative externalities reduce the economy's efficiency by interfering with the market's ability to allocate resources according to their actual costs.

An externality tax, such as a pollution fee, aims the tax burden squarely on those who, in the process of producing or using some good, cause health effects and other costs to others. Unlike other taxes, externality taxes do not distort the relative price of the good or service being taxed if the fee is set at a level that reflects the indirect costs generated by its production or use.

Just as user fees can incorporate the direct cost of a good in the price of using it, externality taxes can incorporate the good's indirect externality costs. User fees and externality taxes, in essence, can ensure that people pay for what they get.

Motor fuel taxes used to finance surface transportation combine the features of a user fee and an externality tax. As with other user fees, the burden of a motor fuel tax on any individual is determined by his or her need and willingness to use the transportation system supported by the tax.

Motor fuel taxes can provide other efficiency advantages as well, compared to other taxes. For example, motor fuel use is the largest tax base available that is also directly related to the goods and services being financed. The larger the base of any tax, the lower is the tax rate required to raise the necessary revenue; and a lower tax rate imposes relatively smaller economic distortions.

Of course, all retail sales or all income would provide a larger tax base, but it also forces non-drivers to support highways, undermining the efficiencies of the user fee. Furthermore, financing highways from taxes unrelated to their use would encourage overuse of roadways by making them, in effect, "free" to drivers. Some evidence for this effect may be seen in the relatively poor repair of local streets, as compared to state and national highways: Local motor fuel taxes cover just over 6 percent of local transportation spending, compared to federal fuel taxes which account for 93 percent of federal spending on surface transportation and state fuel taxes covering 56 percent of state surface-transportation spending.[27] At the same time, limiting the burden of supporting highways to those who use them is equitable, as well as efficient.[28]

Shortcomings of the Fuel Tax as a User Fee

While a tax on motor fuels is not an economically-perfect form of user fee to finance surface transportation, it is the most practical and efficient user fee currently available for the purpose. Its shortcoming lies in its uniformity in that everyone pays the tax at a set rate per-gallon or per-dollar of fuel purchased, but the underlying costs of highway use vary from automobile to automobile. An SUV or light truck will impose higher costs on a roadway than most automobiles, even as drivers of SUVs and older cars with low gas mileage pay the same motor fuel tax. Similarly, an older vehicle or one in need of repairs may require more fuel, and therefore pay more fuel tax, than a newer vehicle or one in better shape, even as both impose the same costs on roadways.

The reality is that a fuel tax that varied depending on a vehicle's weight, age or state of repair would entail much higher administrative costs, which in turn would increase the tax rate required to fund roadways, reducing its efficiency. A motor fuel tax set at the rate required to recover the system's direct costs, with reasonable administrative costs, is the best available approximation to an ideal user fee.

Based on considerations of economic efficiency, the real shortcoming of current motor fuel taxes is that they do not cover all these costs. In 2000, government at all levels raised $61.24 billion through fuel taxes, sufficient to cover 50 percent of the $122.7 billion spent on highways and roads, and less than 40 percent of the $153 billion

[27] *Ibid.*

[28] The gas tax does not provide perfect equity, because highways produce "spillover" benefits to those who do not directly use them: For example, business owners gain customers from construction or improvements of a nearby highway, and homeowners whose property values are raised by construction or improvements of a nearby road. In this regard, business and property taxes may be an appropriate source of additional revenues for surface transportation, especially at a local level.

devoted to both highways and public transit.[29] The economy would operate more efficiently if government raised more revenues for surface transportation through fuel taxes and fewer revenues using other kinds of taxes. This is most relevant at the federal level, since state and local governments also use other forms of user fees, notably transit fares and highway tolls, to finance the operations of their surface transportation systems.

Based on considerations of social equity, the other shortcoming of fuel taxes is their distributional impact: As a form of consumption tax, fuel taxes burden low-income drivers to a greater degree than higher-income drivers. This regressive impact is partly offset by public transportation, which in urban areas provides individuals a lower-cost alternative to automobile use. This distributional problem could be addressed by using progressive income or wealth taxes to fund surface transportation, but that would undercut the efficiency benefits gained from using fuel taxes. The most efficient response to inequities raised by fuel taxes would be to address any unacceptable or untenable burdens on low-income people or small businesses through existing social service and other programs.

This raises the most often heard objection to higher fuel taxes; namely that they can slow the economy and drive up prices, especially for low-income people. As just noted, we can best address adverse effects on low-income Americans not by allowing surface transportation systems to decline, but through social service programs. As for the larger economy, it is correct that when higher fuel prices increase the cost of fuel, it will reduce spending on other things by both individuals and businesses, potentially slowing economic growth. But if higher fuel taxes are matched by reductions in other taxes currently used to finance surface transportation, the initial adverse impact is largely negated. Moreover, since fuel taxes also carry the efficiency benefits of user fees and externality taxes, the overall economic impact of such “tax shifting” is positive, not negative. Higher fuel taxes may increase the price of other goods, when the fuel is one of the goods’ critical inputs. Yet, if the increase means that the price better reflects the actual cost of the good, including the negative externalities associated with fuel, the overall effect on the economy, once again, is positive. Finally, when higher fuel taxes finance needed improvements or expansions in surface transportation systems, the associated benefits far outweigh the associated costs.

Indexing Federal Motor Fuel Taxes for Inflation

In addition to the economic advantages of setting fuel tax rates at a level related more closely to the public costs of surface transportation, fuel taxes should be set at the level required to maintain and modernize highway and transit investments which, as we have seen, produce substantial economic benefits for business and individuals. Since federal fuel taxes are levied on a per-gallon basis, the revenues rise automatically and proportionately with increases in motor vehicle use. This arrangement takes account of the increasing use of surface transportation system, but not of independent increases in the cost of labor, materials, equipment and so forth. A 5 percent increase in motor vehicle use will produce a corresponding increase in tax receipts sufficient to repave or

[29] See Table 6 and Table 8, above.

build highway lanes to accommodate the increased use *only* if the price of doing so hasn't risen as well.

Since inflation is a normal feature of our economy, setting the fuel tax at a certain *per*-gallon rate ensures that the revenues keep pace only with use but not with costs. The almost unavoidable consequence is deteriorating highways, roads and public transit systems. A 1997 report by the Department of Transportation found that almost 49 percent of rural interstate highways and 60 percent of urban interstate highways were in fair to poor condition.[30] Moreover, many other analysts have concluded that the condition of state and local roads outside the interstate system is even worse. Indexing the fuel tax rate to inflation would be a simple way of ensuring that fuel tax revenues can cover the actual costs of accommodating the increased use of surface transportation. If the federal fuel tax had been adjusted for inflation since 1993, when Congress last raised the rate to 18.4-cents/gallon, the current rate would be 23.46-cents/gallon.

Much like a user fee, externality taxes can promote economic efficiency by incorporating in the price of a good all of the costs involved in producing it. The economic costs entailed in our use of motor fuels include not only those associated with drilling and refining oil and distributing fuels, but also the health-care costs imposed on others who breathe air polluted by its use and the value to the economy of the time people spend stuck in traffic congestion caused by other drivers. The costs of these negative externalities are not incorporated in the price of fuel or vehicles, nor are they borne by those who produce them. A motor fuel tax that takes account of these pollution and congestion-related costs should improve the nation's economic efficiency by enabling markets to allocate our resources based on demand that reflects real costs.

Shortcomings of a Fuel Tax as an Externality Tax

As we found in our examination of fuel taxes and fees, these taxes are too uniform to be ideal externality fees. In particular, motor fuel taxes imposed at a set rate per-gallon or per-dollar of fuel purchased cannot capture the varying externality burdens created by different vehicles and drivers. Heavy cars, older vehicles or those in need or repair may produce more pollution per gallon than vehicles that are lighter, newer or in better shape; and driving faster will usually consume more fuel, and so produce more pollution, over a given distance than driving more slowly. However, varying the tax rate according to a vehicle's weight, age or state of repair, much less based on how fast each person drives, would involve substantial administrative burdens that would raise the tax rate required to finance surface transportation, and reduce the economy's efficiency. A motor fuel tax that incorporates the costs of pollution provides a good approximation to an ideal pollution-externality tax with reasonable administrative burdens.

Similarly, congestion depends most directly on traffic conditions that vary from hour to hour, and tolls set according to such conditions might be a more ideal congestion-related externality tax than a charge on motor fuels. But as with pollution taxes set

[30] *1997 Status of the Nation's Surface Transportation System: Condition and Performance*, Federal Highway Administration, department of Transportation, Report No. FHWA-PL-98-027, 1997.

according to the various factors that determine how much pollution each driver produces, practical considerations make varying universal tolls an unpalatable alternative. Such tolls are not an option for most roadways; and if they were, imposing them on a locality-specific basis across the surface transportation system would entail high administrative costs that would probably require tolls set at levels far exceeding congestion costs and benefits. A motor fuel tax incorporating congestion costs is probably the closest practical approximation to an ideal congestion-externality tax.

Motor Fuel Taxes and Public Transportation.

Public transportation produces economic and social benefits to American businesses and communities at least as broad as those provided roadways, and therefore merits public support along with roadways. In practice, public transit provides economy-wide benefits outside the capacity of the highway system, affording basic access to labor, service and consumer markets for tens of millions of people who for reasons of age, physical condition or lack of funds cannot drive themselves. Elderly and disabled people comprise an increasing share of the nation's population who, along with low-income Americans, would be much less able to participate in the mainstream economy and society without access to public transportation. Public transportation also provides alternative access to these opportunities and markets for people who can drive. In both ways, therefore, public transit systems promote higher growth, productivity and consumer welfare.

Motor fuel taxes paid by drivers are an appropriate way to finance this access. It is fitting that drivers contribute to the support of public transportation through motor fuel taxes, since transit users bear part of many of the costs of the highway and road system. In particular, transit users and drivers alike fund the non-fuel taxes and bond issues that provide over 90 percent of the revenues raised locally for roadways and more than 26 percent of state revenues raised for state highway use. All told, transit riders and drivers share tax burdens that provide $48.5 billion in funding for highways and roads, while public transportation receives about $14 billion from taxes applied to transit users and drivers alike and just over $5 billion from motor fuel taxes on drivers alone.[31] Transit riders also share the health-care costs associated with the pollution created by motor vehicles, costs which the Environmental Protection Agency (EPA) calculates at more than $40 billion a year.[32] Further, transit users share the costs of certain services benefiting drivers, including the cost of "free" parking on local streets, which some experts estimate is worth more than $100 billion a year to automobile users.[33] The use of public transit also lessens the carrying load on highways and streets, reducing the direct costs of highway construction, maintenance and traffic service borne by drivers.[34]

Highway users derive other benefits from public transportation, because the use of public transit reduces the externality costs of private vehicles. By one estimate, the

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[31] *Highway Statistics 2001, op cit.*, Table MT-2A, Table MT-2B, Table SF-1, Table LGF-1, Table LGF-21..
[32] See following section.
[33] *Ibid.*
[34] *Ibid.*

external costs associated with urban, rush-hour travel averages 50-cents per-passenger mile for automobiles — principally in pollution and congestion–compared to 20-cents per-passenger mile for bus riders.[35] Every 10-mile bus ride under these conditions produces a $3 cost saving, which is not returned to bus riders, but instead appears in lower taxes and health-related costs borne by everyone. To document these findings, we present in the following section the health-care costs associated with automobile pollution and the congestion-related savings associated with the use of public transportation.

Moreover, the efficiency benefits of the fuel tax, as an externality tax, depend on two factors: First, the extent to which the tax helps incorporate these externalized costs into the price of motor fuel; and, second, the extent to which the revenues are used to offset or reduce the burden on those who bear those externalized costs. By reducing the pollution and congestion created by private vehicle use, therefore, public transportation enhances the economic efficiency of fuel taxes.

Finally, by providing an alternative to private vehicles, public transportation benefits drivers, and the society as a whole, in other ways. At a time in which terrorism and armed conflicts threaten Mid East oil supplies, the use of public transportation promotes energy independence and national security: A recent study found that public transportation saves Americans more than 855 million gallons of gasoline a year, the equivalent of one month's imports from Saudi Arabia.[36] And by ensuring a greater measure of social equity in access to public services and private goods, the public transportation system provides a public good that benefits everyone.

In the final analysis, roadways and public transportation comprise an integrated surface transportation system, and the motor fuel taxes that provide substantial funding for highways also provide an efficient, equitable and appropriate source of support for public transportation.

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[35] Todd Litman, "Evaluating Public Transit's Benefits and Costs," Victoria Transport Policy Institute, March 2002, www.vtpi.org/tdm/tdm62.htm.

[36] Robert Shapiro, Kevin Hassett and Frank Arnold, "Conserving Energy and Preserving the Environment: The Role of Public Transportation," American Public Transportation Association, 2002.

V. The Health Costs of Motor Vehicle Pollution and the Related Benefits of Public Transportation

Along with their large economic benefits for businesses and individuals, surface transportation systems also generate substantial indirect costs or negative externalities, principally in the form of pollution and congestion. By incorporating in the price of fuels a significant share of the indirect costs that arise from the use of these fuels in motor vehicles, fuel taxes can improve the economy's overall efficiency.

In terms of size, motor fuel taxes capture the health-related costs of pollution caused by gasoline, and so can qualify as a pollution-related externality tax. The combined federal and state tax burden on motor fuels averages 36.9-cents per gallon: The federal tax is 18.4-cents per gallon, and state taxes average 18.5-cents per gallon, ranging from 7.5-cents per gallon in Georgia to 36-cents per gallon in Connecticut. As detailed below, the health-related costs arising from pollution produced by gasoline use are at least 32.9-cents per gallon, or a few cents less per gallon than the combined federal and average state taxes on motor fuels. This relationship is also apparent in total costs. In 2000, the federal government raised $30.3 billion from fuel taxes, and government at all levels raised $61.2 billion from these taxes. The health-related costs of pollution caused by vehicles using gasoline in 2000 came to an estimated $41 billion in 2000 or 67 percent of the cost of motor fuel taxes collected by all levels of government.

Table 13. Motor Fuel Taxes as an Externality Tax:
Fuel Taxes and the Health Costs of Gasoline Pollution from Private Vehicles

	Per Gallon Costs	Total Costs
Federal Motor Fuel Taxes	18.4-cents	$30.27 billion
Federal, State and Local Motor Fuel Taxes	36.9-cents	$61.24 billion
Health-Related Pollution Costs (Gasoline)	32.9-cents	$41.01 billion

Recent surveys and studies by the EPA examining the health benefits associated with the Clean Air Act Amendments of 1990 (CAAA) make it possible, for the first time, to scientifically estimate the health-related costs of motor-vehicle pollution. The EPA calculated the health-related savings arising from reductions in emissions of many pollutants required by the 1990 Amendments, including four produced by gasoline use: Volatile organic compounds (VOC); nitrogen oxides (NOx), which together with sunlight form smog (O3); and large and small particulates (PM-10 and PM-2.5).[37] For example, EPA estimated the following benefits in the year 2000 from reductions in particulates from all sources, including motor vehicles, mandated by CAAA (cost and benefit estimates originally stated in 1990 dollars have been converted to 2000 dollars):

Table 14. Selected Health Benefits from Clean Air Act Amendments, 2000 [38]

Health Effect	Pollutant	Cost Per Case	Reduced Cases	Benefit
Mortality/ age 30+	PM-2.5	$6,326,400	14,000	$88.57 billion
Chronic Bronchitis	PM-10	$342,000	13,000	$4.45 billion
Minor Illness - Lost Workdays	PM-10	$109.39/day	2.5 million	$273.5 million
Minor Illness – Restricted Action	PM-2.5, O3 (VOC + NOx)	$50.08/day	19 million	$951.5 million

EPA also has estimated on-road emissions of the four major gasoline-related pollutants fuels that carry significant health effects, the most recent covering 2000:

Table 15. On-Road Vehicle Emissions of Health-Impairing Pollutants, 2000[39]

Pollutant	Emissions, Tons Per Year
PM-2.5	**209,000**
PM-10	**273,000**
VOC	**5,035,000**
NOx	**8,150,000**

Drawing on these two EPA analyses, we estimate the health-related costs associated with motor-vehicle gasoline use. We assume only that if a given level of reduction in a pollutant produces a specific amount of health-related savings, equivalent emissions reductions of the same pollutant will produce comparable health-related costs. Using this approach, we find that these health-related costs total about $41 billion per year, or the equivalent of 32.9-cents per gallon or motor fuel. Mortality accounts for more than 95 percent of these health-related costs, principally in deaths from lung cancer and other respiratory and cardiovascular diseases caused by small particulates (PM-2.5). The other significant health costs associated with gasoline pollution from private vehicles arise from chronic bronchitis and a range of minor respiratory-related illnesses, accounting for about 5 percent of these health costs.

[37] "The Benefits and Costs of the Clean Air Act 1990-2010," Environmental Protection Agency, Office of Air and Radiation, Office of Policy, November 1999;
[38] *Ibid.*
[39] Environmental Protection Agency, "Trends 2000" available at www.epa.gov/ttn/chief/trends.

Table 16A. Health Costs of Major Pollutants
Emitted by Gasoline-Powered Private Vehicles, 2000

Health Effect	PM-2.5	PM-10	VOC + NOx	All Pollutants
Mortality	$39.500 billion	--	--	$39.500 billion
Bronchitis	--	$0.757 billion	--	$0.757 billion
Minor Illness	$0.038 billion	$0.050 billion	$0.665 billion	$0.753 billion
All Effects	$39.538 billion	$0.807 billion	$0.665 billion	$41.01 billion

Table 16B. Health Costs of Major Pollutants
Emitted by Gasoline-Powered Private Vehicles, Per Gallon, 2000

Health Effect	PM-2.5	PM-10	VOC + NOx	All Pollutants
Mortality	31.686 cents	--	--	31.686 cents
Bronchitis	--	0.608 cents	--	0.608 cents
Minor Illness	0.030 cents	0.040 cents	0.533 cents	0.603 cents
All Effects	31.716 cents	0.648 cents	0.533 cents	32.897 cents

Transportation-Related Pollution: Private Vehicles versus Public Transportation

All modes of surface transportation — private automobiles and light trucks, public buses and rail systems — produce harmful pollution. Travel on public transportation, however, produces fewer harmful emissions, on a *per* passenger-mile basis, than private vehicles. As shown below, for every passenger mile traveled, public transportation produces a small fraction of the volatile organic compounds, carbon monoxide and nitrogen oxides, as well as significantly less large and small particulates. The use of public transportation therefore reduces the overall pollution generated by surface transportation and saves health care costs, which makes motor fuel taxes true externality fees when the proceeds are used to fund public transportation.

Public transportation is provided through electrically-powered heavy rail, light rail and commuter rail system, and diesel-powered buses and commuter rail. Measuring pollution produced by electrically powered sources, in grams *per* million-kilowatt hours (G/MKWH), is a straight-forward calculation, using EPA data on emissions produced by the electric utility industry, and Department of Energy data on electric utility industry net generation and the share of electric energy used for transportation.[40]

Measuring the emissions from diesel-powered buses and commuter rail is more complex and less certain. EPA and the Department of Energy data on diesel emissions are reported only in an aggregate covering all heavy-duty diesel vehicles in service, including tractor trailers, dump trucks and construction vehicles, as well as public buses

[40] For total emissions by electric utility industry, see www.epa.gov/ttn/chief/trends; for electric utility industry net generation, see *Electric Annual Power 2000*, Department of Energy, Volume 1, Table 1.

and commuter rail.[41] These data do not provide an accurate measure of the dangers associated with emissions by public buses, because EPA standards for particulate matter (PM-2.5 and PM-10) are much stricter for buses than for other heavy-duty diesel vehicles.[42] Over nearly the last decade, EPA has required that new buses emit particulates at no more than half the rate of other heavy-duty diesel vehicles. Moreover, new buses are permitted to emit particulates at just one-fifth of the rate allowed for heavy-duty diesel vehicles placed in service as recently as 1993 and less than *one-tenth* the rate allowed for heavy-duty vehicles in 1990 and earlier. For pollutants other than particulates, new buses also are allowed to emit less than half the previous levels of smog or ozone (VOC and NOx), but the same levels of carbon monoxide (CO).

Given the many years that heavy-duty diesel vehicles can remain in service, we adopt a more prospective approach. For this analysis, new bus emission factors for particulates are taken to be one-fifth the current average for all heavy-duty vehicles, and those for VOC and NOx are taken to be one-half the current average. This approach should be considered conservative, given the large stock of heavy-duty diesel vehicles emitting five or even ten times as many particulates as new transit buses.

Using these assumptions and converting the pollution data for each mode of transportation to emissions *per* passenger mile, we find that public transportation produces substantially less pollution per passenger mile than private vehicles. Compared to private vehicles, public transportation produces, *per* passenger mile, less than 6 percent of the volatile organic compounds and 36 percent of the nitrogen oxides, the two components of smog. Public transit also produces just over 6 percent of the carbon monoxide emitted by private vehicles, per passenger mile. Finally, public transportation produces, *per* passenger mile, roughly 54 percent fewer large particulates and 27 percent fewer small particulates than private vehicles.

Table 17. Pollution Emissions by Transportation Mode, Grams Per Passenger Mile

	VOC	NOx	CO	PM-10	PM-2.5
Public Transit	0.08634	0.35077	0.85276	0.00898	0.00792
Private Vehicles	1.51736	0.96463	13.44057	0.01964	0.01086
Automobiles	1.35859	0.86799	12.12664	0.01849	0.00994
Light Trucks	1.79265	1.13220	15.71869	0.02164	0.01245

The popularity of SUVs (classified with light trucks) accounts for some of the disproportionate pollution produced by private vehicles. In fact, automobiles produce fewer small particulates per passenger mile than public transit as a whole. However, the nation's 18 diesel-powered rail systems account for much of the small particulates emitted by public transportation. Setting aside diesel-powered systems, we find that, *per* passenger mile, electrically-powered public transit produces a very small fraction of the

[41] *National Transportation Statistics 2001, op. cit.*, Table 4-38; EPA, *MOBILE6 Vehicle Pollutant Simulation Mode.*
[42] *Ibid.*

harmful emissions of private vehicles. Looking at small particulates, the emission producing the most serious and costly health effects, electrically-powered transit emits less than one-tenth of 1 percent of the small particulates that private vehicles produce, *per* passenger mile. Electrically-powered rail also produces, *per* passenger mile, just 2.2 percent of the volatile organic compounds, 3 percent of the carbon monoxide, one-two-thousandth of 1 percent of the nitrogen oxides, and one-tenth of 1 percent of the large particulates emitted by private vehicles.

Table 18. Pollution Emissions, Grams *per* Passenger Mile, Electrically-Powered Public Transit versus Private Vehicles

	VOC	NOx	CO	PM-10	PM-2.5
Transit – Electric	**0.03442**	**0.000005**	**0.40726**	**0.000021**	**0.00001**
Commuter Rail	0.02650	0.000004	0.31333	0.000016	0.000008
Heavy Rail	0.03724	0.000005	0.44070	0.000023	0.000012
Light Rail	0.04960	0.000007	0.58698	0.000030	0.000016
Private Vehicles	**1.51736**	**0.96463**	**13.44057**	**0.01964**	**0.01086**
Automobiles	1.35859	0.86799	12.12664	0.01849	0.00994
Light Trucks	1.79265	1.13220	15.71869	0.02164	0.01245

After walking and bicycling, electrically-powered public rail is, by far, the cleanest, healthiest and most efficient means of surface transportation available.

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VI. The Economic Costs of Motor Vehicle Congestion and the Related Benefits of Public Transportation

Recent studies suggest that the single largest negative externality associated with private vehicles is traffic congestion. If the price of motor fuels can capture these indirect costs through fuel taxes, these taxes may improve the economy's efficiency.

At regular intervals, the Texas Transportation Institute (TTI) conducts studies of the costs of traffic congestion, measured principally in the time lost and additional fuel consumed by drivers in 75 major U.S. metropolitan areas. The most recent TTI study found that in 2000, traffic congestion cost the American economy some $67.5 billion.[43]

These congestion-related costs nearly equal the monies raised by motor fuel taxes. As noted earlier, governments at all levels collected $61.2 billion in 2000 from motor fuel taxes, including $30.37 billion raised by the federal government, $28.71 billion collected by states, and $1.84 billion collected by localities. The congestion-related externalities associated with vehicle use, therefore, were about 10 percent greater than all fuel taxes collected in 2000 and more than twice federal fuel tax revenues. In their extent or size, therefore, motor fuel taxes incorporate most of the costs of private-vehicle congestion, and in this sense approximate a congestion-related externality tax. On a per-gallon basis, the congestion costs arising from vehicles using motor fuels in 2000 equaled 41.8-cents per gallon, compared to federal and state fuel taxes averaging 36.9-cents per gallon.[44]

Table 19. Motor Fuel Taxes as an Externality Tax:
Fuel Taxes and the Costs of Congestion from Private Vehicle Use

	Per Gallon Costs	Total Costs
Federal Motor Fuel Taxes	18.4-cents	$30.27 billion
Federal, State and Local Motor Fuel Taxes	36.9-cents	$61.24 billion
Congestion-Related Costs	41.8-cents	$67.50 billion

Motor fuel taxes operate most nearly as congestion-related externality taxes when the revenues are used to support public transportation, because the use of public transportation reduces congestion and its associated costs. Other uses of highway revenues may also help relieve congestion — for example, highway maintenance and

[43] David Schrank and Tim Lomax, *The 2002 Urban Mobility Report*, Texas Transportation Institute, Texas A&M University, June 2002, www.mobility.tamu.edu.
[44] If fact, this understates actual congestion costs per gallon, because the TTI analysis covers only the nation's 75 largest metropolitan areas while the data on fuel use cover the entire country.

building additional roads or creating new HOV lanes in congested areas — but public transit offers the greatest and most certain congestion-related benefits.

Based on TTI's findings of the congestion-related costs of automobile travel, during rush hours and in off-peak times, and data on the use of public transportation in 33 major metropolitan areas, we estimate that public transit saves nearly $15 billion a year in congestion-related costs (Table 20, below).[45] The actual savings must be substantially more because our estimate is limited to the 33 metropolitan areas for which we have detailed data on both public transit use and the congestion costs of private vehicles. It is certain that public transit provides significant congestion-related benefits in other metropolitan areas as well. The use of public transportation in 33 major urban areas, therefore, produces direct savings just from reduced congestion that equal nearly three times the $5.14 billion in federal motor fuel taxes used to support public transit, and nearly half the $30.1 billion spent on public transit by all levels of government.

The savings are greatest in areas with the largest population, the most congestion, and highly-developed transit systems. For example, New York has more than five times the transit commuters of Los Angeles, but New York's congestion-related savings from public transit are less than three times those as Los Angeles because congestion-related costs per driver are higher in Los Angeles. Similarly, public-transit use generates relatively small benefits in Philadelphia and Detroit, because per-person congestion costs are relatively small in Philadelphia, and public-transit use is relatively low in Detroit.

A Note on Methodology: Deriving Congestion-Related Savings

The American Public Transportation Association (APTA) reports that Americans use public transit an average of 31.3 million times every weekday and 9.17 billion times in the year 1999. Multiplying weekday ridership by 250 weekday working days per year, we calculate 7.83 billion weekday trips on public transit per year, which leaves 1.33 billion weekend trips per year (9.17 – 7.83 = 1.33). APTA also reports that 69 percent of weekday public-transit trips involve commuting to and from work (54 percent) or school (15 percent). We assume that the commuting trips occur during peak or rush hours, and other weekday trips and all weekend trips occur during non-peak-hours. This produces an estimate that 59 percent of public-transit trips (5.41 billion) occur during rush hours and 41 percent (2.43 billion) during non-rush hours. We apply these percentages to the TTI findings on congestion-related, per-person costs of motor vehicle use in peak and non-peak hours, in the 33 metropolitan areas where public transit use is tracked by APTA.

[45] Sources for derivation of estimates: American Public Transportation Association, *Fact Book 2001*, Table 26, Table 28, Table 29, Table 34; Shrank and Lomax, o*p. cit.*, Exhibit A-7; Bureau of Transportation Statistics, *National Transportation Statistics 2001*, Department of Transportation, Table 4-10.

Table 20. Congestion-Related Benefits from the Use of Public Transportation, 33 Major Metropolitan Areas, 2000

	Peak-Hour Transit Commuters	Non-Peak Hour Transit Commuters	Peak-Hour Congestion Cost/Person	Non-Peak Hour Congestion Cost/Person	Peak-Hour Saving (millions)	Non-Peak Saving (millions)	Total Transit Saving (millions)
N.Y./N.J.	3,801,895	1,812,895	$1,400	$450	$5,323	$816	$6,138
Los Angeles	694,445	331,132	$2,510	$1,155	$1,743	$382	$2,126
S.F./Oakland	514,847	245,494	$1770	$795	$911	$195	$1,106
Chicago	704,217	335,791	$1,235	$505	$870	$170	$1,039
Washington	449,317	214,248	$1,595	$655	$717	$140	$857
Boston	418,874	199,731	$1,255	$525	$526	$105	$631
Philadelphia	387,575	184,807	$780	$290	$302	$54	$356
Atlanta	200,469	95,589	$1,350	$635	$271	$61	$331
Seattle	153,961	73,413	$1,605	$660	$247	$48	$296
Houston	118,469	56,490	$1,410	$675	$167	$38	$205
Miami	102,573	48,910	$1,255	$600	$129	$29	$158
Baltimore	136,106	64,899	$965	$395	$131	$26	$157
Dallas-Ft. Worth	87,700	41,818	$1,390	$695	$122	$29	$151
San Diego	121,224	57,803	$1,015	$480	$123	$28	$151
Denver	90,948	43,367	$1,235	$640	$112	$28	$140
Portland	110,497	52,688	$910	$445	$101	$23	$124
Minneapolis-St Paul	93,684	44,671	$1,050	$495	$98	$22	$120
San Jose	68,915	32,861	$1,415	$635	$98	$22	$120
Detroit	67,359	32,219	$1,030	$475	$69	$15	$85
St. Louis	63,878	30,459	$840	$395	$54	$12	$66
Milwaukee	86,721	41,351	$620	$285	$54	$12	$66
Phoenix	47,083	22,451	$1,115	$525	$52	$12	$64
San Antonio	53,570	25,544	$810	$380	$43	$10	$53
Ft. Lauderdale	33,570	16,007	$1,105	$520	$37	$8	$45
Riverside	26,489	12,631	$1,250	$575	$33	$7	$40
Cincinnati	36,851	17,572	$855	$395	$32	$7	$39
New Orleans	74,237	35,398	$415	$195	$31	$7	$38
Cleveland	76,028	36,252	$410	$165	$31	$6	$37
Sacramento	35,399	16,879	$840	$385	$30	$6	$36
Pittsburgh	92,629	44,168	$280	$130	$26	$6	$32
Tampa-St Petersburg	22,843	10,892	$815	$380	$19	$4	$23
Norfolk	22,718	10,833	$490	$230	$11	$2	$14
Kansas City	18,377	8,763	$365	$175	$7	$2	$8
TOTAL					**$12,518**	**$2,331**	**$14,850**

Fuel Taxes and the Major Externalities of Motor Vehicle Use

Fuel tax would operate as genuine externality taxes if they could incorporate in the price of fuel the indirect costs of these two major externalities. As we have seen, auto pollution produces health problems that cost Americans some $41 billion a year or 32.9-cents per gallon. Auto congestion produces delays and wastes fuel that, taken together, cost Americans another $67.5 billion a year or 41.8-cents per gallon. The fuel tax would operate as a classic externality tax for pollution and congestion, and so improve the economy's overall efficiency, if its level were 74.7-cents per gallon, compared to the current 36.9-cents per gallon.

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VII. Conclusion

By a range of economic measures, America's highways and public transportation systems are very sound investments; and the federal and state motor fuel taxes used to help finance them are efficient ways of supporting the public systems that produce large economic returns.

Public highway and transit systems contribute to virtually everything of value in the economy and our lives — from transporting goods and people for business purposes, to educating our children, treating illness and enjoying leisure time. For this report, we calculated the economic benefits of surface transportation in two significant areas. First, American businesses derive more than $260 billion a year in benefits from the use of highways and public transit, chiefly in lower costs and higher productivity. Second, individual Americans derive more than $440 billion a year from using highways and public transportation, chiefly in the time they save commuting to work and the higher pay they earn by working further from home.

Americans pay about $150 billion a year in taxes, fees and other charges to build, operate and maintain the transportation systems that generate these $700 billion in annual benefits. Motor fuel taxes, including federal fuel taxes, provide about $61 billion of these public resources and are the largest and most economically-efficient source of these funds. Two features make fuel taxes relatively efficient, compared to other taxes. First, fuel taxes operate much like user fees, targeting much of the direct costs of building and maintaining highways and roads on those who use them. Second, fuel taxes also operate much like an externality fee, incorporating in the price of fuel much of the indirect costs or "negative externalities" associated with consuming the fuel. As an externality fee, motor fuel taxes can actually enhance the economy's efficiency, improving market pricing by focusing more of the total costs associated with fuel on those who purchase it. And the use of surface transportation involves substantial negative externalities, mainly in health-related costs from pollution and the time lost from congestion. We calculate that the pollution and congestion directly associated with highway and roadway use cost Americans nearly $110 billion a year: More than $41 billion a year in health-related costs associated with automobile pollution, and more than $67 billion a year in time lost from highway and roadway congestion in just 33 major metropolitan areas.

Since fuel taxes approximate both a user fee and an externality tax for highway use, and user fees and externality taxes can enhance economic efficiency (so long as the revenues are used productively, as they are here), the American economy could be more efficient if fuel taxes were used to raise even more of the funds for surface transportation. Under the current arrangement, in which a set fuel tax is added to each gallon of fuel purchased, fuel tax revenues keep up with the increases in fuel consumption, but not with the rising cost of surface transportation. To ensure sufficient fuel-tax revenues to maintain and modernize highways and transit systems, the fuel tax rate could, at the least, be indexed to inflation. If Congress had indexed the federal fuel tax to inflation when it was last raised to 18.4-cents/gallon in 1993, the level today would be 23.46-cents/gallon.

To cover all of the public costs of surface transportation with user fees, current federal, state and local fuel taxes would have to rise from 36.9-cents per gallon to 74.6-cents per gallon.[46] To incorporate the pollution and congestion-related costs of surface transportation in the price of fuel, those taxes would have to rise from 36.9-cents per gallon to 74.7-cents per gallon.

The economic benefits of surface transportation and its funding through fuel taxes are enhanced by using fuel tax revenues to support public transportation. One reason is that the use of public transit directly reduces the negative externalities generated by private vehicles. Compared to automobiles and light trucks, public transportation produces, *per* passenger mile, a small fraction of the pollutants that cost Americans $41 billion a year in health costs — about 6 percent of the volatile organic compounds and carbon monoxide, about one-third of the nitrogen oxide, less than half the large particulates, and less than three-quarters of the small particulates. The implicit health savings from electric-powered transit are even greater. Looking at the particulates that produce the greatest and most-costly health problems, electric rail emits just one-tenth of 1 percent of the small particulates and one one-hundredth of 1 percent of the larger particulates, *per* passenger mile, of private vehicles. Public rail also produces, *per* passenger mile, barely 2 percent of the volatile organic compounds, 3 percent of the carbon monoxide and virtually none of the nitrogen oxides of private vehicles. Finally, the use of public transit in just 33 major metropolitan areas also reduces the economic costs associated with automobile congestion by nearly $15 billion a year.

The use of public transportation lessens highway construction and maintenance costs by reducing their carrying load, which ultimately benefits drivers. In addition, it is only appropriate that drivers should bear part of the cost of public transportation, since transit riders bear part of the cost of the highway and road system: Transit riders and drivers alike bear the burden not only of health costs associated with automobile pollution, but also of the non-fuel taxes and bond issues that contribute half of the funding for highways and roads.

The day may not be far off when a significant share of the vehicles using public highways and roads do not rely on gasoline or diesel fuels. Public transportation is participating fully in this development, with more than 10 percent of public buses today powered by natural gas, biofuels, electricity, and other non-oil based fuels. President Bush has endorsed long-standing proposals to accelerate the development of hydrogen-powered vehicles. In addition, new "hybrid" vehicles powered by both electricity and gasoline have been introduced by several automakers and may claim a growing share of

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[46] This assumes the continued use, at current levels, of non-fuel user fees such as highway tolls, motor vehicle taxes, transit fares and other transit operator receipts.

future, new car sales. If these developments continue, new sources of support for surface transportation beyond traditional motor fuel taxes may have to be found.

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Tables

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