The Best Investment A Nation Ever Made

A Tribute to The Dwight D. Eisenhower System of Interstate and Defense Highways

By Wendell Cox & Jean Love
for the American Highway Users Alliance
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EXECUTIVE SUMMARY

Without a first class system of interstate highways, life in America would be far different --- it would be more risky, less prosperous, and lacking in the efficiency and comfort that Americans now enjoy and take for granted. People would be crowded into more densely packed inner cities, intercity travel would occur less often and be more cumbersome; freight charges would be higher and, as a consequence, so would prices. Vacation travel would be more restricted.

The Dwight D. Eisenhower System of Interstate and Defense Highways is in place and celebrating its 40th anniversary, must surely be the best investment a nation ever made. Consider this:

- It has enriched the quality of life for virtually every American.
- It has saved the lives of at least 187,000 people.
- It has prevented injuries to nearly 12 million people.
- It has returned more than $6 in economic productivity for each $1 it cost.
- It has positioned the nation for improved international competitiveness.
- It has permitted the cherished freedom of personal mobility to flourish.
- It has enhanced international security.

It is not an exaggeration, but a simple statement of fact, that the interstate highway system is an engine that has driven 40 years of unprecedented prosperity and positioned the United States to remain the world's pre-eminent power into the 21st century.

While it is not typically thought of in this way, the system is in reality a gift from one group of people --- highway users --- to the nation as a whole, which has reaped a gain of at least $6 in benefit for each $1 spent in construction. And that's just the beginning --- there are additional benefits such as higher employment rates and greater economic opportunity that are simply beyond quantification. Fortunately, the group of people who paid for the interstate highway system is sufficiently large that it's difference from the nation as a whole is virtually without

distinction. But it is a worthy difference to keep in mind as a backdrop for public policy deliberations over future funding of highways.

This report provides an assessment of the manifold benefits of the interstate highway system. Research by leading transportation authorities and standard statistical methods have been used to estimate the impacts of the interstate highway system. The imperative for upgrading the interstate highway system and other super-highways is described and shown to be readily affordable within the capability of present highway user fee revenue.

The interstate highway system has contributed mightily to the economic growth and quality of life in America. The interstates and other super-highways will continue to contribute to economic growth and improved quality of life if necessary investments are made. In large measure, the interstate highway system has democratized mobility in the United States, providing virtually all Americans with the ability to move quickly to any destination within their communities and to travel throughout the nation, inexpensively, and at whatever time or date they desire.

INTRODUCTION: THE INTERSTATE HIGHWAY SYSTEM IN CONTEXT

America is a nation on wheels --- they benefit from a freedom of mobility that is unrivaled anywhere in the world. A substantial portion of that mobility is attributable to the Dwight D. Eisenhower System of Interstate and Defense Highways, which celebrates its 40th anniversary in 1996. The interstate highway system, the largest public works program in history, has had an enormous impact on the nation. The interstate highway system has positively influenced economic growth, reduced traffic deaths and injuries, provided substantial benefits to users, and been a crucial factor in the nation's defense.

Background[1]

Early Planning: As automobiles began to democratize mobility in America in the 1920s and 1930s, it became increasingly clear that greatly improved highways would be needed to accommodate the demand. "Super-highways,"[2] grade separated roadways with four lanes of direction-separated traffic, first appeared in the New York City area parkways that opened in the 1920s. By the early 1940s, the success of early super-highways, especially the Pennsylvania Turnpike, sparked considerable interest in developing a national toll road system. But, the advent of World War II and the policy priorities of the immediate post war years prevented substantial progress until much later.

The interstate highway system was first approved by Congress in 1944, but it was not until 1956 that a comprehensive program was enacted to build the system. By this time, it had become apparent that post-war affluence had produced a huge increase in highway demand and that rapidly expanding highway freight movements required a much improved system. Further, in the volatile Cold War era, national defense provided a primary justification for developing a super-highway system to accommodate the quick and efficient movement of military equipment and

personnel.

Authorization of the Interstate Highway System: On June 29, 1956, President Eisenhower signed the Federal Aid-Highway Act of 1956, which authorized the interstate highway system (later formally named the Dwight D. Eisenhower System of Interstate and Defense Highways). The Act authorized 41,000 miles of high quality highways that were to tie the nation together. Later, congressional action increased the length to 42,500 miles and required super-highway standards for all interstate highways.

The system was to be completed by 1975. It was conceived as a "pay as you go" system that would rely primarily on federally imposed user fees on motor fuels --- the federal user fee per gallon of gasoline was increased by one cent. The federal user fees would provide 90 percent of the cost of construction with the balance provided primarily by state user fees. The interstate highway system would incorporate approximately 2,000 miles of already completed toll roads.

High standards were adopted for the interstate highway system. Access to all interstates was to be fully controlled. There would be no intersections or traffic signals. All traffic and railroad crossings would be grade separated, requiring the construction of more than 55,000 bridges. Interstates were to be divided and have at least four wide traffic lanes (two in each direction) and adequate shoulders. Curves were to be engineered for safe negotiation at high speed, while grades were to be moderated, eliminating blind hills. Rest areas were to be conveniently spaced. Each interstate was to be designed to handle traffic loads expected 20 years after completion.

The states were soon underway with construction. As time passed, it became clear that the goal of system completion by 1975 would not be achieved. But by 1960, more than 10,000 miles were opened. By 1965, 20,000 miles were opened, and by 1970, 30,000 miles were open to traffic. And by 1980, 40,000 miles were complete. While some segments remain to be completed, more than 42,700 miles of interstate highways are now opened to traffic.[3]

The interstate highway system serves virtually all of the nation's large urban areas and serves 49 states (all but Alaska[4]). Despite this broad expanse, the interstate highway system represents just over one percent of the nation's road network.

Performance of the Interstate Highway System

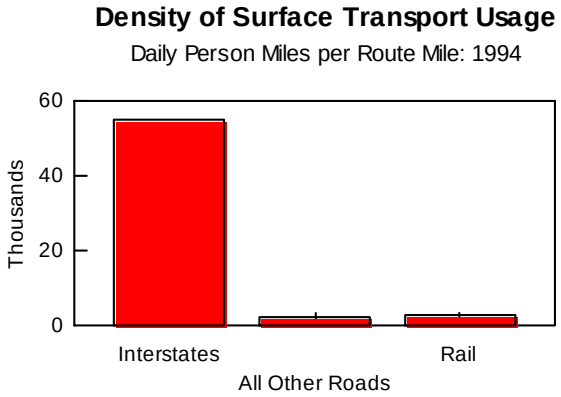
There have been tremendous changes in America since authorization of the interstate highway system in 1956. Population has increased by 70 percent, but employment has increased by more than 100 percent. The percentage of the nation's population that is employed has increased by nearly one-third in 40 years, reflecting a far higher rate of female participation in the work force. Household size has declined significantly. These factors combined to increase travel demand at a far greater rate than had been expected. And much of this increased travel has been on the interstate highway system.

The interstate highway system is the "work horse" of the nation's highway system. Representing

just over one percent of the nation's highway system[5] mileage, the interstate highway system carries nearly one quarter (23 percent) of all roadway traffic, [6] --- more than 20 times its one percent share measured in mileage,[7] and more than 60 times as many person miles[8] as all passenger rail services (Amtrak and urban rail).[9]

Surface Transport Share: 1994 In Person Miles and Route Mileage		
Transport System	Market Share	Mileage Share
Interstate	23.0%	1.1%
All Other Roads	76.4%	98.2%
Passenger Rail	0.6%	0.7%

The interstate highway system has a much higher density of use than other components of the nation's surface transportation system. The interstate highway system carries nearly 60,000 daily person miles per route mile, 26 times as many person miles per route mile as all other roads (including low usage rural roads), and 22 times as many person miles per route mile as intercity rail (Amtrak) and urban rail combined.



Each year, nearly one trillion person miles are carried on the interstate highway system --- a figure equal to providing trips around the world for 37 million people --- more people than live in Pennsylvania, Illinois, and Ohio combined. In its 40 years, more than 17 trillion person miles have been traveled over the interstate highway system.[10] This is the equivalent of:

- Nearly three trips around the world for each American.
- A trip to the moon for all of the people living in California, New York, Texas, and New Jersey --- nearly 75 million people.
- Three *light years* of travel through space --- nearly three-quarters of the distance to the nearest star outside the solar system (Alpha Centauri).

The interstates highway system in intercity and rural travel: The value of the interstate highway system may be most obvious in rural and intercity travel. For the most part, rural and intercity interstate travel is uncongested, permitting highly efficient traffic movement. Rural and intercity interstates provide a large measure of mobility, representing nearly 24 percent of all surface rural and intercity transportation --- 60 times that of passenger rail (Amtrak).[11]

Intercity & Rural Market Share: 1994 In Person Miles	
Interstate	23.7%
Other Highway	75.9%
Passenger Rail	0.4%

Rural and intercity interstates also play a crucial role in freight transportation. It has been estimated that 45 percent of the nation's large truck (tractor-trailer) operations are on the interstate highway system.[12]

Interstate highways have generally reduced travel times by 20 percent or more between cities. For example:[13]

- Travel time between Seattle and Portland, Oregon has declined by nearly 25 percent.
- Travel time between Cleveland and New York City has declined by a third.
- Travel time between Atlanta and Birmingham has declined by nearly 40 percent.
- Travel time between Chicago and Minneapolis has declined by nearly 25 percent.

The time advantage of the interstates remains clear even today, when interstate and non-interstate corridors are compared.

- The average speed from Harrisburg to Albany, which is served by interstates, is more than 20 percent greater than from Harrisburg to Buffalo, which is not.[14]
- Travel time from Sacramento to Salt Lake City, served by an interstate, is 1.5 hours less than virtually the same distance from Phoenix to Salt Lake City, which includes a major gap without an interstate.
- Average travel time from Springfield, Missouri to Alexandria, Louisiana, which is not served by an interstate, is more than 40 percent longer than Springfield to Dallas, which is served by an interstate.

The interstate highway system in urban travel: The positive role of the interstates in the nation's urban areas is often overlooked or even discounted. In the early stages of interstate

planning (1940s and early 1950s), proposed programs omitted cities from the system, limiting the role of the interstates to intercity transportation. The urban interstates were added to the system at the insistence of urban interests.

The interstate highway system provides crucial mobility in urban areas. The interstate highways provide a backbone transportation system that expedites urban trips for automobiles, buses, and trucks, while reducing traffic congestion on non-interstate arterials.

Even in New York City, which relies on non-highway (urban rail) transportation to a far greater extent than any other U.S. metropolitan area, the interstate highway market share (measured in person trips) is nearly double that of the region's sprawling rail system.[15] In other urban areas, the interstate highway system is even more important, with interstate market share exceeding that of rail transit by more than thirty times.

Among the 30 largest urbanized areas outside New York City, interstate highways carry from seven to 10 times the person miles of non-highway modes (primarily urban rail) in three urban areas (Boston, Chicago and Philadelphia); from 10 to 50 times as many person miles in four (San Francisco-San Jose, Washington-Baltimore, Atlanta and Miami-Fort Lauderdale); and from 50 to 150 times in eight urban areas (Buffalo, Cleveland, Pittsburgh, Portland St. Louis, San Diego, New Orleans and Sacramento). In the remaining urban areas, non-highway market share is negligible in comparison with that of the urban interstate highways (Table A-1).[16]

Urban Market Share: 1994 In Person Miles		
	Other Urban Areas	New York City Urban Area
Interstate	21.7%	13.6%
Other Highway	77.6%	78.7%
Rail Transit	0.7%	7.7%

Each lane of urban interstate is capable of moving between 2,500 and 4,000 persons per hour. This huge volume of traffic qualifies interstates as among the most effective urban mass transportation systems. The average urban interstate *lane* carries more people on a daily basis than the most successful of the nation's new light rail systems,[17] and many interstate lanes carry more people than rail lines during their *peak* travel hours.[18]

Interstates are capable of carrying far more people where they include high-occupancy vehicle lanes that expedite trips for buses and car pools. The most successful high occupancy vehicle lane carries up to seven times the volume of general purpose lanes,[19] and more people during peak hour than any of the nation's urban rail lines outside New York City. Interstate high occupancy vehicle lanes provide a form of mass transportation that cannot be provided by conventional mass transit services, providing commuters with door-to-door convenience, and faster and more efficient access to the entire metropolitan region, not just the downtown markets

to which efficient mass transit services are necessarily limited. This vastly increases potential destinations in the mass transportation market beyond the downtown areas, which comprise, on average, only one-tenth to one-thirtieth of employment in urban areas.

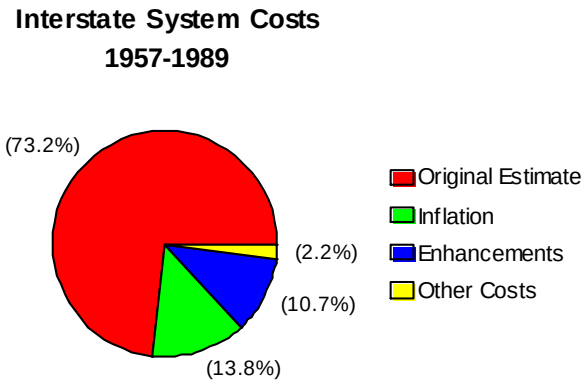
Urban residents use the interstates primarily because of the time that they save. In urban corridors, time savings of up to 60 percent have been observed.[20]

And while traffic congestion is increasing, the urban interstate highway system has continued to perform effectively, despite the fact that the 20 year capacity growth for which they were designed has long since passed in most cases. As employment and residences have spread, and as the number of work trips has increased, work trip travel times have declined, and average work trip distances have increased.[21] While automobile commuting has increased more than 60 percent since 1970, the average automobile driver spends 10 percent less time traveling 20 percent further to work. Part of this is due to the impact of the interstates. The highway commuting system with its interstate backbone provides quicker commutes. Even in cities with urban rail systems, highway commuting speeds are 30 percent greater than rail commuting speeds.[22]

The urban interstates are the high capacity component of what has developed as the world's most democratic, extensive, highly used, inexpensive, and flexible system of urban mass transportation --- the urban highway system.

Cost of the Interstate Highway System

In 1958, the United States Department of Commerce estimated that the interstate highway system would cost $41 billion to construct. Through the years, Congress required periodic reports from the Federal Highway Administration on system progress and the cost to complete the system. In the forty years that have passed, legal, regulatory and political changes have greatly expanded the scope of the interstate highway system. Through 1989,[23] total interstate costs were 37 percent above the original estimate. Most of the difference between the original estimate and the actual cost is attributable to elements that were not anticipated in the original estimate, such as unit cost inflation (more than half of the increase, or 13.8 percent of total costs), and system revisions, such as system additions, and new environmental, safety, relocation and other requirements (40 percent of the increase, or 10.7 percent of total costs). Other cost increases --- the extent by which the original estimate underestimated the cost of the system as anticipated at the time --- accounted for less 10 percent of the increased costs (2.2 percent of total costs). It is estimated that the total construction cost of the interstate highway system, through 1995, is $329 billion in 1996 dollars ($58.5 billion in 1957 dollars).[24] In view of the complexity of projecting costs for such a large program over so long a period of time, the original cost was amazingly accurate.



IMPACT OF THE INTERSTATE HIGHWAY SYSTEM

Impact on the Economy

The interstate highway system has had a profound effect upon the American economy and contributed significantly to improved economic efficiency and productivity.

- By increasing speed and expanding access, freight costs have been reduced substantially. Tractor-trailer operating costs have been estimated at 17 percent lower on interstate highways than other highways.[25]

- The interstate highway system made less expensive land more accessible to the nation's transportation system and encouraged development.

- The travel time reliability of shipment by interstate highway has made "just in time" delivery more feasible, reducing warehousing costs and adding to manufacturing efficiency.

- By broadening the geographical range and options of shoppers, the interstate highway system has increased retail competition, resulting in larger selections and lower consumer prices.

- By improving inter-regional access, the interstate highway system has helped to create a genuinely national domestic market with companies able to supply their products to much larger geographical areas, and less expensively.

Each of these cost reducing impacts have made both labor and capital more efficient and this has encouraged business expansion, new investment, and job creation.

Through the years, various estimates have been made of the contribution of the interstate highway system to the economy, generally finding that the interstate highway system has more than paid for itself in improved commercial productivity.[26] A recent study indicated that with

respect to non-local roads (arterial highways, especially the National Highway System, which includes the interstate highway system), each dollar of investment in highways produces an annual reduction in product costs of 23.4 cents, with larger cost reductions in the early years and smaller reductions in more recent years.[27] While an interstate specific estimate is not available, it is likely that this most productive sector of non-local roads contributes even more per invested dollar than the non-local road system.

Using the results of this research, it is estimated that the interstate highway system is now producing approximately $14 billion[28] in annual producer cost reductions. This annual economic benefit is estimated to have peaked in 1970 at approximately $38 billion. Over the 40 year period, it is estimated that gross producer cost reductions have exceeded $1 trillion[29] --- more than three times the gross original investment in the interstate highway system.[30] This represents a substantial economic benefit, which is likely to have created employment and reduced consumer prices,[31] --- permitting the financial resources of consumers to be stretched to purchase more than would be otherwise possible.

The same report also found that highways have contributed substantially to national productivity growth. From 1950 to 1989, approximately one-quarter of the nation's productivity increase is attributable to increased investment in the highway system.[32] Again, while a separate estimate for the interstate highway system is not available, the superiority and efficiency of the interstate highway system leads to a reasonable presumption of substantial contribution.

Share of the economy: The interstate highway system is also a direct generator of jobs. As it was being built, it provided thousands of construction and related jobs. It has spawned a large number of new roadside businesses. While the direct impact of the interstates is not known, employment in dining establishments has increased more than seven times the rate of population growth, and employment in lodging establishments has increased at twice the national population growth rate (1958-199).[33] Highway transportation, and directly related industries[34] is 7.5 million, more than one-sixth of total employment, while personal expenditures on highway transport represent one-ninth of total personal expenditures.[35] Interstate highways, which carry nearly one-quarter of the nation's surface passenger transport and 45 percent of motor freight transport, accounts for a considerable portion of this employment and economic activity.

International Competitiveness and the Interstates: Super-highways got their start with the construction of German autobahns in the 1930s. Indeed, General Dwight D. Eisenhower's fascination with the German system provided major impetus to the vision of the interstates in the United States. Following the Second World War, super-highway construction resumed. When it was completed in the 1950s, Canada's MacDonald-Cartier Freeway from Montreal through Toronto and toward Windsor was the longest super-highway in North America at more than 500 miles. Since then, Canada has built less than 1,500 miles, while the United States has built more than 50,000 miles (including super-highways that are not a part of the interstate highway system). It was not long before the U.S. took unprecedented leadership in developing super-highways through the interstate highway program.

The United States now leads the world by a considerable margin in super-highways. U.S. mileage is nearly 10 times that of the former West Germany, 12 times that of France, 20 times that of Japan and nearly 30 times that of the United Kingdom. In fact, seven states have more at least as much mileage as the entire United Kingdom (California, Florida, Illinois, New York, Pennsylvania and Texas).[36] Even when adjusted to account for geographic size and population, the United States has a far more extensive network of super-highways than other developed nations --- 2.4 times the former west Germany, 2.9 times France, 6.5 times the United Kingdom and 9.7 times Japan.[37]

Virtually all major urban areas in the United States are connected to one another by the interstate highway network. This is not so in many developed nations. Super-highway networks contain major gaps or have barely been developed at all. For example:

- Four of the United Kingdom's largest urban areas ---Glasgow, Edinburgh, Aberdeen and Newcastle-on-Tyne --- remain unconnected to the rest of the nation by super-highways.

- Five western European national capitals --- Lisbon, Madrid, Oslo, Stockholm and Helsinki --- are not connected to the European network.[38] A major gap remains between Paris and the closest large urban area in Italy, Turin.

- There is no direct connection between Canada's largest urban area --- Toronto --- and the federal capital of Ottawa despite a distance that is little more than from America's largest urban area (New York) to the federal capital (Washington, DC). The major ports of Vancouver and Halifax, together with Winnipeg, are connected to no other major Canadian urban areas.[39]

- Gaps remain in the link between Australia's largest urban area, Sydney, its federal capital, Canberra, and its second largest urban area, Melbourne --- a distance similar to the Denver to El Paso Interstate 25 corridor, which is considerably *less* densely populated. No major urban area in either Australia or New Zealand is connected to any other major urban area by super-highways.

While traffic congestion in urban areas is not unusual in the United States, rural traffic congestion is rare. By contrast, rural traffic delays are far more frequent and serious in Europe.

But the U.S. advantage in super-highways could be challenged by planned improvements. The European Union will spend nearly $100 billion over the next decade to build 9,000 miles of new super-highways and is upgrading an additional 3,000 miles.[40] This investment is likely to improve the competitiveness of this already formidable trading block. And there is a rush to build super-highways in a number of nations, especially in the emerging economies of Asia.

The U.S. advantage in super-highways and the significance of the estimated 25 percent highway contribution to productivity[41] is illustrated by the fact that U.S. gross domestic product per capita leads the next most affluent nation,[42] Switzerland, by only 5 percent, Japan by 17 percent and

Canada by 20 percent.[43]

A nation's international competitiveness depends on a variety of factors such as its labor force, capital investment, natural resources, and infrastructure. With respect to infrastructure, and in particular, the comprehensive and efficient interstate highway system, the United States holds considerable comparative advantage over its international competitors.[44] The interstate highway system reduces manufacturing and distribution costs in the large domestic market, which, in turn, makes U.S. products more competitive in world markets. This increases employment[45] and, by making the U.S. a lower cost economy, allows its citizens to purchase more with their earnings.

The highway system has been very important in maintaining the superiority of U.S. productivity. While estimates for the interstate highway system alone are not available, the efficiency and substantial role of the interstates leads to a reasonable presumption of their important contribution to international competitiveness.

Impact on Safety

The interstate highway system is by far the safest component of the nation's highway system, and its use has reduced traffic accidents, saved lives, and reduced injuries.

- The fatality rate for interstate highways is nearly 60 percent lower that of the rest of the system.[46] It is estimated that use of the interstate highway system in 1994 saved 6,100 lives, compared to the fatalities that would have occurred if there had been no interstates. Over 40 years, an estimated 187,000 lives have been spared by use of the interstates --- more people than live in either Dayton, Ohio or Salt Lake City.[47]

- The injury rate for interstate highways is more than 70 percent lower that of the rest of the system. It is estimated that use of the interstates reduced traffic related injuries by 440,000 in 1994 --- as many people as live in Portland, Oregon or Kansas City, Missouri. Over 40 years, the reduction in injuries is estimated at 11.8 million --- equal to the population of New York City, Chicago and Philadelphia *combined* --- as many people as live in the nation's fifth largest state, Pennsylvania.[48]

- Use of the interstates is estimated to have reduced traffic accidents by more than 400,000 in 1994.[49]

Estimate of Reduced Fatalities & Injuries Attributable to Use of the Interstate Highway System		
	1994	1957-1996
Fatalities Avoided	6,100	187,000
Injuries Avoided	440,000	11,800,000

In urban areas, interstates provide the safest travel.[50]

- Urban interstate fatality rates are more than 50 percent lower than that of other roads, while the injury rate is more than 70 percent lower.

- Urban interstate fatality rates are 65 percent lower than urban rail, while injury rates are 50 percent lower.

Urban Fatality & Injury Rates Per 100 Million Person Miles: 1994		
Type of Transport	Fatalities	Injuries
Interstates	0.386	38.1
Other Highways	0.806	134.7
Urban Rail	1.113	80.7

For each mile of urban interstate highway constructed, more than four lives have been saved and more than 250 injuries have been avoided.

Economic gains from improved safety: There is a significant economic benefit to improved safety. Using National Safety Council estimates of the direct economic cost of traffic accidents, it is estimated that the lower interstate accident rate in 1994 will produce $17.2 billion in direct economic savings.[51] This is nearly as much as the federal government spends on highways annually. Gross losses in terms of quality of life are even higher --- estimated at $57.1 billion using National Safety Council estimates, more than three times annual federal government expenditure on highways.

Estimate of Reduced Economic Loss Attributable to Use of the Interstate Highway System: 1994 In Billions of 1996$		
	Economic	Quality of Life
Fatalities	$5.8	$18.3
Disabling Injuries	$9.6	$36.2
Property & Other	$1.8	$2.6
Total	$17.2	$57.1
Based on National Safety Council Accident Costs		

From 1957 to 1996, the safety related direct economic losses avoided due to the use of the interstate highway system are estimated at $368 billion (1996$).[52] Using this figure, the interstate highway system has produced $1.12 in safety related economic benefit alone for each dollar spent on construction.[53]

Estimate of Reduced Economic Loss Attributable to Use of the Interstate Highway System: 1957-1996 In Billions of 1996$	
Fatalities	$136
Injuries	$194
Property & Other	$38
Total	$368
Based on National Safety Council Accident Costs	

Safety in the States: The safety impacts of the interstates has been considerable in the states. In 1994, use of the interstates is estimated to have saved more than 250 lives in California (695), Texas (670), Florida (320) and Illinois (290) (Table A-2). Over 40 years, three states exceeded 10,000 in estimated fatalities avoided: California (19,500), Texas (18,900) and Illinois (10,300).[54]

In terms of population, the greatest reduction in estimated fatalities occurred in Wyoming (4.72 per 1,000 population[55]), New Mexico (3.17), Montana (2.27), Nevada (2.13), and Utah (2.10).[56] Each of these states were more than double the national rate of 0.86.

In 1995, interstate usage averted more than an estimated 20,000 injuries in Texas (68,200), California (46,100), Ohio (24,800) and Illinois (20,900). Large numbers of injuries have been avoided over the last forty years (Table A-3).[57]

- More than half a million injuries are estimated to have been avoided in Texas (1,665,000), California (1,122,000), Ohio (752,000), Illinois (634,000) and New York (607,000)

- In two states, estimated injuries exceeded the population of cities ranked among the largest six in the nation (Texas averted more injuries than the population of Houston [1,665,000], while California averted more injuries than the population of San Diego [1,122,000]).[58]

- In seven states, the estimated number of injuries avoided exceeds the population of the largest city: Connecticut (Bridgeport), Georgia (Atlanta), New Jersey (Newark), Ohio (Columbus), South Carolina (Columbia), Texas (Houston) and West Virginia (Charleston).

- Other large cities are similar in size or smaller than the number of injuries avoided in their respective states, such as San Francisco, San Jose, Oakland, Sacramento, Fresno, and Long Beach, California; Hartford, Connecticut, Miami, Tampa, St. Petersburg and Orlando, Florida; St. Louis, Missouri; Jersey City, New Jersey, Buffalo and Rochester, New York; Cleveland, Cincinnati and Toledo, Ohio; Pittsburgh, Pennsylvania; Dallas, San Antonio and Fort Worth, Texas and Norfolk, Virginia.

Compared to population, the greatest reduction in estimated injuries occurred in Texas (12.4 percent of average population[59]),Wyoming (12.2 percent), Washington (9.6), Georgia, Utah, and Nevada (all 9.6 percent).[60] The reduction of injuries in each of these states was nearly twice the national rate of 5.4 percent.

The fatalities and injuries averted produced an estimated economic savings of more than half a billion dollars in 1994 alone in Texas, California, Illinois, Florida, Ohio, New York and Virginia (Table A-4). Quality of life gains exceeded one billion dollars in 17 states.

Over 40 years, the estimated economic gains (Table A-5) from the use of interstate highways were highest in Texas ($45.7 billion), California ($36.3 billion), Illinois ($19.9 billion), Ohio ($18.8 billion) and New York ($16.0 billion). Estimated economic gains exceeded $5 billion in 25 states.

The greatest economic gains per capita[61] were in Wyoming ($6,000), New Mexico ($4,200), Nevada ($3,500), Texas ($3,400), Utah ($3,300) and Colorado ($3,000), all nearly double or more than national average of $1,700.

Impact on the Quality of Life

Quantifiable Economic Benefits: The primary benefits of the interstate highway system have been experienced by the people who have used and paid for them.

Benefits to users are of two related varieties:

- Time savings made possible by higher speeds on interstate highways.

- Expanded mobility --- the expanded geographical area in which users can operate also due to the higher speeds on interstate highways.

The direct user benefits have been at least equal to the $329 billion user fee investment. But direct user benefits may have been even greater. If it is conservatively assumed that the interstates provide a time savings of 20 to 30 percent,[62] then total time savings for non-commercial interstate use have been between 75 billion and 125 billion hours --- the equivalent of seven to 12 weeks for all 260 million Americans. The value of time saved for non-commercial users was between $45 billion and $77 billion in 1994 and $650 billion and $1.1 trillion over 40 years.[63]

Users have also benefitted from lower vehicles operating costs, through reduced maintenance requirements, improved tire wear, lower oil consumption, and lower depreciation costs, which have more than offset the higher fuel costs attributable to higher speeds. Operating cost savings are estimated at $2 billion in 1996 and $41 billion over 40 years.[64]

Other Benefits: The interstate highway system has improved the quality of life for Americans in

a number of dimensions that are not readily quantifiable. Nonetheless, each of these benefits has contributed in a material way to maintaining and improving the standard of living.

- Time savings translate into additional time for preferred activities. Travel, especially day to day travel, is generally not an end in itself, it is a means to an end. People travel to get to work, to reach shopping locations, or to keep medical, dental or social appointments, which are primary activities. If people are able to spend less time traveling, they are able to spend more time pursuing preferred activities.

- Expanded mobility allows people to choose from a wider range of options and activities. Faster travel on an interstate can bring more jobs within reach of employees and make it possible for shoppers to take advantage of lower prices or larger selections that may be available at more remote locations.

Additional time and expanded mobility are both products of the interstate highway system. Where mobility improves, opportunity is expanded. Greater employment mobility serves not only the employee, but also the employer and the economy. With a broader geographical range of jobs to choose from, employees are better matched to their employment, improving labor efficiency and productivity. All of this increases economic activity, and translates into a higher quality of life. This is so not only for Americans, but also people in other developed nations, where a close relationship has developed between expanded personal mobility and increasing affluence[65]. Personal mobility is both an economic and social asset.

- **Democratization of mobility:** The interstate highway system has facilitated an unprecedented expansion of mobility and in a democratic manner --- no nation on earth can equal the mobility that is available to the overwhelming majority of Americans. More than 90 percent of the nation's households have access to automobiles, and by extension to the nations' highway system. More than any component of that system, the interstate highway system has expanded the options of people to travel within and between their communities. The interstate highway system provides the crucial express links that make it possible for people to reach virtually any point in their communities for employment or shopping, at whatever time they desire.

- **Expanded employment freedom:** The interstate highway system has made it possible for people to pursue employment across far larger areas than before. People in previously isolated rural areas are now able to use the interstates to reach employment centers. Within urban areas, where interstate highways have reduced travel times up to 60 percent, the interstates make it possible for workers to travel relatively quickly to virtually any location for employment.

- **Expanded residential freedom:** The interstate highway system has played a significant role in producing the American dream of the single family house in the suburbs. As the interstate highway system reduced travel time, people had broader options in residential location. At the same time, lower land prices and increasing affluence made larger

dwellings possible, and the size of the average new house has increased by 40 percent over the last quarter century.[66]

- **Multi-purpose trips:** The improved mobility provided by the interstates has supported a significant increase in multi-purpose trips, especially with respect to work trips. People regularly combine child care, shopping, and other trips with work trips, making valuable time available for preferred activities. Indeed, without the interstate highway system, the barriers to mobility would prevent some people from earning a living, and require others to accept less lucrative employment.

- **Empowerment of the poor:** The combination of market priced (lower priced) gasoline[67] and the interstate highway system have truly democratized mobility in the United States. The large majority of households, including households below the poverty line, have automobiles available and are thus able to access a broader range of employment, shopping, and other opportunities. Indeed, the poor in America generally have greater personal mobility by virtue of the automobile and the interstate highway system than many middle income households in developed nations where quality roadways are less extensive.

- **Lower retail prices:** America's democratized mobility has lowered retail prices, thus benefitting consumers. As freedom of movement has expanded, people have been able to travel further to shop. At the same time, large discount retailers have been established, placing further competitive pressure on prices. To compete, smaller local retailers have had to become more efficient. One of the most important reasons that people get more for their retail dollar today is that they have more options --- they are able to travel wherever they like for bargains or larger selections that would not be available if they were restricted to shopping opportunities in their own immediate areas. And, because they rely on their own personal transportation, they are able to shop at whatever time they desire. This has encouraged longer store hours, more efficient utilization of retail facilities, and created additional jobs. The interstate highway system has been a major contributor to this advance.

- **Improved access to health care:** The interstate highway system has improved the quality of health care. By making it possible to transport those in need of acute care to hospitals much more quickly and over greater distances, the interstates have reduced mortality. The interstate highway system also improves access to specialists and specialized medical equipment for chronic care patients.

- **Improved Air Quality:** Interstate highways contribute materially to the reduction of air pollution and, thereby, to improved health by permitting more consistent speeds and smoother traffic flows.[68] The "stop and go" traffic typical of non-interstate roadways, increases air pollution by up to three times that of smoothly operating traffic, which is typical of most interstate highways.[69]

- **Security:** There is considerable concern about personal security in the United States. During the period that the interstate highway system was constructed, violent crime rates increased by more than five times. People tend to feel safe from crime in their automobiles, and the interstate highway system has permitted people, especially women, to confidently travel longer distances at virtually any time of the day.

- **Leisure activities and vacations:** The broadened mobility provided by the interstate highway system has made it possible for people to take longer trips on weekends and during vacations. This, in turn, has generated a significant increase in highway related businesses, such as lodging establishments, restaurants, service stations, etc.

Impact on National Defense

One of the principal reasons for building the interstate highway system was to support national defense. When the system was approved --- during one of the most instable periods of the Cold War, national security dictated development of an efficient national highway system that could move large numbers of military personnel and huge quantities of military equipment and supplies. The interstate highway system effectively performs that function, but perhaps more importantly, its availability provides the nation with a potential resource that could have been reliably called upon if greater military conflict had arisen. Throughout the Cold War (and even to today), America's strategic advantage in effective surface transportation was unchallenged. Even today, no constituent nation of the late Soviet Union has begun to develop such a comprehensive surface transportation system.

In the post-communist world, it may be tempting to underestimate the role of the interstate highway system in national defense. But the interstate highway system continues to play a critical role. The U.S. military's Strategic Highway Corridor Network (STAHNET) relies primarily on the interstate highway network, which represents 75 percent of network mileage. The U.S. Army cited the that system as being critical to the success of the 1990-1991 "Desert Shield-Desert Storm operation (the U.S. led operation to free Kuwait from Iraq):

> *Much of the success of the operation was due to our logistical ability to rapidly move troops to the theater. The capacity of the U.S. highway system to support the mobilization of troops and to move equipment and forces to U.S. ports of embarkation was key to successful deployment.*[70]

The Army also noted the "modal redundancy" of the highway system, which provided rapid and effective movements of a military division when difficulties with a rail line precluded the planned transport by rail.[71] This illustrates the fact that the interstate highway system continues to play an important role in national defense, even in the post-Cold War era.

The Interstate Highway System: 40 Years of Serving America

Over the last 40 years, the Dwight D. Eisenhower Interstate System of Interstate and Defense

Highways has served the nation well.

- It has benefitted users by increasing mobility, reducing travel time, reducing operating costs, and generally expanding options for a higher quality of life.

- It has benefitted the community by reducing the costs of motor vehicle accidents.

- It has contributed substantially to economic growth.

The 40-year benefits quantified above are estimated at between $2.1 trillion and $2.5 trillion (1996$) --- between 6 and 7.5 times the gross original investment in the interstate highway system. Benefits in 1996 alone are estimated at from $78 billion to $110 billion --- more than the gross state product of Oregon.

Quantified 40 Year Benefits of the Interstate Highway System: 1995$		
Benefits	1996 (Billions)	1957-1996 (Trillions)
Lower Product Prices	$14	$1.0
User Benefits (Time Savings & Operating Costs)	$47-$79	$0.7-$1.1
Reduced Fatalities, Injuries and Accidents	$17	$0.4
Total Quantified Benefits	$78-$110	$2.1-$2.5

But the quantified benefits fall short of the actual benefits that have been produced by the interstate highway system, such as:

- Increased business investment.

- Increased employment opportunities.

- Greater employment mobility.

- Expanded housing opportunities

- Greater economic freedom due to multi-purpose trips

- Greater mobility for low income citizens

- Improved access to health care

- Improved security

- Greater leisure time and broadened vacation options

Each of these benefits do not lend themselves easily to economic analysis, but their impact has clearly been profound. The interstate highway system has improved and enriched the quality of life of Americans.

THE FUTURE OF THE INTERSTATES

While the economic and social benefits of the first 40 years of the interstate highway system are clear, the gargantuan load of automobiles, light trucks, buses, and commercial vehicles has taken a toll on the interstates.

Condition of the Interstates: Despite the important role played by the interstates in the nation's economy and quality of life, the system requires renewed investment. Many portions of the interstate highway system are strained to capacity, increasing delays and air pollution and dampening economic activity. This is not surprising. The interstate highways were built to accommodate 20 years of traffic growth. By 1985, half of the system had reached its design life, and, by 1995, 90 percent of the system was 20 years or older. The original interstate highway system, authorized when the nation's population was less than 170 million, is not much more extensive today when the nation's population approaches 270 million. Including non-interstate super-highways, expressways and toll roads now total 55,000 miles, 30 percent more than the interstate highway system as conceived in the late 1950s, but the nation's population has increased by 70 percent over the same period.

- From 1982 to 1992, urban traffic congestion increased by more than 15 percent.[72]

- The percentage of urban interstate lane miles operating at above 80 percent of capacity at peak hour has nearly doubled since 1975.[73]

And, rural interstate congestion, though minimal compared to that of urban areas, continues to grow.

At the same time, the physical structure of the system is in need of attention.

- Approximately 60 percent of interstate pavements are rated from fair to poor.[74]

- Six percent of interstate bridges are structurally deficient.[75] Structural deficiency can result in catastrophic bridge failure and loss of life (within the past 15 years, there have been two well publicized bridge collapses claiming 13 lives[76]).

The Imperative for Interstate Investment: Expensive as they might appear, improvements are necessary. According to reports prepared for the Federal Highway Administration, the pace of super-highway lane construction in urban areas over one million would have to be increased substantially to stop the growth of traffic congestion. Yet, the annual cost of such would be only $3 billion[77] --- a fraction of the peak annual construction costs incurred during the 1960s and 1970s, and a 2.5 percent increase in the nation's annual surface transportation budget.[78] The

safety impacts alone would justify such expenditures. Each new ten mile segment of urban interstate could be expected to save, on average, two lives and 250 injuries annually. Over a ten year period, this urban interstate improvement rate could save 1,950 lives and avert 240,000 injuries.[79] The economic impacts of improved safety would exceed the cost of the new roadway in less than 15 years.[80] Each new 10 mile segment of rural interstate could be expected to save one life and 40 injuries per year.

The increase in traffic congestion takes an additional economic toll in terms of excess fuel consumption and the costs of delay. In 1992, these urban "congestion costs" were $34 billion and were increasing at an annual rate of approximately $2.1 billion[81] --- nearly two thirds of the annual cost of required capacity expansion ($3.0 billion, above). Urban super-highway (largely interstate) congestion increases motor vehicle related pollution by consuming more than 14 billion excess gallons of fuel annually --- 58 gallons of fuel per household. This is enough fuel to transport the average household 1,250 miles by automobile (equal to trips from New York to Minneapolis, Seattle to San Diego, Milwaukee to Orlando or Denver to New Orleans).

A report on 1989 conditions indicated that free traffic flow could be achieved through super-highway (largely interstate) expansions in even the most congested urban areas.[82]

- By far the highest cost --- $8 billion --- would be required in Los Angeles[83] --- considerably less than that urban area is spending to build urban rail systems that are unlikely to significantly improve traffic flow.

- $1 billion would be required in Washington, D.C. Again, while this is a considerable figure, it represents a relatively small investment compared to other non-highway transportation investments that have failed to reduce the area's traffic congestion.

There has been considerable opposition to expansion of urban interstates, much of it based upon the presumption that expanded interstate capacity is quickly consumed by new traffic. Yet, traffic congestion has *declined* in two of the nation's fastest growing urban areas (between 1982 and 1992).[84]

- In Phoenix, traffic congestion declined by six percent from 1982 to 1992, while population increased by 40 percent (1980-1990).

- In Houston, traffic congestion declined by four percent from 1982 to 1992, while population increased by 20 percent (1980-1990).

A major component of the improved traffic conditions in these two urban areas has been a substantial program to build and expand super-highways. By contrast, the average large urban area experienced a 20 percent increase in traffic congestion, while population increased by approximately 10 percent.

Nationally, improvement of interstate highways and other super-highways to support anticipated

rates of economic growth would require an annual increase in capital expenditures of approximately $3.5 to $4.5 billion --- $24 billion from 1997 through 2002.[85] Recent analysis by the Congressional Budget Office indicated that federal highway expenditures could be increased by nearly $28 billion from 1997 through 2002 --- more than enough to pay for the required investment, through use of existing and anticipated Highway Trust Fund resources.[86] Further, even after 2002, highway user fees will continue to produce more revenue than is spent on building, maintaining, and patrolling the nation's highways --- considerably more than would be required to fund the investments required to preserve the positive economic contribution of the interstate highway system to the national economy.

The economic imperative: The nation's continued economic growth depends, in part, on an interstate highway system that grows along with the nation. Population growth will continue. All demographic trends indicate overwhelmingly that people will continue to pursue the "American Dream" of the house in the suburbs and a high degree of personal mobility. But the challenges to U.S. economic growth are substantial. International competitors are becoming stronger, while total compensation per U.S. employee is increasing at lower rates that before. If traffic congestion is permitted to worsen, then American consumers will pay a heavy toll, in higher prices due to higher shipping costs, jobs lost due to foreign competition, reduced employment opportunities, and less leisure time.

America's Future Depends on the Interstates

It has been a momentous 40 years. Interstate highways have contributed to the economic growth and quality of life in America. Indeed, the interstate highway system has been a major factor in making the United States the homogeneous nation that it has become.

The interstate highway system, and other super-highways, will continue to make a positive contribution to the nation's economy and quality of life. This requires that investments be made to preserve and expand the mobility that has helped to make Americans the world's most prosperous people, America the world's premier economic power, and provided an international model for expanding freedom of mobility for virtually everyone. In important dimensions, the future of the nation depends upon the interstate highway system.

THE AMERICAN HIGHWAY USERS ALLIANCE

The American Highway Users Alliance traces its roots to 1932, when it was chartered by General Motors President Alfred Sloan to "get the farmers out of the mud." The Highway Users (knows as the Highway Users Federation from 1970 to 1995) serves the long-term interests of business and industry in transportation. Many industries are dependent on highways to be successful, including automotive, travel and shipping. Almost 80 percent of all U.S. Expenditures for passenger and freight transportation --- $800 billion annually --- are highway related. Highway passengers spend over $350 billion per year on their travel --- about 12 percent of the nation's GDP. And freight movement over highways counts for 80 percent of all shipping.

The Highway Users works for better, safer highway transportation through public policy analysis, public information and education, and legislative and regulatory advocacy. It believes that good highways are essential to a strong economy and the costs of improving highway transportation should be borne by the users.

Led by President William D. Fay, the Highway Users has over 500 individual and 100 corporate/association members and affiliates in 18 states.

THE AUTHORS

Wendell Cox and Jean Love are public policy consultants with the Wendell Cox Consultancy. Both have worked on projects in the United States, Canada, Australia, Africa, Europe, and New Zealand. They have recently established an Internet public policy journal, *The Public Purpose*.

Mr. Cox was appointed to three terms (1977-85) on the Los Angeles County Transportation Commission by Mayor Tom Bradley and has chaired national committees on energy conservation and urban transit planning. He also serves on the steering committee of the bi-ennial International Conference on Competition and Ownership in Surface Passenger Transport. He holds an MBA from Pepperdine University in Los Angeles.

Ms. Love has performed research in a variety of fields, and edited three editions of a comprehensive public policy manual (*Legislative Issue Briefs*). She organized the Third International Conference on Competition and Ownership in Surface Passenger Transport, held in Toronto in 1993. She earned a Masters degree from Southern Illinois University in Edwardsville.

They are co-authors of many books and papers, including *Moving America Competitively, The Livable American City* and *People, Markets, and Government: A State Legislator's Guide to Economics.* Their practice is based in the St. Louis area.

APPENDICES

Table A-1 Urban Travel Market Share (Person Miles): 1994 Largest Urban Areas				
Urban Area	Interstate	Other Highway	Non-Highway (Primarily Rail)	Interstate Times Non-Highway
Atlanta	26.5%	72.8%	0.7%	39
Boston	22.8%	74.2%	3.0%	8
Buffalo	17.0%	82.8%	0.2%	98
Chicago-Northwestern Indiana	20.9%	76.6%	2.5%	8
Cincinnati	30.2%	69.8%	0.0%	**
Cleveland	27.6%	72.1%	0.3%	84
Columbus	27.6%	72.4%	0.0%	**
Denver	19.9%	80.1%	0.0%	1,659
Detroit	21.2%	78.8%	0.0%	**
Dallas-Ft. Worth	20.7%	79.3%	0.0%	**
Houston	19.7%	80.3%	0.0%	**
Kansas City	24.9%	75.1%	0.0%	**
Los Angeles	21.5%	78.4%	0.1%	172
Miami-Fort Lauderdale	14.3%	85.1%	0.6%	25
Milwaukee	17.4%	82.6%	0.0%	**
Minneapolis-St. Paul	24.1%	75.9%	0.0%	**
New Orleans	22.8%	77.1%	0.2%	133
Norfolk-Va. Beach-Newport News	18.7%	81.3%	0.0%	**
New York-Northeastern New Jersey	13.6%	78.7%	7.7%	2
Pittsburgh	16.4%	83.4%	0.2%	93
Philadelphia	15.3%	82.6%	2.1%	7
Phoenix	12.4%	87.6%	0.0%	**
Portland	23.0%	76.7%	0.3%	85
Sacramento	16.9%	82.9%	0.2%	77
San Antonio	25.0%	75.0%	0.0%	**
San Diego	27.7%	72.1%	0.2%	135
Seattle	25.2%	74.8%	0.0%	**
San Francisco-San Jose	21.6%	76.8%	1.6%	14
St. Louis	27.3%	72.5%	0.1%	235
Tampa-St. Petersburg	14.7%	85.3%	0.0%	**

Washington-Baltimore	23.5%	74.7%	1.7%	14
**Non-highway person miles zero or negligible.				

Table A-2 Estimate of Reduced Fatalities Attributable to Use of the Interstate Highway System: By State			
State	1994	40 Years	Fatalities Avoided per 1,000 Population*
Alabama	135	4,400	1.19
Alaska	0	0	---
Arizona	170	4,200	1.70
Arkansas	60	1,900	0.90
California	695	19,500	0.85
Colorado	170	4,700	1.79
Connecticut	70	2,300	0.77
Delaware	5	100	0.17
District of Columbia	10	300	0.44
Florida	320	8,100	0.91
Georgia	175	5,000	0.95
Hawaii	10	300	0.37
Idaho	50	1,500	1.75
Illinois	290	10,300	0.93
Indiana	130	4,500	0.85
Iowa	70	2,400	0.85
Kansas	55	1,800	0.77
Kentucky	90	3,000	0.87
Louisiana	110	3,800	0.98
Maine	20	600	0.55
Maryland	110	3,400	0.83
Massachusetts	70	2,600	0.46
Michigan	120	4,200	0.47
Minnesota	80	2,500	0.63
Mississippi	105	3,500	1.46
Missouri	190	6,400	1.33
Montana	50	1,700	2.27
Nebraska	30	1,100	0.72

Nevada	80	1,600	2.13
New Hampshire	20	500	0.58
New Jersey	90	2,900	0.41
New Mexico	140	3,900	3.17
New York	170	6,100	0.34
North Carolina	140	4,300	0.76
North Dakota	10	300	0.47
Ohio	180	6,300	0.60
Oklahoma	130	4,200	1.50
Oregon	60	1,800	0.75
Pennsylvania	145	5,200	0.44
Rhode Island	20	600	0.64
South Carolina	110	3,300	1.12
South Dakota	20	600	0.87
Tennessee	180	5,600	1.30
Texas	670	18,900	1.41
Utah	100	2,800	2.10
Vermont	10	300	0.62
Virginia	200	5,900	1.14
Washington	90	2,400	0.61
West Virginia	50	1,800	0.98
Wisconsin	60	1,900	0.42
Wyoming	60	1,900	4.72
United States	6,100	11,800,000	0.86

*Population is weighted 40 year average
Note: Alaska has no designated interstate standard highways.

Table A-3
Estimate of Reduced Injuries Attributable to
Use of the Interstate Highway System: By State

State	1994	40 Years	Similar Sized Cities or Counties	% of Population*
Alabama	4,700	134,000	Tuscaloosa + Dothan	3.6%
Alaska	0	0	---	---
Arizona	4,800	103,000	Flagstaff + Yuma	4.2%
Arkansas	1,800	51,000	Jonesboro	2.4%
California	46,100	1,122,000	San Diego	4.9%
Colorado	9,500	231,000	Aurora	8.8%

Connecticut	8,000	239,000	New Haven + Waterbury	8.0%
Delaware	700	17,000	Milford + Seaford + Smyrna	3.0%
District of Columbia	600	22,000	---	3.2%
Florida	19,800	439,000	Miami + Lakeland	4.9%
Georgia	19,700	489,000	Atlanta + Albany	9.3%
Hawaii	1,600	40,000	Hilo	5.0%
Idaho	2,400	61,000	Pocatello + Rexburg	7.1%
Illinois	20,900	634,000	Lake County + Decatur	5.7%
Indiana	5,700	168,000	Fort Wayne	3.2%
Iowa	1,800	58,000	Council Bluffs	2.1%
Kansas	3,400	99,000	Lawrence + Manhattan	4.2%
Kentucky	5,500	161,000	Owensboro + Covington + Bowling Green	4.7%
Louisiana	5,900	172,000	Lafayette + Lake Charles	4.4%
Maine	1,700	50,000	Bangor + Waterville	4.6%
Maryland	10,500	281,000	Howard County + Annapolis	6.9%
Massachusetts	5,000	151,000	Springfield	2.7%
Michigan	13,500	408,000	Flint, Grand Rapids + Kalamazoo	4.6%
Minnesota	5,700	161,000	Duluth + Rochester	4.1%
Mississippi	1,800	52,000	Biloxi	2.2%
Missouri	14,000	412,000	St. Louis + Rolla	8.6%
Montana	1,600	46,000	Missoula	6.1%
Nebraska	2,500	75,000	Grand Island + Hastings + Scottsbluff	4.9%
Nevada	3,800	70,000	Henderson	9.3%
New Hampshire	700	18,000	Laconia	2.1%
New Jersey	9,700	284,000	Newark	4.0%
New Mexico	4,400	110,000	Santa Fe + Roswell	9.0%
New York	19,600	607,000	Buffalo + Rochester + Rome	3.4%
North Carolina	8,700	231,000	Raleigh	4.1%
North Dakota	500	16,000	Dickinson	2.5%
Ohio	24,800	752,000	Cleveland + Akron	7.1%
Oklahoma	5,600	159,000	Lawton + Norman	5.7%
Oregon	3,200	82,000	Medford + Albany	3.4%
Pennsylvania	12,200	378,000	Pittsburgh	3.2%
Rhode Island	1,400	43,000	Woonsocket	4.6%
South Carolina	4,200	111,000	Columbia	3.8%
South Dakota	1,200	35,000	Aberdeen + Vermillion	5.1%
Tennessee	9,100	249,000	Knoxville + Jackson + Kingsport	5.8%

Texas	68,200	1,665,000	Houston	12.4%
Utah	5,200	124,000	Provo + Logan	9.3%
Vermont	400	10,000	Barre	2.1%
Virginia	12,100	313,000	Norfolk + Charlottesville	6.1%
Washington	15,400	377,000	Spokane + Tacoma + Wenatchee	9.6%
West Virginia	2,800	89,000	Huntington + Wheeling	4.8%
Wisconsin	5,500	158,000	Green Bay + Eau Claire	3.5%
Wyoming	1,700	49,000	Casper	12.2%
Totals	439,600	11,806,000		5.4%

*Population is weighted 40 year average
Note: Alaska has no designated interstate standard highways.

Table A-4
Estimate of Reduced Economic Loss Attributable to
Use of the Interstate Highway System: 1994 By State
In Millions of 1996$

	Economic	Quality of Life
Alabama	$260	$830
Alaska	$0	$0
Arizona	$300	$950
Arkansas	$110	$340
California	$1,870	$6,170
Colorado	$410	$1,350
Connecticut	$270	$900
Delaware	$20	$70
District of Columbia	$20	$80
Florida	$820	$2,700
Georgia	$670	$2,250
Hawaii	$50	$170
Idaho	$110	$370
Illinois	$820	$2,730
Indiana	$280	$900
Iowa	$120	$370
Kansas	$140	$460
Kentucky	$230	$760
Louisiana	$260	$860
Maine	$60	$210
Maryland	$370	$1,250

Massachusetts	$200	$660
Michigan	$460	$1,550
Minnesota	$220	$730
Mississippi	$160	$490
Missouri	$540	$1,800
Montana	$90	$300
Nebraska	$90	$310
Nevada	$180	$580
New Hampshire	$40	$120
New Jersey	$330	$1,100
New Mexico	$250	$810
New York	$660	$2,220
North Carolina	$360	$1,200
North Dakota	$20	$70
Ohio	$790	$2,690
Oklahoma	$280	$890
Oregon	$140	$460
Pennsylvania	$450	$1,500
Rhode Island	$50	$180
South Carolina	$220	$710
South Dakota	$50	$160
Tennessee	$410	$1,340
Texas	$2,380	$7,990
Utah	$240	$770
Vermont	$20	$60
Virginia	$510	$1,670
Washington	$470	$1,600
West Virginia	$120	$390
Wisconsin	$190	$650
Wyoming	$100	$330
Based on National Safety Council Accident Costs Note: Alaska has no designated interstate standard highways		

Table A-5 Estimate of Reduced Economic Loss Attributable to Use of the Interstate Highway System: 1957-1996 By State In Billions of 1996$		
State	Economic	Per Capita*

Alabama	$6.0	$1,600
Alaska	$0.0	$0
Arizona	$5.2	$2,100
Arkansas	$2.5	$1,200
California	$36.3	$1,600
Colorado	$8.0	$3,000
Connecticut	$6.2	$2,100
Delaware	$0.4	$700
District of Columbia	$0.6	$900
Florida	$14.5	$1,600
Georgia	$12.9	$2,400
Hawaii	$0.9	$1,100
Idaho	$2.3	$2,700
Illinois	$19.9	$1,800
Indiana	$6.7	$1,300
Iowa	$3.0	$1,100
Kansas	$3.2	$1,400
Kentucky	$5.4	$1,600
Louisiana	$6.2	$1,600
Maine	$1.4	$1,300
Maryland	$7.9	$1,900
Massachusetts	$4.8	$800
Michigan	$10.8	$1,200
Minnesota	$4.9	$1,200
Mississippi	$3.8	$1,600
Missouri	$12.7	$2,600
Montana	$2.2	$2,900
Nebraska	$2.2	$1,400
Nevada	$2.6	$3,500
New Hampshire	$0.7	$800
New Jersey	$7.5	$1,000
New Mexico	$5.1	$4,200
New York	$16.0	$900
North Carolina	$7.6	$1,300
North Dakota	$0.5	$800
Ohio	$18.8	$1,800
Oklahoma	$6.3	$2,200

Oregon	$2.9	$1,200
Pennsylvania	$11.0	$900
Rhode Island	$1.2	$1,300
South Carolina	$4.7	$1,600
South Dakota	$1.1	$1,600
Tennessee	$9.0	$2,100
Texas	$45.7	$3,400
Utah	$4.4	$3,300
Vermont	$0.4	$800
Virginia	$10.5	$2,000
Washington	$8.8	$2,200
West Virginia	$3.0	$1,600
Wisconsin	$4.4	$1,000
Wyoming	$2.4	$6,000
United States	$368.0	$1,700

*Based on weighted 40 year average population
Based on National Safety Council Accident Costs
Note: Alaska has no designated interstate standard highways

END NOTES

1. Much of the information in this section is from Richard F. Weingroff, "A Partnership that Makes a Difference," *Public Roads* (Washington DC: United States Department of Transportation, Federal Highway Administration, Summer 1996) and "Development of the Interstate Program," in *America's Highways: 1776-1976* (Washington, DC: United States Department of Transportation, Federal Highway Administration, 1976).

2. The term "super-highway" is used to denote a controlled access (grade separated) roadway with at least four lanes of traffic separated by direction. Super-highways may be toll roads or free (freeways). In most nations, including the United States, "free" super-highways are not really free, in that their construction, maintenance and patrolling costs are paid by highway user fees.

3. There have been additions to the system beyond the 42,500 authorization.

4. Some highways in Alaska have been eligible for receipt of federal interstate funding, but Alaska contains no highways that are formally designated as a part of the interstate standard system.

5. Unless otherwise noted, "highway system" refers to the system of all urban roadways in the United States (urban, intercity, and rural).

6. Calculated from data in *1994 Highway Statistics* (Washington, DC: United States Department of Transportation, Federal Highway Administration, 1995).

7. Calculated from data in *1994 Highway Statistics.*

8. A person mile is one person traveling a mile. For example, a car with a driver and no passengers produces one person mile per each vehicle mile traveled. A car with a driver and two passengers produces three person miles for each vehicle mile traveled.

9. Calculated from data in *National Transportation Statistics 1996* (Washington, DC: United States Department of Transportation, Bureau of Transportation Statistics, 1996), *1994 Highway Statistics* and *National Transit Database 1994* (Washington, DC: United States Department of Transportation, Federal Transit Administration, 1996)..

10. Assumes vehicle occupancy on the interstates equals that of the entire highway system.

11. Calculated from data in *National Transportation Statistics 1996* (Washington, DC: United States Department of Transportation, Bureau of Transportation Statistics, 1996) and *1994 Highway Statistics.*

12. *Benefits of Interstate Highways* (Washington, DC: United States Department of Transportation, Federal Highway Administration, 1983).

13. Travel time comparisons from analysis of "United States Mileage Chart" and "Driving Distances and Driving Times" in American Automobile Association maps of the United States (Heathrow, FL: American Automobile Association: 1954, 1955 and 1996).

14. Travel time comparisons from analysis of "Highway and Driving Times Map," *Rand McNally 1996 Road Atlas* (Skokie, IL: Rand McNally Company, 1996).

15. Estimated from data in *1995 Highway Statistics* and *National Transit Database 1994.* Average urban interstate vehicle occupancy is estimated at 1.65, based upon analysis of data in the 1990 *National Personal Transportation Survey* and *1994 Highway Statistics.*

16. Estimated from data in *1994 Highway Statistics* and *National Transit Database 1994.*

17. The average interstate lane carries 12,888 vehicles daily (*1994 Highway Statistics*) and an estimated 42,500 people (estimated using average vehicle occupancy rates). New light rail systems with the highest daily ridership are Los Angeles (nearly 40,000), Buffalo, Portland and St. Louis (each between 25,000 and 30,000) (*National Transit Database 1994*).

18. Based upon peak hour light rail ridership data as reported in Dennis L. Christiansen, *High Occupancy Vehicle System Development in the United States* (Washington, DC: United States Department of Transportation, 1990).

19. Calculated from data in Christiansen.

20. *Benefits of Interstate Highways,* 1970.

21. Calculated from data in *Nationwide Personal Transportation Survey* (Washington, DC: United States Department of Transportation, Federal Highway Administration, 1977 and 1990).

22. Calculated from data in *Nationwide Personal Transportation Survey: Urban Travel Patterns* (Washington, DC: United States Department of Transportation, Federal Highway Administration, 1994).

23. The last analysis of interstate cost changes was completed by the Federal Highway Administration in 1991 and covered expenditures through 1989.

24. Methodology: Classification of diversion from original projection estimated based upon an analysis of data in *Interstate Cost Estimate* reports from 1958 through 1991 (produced by the United States Department of Commerce and the United States Department of Transportation). Total construction cost estimated using annual federally funded construction costs (including preliminary engineering, right of way acquisition and construction) supplied by the Federal Highway Administration (unpublished), adding a factor to account for non-local costs (based upon the ratio of costs from 1957 to 1990 in the 1991 *Interstate Cost Estimate*. Inflation adjustment based upon gross domestic

product implicit price deflator.

25. *Benefits of Interstate Highways* (Washington, DC: United States Department of Transportation, Federal Highway Administration, 1983).

26. See for example, *Benefits of Interstate Highways* (Washington, DC: United States Department of Transportation, Federal Highway Administration, 1970) and *Benefits of Interstate Highways* (Washington, DC: United States Department of Transportation, Federal Highway Administration, 1983).

27. M. Ishaq Nadiri and Theofanis P. Mamuneas, *Contribution of Highway Capital to Industry and National Productivity Growth* (Washington, DC: United States Department of Transportation, Federal Highway Administration, 1996).

28. In 1996 dollars, based upon year of construction expenditure. Throughout the balance of the report all financial data is in 1996 dollars, unless otherwise noted.

29. Estimated based upon data in Nadiri and Mamuneas. A production cost decrease factor was estimated for each year from 1957 to 1996 by using their time series rates of change for the social rate of return for the non-local highway system (the 1970s to 1980s rate of change was used for years after 1989). Yearly interstate construction costs developed above are used, and a 60 year depreciation schedule is assumed (consistent with the assumptions in *Fixed Reproducible Tangible Wealth in the United States, 1925-89* [Washington, DC: United States Department of Commerce, Economics and Statistics Administration, Bureau of Economic Analysis: 1993]). The resulting figure should be considered a general approximation, since additional research is underway to more reliably isolate the benefits of the highway contribution from other potential contributing factors (such as other infrastructure). Moreover, the Nadiri and Mamuneas data on which this estimate is based are aggregate figures for the economy. The production cost impacts vary substantially by industry.

30. $1 trillion divided by $329 billion.

31. Based upon the competitiveness of the U.S. economy, it is assumed that virtually all of the lower product costs resulted in consumer benefit through lower consumer prices and higher profits that, in turn, increased business investment and thereby created new jobs.

32. Nadiri and Mamuneas.

33. Calculated from data in *Statistical Abstract of the United States* (multiple annual editions).

34. Calculated from data in *National Transportation Statistics 1996.*This figure does not include employment in related businesses outside the transport sector, such as road side business.

35. Calculated from National Income and Product Accounts, 1994, *Survey of Current Business* (Washington, DC: United States Department of Commerce, Economics and Statistics Administration, Bureau of Economic Analysis, January-February 1996).

36. Calculated from *Book of Vital Statistics* (London, UK: The Economist Books, 1990).

37. Based upon a ratio of super-highway mileage per 1,000 square miles to population per square mile. Calculated from data in *Book of Vital Statistics*.

38. This will remain the case even after completion of the Oresund link across the strait between Denmark and Sweden.

39. Vancouver is, however, connected to the U.S. interstate highway system.

40. Commission of the European Communities, *Trans-European Networks: Towards a Master Plan for the Road Network* (Brussels, Belgium: Commission of the European Communities, Director-General for Transport, December 1992).

41. Nadiri and Mamuneas.

42. Only Luxembourg, a highly specialized nation, slightly larger in area than the city of Jacksonville, Florida, with 40 percent fewer people (400,000, compares to Jacksonville's 640,000) has a higher gross domestic product per capita than the United States (based upon purchasing power parities).

43. *Purchasing Power Parities and Real Expenditures: EKS Results, Volume I 1993* (Paris, France: Organization for Economic Co-operation and Development, 1995).

44. For a discussion of comparative advantage in international economics, see Michael E. Porter, *The Comparative Advantage of Nations* (New York, NY: The Free Press, 1990).

45. U.S. unemployment rates have been considerably below that of European nations for a decade.

46. 1994, measured in fatalities per 100 million person miles.

47. Methodology: It is assumed that interstate traffic would be on the non-interstate highway portions of the federal aid-primary (FAP) system if there were no interstate highways. This estimate of lives lost is calculated using the differential in interstate and FAP fatality rates per 100 million passenger miles for the available years (1966 through 1991). Data for unavailable years is estimated based upon a trend analysis. 1995 and 1996 data projected based upon 1994 actual data.

48. Methodology: Assumes that interstate traffic would be on the non-interstate highway portions of the federal aid-primary (FAP) system if there were no interstate highways, estimating injuries avoided based upon the differential injury rates for the interstate and

FAP systems. Uses available data, and models injury rates for unavailable years based upon trends in fatality rates. 1995 and 1996 data projected based upon 1994 actual data.

49. Estimated from comparing interstate accident rates with rates for the balance of the National Highway System. Data from *1994 National Highway Statistics*.

50. Calculated from data in *Highway Statistics 1994* and *National Transit Database 1994*.

51. 1994 calculation uses National Safety Council rates as follows: Economic cost: $920,000 per fatality, $34,200 per disabling injury (disabling injuries from the National Safety Council), property and other per accident: $6,600. Quality of life cost: $2,890,000 per fatality, $129,200 per disabling injury (estimated based upon category costs provided, scaled using economic cost categories), $8,600 per accident property and other 40 year estimate based upon National Safety Council rates. Source: *Accident Facts: 1995 Edition*, (Itasca, IL: National Safety Council, 1995).

52. Based upon National Safety Council costs deflated each year before 1994 in proportion to the size of that year's gross domestic product relative to 1994. Property and other costs are estimated based upon their 1994 relationship to fatality and injury costs.

53. $368 billion divided by $329 billion.

54. Annual state by state fatalities estimated based upon the ratio of state interstate fatalities to total interstate fatalities in 1994 scaled to reflect annual population changes from 1957 to 1996.

55. Calculated using average population 1957-1996.

56. Western states with smaller populations and transcontinental interstate highways tend to have less favorable per capita safety indicator because travel that originates in other states is disproportionately high. For example, Wyoming has the nation's smallest population, yet contains nearly one-seventh of the one of the busiest transcontinental interstate (I-80, which extends from New York City to San Francisco).

57. Annual state by state injuries estimated based upon the ratio of state interstate injuries to total interstate injuries in 1994, scaled to reflect annual population changes from 1957 to 1996. Where 1994 state injury data was unavailable, 1994 figure was estimated based upon 1992 ratio.

58. Population analysis based upon 1990 United States Census.

59. Calculated using average population 1957-1996.

60. Western states with smaller populations and transcontinental interstate highways tend to have less favorable per capita safety indicators, because travel that originates in other states is disproportionately high.

61. Calculated using average population 1957-1996.

62. The discussion below estimates interstate highway system intercity time savings relative to other roadways at 20 percent and urban time savings at up to 60 percent.

63. Based upon Texas Transportation Institute 1992 valuation of time at $10.50 per hour, with the value of time discounted based upon real gross domestic product size for other years as contained in Texas Transportation Institute, *Urban Roadway Congestion-1982 to 1992, Volume 1: Annual Report* (College Station, TX: Texas A&M University, 1995).

64. Operating cost savings for automobiles, light trucks, and vans of 3.14 percent. Calculated from data in *Benefits of Interstate Highways* (Washington, DC: United States Department of Transportation, Federal Highway Administration, 1983). Actual operating costs from consumer operating expenditures for user operated transportation from the gross domestic product accounts. Interstate operating expenditures estimated based upon annual 1957 to 1996 percentage of total consumer vehicle operation on the interstates.

65. Especially western European nations.

66. *Statistical Abstract of the United States: 1995* (Washington, DC: United States Department of Commerce, Economics and Statistics Administration, Bureau of the Census, 1995).

67. Among developed nations, gasoline prices are closest to market prices in the United States. Most developed nations impose heavy taxes on gasoline, raising prices per gallon to double, triple or more the price of production.

68. Committee for the Study of Impacts of Highway Capacity Improvements on Air Quality and Energy Consumption, Transportation Research Board, National Research Council (Washington: National Academy Press, 1995).

69. Steve Nadis and James J. MacKenzie, *Car Trouble* (Boston, MA: Beacon Press, 1993).

70. "Statement of Lieutenant General Kenneth R. Wykle, United States Army, Deputy Commander in Chief, United States Transportation Command before the House Committee on Transportation and Infrastructure, Surface Transportation Committee, United States House of Representatives, on the U.S. Department of Transportation's Recommended National Highway System" (Washington, DC: March 2, 1995).

71. "Statement of Lieutenant General Kenneth R. Wykle."

72. *Urban Roadway Congestion-1982 to 1992.*

73. *1994 Highway Statistics.*

74. Clifford M. Comeau, "Condition and Performance of the Interstate System - After 40 Years," *Public Roads* (Washington, United States Department of Transportation, Federal Highway Administration, Summer 1996).

75. Calculated from *1995 Status of the Nation's Surface Transportation System: Conditions and Performance* (Washington, DC: United States Department of Transportation, 1995),

76. Mianus River Bridge on I-95 in Connecticut (1983) and Schoharie Creek Bridge on I-95 in New York (1987).

77. Lane mile data from Texas Transportation Institute, 1995. Per lane mile cost calculated from data in *1995 Status of the Nation's Surface Transportation System: Conditions and Performance* adjusted to reflect 1996 prices.

78. 1994 surface transportation expenditures were approximately $120 billion (1996$), $95 billion for highways and $25 billion for transit.

79. Based upon improved lower fatality and injury rate of the interstate highway system relative to the balance of the federal aid primary system. Average urban interstate assumed to be six lanes. 10 year projection assumes that 1,104 lane miles of urban interstates would be built per year over the period.

80. Conversion from lane miles to roadway assumes an average of six traffic lanes. Lives and injuries avoided based upon comparison of rates between interstates and the federal aid-primary system. Construction costs based on data in *1995 Status of the Nation's Surface Transportation System: Conditions and Performance* converted to 1996$.

81. In 1996 dollars. Super-highway congestion costs estimated using relationship of freeway delay hours to total system delay hours. Calculated using data for 50 large urban areas in *Urban Roadway Congestion - 1982 to 1992.*

82. *1989 Roadway Congestion Estimate and Trends* (College Station, Texas: Texas Transportation Institute, July 1992).

83. In 1996$, based upon costs calculated from *1995 Status of the Nation's Surface Transportation System: Conditions and Performance.*

84. *Urban Roadway Congestion - 1982 to 1992.*

85. Calculated from data for the "Economic Efficiency" scenario in *1995 Status of the Nation's Surface Transportation System: Conditions and Performance.*

86. Calculated from data in Statement of Robert A. Sunshine, Deputy Assistant Director for Budget Analysis, Congressional Budget Office, on The Highway Trust Fund, before the Subcommittee on Surface Transportation, Committee on Transportation and Infrastructure, United States House of Representatives, May 16, 1996.